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Interventions to prevent obesity in children aged 12 to 18 years old

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Abstract

Background

Prevention of obesity in adolescents is an international public health priority given the prevalence of the condition (and its significant impact on health, development and well-being). The proportions of adolescents living with overweight or obesity are over 25% in North and South America, Australia and most countries in Europe and the Gulf region. Interventions which aim to prevent obesity involve behavioural change strategies that promote healthy eating and/or physical activity which work by reducing energy intake and/or increasing energy expenditure, respectively.

Objectives

The primary objectives are to evaluate the effects of interventions that aim to modify dietary intake or physical activity, sedentary behaviour, sleep, play and/or structured exercise, or a combination of both, on changes in zBMI score, BMI and serious adverse events among children and adolescents. The secondary objectives are to collect information on factors related to health inequity and about the costs of interventions

Search methods

We used standard, extensive Cochrane search methods. The latest search date was February 2023.

Selection criteria

Randomised controlled trials of dietary and/or activity interventions that aimed to prevent overweight or obesity in children and young people aged 12 to 18 years, reported outcomes at a minimum of 12 weeks post baseline and targeted children in the general population

Data collection and analysis

We used standard Cochrane methods. Our outcomes were BMI, age- and sex-standardised BMI (zBMI), BMI percentile and serious adverse events. We used GRADE to assess the certainty of the evidence for each outcome.

Main results

Included studies

We included 74 studies (83,407 participants), of which 54 (46,358) participants were included in meta-analyses. The studies were based mainly in high-income countries such as the USA and in Europe, 11% were in upper middle-income and 4% in lower middle-income countries. The majority of the studies compared an intervention involving intervention components to improve both dietary intake and activity levels with a control group. Interventions were mostly delivered at school, with some being delivered at home, in the community or within a primary care setting. Most interventions were implemented for less than 9 months with the shortest intervention conducted over one visit and the longest over 28 months.

Effects of interventions

Dietary interventions versus control

Dietary interventions may have little to no effect, compared with control, on BMI and zBMI at short-term (BMI: MD -0.18, 95% CI -0.41 to 0.06; 3 studies, 605 participants; very low-certainty evidence; zBMI: MD -0.06, 95% CI -0.12 to 0.01; 5 studies, 3154 participants; low-certainty evidence), zBMI at medium term follow-up (MD 0.02, 95% CI -0.17 to 0.21; 1 study, 112 participants; low-certainty evidence) or BMI and zBMI at long-term (BMI: MD -0.30, 95% CI -1.67 to 1.07; 1 study, 44 participants; very low-certainty evidence; MD -0.14, 95% CI -0.38 to 0.10; 2 studies, 1089 participants; very low-certainty evidence) follow-up, but the evidence is very uncertain), whereas they may reduce BMI at medium-term follow-up (MD -0.65, 95% CI -1.18 to -0.11; 3 studies, 900 participants; very low-certainty evidence), but the evidence is very uncertain.

Activity interventions versus control

Activity interventions compared with control likely do not reduce BMI or zBMI at short-term follow-up (BMI: MD -0.64, 95% CI -1.86 to 0.58; 6 studies, 1780 participants; moderate-certainty evidence; zBMI: MD 0.02, 95% CI -0.01 to 0.05; 7 studies, 4718 participants; high-certainty evidence) and likely do not reduce zBMI at medium-term (MD 0, 95% CI -0.04 to 0.05; 6 studies, 5335 participants; moderate-certainty evidence) or long-term follow-up(MD -0.05, 95% CI -0.12 to 0.02; 1 study, 985 participants; moderate-certainty evidence) wherease they may reduce BMI at medium-term follow-up (MD -0.32, 95% CI -0.53 to -0.11; 3 studies, 2143 participants; low-certainty evidence) and at long-term follow-up (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 985 participants; low-certainty evidence).

Dietary and activity interventions versus control

Dietary and activity interventions, compared with control, result in little to no difference in BMI at short-term follow-up (BMI: MD 0.03, 95% CI -0.07 to 0.13; 11 studies, 3429 participants; high-certainty evidence, and we found no effects on BMI at medium-term (MD 0.01, 95% CI -0.09 to 0.11; 8 studies, 5612 participants; moderate-certainty evidence) or long-term (MD 0.06, 95% CI -0.04 to 0.16; 6 studies, 8736 participants; moderate-certainty evidence) follow-up. They may have little to no effect on zBMI at short-term follow-up but the evidence is very uncertain (MD -0.09, 95% CI -0.2 to 0.02; 3 studies, 515 participants; very low-certainty evidence) and do not reduce zBMI at medium-term (MD -0.05, 95% CI -0.1 to 0.01; 6 studies, 3511 participants; low-certainty evidence) or at long-term (MD -0.02, 95% CI -0.05 to 0.01; 7 studies, 8430 participants; low-certainty evidence) follow-up.

We also found that a combination of dietary and activity intervention may reduce BMI percentile at short-term follow-up only but the evidence is very uncertain (MD -1.69, 95% CI-3.22 to -0.16; 1 study, 46 participants; very low-certainty evidence).

Of fourteen studies reporting data on severe adverse events, only three observed such events; two reported injuries relating to the exercise component of the intervention, and one reported an increase in weight concern in a small number of adolescents.

Heterogeneity was apparent in the results from all outcomes at the three follow-up times, which could not be explained by main setting of the interventions (school; home; school and home; other), country income status (high income versus non-high income) and participants socioeconomic status (low versus mixed). Most studies excluded children and young people with a mental or physical disability.

Authors' conclusions

The body of evidence in this review demonstrates that a range of diet and/or activity interventions may have no or a very small beneficial effect on obesity in adolescents. Limited evidence of low quality was identified on the effect of these interventions on adverse effects and suggest no meaningful impact. A dearth of evidence was identified for community-based settings (e.g. delivered through local youth groups) and for adolescents living with disabilities.

Plain language summary

Do dietary and activity strategies help prevent obesity in children and young people aged 12 to 18 years?

Key messages

- School-based interventions for changing diet or activity levels in adolescents which aim to prevent them becoming overweight or developing obesity appear to make no or very difference to their body mass index (BMI).

- There is very little information about whether the interventions resulted in serious harms (e.g. eating disorders) but from what we found there appears to be little or no effect.

- Public health interventions that result in even a small improvement in BMI of adolescents (i.e. with them gaining less excess weight than they would othersise experience) may be useful in trying to tackle obesity through the life-course.

Why is preventing obesity in children and young people important?

More adolescents are developing overweight and obesity worldwide. Being overweight as an adolescent can cause health problems, and people may be affected psychologically and in their social life. Puberty and moving into adulthood is a challenging time, and many struggle with their mental health. Adolescents living with overweight are likely to be overweight or obese as adults and continue to experience poor physical and mental health.

What did we want to find out?

We wanted to find out if interventions to help people modify their diet or activity (or both) are effective at preventing obesity in children and young people aged 12-18 years. We also wanted to find out if dietary or activity interventions or both were associated with any serious adverse events.

What did we do?

We searched many scientific databases to find studies that looked at ways of preventing obesity in children. We included studies aimed at children and young people aged 12 to 18 years. We only included studies if the methods they were using were aimed at changing children's diet, their level of activity (i.e. increasing physical activity or reducing inactive time), or both. We looked only for the studies that randomly placed people into groups receiving different interventions (which may include changing nothing). We looked at how well the studies were done and analysed them in sets of similar ones.

What did we find?

We found 74 studies that involved 83,407 children and young people. The studies were based mainly in high-income countries such as the USA and in Europe, although 11% were in upper middle-income and 4% in lower middle-income countries. The majority of the studies compared an intervention involving intervention components to improve both dietary intake and activity levels with a control group. Most interventions were tried in schools, though some were based in the home or other places. We found very few studies based in community settings such as youth groups. Most interventions were implemented for less than 9 months with the shortest intervention conducted over one visit and the longest over 28 months. The majority of the studies declared non-industry funding, five studies were funded in part by industry (food suppliers, a PlayStation manufacturer, a gym equipment supplier, an healthcare device manufacturer and a private healthcare facility).

Our analyses included results from 54 studies of 46,358 adolescents. We found that adolescents who were helped with a strategy to change their diet or activity levels (or both) did not reduce their BMI or any reduction was meager, compared to children who were not given a strategy.

Only a few studies reported any possible harms of the interventions, and no serious harms were identified in these.

What are the limitations of the evidence?

Our confidence in the evidence is very low. However, it is difficult to be confident that funding more studies, at least more school-based studies, would produce a much higher level of confidence in the results. Four main factors reduced our confidence in the evidence.

1. Results were very inconsistent across the different studies.

2. A lot of the studies had limitations in how they were done.

3. Studies were very small or there were not enough studies of a similar type to be certain about the results.

4. Results from some studies are not reported and this may have an impact on the results of our analyses.

This review does not provide sufficient information to be able to assess how well interventions work for adolescents with disabilities, or whether those implemented in community settings are effective.

How up to date is this evidence?

This review updates our previous review. The evidence is up to date to February 2023.

Summary of findings

Summary of findings 1

Dietary interventions compared with control

Patient or population: children aged 12-18 years

Setting: all settings (school, home, school + home, others)

Intervention: dietary interventions

Comparison: control (no active interventions)

Outcomes	Illustrative comparative risks (95% CI)		N of participants (studies)	Certainty of the evidence (GRADE**)	Comments
	Without intervention*	With dietary interventions (mean difference)			
BMI short term (12 weeks from baseline to <9 months)	Average BMI = 20.2	The mean BMI score at short-term follow-up in the intervention group was, on average 0.18 points lower (0.41 points lower to 0.06 points higher)	605 (3 studies)	+--- Very low[a]	There may be little to no difference in BMI
BMI medium term (9 months to <15 months)	Average BMI = 20.5	The mean BMI score at medium-term follow-up in the intervention group was, on average 0.65 points lower (1.18 points lower to 0.11 points lower)	900 (3 studies)	+--- Very low[b]	Dietary interventions may reduce BMI
BMI long term (> 15 months)	Average BMI = 20.8	The mean BMI score at long-term follow-up in the intervention group was, on average 0.3 points lower (1.67 points lower to 1.07 points higher)	44 (1 study)	++-- low[c]	There may be little to no difference in BMI
zBMI short term (12 weeks from baseline to <9 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean zBMI score at short-term follow-up in the intervention group was, on average 0.06 points lower (0.12 points lower to 0.01 points higher)	3154 (5 studies)	++-- Low[d]	There may be little to no difference in zBMI
zBMI medium term (9 months to <15 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean zBMI score at medium-term follow-up in the intervention group was, on average 0.02 points higher (0.17 points lower to 0.21 points higher)	112 (1 study)	+--- Very	There may be little to no difference in zBMI
zBMI long term (> 15 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean zBMI score at long-term follow-up in the intervention group was, on average 0.14 points lower (0.38 points lower to 0.1 points higher)	1089 (2 studies)	+--- Very low[f]	There may be little to no difference in zBMI
Serious adverse events	No evidence of effect of intervention on reported serious adverse events one study reported that no harm or unintended effects were observed in either group that could be directly attributed to the intervention. One study reported that no injuries or adverse effects were observed during the activity sessions or assessments. One study reported that one enrolled patient (in control group) death occurred during the study period; however, the authors stated that the death was in no way related to participation in this research study. The patient's death occurred following data collection at the the first month time point, but prior to data collection at the sixth months time point.		377 (2 studies)**	++-- Low[g]	

*The median BMI without the intervention is the 50th percentile values of BMI in children aged 15.5 (short term; ~ 6 months), 16 (medium term; ~ 12 months) and 16.5 (long term; ~18 months) years derived from the CDC 2000 growth charts for boys and girls; the median zBMI without intervention is calculated from the zBMI of participants in the control group of our included studies measured at follow-up.

**Criteria for judging certainty in the evidence are reported in Appendix 1.

***Number of randomized participants.

EXPLANATIONS

[a]Downgraded two levels due to risk of bias (evidence contributing 61.4% of the weight is from one result at high risk of bias) and one level due to imprecision (evidence from 605 participants; indirectness: concerns on substantial contribution to weight of two studies in highly

specific populations: one study targeted adolescents who reported consuming at least 1 serving per day of sugar-sweetened beverages (SSB) and lived predominately in one household; one study included girls and boys at-risk for excess weight gain (i.e., BMI ≥70th percentile or two biological parents with reported obesity [BMI ≥30 kg/m^2]));

[b]Downgraded one level due to risk of bias (evidence contributing 37.3% of the weight is from one result at high risk of bias); one level due to imprecision (evidence is from 900 participants); one level due to inconsistency (considerable heterogeneity (I^2 = 88%, P = 0.0002), and point estimates and confidence intervals vary considerably);

[c]Downgraded one level due to imprecision (evidence is from 44 participants) and one level due to indirectness (concerns on the study being conducted in a highly specific population: the study included girls and boys at-risk for excess weight gain (i.e., BMI ≥70th percentile or two biological parents with reported obesity [BMI ≥30 kg/m^2]);

[d]Downgraded onelevel due to risk of bias (evidence contributing 38.9% of the weight is from two results at high risk of bias) and one level due to inconsistency (considerable heterogeneity (I2 = 78%, P = 0.001) and point estimates and confidence intervals vary considerably);

[e]Downgraded one leve due toimprecision(evidence is from 112 participants) and one level due to outcome non-reporting bias(one large study reported no significant difference with potential of overturning the results of the meta-analysis);

[f]Downgraded one level due to imprecision (evidence is from 1089 participants); one level due to inconsistency (considerable heterogeneity (I^2 = 75%, P = 0.04) and point estimates and confidence intervals vary considerably); one level due to indirectness (concerns on substantial contribution to weight of one study in a highly specific population: one study included girls and boys at-risk for excess weight gain (i.e., BMI ≥70th percentile or two biological parents with reported obesity [BMI ≥30 kg/m^2]));

[g]Downgraded one level due to imprecision (evidence is from 377 participants) and one level due to outcome non-reporting bias (there is potential for missing evidence as the reported results are from studies that measured BMI, zBMI or BMI percentile at baseline and follow-up only).

Abbreviations: CDC: Centers for Disease Control and Prevention; CI: confidence interval.

Summary of findings 2

Activity interventions compared with control

Patient or population: children aged 12-18 years

Setting: all settings (school, home, school + home, others)

Intervention: activity interventions

Comparison: control (no active interventions)

Outcomes	Illustrative comparative risks (95% CI)		N of participants (studies)	Certainty of the evidence (GRADE)**	Comments
	Without intervention*	With activity interventions (mean difference)			
BMI short term (12 weeks from baseline to <9 months)	Average BMI = 20.2	The mean BMI score at short-term follow-up in the intervention group was, on average 0.64 points lower (1.86 points lower to 0.58 points higher)	1780 (6 studies)	+++- Moder[a]	There may be little or no difference in BMI
BMI medium term (9 months to <15 months)	Average BMI = 20.5	The mean BMI score at medium-term follow-up in the intervention group was, on average 0.32 points lower (0.53 points lower to 0.11 points lower)	2143 (3 studies)	++-- Low[b]	Activity interventions may reduce BMI slightly
BMI long term (> 15 months)	Average BMI = 20.8	The mean BMI score at long-term follow-up in the intervention group was, on average 0.28 points lower (0.51 lower to 0.05 points lower)	985 (1 study)	+--- Very l[c]	Activity interventions may reduce BMI slightly
zBMI short term (12 weeks from baseline to <9 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean zBMI score at short-term follow-up in the intervention group was, on average 0.02 higher (0.01 points lower to 0.05 points higher)	4718 (7 studies)	++++ High[d]	There may be little to no difference in zBMI
zBMI medium term (9 months to <15 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean zBMI score at medium-term follow-up in the intervention group was, on average no different from the control (0.04 points lower to 0.05 points higher)	5335 (6 studies)	+++- Moderate[e]	There may be little to no difference in zBMI
zBMI long term (> 15 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean zBMI score at long-term follow-up in the intervention group was, on average 0.05 points lower (0.12 points lower to 0.02 points higher)	985 (1 study)	+++- Moderate[f]	There may be little to no difference in zBMI
Seriou adverse events	In one study 20% of the participants in the intervention group reported an injury (e.g., bruises or strained muscles/tendons) as result of the intervention; one study reported that some participants did not complete the study due to injuries or illness (no further details). Five studies reported no effect of intervention on reported serious adverse events.		5428 (7 studies)***	++-- Low[g]	

*The median BMI without the intervention is the 50th percentile values of BMI in children aged 15.5 (short term; ~ 6 months), 16 (medium term; ~ 12 months) and 16.5 (long term; ~18 months) years derived from the CDC 2000 growth charts for boys and girls; the median zBMI

without intervention is calculated from the zBMI of participants in the control group of our included studies measured at follow-up.

**Criteria for judging certainty in the evidence are reported in Appendix 1.

***Number of randomized participants.

EXPLANATIONS

[a]Downgraded one level due toimprecision (evidence is from 1780 participants);

[b]Downgraded one level due to risk of bias (evidence contributing 32.2% of the weight is from one result at high risk of bias) and one level due to imprecision(evidence from 2143 participants);

[c]Downgraded one level due to imprecision (evidence from 985 participants) and one level due to outcome non-reporting bias(there is missing evidence from one study, as the meta-analysis shows benefit there is potential to impact on the result);

[d]Not downgraded;

[e]Downgraded one level due to inconsistency (moderate hetherogeneity (I^2 = 48%, P = 0.08) and point estimates and confidence intervals vary considerably

[f]Downgraded one level due to imprecision (evidence is from 985 participants);

[g]Downgraded one level due to inconsistency (two studies reported a negative effect of the intervention, four studies reported no effect) and one level due to publication bias (there is potential for missing evidence as the reported results are from studies that measured BMI, zBMI or BMI percentile at baseline and follow-up only).

Summary of findings 3

Dietary and activity interventions compared with control

Patient or population: children aged 12-18 years

Setting: all settings (school, home, school + home, others)

Intervention: dietary and activity interventions

Comparison: control (no active interventions)

Outcomes	Illustrative comparative risks (95% CI)		N of participants (studies)	Certainty of the evidence (GRADE)**	Comments
	Without intervention*	With dietary and activity interventions (mean difference)			
BMI short term (12 weeks from baseline to <9 months)	Average BMI = 20.2	The mean BMI score at short-term follow-up in the intervention group was, on average 0.03 points higher (0.07 points lower to 0.13 points higher)	3429 (11 studies)	++++ High[a]	There may be little to no difference in BMI
BMI medium term (9 months to <15 months)	Average BMI = 20.5	The mean BMI score at medium-term follow-up in the intervention group was, on average 0.01 points higher (0.09 points lower to 0.11 points higher)	5612 (8 studies)	+++- Moderate[b]	There may be little to no difference in BMI
BMI long term (> 15 months)	Average BMI = 20.8	The mean BMI score at long-term follow-up in the intervention group was, on average 0.06 points higherr (0.04 points lower to 0.16 points higher)	8736 (6 studies)	+++- Moderate[c]	There may be little to no difference in BMI
zBMI short term (12 weeks from baseline to <9 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean BMI score at short-term follow-up in the intervention group was, on average 0.09 points lower (0.2 points lower to 0.02 points higher)	515 (3 studies)	+--- Very low[d]	There may be little to no difference in zBMI
zBMI medium term (9 months to <15 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean BMI score at medum-term follow-up in the intervention group was, on average0.05 points lower (0.1 points lower to 0.01 points higher)	3511 (6 studies)	++-- Low[e]	There may be little to no difference in zBMI
zBMI long term (> 15 months)	Average zBMI in the general population is 0 by definition. zBMI in included studies ranges from -0.16 to 1.5 with median 0.6	The mean BMI score at long-term follow-up in the intervention group was, on average 0.02 points lower (0.05 points lower to 0.01 points higher)	8430 (7 studies)	++-- Low[f]	There may be little to no difference in zBMI
Serious adverse events	In one study 8.7% of the participants reported clinical levels of concern about shape and weight. Three studies reported no effect of intervention on reported serious adverse events.		2394 (4 studies)***	+--- Very low[g]	

*The median BMI without the intervention is the 50th percentile values of BMI in children aged 15.5 (short term; ~ 6 months), 16 (medium term; ~ 12 months) and 16.5 (long term; ~18 months) years derived from the CDC 2000 growth charts for boys and girls; the median zBMI without intervention is calculated from the zBMI of participants in the control group of our included studies measured at follow-up.

**Criteria for judging certainty in the evidence are reported in Appendix 1.

***Number of participants randomized.

EXPLANATIONS

[a]Not downgraded;

[b]Downgraded one level due to outcome non-reporting bias (there is missing evidence from three studies, two sdudies show no effect and one study do not provide any information on the direction of the effect; the meta-analyses show no effect, but the lack of information has potential to impact on the result);

[c]Downgraded level due to inconsistency (substantial heterogeneity (I^2 = 55%, P = 0.05) and point estimates and confidence intervals vary considerably);

[d]Downgraded two levels due to risk of bias (evidence contributing 69.5% of the weight is from two results at high risk of bias), one level due to imprecision:(evidence from 515 participants); one level due to inconsistency (considerable heterogeneity (I^2 = 77%, P = 0.01) and point estimates and confidence intervals vary considerably); one level due to indirectness (concerns on substantial contribution to weight of two studies in highly specific populations: in one study eligible girls were girls considered “at risk” of obesity based on their physical activity and dietary behaviors; one study targeted adolescent boys with sub-optimal cardiorespiratory fitnes (i.e., at risk of obesity)); one level due to outcome non-reporting bias (there is missing evidence from two studies, one shows beneficial effect of the intervention and one do not provide any information on the direction of the effect; as the meta-analyses shows no effect there is potential impact on the result);

[e]Downgraded one level due to inconsistency (substantial heterogeneity (I^2 = 58%, P = 0.03) and point estimates and confidence intervals vary considerably); one level due to outcome non-reporting bias (there is missing evidence from five studies, two show no effect and three do not provide any information on the direction of the effect; the meta-analyses show no effect, but the lack of information has potential to impact on the result);

[f]Downgraded one level due torisk of bias (evidence contributing 42.8% of the weight is from three results at high risk of bias); one leve due to inconsistency (moderate heterogeneity (I^2 = 30%, P = 0.20) and point estimates and confidence intervals vary considerably);

[g]Downgraded one level due to imprecision (evidence is from 2394 participants); one leve due to inconsistency (one study reported a negative effect of the intervention, three studies reported no effect), one level due topublication bias(there is potential for missing evidence as the reported results are from studies that measured BMI, zBMI or BMI percentile at baseline and follow-up only).

Background

Population levels of overweight and obesity have become a growing, major challenge throughout the world (WHO 2022; World Obesity Atlas 2023). The causes of this are complex: the 2007 foresight report mapped over 100 interconnected factors, all of which contribute to the population prevalence of obesity (GOS 2007). These factors include macroeconomic drivers, biological factors, food supply and production, media, healthcare, built environment, transport and recreation, technology, early life experiences and education. These factors can operate differently in different people, and partially explain inequalities in childhood obesity. A good example is the relative cost of healthy food such as fruits and vegetables, which may be prohibitive for families on a low income (Power 2021).

The global evidence suggests that the prevalence of overweight and obesity in children started to rise at the end of the 1980s (Ng 2014). By 2010, 43 million children under five years of age were categorised as having overweight or obesity, with approximately 35 million of these children living in low- and middle-income countries (de Onis 2010). Internationally, childhood obesity rates continue to rise in some countries (e.g. Mexico, India, China, Canada), although there is evidence of a slowing of this increase or a plateauing in some age groups in some countries (WHO 2016; WHO 2017). In 2015, the World Health Organization (WHO) Commission on Ending Childhood Obesity found that childhood obesity is reaching alarming proportions in many countries. The WHO posited that this posed an urgent and serious challenge (WHO 2016; WHO 2017). The Sustainable Development Goals, set by the United Nations in 2015, also identify prevention and control of non-communicable diseases, including obesity, as core priorities (United Nations 2018). Obesity in childhood and adolescence can be difficult to reverse through interventions (Al-Khudairy 2017; Mead 2017).

Children and adolescents with obesity have poorer psychological well-being and elevated levels of cardio-metabolic risk factors (Sommer 2018). Obesity comorbidities, including high blood pressure, high blood cholesterol and insulin insensitivity, are being observed at an increasingly early age (Freedman 1999). Childhood obesity may also cause musculoskeletal problems, obstructive sleep apnoea, asthma and a number of psychological issues (NHS England 2014; Papoutsakis 2013; Paulis 2014; Rankin 2016). Childhood obesity is associated with type 2 diabetes and heart disease in adulthood and middle-age mortality (Umer 2017; PHE 2022). Obesity itself tracks through to adulthood (Simmonds 2016), strengthening the case for primary prevention. Adult obesity is associated with increased risks for heart disease, stroke, metabolic syndrome, type 2 diabetes and some cancers (Bhaskaran 2014; Yatsuya 2010).

Estimates of the economic impacts of obesity (adult and child) as a percentage of gross domestic product (GDP) range from 0.13% in Thailand (Pitayatienanan 2014) to 9.3% in the USA (Waters 2018). However, the methods used to estimate these costs vary between studies, and most studies use a health system perspective rather than a societal perspective. Recently, Okunogbe 2021 estimated current and future national economic impacts of obesity across a sample of heterogeneous contexts globally. They estimated that obesity cost between 0.8% and 2.4% of GDP in 2019 in the eight countries in their study (Australia, Brazil, India, Mexico, Saudi Arabia, South Africa, Spain and Thailand). Their projections revealed an increasing trend in obesity costs as a percentage of GDP over time, estimated to reach 2.4% of GDP in Spain and up to 4.9% in Thailand by 2060. They concluded that economic impacts of obesity are substantial and reach a similar magnitude in low-income and middle-income countries as in high-income contexts. A separate projection for England reports that halving childhood obesity by 2030 could save the National Health Service GBP 37 billion and wider society GBP 202 billion (Hochlaf 2020).

Children aged 12 to 16 years attend secondary schools in most countries, and schools are seen as a key setting for obesity prevention as the majority of children have long-term and in-depth contact with them (WHO 2021a). However, the other environments (in real life and virtual environments) in which they live and play also provide opportunities for intervention. Adolescence may be a critical time for excess weight gain, in that this age group normally has more freedom in food and beverage choices made outside the home compared with younger children. This, alongside the fact that physical activity levels usually decline (and sedentary behaviours rise) during adolescence, particularly in girls, offers both opportunities and barriers for those developing interventions.

The potential for negative unintended consequences of obesity prevention interventions has received much attention. Whilst the risk of inducing or worsening eating disorders/disordered eating as part of an obesity prevention intervention remains small, when this does occur the results can be severe (Allen-Scott 2014). The shared aetiology of obesity and eating disorders has implications for the design of interventions to prevent childhood obesity. Researchers in both the obesity and eating disorder fields have proposed using an integrated approach to prevention that addresses the spectrum of weight-related disorders within interventions. The identification of risk factors that are shared between these weight-related disorders is an essential step in developing effective prevention interventions (Haines 2006)

Obesity prevalence is inextricably linked to the degree of relative social inequality, and being in lower social strata is associated with a higher risk of obesity in most high-income countries (even in infants and young children) (Ballon 2018). It is therefore critical that in preventing obesity we are also reducing the associated gap in health inequalities, ensuring that interventions do not inadvertently lead to more favourable outcomes in those with a more socio-economically advantaged position in society. McNulty 2019 suggest that the preferred way of addressing health inequalities is to target the health disparity population exclusively. Where interventions are universal in nature (i.e. target the whole population) then it is important to assess whether their effectiveness varies by level of deprivation/disagvantage. Equally, there is a need to understand how to minimise obesity in more affluent groups in low-income countries. The available knowledge base includes limited evidence on which we can develop a platform for obesity prevention action and select appropriate public health interventions, whether for the whole population or for those at greatest risk of obesity *(*Hillier-Brown 2014*).*

The WHO Commission on Ending Childhood Obesity states that progress in tackling childhood obesity has been slow and inconsistent, and obesity prevention and treatment requires a whole-of-government approach in which policies across all sectors systematically take health into account, avoid harmful health impacts, and thus improve population health and health equity (WHO 2016; WHO 2017). Indeed, it is now acknowledged that tackling obesity requires a systems approach and policy initiatives across government departments that are joined-up (Rutter 2017).

The broader system that influences obesity has been elegantly described (GOS 2007), and is multi-level and complex in nature. Understanding this broader system allows us to identify points that could be reasonable targets for intervention development. Some of these points are upstream (e.g. policy environment) and some downstream (e.g. individual-level education), and some points in the system are more modifiable than others. Downstream interventions rely on individuals actively making a choice to consume a healthier diet or have a more active lifestyle. These types of interventions often simply provide education and information on a healthy diet or healthy physical activity levels, and rely on the individual child and family being willing and able to make these changes. Upstream interventions change policy or the environment in which the child lives (home, school, the wider environment), which makes consuming a healthy diet and being physical activity the easy choice (sometimes the only choice). Examples include mandatory food standards and guidance on physical education for schools, policies around marketing of foods with a high level of fat, salt or sugar (HFSS foods), which are targeted at children (including in supermarkets); town planning policies on mobile food and beverage vans close to schools; and the number and locations of takeaways on walking journeys experienced by adolescents. There is evidence that downstream interventions are more likely to result in intervention-generated inequalities (Adams 2016; McGill 2015; Hillier-Brown 2014). Importantly, the most successful approach to tackling childhood obesity is to develop and implement both upstream and downstream interventions. Experts have noted, in relation to Chapter 2 of the Childhood Obesity Plan for England, that the main focus of interventions relies on self-regulation at an individual level (downstream interventions), and that an equal focus on upstream interventions is also required if a step change in tackling childhood obesity is to be realised (Griffin 2021; Knai 2018). There is also evidence that the successful implementation of a whole-school approach, such as that used in the Nutrition-Friendly Schools Initiative (WHO 2021b), is a key factor in the effectiveness of interventions to promote healthy eating for children. However, careful consideration should be given to how school culture can and needs to be shifted, working with schools to tailor the approach and circumnavigate staff capacity issues, and building relationships within and outside the school gates to enhance sustainability (Daly-Smith 2020; Tibbitts 2021).

Description of the condition

Overweight and obesity are terms used to describe an excess of adipose tissue (or fatness) above the ideal for good health. Current expert opinion supports the use of body mass index (BMI) cut-off points to determine weight status (as healthy weight, overweight or obese) for children, and several standardised BMI (zBMI) cut-offs have been developed that account for the child's age and gender (Adab 2018; Bell 2018). Population monitoring of overweight and obesity is best done through use of BMI, but this measure has limitations at an individual level and, in children, zBMI is deemed to be more useful. Despite this, there is no consistent application of this methodology by experts and a variety of percentile-based methods are also used, which can make it difficult to compare randomised controlled trials (RCTs) that have used different measures and weight outcomes.

Overweight and obesity in childhood are known to have significant impacts on both physical and psychosocial health (reviewed in Lobstein 2004). Indeed, many of the cardiovascular consequences that characterise adult-onset obesity are preceded by abnormalities that begin in childhood. Hyperlipidaemia, hypertension, abnormal glucose tolerance, and type 2 diabetes occur with increased frequency in children with obesity (Freedman 1999). In addition, obesity in childhood is known to be associated with cardiovascular disease risk factors in adults (Umer 2017), underpinning the importance of obesity prevention efforts.

Health inequalities

Obesity results from a sustained positive energy imbalance, and a variety of genetic, behavioural, cultural, environmental and economic factors have been implicated in its development (reviewed in Lobstein 2004). The interplay of these factors is complex and has been the focus of considerable research. However, the burden of obesity is not experienced uniformly across a population, with the highest levels of the condition experienced by those (including children) most disadvantaged (Ballon 2018). In high-income countries there is a significant trend observed between obesity and lower socio-economic status e.g. in the UK, Office for National Statistics & NHS Digital (NHS Digital 2020). In the UK, body mass trends over adolescence were associated with local area deprivation in a large UK cohort, even when controlling for family socioeconomic circumstances (Staatz 2021). In a study of children aged six to nine years living in 24 countries in the WHO European region, an inverse relationship between the prevalence of childhood overweight or obesity and parental education was found in high-income countries, whereas the opposite relationship was observed in most of the middle-income countries (Buoncristiano 2021). In low-income countries the relationship is variable, and there appears to be a shifting of the obesity burden across socioeconomic groups and different patterns by gender (Jiwani 2019; Monteiro 2004). On this basis, we explored any reported effects of interventions by World Bank category high-, upper middle-, lower middle-, and low-income countries (World Bank 2021).

Description of the intervention

This review involves assessing interventions aimed at preventing obesity, either the primary aim of the intervention or one of the key aims of the intervention.These intervention may be implemented in any setting, though it is to be expected that most will take place in schools.

ADD THIS SECTION TO THE DISCUSSION?

How the intervention might work

Interventions that aim to prevent childhood obesity seek to maintain an energy balance that is ideal for the healthy growth and development of the child. All such interventions work either by limiting the amount of energy (calories) consumed or by increasing the amount of energy expended (which includes basal metabolic rate, physical activity and other movement, including sleep and energy required for child growth), or by both limiting the amount of energy consumed and increasing the amount of energy expended. If sustained energy expenditure (normal metabolic demands plus cost of growth) exceeds energy consumed, the child may become malnourished. A severe energy deficit over a prolonged period in childhood, particularly during rapid periods of growth such as adolescence, may have serious negative consequences for growth and development, and these effects are potentially irreversible. Getting the balance of short-term effectiveness versus a more moderate, safer and sustained energy deficit in the context of childhood obesity prevention interventions 'right' remains a key public health challenge (Emmett 2015).

The safest and most reliable way to ensure an ideal energy balance in growing children is for the child to eat a healthy diet (low in fat and sugar) and be physically active. Most countries have age-specific recommendations for daily food and drink intakes, and physical activity levels.

Most interventions that include a diet component promote a low fat or low sugar intake, or both; for example by replacing sugary drinks with water and high fat snacks with fruit and vegetables. Takeaways and fast food are particularly high in fat, and these are often the target of interventions to prevent obesity. Examples relevant for adolescents include town planning regulations that restrict the presence of mobile food vans and fast-food outlets close to schools (Brown 2021), limiting vending machine content in schools and other environments where children frequent and play (Kubik 2011), and monitoring the content of packed lunches (Singhal 2010). Voluntary and mandatory school food standards are in place in many countries.

Interventions that include a physical activity component promote sport and active leisure time activities, active travel, a reduction in sedentary behaviour, or a combination of these. Examples relevant for adolescents include the introduction of after-school dance or sport sessions (Mears and Jago 2016), a limit on the time an adolescent can spend on gaming or Internet use in a day (Bonnaire 2019), and the introduction of safe cycling and walking routes to school (Schonbach 2020). Most countries include physical education as part of the curriculum in schools.

Why it is important to do this review

Governments internationally are being urged to take action to prevent childhood obesity and to address the underlying determinants of the condition. To provide decision makers with high-quality research evidence to

inform their planning and resource allocation, this review aims to provide an update of the evidence from RCTs designed to prevent childhood obesity

Previous work has highlighted that the current evidence base focuses mainly on individual-level interventions that are assessed via an RCT. Where possible, the totality of the evidence base should also capture studies that evaluate the effectiveness of upstream interventions (Nobles 2021), mindful of the fact that these types of interventions are not commonly assessed via an RCT because of the design challenges at scale.

There has been considerable growth in the number of studies in this field over the last five to 10 years. Importantly, many of the relatively recent studies we have identified have reported data on inequalities and new evidence that could affect the recommendations.

The burden of children with obesity was exacerbated in most countries during the Covid-19 pandemic. Indications in a number of countries show that the rising levels of childhood obesity (www.worldobesity.org/) also increased health inequalities. In some countries, particularly low-income countries, the double burden of malnutrition (obesity and undernutrition) has risen sharply during the pandemic (IFPRI 2020; Zemrani 2021). Those responsible for public health in all regions of the world, countries, and local communities are planning (and then implementing) their Covid-recovery policies. As such, our public health policymakers' needs for cost-effective interventions to prevent childhood obesity that are scalable and feasible are more urgent than ever before. These interventions should then feed into a broader strategy that includes upstream interventions.

Objectives

Primary objectives

- To evaluate the effects of interventions that aim to modify dietary intake on changes in zBMI score, BMI and serious adverse events among children and adolescents.
- To evaluate the effects of interventions that aim to modify physical activity, sedentary behaviour, sleep, play and/or structured exercise on changes in zBMI score, BMI and serious adverse events among children and adolescents.
- To evaluate the combined effects of interventions that aim to modify both dietary intake and physical activity/movement behaviours on changes in zBMI score, BMI and serious adverse events among children and adolescents.
- To compare the effects of interventions that aim to modify dietary intake with those that aim to modify physical activity/movement behaviours on changes in zBMI score, BMI and serious adverse events among children and adolescents.

Secondary objectives

- To collect information to explore if, how, and why the effectiveness of interventions on zBMI/BMI varied on factors related to health inequity, using the PROGRESS factors (O'Neill 2014).
    - **P**lace of residence
    - **R**ace/ethnicity/culture/language
    - **O**ccupation
    - **G**ender/sex
    - **R**eligion
    - **E**ducation
    - **S**ocioeconomic status
    - **S**ocial capital
- To collect information about the costs of interventions to enable use of the review as a source of information to inform economic analyses.

Methods

Criteria for considering studies for this review

Types of studies

We included studies that:

- were individually-randomised, or cluster-randomised with at least three clusters per intervention arm (to allow some level of comparability between arms and to allow reasonable estimation of the intra-cluster

correlation coefficient (ICC)). We included only the first period of any trials with a cross-over design (due to important concerns about carry-over effects);

- measured BMI at baseline and after the end of the intervention period (including collection of self-reported measurement); and
- included an active intervention period of any duration, provided that the studies reported follow-up outcome data at a minimum of 12 weeks from baseline (any intervention shorter than 12 weeks is less likely to result in a sustainable change in BMI).

We included studies written in any language. We excluded studies published before 1990, since global evidence suggests that the prevalence of overweight and obesity in children started to rise at the end of the 1980s (de Onis 2010; Ng 2014). Given the time lag between the conception, funding, and completion of RCTs, we considered a 1990 publication date as a pragmatic and reasonable starting point for the literature in the area. We excluded experimental, comparative studies that did not use formal randomisation (so-called "quasi-randomized studies").

Types of participants

We included children and adolescents with a mean age of 12 years and above, but less than 19 years, at baseline. We applied this rule if an age-based subset of children from a trial including a wide range of ages was reported separately and fulfilled this criterion.

We considered studies to include eligible children if they met any one of the following criteria:

- targeted children or adolescents in the general population;
- included children or adolescents who were part of a family group receiving the intervention, if outcome data could be extracted separately for the children;
- targeted children who were ‘at risk’ for overweight or obesity; for example, because a parent was with overweight or obesity; or
- targeted children and adolescents who were from specific place-based areas (e.g. of high deprivation) or specific settings (e.g. religious settings) where that population was known to have relatively low levels of physical activity, high levels of energy intake, high levels of obesity, or a combination of these factors.

In order to reflect a public health approach that recognises the prevalence of a range of weights of children and adolescents within the general population, we included RCTs that recruited participants with overweight or obesity, with the exception of RCTs that had an aim to treat obesity.

We excluded:

- RCTs that recruited *only* children and adolescents with overweight or obesity at baseline, because we considered these interventions to be focused on treatment rather than prevention; and
- RCTs of interventions designed for children and adolescents with a critical illness or severe comorbidities.

Types of interventions

Eligible interventions were those whose main aim was changing at least one factor from: diet, physical activity, sedentary behaviour, sleep, play or structured exercise to help prevent obesity in children and adolescents.

Examples of interventions that were included in the review include the following.

- Interventions that provided opportunities for children to do more physical activity in school time (e.g. active lessons) so as to improve concentration in the classroom, and in the longer term, help prevent obesity.
- Interventions that altered the food environment within the school canteen (e.g. layout of food by kiosks) so as to make it easier to purchase healthier food items.
- Interventions that provided education to children and adolescents and their families on how to have a healthier diet and to do more physical activity.
- Interventions that regulated how HFSS foods are advertised to children within, and in close proximity to, educational settings.
- Digital interventions that were accessed by children and adolescents on their smartphones that used interactive games to educate on nutritional value of certain food types.

We excluded studies of:

- interventions designed primarily to improve sporting performance (focused on strength and sport-specific fitness training); and
- interventions designed to prevent obesity in people who were pregnant.

Setting

We included interventions in any setting, including the home, healthcare settings, childcare, schools and the wider community. We also included digital interventions. There is no single agreed definition of a digital

intervention, and we operationalised it here as one that employs software, hardware and digital services (e.g. mobile health apps, wearable devices, telehealth and telemedicine, and personalised medicine) to help prevent childhood obesity.

Comparators

We included studies that compared an eligible intervention with a non-intervention control group who received no intervention or usual care, or with another eligible intervention (i.e. head-to-head comparisons).

Types of outcome measures

Primary outcomes

Our primary outcomes are:

- zBMI score, measured from weight and height of the children at least 12 weeks after randomisation and standardised to age-specific local or national tables for BMI;
- unstandardised BMI, measured from weight and height of the children at least 12 weeks after randomisation;
- BMI percentile, measured from weight and height of children at least 12 weeks after randomisation and standardised to age-specific local or national tables for BMI; and
- serious adverse events, defined as eating disorders, body dysmorphia disorder, body image disturbance or injuries sufficient to seek medical attention.

We consider zBMI to be more useful than BMI as a measure of body fatness in children. We present results for BMI because zBMI is not reported in some studies, particularly older studies. We added BMI percentile as an outcome since writing the protocol (Moore 2022), as we found studies reporting only this interpretation of BMI. In the event of presentation of multiple sets of data for zBMI or BMI, we followed the decision rules set out under Data extraction and management and Measures of treatment effect. We presented these main outcomes in the summary of findings tables.

We included zBMI, BMI and BMI percentile results taken from either measured or self-reported weight and height data. To address the impact of using self-reported data, we conducted a sensitivity analysis (see Sensitivity analysis). Serious adverse events were assessed as number of cases in each study.

Time points

We collected data from all reported post-intervention time points at least 12 weeks from baseline. We grouped data for analysis into three time periods: i) 12 weeks from baseline to < 9 months (short term); ii) 9 months from baseline to < 15 months (medium term; corresponding to approximately one school year); and iii) 15 months or more (long term).

Secondary outcomes

There are no secondary outcomes.

Search methods for identification of studies

The search methods for this review (12 to 18 years) were built on, and are an update of, the literature searches and record screening activities, previously undertaken for the Cochrane Review of children aged 0-18 years (Brown 2019). Because our eligibility criteria coincide with those of the Brown 2019 review, we updated but did not repeat their earlier searches. This review, and three other reviews covering children aged 0 to 2, 2 to 4, and 5 to 11 will replace and update the Brown 2019 review.

Electronic searches

For this review, studies were obtained from several different electronic searches, including updated searches from collaborators, an appended search of CENTRAL on the Cochrane Library and the inclusion of educational databases and grey literature.

Hodder update searches

Searches were conducted for an interim (non-Cochrane) update of the Brown 2019 review (Hodder 2022). The Hodder 2022 review sought records published from 2018 (the date of the last full search for Brown 2019) up to 23 March 2021, and also screened the records listed as ongoing and awaiting classification studies in Brown 2019. Details of the search strategies and methods of selection of studies can be found in Hodder 2022. They included searches of Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycINFO and trial registries.

New databases and grey literature searches

Database searches (September 2021)

We searched the following databases to update previous searches as mentioned above (see section 1..1 in Appendix 2):

- Cochrane Central Register of Controlled Trials (CENTRAL; 2021, Issue 9) in the Cochrane Library (searched 26 September 2021);
- MEDLINE Ovid (23 March to 24 September 2021);
- Embase Ovid (23 March to 24 September 2021); and
- PsycINFO Ovid (23 March to 24 September 2021).

In addition, in September 2021, we searched the following education databases from 1990 onwards, to extend our reach compared with previous versions of the Brown 2019 and Hodder 2022 reviews (see section 1.4 in Appendix 2):

- Australian Education Index (AEI) ProQuest (1990 to 26 September 2021);
- British Education Index (BEI) EBSCOhost (1990 to 26 September 2021);
- ERIC (Education Resources Information Center) EBSCOhost (1990 to 26 September 2021); and
- Appended search of CENTRAL (1990 to 2021, Issue 9) in the Cochrane Library (searched 26 September 2021).

The appended search of CENTRAL (see sections 1.2 and 1.3 in Appendix 2) included search terms for interventions around the following topics of: marketing; beverages and sweetening agents; food labelling; school meals; after/out-of-school activities; parental interventions; public health; electronic apps and web-based interventions(backdated to 1990 onwards). The decision to limit the appended search to CENTRAL only was pragmatic, as Cochrane's Centralised Search Service (CSS) uses a highly efficient search strategy to capture reports of RCTs from MEDLINE and Embase (for inclusion in CENTRAL) (Noel-Storr 2020). Also, our full rolling search (run across all databases, all years to date) includes several generic 'prevention' search strings, to capture any type of intervention.

International trial registers (September 2021)

We searched the international trial registers (ClinicalTrials.gov) and the WHO International Clinical Trials Registry Platform, search portal (ICTRP) via CENTRAL on the Cochrane Library.

Grey literature

We restricted the search of the grey literature to theses and dissertations and ran a pragmatic search for PhD theses (1990 onwards) on the following databases (see section 1.5 in Appendix 2):

- Proquest Dissertations & Theses Global (search.proquest.com/pqdtglobal/dissertations/) (1990 to 24 February 2022);
- Electronic Theses Online Service (EThOS) - British Library (ethos.bl.uk/Home.do) (1990 to 11 March 2022); and
- DART - Europe e-theses Portal (dart-europe.eu/basic-search.php) (1990 to 31 March 2022).

Retractions and corrigenda

We ran a search for retractions and corrigenda (6 April 2022) (see section 1.6 in Appendix 2)

Search updates (February 2023)

From September 2021 to 7 February 2023, we ran automated weekly searches for new studies or additional reports of those already included, and screened the results. This search comprised a multifile search of Ovid MEDLINE, Embase and PsycINFO together with a search of CENTRAL on the Cochrane Library (see section 1.7 in Appendix 2). This search supersedes all previous searches of the four main bibliographic databases (MEDLINE, Embase, PsycINFO, CENTRAL), as it is far more sensitive, based on terms for condition and population only (plus a RCT filter) (no terms for intervention).

Searches of the education databases were manually updated on 7 October 2022.

In databases where it was possible and appropriate, study design filters for randomised trials were used; in MEDLINE we used a modified version of the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity- and precision-maximizing version (2008 revision) (Lefebvre 2021).

We regard the date of last search for this review as 7 February 2023 because, with the exception of the grey literature and education databases, this is the latest date that all other databases were searched.

Searching other resources

We scanned the references of the included studies reports to identify additional relevant records. We also screened the records that were classified as awaiting classification and ongoing by Hodder's team (obtained via personal communication with the authors).

Data collection and analysis

In successive sections, we only report the methods we used and the reader should refer to our protocol (Moore 2022)and Differences between protocol and review section for pre-planned but unused methods.

Selection of studies

Two review authors (FS, ET) screened titles and abstracts independently and in duplicate using Covidence systematic review software. They retrieved full-text articles of records that potentially meet the eligibility criteria and screened these independently and in duplicate. The two authors resolved any differences in opinion or uncertainty through a process of discussion and, when necessary, they involved a third author. We recorded the selection process in a PRISMA diagram (Page 2021)

Data extraction and management

We modified a data collection form for study characteristics and outcome data that was used in the Brown 2019 Cochrane Review of interventions to prevent obesity in children. Two review authors (FS, ET) piloted the form, then extracted study characteristics and numerical data independently and in duplicate. We extracted the study characteristics listed in Appendix 3.

Where we were not able to extract desirable statistics directly (e.g. standard deviations of BMI), we computed or estimated these using the methods described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Li 2019). We provide details of these imputation methods in Section 3.2 of the Statistical Appendix 4.

Furthermore, for studies that only reported outcome data as prevalence of overweight or obesity (i.e. not BMI, zBMI or BMI percentile), we used the prevalence data to estimate mean zBMI. The estimation procedure assumes that zBMI in each study sample follows a normal distribution. We describe the methods in detail in Section 3.1.3 of the Statistical Appendix 4.

We examined serious adverse events only in the studies meeting the main eligibility criteria and we did not perform an additional search focusing on serious adverse events.

Assessment of risk of bias in included studies

We assessed the risk of bias (RoB) for all BMI, zBMI and BMI percentile results using the RoB 2 tool (Sterne 2019). RoB 2 is structured into five domains of bias: bias arising from the randomization process; bias due to deviations from intended interventions; bias due to missing outcome data; bias in measurement of the outcome; and bias in selection of the reported result. For cluster RCTs we used the version of the RoB 2 tool designed for studies using cluster randomisation (Eldridge 2021), which has an additional domain 'bias arising from the identification or recruitment of participants into clusters'. Judgements about risk of bias were determined using the algorithms in the tool, based on answers we gave to the relevant signalling questions. Judgement can be 'Low' or 'High' risk of bias, or can express 'Some concerns'. All assessments were managed using the RoB2 Excel tool available at https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool.

We assessed risk of bias for the effect of assignment to the intervention at baseline (i.e., the 'interntion-to-treat' effect, ITT) for zBMI, BMI and BMI percentile at short, medium and long term follow-up, and only for specific results that contributed to meta-analyses. For studies with multiple intervention arms, we assessed risk of bias for each specific pairwise comparison contributing to meta-analyses.

For studies identified through new searches, two authors independently used the RoB 2 tool to carry out the assessments (ET, FS, JPTH, JS, TM). Results included in either the Brown 2019 Cochrane Review or the Hodder 2022 review had been assessed for risk of bias by two authors independently using the original Cochrane risk of bias tool (RoB 1) (Higgins 2011). We transformed these RoB 1 assessments into RoB 2 assessments as follows. One author (ET, FS) first completed an independent RoB 2 assessment (blind to the RoB 1 assessment). She then compared this with the previous RoB 1 assessment. Differences or uncertainties were resolved through discussion with a second reviewer (FS, ET) and, where necessary, by involving a third author (JPTH, JS, TM). Detailed answers to signalling questions for all outcomes are available in Figshare (doi.org/10.6084/m9.figshare.23904684).

To draw an overall conclusion about the risk of bias in a synthesised result across included studies, we used the methods set out in Table 14.2.a of the *Cochrane Handbook for Systematic Reviews of Interventions* (Schünemann 2019). We used our overall risk of bias assessment for each result in the review to inform GRADE (see Summary of findings and assessment of the certainty of the evidence) and for sensitivity analyses (see Sensitivity analysis).

Measures of treatment effect

We measured intervention effects on BMI, zBMI, and BMI percentile using an unstandardised mean difference (MD) between intervention groups and computed 95% confidence intervals. Most studies reported arm-level data rather than contrast-level data. Where contrast-level data were reported, they often arose from models that were either not fully explained or involved a high level of covariate adjustment. For these reasons, we used the arm-level data (in preference to contrast-level data) to calculate mean differences in the change of zBMI/BMI/BMI percentile from baseline to post-intervention. In accordance with our prioritisation of arm-level data, we calculated

mean differences from (in order of preference) (i) post-intervention means adjusted for baseline values, (ii) mean change from baseline reported in the study (change scores), (iii) change from baseline calculated from unadjusted baseline and post-intervention means. In the absence of arm-level data, we used contrast-level data if they could be interpreted as a measure of mean difference in outcome change. We provide details of these calculations in Section 3.1 of the Statistical Appendix 4. For serious adverse events, we intended to measure intervention effects using risk ratios, where possible.

Unit of analysis issues

We examined each cluster-RCT to determine whether the analysis accounted for clustering. For results that were not adjusted for clustering, we created an approximate analysis by inflating the standard error of the estimated intervention effect according to an estimated 'design effect' (Higgins 2019a). This required an estimate of the intra-cluster correlation coefficient (ICC), describing the relative variability within and between clusters. For studies that did not report an ICC, we used an external estimate based on other cluster-RCTs in the review. Given the values of ICC reported in these other trials, we chose a value of ICC = 0.02 for trials with clusters at the classroom and school level. We performed a sensitivity analysis with ICCs of 0 and 0.04 (see Sensitivity analysis). We chose not to adjust for clustering on the family level as cluster sizes were very small. We provide details of the cluster adjustment methods and choice of ICC in Section 1.3 of the Appendix 4. Furthermore, we report all values of unadjusted and adjusted standard errors plus the data used to calculate them in supplemetary data in Appendix 5.

We addressed RCTs with more than two intervention groups according to guidance in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2019a). For RCTs with more than two experimental (or comparator) arms relevant to the same meta-analysis, we combined the arms to create a single pairwise comparison. See Section 3.2 of the Statistical Appendix 4 for details.

Dealing with missing data

We examined the extent and reasons for missing data as part of the risk of bias assessment of each included RCT. We did not impute missing data. Missing summary data were handled as reported in section 3.2.1.4 of Appendix 4.

Assessment of heterogeneity

We used the I^2 statistic to quantify the degree of inconsistency across results, supplemented by a P value from a test of homogeneity to measure the strength of evidence of statistical heterogeneity (Deeks 2019). For each meta-analysis, we report the the results of the heterogeneity assessments (I^2 and P value) alongside the measure of treatment effect.

Assessment of reporting biases

We assessed risk of bias arising from (non)reporting bias and selective reporting bias using a preliminary version of the ROB-ME (risk of bias due to missing evidence) tool (Page 2020), which is based on the framework described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Page 2019). For meta-analyses with more than 10 studies, this included examination of contour-enhanced funnel plots and the Egger test for funnel plot asymmetry.

Data synthesis

We performed meta-analyses of zBMI scores, BMI and BMI percentile using the generic inverse variance method with a random-effects model (Deeks 2019), and method of moments estimates of among-study variance. Our main comparisons are:

- dietary intervention versus no intervention/control;
- activity intervention (including those targeting sedentary behaviour, sleep, play and exercise) versus no intervention/control;
- intervention with both dietary and activity components versus no intervention/control;
- intervention with both dietary and activity components versus dietary intervention alone;
- intervention with both dietary and activity components versus activity intervention alone; and
- dietary intervention versus activity intervention.

We analysed the MD, as described in the Measures of treatment effect section. We analysed differences that were adjusted for clustering (including our own approximate adjustments) in preference to analyses that were not adjusted for clustering. Decision rules regarding which effect measure to extract and analyse, when multiple measures were presented, are described in the Data extraction and management and Measures of treatment effect sections. All the studies eligible for meta-analysis were included in the primary analyses.

Synthesis if data cannot be combined with meta-analysis

We supplemented the meta-analyses with comments about the potential impact of studies from which data were not suitable for inclusion in the meta-analyses.

Serious adverse events

Due to the diversity of measures used to define adverse events, and the sparsity of data for this outcome, we tabulated information about serious adverse effects and summarised the results narratively.

Subgroup analysis and investigation of heterogeneity

We explored heterogeneity in the primary analyses by performing the following pre-planned subgroup analyses according to study-level characteristics and participant-level characteristics.

- Main setting of the intervention. This was coded as 'school'; 'school and home'; 'home'; or 'other'. After-school programmes were coded as 'school'. The 'other' category included settings such as community, web, health service and telehealth. Studies in mixed settings were coded according to the following rules:
    - school and other was coded as 'school';
    - home and other was coded as 'home'; and
    - school and home and other was coded as 'school and home', unless 'other' was clearly the main setting and the other elements were minor (e.g. intervention was carried out in a community setting but with some short homework tasks).
- income status of country (high-income country versus non-high-income country, using World Bank criteria).
- socioeconomic status (low versus mixed, based on categorisations as described by the trial authors).

We also planned subgroup analyses according to sex and duration of intervention. However, not enough studies presented subgroup analyses by sex and we decided that attempting to code duration of intervention was not particularly meaningful when some of the interventions sought long-term changes by short-term activity to change physical environments.

Tests for subgroup differences were based on standard heterogeneity tests as described in Chapter 10, section 10.11.3.1 of the *Cochrane Handbook* (Deeks 2019).

Sensitivity analysis

We performed sensitivity analyses to examine the robustness of our findings to inclusion of i) results assessed as being at high risk of bias; and ii) results where the outcome (BMI/zBMI/BMI percentile) has been self-reported, by repeating analyses with such results omitted. We investigated the impact of imputing ICCs in cluster-RCTs, as described in the section Unit of analysis issues.

Summary of findings and assessment of the certainty of the evidence

We prepared summary of findings tables for each of our main comparisons (i.e. dietary intervention versus control, activity interventions versus control and dietary and activity interventions versus control) using Excel. Each summary of findings table summarises the size and certainty of effects of the interventions for BMI; zBMI and serious adverse events at short, medium and long term follow-ups. We based our assessments of certainty on the five GRADE considerations (overall risk of bias, consistency of effect, imprecision, indirectness and publication bias) and the criteria that we have used are reported in Appendix 1. We followed the methods described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Schünemann 2019).

Two authors worked independently to make GRADE judgements, resolving any disagreements by discussion. All decisions to rate down certainty in the results were justified using footnotes, with comments added to aid readers' interpretation of the tables. We documented and incorporated the GRADE judgements into reporting of results for each outcome.

Results

Description of studies

Results of the search

The study selection process is summarised in the PRISMA flowchart reported in Figure 1. From the studies included in the previous version of this review (Brown 2019), we identified 32 age-relevant studies: we included 31 studies and excluded one study due to it having fewer than three clusters per group. From the update searches from Hodder 2022, we identified 34 age-relevant studies: we included 21 studies and excluded 13 studies (see Excluded studies). From our new searches, after deduplication, two review authors screened 6121 records by title and abstract; from citation searching, 87 reports were identified and assessed for eligibility. We finally included 74 studies. in total, we excluded at full text 531 records of studies that were not eligible for inclusion in this review, 4 studies are awaiting classification and 45 are reports of 34 ongoing studies.

Included studies

Summaries of each of the 74 included studies are provided in the Characteristics of included studies. We summarise additional material relating to the study design, participants, intervention, setting, comparisons, serious adverse events, costing, PROGRESS characteristics and studies excluded from the meta-analyses in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6. Studies are ordered within these tables to correspond to the order in which they appear in subsequent forest plots.

Study design

Twenty five of the included studies were individually-randomised and 48 were cluster-randomised (see Characteristics of included studies) with one trial starting as individually-randomised and being modified to a cluster-RCT in its second year. The majority of included studies were two-arm studies (n = 66, 89%), five had 3 arms (7%), and three studies had 4, 5 and 8 arms each (1%). In most cluster-RCTs, the unit of allocation was the school (n = 36, 49%) or the classroom (n = 7, 9.5%); in the remainder the unit of allocation was the family (n = 3, 4%), parent/caregiver-child dyad (n = 2, 3%), scout troop (n = 1, 1%), orthodontist practice (n = 1, 1%) and primary care clinic (n = 1, 1%).

Study setting

Details of the study setting in the included studies can be found in Characteristics of included studies and Table 1. Most studies were conducted in North America (n = 35, 47%), with most of these in the USA (n = 33; 45%); the remainder were conducted in Europe (n = 19, 26%), Australasia (n = 10, 14%), South America (n = 7, 9%); Asia (n = 2, 3%), and the Middle East and North Africa (n = 2, 3%) (Figure 2). Based on the World Bank classification of countries by income, most RCTs were conducted in high-income countries (n = 60; 81%), with 8 (11%) in upper-middle income countries, and 3 (4%) in lower-middle-income countries. Note that three studies (4%) were conducted in more than one country (high-income and upper-middle income countries).

Participants

Details of the participants in the included studies can be found in Characteristics of included studies and Table 1. Nineteen studies (26%) specifically targeted disadvantaged children or families, or both, in a particular setting (e.g. school/community/area) or a school or community within a disadvantaged area. Indeed, this is the preferred way of addressing health inequalities, i.e. to target the health disparity population exclusively (McNulty et al 2019). In most studies (n = 65, 88%) participants were selected from the general population, and in nine studies (12%) participants were selected amongst specific population; for example, three studies only recruited participants at risk of developing overweight or obesity, one study recruited participants from immigrant and refugee populations, one study recruited participants considered by their teachers to be disengaged in physical activity, three studies only recruited girls practising low physical activity (defined as less than one daily hour of physical activity or with activity levels at or below 30 minutes per day/3 days per week) and one study recruited participants that reported consuming at least one serving per day of sugar-sweetened beverage. In 26 studies (35%) children with physical disabilities were excluded and in 29 studies (39%) children with mental disabilities were excluded.

Interventions

Details of the interventions in the included studies can be found in Characteristics of included studies and Table 2. Most studies investigated one intervention against a control (n = 61, 82%). Ten studies (14%) compared two interventions; two (3%) compared three interventions, and one used a 2 x 2 x 2 factorial design so that the study had eight arms; one study (1%) implemented four interventions.

In 42 studies (57%) the intervention was reported to be based on one or more theories, the most common being social cognitive theory (n = 24, 32%). The majority of the interventions were implemented for less than nine months (n = 51, 69%); 19 interventions (26%) were implemented for a period between 9 and less than 15 months, and four interventions (5%) were implemented for 15 or more months. The shortest intervention was conducted over one visit (NCT02067728 2014) and the longest over 28 months (Andrade 2014).

Most studies were conducted in schools (n = 43, 58%) and some of these included after-schools programmes (ASP, n = 9, 12%); others were conducted in the community (n = 5, 7%), in the home (n = 5, 7%), in a primary care setting (n= 3, 4%), by tele-health (n = 1, 1%), and in more than one setting (n = 12, 16%). Community setting included the research centers where the study was based (n = 3), recreation centers (n = 1), and boy scout groups (n = 1). Primary care setting included offices from a healthcare center (n = 1), orthodontist offices (n = 1) and a primary care clinic (n = 1). For the purpose of meta-analyses, we classified RCTs into the following subgroups according to the main setting (i.e. the setting where most of the intervention was carried out): school (n = 46, 62%), home (n = 6, 8%), school + home (n = 11, 15%), other (n = 11, 15%)(Figure 2).

Of the 74 studies included, 19 studies (26%) implemented a dietary intervention, 22 studies (30%) implemented an activity intervention and 33 studies (45%) implemented a combined dietary and activity intervention. Most studies compared a combined dietary and activity intervention with a control group (n = 31, 42%); 20 studies (27%) compared an activity intervention with control and 16 (22%) compared a dietary intervention with control (Figure 2). One three-arm study compared both a dietary and activity intervention and an activity intervention with a control group. One study compared a dietary intervention with control in year one and two dietary interventions in year two (the control group received a reduced intervention in year 2). Five studies reported

head-to-head comparisons: one compared an activity intervention with a dietary intervention, two compared two combined dietary and activity interventions, one compared two dietary interventions and one compared two activity interventions.

More details of some key characteristics of the interventions (ordered by type of intervention) are reported below.

Dietary interventions

Among the 18 studies in which dietary interventions were implemented: in six (33%) the intervention included a home activity (note that only in two of these the intervention was partially set at home); in five studies (28%) the intervention was experienced by the children individually, in 8 studies (44%) it was experienced as a group and in five studies (28%) it was experienced both individually and as a group. In only two studies (11%) the intervention was delivered electronically (either exclusively or significantly) and in three studies (17%) there was a minor component that was delivered electronically. Only just over half of the studies (10, 56%) delivered multicomponent interventions (i.e., included three or more components). In 8 studies (44%) the intervention had an explicit component of modifying the child's behaviour, in 14 studies (78%) the intervention had an explicit component that provided education or information for the child, in 9 studies (50%) the intervention had an explicit component aiming to change the social environment of the child and in six studies (33%) the intervention had an explicit component aiming to change the physical environment of the child.

Activity interventions

Among the 23 studies in which dietary interventions were implemented: in six (26%) the intervention included a home activity (note that in only three of these the intervention was partially set at home); in three studies (13%) the intervention was experienced by the children individually, in 15 studies (65%) it was experienced as a group and in five studies (22%) it was experienced both individually and as a group. In seven studies (30%) the intervention was delivered electronically (either exclusively or significantly) and in one study (4%) there was a minor component that was delivered electronically. Only just over half of the studies (13, 57%) delivered multicomponent interventions. In 20 studies (87%) the intervention had an explicit component of modifying the child's behaviour, in 13 studies (57%) the intervention had an explicit component that provided education or information for the child, in 11 studies (48%) the intervention had an explicit component aiming to change the social environment of the child and in five studies (22%) the intervention had an explicit component aiming to change the physical environment of the child.

Dietary and activity interventions

Among the 34 studies in which combined dietary and activity interventions were implemented, in 11 studies (32%) the intervention included a home activity (note that only in six of these the intervention was set at home, either exclusively or partially); in 13 studies (38%) the intervention was experienced by the children individually, in eight studies (24%) it was experienced as a group and in 13 studies (38%) it was experienced both individually and as a group. In seven studies (21%) the intervention was delivered electronically (either exclusively or significantly) and in three studies (9%) there was a minor component that was delivered electronically. The majority of the studies (22, 65%) delivered multicomponent interventions. In most of the studies (24, 71%) the intervention had an explicit component of modifying the child's behaviour, in 30 studies (88%) the intervention had an explicit component that provided education or information for the child, in 22 studies (65%) the intervention had an explicit component aiming to change the social environment of the child and in only nine studies (26%) the intervention had an explicit component aiming to change the physical environment of the child.

Comparisons

Details of the intervention comparisons reported in the included studies can be found in Characteristics of included studies and Table 2. The nature of control groups varied across the 74 included studies. In the majority (n = 59, 80%), the comparison group was 'no active intervention' (i.e. reported as no intervention, usual care, or waiting list comparisons). Some studies (n = 10, 14%) included an active control comparison in which the type of the intervention was not eligible for inclusion (e.g. a smoking reduction and second-hand smoke exposure programme, a health and safety programme, general health programmes, a sun protection behaviour program, and a self-help programme). As both 'no active intervention' and 'attention control' interventions were not expected to affect the outcomes, we coded such comparison as 'controls' in the meta-analyses. In three studies (4%), the comparison was made against the same type of intervention (two were dietary and activity interventions and one was a dietary intervention); the remaining study (n =1, 1%) had a dietary intervention as comparator for an activity-only intervention (Jago 2006).

Outcomes

Details of all outcomes reported in the included studies can be found in Characteristics of included studies and Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6. The most common measures of adiposity (fatness) reported were BMI (n = 37, 50%), zBMI (n = 29, 39%), and BMI percentile (n = 10, 14%). Some studies reported only the proportion of children who were living with obesity or overweight (n= 8, 11%) and one study (1%) reported only the proportion of children living with obesity. Fourteen studies (19%) reported data on serious adverse events (Table 3) and three studies (4%) reported data on observed serious adverse events (e.g. injuries) that were related to participation in the study.

Funding sources

Details of funding sources reported in the included studies can be found in Characteristics of included studies. The majority of the studies declared non-industry funding, such as funding from not-for-profit charitable organisations and government institutes (n = 62, 84%). Five studies (7%) described mixed funding from both industry and not-for-profit organisations, including sponsorship received from food suppliers (n = 1), a PlayStation manufacturer (n = 1), a gym equipment supplier (n = 1), healthcare device manufacturer (n = 1) and a private healthcare facility (n = 1). No RCTs were funded wholly by industry. Six studies (8%) did not report any details on funding, and one study (1%) declared that no funding was received. Nineteen studies (26%) declared that both research and writing of the trial reports had been done independently from the funders, including three (4%) that received some industry sponsorship.

Implementation factors

Economic information

Details of economic information reported in the included studies can be found in and in Table 4. Of the 74 trials identified, 31 studies mentioned resources associated with the trial or the intervention or referenced a linked economic evaluation. Of these, seven did not provide further details. Eleven studies only reported trial-related costs, and in all cases, these were incentives for participation or data collection or both, and were paid to participants in both intervention and control arms. Total incentives ranged from USD$5 to $100 per participant. These costs would not usually be included in an economic evaluation. In total, 13 studies reported intervention costs. In several cases the cost of a package of resources for schools to deliver the intervention was provided or the cost of a limited grant to purchase equipment themselves. These costs ranged from AUD$1500 to $5000 per school. None of the publications reported a full economic evaluation; however, four referenced linked economic analyses. All were trial based, with no modelling of costs and effects conducted.

Equity and disadvantage – PROGRESS characteristics

Details of PROGRESS characteristics reported in the included studies can be found in the Characteristics of included studies and Table 5. The vast majority of the studies (n = 72, 97%) reported baseline data on at least one PROGRESS characteristic, with only two studies (3%) mentioning none of them. Data on place of residence were reported by 28 studies (38%), race/ethnicity/culture/language by 48 studies (65%), parent(s) occupation by 5 studies (7%), gender/sex by 70 studies (95%), parent(s) education by 23 studies (31%) and socioeconomic status by 42 studies (57%); none of the studies reported data on religion or social capital.

Seventeen studies (23%) reported on the impact of at least one PROGRESS characteristics on the effectiveness of the intervention (i.e. test for interaction, effect modification or subgroup analysis); the impact of race/ethnicity/culture/language was assessed in three studies (4%); parent(s) occupation in one study (1%); gender/sex in 15 studies (20%); parent(s) education in one study (1%); and socioeconomic status in five studies (7%). None of the studies reported on the impact of place of residence, religion or social capital.

Studies awaiting classification and ongoing studies

We were not able to obtain the full text of three records (Miller-Whitehead 2001; Roy 2016; Salminen 2005) and one record awaits translation (Radilla Vasquez 2021). Details of studies awaiting classifications are reported in Characteristics of studies awaiting classification. We identified 34 ongoing studies (45 records), and details are reported in Characteristics of ongoing studies. Ongoing studies and those awaiting classification will be incorporated into future updates of this review.

Excluded studies

Details of the 16 excluded studies we identified the were most likely to be considered eligible are reported in Characteristics of excluded studies. From Brown 2019, we excluded one study (Robbins 2006) with an ineligible study design (i.e. the participants of age relevant to this review were recruited from two clusters/group). We also excluded two studies from Hodder 2022 updated searches, one study (Carlin 2018) with ineligible study design and one study (Luszczynska 2016a) in which BMI was measured at baseline but not at follow-up. We excluded two studies (Dong 2021; Sallis 2003) identified by our database searches that were initially assessed as included when the full text of the paper was first read, but where during the process of data extraction it was apparent that the study did not meet the inclusion criteria due to ineligible study design. We also reported details of 11 studies that we have excluded from the list of ongoing studies in the Hodder review: five studies were excluded due to outcome of interest not being measured (NCT00061165 2003; NCT03469752002018; NCT037107460 2018; NCT03885115 2019; Trude 2019), three due to ineligible study design (Partridge 2019; Prieto-Zambrano 2021; Weigensberg 2021), and thre due to ineligible population (NCT0184548002013; NCT04362280 2020; Quintiliani 2014).

A full citation list of the 580 excluded reports is available by emailing the contact author.

Risk of bias in included studies

We used the RoB 2 tool to assess the risk of bias of the results from the 54 studies that were included in the meta-analyses. Traffic light plots (domain-level judgments and overall) for each individual result are reported alongside each study result in the relevant forest-plots and risk of bias tables are located after the characteristics of studies sections; a supplementary file containing detailed answers to signalling questions for all outcomes is

available in Figshare (doi.org/10.6084/m9.figshare.23904684). Since each of the 54 studies may have contributed to more than one meta-analysis, we assessed the risk of bias in 91 results. Overall, eight results (9%) were judged as 'low' risk of bias, 59 (65%) were judged as 'some concerns' and 24 (26%) were judged as 'high'. Most judgements of high risk of bias were due to missing outcome data (n = 20, 22%). Supporting statements for each domain judgment are reported in the Risk of bias (tables)

We used a preliminary version of the ROB-ME tool to assess the risk of bias due to missing evidence in each of the main meta-analyses (Table 7). Twenty meta-analyses were judged as 'some concerns' due to potential for missing studies that are likely to have eligible results (traditional publication bias). Fifteen of these meta-analyses had no missing results in the included studies; in five meta-analyses, results were missing from included studies, but we judged that the synthesized effect estimate would be unlikely to be impact by missing results. Six meta-analyses were judged at 'high' risk of bias due to results being missing from the included studies that had the potential to impact on the synthesised effect estimate.

Effects of interventions

See Summary of findings table 1, Summary of findings table 2 and Summary of findings table 3.

Overview of evidence

We present the results by comparison, and within that by outcome, and within that by time point (short, medium or long term as defined in the Types of outcome measures section in the methods). Of the 74 studies included in this review, 54 studies (73%) were included in meta-analyses. Among these, thirty-one reported BMI, twenty-five reported zBMI, seven reported the proportion of children with obesity or overweight (from which we derived zBMI) and eight studies reported BMI percentile. For each outcome, we provide a summary forest plot presenting the results for all comparisons and all three time points. Forest plots displaying results of individual studies can be found in each comparison section. We focus on findings for average effects across studies within each subset. Importantly, heterogeneity was generally high across the analyses. We present findings from our pre-specified subgroup analyses and note that heterogeneity was generally not well explained by the subgrouping.

Details of 20 studies excluded from the meta-analyses, and reasons for exclusion are reported in Table 6. In five studies (7%), the results were reported narratively and in four studies the results reported were not usable for inclusion in the meta-analyses. We present findings from these studies alongside the meta-analysis results. In a further four studies, outcomes were measured at follow-up, but results are not reported and in five studies (7%), measurement of the outcome(s) at eligible follow-up(s) was planned (e.g. listed in the trial registry or study protocol or both) but results are not reported (and we found no evidence that it was measured). In two studies (3%) the comparison was not eligible for inclusion in the meta-analysis (i.e. the comparison was between the same type of intervention). In addition to the excluded studies, we also report that evidence was missing for some time points from four included studies (5%).

For clarity, the results provided in this review describe the effect of interventions in terms of the difference in change in BMI between the intervention and control groups. The aims of the interventions were to limit the upward trend to increasing BMI (and gaining excess weight and developing overweight and obesity) compared with what adolescents might otherwise experience. The aim of the interventions was not to reduce BMI *per se* in children living with underweight or ideal weight. However, given that most study samples included a combination of adolescents who were living with underweight, ideal weight, overweight and obesity (note: some studies excluded adolescents with underweight or with obesity), the potential positive impact of these interventions for adolescents already living with obesity was to reduce further excess weight gain.

Dietary interventions versus control

We found 17 studies (13071 participants) that compared dietary interventions versus control and, of these, 13 studies (8982 participants) were included in meta-analyses.

BMI

Meta-analyses results for BMI are reported in Figure 3. We found that dietary interventions, when compared with control, may have little to no effect on BMI at short-term follow-up (MD -0.18, 95% CI -0.41 to 0.06; 3 studies, 605 participants; I^2 0%, P=0.83; very low-certainty evidence; Analysis 1.1) or at long-term follow-up (MD -0.30, 95% CI -1.67 to 1.07; 1 study, 44 participants; very low-certainty evidence; Analysis 1.3), but the evidence is very uncertain. In contrast, we found that dietary interventions, when compared with control, may reduce BMI at medium-term follow-up, but the evidence is very uncertain (MD -0.65, 95% CI -1.18 to -0.11; 3 studies, 900 participants; I^2 88%, P=0.0002; very low-certainty evidence; Analysis 1.2). One of the three studies was at high risk of bias due to selection of the participants onto the study and to missing outcome data. Sensitivity analysis removing studies at high risk of bias resulted in loss of the evidence of a beneficial effect at medium-term follow-up (MD -0.67, 95% CI -1.75 to 0.41; 2 studies, 394 participants;), whereas it did not change the overall results of the meta-analyses for BMI at short- and long-term follow-up (Appendix 6).

In addition to the studies included in the meta-analyses, one study that reported the data narratively found that dietary interventions on average, when compared with control, may have little to no effect of dietary interventions compared with control on BMI at medium-term follow-up (Nanney 2016) (Table 6). One study measured the effect of dietary interventions on BMI at medium-term follow-up but did not report the results (Lana 2014)

zBMI

Meta-analyses results for zBMI are reported in Figure 4. The evidence suggests that dietary interventions compared with control do not reduce zBMI at short-term (MD -0.06, 95% CI -0.12 to 0.01; 5 studies, 3154 participants; I^2 78%, P=0.001; low-certainty evidence; Analysis 1.4) or at medium-term (MD 0.02, 95% CI -0.17 to 0.21; 1 study, 112 participants; low-certainty evidence; Analysis 1.5); fuerhermore, we found that dietary interventions compared with control may have little to no efect on long-term follow-up zBMI, but the evidence is very uncertain (MD -0.14, 95% CI -0.38 to 0.10; 2 studies, 1089 participants; I^2 75%, P=0.04; very low-certainty evidence; Analysis 1.6). Sensitivity analysis removing studies at high risk of bias did not change the overall results of the meta-analyses (Appendix 6).

In addition to the studies included in the meta-analyses, one study that reported the data narratively found that, when measured at the medium-term follow-up, the intervention may decreased the proportion of children with obesity, but did not reportwhether the same effect was observed in the control group (Afam-Anene 2021) (Table 6).

BMI percentile

Meta-analyses results for BMI percentile are reported in Figure 5. The evidence suggests that dietary interventions compared with control do not reduce BMI percentile at short-term (MD -0.05, 95% CI -1.23 to 1.13; 2 studies, 453 participants; I^2 0%, P=0.64; low-certainty evidence; Analysis 1.7) or long-term (MD -2.53, 95% CI -7.02 to 1.96; 1 study, 44 participants; low-certainty evidence; Analysis 1.9) follow-up. Furthermore, we found that dietary interventions compared with control likely do not reduce BMI percentile at medium-term follow-up (MD -1.89, 95% CI -3.95 to 0.18; 2 studies, 421 participants; I^2 0%, P=0.52; moderate-certainty evidence; Analysis 1.8) Sensitivity analysis removing studies at high risk of bias did not change the overall results of the meta-analyses (Appendix 6). Two studies measured the effect of dietary interventions on BMI percentile at short term follow-up (Lappe 2017 and O'Connell 2005) but did not report the results (Table 6).

Serious adverse events

Details of serious adverse events are reported in Table 3. Two studies (377 participants) reported data on serious adverse events (Ebbeling 2006; Lappe 2017) but neither found that any occurred as a result of the intervention.

Activity interventions versus control

We found 21 studies (17402 participants) that compared activity interventions versus control and of these 15 studies (13447 participants) were included in meta-analyses.

BMI

Meta-analyses results for BMI are reported in Figure 3. We found that activity interventions on average, compared with control, likely do not reduce BMI at short-term follow-up (MD -0.64, 95% CI -1.86 to 0.58; 6 studies, 1780 participants; I^2 98%, P<0.00001; moderate-certainty evidence; Analysis 2.1). In contrast, we found that activity interventions may result in a slight reduction in BMI at medium-term follow-up (MD -0.32, 95% CI -0.53 to -0.11; 3 studies, 2143 participants; I^2 33%, P=0.22; low-certainty evidence; Analysis 2.2). Of the three studies included in the meta-analysis, one study was at high risk of bias due to potential bias in the selection of the reported result. We also found that activity interventions may reduce slightly BMI at long-term follow-up (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 985 participants; low-certainty evidence; Analysis 2.3). Sensitivity analysis removing studies at high risk of bias did not change the overall results of the meta-analyses (i.e., no evidence of a difference; Appendix 6). In addition to the studies included in the meta-analyses, one study that reported the data narratively found no effect of activity interventions on BMI (Cohen 2021) (Table 6). Furthermore, one study measured the effect of activity interventions on BMI at medium-term follow-up but did not report the results (Belton 2019), and in two studies, measurement of BMI at short-term (Barbosa Filho 2017)and medium-term Zhou 2019follow-up was planned but results are not reported and we have no evidence that it was measured

zBMI

Meta-analyses results for zBMI are reported in Figure 4. We found thatactivity interventions compared with control do not reduce zBMI at short-term (MD 0.02, 95% CI -0.01 to 0.05; 7 studies, 4718 participants; I^2 0%, P=0.76; high-certainty evidence; Analysis 2.4). We also found that activity interventions compared with control likely do not reduce zBMI at the medium-term (MD 0, 95% CI -0.04 to 0.05; 6 studies, 5335 participants; I^2 48%; P=0.08; moderate-certainty evidence; Analysis 2.5) for long-term (MD -0.05, 95% CI -0.12 to 0.02; 1 study, 985 participants; moderate-certainty evidence; Analysis 2.6) follow-up. Sensitivity analysis removing studies at high risk of bias did not change the overall results of the meta-analyses (i.e., no evidence of a difference; Appendix 6. In two studies, zBMI at medium-term follow-up was planned (TenHoor 2018; Zhou 2019), but results are not reported and we have no evidence that it was measured (Table 6).

BMI percentile

Meta-analyses results for BMI percentile are reported in Figure 5. We found that activity interventions compared with control may have little to no effect on BMI percentile at medium-term follow-up but the evidence is very

uncertain (MD -1.09, 95% CI -2.81 to 0.63; 1 study, 1020 participants; very low-certainty evidence; Analysis 2.7).. We found no studies reporting BMI percentile at long-term follow-up but we found one study that measured BMI percentile at short term but did not report the results (Isensee 2018) (Table 6).

Serious adverse events

Details of serious adverse events are reported in Table 3. Seven studies (5428 participants) reported data on serious adverse events (Belton 2019; Harrington 2018; Hollis 2016; Kennedy 2018; Lubans 2021; Simons 2015; Smith 2014). Of these, two studies reported occurrence of serious adverse events: one study, Simons 2015, reported that 20% of the participants in the intervention group reported an injury (e.g. bruises or strained muscles/tendons) as result of the intervention; another study, Belton 2019, reported that some participants did not complete the study due to injuries or illness, although it is not reported whether these were related to participation in the study, and no quantification is provided.

Dietary and activity interventions versus control

We found 32 studies (31445participants) that compared dietary and activity interventions versus control and of these 25 studies (23456 participants) were included in meta-analyses.

BMI

Meta-analyses results for BMI are reported in in Figure 3. We found that dietary and activity interventions on average, compared with control, result in litle to no difference in BMI at short-term follow-up (MD 0.03, 95% CI -0.07 to 0.13; 11 studies, 3429 participants; I^2 0%, P=0.58; high-certainty evidence; Analysis 3.1). In a sensitivity analysis excluding one study in which the outcome was self-reported (Neumark-Sztainer 2003) we still found little to no effect of interventions (MD 0.03, 95% CI -0.07 to 0.13; 10 studies, 3249 participants) Similarly, we found that dietary and activity interventions compared with control may not reduce BMI at medium-term (MD 0.01, 95% CI -0.09 to 0.11; 8 studies, 5612 participants; I^2 0%, P=0.95; moderate-certainty evidence; Analysis 3.2) or long-term (MD 0.06, 95% CI -0.04 to 0.16; 6 studies, 8736 participants; I^2 55%, P=0.05; moderate-certainty evidence; Analysis 3.3) follow-up. Sensitivity analysis removing studies at high risk of bias did not change the overall results of the meta-analyses (i.e., no evidence of a difference) at any of the follow-up times (Appendix 6) and a funnel plot did not show evidence of small-study effects (Appendix 7).

In addition, one study narratively reported little to no effect of dietary and activity interventions compared with control on BMI at medium-term follow-up (Sabino 2021) (Table 6). A further study reported the odds of maintaining a normal BMI or improving from a BMI indicating overweight or obesity at medium- and long-term follow-up and found little to no effect of the intervention (Haire-Joshu 2015). Two studies measured the effects of dietary and activity interventions compared with control on BMI at medium-term (Bonsergent 2013) and long-term (Wieland 2018) follow-up but did not report the results. Furthermore, two studies planned measurement of BMI at short-term (Ahmed 2021) and medium-term (Zhou 2019) follow-up (;), but results are not reported and we have no evidence that the measurements took place (Table 6).

zBMI

Meta-analyses results for zBMI are reported in Figure 4. We found that dietary and activity interventions compared with control may have little to no effect on zBMI at short-term follow-up but the evidence is very uncertain (MD -0.09, 95% CI -0.2 to 0.02; 3 studies, 515 participants; I^2 77%, P=0.01; very low-certainty evidence; Analysis 3.4); furthermore, the evidence suggests that dietary and activity interventions compared with control do not reduce zBMI at medium-term (MD -0.05, 95% CI -0.1 to 0.01; 6 studies, 3511 participants; I^2 58%, P=0.03; low-certainty evidence; Analysis 3.5) or long-term (MD -0.02, 95% CI -0.05 to 0.01; 7 studies, 8430 participants; I^2 30%, P=0.2; low-certainty evidence; Analysis 3.6) follow-up. Sensitivity analysis removing one study at high risk of bias resulted in dietary and activity interventions likely to reduce zBMI at the short term follow-up (MD -0.22, 95% CI -0.33 to -0.11; 1 study, 194 participants; Appendix 6), but did not change the overall results of the meta-analyses (i.e., no evidence of a difference) at the medium- and long-term follow-ups . Two studies narratively reported little to no effect of dietary and activity interventions compared with control on zBMI at medium-term follow-up (Kuhlemeier 2022; Patrick 2006) (Table 6). One study only reported the effect estimate of a beneficial effect of the intervention at the short term follow-up (Slawson 2015). Three studies measured the effects of dietary and activity interventions compared with control on zBMI at short-term (Mauriello 2010) and medium-term (Bonsergent 2013; Mauriello 2010; Slawson 2015) but did not report the results (Table 6).

BMI percentile

Meta-analyses results for BMI percentile are reported in Figure 5. We found that dietary and activity interventions compared with control may reduce BMI percentile at short-term follow-up but the evidence is very uncertain (MD -1.69, 95% CI-3.22 to -0.16; 1 study, 46 participants; very low-certainty evidence; Analysis 3.7); note that the one study reporting data had high risk of bias due to missing outcome data. We found little to no effect of dietary and activity interventions compared with control on BMI percentile at long term follow-up but the evidence is very uncertain(MD -1.05, 95% CI -2.85 to 0.75; 1 study, 1368 participants; very low-certainty evidence; Analysis 3.8). We found no studies reporting BMI percentile at medium-term follow-up.

Serious adverse events

Details of serious adverse events are reported in in Table 3. Four studies (2394 participants) reported data on serious adverse events (Dunker 2018; Leme 2018; NCT02067728 2014; Wilksch 2015), and only one study reported that 8.7% of the participants developed clinical levels of concern about shape and weight (Wilksch 2015).

Activity interventions versus dietary interventions

We found one study (473 participants) that compared activity interventions versus dietary interventions and was included in meta-analyses.

BMI

Meta-analyses results for BMI are reported in Figure 3. We found that activity interventions compared with and dietary interventions may have little to no effect of on BMI at short term follow-up but the evidence is very uncertain (MD 0, 95% CI -0.28 to 0.28; 1 study, 416 participants; very low-certainty evidence; Analysis 4.1). We found no studies reporting BMI at medium-term or long-term follow-up.

zBMI

We found no studies reporting zBMI at short-term, medium-term or long-term follow-up.

BMI percentile

Meta-analyses results for BMI percentile are reported in Figure 5. The evidence suggests thatdietary interventions, compared with activity interventions, do not reduce BMI percentile at short term follow-up (MD -1.35, 95% CI -2.99 to 0.29; 1 study, 403 participants; low-certainty evidence; Analysis 4.2). We found no studies reporting BMI percentile at medium-term or long-term follow-up.

Serious adverse events

We found no studies reporting serious adverse events.

Dietary intervention versus dietary intervention

We found one study (n 21261) that compared two dietary intreventions (i.e., with no control group; Table 6).

BMI

One study compared two dietary interventions (i.e. with no control group) (Table 6), that were delivered as multicomponent compared with an environmental intervention groups (Zota 2016). All students enrolled in a school participating in the DIATROFI Program received a boxed fresh meal at 10 a.m. every school day. In the schools assigned to the multicomponent intervention group, a healthy nutrition educational program was also implemented, including educational material and activities for each target group. The outcome was the proportion of participants whom BMI changed from indicating overweight or obesity to normal weight BMI and the authors reported that there was little to no effect of the multicomponent intervention, compared with an environement interevention, on the probability of improving from overweight or obesity to normal weight in adolescents at medium follow-up.

zBMI, BMI percentile and serious adverse events

We found no studies reporting zBMI, BMI percentile or serious adverse events

Activity intervention vs activity intervention

We found one study (78 participants) that compared two activity interventions (i.e., with no control group; Table 6).

BMI

We found one study that planned to measure BMI at short-term follow-up but results are not reported and we have no evidence that BMI was measured (Razani 2018)

zBMI and BMI percentile

We found no studies reporting zBMI or BMI percentile

Serious adverse events

We found one study (78 participants) that reported data on serious adverse events (Razani 2018). The authors reported that there were no serious adverse events (including all causes mortality); however, it is not clear if these results refer to the parents or the children or both.

Dietary and activity intervention versus dietary and activity intervention

We found two studies (435 participants) that compared the effect of two dietary and activity interventions (i.e., with no control group; (Table 6) .).

BMI

One study compared a dietary and activity intervention that included training sessions on coping skills with the same intervention without the training sessions (Whittemore 2013). The authors found little to no effect of the interventions on BMI at short-term follow-up.

zBMI

We found no studies reporting zBMI.

BMI percentile

One study compared a dietary and activity intervention that included a motivational interviewing component with the same dietary and activity intervention but without the motivational interviewing component (Bernstein 2019). The authors found no effect of the interventions on BMI percentiles at short-term follow-up.

Serious adverse events

We found no studies reporting serious adverse events.

Subgroup analyses

We conducted pre-specified subgroup analyses by main setting of the interventions (school, home, school and home, other), country income status (high income versus non-high income) and participants socioeconomic status (low versus mixed). Results for all individual subgroups are presented in Appendix 8.

Subgrouping by these factors did not provide an explanation for the heterogeneity observed amongst the studies. Although some tests for subgroup differences were statistically significant at a 5% significance level Appendix 8), these arose from subgroups containing single studies and they reflected the heterogeneity pervasive amongst the studies. However, in the tests for subgroup difference in studies comparing dietary and activity intervention with control, the intervention appeared to be more effective at reducing zBMI in studies that targeted children and adolescents from low socio-economic status families or targeted places or areas of relative deprivation (MD -0.08; 95% CI: -0.12 to -0.04; 4 studies, 813 participants) compared with children and adolescents in studies in which socio-economic status was mixed (MD: 0.02; 95% CI: -0.03 to 0.06; 2 studies; 2698 participants) when measured at the medium-term follow-up.

Sensitivity analysis > Different ICCs

In our main analysis, we imputed an ICC = 0.02 in cluster-RCTs that had not been analysed according to the cluster design. In our sensitivity analyses, we investigated the impact of imputing ICCs of 0 and 0.04, and we found no material differences in the results (Appendix 6).

Discussion

Summary of main results

This review includes 74 studies (83,407 participants) of interventions for the prevention of obesity in children aged from 12 to 18 years. The majority of the studies compared an intervention involving interventions components to improve both dietary intake and physical activity levels with a control group. Interventions were mostly delivered at school, with some being delivered at home, in the community or within a primary care setting. Most interventions were implemented for less than nine months, with the shortest intervention conducted over one visit and the longest over 28 months. Over half of the interventions were based on one or more theories of behaviour change, the most common being social cognitive theory.

Meta-analyses of results from 54 studies (46,358 participants) suggest that a dietary intervention and a physical activity intervention on their own, and in combination, compared with control, may reduce measures of adiposity (fatness) slightly in children aged 12 to 18 years. Specifically, we found that dietary interventions, when compared with control, may reduce the increase in BMI at medium-term follow-up (9 to < 15 months), but the evidence is very uncertain (Summary of findings table 1). We found that physical activity interventions delivered on their own may result in a slight reduction in the increase in BMI at medium-term follow-up (low-certainty; Summary of findings table 2). The largest amount of evidence (i.e., number of studies) was available for interventions which combined dietary and physical activity intervention components compared with control (Summary of findings table 3). We found that dietary and activity interventions compared with control may reduce BMI percentile at short-term follow-up (12 weeks to <9 months) but the evidence is very uncertain.

An important observation in most of our meta-analyses was of high statistical heterogeneity, i.e. that effects varied substantially across studies within the comparisons. Prespecified subgroup analyses by main setting of the interventions (school, home, school and home, other), country income status (high income versus non-high income) and participants socioeconomic status (low versus mixed) did not provide an explanation for the heterogeneity observed among the studies. This heterogeneity might be due to the interventions pooled within each category (diet, activity, diet combined with activity) being variable in nature, intensity and duration; their only common feature was the intended mechanism by which they worked. It is also possible that the

heterogeneity is due, at least in part, to variability in the fidelity of the interventions, although we did not collect data on this.

See 5-11 discussion to amend this section

All interventions involved some level of provision of information. Most interventions that aimed to change and improve the dietary behaviours of children (with or without also changing physical activity levels) sought to provide the children with information and also to change the children's social environment, enabled and guided by their parents, teachers or other responsible adults. Most interventions that aimed to change and improve physical activity behaviours sought to enable and/or guide choice by changing the childrens' physical environment (at school or at home).

Nineteen studies specifically targeted individuals or communities of low socioeconomic status (also known as disadvantaged or underserved). As highlighted by McNulty 2019, the preferred way of addressing health disparities is to target the health disparity population exclusively. Of note, although these 19 studies were included in our analysis exploring differences in impact of an intervention between individuals of low vs mixed SES, their findings were unable to contribute to our learning because, usually, all participants were considered low SES.

The vast majority of studies (72 of 74) collected and reported data at baseline on at least one PROGRESS characteristic (Place of residence, Race, Occupation, Gender, Religion, Education, Socio-economic status, Social status). However, only 17 studies reported on the impact of at least one PROGRESS characteristic on the effectiveness of the intervention; gender/sex (15 studies), socio-economic status (5 studies), parent(s) education (1 study), parent(s) occupation (1 study). Although we understand the reluctance of researchers to perform multiple, post-hoc analyses of this type, the dearth of evidence in this review on the impact of interventions on health inequalities is a significant limitation.

Only fourteen studies reported data on serious adverse events, and of these only three studies observed serious adverse events related to the interventions, including clinical levels of concern about shape and weight, injuries and illness.

Overall completeness and applicability of evidence

Most studies were undertaken in general populations of high-income countries. We identified eight studies from upper-middle-income countries, three from a lower-middle-income country and three from a mix of high and upper middle-income countries. In most of the studies the participants were a mix of genders (59 studies); 11 studies were conducted only in girls, and two only in boys. It is worth noting that many (28 of 74) of the interventions included in this review were only tested in adolescents considered hard-to-reach and/or disadvantaged (mainly low income), or at greater risk of developing obesity. Nineteen studies specifically targeted disadvantaged children (or families) in a particular setting (e.g. school/community/area) or specifically targetted a school or community within a disadvantaged area. Nine studies targeted children considered 'at risk' of obesity based on their physical activity and dietary behaviours, including children disengaged in physical activity, children consuming at least one serving per day of sugar-sweetened beverages, and one study recruited participants from immigrant and refugee populations. Given that public health policymakers require evidence of the impact of interventions to prevent obesity in adolescents who are in the greatest need (disadvantaged, underserved), they can be reasonably confident of the completeness and applicability of the evidence reviewed here. Most interventions identified were school-based.

30% of studies aimed to improve physical activity behaviours, 26% dietary behaviours, and 45% both dietary and physical activity behaviours. The comparator for the majority of interventions was usual care, although some studies used an alternative intervention that was not associated with energy balance behaviours and a few studies tested one type of intervention to prevent obesity versus another.

A lack of completeness of evidence was identified for certain individuals within our society (population), interventions and outcomes. First, twenty-six studies excluded children with physical disabilities and 29 studies excluded children with mental disabilities. Second, we did not identify any studies (that met our inclusion criteria) that used a 'whole systems' or 'whole school' approach, or were focussed on improving the wider (i.e. beyond the home, school and community) environment. We did not identify any interventions that specifically targeted settings for adolescents who had chosen not to stay in mainstream education beyond the age of 15 or 16. Also, we did not identify any interventions which specifically focussed on digital or A.I. technology, which has developed at pace over the last 5 years; such innovation may be a focus of interventions for adolescents in the future. Furthermore, although zBMI and/or BMI outcomes were reported by the majority of studies, some studies (including those published in the last 10 years) only reported BMI percentile or other body weight-related outcomes (e.g. proportion of children living with overweight and obesity). Most studies did not report on serious adverse events.

Due to the fact that the majority of evidence (58%) identified was from school-based interventions, the recommendations from this review are mostly applicable for policymakers, local education authorities and schools, and health professionals who work with schools. These stakeholders can be reasonably confident of the completeness of the evidence reviewed for school-based interventions for adolescents. Importantly, increasing physical activity levels and eating a healthier diet have health and well-being benefits (outcomes) beyond the prevention of obesity and there is evidence that these behaviours track from childhood to adulthood. Indeed, major health conditions that make the greatest contribution to the burden of healthcare in adulthood in most high

and middle-income countries are driven by unhealthy and risky behaviours, including low levels of physical activity and an unhealthy diet. Tackling these behaviours during adolescence should therefore be a priority. For adolescents and their parents/carers, the evidence reviewed (albeit it limited in some respect and of low quality) provides some reassurance that interventions to prevent obesity do not appear to cause harm, including the promotion of eating disorders.

Quality of the evidence

We used the RoB 2 tool to assess the risk of bias of the 91 results from the 54 studies that were included in the meta-analyses. Overall, most of the results (59) were judged as 'Some concerns', while eight results were judged at 'Low risk of bias', 24 results were judged as 'High risk of bias', mostly because of missing outcome data). We tested the effect of removing studies rated at 'High' risk of bias (Appendix 6).

We used GRADE to assess the certainty of evidence of effects; we downgraded almost all results to 'moderate', 'low' or 'very low' ceratinty depending on the proportion of results at high risk of bias, the level of imprecision and heterogeneity, the generalisability of the results and the amount of missing evidence. Reasons for downgrading for each of the GRADE criteria is reported below.

Risk of bias

Of the 26 outcomes (i.e., BMI, zBMI and BMI percentile at short-, medium- and long-term follow-up) included in meta-analyses, 11 were downgraded one or two levels due to high risk of bias (i.e., the studies at high risk of bias contributed > 30% of the weight in the meta-analysis). The results within the downgraded outcomes were these judged at high risk of bias mostly due to missing outcome data (ten results), the randomisation process (three results) the selection of the reported result (two results) and deviations from the intended interventions (one outcome). The other 15 outcomes were not downgraded due to risk of bias as the results at high risk of bias contributed ≤ 30% of the weight in the meta-analysis or there were no results at high risk of bias included in the meta-analysis. We did not downgrade outcomes with high number of results judged as some concern as such judgement was mostly due to lack of information.

Imprecision

Of the 26 outcomes included in meta-analyses, 18 were downgraded one level due to imprecision (the number of participants included in each meta-analysis was < 3,000 and there was no clear evidence of an effect). The number of participants was less than 100 in three outcomes, between 100 and 500 in five outcomes, between 500 and 1000 in five outcomes, between 1000 and 2000 in four outcome and 2143 in one outcome. The other eight outcomes were not downgraded as the number of participants was > 3,000 per outcome.

Inconsistency

Of the 26 outcomes included in meta-analyses, eight were downgraded one level due to inconsistency. Four outcomes reported considerable heterogeneity (I^2>60%), two reported substantial heterogeneity (I^2>50%) and two reported moderate heterogeneity (I^2>30%). In all the eight downgraded outcomes point estimates and confidence intervals varying considerably

Indirectness

Of the 26 outcomes included in meta-analyses, six were downgraded one level due to indirectness (i.e., substantial contribution of the results of studies in highly specific population). Specifically, we had concerns over these outcome including results from studies conducted in children that are at risk of developing obesity, mainly due to their lifestyle (high sugar diet, low physical activity) and to having parents with obesity. Six outcomes also included data from highly specific populations (also regarded as at High risk for obesity), but we didn't downgrade these outcomes as the contribution of these studies to the results was moderate (<30% weight). The other 14 outcomes only included data from the general population.

Non-reporting bias

Of the 26 outcomes included in meta-analyses, six were downgraded one level due to non-reporting bias. For two outcomes evidence, the meta-analyses show benefit, and there was potential for missing data to impact on the result. For the four other outcomes the meta-analyses showed no effect of the interventions, but the size of the missing data was relatively high therefore there was potential for missing data to impact on the result. We did not downgrade five outcomes in which the interventions did not affect adiposity (fatness), for which evidence was missing due to relatively small number of participants from whom data were missing. For the remaining 15 outcomes there was no evidence of missing data.

Overall, our confidence in the evidence is reduced mainly due to the high proportion of studies judged at high risk of bias (mainly due to missing participants data and the randomisation process), imprecision of the results (studies were very small or there were not enough studies with data contributing to the evidence for some of the outcome) and inconsistency of the results across the different studies.

Potential biases in the review process

Our review updates part of a previous Cochrane Review using the same eligibility criteria and largely the same methodology (Brown 2019). Following the original review, we included only studies that stated the (or one of a limited number of) main aim of changing diet, physical activity, sedentary behaviour, sleep, play or structured

exercise to help prevent obesity in children and adolescents. We therefore excluded studies of similar interventions that did not report such an aim. There is potential for this to bias our selection of studies if the reporting of primary studies' aims have been influenced by their findings. If in any doubt, we checked the aim with that provided in the published protocol or trial register, where possible. We restricted eligibility to studies providing evidence of having measured BMI at baseline and follow-up so that we could examine changes from baseline. Again, this restriction may have led to exclusion of studies with similar interventions to those we included.

Following the previous review, we also grouped studies into somewhat crude comparisons according to the broad target of behaviour change (diet or physical activity or both) of the intervention. This led to a diversity of specific intervention approaches within comparisons and probably accounts for some of the subsequent statistical heterogeneity. We were unable to determine the specific causes of this heterogeneity with our planned analyses. Further investigation of how the variation in intervention approaches and intervention fidelity impact on outcomes may be valuable, including how these relate to the wider determinants of health.

We made some additions to the planned methods as set out in the protocol due to the design details of studies that we included in this review. We collected and analysed additional data where adiposity (fatness) was only reported as BMI percentile (rather than BMI or zBMI).

We restricted our attention to the outcome measures zBMI, BMI and BMI percentile. Outcome reporting bias may be operating if studies with systematically different results reported different outcome measures (Dwan 2010; Kirkham 2010), although we regard this as unlikely. Evidence of possible suppression of uninteresting findings is addressed as part of our GRADE assessment. Finally, because we are looking at general populations of children rather than clinical populations, and the main aim of many of our interventions of interest was not exclusively the prevention of obesity (for example, many studies focussed on improving diet or physical activity levels to improve health in general, although one of the stated aims was the prevention of obesity); many RCTs reported a wide variety of other outcomes that we did not examine in this review.

Agreements and disagreements with other studies or reviews

Other comprehensive reviews on this topic have found similar results as those reported in this review, in that there is a modest effect or no effect of interventions, that target individual change, to prevent obesity in adolescents. Of course, one can always find the rare study that shows that an intervention is effective, but the evidence base taken together suggests that the effect of these interventions is, at best, modest. Compared with previous reviews, including the previous version of the Cochrane review on preventing obesity in children, this review includes the largest number of studies and adolescents. The stark increase in the number of studies published over the past 5–8 years reflects the focus and effort on tackling obesity in adolescents by research funding bodies and researchers. Although the confidence in the certainty of results remains low or very low, mainly due to methodological issues of the studies, the increased volume of evidence available for this review provides readers and stakeholders with reassurance that the results, at least for school-based interventions, are unlikely to change with the addition of further studies which meet the same inclusion criteria.

Authors' conclusions

Implications for practice

This review update provides policy makers with a robust evidence base because it is restricted to randomised controlled trials (RCTs), and it includes almost three times as many (74 compared with 29) studies relevant to adolescence included in the previous version of this review (Brown 2019). The body of evidence in this reviewsuggests that a range of diet or activity interventions, may have a modest beneficial effect on developing obesity (i.e. gaining excess weight compared with what adolescents may otherwise experience) interventions that combine diet with physical activity, may have little to no difference. Compared with the previous (2019) Cochrane review, where no effect of diet (only two studies) or diet combined with physical activity interventions (8 studies) were found in adolescents, the increased number of studies in this review provides a more balanced and comprehensive summary of the impact of these interventions.

The long term clinical significance, at a population level, of a very small benefit of an intervention which prevents the gain of BMI and excess weight, compared with what an adolescent would otherwise experience, over the short or medium term is difficult to assess and, at best, minor. However, we know that the diet and physical activity behaviours that are adopted in childhood track throughout life (Craigie 2011). The potential cumulative effect of small but sustainable changes towards a healthier diet and a more physically active lifestyle could, at least in theory, reap long-term benefits for the promotion of healthy weight for individuals, communities and populations (Chen 2019). A healthy diet and a being physically active have many health and well-being benefits for adolescents beyond the promotion of a healthy body weight, including positive associations with academic achievement (Faught 2017).

The WHO Commission on Ending Childhood obesity suggests that part of the failure of interventions, such as the majority of those included in this Cochrane Review, is due to the fact that they target individual behaviour change (WHO 2016). The WHO Commission suggests that upstream interventions may be particularly important, and more effort is required in this area. Example interventions for adolescents include tackling the marketing of unhealthy foods such as sugar-sweetened beverages, and the obesogenic environment such as take-away food outlets. It is now acknowledged that tackling obesity requires a systems approach, and policy initiatives across government departments should be joined up (Rutter 2016; Rutter 2017).

From our exploratory analyses we found no indication that interventions to prevent obesity in adolescents are less effective in these with low socio-economic status. The preferred way of addressing health disparities is to target the health disparity

population exclusively (McNulty 2019), and we identified 19 (of 74) such studies. Most (55 of 74) excluded adolescents from taking part in the trial if they had a physical or mental disability and note this potential source of inequity in this review with reference to the WHO guidelines on physical activity sedentary behaviour in adolescents living with disability (WHO 2020).

Another important finding is that none of the 14 studies that reported relevant data found any serious adverse events; however, one study reported that a small number (about 10%) of adolescents reported an increase in weight concerns. Adolescence, which includes puberty and the transition to adulthood, is a critical time for mental health and well-being. Only a few studies assessed the costs and cost-effectiveness of interventions included in this review. On this basis, it is not possible to say whether these interventions are cost-effective. Evidence from newly identified studies from upper- and lower-middle-income countries is an important contribution to this review (11 of 74 studies), in terms of context and external validity, particularly for policymakers in those countries.

Implications for policy

The interventions included in this update mainly focused on changing individual (personal) behaviours and were mainly conducted in schools, with some being delivered at home, in the community, or within a primary care setting. A school setting may be a relatively easy setting to target, however, many adolescents who are hard-to-reach are disengaged with school but do have meaningful affiliations with local youth groups and sports clubs, and some have meaningful involvement with faith-based groups. Social media and peer pressure also play an important role in shaping energy-balance related behaviours in this age group.

We recognise that the methods we chose to employ, including the lumping of all types of interventions together under one of three categories (diet, activity, or diet combined with activity), may create results of limited value to policymakers deciding on which specific interventions within each category would 'work best' in their context. However, within these categories, hierarchies of specific interventions by observed effectiveness could be misleading. The effectiveness of the same intervention is likely to be vary by age and sex (even within the 12-18 year age group) and context (e.g. type of school provision), and the feasibility of implementation is likely to be dependent on local resources. Furthermore, policymakers who are responsible for implementing specific policies for the prevention of obesity in adolescents need to ensure that such policies 'fit' within the wider public health strategy and initiates of the community and population they serve. However, this review does provide policymakers with information about whether such policies should best focus on diet, activity, or both, and more detailed information about each intervention within these categories (and by country and setting) is provided if policymakers require further information.

We did not identify interventions for this review that aimed to take a (whole) systems approach to preventing obesity in adolescence. Local health authorities and national guidance usually champion the importance of taking such an approach in tackling obesity (incorporating both prevention and treatment initiatives). However, research studies (mainly evaluations) designed to assess the impact of implementing such an approach are not traditional RCTs and therefore did not meet our inclusion criteria.

An explanation or potential opportunity to enhance the impact of interventions that aim to prevent obesity in adolescents is through greater application to implementation science. There are some suggestions that the effects of health innovations can be enhanced by up to 12 times with potent implementation approaches (Durlak and DuPre 2008). A recent Cochrane Review found that the use of implementation strategies may result in large increases in implementation of interventions, and slight improvements in measures of diet and physical activity (Wolfenden 2022). As implementation science advances, the application of it could be important to amplify the effects of behavioural interventions to prevent obesity in adolescents.

Implications for research

We do not anticipate the effect sizes we found in this review to change significantly with the addition of more school-based interventions that target individual-level energy balance-related behaviours in adolescents. However, we do recommend that further research of this type, in adolescence, should be conducted where it includes a wider range of community settings (including faith-based groups, local youth groups and local sports clubs, and social media-based and digital-based interventions). We also recommend that future research in this area proactively includes adolescents with disabilities.

For existing and ongoing studies that would meet the inclusion criteria of this review, we suggest they should include follow-up over several years and we understand that funding issues for such follow-up work can be of existing studies that have been completed. Such follow-up data could provide important information on the sustainability of behaviour change and impact on weight. We understand the barriers to conducting this type of work, including funding challenges, ethical approval and data protection issues. We also understand the perceived higher prestige attached to primary research compared with secondary or follow-up research. We urge funding bodies and journal editors to place a higher value on this type of research activity. We also suggest that a better understanding of process and implementation, using evaluation methods by which one can better compare the results of one study with the next (and summarise the information for reviews such as this), would be extremely useful. This type of activity is critical for the successful translation of interventions from one context to another, and across different countries.

We also urge researchers to collect baseline information on gender and other PROGRESS (place, race, occupation, gender, religion, education, socio-economic status (SES), social status) factors, including SES, and also to analyse the effect of the intervention by these factors. We understand the reluctance of researchers to perform multiple, post-hoc analyses of this type; however, these are necessary if we are to provide confidence for practice and policy that the interventions we deem effective do not increase inequalities.

Going forward, we suggest the need to rethink the priorities and methods for research that aims to prevent obesity in adolescence. This may include a focus on valuing and conducting research that assesses the impact of multilevel, community, or other interventions that better address systemic and structural factors related to obesity, including those that take a 'whole systems approach', and do not rely on traditional randomised controlled trials. We suggest that research in this field also needs to look beyond diet and activity behaviours as the focus of interventions and instead explore both a focus on the wider environment and political factors which drive obesity, and also the wider determinants of health which drive inequalities in dietary intake and food insecurity, physical activity and physical activity insecurity, and obesity. The research community needs to help and support policymakers and stakeholders in bringing the totality of the evidence base together in a balanced and accessible format.

We urge researchers and funding bodies in all countries to continue to support research on adolescent obesity in low- and middle-income countries, and better understand the experiences of nutrition transition and rapid weight gain. In the context of some countries, this research should aim to address the double burden of malnutrition.

Finally, we support the research recommendations set out by the WHO Commission on Ending Childhood Obesity (WHO 2017).

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Editorial and peer-reviewer contributions

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• Sign-off Editor (final editorial decision): Brenda Bongaerts;

• Managing Editor (selected peer reviewers, provided editorial guidance to authors, edited the article): Joanne Duffield, Central Editorial Service Editorial Team;

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The views expressed in this review are those of the authors and do not necessarily represent those of the NHS, the NIHR, NIHR ARC, or the NHMRC.

Data and analyses

Comparison 1

Dietary vs control (all studies)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 BMI short term	3		Mean Difference (IV, Random, 95% CI)	-0.18 [-0.41, 0.06]
1.2 BMI medium term	3		Mean Difference (IV, Random, 95% CI)	-0.65 [-1.18, -0.11]
1.3 BMI long term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
1.4 zBMI short term	5		Mean Difference (IV, Random, 95% CI)	-0.06 [-0.12, 0.01]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size	
1.5 zBMI medium term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	
1.6 zBMI long term	2		Mean Difference (IV, Random, 95% CI)	-0.14 [-0.38, 0.10]	
1.7 Percentile short term	2		Mean Difference (IV, Random, 95% CI)	-0.05 [-1.23, 1.13]	
1.8 Percentile medium term	2		Mean Difference (IV, Random, 95% CI)	-1.89 [-3.95, 0.18]	
1.9 Percentile long term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	

Comparison 2

Activity vs control (all studies)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size	
2.1 BMI short term	6		Mean Difference (IV, Random, 95% CI)	-0.64 [-1.86, 0.58]	
2.2 BMI medium term	3		Mean Difference (IV, Random, 95% CI)	-0.32 [-0.53, -0.11]	
2.3 BMI long term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	
2.4 zBMI short term	7		Mean Difference (IV, Random, 95% CI)	0.02 [-0.01, 0.05]	
2.5 zBMI medium term	6		Mean Difference (IV, Random, 95% CI)	0.00 [-0.04, 0.05]	
2.6 zBMI long term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	
2.7 Percentile medium term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	

Comparison 3

Dietary and activity vs control (all studies)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size	
3.1 BMI short term	11		Mean Difference (IV, Random, 95% CI)	0.03 [-0.07, 0.13]	
3.2 BMI medium term	8		Mean Difference (IV, Random, 95% CI)	0.01 [-0.09, 0.11]	
3.3 BMI long term	6		Mean Difference (IV, Random, 95% CI)	0.06 [-0.04, 0.16]	
3.4 zBMI short term	3		Mean Difference (IV, Random, 95% CI)	-0.09 [-0.20, 0.02]	
3.5 zBMI medium term	6		Mean Difference (IV, Random, 95% CI)	-0.05 [-0.10, 0.01]	
3.6 zBMI long term	7		Mean Difference (IV, Random, 95% CI)	-0.02 [-0.05, 0.01]	
3.7 Percentile short term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	
3.8 Percentile long term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	

Comparison 4

Activity vs dietary (all studies)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size	
4.1 BMI short term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	
4.2 Percentile short term	1		Mean Difference (IV, Random, 95% CI)	Totals not selected	

History

Protocol first published: Issue 7, 2022

Contributions of authors

FS assessed studies for inclusion, collected data and information on risk of bias, extracted data, analysed the data, assessed the certainty in the body of evidence and interpreted of data, amended the methods from the protocol, wrote the results and discussion sections and was responsible for project administration.

ET assessed studies for inclusion, collected data and information on risk of bias, extracted data, edited and provided advice on the manuscript.

AD extracted data, analysed the data, amended the methods from the protocol, wrote the results, edited and provided advice on the manuscript.

THMM developed the concept of the review, produced the infographic, advised on risk of bias assessments, edited and provided advice on the manuscript.

SD designed the search strategies, conducted the searches, amended the methods from the protocol, edited and provided advice on the manuscript.

KB extracted and analysesd the costing data, edited and provided advice on the manuscript.

JS developed the concept of the review, provided advice on risk of bias assessment, edited and provided advice on the manuscript.

RKH provided lists of records and of completed data extraction forms, edited and provided advice on the manuscript.

LW edited and provided advice on the manuscript.

JPTH developed concept for the review update, acquired funding, acted as the co-lead senior author, checked data extraction, provided advice on risk of bias assessment, assessed the certainty in the body of evidence and interpreted of data, edited and provided advice on the manuscript.

CDS developed concept of the review, acted as the co-lead senior author, amended the background, checked data extraction, wrote the discussion and edited and provided advice on the manuscript. CDS is the guarantor for the review.

Declarations of interest

- **Francesca Spiga:** declares that they have no conflict of interest.
- **Eve Tomlinson:** declares that they have no conflict of interest.
- **Annabel Davies:** declares that they have no conflict of interest.
- **Theresa HM Moore:** reports being employed by Cochrane as a Methodology Editor, and was not part of the peer review process of this review. The author was not involved in the editorial process.
- **Katie Breheny**: receives support from the National Institute for Health Research(NIHR) Applied Research Collaboration ARC West and Alzheimer's Society and is funded through a Post-Doctoral Fellowship. Previously, Katie Breheny received support from the NIHR School for Public Health Research (SPHR) through a Post-Doctoral Launching Fellowship.
- **Sarah Dawson:** reports being employed by Cochrane as Information Specialist (Common Mental Disorders Group). The author was not involved in the editorial process.
- **Jelena Savovic:** JS has received payment from Core Models ltd. in 2021 to deliver online teaching of introductory systematic review methods.
- **Rebecca K Hodder:** reports working as a Program Manager, Hunter New England Population Health, Hunter New England Local Health District, responsible for the delivery of chronic-disease prevention programs in secondary schools. RH works as a research associate for Cochrane Public Health and had no role in the editorial process for the review.
- **Luke Wolfenden:** reports research grants to undertake trials likely to be included in the review; paid to University of Newcastle. LW reports that he benefited financially from these payments and/or has access to or control of the funds. LW reports involvement in conducting a study (or studies) that is (are) eligible for inclusion in the work (Ooi 2021: funded by the New South Wales Health Translational Research Grant Scheme; Hollis 2016: funded by the NSW Ministry of Health, Heath Promotion Demonstration grant scheme). LW has received funding, via grants awarded to his institution, for his time to undertake research, and to conduct research trials including activities from study development, conduct, analysis and reporting from NSW Ministry of Health, Nib Foundation, Heart Foundation and National Health and Medical Research Council. LW reports that he has published numerous opinions, commentary or editorial on topics pertaining to chronic disease prevention, healthy eating, physical activity and obesity. LW reports working as a health promotion program manager at Hunter New England Local Health District, a government funded health service. LW is Co-ordinating Editor of Cochrane Public Health; however, he was not involved in any stage of the editorial management or assessment of this protocol.
- **Julian P T Higgins:** receives support from the National Institute for Health Research (Public Health Research, NIHR131572).
- **Carolyn D Summerbell:** reports being affiliated with the WHO, and contributed to their work for their 'Ending Childhood Obesity' report.

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Differences between protocol and review

We changed the author list to reflect contributions to the review.

We made

We ran a search for retractions and corrigenda.

We added BMI percentile as an outcome as we found studies reporting only this interpretation of BMI.

We changed the coding of the sub-group analysis by setting and socioeconomic status to reflect the setting and population of the included studies.

We did not:

- undertake additional analyses ('syntheses without meta-analysis') using methods based on P values and directions of effect. We made extensive efforts to estimate intervention effects from diversely reported results (e.g. from regression coefficients, from P values and from analyses based on dichotomised BMI scores (Higgins 2019b)). However, very few of the studies not included in meta-analyses provided this basic information;
- undertake SMD sensitivity analyses; we observed that studies included importantly different age ranges (e.g. many in single year groups but others across multiple year groups), so that the SDs for BMI used for the standardization would be expected to reflect mainly the spread of age ranges rather than the differenecs in the measurement scale (section 8.2, Cochrane Handbook Chapter 8).
- write to authors to request missing data due to scarsity of time and resources
- undertake subgroup analyses according to sex and duration of intervention. Not enough studies presented subgroup analyses by sex and we decided that attempting to code duration of intervention was not particularly meaningful when some of the interventions sought long-term changes by short-term activity to change physical environments.

Characteristics of studies

Characteristics of included studies [ordered by study ID]

Afam-Anene 2021

Study characteristics	
Methods	

	Study name: NR Study dates: study dates not reported Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 3 months Follow-up time(s): 3 months
Participants	Participants randomized: 346 Setting: secondary school(s) Location: Owerri North, Local Government Area of Imo State; Nigeria Country income: lower middle income Recruitment: NR % of eligible population enrolled: NR Age: participants are adolescents in secondary schools Gender/Sex: NR
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 189 Comparator type: no active intervention Participants in the comparison group(s): 157 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children with obesity Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: NR Reason for exclusion from the meta-analysis: results described narratively
Notes	Clinical Trial Registry: NR Funder(s) type: NR Writing and/or research independent from funder(s): NR Funding details: NR Declaration of interest: none General notes: conference abstract; narrative results only

Ahmed 2021

Study characteristics	
Methods	Study name: NR Study dates: date of first participant enrollement: 12 March 2019; date of last data collection: 7 July 2019 (extracted from trial registration) Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 weeks Follow-up time(s): 12 weeks (note: BMI as outcome was planned but not measured)
Participants	Participants randomized: 320 Setting: eight schools Location: Dhaka; Bangladesh Country income: lower middle income Recruitment: "Thirteen schools were purposively invited to participate in the study. Eleven schools accepted the intervention, and eight of them were randomly allocated for the study. All randomly selected schools were then randomised. An information pack, containing information sheet, consent and assent form, was distributed to interested students so that they could discussed with their parents about their participation in the study. Written informed parental consent and student's assent were obtained from all students participated in this study, and the response rate was 100%. A minimum of 40 students were recruited from each school, as per the inclusion criteria. For a school with more than 40 students in Grade 8 and 9, a random allocation was performed to achieve the required sample size." % of eligible population enrolled: schools: 73% (8/11); children: 100% (320/320) Age (years): mean (SD): intervention: 14.42 (1.15); control: 14.18 (0.89) Gender/Sex: 41.25% boys
Interventions	Theory: Health-Promoting School Framework Intervention type: dietary and activity intervention Participants in the intervention group(s): 160 Comparator type: no active intervention Participants in the comparison group(s): 160 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): none Outcome(s) included in the meta-analysis (time of assessment): NA Outcome self-reported: no Reason for exclusion from the meta-analysis: measurement of proportion of children with obesity or overweight was planned but results are not reported (there is no evidence that it was measured)
Notes	Clinical Trial Registry: ACTRN12619000091101 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: there was no external financial support with this project

	Declaration of interest: The authors declare that they have no competing interests. General notes: BMI outcome was planned but not reported

Amaro 2006

Study characteristics	
Methods	Study name: Kaledo Study dates: study dates not reported Study design: cluster RCT N of arms: 2 Unit of allocation: classroom Unit of analysis: individual Intervention period: 24 weeks Follow-up time(s): 24 weeks
Participants	Participants randomized: 291 Setting: three middle school Location: Naples; Italy Country income: high income Recruitment: "All students from three middle school in Naples were invited to participate." % of eligible population enrolled: children: 95% (291/307) Age (years): mean (SD): intervention: 12.3 (0.8); control: 12.5 (0.7) Gender/Sex: 55.2% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 188 Comparator type: no active intervention Participants in the comparison group(s): 103 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (24 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study has been made possible by contributions from the Italian Association Amici di Raoul Follereau (AIFO), Commune of Naples and from the Second University of Naples." Declaration of interest: NR General notes: NR

Andrade 2014

Study characteristics	
Methods	Study name: ACTIVITAL (actividad y vitalidad) Study dates: ACTIVITAL started in October 2009 and finished in June 2012 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 28 months Follow-up time(s): 17 months; 28 months
Participants	Participants randomized: 1440 Setting: twenty schools Location: Cuenca; Ecuador Country income: upper middle income Recruitment: "All students in 8th and 9th grades from 20 schools in urban Cuenca were invited to participate." % of eligible population enrolled: schools: 71% (20/28); children: 100% Age (years): mean (SD): intervention: 12.8 (0.8); control: 12.9 (0.8) Gender/Sex: intervention: 33.6% boys; control: 40.7% boys
Interventions	Theory: Social Cognitive Theory, Information-Motivation, Behavioral Skills Model, Control Theory, Trans-theoretical Mode, Theory of Planned Behavior Intervention type: dietary and activity intervention Participants in the intervention group(s): 700 Comparator type: no active intervention Participants in the comparison group(s): 740 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI long term (17 months); zBMI long term (17 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01004367 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR

	Funding details: "This work was supported by generous financial support from VLIR-UOS and Nutrition Third World and conducted within the cooperation between the Cuenca University (Ecuador) and the Ghent University (Belgium)." Declaration of interest: The authors declare that they have no competing interests. General notes: eligible schools were paired according to monthly school fee (as proxy for the socioeconomic status of the school).

Arlinghaus 2021

Study characteristics	
Methods	Study name: FLOW-PA (Family Lifestyle Overweight Prevention Program-Physical Activity) Study dates: 2011 to 2014 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 6 months Follow-up time(s): 6 months
Participants	Participants randomized: 491 Setting: middle school students from a school district Location: Houston, Texas; United States Country income: high income Recruitment: "Middle school students from a school district in Houston, Texas." % of eligible population enrolled: children: 100% Age (years): mean (SD): weekday group: 12.10 (0.63), weekend group: 12.06 (0.60) Gender/Sex: weekday group: 47.15% boys; weekend group: 43.38% boys
Interventions	Theory: Social Cognitive Theory Intervention type: activity intervention Participants in the intervention group(s): 251 Comparator type: no active intervention Participants in the comparison group(s): 240 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (6 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT04396769 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was supported by funds from the US Department of Agriculture, Grant No. ARS 2533759358. The contents of this publication do not necessarily reflect the views or policies of the USDA, nor does mention of trade names, commercial products, or organizations imply endorsement from the US government." Declaration of interest: The authors declare no conflict of interest. Dr. Arlinghaus is employed full time at the University of Minnesota. Drs. Ledoux and Johnston are employed full time at the University of Houston. All authors received a grant from the Peanut Institute for unrelated work in June 2019. General notes: NR

Barbosa Filho 2017

Study characteristics	
Methods	Study name: Fortaleça sua Saúde Study dates: the study was conducted in 2014 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 4 months Follow-up time(s): 4 months (note: BMI as outcome was planned but not measured)
Participants	Participants randomized: 1272 Setting: six full-time schools of the city that were linked to a national program called School Health Program Location: Fortaleza; Brazil Country income: upper middle income Recruitment: "All six full-time schools of the city that were linked to a national program called School Health Program were included./The six schools had similar characteristics (e.g., size, target audience, curriculum, etc.) and were located in different administrative regions (geographically dispersed). After authorization of the study by the Municipal Education Department, all directors of eligible schools were informed about the study and the participation criteria. All directors agreed to participate without being informed which treatment group the schools would be assigned to in the study." % of eligible population enrolled: schools: 100% (6/6); children: 93% (1182/1272) Age (years): rang: 11–13 : 52.9%; 14–18: 47.1% Gender/Sex: 51.5% boys
Interventions	Theory: Different theoretical aspects, including the Socio-Ecological Theory and Health-Promoting School Framework Intervention type: activity intervention Participants in the intervention group(s): 639 Comparator type: no active intervention Participants in the comparison group(s): 633 Comparison: activity intervention vs control

	Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): none Outcome(s) included in the meta-analysis (time of assessment): NA Outcome self-reported: NA Reason for exclusion from the meta-analysis: measurement of proportion of children with obesity or overweight at follow-up was planned but results are not reported (there is no evidence that it was measured)
Notes	Clinical Trial Registry: NCT02439827 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "There was no financial funding to perform this study. Individual grants for VCBF (N. 10737/2014-6) from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), and ASL (N. 303012/2013-7) from the Conselho Nacional de Ciência e Tecnologia (CNPQ). The funding agencies had no participation in the interpretation, analysis, writing and approval of this manuscript." Declaration of interest: NR General notes: BMI outcome was planned but not reported

Bayne-Smith 2004

Study characteristics	
Methods	Study name: PATH (Physical Activity and Teenage Health Study dates: 1994-1996 Study design: RCT/clustered RCT (the study tarted as RCTand then became a cluster RCT, see Notes) N of arms: 2 Unit of allocation: classroom Unit of analysis: individual Intervention period: 12 weeks Follow-up time(s): 12 weeks
Participants	Participants randomized: 442 Setting: students from three New York City high schools Location: New York City, New York; United States Country income: high income Recruitment: students from three New York City high schools % of eligible population enrolled: NR Age (years): mean (SD): intervention: 16.2 (1.3); control: 15.9 (1.2) Gender/Sex: 100% girls
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): 310 Comparator type: no active intervention Participants in the comparison group(s): 132 Comparison: dietary and activity intervention vs control Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (12 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was funded in part by grants from the Professional Staff Congress-City University of New York (CUNY), Faculty Research Awards Program, the Research Foundation of CUNY; the Department of Health, State of New York; and Operation Fitkids, Inc." Declaration of interest: NR General notes: the trial started as an RCT with individuals being randomised, then became a CRCT in year 2 and 3 with classes being randomised after year one. No details given about number of clusters.

Belton 2019

Study characteristics	
Methods	Study name: Y-PATH (Youth-Physical Activity Towards Health) Study dates: outcome assessments were conducted with students in all 20 schools at baseline (T1, September-October 2013), at 12 months follow up (T2, September-October 2014) Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 9 months (one school year) Follow-up time(s): 12 months; 24 monts (note: results at 24 months are not reported)
Participants	Participants randomized: 534 Setting: twenty mixed-gender schools in the particular Irish geographical region Location: Dublin County; Ireland Country income: high income Recruitment: "Inclusion criteria for post primary schools in this study were that a) schools have a qualified PE teacher on staff, b) first year students attending the school were timetabled for a minimum of 70 minutes of PE weekly, c) schools were mixed gender and situated in the greater area of a large Irish city. All mixed-gender schools in the particular Irish geographical

	region (n = 104) were invited to express interest in participation in the study if they met the above inclusion criteria....Principals of 26 schools returned expressions of interest, screening of these schools highlighted that 22 schools met the inclusion criteria, all 22 schools were recruited to participate in the study. One first year class group from each school was randomly selected by the school principal to participate. Two schools subsequently withdrew from the study prior to commencement due to changes in staffing (PE teacher and principal), reducing numbers to 20 overall." % of eligible population enrolled: school; 91% (20/22); children: 96% (534/555) Age (years): mean (SD): intervention boys: 12.8 (0.41); intervention girls: 12.79 (0.40); control boys: 12.81 (0.44); control girls: 12.8 (0.42) Gender/Sex: intervention: 50% boys; control: 52% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 275 Comparator type: no active intervention Participants in the comparison group(s): 259 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): NA Outcome self-reported: no Reason for exclusion from the meta-analysis: BMI was measured at follow-up but results are not reported
Notes	Clinical Trial Registry: ISRCTN20495704 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "The Y-PATH research study was funded by the Dublin Local Sports Partnerships, and the Dublin City University Career Start grant. The funders had no role in study design; collection, analysis, and interpretation of data; writing the report; and the decision to submit the report for publication." Declaration of interest: none declared General notes: BMI was measured at baseline and at follow-up at 12 and 24 months but data are not reported. The 20 recruited schools were pair-matched prior to baseline testing based on the following criteria: socioeconomic status (disadvantaged, non-disadvantaged, and fee paying).

Bernstein 2019

Study characteristics	
Methods	Study name: ECT (Expand, Connect, Thrive) Study dates: participants were adolescents entering grades 6-9 in Fall 2017 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 7.5 months (6 weeks of primary intervention + 6 months of motivational interviewing sessions) Follow-up time(s): 4.5 months (3 months post-intervention); 7.5 months (6 months post-intervention)
Participants	Participants randomized: 51 Setting: summer camp at school based health clinic Location: North Miami Beach, Florida; United States Country income: high income Recruitment: "Participants were recruited using flyers posted at feeder schools for the Middle School and at the Middle School. All adolescents voluntarily indicated interest in participation. Only youth entering grades 6-9 and their parents who were enrolled in the summer camp were approached by study staff (i.e., trained social workers and/or a graduate student). Parental consent and youth assent were obtained from interested families. Additionally, parents signed a video/audio recording authorization." % of eligible population enrolled: children: 96% (51/53) Age (years): mean (SD): 12.06 (1.16) Gender/Sex: 44% boys
Interventions	Theory: Cognitive Behaviour Therapy, Self Determination Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 27 Comparator type: dietary and activity Participants in the comparison group(s): 24 Comparison: dietary and activity intervention vs dietary and activity intervention Setting of the intervention: school (after school programme) Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: comparison is not eligible (the comparion is between the same type of interventions)
Notes	Clinical Trial Registry: NR Funder(s) type: NR Writing and/or research independent from funder(s): NR Funding details: NR Declaration of interest: NR General notes: weight status at baseline: 54% of the sample fell into the overweight category and 18% met the cut off for obesity. Narrative results only.

Black 2010

Study characteristics	
Methods	Study name: Challenge! Study dates: adolescents and caregivers participated in a baseline evaluation between July 2002 and May 2004 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 12 weeks Follow-up time(s): 10 months; 24 months
Participants	Participants randomized: 235 Setting: mid-Atlantic, urban, University Medical Center Location: Baltimore, Maryland; United States Country income: high income Recruitment: two groups of adolescents were recruited. One group (n=84) participated in a longitudinal investigation of growth and development. "Approximately 17.9% experienced growth faltering by age 2 years; by 6 years, their growth had recovered. The other group (n=151) was recruited from middle schools." % of eligible population enrolled: NR Age (years): mean (SD): 13.3 (1) Gender/Sex: 51% boys
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 121 Comparator type: no active intervention Participants in the comparison group(s): 114 Comparison: dietary and activity intervention vs control Setting of the intervention: home + community Setting of the intervention in sub-group analyses: home
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI medium term (10 months); zBMI long term (24 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT00746083; NCT03103269; Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was supported by grant R40MC00241 from the Maternal and Child Health Research Program, US Department of Health and Human Services to Maureen Black, Ph.D., and the University of Maryland General Clinical Research Center grant M01 RR16500, General Clinical Research Centers Program, National Center for Research Resources (NCRR), NIH." Declaration of interest: The authors have indicated they have no financial relationships relevant to this article to disclose. General notes: NR

Bogart 2016

Study characteristics	
Methods	Study name: SNaX (Students for Nutrition and Exercise) Study dates: the study began in January 2009. Study implementation was staggered over 3 semesters, such that 1 matched-pair received SNaX in the 2009 spring semester, and 2 matched-pairs each received SNaX in the 2010 and 2011 spring semesters. The first 2-year post-intervention anthropometric assessment occurred in the spring 2011 semester, and the last 2-year post-intervention anthropometric assessment occurred in the spring 2013 semester Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 5 weeks Follow-up time(s): 2 years
Participants	Participants randomized: 4022 Setting: ten schools Location: Los Angeles Unified School District (LAUSD), California; United States Country income: high income Recruitment: from Bogart 2014: "We identified 31 eligible schools with >50% NSLP-eligible students (a proxy for low income) and <900 seventh-graders (a greater number of smaller schools provides more statistical power than a few larger schools). The number of schools selected (5 intervention, 5 wait-list control) was based on a pre-RCT power analysis for small-to-medium effects. / Seventh-graders were recruited via in-class presentations and informational tables for a peer leader club in which they learned educational messages and conducted lunchtime giveaways (e.g., educational bookmarks) and cafeteria-food taste-tests." % of eligible population enrolled: school: 32% (10/31); children: 91% (3678/4022) Age (years): mean (SD): 12.2 (0.68) Gender/Sex: 49.1% boys
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 1954 Comparator type: no active intervention Participants in the comparison group(s): 2068 Comparison: dietary and activity intervention vs control Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school + home
Outcomes	

	Measured outcome(s): zBMI and BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI percentile long term (2 years) Outcome self-reported: no Reason for exclusion from the meta-analysis: results described narratively (zBMI long term)
Notes	Clinical Trial Registry: NCT01914471 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Supported by the National Institute on Minority Health and Health Disparities (R24 MD001648; Dr Schuster, Principal Investigator). Funded by the National Institutes of Health (NIH)." Declaration of interest: The authors have indicated they have no potential conflicts of interest to disclose. General notes: one school served as a control school in 2009 and then again as an intervention school 1 year later in 2010: "based on our school selection criteria (in which we matched pairs of control and intervention schools within the same district area), 1 school served as a control school in 2009 and then again as an intervention school 1 year later in 2010."

Bonsergent 2013

Study characteristics	
Methods	Study name: PRALIMAP (PRomotion de l'ALIMentation et de l'Activité Physique) Study dates: adolescents entering the selected high schools in Grade 10 in 2006 or 2007 (according to the school) and in Grade 11 in 2007 or 2008 benefited from interventions Study design: clustered RCT (2x2x2 factorial design) N of arms: 8 Unit of allocation: school Unit of analysis: individual Intervention period: 2 school years (6 months/year) Follow-up time(s): 12 months; 24 months (note: results at 12 months are not reported)
Participants	Participants randomized: 6371 Setting: twenty-four public high schools Location: Lorraine region; France Country income: high income Recruitment: "A total of 24 public high schools were included in PRALIMAP, in the administrative region of Lorraine, northeast France (population 2,339,000, according to the 2006 census) in 2006 and 2007. All adolescents entering the selected high schools in Grade 10 in 2006 or 2007 (according to the school) and in Grade 11 in 2007 or 2008 were enrolled." % of eligible population enrolled: schools: 19% (24/124); children: 84% (5354/6371) Age (years): mean: 15.8 Gender/Sex: 47.1% boys
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): education strategy: 3424; no education strategy: 2947; environmental strategy: 3150; no environmental strategy: 3221; screening and care strategy: 3191; no screening and care strategy: 3180 Comparator type: attention control Participants in the comparison group(s): Comparison: dietary and activity intervention vs control Setting of the intervention: school + healthcare service + community Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI long term(24 months); zBMI long term (24 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT00814554 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "The PRALIMAP trial was funded by grants from public and private sectors. Special acknowledgements are addressed to ARH Lorraine, Conseil Régional de Lorraine, DRASS de Lorraine, GRSP de Lorraine, Fondation Coeurs et Artères, Fondation Wyeth, Ministère de l'enseignement supérieur et de la recherche, Inca, IRESP, Régime local d'assurance maladie d'Alsace Lorraine and Urcam de Lorraine. All trial steps, design,data collection, analysis, write-ups, and reports are and will be performed independently of any funding or sponsoring agency." Declaration of interest: No financial disclosures were reported by the authors of this paper. General notes: the design of the trial is a 2x2x2 factorial and data are reported and analysed according to this design: "Each high school was assigned to receive or not receive each of the three strategies according to a 2x2x2 factorial cluster (high school) randomization, stratified on administrative area and type of school."

Brito Beck da Silva 2019

Study characteristics	
Methods	Study name: StayingFit Brazil Study dates: the study was conducted from September 2016 to September 2017 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months
Participants	Participants randomized: 895 Setting: twelve mid-sized public schools of the public comprehensive education system Location: Salvador, Bahia; Brazil Country income: upper middle income

	Recruitment: "7th to 9th graders who were enrolled in twelve mid-sized public schools of the public comprehensive education system in Salvador, Bahia, Brazil participated in this research. Eligible students provided a signed informed consent document and agreed to participate in the study." % of eligible population enrolled: schools: NR; students: 50% (895/1800) Age (years): mean (SD): 14.5 (1.42) Gender/Sex: 51.6% boys
Interventions	Theory: Cognitive Behavioural Therapy Intervention type: dietary and activity intervention Participants in the intervention group(s): 428 Comparator type: no active intervention Participants in the comparison group(s): 467 Comparison: dietary and activity intervention vs control Setting of the intervention: school + home + web Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: RBR-7qgnbn Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was funded by National Council for Scientific and Technological Development (CNPq; n. 446763/2014-4), the Bahia Research Foundation (FAPESB; n.app 0103/2016) and Coordination of Superior Level Staff Improvement (CAPES: 001)." Declaration of interest: The authors declare no conflict of interest. General notes: NR

Chen 2011

Study characteristics	
Methods	Study name: Web ABC (Web-Based Active Balance Childhood) Study dates: data were collected from October 2007 to May 2009 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 8 weeks Follow-up time(s): 8 months
Participants	Participants randomized: 54 Setting: community programs Location: San Francisco Bay area, California; United States Country income: high income Recruitment: convenience sampling was used to recruit participants from community programs in the San Francisco Bay area. % of eligible population enrolled: children: 86% (54/63) Age (years): mean (SD): 12.52 (3.15) Gender/Sex: 53.7% boys
Interventions	Theory: Trans-theoretical Model, Stages of Change, Social Cognitive Theory, Intervention type: dietary and activity intervention Participants in the intervention group(s): 27 Comparator type: attention control Participants in the comparison group(s): 27 Comparison: dietary and activity intervention vs control Setting of the intervention: community + Web Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (8 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This publication was made possible by grant number KL2 RR024130 to J.L.C. from the National Center for Research Resources, a component of the National Institutes of Health (NIH) and NIH Roadmap for Medical Research, Hellman research grant, and in part by NIH grant DK060617 to M.B.H. Declaration of interest: NR General notes: NR

Cohen 2021

Study characteristics	
Methods	Study name: SIMAC (Fuerza muscular y capacidad aero´bicarelacio´n SImbio´tica en escolares con bajo peso al nacer y riesgo MetAbo´liCo) Study dates: the study started in February 2016 Study design: RCT N of arms: 3 Unit of allocation: individual

	Unit of analysis: individual Intervention period: 16 weeks Follow-up time(s): 16 weeks
Participants	Participants randomized: 129 Setting: one state school Location: Piedecuesta, Santander; Colombia Country income: upper middle income Recruitment: "We recruited by inviting all students aged between 13–17 and their parents to presentations given by the investigators at the school to outline the study. For those students who were interested in participating and their parent or guardian gave their assent, we obtained written informed consent from the parent/guardian." % of eligible population enrolled: children: 83% (129/155) Age (years): mean (SE): resistance intervention: 15 (0.95); aerobic intervention: 14.8 (1.04); control: 14.7 (1.09) Gender/Sex: resistance intervention: 55% boys; aerobic intervention: 47.5% boys; control: 50% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): resistance training: 44; aerobic training: 43 Comparator type: no active intervention Participants in the comparison group(s): 41 Comparison: activity intervention vs control Setting of the intervention: school (after school programme) Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: results described narratively
Notes	Clinical Trial Registry: NCT03779737 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "FOSCAL received funding for this project in the form of a grant (2014 Colciencias grant ID: 651765741093 number:657), which was awarded to DDC and PAC and used for equipment and other human resources relating to the present study." Declaration of interest: The authors have declared that no competing interests exist. General notes: narrative results only. Outcome estimate is reported for lean body mass and sum of skinfold, but not for BMI, despite being included as primary outcome in the trial registration.

Dewar 2013

Study characteristics	
Methods	Study name: NEAT Girls (Nutrition and Enjoyable Activity for Teen Girls) Study dates: baseline assessments were carried out before randomization during May/June 2010. The 12-month (immediate postprogram) assessments were completed during May/June 2011 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months; 24 months
Participants	Participants randomized: 357 Setting: twelve government secondary schools Location: Hunter Region and Central Coast areas in New South Wales; Australia Country income: high income Recruitment: "Government secondary schools located in the Hunter Region and Central Coast areas in New South Wales (Australia), with a SEIFA index of = 5 (bottom 50%) were considered eligible for inclusion. Eligible study participants were adolescent girls in Grade 8 (2nd year of secondary school) attending one of the 12 recruited schools." % of eligible population enrolled: schools: 67% (12/18); children: NR Age (years): mean (SD): 13.2 (0.5) Gender/Sex: 100% girls
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 178 Comparator type: no active intervention Participants in the comparison group(s): 179 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (12 months); BMI long term (24 months); zBMI medium term (12 months); zBMI long term (24 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ACTRN12610000330044 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This research project is funded by an Australian Research Council Discovery Project Grant (DP1092646). This sponsor had no involvement in the design or implementation of this study, in analyses of data, or in the drafting of this paper." Declaration of interest: The authors have no conflicts of interest that may influence this research to declare. General notes: twelve eligible schools were recruited (based on a Socio-Economic Indices for Areas [SEIFA] index ≤ 5. This

	index is derived from information [e.g., education, employment and financial well-being] used to characterise individuals and households in a specified area). To be eligible for the study, students were considered by their teachers to be disengaged in physical activity and/or not currently participating in organized team or individual sports.

Dunker 2018

Study characteristics	
Methods	Study name: BNMP (Brazilian New Moves program) Study dates: recruitment occurred between February 2014 and March 2015 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 26 weeks (two blocks of 9 weeks with a break in between) Follow-up time(s): 26 weeks
Participants	Participants randomized: 270 Setting: ten public schools Location: Sao Paulo (central and southern areas); Brazil Country income: upper middle income Recruitment: "Out of a total 46 schools from the Central-South area of São Paulo city, we consulted 20 schools. Institutions were selected after principals agreed to have their schools involved. Ten public schools from the were interested in participating in the clinical trial at the beginning of each semester. The primary researcher advertised the project during school hours to all seventh and eighth-grade students. During the recruitment process, only girls were asked to participate." % of eligible population enrolled: schools: 22% (10/46); children: 95% (270/285) Age (years): mean (SD): 13.39 (0.64) Gender/Sex: 100% girls
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 131 Comparator type: no active intervention Participants in the comparison group(s): 139 Comparison: dietary and activity intervention vs control Setting of the intervention: school (after school programme) Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (18 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: RBR-6ddpb3 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This work was supported by the São Paulo Research Foundation (FAPESP) [grant number 2012/16952-8]; and by the Brazilian National Council for Scientific and Technological Development (CNPQ) [grant number 483871/2013-3]. The authors received statistical and English reviewing assistance from SporeData Inc. The authors declare that there is no conflict of interest regarding the publication of this paper. Our funding sources had no involvement in the study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication." Declaration of interest: The authors declare that there is no conflict ofinterest regarding the publication of this paper. General notes: eligible participants were girls practicing less than one dailyhour of physical activity at the time of study recruitment.

Ebbeling 2006

Study characteristics	
Methods	Study name: BASH - Beverages and Student Health Study dates: the study was conducted during the 2003–2004 academic year Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 25 weeks Follow-up time(s): 25 weeks
Participants	Participants randomized: 103 Setting: home Location: United States Country income: high income Recruitment: "Recruitment was conducted in collaboration with a local high school that provided mailing lists. Packets containing an invitation letter and informed consent and assent documents were sent to parents of all students enrolled at the school. Parents were instructed to contact staff members by telephone, if interested, to obtain more information about the study protocol. The study director supervised the evaluation of eligibility criteria and enrolment. Adolescents aged 13-18 years who reported consuming at least 1 serving per day of sugar-sweetened beverages (SSB) and lived predominately in 1 household were eligible." % of eligible population enrolled: children: 77% (103/133) Age (years): mean (SD): intervention: 16 (1.1); control: 15.8 (1.1) Gender/Sex: intervention: 45% boys; control 46% boys
Interventions	Theory: NR Intervention type: dietary intervention

	Participants in the intervention group(s): 53 Comparator type: no active intervention Participants in the comparison group(s): 50 Comparison: dietary intervention vs control Setting of the intervention: home + telehealth Setting of the intervention in sub-group analyses: home
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (25 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was supported by grants R01 DK63554 and K01 DK62237 from the National Institute of Diabetes and Digestive Kidney Diseases, the Charles H. Hood Foundation, and grant M01 RR02172 awarded by the National Institutes of Health to support the General Clinical Research Center at Children's Hospital Boston." Declaration of interest: NR General notes: adolescents aged 13-18 years who reported consuming at least 1 serving per day of sugar-sweetened beverages (SSB) and lived predominately in one household were eligible to participate.

El Ansari 2010

Study characteristics	
Methods	Study name: NR Study dates: baseline measurements were colelcted during the first school term (2007) Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 3 months Follow-up time(s): 3 months
Participants	Participants randomized: 160 Setting: one secondary school with both indoor and outdoor sport facilities and sport equipment Location: Mansoura City; Egypt Country income: lower middle income Recruitment: "A little minority of schools in Mansoura city have both indoor and outdoor sport facilities and sport equipment, which were needed for the study. One secondary school in Mansoura city was selected due to the availability of both indoor and outdoor sport facilities and sport kits at the school." % of eligible population enrolled: children: 44% (200/450) agreed to participate; 100% of eligible students were included (180/180) Age (years): mean (SD): intervention: 15.7 (1.8); control: 15.4 (1.6) Gender/Sex: 43.75% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 80 Comparator type: no active intervention Participants in the comparison group(s): 80 Comparison: activity intervention vs control Setting of the intervention: school (after school programme) Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (3 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: NR Writing and/or research independent from funder(s): NR Funding details: NR Declaration of interest: NR General notes: NR

Ezendam 2012

Study characteristics	
Methods	Study name: FATaintPHAT Study dates: the study was conducted with assessments at baseline and 4-month (school year 2006-2007) and 2-year follow-up (school year 2008-2009) Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 10 weeks Follow-up time(s): 2 years
Participants	Participants randomized: 883 Setting: twenty-three schools for secondary education Location: Netherlands Country income: high income

	Recruitment: "Eighty-eight schools for secondary education in the Rotterdam area were invited to participate. Twenty-three schools were eligible and willing to participate. Second, adolescents from 1 to 5 first-year classes in each school (depending on the number of first-year classes in the school, maximum of 5) were invited to participate. Students received information and an informed consent form for themselves and their parents for active consent. The completed consent forms were returned through the schools % of eligible population enrolled: schools: 33% (23/70); children: 59% (883/1494) Age (years): mean (SD): intervention: 12.7 (0.7); control: 12.6 (0.6) Gender/Sex: intervention: 58.9% boys; control 49.7% boys
Interventions	Theory: Theory of Planned Behavior, Precaution Adoption Process Model, Implementation intentions Intervention type: dietary and activity intervention Participants in the intervention group(s): 485 Comparator type: no active intervention Participants in the comparison group(s): 398 Comparison: dietary and activity intervention vs control Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI long term (2 years) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ISRCTN15743786; NTR811; Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "Funding/Support: This study was funded by grant 62200020 from ZonMw, the Netherlands Organization for Health Care Research and Development. Role of the Sponsors: The funding organization was not involved in any aspect of the analyses or in the preparation of the manuscript" Declaration of interest: Financial disclosure: None reported. General notes: NR

Farias 2015

Study characteristics	
Methods	Study name: NR Study dates: the study was conducted during the 2011 school year Study design: cluster RCT N of arms: 2 Unit of allocation: classroom Unit of analysis: individual Intervention period: 1 school year Follow-up time(s): 1 school year
Participants	Participants randomized: 567 Setting: high school Location: Colégio Meta, Rio Branco, Acre ; Brazil Country income: upper middle income Recruitment: "Post-pubertal school children attending the first to the third year of high school of Colégio Meta, Rio Branco, AC, Brazil, aged 15 to 17 years, during the 2011 school year." % of eligible population enrolled: children: 68% (386/567; number of children excluded because not eligible is not reported) Age (years): mean (SD): intervention: 15.9 (0.8); control: 16 (0.8) Gender/Sex: intervention: 56.9% boys; control: 49.3% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 283 Comparator type: no active intervention Participants in the comparison group(s): 284 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: NR Reason for exclusion from the meta-analysis: it is apparent that there is a typo in the results and the transformation of the data from proportion of children with obesity or overweight to zBMI looks implausible
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: CNPq (Conselho Nacional de Desenvolvimento Científico eTecnológico)-process n. 475959/2010-8. Declaration of interest: The authors declare no conflicts of interest. General notes: NR

French 2011

Study characteristics	
Methods	Study name: Take Action Study dates: study dates not reported Study design: cluster RCT N of arms: 2 Unit of allocation: family (parents + ≥ 1 child)

	Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months
Participants	Participants randomized: 75 Setting: community and home Location: Minneapolis, Minnesota; United States Country income: high income Recruitment: "Households were recruited from the community for a one-year obesity prevention intervention trial. The intervention included both household environment and individual-level behavioral components. Recruitment sources included community libraries, worksites, schools, day-care centers, health clinics, religious institutions, park and recreation centers, grocery stores and food co-ops." % of eligible population enrolled: households: 31% (90/289) Age (years): mean (SD): 14.7 (1.7) Gender/Sex: 61.1% boys
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): NR Comparator type: no active intervention Participants in the comparison group(s): NR Comparison: dietary and activity intervention vs control Setting of the intervention: home + community + telehealth Setting of the intervention in sub-group analyses: home
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was supported by grant #1U54CA116849 and #R21CA137240 from the National Institutes of Health/National Cancer Institute." Declaration of interest: The authors declared no conflicts of interest. General notes: the unit of randomization is the household (HH), more than one children per HH was eligible to participate and ther analysis is adjusted for clustering, therefore the study is coded and assesses as CRCT: quote: "HH configuration was a four-category variable created based on crossing the number of adults and children living in the HH: one adult/one child; one adult/multiple children; two adults/one child; two adults/multiple children."

Gustafson 2019

Study characteristics	
Methods	Study name: Go Big and Bring it Home Study dates: the study began in fall 2017 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 8 weeks Follow-up time(s): >12 weeks
Participants	Participants randomized: 530 Setting: eight high schools (four in rural eastern Kentucky and four in rural eastern North Carolina) Location: Eastern Kentucky and Eastern North Carolina; United States Country income: high income Recruitment: "A total of eight high schools (four in rural eastern Kentucky and four in rural eastern North Carolina) agreed to participate in the intervention in the fall of 2017. Schools were asked to participate in the intervention through Cooperative Extension agents in each county in Kentucky and in North Carolina through existing relationships with school staff and administration. Advertising for recruitment was conducted through several channels including e-mail and text message, information sheets about the intervention, information on the school websites and/or Facebook web page, orientation events "Teachers handed out information to students in foods/culinary classes, physical education and health classes, home room, English classes, and in a general agriculture course." % of eligible population enrolled: schools: NR; students: 91% (482/530; 48 students from the intervention arm dropped from the study) Age (years): mean (SE): intervention: 15 (0.07); control: 15 (0.1) Gender/Sex: intervention 38% boys; control 30% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 380 Comparator type: no active intervention Participants in the comparison group(s): 150 Comparison: dietary intervention vs control Setting of the intervention: telehealth Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI percentile short term (>12 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT02793024 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR

	Funding details: "This work was funded by the United States Department of Agriculture (USDA) Agriculture and Food Research Initiative Grant 30000045856." Declaration of interest: The authors declare no conflicts of interest. General notes: authors of a previous review (Hodder 2021) contacted the authors to enquire about the duration of the intervention and the authors confirmed it was over 12 weeks long

Haerens 2006

Study characteristics	
Methods	Study name: NR Study dates: measures were assessed at the beginning of the first school year (September 2003), assessed at the end of the first school year (Post 1: May–June 2004) and repeated at the end of the second school year (Post 2: May–June 2005) Study design: cluster RCT N of arms: 3 Unit of allocation: school Unit of analysis: individual Intervention period: 2 school years (9 months/year) Follow-up time(s): 8-9 months; 20-21 months
Participants	Participants randomized: 2840 Setting: fifteen schools with technical and vocational education Location: West Flanders; Belgium Country income: high income Recruitment: "A random sample of 15 schools of the 65 schools with technical and vocational education in West-Flanders (Belgium) was selected to participate in this study." All students in 7th and 8th grades were invited. % of eligible population enrolled: schools: 23% (15/65); children: 95% (2840/2991) Age (years): mean (SD): 13.06 (0.81) Gender/Sex: 63.4% boys
Interventions	Theory: An ecological framework Intervention type: dietary and activity intervention Participants in the intervention group(s): intervention + parents involvement: 1226; intervention only: 1006 Comparator type: no active intervention Participants in the comparison group(s): 759 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (8-9 months) ; BMI long term (20-21 months); zBMI medium term (8-9 months); zBMI long term (20-21 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This work was supported by the Policy Research Centre Sport, Physical Activity, and Health funded by the Flemish Government." Declaration of interest: none declared General notes: NR

Haire-Joshu 2015

Study characteristics	
Methods	Study name: BALANCE (Balance Adolescent Lifestyle Activities and Nutrition Choices for Energy) Study dates: study dates not reported Study design: cluster RCT N of arms: 2 Unit of allocation: community Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months; 24 months
Participants	Participants randomized: 1325 Setting: participants of the Parent As Teachers (PAT) Teen Program Location: 30 states; United States Country income: high income Recruitment: adolescents were eligible to participate if they were enrolled in the Parent As Teachers (PAT) Teen Program. Eligibility and willingness to participate were assessed at the sites by the parent educator. Study staff followed up with interested adolescents to formally recruit and obtain consent. % of eligible population enrolled: communities: NR; children: 100% (1325/1325) Age (years): mean (SD): intervention: 17.7 (1.3); control: 17.9 (1.3) Gender/Sex: 100% girls
Interventions	Theory: Social Cognitive Theory and an ecological framework Intervention type: dietary and activity intervention Participants in the intervention group(s): 774 Comparator type: no active intervention Participants in the comparison group(s): 551 Comparison: dietary and activity intervention vs control Setting of the intervention: school + home + web Setting of the intervention in sub-group analyses: school + home

Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: non-usable data. Data reported as Odds Ratio (OR; the outcome is odds of weight success, (i.e., maintaining normal BMI percentile from baseline to follow-up, decreasing from overweight BMI percentile at baseline to normal BMI at follow-up, or decreasing from obese BMI at baseline to overweight or normal BMI at follow-up) comparing those in BALANCE to those in the control group).
Notes	Clinical Trial Registry: NCT01617486 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The National Cancer Institute of the National Institutes of Health (Grant #USPHS 1 R01 CA121534) funded this project. Additional support was contributed by the National Institutes of Diabetes, Digestive and Kidney Institute of the National Institutes of Health (Grant # 1P30DK092950)." Declaration of interest: The authors declare that they have no competing interests. General notes: data not used; outcome is BMI success defined as maintaining normal BMI at baseline, decreasing overweight BMI at baseline to normal BMI, or decreasing obese BMI at baseline to overweight or normal BMI.

Harrington 2018

Study characteristics	
Methods	Study name: Girls Active Study dates: baseline measures were colelcted between February 2015 and April 2015; the 7 month follow-up were in September 2015 to November 2015; 14 month follow-up were in April 2016 to June 2016 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 7 months; 14 months
Participants	Participants randomized: 1753 Setting: twenty state secondary schools Location: The Midlands (Leicester City, Leicestershire and Rutland, Derbyshire, Nottinghamshire and Warwickshire); United Kingdom Country income: high income Recruitment: "All state secondary schools in Leicester, Leicestershire and Rutland (LLR) with female pupils aged 11–14 years (n = 56 schools) were eligible and were invited to take part in the trial along with 26 other state secondary schools in Derbyshire, Nottinghamshire and Warwickshire. These schools were sent an initial letter outlining the Girls Active programme and evaluation and inviting them to a briefing event. Schools provided the research team a list of all eligible girls between the ages of 11 and 14 years and in years 7, 8 and 9. All eligible pupils were provided with an information pack that contained a separate participant and parent/guardian information sheet and opt out consent form as well as an invitation letter." % of eligible population enrolled: schools: 24% (20/82); children: 100% (1752/1753) Age (years): mean (SD): 12.8 (0.8) Gender/Sex: 100% girls
Interventions	Theory: Social Cognitive Theory Intervention type: activity intervention Participants in the intervention group(s): 867 Comparator type: no active intervention Participants in the comparison group(s): 885 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (7 months); zBMI medium term (14 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ISRCTN10688342 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This project was funded by the National Institute for Health Research (NIHR) Public Health Research programme and will be published in full in Public Health Research; Vol. 7, No. 5. See the NIHR Journals Library website for further project information. The YST funded the intervention. This study was undertaken in collaboration with the Leicester Clinical Trials Unit, a UK Clinical Research Collaboration-registered clinical trials unit in receipt of NIHR Clinical Trials Unit support funding. Neither the YST nor the NIHR Clinical Trials Unit had any involvement in the Trial Steering Committee, data analysis, data interpretation, data collection or writing of the report. The University of Leicester authors are supported by the NIHR Leicester–Loughborough Biomedical Research Unit (2012–17), the NIHR Leicester Biomedical Research Centre (2017–22) and the Collaboration for Leadership in Applied Health Research and Care East Midlands. These funders had no involvement in the Trial Steering Committee, the data analysis, data interpretation, data collection or writing of the report." Declaration of interest: All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years and no competing interest related to this work. MJD and KK reports personal fees from Novo Nordisk, Sanofi-Aventis, Lilly, Merck Sharp & Dohme, Boehringer Ingelheim, AstraZeneca, Janssen, Servier, Mitsubishi Tanabe Pharma Corporation, Takeda Pharmaceuticals International Inc. and grants from Novo Nordisk, Sanofi-Aventis, Lilly, Boehringer Ingelheim, and Janssen. Outside of the submitted work, JC reports grants from Public Health Wales. CE reports grants from National Institute for Health Research Public Health Research during the conduct of the study. YC, TP, RTE, DB, TG, DMH, AR, LS and TY all

	have nothing to declare. General notes: NR

Hollis 2016

Study characteristics	
Methods	Study name: PA4E (Physical Activity 4 Everyone) Study dates: schools were invited to take part in the study between October and December 2011 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 7-8 school terms (19-24 months) Follow-up time(s): 12 months; 24 months
Participants	Participants randomized: 1233 Setting: ten secondary schools Location: New South Wales; Australia Country income: high income Recruitment: "Randomly selected secondary schools within the study region were invited to participate between October and December 2011. A cohort of first-year high-school students (Grade 7, aged 12–13 years) at the consenting secondary schools were invited to participate. Parents were provided with an information package and asked to provide written informed consent for their child. Two weeks following the distribution of the information package, the non-responding parents were telephoned and asked to provide verbal consent. Children also provided assent for participating in the study." % of eligible population enrolled: schools: 45% (10/22); children: 84% (1233/1468) Age (years): median: 12 Gender/Sex: intervention: 48% boys; control: 49% boys
Interventions	Theory: Social Cognitive Theory and Socio-ecological Theory Intervention type: activity intervention Participants in the intervention group(s): NR Comparator type: no active intervention Participants in the comparison group(s): NR Comparison: activity intervention vs control Setting of the intervention: school + community + home Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (12 months); BMI long term (24 months); zBMI medium term (12 months); zBMI long term (24 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ACTRN12612000382875 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study is funded through the NSW Ministry of Health, Heath Promotion Demonstration grant scheme. In kind, support for the study is also provided by the Hunter New England Local Health District. The project also received infrastructure support from the Hunter Medical Research Institute (HMRI)." Declaration of interest: The authors declare no conflicts of interest. General notes: NR

Hovell 2018

Study characteristics	
Methods	Study name: Healthy Smiles Study dates: recruitment occurred between between 2009 and 2013 Study design: cluster RCT N of arms: 2 Unit of allocation: orthodontist practice Unit of analysis: individual Intervention period: 18-24 months Follow-up time(s): 12 months; 18 months
Participants	Participants randomized: 693 Setting: US and Mexico orthodontists Location: San Diego, Orange, and Riverside Counties in Southern California and along the Northern border region of Baja California; United States (80% of participants) and Mexico (20% of participants) Country income: high income (USA); upper middle income (Mexico) Recruitment: orthodontists: US orthodontists were identified from the American Association of Orthodontist membership listing and online searches. Mexican pediatric orthodontists were identified from telephone directory advertisements and referrals from participating orthodontists. About 8% (n=33) of contacted offices enrolled. Patients: Participating offices informed their patients of the study by letter or personal contact. Patients allowing contact by study personnel were then screened for study inclusion. At an initial in-person visit the parent and child signed consent and assent forms % of eligible population enrolled: orthodontists: 3% (n=33; number of eligible practices not reported); children: 70% (693/991) Age (years): mean (SD): 12.1 (1.9) Gender/Sex: intervention 43.4% boys; control: 54.6% boys;
Interventions	Theory: Behavioral Ecological Model, Geoffrey Rose model Intervention type: dietary and activity intervention Participants in the intervention group(s): 332 Comparator type: attention control Participants in the comparison group(s): 361

	Comparison: dietary and activity intervention vs control Setting of the intervention: community Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI long term (18 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01510483 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This work was supported by the National Institutes of Health, National Cancer Institute, [grant number CA138192]. NIH/NCI was not involved in the design, collection, analysis or interpretation of the data, the writing of this manuscript or in the decision to submit this manuscript for publication." Declaration of interest: All authors declare that they have no conflicts of interest in relation to this manuscript. General notes: NR

Isensee 2018

Study characteristics	
Methods	Study name: The Lauft Program Study dates: October 2013 to January 2014 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 weeks Follow-up time(s): 12 weeks; 14.8 months (note: results at 12 weeks are not reported)
Participants	Participants randomized: 1489 Setting: twenty-nine secondary schools Location: Schleswig-Holstein; Germany Country income: high income Recruitment: schools were selected from a complete list of all secondary schools in Schleswig- Holstein in Germany obtained from the Ministry of Education. All secondary schools were invited to participate with their eighth grade classes. All students of participating classes were included in the study % of eligible population enrolled: schools: 22% (29/134); children: NR Age (years): mean (SD): intervention: 13.68 (0.65); control: 13.71 (0.66) Gender/Sex: intervention: 53.8% boys; control: 50.1% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 887 Comparator type: no active intervention Participants in the comparison group(s): 602 Comparison: activity intervention vs control Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI percentile medium term (14.8 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ISRCTN49482118 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: German Cancer Aid in the Priority Program Primary Prevention of Cancer (Nutrition and Physical Activity, reference number: 110012) Declaration of interest: NR General notes: randomization conducted with a ratio intervention vs control of 3:2

Jago 2006

Study characteristics	
Methods	Study name: Fit for Life Badge Programme Study dates: the study was conducted in two waves that started in spring (16 troops) or fall (26 troops) of 2003 Study design: cluster RCT N of arms: 2 Unit of allocation: troop Unit of analysis: individual Intervention period: 9 weeks Follow-up time(s): 8 months and 1 week
Participants	Participants randomized: 473 Setting: forty-two Boy Scouts troops Location: Greater Houston area, Texas; United States Country income: high income Recruitment: participants were 10- to 14-year-old Boy Scouts recruited from 42 troops within the greater Houston area % of eligible population enrolled: troops: 100% (42/42); children: 64% (473/736) Age (years): mean (SE): 13 (0.1) Gender/Sex: 100% boys;
Interventions	

	Theory: Social Cognitive Theory (5-a-Day Achievement Badge Program) Intervention type: activity intervention Participants in the intervention group(s): 240 Comparator type: dietary Participants in the comparison group(s): 233 Comparison: activity intervention vs dietary intervention Setting of the intervention: community + Web Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI and BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI short term; BMI percentile short term (8 months and 1 week) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was funded in part by a grant from the American Cancer Society, ACS TURSG-01. This work is also a publication of the USDA/ARS Children's Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine and Texas Children's Hospital, Houston, Texas. This project has been funded in part by federal funds from the USDA/ARS under co-operative agreement 58-6250-6001.' Declaration of interest: NR General notes: the study was conducted in two waves: in the spring with 16 troops and in the fall with 26 troops; outcome data are reported separately for each wave.

Kennedy 2018

Study characteristics	
Methods	Study name: Resistance Training for Teens Study dates: pretests occurred in term 2 (April–June), the intervention was delivered in term 3 (July–September), and posttest occurred during term 4 (October–December) Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 6 months Follow-up time(s): 6 months; 12 months
Participants	Participants randomized: 607 Setting: sixteen government secondary schools Location: Hunter, Central Coast and Sydney regions of New South Wales; Australia Country income: high income Recruitment: eligible schools were government secondary schools within approximately 50 km of the University of Newcastle and the University of Sydney were identified via the NSW Department of Education website 'School Locator' function. % of eligible population enrolled: schools: 20% (16/81); children: NR Age (years): mean (SD): 14.1 (0.5) Gender/Sex: 49.9% boys;
Interventions	Theory: Social Cognitive Theory, Social-determination Theory Intervention type: activity intervention Participants in the intervention group(s): 353 Comparator type: no active intervention Participants in the comparison group(s): 254 Comparison: activity intervention vs control Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); BMI medium term (12 months); zBMI short term (6 months); zBMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ACTRN12615000360516. Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The authors thank the Australian Research Council and the DoE School Sport Unit (with special thanks to Ross Morrison and Sue Meade) for providing funding"; "The results of the present study do not constitute endorsement by the American College of Sports Medicine." Declaration of interest: There are no conflicts of interest. General notes: NR

Kuhlemeier 2022

Study characteristics	
Methods	Study name: ACTION-PAC Study dates: the study was conducted from 2014 to 2017 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual

	Intervention period: two 20 min sessions over two years Follow-up time(s): 12 months; 24 months
Participants	Participants randomized: 608 Setting: eight public high schools from a state in the Southwestern United States Location: New Mexico; United States Country income: high income Recruitment: "Schools were eligible if they had functioning school-based health centers (SBHC), enrolled ≥ 700 students, had ≥ 40% Latinx students, and were located in high poverty areas. Participants were in the 9th or 10th grade. Consent was obtained from a parent and assent from the participant. % of eligible population enrolled: school: NR; children: NR Age (years): mean: 15.3 (range: 13.4 years to 17.7 years) Gender/Sex: 45.4% boys
Interventions	Theory: King's Theory of Goal Attainment and Transaction Process Intervention type: dietary and activity intervention Participants in the intervention group(s): 318 Comparator type: no active intervention Participants in the comparison group(s): 290 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI long term (24 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT02502383 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This work was supported by the National Institutes of Health, National Heart, Lung, and Blood Institute [R01HL118734] (PI: Kong).The authors have no conflicts or competing interests to disclose." Declaration of interest: The authors have no conflicts or competing interests to disclose. General notes: NR

Kuroko 2020

Study characteristics	
Methods	Study name: COOK (Create Our Own Kai) Study dates: Jan 2017 - Jul 2017 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 7 weeks Follow-up time(s): 12 months
Participants	Participants randomized: 164 Setting: local educational facilities' teaching kitchens and home Location: Dunedin; New Zealand Country income: high income Recruitment: "Adolescents in their first two years of high school (mostly 12–15 years old), residing in Dunedin, New Zealand, were recruited via social media, posters and word of mouth." % of eligible population enrolled: children: 92% (164/179) Age (years): mean (SD): 13.6 (0.8) Gender/Sex: 35.6% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 109 Comparator type: no active intervention Participants in the comparison group(s): 55 Comparison: dietary intervention vs control Setting of the intervention: school (after school programme) + home + web Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ACTRN12616001664437 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: Lotteries Health New Zealand and the Foodstuffs Community Trust Declaration of interest: The authors declare no conflict of interest. General notes: NR

Lana 2014

Study characteristics	
Methods	Study name: PREVENCANADOL program Study dates: the dtudy was conducted between 2009 and 2012 Study design: RCT

	N of arms: 3 Unit of allocation: individual Unit of analysis: individual Intervention period: 9 months Follow-up time(s): 9 months
Participants	Participants randomized: 2001 Setting: secondary education schools Location: Mexico (78% of participants); Spain (22% of participants) Country income: upper middle income (Mexico); high income (Spain) Recruitment: secondary education schools in Mexico and Spain. Quote: "Programme information was sent by email to all teachers. Links and banners were placed on the main educational portals. Participation was voluntary, but most interested teachers encouraged their students to participate." % of eligible population enrolled: children: 52% (2001/3855) Age: NR Gender/Sex: 45.2% boys
Interventions	Theory: Attitude, Social influence and self-Efficacy (ASE) Model, Trans-theoretical Model Intervention type: dietary intervention Participants in the intervention group(s): 1014 Comparator type: no active intervention Participants in the comparison group(s): 987 Comparison: dietary intervention vs control Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: yes Reason for exclusion from the meta-analysis: non-usable data. Definition of obesity and overweight not reported.
Notes	Clinical Trial Registry: ISRCTN27988779 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was funded by the Spanish Ministry of Health (Reference: FISS 08PI080544)." Declaration of interest: The authors declare no conflict of interest. This study was funded by the Spanish Ministry of Health. The financial backer had no role in the study design or in the collection, analysis and interpretation of data. Both thewriting of themanuscript and the decision to submit it for publication belong to the authors, who acted independently of the financial backer. All contributors had access to all data. General notes: data not used. Definition of obesity and overweight is not reported

Lappe 2017

Study characteristics	
Methods	Study name: NR Study dates: recruitment for the study started in May 2008 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 6 months; 12 months (note: results at 6 months not reported)
Participants	Participants randomized: 274 Setting: Creighton University Osteoporosis Research Center Location: Omaha, Nebraska (note: this is the location of the Medical Center where the study is based); United States Country income: high income Recruitment: "Participants were recruited from the community by using a wide range of methods, such as direct mailing to parents, advertisements in the media, flyers placed in various community locations, and recruitment collaboration with schools, health care providers, and the Girl Scouts. Extensive efforts were made to recruit girls from all racial-ethnic groups in the community. Interested families were encouraged to call the research center at which time a telephone screening was completed to determine eligibility. Those who passed the telephone screening were mailed a 3-d diet diary, which was completed and returned. If eligible by dietary analysis, the girl and her parent were scheduled for a screening study visit." % of eligible population enrolled: children: 100% (274/274) Age (years): mean (SD): intervention: 13.5 (0.5); control: 13.5 (0.5) Gender/Sex: 100% girls
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 136 Comparator type: no active intervention Participants in the comparison group(s): 138 Comparison: dietary intervention vs control Setting of the intervention: community Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI percentile medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01066806 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Supported by the National Institute of Nursing grant R01NR010108."

	Declaration of interest: None of the authors reported a conflict of interest related to the study. General notes: NR

Leme 2018

Study characteristics	
Methods	Study name: H3G-Brazil (Healthy Habits, Healthy Girls–Brazil) Study dates: the study was conduycted from March to September 2014 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 6 months Follow-up time(s): 6 months; 12 months
Participants	Participants randomized: 253 Setting: ten technical public schools that offer nutrition and dietetics training Location: San Paulo; Brazil Country income: upper middle income Recruitment: "The Human Development Index (HDI) was used to identify eligible high schools. Technical public schools that offer nutrition and dietetics training in the city of São Paulo were selected for the current study. Once schools agreed to participate in the study, research assistants visited the study schools and provided a presentation to the students describing the proposed intervention and assessment procedures. Study participants were then asked to complete a questionnaire regarding PA and eating behaviors to identify girls “at risk” for obesity. Those who were considered “at risk” of obesity based on their PA and dietary behaviors were then eligible to participate in the intervention. The target for recruitment was 25 students per school, but up to 30 students from each school could be accepted. The 30 first students from each school to return their completed consent forms were in cluded in the study." % of eligible population enrolled: schools: 91% (10/11); children: 100% (253/253) Age (years): mean (SE): 16.05 (0.05) Gender/Sex: 100% girls
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 142 Comparator type: no active intervention Participants in the comparison group(s): 111 Comparison: dietary and activity intervention vs control Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); BMI medium term (12 months); zBMI short term (6 months); zBMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT02228447 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Author ACBL received a scholarship from the Brazilian Federal Agency for Evaluation and Support of Graduate Education (Coordenação De Aperfeiçoamento de Pessoal de Nível Superior—CAPES). Author PG holds a postdoctoral scholarship from the São Paulo Research Foundation (Fundação de Amparo à Pesquisa do Estado de São Paulo—FAPESP) process no.: 2013/22,204–7." From Leme 2018: "Funding for AL was provided by FAPESP (2016-21144-9). This work is also a publication of the United States Department of Agriculture (USDA/ARS) Children's Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine, Houston, Texas, and had been funded in part with federal funds from the USDA ARS under Cooperative Agreement No. 58-3092-5-001." Declaration of interest: The authors do not hold any particular conflict of interest. General notes: eligible girls were girls considered “at risk” of obesity based on their physical activity and dietary behaviors.

Lubans 2021

Study characteristics	
Methods	Study name: B2L (Burn 2 Learn) Study dates: the RCT was conducted in two cohorts: the first started in 2018 and finished in 2019 (10 schools); the second started in 2019 and finished in 2020 (10 schools) Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 20 weeks Follow-up time(s): 6 months; 12 months
Participants	Participants randomized: 670 Setting: twenty government secondary schools with senior school students Location: New South Wales; Australia Country income: high income Recruitment: "New South Wales (NSW) government secondary schools with senior school students (i.e., grades 11 and 12, students aged 16–18) were eligible to participate in the study. Schools were asked to identify two grade 11 teachers from each school and eligible participants were grade 11 students taught by one of the participating teachers. School principals, teachers, parents and students all provided informed written consent prior to enrolment. Schools were recruited via presentations at conferences and meetings (e.g., regional meetings of the NSW Principals' Association) and emails were sent directly to eligible schools (i.e., school principals and grade 11 coordinators). Once schools have expressed an interest in

	the study, the Project Manager met with the school representative(s) and explained the study requirements." % of eligible population enrolled: schools: 23% (20/87); children: 90% (604/670) Age (years): mean (SD): 16 (0.4) Gender/Sex: 55.4% boys
Interventions	Theory: Theory of expanded, extended and enhanced opportunities. Intervention type: activity intervention Participants in the intervention group(s): 337 Comparator type: no active intervention Participants in the comparison group(s): 333 Comparison: activity intervention vs control Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (6 months); zBMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ACTRN12618000293268; NTR811; Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The study was funded by the National Health and Medical Research Council (APP1120518) and the New South Wales Department of Education School Sport Unit. DRL is supported by a National Health and Medical Research Council Research Fellowship (APP1154507)." Declaration of interest: none declared General notes: the RCT was conducted in two cohorts: the first started in 2018 and finished in 2019 (10 schools); the second started in 2019 and finished in 2020 (10 schools). Following recruitment, pairs of schools will be matched based on the following key characteristics: geographic location (i.e., region, rural/urban, coastal/inland).

Luszczynska 2016b

Study characteristics	
Methods	Study name: NR Study dates: study dates not reported Study design: RCT N of arms: 3 Unit of allocation: individual Unit of analysis: individual Intervention period: 8-11 weeks Follow-up time(s): 14 months
Participants	Participants randomized: 702 Setting: ten public middle and high schools in rural (three schools, 36% of participants) and urban areas (seven schools, 64% of participants). Location: Poland Country income: high income Recruitment: potential respondents were recruited during the classes. All students received information about the study aims and the procedures % of eligible population enrolled: schools: NR; children: 85% (702/830) Age (years): mean (SD): 16.35 (0.79) Gender/Sex: 42% boys
Interventions	Theory: Social Cognitive Theory, Behaviour Change Theory, Self efficacy, Planning Intervention type: dietary intervention Participants in the intervention group(s): planning intervention: 227; self-efficacy intervention: 233 Comparator type: attention control Participants in the comparison group(s): 242 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (14 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The preparation of this paper was supported by the National Science Center [grant number NN106 012240]." Declaration of interest: No potential conflict of interest was reported by the authors. General notes: NR

Mauriello 2010

Study characteristics	
Methods	Study name: Health in Motion Study dates: the study was conducted between 2006 and 2007 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual

	Intervention period: 2 months Follow-up time(s): 6 months; 12 months (note: results are not reported)
Participants	Participants randomized: 1800 Setting: eight high schools Location: Rhode Island, Massachusetts, New York, Tennessee; United States Country income: high income Recruitment: "Students were recruited from eight high schools in Rhode Island, Massachusetts, New York, and Tennessee. School administrators invited students from various classes to participate. Some schools over-recruited students due to the ease of incorporating the research into their schedules, making it easier to retain students in the research in subsequent semesters. This unique process for each school, reflecting a real-world effectiveness trial, contributed to the larger sample size for the treatment group. Parents received a letter describing the research and opt-out forms two weeks prior to the baseline session. Few parents (n=48) withheld permission (2.6%) and 8 students refused to participate (0.4%). Once enrolled, only 10 students refused to complete a follow-up session." % of eligible population enrolled: children: 97% (1800/1856) Age (years): mean: 15.97 Gender/Sex: 49.2% boys
Interventions	Theory: Trans-theoretical Model of Behaviour Change Intervention type: dietary and activity intervention Participants in the intervention group(s): 1128 Comparator type: no active intervention Participants in the comparison group(s): 672 Comparison: dietary and activity intervention vs control Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: yes Reason for exclusion from the meta-analysis: proportion of children who are overweight was measured at follow-up but results are not reported
Notes	Clinical Trial Registry: NCT01033253 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Funding for this research was provided by the National Heart, Lung, and Blood Institute (Grant # R43 HL074482)." Declaration of interest: NR General notes: outcome is measured as percent of students that moved to the overwight category after the intervention but data are not reported.

Melnyk 2013

Study characteristics	
Methods	Study name: COPE (Creating Opportunities for Personal Empowerment) Healthy Lifestyles TEEN (Thinking, Emotions, Exercise, Nutrition) Program Study dates: data were collected from January 2010 to May of 2012 and analyzed in 2012–2013 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 15 weeks Follow-up time(s): 15 weeks; 6 months; 12 months
Participants	Participants randomized: 807 Setting: teens in health education courses in 11 high schools from two school districts Location: Large metropolitan city in the southwest; United States Country income: high income Recruitment: all teens in the selected health education courses in 11 high schools from two school districts in the Southwestern United States were invited to participate in the study. Research team members introduced the study to all students in each participating health class and sent consent/assent packets home with those teens who expressed interest in study participation. % of eligible population enrolled: children: 52% (807/1560; teens returned assent/consent if they chose to participate and met the specified age range) Age (years): mean: 14.74 Gender/Sex: 48.4% boys
Interventions	Theory: Cognitive Theory (COPE); Social Learning Theory (Healthy teens); Intervention type: activity intervention Participants in the intervention group(s): 374 Comparator type: attention control Participants in the comparison group(s): 433 Comparison: activity intervention vs control Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); BMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01704768 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was funded by the NIH/ National Institute of Nursing Research 1R01NR012171."

	Declaration of interest: No financial disclosures were reported by the authors of this paper. General notes: NR

Mihas 2010

Study characteristics	
Methods	Study name: VYRONAS (Vyronas Youth Regarding Obesity, Nutrition and Attitudinal Styles) Study dates: the intervention took place between September 2007 and January 2008 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 12 weeks Follow-up time(s): 12 months
Participants	Participants randomized: 218 Setting: five high schools Location: Vyronas, Athens; Greece Country income: high income Recruitment: "In the study, 342 adolescents aged 12–13 years who were students (7th grade) of all (n 5) high schools located in Vyronas district, Athens, Greece, were initially eligible. The Vyronas area was selected because it represents the socio-economic status of the citizens of Athens." % of eligible population enrolled: children: 76% (218/286) Age (years): mean (SD): intervention: 13 (0.8); control: 13.3 (0.9) Gender/Sex: intervention 49% boys; control 49.5% boys
Interventions	Theory: Social Cognitive Theory, Stages of Change Intervention type: dietary intervention Participants in the intervention group(s): 108 Comparator type: no active intervention Participants in the comparison group(s): 105 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The raw material for health promotion activities covering the thematic areas of 'Nutrition–dietary habits' and 'Physical activity and health' was funded by the Ministry of Education and the National Foundation for the Youth" Declaration of interest: none declared General notes: NR

Nanney 2016

Study characteristics	
Methods	Study name: Project breakFAST Study dates: the stuydy was conducted between 2012 and 2015 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months; 24 months (note: results at 24 months are not reported)
Participants	Participants randomized: 1253 Setting: sixteen rural high schools Location: Minnesota; United States Country income: high income Recruitment: schools recruitment: "A convenience sample of 16 rural high schools agreed to study participation and were randomized to treatment or delayed treat ment groups in equal allocation. To recruit the study schools an open invitation was posted on the Minnesota School Nutritional Association (MNSA) website and listserv. The MSNA is used by many Minnesota food service directors as a resource to locate funding and support for school food programs. Several informational webinars were conducted for interested school personnel (mainly the principal and food service director). The webinar recordings are available on the study website: z.umn.edu/projectbreakfast." students recruitment: "The initial identification of "breakfast skippers" (eat breakfast ≤ 3 days in a school week) was important in assessing influence of the intervention on most at risk students. All 9th and 10th grade students attending study schools and who were present on the day of screening were invited to complete an initial 7-item screening paper/pencil questionnaire to assess the frequency of eating breakfast during a normal school week (Monday through Friday)./To meet a minority enrolment goal of 30%, we oversampled for non-White/minority students at each study school. A passive parental consent process was used, with a signed letter from the school principal and the study principal investigator (PI) mailed to the parent(s) or guardian(s) of the invited students describing the study. The mailing also included a consent page, an example of survey items, and instructions on how to withdraw consent for participation of their student. Parents were given 10 days to withdraw consent by contacting the school or project manager by phone, email, or mail with all contact information provided. /After the 10-day waiting period, contact information (address and phone number) was requested from the schools for all initially eligible and consented students. Students were then mailed a letter inviting them to be screened for a second time to determine eligibility to participate in the study. Multiple modalities (e.g., internet, phone, at school) were

	necessary to maximize recruitment rates)." % of eligible population enrolled: schools: NR; children: 50% (1253/2512) Age (years): range: 14-16; grade 9th and 10th; 10th grade % median (IQR) 48.2(3) Gender/Sex: % of girls: median (IQR): 48.2 (4.2)
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): NR Comparator type: no active intervention Participants in the comparison group(s): NR Comparison: dietary intervention vs control (year 1); dietary intervention vs dietary intervention (year 2) Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: results described narratively
Notes	Clinical Trial Registry: NCT02004977 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Funding/financial disclosure: NIH NHLBI R01HL113235; The funding for this study is provided by the National Heart, Lung and Blood Institute of the National Institutes of Health (5R01-HL113235-03, PI: Nanney, MS)." Declaration of interest: The Authors have no conflicts of interest to report. General notes: narrative results only. BMI measured at 12 and 24 months follow-up but narrative data only reported for the 12 months follow-up. Comparison group received a modified intervention in year 2 of the study and therefore the comparison between intervention and control at the second follow-up would not be eligible for inclusion in the meta-analysis.

NCT02067728 2014

Study characteristics	
Methods	Study name: FNPA (Family nutrition physical activity tool) Study dates: study Start Date: February 2014 Study design: cluster RCT N of arms: 2 Unit of allocation: primary care clinic Unit of analysis: individual Intervention period: 1 visit Follow-up time(s): 6 months
Participants	Participants randomized: 430 Setting: offices from three healthcare networks Location: Peoria, Illinois; United States Country income: high income Recruitment: practice recruitment: "For 3 months, practice recruitment meetings will be held with offices from three healthcare networks during which the research protocol will be explained, roles and responsibilities of research staff and practices will be outlined, and written agreements signed." subject Recruitment: "Subject recruitment will occur one month before implementation. Eligible subjects with scheduled well-child visits will receive a letter signed by their provider and the PI (Amy Christison, MD). The letter will briefly describe the study and offer the opportunity to enrol. They will be given an opt-out phone number to call within one week of mailing this letter if they do not want to participate. If the research coordinator does not receive a call, he/she will contact the family by phone to answer questions and send a consent form to the family. The subject will be considered enrolled after obtaining a signed written consent from the family." % of eligible population enrolled: practices: NR; children: NR Age (years): range: 11-17 Gender/Sex: 46.5% boys (note: calculated from the whole cohort of participants aged 4-18)
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): 210 Comparator type: no active intervention Participants in the comparison group(s): 220 Comparison: dietary and activity intervention vs control Setting of the intervention: primary care clinic Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (6 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT0206772 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Sponsors and Collaborators: University of Illinois at Chicago; American Cancer Society, Inc.; Feinberg School of Medicine, Northwestern University; New York University; There is NOT an agreement between Principal Investigators and the Sponsor (or its agents) that restricts the PI's rights to discuss or publish trial results after the trial is completed." Declaration of interest: NR General notes: the trial was conducted on participants aged 4-17, results at follow-up are reported for all participants and for the age groups 4-10 and 11-17 separatelly; only data from the age group 11-17 are included in this review. Published data not found; baseline data and results extracted from Trial Registry; limited details on study characteristics and PROGRESS data.

Neumark-Sztainer 2003

Study characteristics	
Methods	Study name: New Moves Study dates: baseline assessment was conducted in September 2000. Post-intervention assessment was held in January 2001. In April 2001, the 8-month follow-up assessment was conducted Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 16 weeks Follow-up time(s): 16 weeks; 8 months
Participants	Participants randomized: 201 Setting: six high-schools Location: Twin Cities area school districts in Minnesota; United States Country income: high income Recruitment: "Immediately following study school assignment, recruitment of intervention and control school participants began. Although schools were randomly assigned to conditions, because of logistical and scheduling issues, girls were recruited after the schools were randomized. Thus, girls in the intervention schools knew that they were enrolling in an alternative physical education class, New Moves. Girls in the control schools were recruited to participate in a research study about eating and exercise patterns of teens. For both conditions, recruitment flyers and posters were used to promote the study to high-school students. Care was taken to avoid advertising the program as one for overweight youth because of labelling and stigmatization concerns. Rather, recruitment materials were designed to attract girls who had low levels of physical activity, who wanted to become more active, and were interested in healthy weight management. Interested students were directed to contact the school study liaison to sign up for the study, turn in a signed parental/guardian consent form, and complete a brief screening survey." % of eligible population enrolled: schools: NR; children: 86.8% of intervention school, 83.6% of control school Age (years): mean (SD): 15.4 (1.1) Gender/Sex: 100% girls
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 89 Comparator type: attention control Participants in the comparison group(s): 112 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (8 months) Outcome self-reported: yes Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was supported by Grant AHA NATL/ 9970064N from the American Heart Association (D. Neumark- Sztainer, principal investigator)." Declaration of interest: NR General notes: the main eligibility criteria for enrolment in the study was self-reported low physical activity (defined as being in precontemplation, contemplation, or preparation stages of change for physical activity), with activity levels at or below 30 min per day/3 days per week.

Neumark-Sztainer 2010

Study characteristics	
Methods	Study name: New Moves Study dates: the study was conductred during the 2007–2008 school year (6 schools) and in 2008–2009 (6 schools) Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 16 weeks Follow-up time(s): 16 weeks; 9 months
Participants	Participants randomized: 356 Setting: high schools Location: Minneapolis/St. Paul metropolitan area of Minnesota; United States Country income: high income Recruitment: "High schools were recruited into the study on the condition that they would participate as either control or intervention sites and were randomized into these conditions. Girls in intervention and control schools were invited to register for an all-girls physical education class as an alternative to the regular coeducational class. Recruitment materials were designed to appeal to inactive girls interested in healthy weight management. Care was used to avoid stigmatizing the class in any way. A class description was included in the school catalogue used for class registration. Additionally, posters and flyers about the program were displayed at schools." % of eligible population enrolled: schools: NR; children: 86% (356/429) Age (years): mean (SD): 15.8 (1.17) Gender/Sex: 100% girls
Interventions	Theory: Health promotion model, Self-determination Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 182 Comparator type: no active intervention

	Participants in the comparison group(s): 174 Comparison: dietary and activity intervention vs control Setting of the intervention: school (after school programme) Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term; BMI medium term (16 weeks; 9 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT00250497 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: “New Moves: Obesity prevention among adolescent girls” (Clinical Trials number: NCT00250497) was supported by Grant R01 DK063107 (D. Neumark-Sztainer, principal investigator) from the National Institute of Diabetes and Digestive and Kidney Diseases, NIH. The content does not necessarily represent the official views of the National Institute of Diabetes and Kidney Diseases or the NIH. Research was supported in part by grant M01-RR00400 from the National Center for Research Resources, the NIH." Declaration of interest: NR General notes: girls practicing high levels of physical activity (≥1 hour/day) were excluded

O'Connell 2005

Study characteristics	
Methods	Study name: HEROS (Healthy Eating to Reduce Obesity through Schools) Study dates: study dates not reported Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 23 weeks Follow-up time(s): 12 months (note: results are not reported)
Participants	Participants randomized: 489 Setting: six middle schools Location: Guildford County, North Carolina; United States Country income: high income Recruitment: "Schools were paired for predominant ethnicity and income level (e.g., high income < 50% and low income > 50% of students receiving free or reduced price lunches). Three pairs of schools were randomly chosen and assigned to intervention or control groups. All seventh grade students were allowed to participate if they returned their informed consent form and met the inclusion criteria." % of eligible population enrolled: schools: 40% (6/15); children: NR Age (years): mean (SD): 12.7 (0.46) Gender/Sex: 44.9% boys
Interventions	Theory: Social Cognitive Theory Intervention type: dietary intervention Participants in the intervention group(s): 220 Comparator type: no active intervention Participants in the comparison group(s): 269 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: BMI at follow-up was measured but results are not reported. Results are reported as proportion of children that are overweight or obese; classification of overweight was based on BMi and classification of obesity was based on BMI and triceps skin fold (TSF): "Participants were classified as overweight if their BMI-for-Age was > 85th percentile and obese if their BMI-for-Age and TSF-for-Age were > 85th percentile.".
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was supported by grants from Team Nutrition, the NC Healthy Weight Initiative, and the Moses Cone Wesley Long Health Foundation." Declaration of interest: NR General notes: BMI outcome measured but not reported. Outcome reported as prevalence of children that are overweight (based on their zBMI) or obese (based on their zBMI and triceps skin fold test)

Ooi 2021

Study characteristics	
Methods	Study name: SwitchURsip Study dates: the study was cpomducted between May and September 2018 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 20 weeks Follow-up time(s): 5 months
Participants	

	Participants randomized: 2265 Setting: six schools Location: Hunter region of New South Wales; Australia Country income: high income Recruitment: "An invitation to participate in the study was posted to a convenience sample of schools after which a research officer contacted the school principal to invite participation. If requested, a face-to-face meeting was arranged if the principal requires more clarification. Fifty-four eligible schools were informed of the study and invited to participate in the study. Recruitment continued until a total of 25 schools were contacted before six schools consented to participate. All students in Years 7 to 9 of participating schools were invited to take part in the data collection component of the study. All parents at participating schools were given a consent form, requesting consent for their child to participate in baseline, mid-point and follow-up data collection. The consent form was distributed to students at school to be taken home for parents' consideration and to discuss participation with their children. One- to two-weeks following the distribution of the letter, parents who had not returned a form indicating their consent or otherwise, were phoned by an authorised staff member to remind parents of the opportunity to participate." % of eligible population enrolled: schools: 24% (6/25); children: 48% (1092/2265; consented data collection/eligible students) Age: school year 7th and 9th Gender/Sex: 47.4% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 1219 Comparator type: no active intervention Participants in the comparison group(s): 1046 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (5 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ACTRN12617001213336 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was funded by the New South Wales Health Translational Research Grant Scheme. The work was supported by infrastructure support from the Hunter Medical Research Institute (HMRI) and Hunter New England Population Health. Dr Rachel Sutherland is supported by a NHMRC Translating Research Into Practice (TRIP) fellowship (APP1150661). Dr Sze Lin Yoong receives salary support via an ARC Discovery Early Career Researcher Award (DE170100382). Dr Nicole Nathan is supported by NHMRC TRIP fellowship (APP1132450), Hunter New England Clinical Research Fellow and Sir Winston Churchill Fellow. Associate Professor Luke Wolfenden receives salary support from an NHMRC Career Development Fellowship (APP1128348) and Heart Foundation Future Leader fellowship (101175). The contents of this manuscript are the responsibility of the authors and do not reflect the views of the NHMRC." Declaration of interest: The authors have stated they have no conflicts of interest. General notes: BMI was measured in a nested sample of students, only year 7 students who consented had their height and weight measured.

Papadaki 2010

Study characteristics	
Methods	Study name: DiOGenes (diet, obesity, and genes) Study dates: volunteer families were invited to participate during the period from November 2005 to April 2007 Study design: RCT N of arms: 5 Unit of allocation: individual Unit of analysis: individual Intervention period: 6 months (12 months in Maastricht and Copenhagen) Follow-up time(s): 6 months
Participants	Participants randomized: 800 Setting: study centres Location: Maastricht (NL), Copenhagen (DK), Cambridge (UK), Heraklion (GR), Potsdam (D) Pamplona (S), Sofia (Bulgaria), Prague (the Czech Republic) ; Netherlands, Denmark, United Kingdom, Greece, Germany, Spain, Bulgaria, and Czech Republic Country income: high income (Netherlands, Czech Republic, Denmark, United Kingdom, Greece, Germany, Spain); upper middle income (Bulgaria) Recruitment: from Larsen 2010: "Recruitment of families was carried out by using a number of strategies, including a waiting list for weight-loss projects, referrals from local general practices or from other medical departments, flyers and posters in public places and advertising through radio, television, newspapers and internet. Families were interviewed by phone, whenever possible, before being invited to attend a screening examination. Some study centres also arranged information meetings before inviting the families to the screening visit." "Eligible adults underwent an 8-week low-calorie diet (LCD) period after their screening, during which the enrolled children received no intervention. Families with at least 1 parent who lost >8% of weight during the LCD were randomly assigned to 1 of 5 ad libitum diets." % of eligible population enrolled: children: 97% (800/827; number of children excluded because not eligible is not reported) Age (years): mean: 12 Gender/Sex: 46% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): low protein (LP)/low glycaemic index (LGI): 162; low protein (LP)/high glycaemic index (HGI): 168; high protein (HP)/low glycaemic index (LGI): 159; high protein (HP)/ high glycaemic index (HGI): 158 Comparator type: no active intervention Participants in the comparison group(s): 153 Comparison: dietary intervention vs control

	Setting of the intervention: community Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); zBMI short term (6 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT00390637 Funder(s) type: mixed Writing and/or research independent from funder(s): NR Funding details: "The DiOGenes study was partially funded by the European Community (contract FOOD-CT-2005-513946). Financial contributions from local sponsors were provided to the supermarket centers, which also received a number of foods free of charge from food manufacturers. A full list of these sponsors is available at www.diogenes-eu.org/sponsors." Declaration of interest: The authors have indicated they have no financial relationships relevant to this article to disclose. General notes: families eligible for inclusion consisted of at least one overweight but otherwise healthy parent/adult aged less than 65 years, and at least one healthy child. Families in which at least one of the overweight/obese parents achieved the target weight loss (8% of initial body weight) during the low calories diet period were cluster-randomized to one of the five diets.

Pate 2005

Study characteristics	
Methods	Study name: LEAP (Lifestyle Education for Activity Program) Study dates: 1998-2000 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months
Participants	Participants randomized: 2744 Setting: twenty-four high schools Location: 14 counties in South Carolina; United States Country income: high income Recruitment: "Representative samples of girls who attended intervention and control schools were recruited to complete a measurement protocol. All eighth-grade girls who attended 1 of the 31 middle schools that “fed” students to the 24 participating high schools were invited to complete the measures. These girls participated in a school assembly during which the measurement protocol was explained, incentives were described (gifts and promotional items valued at <$10), and all girls were invited to participate." % of eligible population enrolled: schools: NR; children: 34% Age (years): mean (SD): intervention: 13.6 (0.6); control: 13.6 (0.6) Gender/Sex: 100% girls
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 1523 Comparator type: no active intervention Participants in the comparison group(s): 1221 Comparison: activity intervention vs control Setting of the intervention: school + community + home Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): zBMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This study was funded by a grant from the National Heart, Lung and Blood Institute (R01HL057775)." Declaration of interest: NR General notes: schools were paired by percentage of girls who were African American

Patrick 2006

Study characteristics	
Methods	Study name: PACE+ (Patient-centered Assessment and Counselling for Exercise + Nutrition) Study dates: recruitment occurred from May 2001 through June 2002 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months
Participants	Participants randomized: 819 Setting: forty-five primary care providers from 6 private clinic sites Location: San Diego County, California; United States Country income: high income Recruitment: "Adolescents between the ages of 11 and 15 years were recruited through their primary care providers. A total of 45 primary care providers from 6 private clinic sites in San Diego County, California, agreed to participate in the study. A

	representative group of healthy adolescents seeing primary care providers was sought by contacting parents of adolescents who were already scheduled for a well child visit and by outreach to families with adolescents." % of eligible population enrolled: children: 59% (819/1381) Age (years): mean (SD): 12.7 (1.3) Gender/Sex: 46.5% boys
Interventions	Theory: Behavioural Determinants model; Social Cognitive Theory; Trans-theoretical Model of Behaviour Change Intervention type: dietary and activity intervention Participants in the intervention group(s): 424 Comparator type: attention control Participants in the comparison group(s): 395 Comparison: dietary and activity intervention vs control Setting of the intervention: home + healthcare service + telehealth + web Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: results described narratively
Notes	Clinical Trial Registry: NCT01657422 Funder(s) type: mixed Writing and/or research independent from funder(s): NR Funding details: "This project was supported by grants R01CA081495 and R01CA098861-03S1 from the National Institutes of Health National Cancer Institute, Bethesda, Md. Financial Disclosure: Drs Patrick, Calfas, and Sallis are co-owners of, and receive income from, the Center for Health Interventions, LLC (San Diego, Calif), which is developing products related to the research described in this paper. The terms of this arrangement have been reviewed and approved by San Diego State University and the University of California, San Diego, in accordance with their respective conflict-of-interest policies." Declaration of interest: Drs Patrick, Calfas, and Sallis are co-owners of, and receive income from, the Center for Health Interventions, LLC (San Diego, Calif), which is developing products related to the research described in this paper. The terms of this arrangement have been reviewed and approved by San Diego State University and the University of California, San Diego, in accordance with their respective conflict-of-interest policies. General notes: narrative results only. zBMI results reported in the text.

Peralta 2009

Study characteristics	
Methods	Study name: FILA (Fitness Improvement Lifestyle Awareness) Program Study dates: baseline measurements were collected in April 2007 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 6 months Follow-up time(s): 6 months
Participants	Participants randomized: 33 Setting: a single-sex secondary school Location: Sydney; Australia Country income: high income Recruitment: "Participants were recruited from the entire 7th Grade (12–13 years) student population of a single-sex (boys) secondary school in Sydney, Australia. Following completion of the school's compulsory fitness testing battery, students' cardiorespiratory fitness results were ranked from highest to lowest (119 to 9 laps). Students with the lowest scores (<49 laps) were invited to participate." % of eligible population enrolled: children: 58% (35/60) Age (years): mean (SD): 12.5 (0.4) Gender/Sex: 100% boys
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 16 Comparator type: no active intervention Participants in the comparison group(s): 17 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: NR Writing and/or research independent from funder(s): NR Funding details: "The authors thank participating students, staff and the broader intervention school community for partly funding the study." Declaration of interest: There is no conflict of interest. General notes: the aim of this study was to assess the feasibility, acceptability and potential efficacy of a multifaceted secondary school-based program (The FILA Program Fitness Improvement Lifestyle Awareness) among adolescent boys with sub-optimal cardiorespiratory fitness (at risk of obesity). Some baseline data extracted from Peralta 2010.

Pfeiffer 2019

Study characteristics	
Methods	Study name: Girls on the Move Study dates: recruitment took place in Septembers of 2012, 2013, and 2014 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 17 weeks Follow-up time(s): 18 -21 weeks
Participants	Participants randomized: 1519 Setting: eight schools Location: Michigan; United States Country income: high income Recruitment: recruitment took place in Septembers of 2012, 2013, and 2014. Prior to participation in the study, parents of girls completed a screening questionnaire to determine eligibility. From the study protocol: "At the beginning of each school year, the project manager schedules mutually convenient times for one or two members of the research team to meet with girls called to an assembly for the sole purpose of discussing the study in each of the eight schools. During the meeting, the researchers share information about the study and invite girls to participate. Girls are informed that their school will be randomly assigned to either receive an after-school physical activity club called Girls Only Activity for Life (G.O.A.L.) or continue with usual school offerings. They are told that girls in all schools will have the opportunity to receive incentives for participating in data collection activities, called “download days,” in the fall and spring and then again in the following school year. In addition to the brief verbal overview of the study, the researchers play an attractive two-minute recruitment video created by the research team in collaboration with a local production company. The video highlights reasons to participate (e.g., no financial cost and opportunity to make or be with friends) and includes short scenes of girls having fun during various study phases, such as data collection. For example, the video shows girls wearing attractive, colourful headphones as they respond to survey questions using an iPad with voiceover. Following the video presentation, the researchers answer questions and distribute packets containing study materials to interested girls. Each packet includes a consent/assent form and screening tool. Girls are told if they return the completed forms to the researchers present at their school during the next day or two, they will immediately receive a $5.00 cash incentive, regardless of whether they are interested in participating or not." % of eligible population enrolled: schools: NR; children: 85% (1543/1823; sample size/ number of participants that agreed to participate in the study and returned signed forms) Age (years): mean (SD): intervention: 12.05 (0.99); control: 12.05 (1.02) Gender/Sex: 100% girls
Interventions	Theory: Health Promotion Model and Trans-theoretical Model Intervention type: activity intervention Participants in the intervention group(s): 753 Comparator type: no active intervention Participants in the comparison group(s): 766 Comparison: activity intervention vs control Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (18 -21 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01503333 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Financial support was provided by R01HL109101 from NHLBI at NIH" Declaration of interest: The authors declare that they have no conflicts of interest. The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official views of National Institutes of Health (NIH). General notes: NR

Prins 2012

Study characteristics	
Methods	Study name: YouR Action Study dates: 2009-2010 Study design: cluster RCT N of arms: 3 Unit of allocation: classroom Unit of analysis: individual Intervention period: 4 weeks Follow-up time(s): 7 months
Participants	Participants randomized: 1213 Setting: twelve schools Location: Rotterdam and surroundings; Netherlands Country income: high income Recruitment: "As a first step in recruitment, the health coordinators of 69 schools in the area of Rotterdam (the Netherlands) were contacted by phone. If they were interested in participating, a brochure with more detailed information about the intervention content and the research procedure was send to the schools and a member of the research team visited the schools for further information exchange and planning. In each participating school between 1 and 12 classes (depending on the size of the school), in which regular secondary education was given, were selected for participation. All adolescents in the selected classes were invited to take part in the study. Prior to the baseline measurement, adolescents and their parents received detailed information about the trial. Based on this information, the adolescent and his/her parent or carer could decide to decline participation in the trial by returning a written objection form." % of eligible population enrolled: schools: 22%; (12/55); children: 98% (1213/1240)

	Age (years): mean (SD): 12.7 (0.5) Gender/Sex: 52.4% boys
Interventions	Theory: Self-regulation Theory, Theory of planned behaviour, Social Cognitive Theory, Environmental Research framework for weight gain prevention (EnRG), Precaution adaptation process model Intervention type: activity intervention Participants in the intervention group(s): YouRAction: 366; YouR Action+e: 423 Comparator type: attention control Participants in the comparison group(s): 424 Comparison: activity intervention vs control Setting of the intervention: school + home + web Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (7 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NTR1923 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This study was financially supported by a grant from ZonMw, The Netherlands Organization for Health Research and Development (grant ID no 7110.0003). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript." Declaration of interest: The authors have declared that no competing interests exist. General notes: BMI was only measured in 40% of participants: "At baseline and six months post-intervention, body weight, body height and WC were measured by trained research assistants in a random subsample (40% of total sample) of adolescents."

Razani 2018

Study characteristics	
Methods	Study name: SHINE (Stay Healthy In Nature Everyday) Study dates: patient recruitment occurred between July 21, 2015, and September 23, 2017 Study design: RCT N of arms: 2 Unit of allocation: dyad (child + parent) Unit of analysis: individual Intervention period: 3 months Follow-up time(s): 3 months (note: BMI as outcome was planned but was not measured)
Participants	Participants randomized: 78 Setting: a primary care clinic that is a Federally Qualified Health Center (FQHC) Location: Oakland, California; United States Country income: high income Recruitment: "In 2012 our pediatric primary care clinic (PCC) partnered with our local park agency to design a park prescription program. Our PCC is a Federally Qualified Health Center (FQHC) that serves a linguistically, racially and culturally diverse group of pediatric patients living near the federal poverty level. This population has higher rates of chronic illness than the national pediatric population." From study protocol: "Eligible dyads will be recruited by providers during patient visits or through self-referral. The principal investigator will train clinic physicians, nurse practitioners, social workers, case managers, and therapists by giving presentations at staff meetings on the health benefits of nature, the locations of local parks, and patient eligibility. The training is based on a curriculum previously developed by the research team. Training consistency will be ensured by using the same presenting materials, and by having presenters review with the principal investigator. Large posters of local nature sites posted in the clinic waiting area and exam rooms and a prompt for health care providers will be integrated into participants' electronic medical records for use during well-child visits. SHINE staff will determine eligibility and consent and obtain baseline measures." % of eligible population enrolled: dyad: 58% (78/134) Age: NR (children eligible age: 4-18 years) Gender/Sex: NR
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 50 Comparator type: activity Participants in the comparison group(s): 78 Comparison: activity intervention vs activity intervention Setting of the intervention: primary care clinic Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): NA Outcome self-reported: NA Reason for exclusion from the meta-analysis: measurement of BMI at follow-up was planned but results are not reported (there is no evidence that it was measured).
Notes	Clinical Trial Registry: NCT02623855 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "The authors report that they have no conflicts of interest. This project was supported by grants from East Bay Regional Parks District, East Bay Regional Parks District Foundation, and National Recreation and Parks Administration and REI Foundation, all to NR. The funders had no role in writing this report or the decision to submit this article for publication." Declaration of interest: The authors report that they have no conflicts of interest. General notes: BMI outcome was planned but not reported. Based on the study protocol: Body mass index (BMI)—"BMI will

	be measured in clinic at baseline, one month, and three months by using weight and an average of three measurements of height." The study targeted population that has higher rates of chronic illness than the national pediatric population.

Reesor 2019

Study characteristics	
Methods	Study name: FLOW (Family Lifestyle Overweight Prevention Program) Study dates: studies were conducted from 2005 to 2010 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 3-6 months Follow-up time(s): 7.5 months; 12.5 months
Participants	Participants randomized: 191 Setting: a primarily Hispanic charter school Location: Houston, Texas; United States Country income: high income Recruitment: "The current study is a secondary analysis of data aggregated across 5 randomized controlled trials (RCTs) with similar designs from 2005 to 2010. It was necessary to aggregate the participants across multiple waves of data collection in order to obtain an adequate sample size to evaluate summer weight gain. Sixth- and seventh grade students at a primarily Hispanic (95%) charter school in Houston, Texas were randomly assigned to either receive a weight management program or a control condition." % of eligible population enrolled: NR Age (years): mean (SD): intervention: 12.04 (0.58); control: 12.12 (0.72) Gender/Sex: intervention: 46% boys; control: 47% boys
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): 101 Comparator type: attention control Participants in the comparison group(s): 90 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (7.5 months); zBMI medium term (12.5 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT00454610 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This work was supported by federal funds from the United States Department of Agriculture/Agricultural Research Service 6250-51000." Declaration of interest: NR General notes: the study is a secondary analysis of data aggregated across 5 randomized controlled trials for which we only have found main articles for two trials; we are only extracting the participants in normal weight group and therefore we do not have the total number of participants and the number of participants randomized to intervention or control. Follow-up time is assumed to be 7.5 and 12.5 months based on what reported int he text: "Participants were assessed at 3 time points: baseline, spring post-test (March-May), and fall follow-up (August-October)."

Rodearmel 2006

Study characteristics	
Methods	Study name: NR Study dates: study dates not reported Study design: RCT N of arms: 2 Unit of allocation: family (parents + one eligible child) Unit of analysis: individual Intervention period: 13 weeks Follow-up time(s): 13 weeks
Participants	Participants randomized: 71 Setting: home Location: Fort Collins, Colorado; United States Country income: high income Recruitment: "Families were recruited from the Fort Collins, Colorado area by printed flyers and e-mail advertising. Eligible families had at least one 8- to 12-year-old child who was classified as at-risk-for-overweight or overweight (≥85th percentile BMI-for-age) who would participate with at least one parent or guardian. Each child who met this criterion was designated as a target child. / We carried out separate analyses for three groups: parents, target children (≥85th percentile BMI-for-age and 8 to 12 years), and other children (all children ages 8 to 17 years who did not meet the target child criteria in each family)." % of eligible population enrolled: NR Age (years): mean: 12.25; intervention girls: 12.8 (SD 0.7); intervention boys 11.8 (SD 0.4); control girls: 11.8(SD 0.8); control boys: 12.0 (SD 0.7) Gender/Sex: 50% boys
Interventions	Theory: NR Intervention type: dietary and activity intervention

	Participants in the intervention group(s): 52 Comparator type: no active intervention Participants in the comparison group(s): 19 Comparison: dietary and activity intervention vs control Setting of the intervention: home Setting of the intervention in sub-group analyses: home
Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI percentile short term (13 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This work was supported by NIH Grants DK042549 and DK048520 and by the W.K. Kellogg Institute." Declaration of interest: NR General notes: children included in the analysis are the "other children" in the non-overweight/at risk for overweight group (i.e., all children ages 8 to 17 years who did not meet the target child criteria in each family (≥85th percentile BMI-for-age and 8 to 12 years).

Sabino 2021

Study characteristics	
Methods	Study name: PANPAs (Physical Activity and Nutrition Program for Adolescents) Study dates: study dates not reported Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 10 months Follow-up time(s): 10 months
Participants	Participants randomized: 1458 Setting: eight schools Location: Madeira Island; Portugal Country income: high income Recruitment: NR % of eligible population enrolled: NR Age (years): range 10-14 Gender/Sex: NR
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): 738 Comparator type: no active intervention Participants in the comparison group(s): 720 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: NR Reason for exclusion from the meta-analysis: results described narratively
Notes	Clinical Trial Registry: NR Funder(s) type: NR Writing and/or research independent from funder(s): NR Funding details: NR Declaration of interest: NR General notes: narrative results only. Conference abstract with limited information about the study design, participants, intervention and PROGRESS characteristics. The follow-up time is not reported but as it is stated that outcome was measured after the intervention and we assumed that the follow-up is at 9 months;

Schreier 2013

Study characteristics	
Methods	Study name: NR Study dates: 2011-2012 school year: intervention from the beginning of October through December (10 weeks); all study measures were collected both at baseline in September 2011 and again in mid-January 2012 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 10 weeks Follow-up time(s): 3.5 months
Participants	Participants randomized: 106 Setting: a large urban public high school Location: British Columbia; Canada Country income: high income Recruitment: "One hundred six students were recruited from 5 classes at a large, urban public high school in western Canada during the 2011-2012 school year. To be eligible for this study, participants had to be (1) enrolled in 10th grade at the school,

	(2) fluent in English, and (3) free of chronic illnesses. Approval was obtained from the local school board, the school principal, and the teachers who were involved. We had permission to recruit students through the Planning 10 classes taught by 2 teachers, totalling 125 students." % of eligible population enrolled: children: 85% (106/125) Age (years): mean (SD): intervention: 14.84 (0.42); control: 14.96 (0.78) Gender/Sex: intervention: 50% boys; control: 53.7% boys
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): 52 Comparator type: no active intervention Participants in the comparison group(s): 54 Comparison: dietary and activity intervention vs control Setting of the intervention: school (after school programme) Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (3.5 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01698034 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "Support for this study was provided by the William T. Grant Foundation, HopeLab Foundation, and the Social Sciences and Humanities Research Council of Canada." Declaration of interest: none declared General notes: NR

Shin 2015

Study characteristics	
Methods	Study name: BHEZ (The Baltimore Healthy Eating Zones) Study dates: baseline surveys were administered between 2008 and 2009, and postintervention surveys were conducted between 2010 and 2011 Study design: RCT N of arms: 2 Unit of allocation: dyad (youth + caregiver) Unit of analysis: individual Intervention period: 8 months Follow-up time(s): 8-10 months
Participants	Participants randomized: 242 Setting: fourteen recreation centers Location: Baltimore City, Maryland; United States Country income: high income Recruitment: "In the present study, 432 African American youth-caregiver dyads were initially recruited from 14 randomly selected recreation centers in East and West Baltimore. To be eligible for the study, youth had to be 10 to 14 years of age, and live within 1 mile of a study recreation center without the intention to move within the next year. In settings where two recreation centers were within 1 mile of each other, children were considered part of the zone of the closest of the two centers to their place of residence. “Caregiver” was defined as a main food shopper and preparer for the youth’s household. Only one youth per household was eligible." % of eligible population enrolled: children: 63% (242/432) Age (years): mean (SD): intervention: 13.0 (1.6); control: 13.0 (1.4) Gender/Sex: intervention: 42.9%; control: 40.4% boys
Interventions	Theory: Mindfulness-based Intervention type: dietary intervention Participants in the intervention group(s): NR Comparator type: no active intervention Participants in the comparison group(s): NR Comparison: dietary intervention vs control Setting of the intervention: community Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI percentile medium term (8-10 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: no funding Writing and/or research independent from funder(s): NA Funding details: "The authors received no financial support for the research, authorship, and/or publication of this article." Declaration of interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. General notes: NR

Shomaker 2019

Study characteristics	
Methods	Study name: Learning to BREATHE Study dates: recruitment started in October 2014 and ended in May 2015. After determining eligibility, the study coordinator assigned participants to interventions. From May 2015 to March 2017, five cohorts were run in parallel on separate days

	during non-school hours. Follow-ups took place between July 2015 and November 2017 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 6 weeks Follow-up time(s): 6 months; 18 months
Participants	Participants randomized: 54 Setting: an outpatient, pediatric research laboratory at Colorado State University Location: Colorado; United States Country income: high income Recruitment: "Volunteers were recruited through letters to Northern Colorado area families, flyers in schools and physician offices, informational community sessions, newspaper/radio advertisements, and e-mails to community list serves. Materials invited adolescents who may be at-risk for gaining too much weight to participate in a group designed to decrease stress and promote healthy growth. Following a phone screen to estimate eligibility, participants attended a screening appointment to determine eligibility and collect baseline assessments. Parents/guardians and adolescents provided written consent and assent, respectively, after having the study described to them in detail." % of eligible population enrolled: children: 75% (54/72) Age (years): mean (SD): intervention: 13.97 (1.42); control: 14.49 (1.72) Gender/Sex: intervention: 45% boys; control: 44% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 29 Comparator type: attention control Participants in the comparison group(s): 25 Comparison: dietary intervention vs control Setting of the intervention: home + community Setting of the intervention in sub-group analyses: other
Outcomes	Measured outcome(s): BMI, zBMI and BMI percentile Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); BMI long term (18 months); zBMI short term (6 months); zBMI long term (18 months); BMI percentile short term (6 months); BMI percentile long term (18 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT03085160 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This work was supported by the Colorado Clinical and Translational Sciences Institute [NIH/NCATS Colorado CTSA Grant Number UL1 TR002535] and the Colorado Agricultural Experiment Station [NIFA/USDA Grant Number COLO0724]; Natalia Sanchez's work on this project was supported by a graduate research assistantship from the Colorado School of Public Health. Contents are the authors' sole responsibility and do not necessarily represent official NIH views." Declaration of interest: none General notes: the study included girls and boys at-risk for excess weight gain (i.e., BMI ≥70th percentile or two biological parents with reported obesity [BMI ≥30 kg/m2])

Simons 2015

Study characteristics	
Methods	Study name: MyGame Study dates: participants started in three waves for which baseline measurements were collected in January/February 2012, March 2012, and June 2012 Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 10 months Follow-up time(s): 4 months; 10 months
Participants	Participants randomized: 270 Setting: home Location: Amsterdam, Amersfoort, Leiden, Breda; Netherlands Country income: high income Recruitment: the recruitment of the adolescents occurred in four cities in The Netherlands; i.e., Amsterdam, Amersfoort, Leiden and Breda. Detailed information about the recruitment is described in Simons et al. 2014 (study protocol). Adolescents and family members interested in participating provided their contact details on our project website or via e-mail and subsequently received an online screening questionnaire by email to assess their eligibility based on the inclusion criteria. The eligible families received information about participation that included a written consent form that the adolescents and their parents were required to complete prior to the collection of the baseline measurements % of eligible population enrolled: children: 69% (270/391) Age (years): mean (SD): 13.9 (1.3) Gender/Sex: intervention: 90% boys; control: 92% boys
Interventions	Theory: Intervention mapping protocol, Behaviour Change and Environmental frameworks Intervention type: activity intervention Participants in the intervention group(s): 140 Comparator type: no active intervention Participants in the comparison group(s): 130 Comparison: activity intervention vs control Setting of the intervention: home Setting of the intervention in sub-group analyses: home

Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (4 months); zBMI medium term (10 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NTR3228 Funder(s) type: mixed Writing and/or research independent from funder(s): yes Funding details: "This work was supported by a grant from The Netherlands Organization for Health Research and Development (http://www.zonmw.nl/nl/)(grant number: 120520012). The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. Sony Benelux provided the PlayStation Move packages and video games for the study participants, but did not have any role in the design, data collection, and analysis, decision to publish or preparation of the manuscript." Declaration of interest: NR General notes: NR

Singh 2009

Study characteristics	
Methods	Study name: DOiT (Dutch Obesity Intervention in Teenagers) Study dates: baseline measurements were colletced from September 15, 2003, through October 13, 2003 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 8 months Follow-up time(s): 8 months; 12 months; 20 months
Participants	Participants randomized: 1108 Setting: eighteen prevocational secondary schools Location: Netherlands Country income: high income Recruitment: "A total of 18 prevocational secondary schools participated in the randomized controlled trial. Participating schools were asked to select 3 classes of first-year students (aged 12-14 years). The selection of classes was based on practical reasons (e.g., similar timetables for lessons in physical education). No inclusion criteria were set for students to take part in the study." % of eligible population enrolled: children: 84% (1108/1323) Age (years): mean (SD): intervention boys: 12.8 (0.5); intervention girls: 12.6 (0.5); control boys 12.9 (0.5); control girls 12.7 (0.5) Gender/Sex: 49.55% boys
Interventions	Theory: Self-determination theory, Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 632 Comparator type: no active intervention Participants in the comparison group(s): 476 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (8 months); BMI medium term (12 months); BMI long term (20 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: ISRCTN87127361 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This study is part of the Netherlands Research Programme for Weight Gain Prevention and is funded by grant 2000Z002 from the Netherlands Heart Foundation, the Dutch Ministry of Health, Welfare, and Sports, and the Royal Association of Teachers of Physical Education (KVLO)." Declaration of interest: Financial Disclosure: None reported. General notes: randomization took place at the school level or at location level (in case 2 schools were located in 1 city) and was stratified by urbanization (urban vs rural).

Slawson 2015

Study characteristics	
Methods	Study name: Team Up for Healthy Living Study dates: recruitment of study participants occurred over two waves, with the first taking place in January 2012 and the second occurring in September 2012 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 8 weeks Follow-up time(s): 3 months; 12 months (note: results at 12 months are not reported)
Participants	Participants randomized: 1509 Setting: ten high schools Location: Southern Appalachia; United States

	Country income: high income Recruitment: -Recruitment of schools: "Five county school districts in Appalachia were contacted based on rurality and socioeconomic status. These school districts were invited to a program-planning workshop conducted in Fall 2011 to identify high schools interested in participating in the project. Ten high schools of thirteen available were interested in participating. One school could not participate due to class scheduling concerns and two did not take part due to minimal interest. The principal investigator (PI) and the project coordinator met with principals and Lifetime Wellness teachers at each school to describe the planned intervention and program requirements. Not all wellness teachers were required to participate in order for the school to be included, although no teachers refused to take part. Classroom materials were offered as incentives to each teacher that participated and office supplies were delivered to each school recruited." recruitment of students: "Current students enrolled in the participating high school Lifetime Wellness classes were eligible to participate in the study. Students were primarily 9th graders with some upper classes minimally represented. Recruitment of study participants occurred over two waves, with the first taking place in January 2012 and the second occurring in September 2012. In order to increase the power, all Lifetime Wellness classes at each of the participating schools were invited to participate in the study for wave two. Trained research staff came to the classrooms to explain the study to students and distribute a study flyer that described the study and asked the parent's permission for his/ her child's participation (via passive parental consent form). A discussion of potential risks and benefits was provided. Inclusion/exclusion criteria were listed in the consent form. The students were asked to take the flyer and consent form to their parents. Parents who did not give consent were not asked whether exclusion criteria were met. This procedure ensured that non-participating students' privacy was protected." -Recruitment of college peer facilitators: "A call for applications was distributed to all eligible students through emails and flyers. Students who were interested in serving as peer facilitators submitted a statement of interest and qualification and a brief resume. The applications were reviewed and selected candidate students were then interviewed by project team members." % of eligible population enrolled: schools: 77% (10/13); children: 91% (1509/1654; number of children excluded because were not eligible is not reported) Age (years): mean (SD): 14.9 (0.7) Gender/Sex: 50.7% boys
Interventions	Theory: Theory of Planned Behavior Intervention type: dietary and activity intervention Participants in the intervention group(s): 686 Comparator type: no active intervention Participants in the comparison group(s): 823 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: non-usable data. Effect only reported in the abstract, no precision and no further details on the analysis.
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The project described was supported by Grant Number R01MD006200 from the National Institute on Minority Health and Health Disparities. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Minority Health and Health Disparities or the National Institutes of Health." Declaration of interest: NR General notes: NR

Smith 2014

Study characteristics	
Methods	Study name: ATLAS (Active Teen Leaders Avoiding Screen-time) Study dates: the intervention was delivered from December 2012 to June 2013 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 8 months Follow-up time(s): 8 months
Participants	Participants randomized: 361 Setting: fourteen secondary schools Location: New South Wales ; Australia Country income: high income Recruitment: "The Socio-Economic Indexes for Areas (SEIFA) of relative socioeconomic disadvantage was used to identify eligible secondary schools. All eligible students received information and consent forms. The recruitment target was 25 students per school; however up to 30 students from each school could be accepted. The first 30 students from each school to return their completed consent form were included in the study." % of eligible population enrolled: schools: 70% (14/20); children: 42% (361/850) Age (years): mean (SD): 12.7 (0.5) Gender/Sex: 100% boys
Interventions	Theory: Self-determination Theory, Social Cognitive theory Intervention type: activity intervention Participants in the intervention group(s): 181 Comparator type: no active intervention Participants in the comparison group(s): 180 Comparison: activity intervention vs control

	Setting of the intervention: school + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (8 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: 12612000978864 Funder(s) type: non-industry Writing and/or research independent from funder(s): yes Funding details: "This study was funded by an Australian Research Council Discovery Project grant (DP120100611). The sponsor had no involvement in the design or implementation of the study, in analyses of data, or in the drafting of the manuscript." Declaration of interest: The authors have indicated they have no financial relationships relevant to this article to disclose. The authors have indicated they have no potential conflicts of interest to disclose. General notes: NR

Takacs 2020

Study characteristics	
Methods	Study name: NR Study dates: recruitment of the study population took place in September 2015 during the registration period Study design: cluster RCT N of arms: 2 Unit of allocation: classroom Unit of analysis: individual Intervention period: 9 months Follow-up time(s): 9 months; 12 months
Participants	Participants randomized: 229 Setting: two state-owned primary schools Location: Budaors-Pest County; Hungary Country income: high income Recruitment: "Two state-owned primary schools (out of four) were enrolled. From the two enrolled schools, a total of eight classes were selected from grade 6th and 7th (two 6th and two 7th grade classes from each school). Recruitment of the study population took place in September 2015 during the registration period. Parents were contacted and informed about the purpose and processes of the study during the first parents' meeting of the academic year. All parents agreed to participate in the study and were contacted for completing the baseline parental questionnaire. All study participants gave their informed consent for inclusion before participating in the study." % of eligible population enrolled: classes: NR; children: 99% (229/232) Age (years): mean (SD): 12.6 (0.1) Gender/Sex: 44.5% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 117 Comparator type: no active intervention Participants in the comparison group(s): 112 Comparison: dietary intervention vs control Setting of the intervention: school + after school programme + web Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: NR Writing and/or research independent from funder(s): NR Funding details: NR Declaration of interest: The authors declare no conflict of interest. General notes: NR

TenHoor 2018

Study characteristics	
Methods	Study name: Focus on Strength Study dates: the intervention was delivered from March 2015 to March 2016 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 12 months (note: BMI and zBMI as outcome were planned but not measured)
Participants	Participants randomized: 695 Setting: schools: 50% (9/18); children: 86% (695/808) Location: Netherlands Country income: high income Recruitment: "Nine Dutch secondary schools (seven schools with Lower Vocational Education, two schools with Senior General Secondary Education) were randomised (stratified on education level; by flip of a coin by the first author under supervision of the fourth author) into an intervention condition (four schools) or a standard curriculum control condition (five

	schools). /Schools were recruited via school management and 695 adolescents (11–15 years old) participated. Following consent from the schools, parents and their children were informed about the intervention and related outcome measurements, and told they could refuse participation at any time." % of eligible population enrolled: Age (years): mean (SD): 12.97 (0.54) Gender/Sex: 50.36% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 353 Comparator type: no active intervention Participants in the comparison group(s): 342 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): NA Outcome self-reported: NA Reason for exclusion from the meta-analysis: measurement of BMI at follow-up was planned but results are not reported (there is no evidence that it was measured).
Notes	Clinical Trial Registry: NTR5676 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was funded by the Netherlands Organization for Health Research and Development (ZonMw; project number 525001004)." Declaration of interest: The authors declare that they have no competing interests. General notes: BMI measurement was planned but not reported

Velez 2010

Study characteristics	
Methods	Study name: NR Study dates: study dates not reported Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 12 weeks Follow-up time(s): 12 weeks
Participants	Participants randomized: 31 Setting: a predominantly Hispanic high school Location: Central New Jersey area; United States Country income: high income Recruitment: students were recruited from physical education classes in a predominantly Hispanic high school % of eligible population enrolled: children: 90% (28/31) Age (years): mean (SD): 16.14 (0.19) Gender/Sex: intervention: 62% boys; control: 53% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 13 Comparator type: no active intervention Participants in the comparison group(s): 15 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (12 weeks) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: mixed Writing and/or research independent from funder(s): yes Funding details: "The funding for this study was provided by LifeFitness Academy and the Youth Sports Research Council. All researchers involved impartially collected, analyzed, and interpreted the data from this study and have no financial interests concerning the outcome of this investigation." Declaration of interest: NR General notes: NR

Viggiano 2015

Study characteristics	
Methods	Study name: Kaledo Study dates: enrollment started in September 2006. Baseline assessment took place in October 2006. The first post-treatment assessment took place in April 2007 and the second post-treatment assessment took place in April 2008 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual

	Intervention period: 20 weeks Follow-up time(s): 6 months; 18 months
Participants	Participants randomized: 3110 Setting: twelve public middle schools and eight public high schools Location: Province of Naples and Salerno (Campania); Italy Country income: high income Recruitment: principals, teachers and all students of 12 public middle schools and 8 public high schools were invited to take part in the trial % of eligible population enrolled: schools: 100% (20/20) children: 95% (3110/3278) Age (years): mean (range): intervention: 13.3 (13.2-13.4); control: 13.0 (12.9-13.04) Gender/Sex: intervention: 55% boys; control: 51% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 1663 Comparator type: no active intervention Participants in the comparison group(s): 1447 Comparison: dietary intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): zBMI Outcome(s) included in the meta-analysis (time of assessment): zBMI short term (6 months); zBMI long term (18 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was funded by Second University of Naples, Associazione Culturale Kaledo, Regione Campania (Assessorato all'Istruzione), Provincia di Napoli, Provincia di Salerno Assessorato allo Sport, Comune di Cercola (Assessorato all'istruzione) and Fondazione per l'Assistenza all'Infanzia." Declaration of interest: Authors have no conflict of interest to declare. General notes: NR

Weeks 2012

Study characteristics	
Methods	Study name: POWER PE (Preventing Osteoporosis With Exercise Regimes in Physical Education) Study dates: study dates not reported Study design: RCT N of arms: 2 Unit of allocation: individual Unit of analysis: individual Intervention period: 8 months Follow-up time(s): 8 months
Participants	Participants randomized: 99 Setting: one high school Location: Gold Coast, Queensland; Australia Country income: high income Recruitment: adolescents enrolled in the ninth grade of a local high school (Gold Coast, Australia) were recruited to participate in the trial % of eligible population enrolled: children: 49% (99/203; number of children excluded because not eligible is not reported) Age (years): mean (SD): 13.8 (0.4) Gender/Sex: 46.5% boys
Interventions	Theory: NR Intervention type: activity intervention Participants in the intervention group(s): 52 Comparator type: no active intervention Participants in the comparison group(s): 47 Comparison: activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (8 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: there were no external funding sources Declaration of interest: Authors declare that there are no conflicts of interest. General notes: NR

Whittemore 2013

Study characteristics	
Methods	

	Study name: HEALTH(e)TEEN Study dates: the trial was conducted between October, 2010 and June, 2011 Study design: cluster RCT N of arms: 2 Unit of allocation: classroom Unit of analysis: individual Intervention period: 6-8 weeks Follow-up time(s): 3 months; 6 months
Participants	Participants randomized: 384 Setting: three high schools Location: New Haven, Connecticut; United States Country income: high income Recruitment: a convenience sample was recruited from students enrolled in health or biology classes in three high schools in two cities in the north east between October 2010 and January 2011 % of eligible population enrolled: children: 64% (384/604) Age (years): mean (SD): 15.31 (0.69) Gender/Sex: 38% boys
Interventions	Theory: Theory of Interactive Technology, Social Learning Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 207 Comparator type: dietary and activity Participants in the comparison group(s): 177 Comparison: dietary and activity intervention vs dietary and activity intervention Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): none Outcome self-reported: no Reason for exclusion from the meta-analysis: comparison not eligible (the comparison is between the same type of interventions)
Notes	Clinical Trial Registry: NCT01560676 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "Funding for this study was provided by the National Institutes of Health (NIH)/National Institute of Nursing Research (NINR) RC1NR011594-02. AC was funded by pre-doctoral fellowships from the NIH/NINR (T32NR008346-09) and the Jonas Center for Nursing Excellence (Whittmore 2013b)." Declaration of interest: NR General notes: the duration of intervention is not clear: the trial registry reports that lessons were delivered over 6-8 weeks and the first follow-up is at 3 months

Wieland 2018

Study characteristics	
Methods	Study name: HIF (The Healthy Immigrant Families study) Study dates: each participant completed consent, enrollment, randomization, and baseline measurements at a community setting from February through March 2014 Study design: cluster RCT N of arms: 2 Unit of allocation: family (parents + ≥ 1 child) Unit of analysis: individual Intervention period: 12 months Follow-up time(s): 6 months; 12 months; 24 months (note: results at 24 months not reported)
Participants	Participants randomized: 81 Setting: home Location: Rochester, Minnesota; United States Country income: high income Recruitment: "Participants were recruited by Rochester (Minnesota) Healthy Community Partnership (RHCP) partners from the Hispanic, Somali, and Sudanese communities in the Midwest city. These partners completed RHCP-developed human subjects protection training before recruitment, which was accomplished through in-person contact and word of mouth with adult members of households throughout the community. Partners identified families who may meet eligibility criteria, explained the study, and gauged interest in participation. Partners obtained permission from an adult family member of an interested household (man or woman) to forward their contact information to a study staff member. A language-congruent study staff member then called the family and performed telephone screening. Eligible families (all adult and adolescent members) were invited to a study event at a community partner location, where full eligibility screening and informed consent were conducted. They identified potentially eligible families through meetings and word-of-mouth advertising. After hearing about the project or after attending community meetings convened by recruitment partners, interested families were then screened by recruitment partners for potential eligibility via a face-to-face meeting or telephone call. They then obtained permission from an interested adult family member to forward their contact information to a study staff member. A language-congruent study staff member then called the family and conducted a full screen for eligibility. Eligible families were invited to participate and enrol in the study. Participants were offered the opportunity to receive family portraits from a professional photographer as an incentive for taking part in these activities." % of eligible population enrolled: families: 44% (44/99); children: NR Age (years): mean (SD): 13.5 (2.5) Gender/Sex: 49.4% boys
Interventions	Theory: Social Cognitive Theory Intervention type: dietary and activity intervention Participants in the intervention group(s): 40 Comparator type: no active intervention Participants in the comparison group(s): 41

	Comparison: dietary and activity intervention vs control Setting of the intervention: home + telehealth Setting of the intervention in sub-group analyses: home
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); BMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NCT01952808 Funder(s) type: mixed Writing and/or research independent from funder(s): yes Funding details: "This publication was supported by NIH Grant No. R01 HL 111407 from the National Heart, Lung, and Blood Institute and by CTSA Grant No. UL1 TR000135 fromthe National Center for Advancing Translational Science (NCATS), and by the Mayo Clinic Office of Health Disparities Research. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH. The funding bodies had no role in study design; in the collection, analysis, and interpretation of data; writing of the manuscript; and in the decision to submit the manuscript for publication." "J.A. Levine provides advice to Kersh, Inc., inventors of the accelerometer used in this study, without financial gain." Declaration of interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This publication was supported by National Institutes of Health (NIH) grant no R01 HL 111407 from the National Heart, Lung, and Blood Institute, by National Center for Advancing Translational Science grant no UL1 TR000135, and by the Mayo Clinic Office of Health Disparities Research. General notes: participants were recruited from immigrant and refugee populations.

Wilksch 2015

Study characteristics	
Methods	Study name: Life Smart Study dates: classes participated with recruitment, interventions and outcome assessments between May 2011 and July 2013 Study design: cluster RCT N of arms: 2 Unit of allocation: classroom Unit of analysis: individual Intervention period: 5 weeks Follow-up time(s): 6 months; 12 months
Participants	Participants randomized: 1441 Setting: twelve schools Location: South Australia, Victoria, Western Australia; Australia Country income: high income Recruitment: schools were invited to participate based on a staff member previously expressing an interest in body image programs (n = 4) or where schools were geographically located within 1 h of the participating university in that state (n = 8) % of eligible population enrolled: schools: 27% (12/45); children: 93% (1316/1414; number of students correctly matched across waves for inclusion in analyses/students that completed baseline) Age (years): mean (SD): 13.21 (0.68) Gender/Sex: 36% boys
Interventions	Theory: NR Intervention type: dietary and activity intervention Participants in the intervention group(s): 347 Comparator type: no active intervention Participants in the comparison group(s): 473 Comparison: dietary and activity intervention vs control Setting of the intervention: school Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI Outcome(s) included in the meta-analysis (time of assessment): BMI short term (6 months); BMI medium term (12 months) Outcome self-reported: no Reason for exclusion from the meta-analysis: NA
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This research was funded by a Butterfly Research Institute Grant" Declaration of interest: S.M.W. and T.D.W. are authors of Media Smart, where sales of the program fund further eating disorder prevention research. S.J.P. is an author of the HELPP program and is currently a consultant to Dove, Unilever. General notes: the aim of this research was to investigate the efficacy of an obesity-prevention program (Life Smart) and two eating disorder-prevention programs (Media Smart and HELPP) against each other and a no-intervention control condition. Only data from Life Smart and Control groups are included in this review as the other two interventions (Media Smart and HELPP) are aimed at preventing eating disorders.

Zhou 2019

Study characteristics	
Methods	

	Study name: CHAMPS (Childhood Health; Activity and Motor Performance Study) Study dates: the ntervention was implemented from August 2015 to June 2016 Study design: cluster RCT N of arms: 4 Unit of allocation: school Unit of analysis: individual Intervention period: 8 months Follow-up time(s): 8 months (note: BMI and zBMI as outcome were planned but not measured)
Participants	Participants randomized: 758 Setting: twelve middle schools Location: Beijing, Wuhu, Anhui Province, Weifang, Shandong Province; China Country income: upper middle income Recruitment: "Student recruitment was coordinated by the school principals and physical education teachers. Parents were informed of the study in announcement posters at the beginning of the school year. All parents received informed consent letters and were asked to indicate if they consented for their children to participate in the study. Signed consent letters were returned to the PE teachers. No incentive was provided for participation in the study." % of eligible population enrolled: schools: NR; children: NR Age (years): mean (SD): 12.66 (0.56) Gender/Sex: 53.4% boys
Interventions	Theory: Socio-ecological model of health promotion Intervention type: dietary and activity activity Participants in the intervention group(s): school physical education (SPE) intervention: 204; after school program (ASP) intervention: 200; school physical education Intervention + after school program intervention (SPE + ASP): 178 Comparator type: no active intervention Participants in the comparison group(s): 176 Comparison: dietary and activity intervention vs control activity intervention vs control Setting of the intervention: school + after school programme Setting of the intervention in sub-group analyses: school
Outcomes	Measured outcome(s): BMI and zBMI Outcome(s) included in the meta-analysis (time of assessment): NA Outcome self-reported: NA Reason for exclusion from the meta-analysis: measurement of BMI at follow-up was planned but results are not reported (there is no evidence that it was measured).
Notes	Clinical Trial Registry: ChiCTR-IOR-14005388 Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "This work was supported by Serving National Special Needs in Doctoral Talents Development Program—Performance Training and Health Promotion for Adolescents; the support program for High-level Teacher TeamDevelopment of Beijing Municipal Institutions (IDHT20170515); Beijing Social Science Funding Project (No. 16YTB018); and the Scientific Research Project of Beijing Educational Committee (No. KM201710029002)." Declaration of interest: The authors declare that they have no competing interests. General notes: BMI measurement was planned but not reported

Zota 2016

Study characteristics	
Methods	Study name: DIATROFI program Study dates: enrollment toke place during the school year 2013-2014 Study design: cluster RCT N of arms: 2 Unit of allocation: school Unit of analysis: individual Intervention period: 9 months (one school year) Follow-up time(s): 9 months
Participants	Participants randomized: 21261 Setting: schools in low socioeconomic status areas Location: Attica, Thessaloniki and the rest of Greece; Greece Country income: high income Recruitment: "After establishing initial contacts with all schools in low socioeconomic status areas, a total of 1053 schools' principals, corresponding to 140,468 students, declared their willingness to participate for the 2013–2014 school year and completed the relevant application form. Depending on funding availability, a set of criteria was used to prioritize the schools that applied. All students of participating schools were offered the opportunity to receive the free meal, irrespective of their socioeconomic status, so as to avoid stigmatization. Parents who did not wish their child to participate provided a signed statement." % of eligible population enrolled: schools: 36% (146/406); children: 35% (21261/61506) Age (years): range 12-18 Gender/Sex: multicomponent intervention: 40.2% boys; environmental intervention: 40.6% boys
Interventions	Theory: NR Intervention type: dietary intervention Participants in the intervention group(s): 10561 Comparator type: dietary Participants in the comparison group(s): 10700 Comparison: dietary intervention vs dietary intervention Setting of the intervention: school + home Setting of the intervention in sub-group analyses: school + home
Outcomes	Measured outcome(s): proportion of children who are with overweight or obesity Outcome(s) included in the meta-analysis (time of assessment): none

	Outcome self-reported: yes (reported by the parents) Reason for exclusion from the meta-analysis: non-usable data. Data reported as odd ratio (OR; the outcome is odds of changing weight status from overweight/obese category to normal weight category comparing these on the multicomponent intervention group to these in the environmental intervention group).
Notes	Clinical Trial Registry: NR Funder(s) type: non-industry Writing and/or research independent from funder(s): NR Funding details: "The DIATROFI Program was funded by the Stavros Niarchos Foundation and has been approved and runs under the auspices of the Greek Ministry of Education and Religious Affairs." Declaration of interest: none General notes: participants were children (4-11 years old) and adolescents (12-18 years old); only data from the adolescent group are included in this review. Data are reported as probability of improving the weight status of adolescents.

Abbreviations: ASP: after school programme; BMI: body mass index; IQR: interquartile range; ITT: intention to treat; NA: not applicable; NR: not reported; RCT: randomized controlled trial; SD: standard deviation; SE: standard error; zBMI: age- and sex-standardized BMI.

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Carlin 2018	Ineligible study design
Dong 2021	Ineligible study design
Luszczynska 2016a	Outcome of interest not mesured
NCT00061165 2003	Outcome of interest not mesured
NCT0184548002013	Ineligible population
NCT03469752002018	Outcome of interest not mesured
NCT037107460 2018	Outcome of interest not mesured
NCT03885115 2019	Outcome of interest not mesured
NCT04362280 2020	Ineligible population
Partridge 2019	Ineligible study design
Prieto-Zambrano 2021	Ineligible study design
Quintiliani 2014	Ineligible population
Robbins 2006	Ineligible study design
Sallis 2003	Ineligible study design
Trude 2019	Outcome of interest not mesured
Weigensberg 2021	Ineligible study design

Characteristics of studies awaiting classification [ordered by study ID]

Miller-Whitehead 2001

Methods	Study design: NR Study name: NET (Nutrition Education Training) project
Participants	Setting: five high schools in aTennessee county Country: USA Age (years): 14-15
Interventions	Intervention type: dietary Brief description: project designed to increase awareness of health risk and wellness factors; it was designed to supplement, not supplant, education on nutrition and health in the schools, using information based on the Dietary Guidelines for America
Outcomes	Measured (or planned) outcome(s): NR
Notes	Trial registration: NR Funding details: NR DOI: NR General notes: eligible participants are 9th grade students; data extracted from the abstract, full text report not available

Radilla Vasquez 2021

Methods	Study design: RCT Study name: NR
Participants	Setting: high schools in Mexico City Country: Mexico Age (years): NR (adolescents)
Interventions	Intervention type: dietary and activity Brief description: intervention designed based on EPODE (Ensemble Prévenons l'Obésité Des Enfants) methodology)
Outcomes	Measured (or planned) outcome(s): BMI
Notes	Trial registration: NR Funding details: NR DOI: NR General notes: article in Spanish, awaiting translation

Roy 2016

Methods	Study design: NR Study name: NR
Participants	Setting: NR Country: Australia Age (years): NR
Interventions	Intervention type: dietary Brief description: NR
Outcomes	Measured (or planned) outcome(s): NR
Notes	Trial registration: NR Funding details: NR DOI: NR General notes: short abstract, full text report not available

Salminen 2005

Methods	Study design: NR Study name: NR
Participants	Setting: NR Country: Finland Age (years): NR
Interventions	Intervention type: dietary and activity Brief description: family-based health education/counseling intervention
Outcomes	Measured (or planned) outcome(s): NR
Notes	Trial registration: NR Funding details: NR DOI: NR General notes: short abstract, full text report not available; eligible participants are children with a familial history of cardiovascular diseases

DOI: diclaration of interests; NR: not reported;

Characteristics of ongoing studies [ordered by study ID]

ACTRN12620001101976 2020

Study name	PPDP (Pasifika Preventing Diabetes Programme)
Methods	Study design: cluster RCT (stepped wedge)
Participants	Setting: churches in Greater Western and South Eastern Sydney Country: Australia Age (years): 4-17
Interventions	Intervention type: dietary and activity Brief description: the intervention aimed at changing lifestyle delivered by community activator
Outcomes	Measured (or planned) outcome(s): zBMI, BMI
Starting date	26 October 2020 (date of first enrolment)
Contact information	Prof David Simmons (da.simmons@westernsydney.edu.au)
Notes	Trial registration: ACTRN12620001101976 Funding details: South Western Sydney Primary Health Network (SWSPHN); South Eastern Sydney Local Health District (SESLHD); NSW Ministry of Health; EIS Health Ltd ;Sanofi-Aventis Australia Pty Ltd; NHMRC Partnership Project Grant; Western Sydney Local Health District (WSLHD); Nepean Blue Mountains Local Health District (NBMLHD); WentWest Limited; Wentworth Healthcare; Diabetes NSW and ACT; NSW Health Pathology; South Western Sydney; Local Health District (SWSLHD); Sydney Partnership for Health, Education, Research and; Enterprise (SPHERE) DOI: NR General notes: recruited churches are required to have at least 70% of their congregation from a Pasifika background

ACTRN12622000906752 2022

Study name	He Rourou Whai Painga (HRWP)
Methods	Study design: RCT
Participants	Setting: communities (four research centers across New Zealand) Country: New Zealand Age (years): 11 and over
Interventions	Intervention type: dietary Brief description: this is a randomised controlled trial of food provision and dietary change support (Group A) compared with a self-selected habitual dietary intake (Group B) for 12 weeks
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	20 June 2022 (recruitment start date)
Contact information	Dr Martin Gagnon (martin.gagnon@otago.ac.nz)
Notes	Trial registration: ACTRN12622000906752 Funding details: High Value Nutrition National Science Challenge (New Zealand)

	DOI: NR General notes: index participants will be adults at risk of metabolic and cardiovascular disease and up to five members of their household/whanau will be invited to also take part in the study

ACTRN12622000949785 2022

Study name	Health4Me
Methods	Study design: RCT
Participants	Setting: NR (delivered online) Country: Australia Age (years): 12-18
Interventions	Intervention type: dietary and activity Brief description: the intervention consists of 6-month semi-personalised text messages designed to support and improve physical and mental health over the intervention period. Topic of the messages includes physical activity, nutrition and food industry, body image, mental health, media and climate change
Outcomes	Measured (or planned) outcome(s): zBMI (using self-reported weight and height); eating disorder risk;
Starting date	1 September 2022 (anticipated enrollement date)
Contact information	Dr Stephanie Partridge (stephanie.partridge@sydney.edu.au)
Notes	Trial registration: Funding details: Medical Research Future Fund, Department of Health DOI: NR General notes: NR

Brown 2020

Study name	SHINE (Supporting Healthy Image, Nutrition and Exercise)
Methods	Study design: cluster RCT
Participants	Setting: 30 secondary schools across metropolitan Melbourne and country Victoria Country: Australia Age (years): 13 (approximatelly, grade 7 students)
Interventions	Intervention type: dietary and activity Brief description: the intervention consist of an online programme, delivered in weekly sessions over eight consecutive weeks during scheduled HPE lessons as per the national curriculum. The programme consists of four themes on healthy habits—nutrition, physical activity, emotions and body (self) image
Outcomes	Measured (or planned) outcome(s): zBMI, BMI; economic evaluation
Starting date	1 May 2018 (date of first participant enrolment)
Contact information	Prof Jo Williams (jwilliams1@swin.edu.au)
Notes	Trial registration: ACTRN 12618000330246 Funding details: "This work was supported by a National Health and Medical Research Council (NHMRC) project grant (1122840) and a Deakin University School of Health and Social Development School Grant (2019-SRG006). VB is supported by a Deakin University Postdoctoral Research Fellowship." DOI: none declared General notes: study protocol for economic evaluation of the SHINE study

CTRI/2017/05/008501 2017

Study name	NR
Methods	Study design: cluster RCT
Participants	Setting: Daddu Majra colony and Dhanas, UT Chandigarh Country: India Age (years): 12-14
Interventions	Intervention type: dietary and activity Brief description: 40 minutes of health education on improved physical activity and healthy diet. Health education will be imparted to participants in intervention schools during 1st visit whereas to participants in control schools during last visit (after 1 year)
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	1 June 2017 (date of first enrolment)
Contact information	Jaun Zeb (jaunzeb1988@gmail.com)
Notes	Trial registration: CTRI/2017/05/008501 Funding details: reported as the study sponsor: Department of Community Medicine, Kasturba Medical College, Manipal University, Manipal (KA) DOI: NR General notes: NR

CTRI/2018/01/011351 2018

Study name	NR
Methods	Study design: cluster RCT
Participants	

	Setting: co-educational private schools in Delhi Country: India Age (years): 12-15
Interventions	Intervention type: dietary and activity Brief description: lifestyle intervention package on health behaviour which includes physical exercises, diet and screen time.
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	1 August 2017 (date of firts enrolment)
Contact information	Diksha Rana (dikshar415@gmail.com)
Notes	Trial registration: CTRI/2018/01/011351 Funding details: National Institute of Nursing Education pgimer Chandigarh DOI: NR General notes: NR

CTRI/2019/11/022064 2019

Study name	i-PROMISe Plus
Methods	Study design: cluster RCT
Participants	Setting: co-educational private schools in Delhi Country: India Age (years): 11-14
Interventions	Intervention type: dietary and activity Brief description: school based intervention to improve dietary and physical activity patterns among adolescents. The intervention includes impact of short videos for teachers and students, manual (comprises interactive activities for students), information booklet for parents to promote healthy lifestyle. The intervention implementation in year 1 will include 1 training session (60 min) for teachers and peer leaders to implement the activities at the classroom level, 4 follow up visits (40 min/activity) to monitor teacher and peer leader led activities at the class room level. In year 2, a session with parents will be conducted for 60 min, 3 follow visits will be conducted to monitor teacher and peer led activities to be planned. The control group will receive delayed intervention
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	25 November 2019 (date of first enrolment)
Contact information	Dr Monika Arora (monika.arora@phfi.org)
Notes	Trial registration: CTRI/2019/11/022064 Funding details: TAKE Solutions Ltd., 27 Tank Bund Road, Chennai 600034, India DOI: NR General notes: NR

CTRI/2020/10/028700 2020

Study name	V-CaN
Methods	Study design: cluster RCT
Participants	Setting: schools Country: India Age (years): 10-30
Interventions	Intervention type: dietary and activity Brief description: The three interventions are with school students as change agents, with Village Health Nutrition and Sanitation Committees (VHNSC) members as change agents and with Women's Self-help group (SHG) members as change agents in addition to the existing government programs for non-communicable diseases (NCDs). The population in control arm will continue to receive the routine care through the existing government programs and no additional activities would be conducted in control arm. If proven effective, the health promotion strategy will also be implemented in the control PHC at the end of project. Intervention 1: the participatory health promotion strategy that will evolve through the project will be implemented. Capacity building of school students will be done through monthly contact sessions for developing NCD specific health action plan for their area/school, formation of V-CaN clubs and conduction of community-based events. Intervention 2: the participatory health promotion strategy that will evolve through the project will be implemented. Capacity building of VHNSC members will be done through monthly contact sessions for developing NCD specific health action plan for their village, formation of V-CaN clubs and conduction of community-based events. Intervention 3: the participatory health promotion strategy that will evolve through the project will be implemented. Capacity building of Women's SHG members will be done through monthly contact sessions for developing NCD specific health action plan for their village, formation of V-CaN clubs and conduction of community-based events.
Outcomes	Measured (or planned) outcome(s): proportion of children classified as living with pre-obesity and obesity
Starting date	1 January 2021 (date of first enrolment)
Contact information	Dr. Sushila Nayar (abhishekvraut@gmail.com)
Notes	Trial registration: CTRI/2020/10/028700 Funding details: Indian Council of Medical Research DOI: NR General notes: NR

Dukhi 2020

Study name	i-SPAN

Methods	Study design: cluster RCT
Participants	Setting: 16 government-funded primary schools in the iLembe district of KwaZulu-Natal Country: South Africa Age (years): 9-15
Interventions	Intervention type: dietary and activity Brief description: school-based diet and physical activity classroom and outdoor activities and Health Promotion Toolkit that consists of the learner pamphlet, the educator manual, and sports box
Outcomes	Measured (or planned) outcome(s): zBMI; Proportion of children and adolescents classified as overweight and living with obesity
Starting date	August 2018 (school randomization)
Contact information	Natisha Dukhi (Dukhin@ukzn.ac.za)
Notes	Trial registration: PACTR201711002699153 Funding details: "This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors." DOI: "The authors declare that they have no competing interests." General notes: NR

Fernandez-Jimenez 2019

Study name	SI!
Methods	Study design: cluster RCT
Participants	Setting: 24 public secondary schools Country: Spain Age (years): 12-16
Interventions	Intervention type: dietary and activity Brief description: classroom intervention, and complementary intervention in the family setting, at school and on teachers. The core intervention consists of teacher-led computer-based simulations and games (virtual trip) targeting the different age groups (grades 1-2 or 1-4).The health challenge topics (healthy eating, physical activity, and substance abuse avoidance) are integrated into the regular curricular subjects (science, physical education, etc.); the classroom activities are carried out in 3 teaching units per academic year, each focused on healthy eating, physical activity or substance abuse avoidance (protective factors).
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	1 June 2017
Contact information	Dr Rosa M Lamuela-Raventós (lamuela@ub.edu)
Notes	Trial registration: NCT03504059 Funding details: "This study was supported by the Fundació la Marató de TV3 (369/C/ 2016), the “la Caixa” Foundation (LCF/PR/CE16/10700001), and the SHE Foundation. VF is a recipient of funding from the American Heart Association under grant No 14SFRN20490315. R.F-J is a recipient of funding from the European Union Horizon 2020 Research and Innovation Programme under Marie Skłodowska-Curie grant No 707642. We would like to thank the Ministerio de Ciencia, Innovación y Universidades for supporting the project AGL2016−75329-R; and Generalitat de Catalunya. The CNIC is supported by the Instituto de Salud Carlos III (ISCIII), the Ministerio de Ciencia, Innovación y Universidades (MCNU) and the Pro CNIC Foundation, and is a Severo Ochoa Center of Excellence (SEV-2015-0505)." DOI: none declared General notes: NR

Hankonen 2016

Study name	Let’s Move It
Methods	Study design: cluster RCT
Participants	Setting: six vocational schools in the Helsinki Metropolitan Country: Age (years): 15-17
Interventions	Intervention type: activity Brief description: activity intervention including six intracurricular group sessions, and a later booster session, supporting online and poster materials, teacher-led activity breaks and other sedentary behaviour reduction practices in classrooms, and increase of other environmental opportunities for physical activity
Outcomes	Measured (or planned) outcome(s): body composition; harms and adverse events; economic evaluation
Starting date	Autum 2014 (recruitment); January 2015 (start of the trial)
Contact information	Dr Nelli Hankonen (nelli.hankonen@uta.fi)
Notes	Trial registration: ISRCTN10979479 Funding details: "The study and the preceding development phase was funded by the Ministry of Education and Culture, funding number 34/626/2012 (years 2012−14), and funding number OKM/81/626/2014, (years 2015−17), the Ministry of Social Affairs and Health, funding number 201310238 (years 2013−15). Process evaluation studies are funded by the Academy of Finland (as part of the Academy Research Fellowship for the first author, years 2015−2020). The funding bodies played no role in the writing of this protocol or the decision to submit it for publication." DOI: "The authors declare that they have no competing interests. Study sites have no competing interests." General notes: NR

ISRCTN06248443 2014

Study name	Obesity Prevention Tailored (OPT) for Health II

Methods	Study design: RCT
Participants	Setting: primary care (Kaiser Permanente Southern California Medical Care Program) Country: USA Age (years): 10-12
Interventions	Intervention type: dietary and activity Brief description: one in-person meeting with a health coach, four newsletters for the parent, four newsletters for the child, five telephone calls to the parent, and two collaborative family activities. All program activities were designed to encourage and/or produce diet and physical activity change.
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	Recruitment between June 2010 and November 2011
Contact information	Dr Kim Reynolds
Notes	Trial registration: ISRCTN06248443 Funding details: National Cancer Institute (USA); National Institute of Diabetes and Digestive and Kidney Diseases (USA); National Institutes of Health (USA) DOI: NR General notes: eligible participants are patients from the Kaiser Permanente Southern California Medical Care Program with a 10-12-year-old child living in the home

ISRCTN76013675 2014

Study name	PESSOA
Methods	Study design: cluster RCT
Participants	Setting: 14 high schools in the Oeiras Municipality Country: Portugal Age (years): 10-12
Interventions	Intervention type: dietary and activity Brief description: The intervention group was provided with 90 min additional weekly sessions with health and weight educational program and physical activities in addition to the standard general information regarding eating and physiscal activity behaviors provided to the control group
Outcomes	Measured (or planned) outcome(s): body composition assessed by dual-energy X-ray absorptiometry (DXA) and by standard anthropometric procedures
Starting date	1 September 2010 (date of first enrolment)
Contact information	Luis Sardinha
Notes	Trial registration: ISRCTN76013675 Funding details: Portuguese Foundation for Science and Technology (Portugal) DOI: NR General notes: eligible participants were boys and girls without contraindications for physical activity enrolled in the 5, 6, and 7th grades

Jones Bell 2019

Study name	Healthy Teens @ School
Methods	Study design: cluster RCT
Participants	Setting: secondary academic schools and vocational schools Country: Austria and Spain Age (years): 14-19
Interventions	Intervention type: dietary and activity Brief description: online, multi-level intervention program for promoting a healthy lifestyle and reducing problematic eating behavior, eating disorder and obesity risk among students. "Participants of the intervention group are assigned to one of two possible program tracks based on the results of the initial online-assessment: Overweight adolescents are assigned to the “Weight Management” track emphasizing balanced eating and exercise for weight maintenance, and all other individuals are assigned to the “Healthy Habits” track which aims at promoting healthy habits related to e.g., nutrition, physical activity, sleep. The participants of both tracks work on ten modules (one 20–30 min module per week) during school hours and/or at home." Control group will receive access to the prevention program by the end of the last follow-up assessment
Outcomes	Measured (or planned) outcome(s): BMI; severe adverse events
Starting date	NR
Contact information	Megan Jones Bell (drmegjones@gmail.com)
Notes	Trial registration: ISRCTN51957280 Funding details: "This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 634757." DOI: "The authors declare that they have no competing interests." General notes: NR

JPRN-UMIN000036544 2019

Study name	Yui Kenko Project 2
Methods	Study design: RCT (cross-over)
Participants	Setting: elementary school children in Okinawa prefecture Country: Japan Age (years): 6 and over

Interventions	Intervention type: dietary Brief description: nutrition survey and information intervention of dietary habit
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	19 June 2013 (date of first enrolment)
Contact information	nknkyu@to.jim.u-ryukyu.ac.jp
Notes	Trial registration: JPRN-UMIN000036544 Funding details: Okinawa Prefecture DOI: NR General notes: NR

NCT00921323 2009

Study name	NR
Methods	Study design: RCT
Participants	Setting: Springboard Academy of the Milton Hershey School Country: USA Age (years): 12-14
Interventions	Intervention type: activity Brief description: the intervention group would be instructed to increase their daily step count by at least 20% above their baseline gradually over 3 months; the control group will be advised to continue to be physically active and record daily steps
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	July 2009
Contact information	Vincent Aluquin
Notes	Trial registration: NCT00921323 Funding details: Milton S. Hershey Medical Center (sponsor) DOI: NR General notes: NR

NCT01373307 2011

Study name	NR
Methods	Study design: cluster RCT
Participants	Setting: churches in 6 Appalachian counties Country: USA Age (years): 9 and over
Interventions	Intervention type: dietary and activity Brief description: faith-placed lay health advisor intervention aimed at increasing fruit and vegetable intake and physical activity among intergenerational Appalachian individuals and families. Based on We Can! and Media Smart Youth curricula.
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	March 2010 (date of first enrolment)
Contact information	Nancy Schoenberg
Notes	Trial registration: NCT01373307 Funding details: National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) DOI: NR General notes: NR

NCT01626807 2012

Study name	WSB (Walking School Bus) program
Methods	Study design: RCT
Participants	Setting: 22 elementary schools Country: USA Age (years): 7-14
Interventions	Intervention type: activity Brief description: children will have the option of walking to and/or from school with study staff who are trained in Safe Routes to School methods
Outcomes	Measured (or planned) outcome(s): zBMI
Starting date	December 2012
Contact information	Jason A Mendoza
Notes	Trial registration: NCT01626807 Funding details: NR DOI: NR General notes: NR

NCT03762135 2018

Study name	LIITAH (Location Initiated Individualized Texts for Adolescent Health)

Methods	Study design: RCT
Participants	Setting: NR Country: USA Age (years): 13-17
Interventions	Intervention type: dietary Brief description: participants will be given the LIITAH app which consists of 1) enhanced location identification (ELI), 2) self reported nutrients by annotated photos (SNAP), 3) delivery of individually and culturally tailored point of purchase (POP) prompts along with tailored messages sent at other times of the day, 4) use of app in connection with parents, 5) goal setting, 6) a point system
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	4 March 2021
Contact information	Susan J Woolford (swoolfor@med.umich.edu)
Notes	Trial registration: NCT03762135 Funding details: NR DOI: NR General notes: eligible participants are children 13 Years to 17 years old that eat restaurant food at least 3 times a week and have a parent who agrees to participate

NCT03805295 2019

Study name	BOKS (Build Our Kids' Success)
Methods	Study design: RCT (cross-over)
Participants	Setting: three schools (K-8) in Revere, MA Country: Age (years): 5-14
Interventions	Intervention type: activity Brief description: 12-week physical activity program, occurring 3x/week, lasting 30-60 minutes per session
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	16 February 2018
Contact information	Elsie Taveras
Notes	Trial registration: NCT03805295 Funding details: American Council on Exercise DOI: NR General notes: eligible participants are children enrolled in the BOKS program. Students in the intervention arm will participate in the BOKS program in Winter-Spring 2018 and they will serve as the control group in Fall 2018.

NCT03996109 2019

Study name	LiGHT (Living Green and Healthy for Teens)
Methods	Study design: RCT
Participants	Setting: community in Hamilton, Ontario Country: Canada Age (years): 10-16
Interventions	Intervention type: dietary and activity Brief description: Canadian smartphone app-based program that combines health promotion (healthy eating, active living, screen time and sleep) with additional novel motivators such as environmental stewardship (e.g. reduce prepackaged foods, walk rather than drive) and cost-savings (e.g., eat at home rather than restaurants), that may further increase the likelihood of behaviour change. Aim2Be smartphone app system and BnLt smartphone app (comparison) Aim2Be smartphone app system: "Youth-parent dyads will receive the LiGHT program (addressing healthy eating, physical activity, screen time and sleep) via the Aim2Be smartphone app for 1 year. It provides personalization beginning with creation of an avatar and identifying user motivations, offers progressive goal-setting considering readiness, sub-tasks, milestones, self-monitoring tools with feedback and positive reinforcement. It applies behaviour change techniques, provides a knowledge centre, simulation narratives to enable decision making, and separate social exchange platforms for parents and youth to share ideas and challenges with peers. A Virtual Coach has been programmed using motivational interviewing theory. Gamification includes elements of choice, challenge, uncertainty, discovery, and kudos for achieving outcomes in the process of developing motivations, skills and mastery." Behavioral: BnLt smartphone app: "Youth-parent dyads will receive a simple app called BnLt for 1 year. It provides web-links to external websites that provide information and tips on healthy eating and activity, including the Canada Food Guide, Canadian Society of Exercise Physiology recommendations for physical activity, screen time and sleep for youth, and other resources."
Outcomes	Measured (or planned) outcome(s): zBMI
Starting date	11 December 2021
Contact information	LiGHT Trial study coordinator (light@phri.ca)
Notes	Trial registration: NCT03996109 Funding details: NR DOI: NR General notes: eligible participants are youth living in a home setting with at least one smartphone or tablet and internet access in the household, one parent or guardian (the "primary parent") who is able to attend all study visits and youth or parent identifying a need or potential to improve health behaviours

NCT04644224 2020

Study name	RE-AIM framework
Methods	Study design: cluster RCT
Participants	Setting: community (participants recruited from allocated churches) Country: USA Age (years): 10-16
Interventions	Intervention type: unclear Brief description: parents/caregivers (group 1) or families (group 2) attend monthly health coaching sessions over 1 hour each for 12 months, 9 resource navigation sessions over 12 months, and monthly support groups for 12 months. Control group families receive an educational handbook on cancer prevention.
Outcomes	Measured (or planned) outcome(s): zBMI
Starting date	17 January 2019
Contact information	Lorna McNeill (lmcneill@mdanderson.org)
Notes	Trial registration: NCT04644224 Funding details: NR DOI: NR General notes: eligible participanats are dyad parent/caregiver and child aged between 10-16 years. Parents/caregivers self-identify as black or African American and are obese (BMI greater than or equal to 30)

NCT04905966 2021

Study name	NR
Methods	Study design: cluster RCT
Participants	Setting: public or private schools of the 22 districts of Caaguazú Department Country: Paraguay Age (years): NR (children)
Interventions	Intervention type: dietary; activity; dietary and activity 9multi-arm study) Brief description: nutrition education sessions and physical activity classes: an additional 45 minute weekly physical education class and 5 weekly active break sessions of 10 minutes each will be added to the provisions of the children's curriculum. In addition, schools will receive high intensity nutrition education, that is, 3 weekly nutrition education classes of one hour in each session over a period of 6 months. Schools receiving a lower intensity nutrition education served as control. This group received 3 sessions of 1 hour with a total of 3 educational sessions over the 6 month period. The educational material was the same as the intervention group but the development of lessons was not as specific and deep as the intervention group.
Outcomes	Measured (or planned) outcome(s): zBMI; proportion of children classified as undernourished, normal, overweight and living with obesity (according to WHO standards)
Starting date	1 June 2018
Contact information	Patricia Rios
Notes	Trial registration: NCT04905966 Funding details: NR DOI: NR General notes: NR

NCT05329753 2022

Study name	NR
Methods	Study design: cluster RCT
Participants	Setting: public secondary schools in the province of Cadiz Country: Spain Age (years): 11-17
Interventions	Intervention type: dietary and activity Brief description: health intervention through a smartphone application that favors the process of learning to improve the degree of sport and nutrition knowledge, eating habits, and level of physical activity of adolescents
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	15 September 2019
Contact information	M J Santi
Notes	Trial registration: NCT05329753 Funding details: NR DOI: NR General notes: eligible participants are dolescents who are studying the 1st to 3rd grades of secondary education in public institutes (11 to 17 years) and have a smartphone or tablet with an Android operating system and internet access.

O'Kane 2020

Study name	WISH (Walking In ScHools)
Methods	Study design: cluster RCT
Participants	Setting: all post-primary schools in Co Donegal (RoI) with 69 an enrolment of >240 girls and all post-primary schools Co Derry/Londonderry (NI) Country: Northern Ireland and Republic of Ireland Age (years): 12-14

Interventions	Intervention type: activity Brief description: school-based peer-led walking intervention: female pupils aged 15–18 years will be invited to train as walk leaders and will lead younger pupils in 10–15 min walks before school, at break and lunch recess
Outcomes	Measured (or planned) outcome(s): zBMI
Starting date	September 2019
Contact information	Maria O'Kane (m.okane@ulster.ac.uk)
Notes	Trial registration: ISRCTN12847782 Funding details: "The WISH Study is funded from INTERREG VA funding of €8.84 m (incl. 15% contribution from the Department of Health in Northern Ireland and Republic of Ireland) that had been awarded to the HSC Research & Development Division of the Public Health Agency Northern Ireland and to the Health Research Board in Ireland for the Cross-border Healthcare Intervention Trials in Ireland Network (CHITIN) project. The funders had no role in the design of this study and will not have any role during its execution, analyses, interpretation of the data, or decision to submit results. The sponsor of this study is Ulster University, Shore Road, Newtownabbey, Co. Antrim, BT37 0QB. The study sponsor was not involved in study design." DOI: "The authors declare that they have no competing interests." General notes: eligible participants are female pupils in Year 9/10 (Northern Ireland) and 1st/2nd year (Ireland)

Porter 2019

Study name	Growing Resilience
Methods	Study design: cluster RCT
Participants	Setting: Wind River Indian Reservation Country: USA Age (years): 5 and over
Interventions	Intervention type: dietary Brief description: 2 years of support designing, installing and maintaining a home food garden of at least 80 square feet (approximately 7 square meters). Families randomly assigned to intervention will receive a full gardening support package for 2 years.
Outcomes	Measured (or planned) outcome(s): zBMI
Starting date	15 February 2016
Contact information	Alyssa M Wechsler (alywex@uwyo.edu)
Notes	Trial registration: NCT02672748 Funding details: "The Growing Resilience study is funded by NHLBI and NIGMS National Institutes of Health, grant no. R01 HL126666-01. The 2013 pilot work was funded by NIGMS/NIH grant no. 8 P20 GM103432-12." DOI: none declared General notes: eligible participants are Native American families in Wind River Indian Reservation who have not gardened recently but want to garden and have at least one member enrolled in a federally-recognised tribe

RBR-86xv46 2019

Study name	NR
Methods	Study design: cluster RCT
Participants	Setting: state public schools Country: Brazil Age (years): 12-16
Interventions	Intervention type: dietary and activity Brief description: multicomponent school-based intervention lasting one semester. The intervention will take place through classes in all school subjects, changing the school environment through physically active opportunities and through health education strategies, working on topics such as the practice of physical activities, food and nutrition education and reduction of sedentary behavior
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	1 February 2020
Contact information	Kesley Pablo Morais de Azevedo (kesley@ufrn.edu.br)
Notes	Trial registration: RBR-86xv46 Funding details: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) DOI: "The authors declare that they have no competing interests." General notes: NR

RBR-9c7pkd8 2022

Study name	NR
Methods	Study design: cluster RCT
Participants	Setting: high schools Country: Brazil Age (years): 14-17
Interventions	Intervention type: dietary and activity Brief description: Health Education Program, consisting of 15 meetings reserved for the evaluation of the investigated outcomes and educational actions on physical activity and healthy eating
Outcomes	Measured (or planned) outcome(s): BMI

Starting date	20 June 2022
Contact information	Samuel Carvalho Dumith (scdumith@yahoo.com.br)
Notes	Trial registration: RBR-9c7pkd8 Funding details: Fundação de Amparo a Pesquisa do Estado do Rio Grande do Sul DOI: NR General notes: NR

RBR-9crqgt 2019

Study name	NR
Methods	Study design: RCT
Participants	Setting: Ifal Murici and Satuba campus from Monsenhor Clóvis Duarte de Barros State School, União dos Palmares Country: Brazil Age (years): 10-19
Interventions	Intervention type: dietary Brief description: the intervention group will receive information on healthy eating through internet based techniques, eg. text messaging, quiz and virtual games. the control group will receive information on healthy eating through conventional nutrition education techniques, eg. Rack Cards
Outcomes	Measured (or planned) outcome(s): Body weight and height
Starting date	1 February 2017 (date of first enrolment)
Contact information	Nassib Bezerra Bueno (nassib.bueno@fanut.ufal.br)
Notes	Trial registration: RBR-9crqgt Funding details: Instituto Federal de Alagoas; Universidade Federal de Alagoas DOI: NR General notes: NR

Smith 2018

Study name	MBA (Mentored Planning to be Active)
Methods	Study design: cluster RCT
Participants	Setting: high schools in Appalachia Country: USA Age (years): 14-15
Interventions	Intervention type: activity Brief description: this study will use the Planning to be Active (PBA) curriculum, a physical activity program designed for delivery in a classroom setting. For this study, the curriculum is adapted to also be delivered via trained peer mentors over a 10-week period for 40 min each week per session. The adapted version is called Mentored Planning to be Active (MBA). Adaptations for MBA include: (a) extending the curricular time to 40 min; (b) incorporating mentor-led activities via Discussion Guides; and (c) engaging in individual and group physical activity
Outcomes	Measured (or planned) outcome(s): BMI; BMI percentile
Starting date	September 2015 (actual study start date)
Contact information	Dr Laureen H Smith (smith.5764@osu.edu)
Notes	Trial registration: NCT02329262 Funding details: "The project described is supported by the Eunice Kennedy Shriver Award Number R01HD080866. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health." DOI: "The authors declare that they have no competing interests." General notes: NR

Strommer 2020

Study name	EACH-B
Methods	Study design: cluster RCT
Participants	Setting: 50 schools from Hampshire and neighbouring counties Country: UK Age (years): 12-13
Interventions	Intervention type: dietary and activity Brief description: modified LifeLab educational module aims to engage adolescents with the knowledge and understanding needed to enable them to make appropriate health choices—their health literacy—and to motivate them to change their dietary and physical activity behaviours
Outcomes	Measured (or planned) outcome(s): zBMI
Starting date	Recruitment started in September 2019
Contact information	Mary Barker (meb@mrc.soton.ac.uk)
Notes	Trial registration: ISRCTN74109264 Funding details: "This research is funded by UK NIHR Programme Grants for Applied Research (RP-PG-0216-20004). The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care. Researchers working on this trial are also supported by the following funding sources: UK Medical Research Council (MC_UU_12011/4), NIHR Southampton Biomedical Research Centre, Wessex Heartbeat and Public Health England. LifeLab has also received research funding from the British Heart Foundation, the Wellcome Trust, Cancer Research UK,

	Research Councils UK, the BUPA Foundation, the Primary Science Teaching Trust (formerly the Astra Zeneca Science Teaching Trust) and the EPSRC (via the UoS Pathways to Impact funding scheme). Study sponsor and funder have had no role in study design and will have no role in collection, management, analysis or interpretation of data; the writing up of a final report; and the decision to submit papers for publication, and they will not have ultimate authority over any of these activities." DOI: "KG has received reimbursement for speaking at conferences sponsored by nutrition companies and is part of an academic consortium that has received research funding from Abbott Nutrition, Nestec and Danone. The University of Southampton has received an unrestricted donation from Danone Nutricia to support LifeLab's work with schools. Wendy Lawrence has received funding from Danone Nutritia Early Life Nutrition for training and presentations. CC has received lecture fees and honoraria from Amgen, Danone, Eli Lilly, GSK, Kyowa Kirin, Medtronic, Merck, Nestlé, Novartis, Pfizer, Roche, Servier, Shire, Takeda and UCB outside of the submitted work. Outside of the submitted work, CV has a non-financial research relationship with a food retail company and maintains independence in all evaluation activities. This article, however, is not related to this relationship. All other authors STS, MB, KWT, SCS, DML, DL, LB, RA, TH, NK, JVS, PC, JC, LC, PL, JL, MG, DC, MH, DF, LM, JB, HMI and MEB have no competing interests to declare." General notes: NR

Sutherland 2019

Study name	PA4E1 (Physical Activity 4 Everyone, scale up)
Methods	Study design: cluster RCT
Participants	Setting: 76 secondary schools located in lower socio-economic areas across four health districts in New South Wales (NSW; Hunter New England (HNE), South Western Sydney (SWS), Central Coast (CC) and Mid North Coast (MNC)) Country: USA Age (years): 13
Interventions	Intervention type: activity Brief description: multi-component school-based physical activity program
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	Schools were recruited from May to November 2017, baseline data were collected August–October 2017
Contact information	Rachel Sutherland (Rachel.Sutherland@hnehealth.nsw.gov.au)
Notes	Trial registration: ACTRN12617000681358 Funding details: "This project is funded by the NSW Ministry of Health, Translational Research Grant Scheme. The NSW Ministry of Health has not had any role in the design of the study as outlined in this protocol and will not have a role in data collection, analysis of data, interpretation of data and dissemination of findings. RS and NN are supported by a NHMRC TRIP Fellowship (APP1150661 and APP1132450). NN is also supported by a Hunter New England Clinical Research Fellowship; LW is supported by a NHMRC Career Development Fellowship (APP1128348), Heart Foundation Future Leader Fellowship (101175) and a Hunter New England Clinical Research Fellowship; DRL is supported by an Australian Research Council Future Fellowship." DOI: "Authors RS, EC, NN, LW, KG, MW, NE, AB and JW receive salary support from their respective Local Health Districts. Hunter New England Local Health District contributes funding to the project outlined in this protocol. None of these agencies were involved in the peer review of this grant. RS and NN are Associate Editors for BMC Public Health. All other authors declare that they have no competing interests." General notes: NR

Walters 2012

Study name	Həli?dx(w) (Healthy Hearts Across Generations project)
Methods	Study design: RCT
Participants	Setting: Tribal Health Clinic in the Pacific Northwest Country: USA Age (years): NR (see general notes)
Interventions	Intervention type: dietary and activity Brief description: the intervention focused on cardiovascular health with a focus on reduction of BMI. Specifically, the MI component for the treatment condition targeted (1) increasing physical activity or movement for the parent and family, (2) reducing the consumption of snack foods, sweets, and sugared soft drinks, (3) increasing the availability of fresh fruits and vegetables in the home, and (4) decreasing sedentary activities and screen time. Personal coaches focused on physical health–related support and activities, and the group sessions included cooking and exercise classes. The comparison arm was based on a previously developed tribal intervention called the Family Life Journey, which focuses on increasing family cohesiveness, communication, and connectedness.
Outcomes	Measured (or planned) outcome(s): BMI
Starting date	January 2010
Contact information	Karina L. Walters (ude.wu@5wk)
Notes	Trial registration: NR Funding details: "This work was supported by a cooperative agreement between the National Heart, Lung, and Blood Institute (NHLBI) and the Indigenous Wellness Research Institute, University of Washington School of Social Work, and a subcontract with the Northwest Tribal partner (U01-HL 087322). Additional support was provided by an NHLBI Diversity Supplement Grant." DOI: NR General notes: NR

Zoellner 2019

Study name	Kids SIPsmartER
Methods	Study design: cluster RCT
Participants	Setting: 12 Appalachian middle schools in southwest Virginia Country: USA Age (years): NR (adolescents students)
Interventions	Intervention type: diet Brief description: school-based, behavior and health literacy program aimed at improving SSB behaviors among middle school students. The program also integrates a two-way short message service (SMS) strategy to engage caregivers in SSB role modeling and supporting home SSB environment changes
Outcomes	Measured (or planned) outcome(s): BMI percentile
Starting date	August 2018 (schools randomization)
Contact information	Jamie M Zoellner (Jz9q@virginia.edu)
Notes	Trial registration: NCT03740113 Funding details: "This study was funded by National Institutes of Health (NIH), National Institute on Minority Health and Health Disparities [R01MD012603]. NIH was not involved is the design of this study or writing of this manuscript." DOI: NR General notes: NR

Abbreviation: BMI: body mass index; DOI: declaration of interests; NA: not applicable; NR: not reported; RCT: randomized controlled trial; SSB: sugar-sweetened beverages; zBMI: age- and sex-standardized BMI.

Risk of bias

Risk of bias for analysis 1.1 BMI short term

Study	Bias							
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement
Ebbeling 2006	Low risk of bias	The allocation sequence was random and concealed and there were no baseline differences between intervention groups suggesting a problem with the randomisation process.	Low risk of bias	Participants were aware of their assigned intervention. There is no suggestion of deviations from the intended intervention because of the trial context and intention to treat analysis was used.	Low risk of bias	Data available for all randomised participants	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.
Papadaki 2010	Some concerns	Randomisation was a simple block randomisation with stratification. The randomisation was	Low risk of bias	Participants knew they were in a trial due to signing assent/consent. Due to the nature of the	High risk of bias	There was a similar attrition between intervention and control	Low risk of bias	The measurement of height and weight using standardised

		stratified according to centre, the number of eligible parents within each family, and to the number of parents with a BMI > 34. The randomisation was performed with a web-based randomisation programme, no information regarding concealment. Similar number of families were assigned to each intervention. Recruitment of the cluster (and participant children) occurred before randomisation. Baseline data only reported for completers children shows no baseline differences between groups.		intervention, students and staff were not blinded to their school's group allocation, however, the intervention components were not detailed specifically to them. No information is provided about deviations from the intended intervention due to the trial context but no reason to suspect these occurred. A modified intention to treat analysis was conducted (completers only analysis).		group (37% vs 42%). The authors reported that there were no differences in baseline characteristics between completers and non-completers, but results of this analysis are the results of the intention to treat analysis with missing data imputation are not shown.		methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.
Shomaker 2019	Some concerns	Randomisation was done using an electronic program (randomisation.com) with permuted blocks and stratified by sex, race/ethnicity, age, and weight by the study coordinator. There is no explicit information about allocation concealment. There were no baseline differences to suggest a problem with the randomisation process.	Low risk of bias	Participants, carers and those delivering the intervention would have been aware of their assigned intervention due to taking part/ delivering mindfulness sessions or health education sessions. There is no information given to suggest deviations from the intended intervention due to trial context took place. An assessment of feasibility/acceptability was generally positive. The article states that intention-to-treat analysis was used.	Low risk of bias	Data were available from 83% of participants in the intervention group and from 72% in the control. The authors stated that a sensitivity analysis showed that results with and without completers were highly similar.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.

Risk of bias for analysis 1.2 BMI medium term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Se re
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Autho judgem
Luszczynska 2016b	Some concerns	Randomisation was completed using a random number	Some concerns	Participants experimenters who delivered the	High risk of bias	Participants that were lost to follow-up were 16.5% in the control, and	Low risk of bias	Experimenters who measured height and weight were	Some concern

		sequence generated by a random digit generator. The sequence was applied to the order of participants entering the classroom at baseline. No details if the allocation was concealed. No baseline differences to suggest a problem with the randomisation process.		intervention and measured body weight and height were blinded to group allocation were blinded to group allocation. The authors states that complete-case analyses were used. As the dropouts and completers differed in age and overweight status, we decided to conduct complete-case analysis. The remaining missing data were imputed with an expectation–maximisation approach.		20.5% in the intervention group. There is no evidence the result was not biased by missing data. Missingness in the outcome could depend on the true value. The author reported that participants with overweight or obesity were more likely to complete all three measurement points and suggest that the difference referring to BMI may be related to higher motivation/interest in nutrition issues among those with higher BMI.		blinded to group allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI.	
Mihas 2010	Some concerns	Participants were randomly assigned using a computerised random number generator. No information is provided about allocation concealment. No significant differences were found at baseline between the groups.	Low risk of bias	Participants and carers, and people delivering the intervention were aware of the assigned intervention. There is no information provided about deviations from the intended intervention. There were a few deviations, e.g., dropping out due to lack of interest, but these would be expected outside of the trial context. It appears a modified intention to treat analysis was used.	Some concerns	Data were available from 90.7% of the participants in the control group and from 88.6% of the participants in the intervention group. We have no evidence that the result was not biased by missing outcome data. Missingness in the outcome could depend on its true value, as some people dropped out due to health problems. However, missingness was similar in each group and it is not known how many people dropped out due to health problems out of the 22 participants with missing data. Other reasons given are losing interest and moving schools.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concern
Takacs 2020	Some concerns	There is not enough information given to determine appropriateness of randomisation and allocation concealment. There were	Low risk of bias	Participants knew they were in a trial as they gave their informed consent for inclusion before participating in the study. Participants,	Some concerns	There is no information to suggest clusters dropped out of the study. The paper stated that 87.5% participated in the follow-up evaluation. There is no evidence the result is not biased	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight	Some concern

		baseline differences between groups, however this may be expected in a small sample size with many variables and may not suggest issues with randomisation. Randomisation occurred after recruitment of participants. The intervention group had participants with slightly higher BMI. The number of children with obesity and number of children with lower aerobic fitness status were also higher in the intervention group. Unlikely to be due to differential recruitment as whole classes enrolled and other variables such as fat mass, nutrition knowledge, waist circumference etc did not differ.		carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention as they received extra activities to the curriculum whereas control received usual curriculum. There is no information to suggest that deviations to the intended intervention due to trial context occurred. The study used modified intention to treat analysis excluding missing data.		by missing data. They imputed missing data but did not conduct sensitivity analysis comparing complete case to intention to treat analysis. Missingness in the outcome could depend on its true value. No reasons are given for missing data. However, missingness was fairly equal suggesting it may not be likely.		measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 1.3 BMI long term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	A juc
Shomaker 2019	Some concerns	Randomisation was done using an electronic program (randomisation.com) with permuted blocks and stratified by sex, race/ethnicity, age, and weight by the study coordinator. There is no explicit information about allocation concealment. There were no baseline differences to suggest a problem with the randomisation process.	Low risk of bias	Participants, carers and those delivering the intervention would have been aware of their assigned intervention due to taking part/ delivering mindfulness sessions or health education sessions. There is no information given to suggest deviations from the intended intervention due to trial context took place. An assessment of feasibility/acceptability was generally positive. The article states that intention-to-treat analysis was used.	Low risk of bias	Data were available from 79% of participants in the intervention group and from 84% in the control. The authors stated that analyses were carried out with multiple imputed data with the intent-to-treat sample. Results using	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the	So cor

						listwise deletion with study completers were highly similar		journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 1.4 zBMI short term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	
Amaro 2006	Some concerns	Some concerns over the lack of information about the method of randomisation and allocation sequence concealment. Participants were recruited before the clusters were randomised. Baseline data reported are from those retained at follow-up included in the final analyses, therefore it is hard to assess for baseline differences. However, it is unlikely that there was differential identification or recruitment of individual participants as recruitment took place before randomisation of clusters to conditions.	Low risk of bias	Participants were likely aware they were in a trial, and participants and carers/ people delivering the intervention would have been aware of the assigned intervention. No information provided regarding deviations from the trial context. However, it does not seem likely that deviations occurred as the teachers assisted in the playing of the board game/ selection of pairs and the intervention took place at school. The control group did not play Kaledo but were likely not aware of the intervention in this study so would not have sought similar games to play. An appropriate analysis was not used because participants were excluded from it. It is unlikely this would have had a substantial impact due to it including few people.	Some concerns	Three clusters were lost to follow-up, aside from this data for zBMI was available from participants in the rest of the clusters. No analysis methods, e.g. sensitivity analysis, reported to correct for bias by missing data. There is no information provided as to why clusters were lost to follow up. It is unlikely that missingness in the outcome depended on its true value. Though one more cluster dropped out in the intervention arm than the control arm, the authors say overall people enjoyed playing the game and it is probably unlikely to be related to zBMI	Low risk of bias	There is no mention in the journal article of outcome assessors being blinded. The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and the allocation. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	S c
Ooi 2021	Low risk of bias	Following baseline data collection schools were randomised to the intervention or control group by a statistician involved in data analyses. Schools were allocated to intervention and	Low risk of bias	Participants knew they were in a trial due to signing assent/consent. Due to the nature of the intervention, students and staff were not blinded to their school's group allocation, however, the intervention	High risk of bias	All clusters were included in the analysis. Only students from grade 7 included in the study (that provided consent) had measurement of zBMI taken	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight	L b

		control conditions in a 1:1 ratio using a matched randomisation procedure based on school sector (CSO or AIS). Details on concealment was not reported but we assumed that this should not introduce bias as randomisation was performed by a statistician involved in data analyses but not involved in the recruitment, study intervention or assessment. Same number of schools in both groups but 3/3 schools in control group were classified as disadvantaged and only 2/3 were disadvantaged in the intervention group. However, outcomes were assessed controlling for baseline values, gender and school Socio-Economic Indexes for Areas. Schools that consented to participate were randomised into the intervention or control group following baseline data, therefore we assumed that participant consent was requested prior to randomisation. In the control group there was a lower number of students and slightly higher percent of children with overweight or obesity. The lower number of students is probably due to having only 3 schools in each group and the difference in % of children with overweight or obesity is probably due to chance.		components were not detailed specifically to them. No information is provided about deviations from the intended intervention due to the trial context but no reason to suspect these occurred. Between-group differences at follow-up for primary and secondary outcomes were assessed under an intention to treat framework using linear mixed models.		and it is not clear how many were missing at follow-up, there is no information about the missing data and whether any test to assess the potential for attrition bias was conducted.		measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	
Papadaki 2010	Some concerns	Randomisation was a simple block randomisation with stratification. The randomisation was stratified according to centre, the number of eligible parents within each family, and to the number of parents with a BMI > 34. The randomisation was performed with a web-based randomisation	Low risk of bias	Participants knew they were in a trial due to signing assent/consent. Due to the nature of the intervention, students and staff were not blinded to their school's group allocation, however, the intervention components were not detailed specifically to them. No information is provided about deviations from the	High risk of bias	There was a similar attrition between intervention and control group (37% vs 42%). The authors reported that there were no differences in baseline characteristics between completers and non-	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome	L b

		programme, no information regarding concealment. Similar number of families were assigned to each intervention. Recruitment of the cluster (and participant children) occurred before randomisation. Baseline data only reported for completers children shows no baseline differences between groups.		intended intervention due to the trial context but no reason to suspect these occurred. A modified intention to treat analysis was conducted (completers only analysis).		completers, but results of this analysis are the results of the intention to treat analysis with missing data imputation are not shown.		assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	
Shomaker 2019	Some concerns	Randomisation was done using an electronic program (randomisation.com) with permuted blocks and stratified by sex, race/ethnicity, age, and weight by the study coordinator. There is no explicit information about allocation concealment. There were no baseline differences to suggest a problem with the randomisation process.	Low risk of bias	Participants, carers and those delivering the intervention would have been aware of their assigned intervention due to taking part/ delivering mindfulness sessions or health education sessions. There is no information given to suggest deviations from the intended intervention due to trial context took place. An assessment of feasibility/acceptability was generally positive. The article states that intention-to-treat analysis was used.	Low risk of bias	Data were available from 83% of participants in the intervention group and from 72% in the control. The authors stated that a sensitivity analysis showed that results with and without completers were highly similar.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	S o
Viggiano 2015	Some concerns	Participants were randomised. No information about allocation concealment. No major baseline differences between intervention groups. Some difference in sex but compatible with chance. Recruitment happened prior to randomisation and allocation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	Participants were aware of being in a trial as the parents of the students willing to participate in the study completed an informed consent form for their child. Likely participants were aware of their assigned intervention due to the addition of Kaledo board game sessions. Those delivering the intervention (teachers) were also aware because they were trained to use the game. It appears deviations might have occurred (i.e., they played less sessions than planned) but this was mostly a consequence of time	Some concerns	One school was lost to follow up at the 6-month assessment in the control group, containing 25% of the subjects. All clusters were present in the intervention group at 6-month assessment. 25% of participants in the control and 35% of participants in the intervention were lost at 6-month	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight	S o

		More participants in control but does not suggest differential identification/ recruitment.		pressure of the school curriculum rather than due to trial context. Participants flow-chart suggests that a modified intention to treat analysis was conducted.		assessment. There is no evidence the result was not biased by missing data. Missingness in the outcome could have depended on its true value. However, it is unlikely because the journal article states that data loss was 'mostly a consequence of time pressure of the school curriculum'.		measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 1.5 zBMI medium term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of th reported result	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Suppor judgen
Kuroko 2020	Some concerns	Randomisation was conducted using papers folded - so that the writing ("intervention" or "control") was hidden - were drawn out of a container, while working sequentially down the participant list for that stream and allocation was concealed. There are baseline differences in group size with 109 randomised to the intervention and 55 to the control despite aiming for 1:1 allocation ratio. In the discussion the authors say 'This study's biggest limitation was the small control group sample size, which was a consequence of not meeting recruitment targets and preferentially randomising to	Low risk of bias	Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. There is no information to suggest that deviations to the intended intervention due to trial context occurred. The authors says that analysis followed intention-to-treat principles, but it seems like a modified intention-to-treat was used.	Some concerns	There was a significantly greater drop-out rate among the control group (51% vs. 17% in the intervention group). There is no evidence the result was not biased by missing data. Missingness could depend on the true value. Reasons given for missingness include no long termer being interested, not responding to contact, not having transport etc. it is unlikely that missingness depended on true value of the outcome.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	No pre-specified statistica analysis protocol available evidence suggest numerica result like have bee selected basis of r from mul eligible outcome measure No sugge of selecti from mul analyses pre-spec statistica analysis available compare

		the intervention group to maintain a suitable class size, compounded by a high drop-out rate (51%) among the control group, many of whom enrolled in the study specifically to participate in the cooking classes.' Individual characteristics did not vary widely between intervention and control groups.								

Risk of bias for analysis 1.6 zBMI long term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	ju
Shomaker 2019	Some concerns	Randomisation was done using an electronic program (randomisation.com) with permuted blocks and stratified by sex, race/ethnicity, age, and weight by the study coordinator. There is no explicit information about allocation concealment. There were no baseline differences to suggest a problem with the randomisation process.	Low risk of bias	Participants, carers and those delivering the intervention would have been aware of their assigned intervention due to taking part/ delivering mindfulness sessions or health education sessions. There is no information given to suggest deviations from the intended intervention due to trial context took place. An assessment of feasibility/acceptability was generally positive. The article states that intention-to-treat analysis was used.	Low risk of bias	Data were available from 79% of participants in the intervention group and from 84% in the control. The authors stated that analyses were carried out with multiple imputed data with the intent-to-treat sample. Results using listwise deletion with study completers were highly similar	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	S c
Viggiano 2015	Some concerns	Participants were randomised. No information about allocation concealment. No major baseline differences between intervention groups. Some difference in	Low risk of bias	Participants were aware of being in a trial as the parents of the students willing to participate in the study completed an informed consent form for their child. Likely participants were	Some concerns	Two intervention and two control schools were lost at follow-up. Data were missing from 27 % of	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment.	S c

		sex but compatible with chance. Recruitment happened prior to randomisation and allocation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. More participants in control but does not suggest differential identification/ recruitment.		aware of their assigned intervention due to the addition of Kaledo board game sessions. Those delivering the intervention (teachers) were also aware because they were trained to use the game. It appears deviations might have occurred (i.e., they played less sessions than planned) but this was mostly a consequence of time pressure of the school curriculum rather than due to trial context. Participants flow-chart suggests that a modified intention to treat analysis was conducted.		the individuals in the treated group and 46 % in the control group. There is no evidence the result was not biased by missing data. Missingness in the outcome could have depended on its true value. However, it is unlikely because the authors stated that data loss was 'mostly a consequence of time pressure of the school curriculum'. In addition, 'attrition bias analysis showed that, at the baseline, the group of students who missed the last post-treatment assessment as well as the group of students who missed both the post-treatment assessments did not show any significant difference in the primary outcomes compared with the group of students who completed the trial'.		They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 1.7 Percentile short term

Study	Bias							
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement
Gustafson 2019	Some concerns	Some concerns over lack of details on method of randomisation and whether the allocation sequence was concealed. After students completed the	Low risk of bias	No concerns over deviation from intended intervention; 41.3% of the students in the intervention group did not respond to text-message but we have no reasons to suspect non-	High risk of bias	Serious concerns over a higher proportion of missing data in the intervention group that	High risk of bias	zBMI score was derived from a BMI measurement calculated from self-reported height and weight. As BMI was self-reported there

		consent form, assent form, and baseline survey, high schools were randomised to either receive the intervention. Some baseline difference in ethnicity (higher % of white students in the intervention group) but no differences in baseline zBMI		responsiveness arose because of the trial.		may be related to the true value of the outcome. Data at follow-up are available from 73% of the intervention group and 89% of the control group. No reasons given for participants dropping out of study. Data from participants with no data at follow-up were not imputed in the analysis and there is no statistical evidence that results are not biased my missing data. Higher attrition in the intervention groups suggests that missing data may be related to BMI values at follow-up in this group.		may be difference in reporting based on the true value of the outcome. Girls with higher BMI may have reported lower values because of the stigma of being overweight/obese.
Shomaker 2019	Some concerns	Randomisation was done using an electronic program (randomisation.com) with permuted blocks and stratified by sex, race/ethnicity, age, and weight by the study coordinator. There is no explicit information about allocation concealment. There were no baseline differences to suggest a problem with the randomisation process.	Low risk of bias	Participants, carers and those delivering the intervention would have been aware of their assigned intervention due to taking part/ delivering mindfulness sessions or health education sessions. There is no information given to suggest deviations from the intended intervention due to trial context took place. An assessment of feasibility/acceptability was generally positive. The article states that intention-to-treat analysis was used.	Low risk of bias	Data were available from 83% of participants in the intervention group and from 72% in the control. The authors stated that a sensitivity analysis showed that results with and without completers were highly similar.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.

Risk of bias for analysis 1.8 Percentile medium term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of t reported resu	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Suppo judge
Lappe 2017	Low risk of bias	The study statistician used a computer-generated scheme to randomly assign eligible girls in a 1:1 ratio to 1 of 2 groups within each of 3 BMI percentile categories: 50th to <70th, 70th to <85th, and 85th to <98th. No details on concealment but given that randomisation was stratified by BMI percentile category it is unlikely that knowledge of the allocated sequence would have affected the randomisation order. The groups were generally well balanced at baseline with respect to anthropometry, diet, and physical activity.	Low risk of bias	Participants knew about the trial from providing written informed consent. No deviation from the intended intervention is reported and the researcher adopted some measure to prevent non-compliance. Data were analysed according to an intention to treat analysis.	Low risk of bias	Only a small percent of missing data reported: 4 participants dropped out from the intervention group (2.9%) and one from the control group (<1%)	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	No pre-specifie statistic analysis protoco availabl evidenc suggest numeri result li have be selecte basis of from m eligible outcom measur No sugg of selec from m analyse pre-spe statistic analysis availabl compar
Shin 2015	Some concerns	No information provided about the random component used in randomisation, or about allocation concealment. No baseline differences suggesting problems with randomisation. Recruitment took place before randomisation of the clusters. No imbalances to suggest differential identification or recruitment - possible imbalances are due to chance.	Low risk of bias	Participants signed consent suggesting they knew they were in a trial. Participants carers and people delivering the intervention were likely aware of their assigned intervention in the trial. There were likely deviations from the intended trial context because participants in the	Some concerns	No information given at the cluster level regarding missing data. Data were available from 63% of the participants. There is no evidence that the results were not biased by missing data. There is no flow diagram presented to show whether missingness was balanced across the groups, but the authors reported no systematic differences in demographic	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically	Some concerns	No pre-specifie statistic analysis protoco availabl evidenc suggest numeri result li have be selecte basis of from m eligible outcom measur No sugg of selec from m analyse pre-spe statistic analysis availabl compar

				comparison group youth were also exposed to all components of the intervention, however this deviation was not due to trial context but due to proximity of the intervention and control centers, therefore leading to control participants visiting some of the shops that had been recruited into the intervention. There is no evidence to suggest it was due to learning about the trial intervention at recruitment and seeking it out. No information given explicitly but it appears from the tables that modified intention to treat was used, excluding missing data.		characteristics between post-intervention survey respondents and those who were lost to follow up suggesting it is unlikely that missingness depends on the true value of the outcome.		the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.		

Risk of bias for analysis 1.9 Percentile long term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	A juc
Shomaker 2019	Some concerns	Randomisation was done using an electronic program (randomisation.com) with permuted blocks and stratified by sex, race/ethnicity, age, and weight by the study coordinator. There is no explicit information about allocation concealment. There were no baseline	Low risk of bias	Participants, carers and those delivering the intervention would have been aware of their assigned intervention due to taking part/ delivering mindfulness sessions or health education sessions. There is no information given to suggest deviations from the intended intervention due to trial context took place. An	Low risk of bias	Data were available from 79% of participants in the intervention group and from 84% in the control. The authors stated that analyses were carried out with multiple	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely	So cor

		differences to suggest a problem with the randomisation process.		assessment of feasibility/acceptability was generally positive. The article states that intention-to-treat analysis was used.		imputed data with the intent-to-treat sample. Results using listwise deletion with study completers were highly similar		outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 2.1 BMI short term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selectio reported	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	S j
El Ansari 2010	Some concerns	There is not enough information provided about randomisation to determine if the method used was appropriate, and allocation concealment is not detailed. No baselines differences to suggest any issue with the randomisation method.	Some concerns	Participants and carers/deliveres were aware of the allocated intervention. No deviation of the treatment group (attendance to PA session was >90%); no information on whether participants in the control group seek any other activity outside school. No information regarding the analysis but it appears that all children were analysed in the allocated group.	Some concerns	There are no information regarding missing data	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	N sp st ar pr av ev su nu re ha se ba fr el ou m N of fr ar B sp st ar av co
Kennedy 2018	Low risk of bias	Randomisation was conducted by an independent researcher using a computer-based random number producing algorithm and allocation sequence was concealed;	Low risk of bias	Participants knew about the trial from providing written informed consent. They also would have known about it as it was new to curriculum and involved undertaking new activities.	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors reported that post-intervention (6-month) assessments were completed by	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI.	Low risk of bias	P ar in st ar in N su nu re ha se ba fr

		schools were match paired on the basis of their size, geographical location, and socioeconomic status. There are some baseline differences, but these could be compatible with chance. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. There were more participants in the intervention group, but the same number of schools (8 schools).		There is nothing to suggest that there were deviations from the intended intervention due to the trial context. A process evaluation also showed there seemed to be a high level of implementation as was resource usage. Figure 1 shows modified intention-to-treat analysis used 'Mixed models are consistent with the intention-to-treat principle, assuming that data are missing at random.		84.5% of the students and sensitivity analysis found similar findings comparing completers analysis and intention-to-treat analysis using last observation carried forward.		It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.		el ou m Tl su th th ba m ar
Melnyk 2013	Some concerns	No information provided on random component used in randomisation, or allocation concealment. There were baseline differences in intervention groups, but these do not suggest a problem with randomisation - many variables were measured, and it could be due to chance. Recruitment happened prior to randomisation. there were some baseline imbalances (e.g. higher BMI in intervention group) but does not suggest differential recruitment/ identification of individual participants because teens were not individually	Low risk of bias	It is likely participants knew they were in a trial because the journal article says 'research team members introduced the study to all students in each participating health class and sent consent/ assent packets home with the teens who expressed interest in study participation'. The journal article states the study was 'blinded'. The trial registry says 'Masking: Double (Participant, Investigator). However, no further information is provided about this. It seems that both participants and teachers delivering the interventions were aware of the intervention as this involved	Some concerns	There is no information to tell if data is available from all clusters, as the journal article only reports data at the individual participant level in the flow diagram (Figure 1), stating 807 participants were randomised out of the 1560 teens approached, so it is not clear how many schools (clusters) were eventually randomised and whether all clusters (schools) provided outcome data. There was missing data. 88 participants were lost in the intervention group and 92 in the control group by the 6-month follow-up. It is unclear how	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	High risk of bias	Tl sp ar av tri re sa ou ex st co 'c pe ar ba m in ar po in (r 12 is in ar A ou al th re is of re se ba fr el ar da ar pr pl co

			screened before randomisation and schools were randomised rather than individuals so it is unlikely that these characteristics influenced recruitment.		additional activity to usual health lessons and signing consent, but they would not have necessarily known if they were in the intervention group or control group, as both undertook new activities to usual. There is no suggestion that there were deviations from the intended intervention that arose because of the trial context. The journal article does note that 'The study team observed incidents of decreased fidelity to the intervention that occurred at least once, in approximately half of the classrooms. Immediate corrective measures by the team were instituted with the teachers when deviations from fidelity occurred'. Though not specified exactly what the deviations were, it is likely that deviations may occur outside of trial context as well. Analyses were performed using all available data (i.e. intent to treat), including participants who subsequently dropped out of the study'.		missing data was split between the clusters (schools). No analysis methods to correct for bias or sensitivity analysis. Missingness in the outcome could depend on its true value. However, it might be unlikely because missingness is balanced across the intervention and control groups. Reasons given for missing data are not detailed - not receiving intervention, missing data collection, asking to be withdrawn, no long termer being at the school.				
Smith 2014	Low risk of bias	Randomisation and allocation concealment were conducted. The journal article states 'After baseline assessments, schools were paired on the basis of their geographic	Low risk of bias	Participants likely knew they were in a trial. Participants and those delivering interventions/ caring for participants were aware of at least some part of the assigned	Some concerns	Data were available from 85.6% of the control group participants and 76.8% of the intervention group participants. There is no evidence the result was not	Low risk of bias	Assessors were blinded to treatment allocation at baseline but not at follow-up. The measurement of height and weight by researchers, using standardised	Low risk of bias	P st ar ou 20 O ar ap be pr jo Th do

		location, size, and SEIFA value and were randomised to either the control or intervention group. Randomisation was performed by an independent researcher with the use of a computer-based random number-producing algorithm'. As randomisation was produced by an independent researcher using a computer-based method, it is likely allocation was concealed. There were some baseline differences however these could be compatible with chance e.g. a slight imbalance between the groups in socioeconomic position. BMI balanced between the groups. Group size balanced. No evidence to suggest problems with randomisation. Recruitment took place prior to randomisation of the clusters. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.		intervention due to additional elements to their classes. No deviations from the intended intervention due to trial context are mentioned in the papers, however both participant and teacher satisfaction with the intervention was high, shown by the process evaluation and adherence was also fairly high. We don't believe that deviations from the intended interventions due to trial context occur. The authors states that all analyses followed the intention-to-treat principle.		biased by missing data. Missingness in the outcome could depend on its true value. Reasons given for missing data include participants withdrawing from the program, leaving the school or being absent on the testing day. There was more missing data in the intervention arm. As there was a high level of satisfaction with the intervention among those who undertook it, it is possibly unlikely that missingness depends on its true value.		measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.		di be co no co w ex m in co se ar dr su th co ho no B
Velez 2010	Some concerns	The authors state that participants were matched on body fat percentage then randomly assigned to the groups, but they do not provide further details of the method used	Some concerns	Participants completed an informed assent form and their parents completed informed consent. They would have been aware of the intervention as it involved	Some concerns	10% of the participants dropped out or were excluded from the study. This could have an impact due to the study having such a small sample size. The authors	Low risk of bias	No information provided regarding the specific method of measuring height and weight, but likely to be appropriate. The authors stated that height and	Some concerns	N sp ar id Th to a ou re ou m ev su

		for randomisation. No information is provided regarding whether the allocation sequence was concealed until participants were enrolled and assigned to interventions. Baseline data not provided for all randomised participants (n = 28 rather than n = 31). There is not much information provided about baseline characteristics (no age, sex information between groups). The groups do not appear markedly different in BMI from looking at table 1, but ability to do the exercises seems to be higher in the intervention group. The authors note that dropouts 'affected the equivalence achieved for body composition and weight through the matching technique used'. As it is a small trial, baseline differences could appear due to chance.		added physical activity to their regular classes. There is no information to suggest whether researchers were masked to the assigned intervention, but it seems like they would have been aware due to the nature of the intervention. No information is provided about deviations from the intended intervention. Presuming these did not occur. 2 participants were excluded from the trial due to non-compliance after randomisation. These participants were not included in the analysis set. It seems unlikely that the two excluded participants could have had a substantial impact due to the small sample size in the study.		reported that change scores were calculated to account for baseline values because the dropouts/ dismissals changed the equivalence created by matching at randomisation. However, no sensitivity analysis or other methods used to show result not biased by missing outcome data. Missingness in the outcome could depend on its true value. The authors stated that one person dropped out and two participants were dismissed due to non-compliance but not to which groups these participants were assigned to. It is unlikely that missingness depended on the true value because participants were weight matched between intervention and control groups.		weight were recorded in conjunction with body composition assessment to calculate BMI. These measurements were obtained in the Rutgers University Human Performance Laboratory.' Though the authors do not specify how height and weight were measured but they were obtained in the laboratory which makes it seem unlikely to differ across groups. No information about the outcome assessors or whether they were masked to intervention received. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.		nu re is be or re m el ar da no ar ch
Weeks 2012	Some concerns	No information regarding method of randomisation or concealment reported. No baseline differences except for boy-girl difference in age of peak height velocity for which analysis was adjusted to.	Low risk of bias	Participants and carers/deliveres aware of intervention but it is unlikely that deviation from the intended intervention occurred as intervention and control groups met at separate locations not visible to each other. Teachers performed a roll call at the start of every PE	Low risk of bias	The overall subject dropout rate was 18%. The authors stated that there were no differences in baseline physical characteristics or body composition between those who dropped out and those who remained in the program.	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is	Some concerns	N sp st ar pr av ev su nu re ha se ba fr el ou m N of fr ar

				session to confirm student attendance in the correct location and prevent intervention contamination. An intention-to-treat analysis was used to examine treatment effects.				relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.		B sp st ar av co

Risk of bias for analysis 2.2 BMI medium term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection reported r	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Su ju
Hollis 2016	Low risk of bias	Randomisation was conducted using a computer-generated block randomisation procedure (1:1 ratio) by an independent statistician and allocation was concealed. There are no major baseline differences to suggest a problem with randomisation. Randomisation occurred after recruitment of participants as the paper states it was following baseline data collection. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	Participants likely knew they were in a trial because they provided verbal assent and their parents signed informed consent. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. All intervention implementation strategies were delivered as planned. Intention to treat analysis was used.	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors stated that 91% of the participants provided adiposity outcome data at medium term (12 months). Sensitivity analysis found similar findings comparing complete case to imputation.	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely. According to the study protocol, the outcome was measured by researchers blinded to the group allocation.	Low risk of bias	A p ana rep stu it d rep det app gen with use in t pap evi sug nun res hav sel bas fro eli out mea The sug the the bas mul ana
Kennedy 2018	Low risk of bias	Randomisation was conducted by an independent researcher using a computer-based random number producing algorithm and allocation sequence was concealed;	Low risk of bias	Participants knew about the trial from providing written informed consent. They also would have known about it as it was new to curriculum and involved undertaking	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors reported that post-intervention (6-month) assessments were completed	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI.	Low risk of bias	Pre ana incl stu and in li No sug nun res hav sel bas fro

		schools were match paired on the basis of their size, geographical location, and socioeconomic status. There are some baseline differences, but these could be compatible with chance. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. There were more participants in the intervention group, but the same number of schools (8 schools).		new activities. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. A process evaluation also showed there seemed to be a high level of implementation as was resource usage. Figure 1 shows modified intention-to-treat analysis used 'Mixed models are consistent with the intention-to-treat principle, assuming that data are missing at random.		by 77.8% of students and sensitivity analysis found similar findings comparing completers analysis and intention-to-treat analysis using last observation carried forward.		It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.		elig out mea The sug the the bas mul ana
Melnyk 2013	Some concerns	No information provided on random component used in randomisation, or allocation concealment. There were baseline differences in intervention groups, but these do not suggest a problem with randomisation - many variables were measured, and it could be due to chance. Recruitment happened prior to randomisation. there were some baseline imbalances (e.g. higher BMI in intervention group) but does not suggest differential recruitment/ identification of individual participants because teens were not individually	Low risk of bias	It is likely participants knew they were in a trial because the journal article says 'research team members introduced the study to all students in each participating health class and sent consent/ assent packets home with the teens who expressed interest in study participation'. The journal article states the study was 'blinded'. The trial registry says 'Masking: Double (Participant, Investigator). However, no further information is provided about this. It seems that both participants and teachers delivering the interventions were aware of the intervention	Some concerns	There is no information to tell if data is available from all clusters, as the journal article only reports data at the individual participant level in the flow diagram (Figure 1), stating 807 participants were randomised out of the 1560 teens approached, so it is not clear how many schools (clusters) were eventually randomised and whether all clusters (schools) provided outcome data. There was missing data. 88 participants were lost in the intervention group and 92	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	High risk of bias	The spe ana ava trial rep sam out exc stat coll 'cha per and bas mor inte and pos inte (not 12- is n in th arti Add out also the regi is n of n resu sele bas fron elig ana data arti pre- plan con

		screened before randomisation and schools were randomised rather than individuals so it is unlikely that these characteristics influenced recruitment.		as this involved additional activity to usual health lessons and signing consent, but they would not have necessarily known if they were in the intervention group or control group, as both undertook new activities to usual. There is no suggestion that there were deviations from the intended intervention that arose because of the trial context. The journal article does note that 'The study team observed incidents of decreased fidelity to the intervention that occurred at least once, in approximately half of the classrooms. Immediate corrective measures by the team were instituted with the teachers when deviations from fidelity occurred'. Though not specified exactly what the deviations were, it is likely that deviations may occur outside of trial context as well. Analysis was performed using all available data (i.e. intent to treat), including participants who subsequently dropped out of the study'.		in the control group by the 6-month follow-up. It is unclear how missing data was split between the clusters (schools). No analysis methods to correct for bias or sensitivity analysis. Missingness in the outcome could depend on its true value. However, it might be unlikely because missingness is balanced across the intervention and control groups. Reasons given for missing data are not detailed - not receiving intervention, missing data collection, asking to be withdrawn, no long termer being at the school.				

Risk of bias for analysis 2.3 BMI long term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of reported resu	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Supp judg

Hollis 2016	Low risk of bias	Randomisation was conducted using a computer-generated block randomisation procedure (1:1 ratio) by an independent statistician and allocation was concealed. There are no major baseline differences to suggest a problem with randomisation. Randomisation occurred after recruitment of participants as the paper states it was following baseline data collection. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	Participants likely knew they were in a trial because they provided verbal assent and their parents signed informed consent. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. All intervention implementation strategies were delivered as planned. Intention to treat analysis was used.	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors stated that 86% of the participants provided adiposity outcome data at 24 months. Sensitivity analysis found similar findings comparing complete case to imputation.	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely. According to the study protocol, the outcome was measured by researchers blinded to the group allocation.	Low risk of bias	A pre-s analysi reporte study p it does report detail b appear genera with m used/ r in the r paper. eviden sugges numeri result l have b selecte basis o from m eligible outcon measu There sugges the sel the res based multipl analys

Risk of bias for analysis 2.4 zBMI short term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Select report
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement
Arlinghaus 2021	Some concerns	Randomisation was conducted using a random numbers table by the principal investigator at the individual level with a 1:1 allocation ratio. No details on whether allocation sequence was concealed. Higher proportion of children with obesity at baseline in the control group. This difference could reflect problems with the randomisation. To account for such difference BMI percentile was included as a covariate	Some concerns	Participants and research staff were not blinded to randomisation condition. No evidence of deviation from intended intervention; the intervention was delivered to the individuals and deviations cannot be excluded. An intention-to-treat model was developed using the last observation carried forward method.	High risk of bias	Unclear how many participants did not have zBMI data at follow-up; the flow-chart reported a similar number of lost to follow up in the two group; incomplete weekend data for MVPA were higher in the intervention group but not clear if such difference is applicable to the zBMI results. An intention-to-treat model was developed using the last observation carried forward method. Higher percent children with	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be	Some concerns

		in the zBMI analysis.				higher BMI may not have completed the measurement of the MVPA at follow-up in the intervention group and this may introduce bias in the zBMI results		influenced by knowledge of intervention, this is highly unlikely.	
Harrington 2018	Low risk of bias	Randomised conducted by an independent statistician to one of two groups stratified by school size and percent black and minority ethnicity pupils (median: < 20%, =20%). Sequentially numbered sections within a folder were used to implement the group allocations. The investigator team were not aware of the sequence until after randomisation. Measurement team members, except the team lead for the day, were blinded to group randomisation. The trial statistician was not blinded. However, the statistical analysis plan was signed off prior to database lock and any deviations from the analysis plan are reported. Some baseline differences but these could be due to chance rather than an issue with randomisation. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of	Low risk of bias	It is likely participants knew they were in a trial due to the intervention being different to usual curriculum, their parents receiving a consent form and they themselves giving verbal assent prior to each measurement session. The process evaluation suggests the interventions were not implemented fully in all schools; however it does not seem that deviations were due to trial context. They attribute it to 'some initial uncertainty in schools as to what to do, a predominant focus on support activities rather than provision of actual physical activity opportunities, and school level constraints (e.g., teacher time, other priorities) that led to time delays in the implementation of intervention components and activities. All schools and recruited pupils were analysed in the group they were randomised to and per protocol analyses were also undertaken for the primary outcome as	Some concerns	All schools in the intervention group were assessed at 7 months, but 8/10 schools were assessed in the control group due to 2 having 'a lack of time in timetable' At 7 months 89.5% of participants were assessed in the intervention group and 71.1% in the control group. There is no evidence the result was not biased by missing data. Missingness in the outcome could depend on its true value. Missingness is higher in the intervention group (89.5% vs 71.1%) but this is likely due to the two schools not assessed in the control group at this time point. Reasons for missing data include opting out, being absent on the day, moving schools, not being able to be located. There is no comparison of completers/ non completers at 7 months. It is hard to decide whether missingness depended on true value but seems more likely it could be due to general attrition.	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. Measurement team members were blinded to group randomisation.	Low risk of bias

		individual participants between intervention groups. Groups were similar at baseline - no information per cluster.		sensitivity analyses.					
Kennedy 2018	Low risk of bias	Randomisation was conducted by an independent researcher using a computer-based random number producing algorithm and allocation sequence was concealed; schools were match paired on the basis of their size, geographical location, and socioeconomic status. There are some baseline differences, but these could be compatible with chance. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. There were more participants in the intervention group, but the same number of schools (8 schools).	Low risk of bias	Participants knew about the trial from providing written informed consent. They also would have known about it as it was new to curriculum and involved undertaking new activities. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. A process evaluation also showed there seemed to be a high level of implementation as was resource usage. Figure 1 shows modified intention-to-treat analysis used 'Mixed models are consistent with the intention-to-treat principle, assuming that data are missing at random.	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors reported that post-intervention (6-month) assessments were completed by 84.5% of the students and sensitivity analysis found similar findings comparing completers analysis and intention-to-treat analysis using last observation carried forward.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk of bias
Lubans 2021	Some concerns	Paired schools were randomised by an independent researcher using a computer-based random number generator. No details on concealment reported in the main article but the trial registration stated that "allocation to control or	Low risk of bias	Participants knew about the trial from providing written informed consent. There is no information to suggest that deviations to the intended intervention due to trial context occurred. Both intention to treat and per-protocol	Some concerns	None of the schools were lost at follow-up, 15% of students missing from the intervention group and 19% of students missing from the control group. Results report analysis of all participants with no evidence that results were not biased by missing data.	Low risk of bias	Outcome assessors were blinded to assigned allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI.	Low risk of bias

			intervention groups will be conducted following baseline assessments. Therefore, group allocation is concealed from study team members determining participant eligibility and enrolment." According to the trial registration allocation to control or intervention groups was conducted following baseline assessments. Baseline measurements were balanced between the two groups.		analysis were conducted.		Sensitivity analysis was performed but results are not reported for BMI. Missing data cold depend on true value of the outcome but the level of attrition in the two groups is similar and the authors assumed data were missed at random.			
Pfeiffer 2019	Low risk of bias	Schools were matched, and a statistician randomly allocated participants, but there is no information about the method of randomisation or allocation, or whether the statistician was independent. Randomisation occurred after recruitment of participants, girls who met the eligibility criteria, provided written informed consent, and participated in baseline data collection, with randomisation occurring after. There are some baseline imbalances with girls in the control group slightly taller and heavier, with corresponding larger BMI (not statistically different), than those in the intervention group. A higher percentage of Black girls were in the	Low risk of bias	Participants knew they were in a trial. Participants and their parents know about the intervention. Those delivering the intervention also seem to be aware. There were some deviations to the intended interventions, as in the discussion the authors note that some participants did not engage with the program and some schools had limited space, however there is no evidence that there were specific deviations due to the trial context. Intention to treat analysis was used.	High risk of bias	Data at follow-up were missing from 11% of the participants. There is no evidence the result is not biased by missing data. They imputed missing data but did not conduct sensitivity analysis comparing complete case to the intention to treat analysis. The amount of missing data in each group is not shown. The authors reported that some girls, despite agreeing to participate in the study, simply did not want to engage in physical activity, even when offered choices of activities, suggesting that for these participants, missing data could be related to the true value of the outcome.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. All staff were blinded to condition, presumably including the outcome assessors.	Low risk of bias

		control. These differences were adjusted for in the models. We presume that these differences do not show a problem with the randomisation process but may be expected to occur by chance and does not necessarily suggest differential identification/ recruitment.							
Prins 2012	Low risk of bias	Randomisation was appropriate and allocation was concealed. School classes (clusters) were randomly assigned to one of the study arms in a computer determined sequence. Randomisation was done in blocks of nine classes, to ensure that equal numbers of classes were assigned to each study arm. The random allocation sequence was concealed until the study arms were assigned. There was a difference between groups in education level but no other major differences and this is unlikely to be due to randomisation issues. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between	Low risk of bias	Participants knew they were in a trial. Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. There is no information to suggest that deviations to the intended intervention due to trial context occurred. Complete case and intention-to-treat with last observation carried forward analyses were conducted. Intention-to-treat analyses resulted in similar, non-significant results.	Low risk of bias	Seven classes from one school dropped out after randomisation due to logistic problems at the school. Outcome was measured in random sample approximately 40% of total sample. Results table suggests no dropout within this sub sample between baseline and follow-up measurements.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		intervention groups.							
Simons 2015	Some concerns	The adolescents were randomly assigned to the intervention group or control group after baseline assessment by the researcher or a research assistant using a pre-determined computer-generated block randomisation list with blocks of 100. There is no information about allocation concealment. There are no baseline differences to suggest a problem with the randomisation process - some differences but to be expected in a trial this size. Not mentioned in the text in terms of statistically significant differences.	Low risk of bias	Participants were aware of their assigned intervention. It is likely that carers/ those delivering the intervention were also aware due to the nature of it. There is no information to suggest that deviations to the intended intervention due to trial context occurred. In the process evaluation, the main paper notes that two participants in the control group owned a PlayStation Move, but they do not say they purchased this from learning about the trial, nor do they say this was used during the trial period (and even if it was, this is likely standard behaviour for this age group). It appears that modified intention-to-treat was used'	Low risk of bias	Data were available from 87% of participants in the intervention group and from 92% of participants in the control group. A sensitivity analysis using imputed data was conducted finding similar results, but this is not shown in the main paper.	Low risk of bias	Outcome assessors were aware of the group allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk of bias

Risk of bias for analysis 2.5 zBMI medium term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Sele repo
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Author judgeme
Harrington 2018	Low risk of bias	Randomised conducted by an independent statistician to one of two groups stratified by school size and percent black and minority ethnicity pupils (median: < 20%, =20%). Sequentially numbered sections within a folder were used to implement the group allocations. The	Low risk of bias	It is likely participants knew they were in a trial due to the intervention being different to usual curriculum, their parents receiving a consent form and they themselves giving verbal assent prior to each measurement session. The process evaluation suggests the interventions were not	Some concerns	All schools in the intervention group were assessed at 14 months, but 9/10 schools were assessed in the control group due to 1 being 'lost to follow-up (uncontactable)'. At 14 months 84.8% of participants were assessed in the intervention group and 70.7% in the control group. There is no evidence the result was not biased by missing data. Missingness in the outcome	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. Measurement team members were blinded to group randomisation.	Low risk bias

			investigator team were not aware of the sequence until after randomisation. Measurement team members, except the team lead for the day, were blinded to group randomisation. The trial statistician was not blinded. However, the statistical analysis plan was signed off prior to database lock and any deviations from the analysis plan are reported. Some baseline differences but these could be due to chance rather than an issue with randomisation. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. Groups were similar at baseline - no information per cluster.		implemented fully in all schools; however it does not seem that deviations were due to trial context. They attribute it to 'some initial uncertainty in schools as to what to do, a predominant focus on support activities rather than provision of actual physical activity opportunities, and school level constraints (e.g., teacher time, other priorities) that led to time delays in the implementation of intervention components and activities. All schools and recruited pupils were analysed in the group they were randomised to and per protocol analyses were also undertaken for the primary outcome as sensitivity analyses.		could depend on its true value. The authors note that: 'Participants who did not complete the 14-month assessment (n = 301) were older (p < 0.001), had a higher zBMI-score (p = 0.021) and provided 0.2 days less accelerometer data (p < 0.001) at baseline (Table 3). Missingness was higher in the intervention group (84.8% vs 70.7%) but this is likely affected by the 1 school not assessed in the control group at this time point. Reasons given for missing data include opting out, being absent on the day, moving schools, not being able to be located. It seems more likely that attrition is not related to the true value but general attrition.			
Hollis 2016	Low risk of bias	Randomisation was conducted using a computer-generated block randomisation procedure (1:1 ratio) by an independent statistician and allocation was concealed. There are no major baseline differences to suggest a problem with randomisation. Randomisation occurred after recruitment of participants as the paper states it was	Low risk of bias	Participants likely knew they were in a trial because they provided verbal assent and their parents signed informed consent. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. All intervention implementation strategies were delivered as planned. Intention to treat analysis was used.	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors stated that 91% of the participants provided adiposity outcome data at medium term (12 months). Sensitivity analysis found similar findings comparing complete case to imputation.	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias

		following baseline data collection. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.						According to the study protocol, the outcome was measured by researchers blinded to the group allocation.	
Kennedy 2018	Low risk of bias	Randomisation was conducted by an independent researcher using a computer-based random number producing algorithm and allocation sequence was concealed; schools were match paired on the basis of their size, geographical location, and socioeconomic status. There are some baseline differences, but these could be compatible with chance. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. There were more participants in the intervention group, but the same number of schools (8 schools).	Low risk of bias	Participants knew about the trial from providing written informed consent. They also would have known about it as it was new to curriculum and involved undertaking new activities. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. A process evaluation also showed there seemed to be a high level of implementation as was resource usage. Figure 1 shows modified intention-to-treat analysis used 'Mixed models are consistent with the intention-to-treat principle, assuming that data are missing at random.	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors reported that post-intervention (6-month) assessments were completed by 77.8% of students and sensitivity analysis found similar findings comparing completers analysis and intention-to-treat analysis using last observation carried forward.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias
Lubans 2021	Some concerns	Paired schools were randomised by an independent researcher using a computer-based random number generator. No details on concealment reported in the	Low risk of bias	Participants knew about the trial from providing written informed consent. There is no information to suggest that deviations to the intended intervention due to trial	High risk of bias	Participants that were lost to follow-up were 16.5% in the control, and 20.5% in the intervention group. There is no evidence the result was not biased by missing data. Missingness in the outcome could depend on the true value. The	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to	Low risk o bias

		main article but the trial registration stated that "allocation to control or intervention groups will be conducted following baseline assessments. Therefore, group allocation is concealed from study team members determining participant eligibility and enrolment." According to the trial registration allocation to control or intervention groups was conducted following baseline assessments. Baseline measurements were balanced between the two groups.		context occurred. Both intention to treat and per-protocol analysis were conducted.		author reported that participants with overweight or obesity were more likely to complete all three measurement points and suggest that the difference referring to BMI may be related to higher motivation/interest in nutrition issues among those with higher BMI.		produce BMI. Most of the assessors were blinded to allocated intervention and it is unlikely that the others would have been influenced by the knowledge of allocated intervention.	
Pate 2005	Some concerns	No details of randomisation methods or concealment are reported. Schools were paired by school size, ethnicity, school location (urban vs rural), and class structure (60- or 90-minute classes). The same number of schools were randomised in each group (12/group). All students were exposed to intervention, and they were all invited to complete the baseline measures. Representative samples of girls who attended intervention and control schools were recruited to complete a measurement protocol. All eighth-grade girls were	Low risk of bias	Participants knew they were in a trial due to signing assent/consent. Due to the nature of the intervention, students and staff were not blinded to their school's group allocation, however, the intervention components were not detailed specifically to them. No information is provided about deviations from the intended intervention due to the trial context but no reason to suspect these occurred. No details regarding whether an intention to treat analysis was used but we have no reason to suspect that participants data were not analysed in accordance	Low risk of bias	Only a small proportion of data were missing (4%) in both groups.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		invited to complete the measures.		with the allocated intervention.					
Simons 2015	Some concerns	The adolescents were randomly assigned to the intervention group or control group after baseline assessment by the researcher or a research assistant using a pre-determined computer-generated block randomisation list with blocks of 100. There is no information about allocation concealment. There are no baseline differences to suggest a problem with the randomisation process - some differences but to be expected in a trial this size. Not mentioned in the text in terms of statistically significant differences.	Low risk of bias	Participants were aware of their assigned intervention. It is likely that carers/ those delivering the intervention were also aware due to the nature of it. There is no information to suggest that deviations to the intended intervention due to trial context occurred. In the process evaluation, the main paper notes that two participants in the control group owned a PlayStation Move, but they do not say they purchased this from learning about the trial, nor do they say this was used during the trial period (and even if it was, this is likely standard behaviour for this age group). It appears that modified intention-to-treat was used'	Some concerns	From the participants flowchart 87% of the participants in the intervention and 92% of the participants in the control groups completed the anthropometric assessment. A sensitivity analysis using imputed data was conducted finding similar results, but this is not shown in the main paper.	Low risk of bias	Outcome assessors were aware of the group allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias

Risk of bias for analysis 2.6 zBMI long term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of reported resu	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Supp judg
Hollis 2016	Low risk of bias	Randomisation was conducted using a computer-generated block randomisation procedure (1:1 ratio) by an independent statistician and allocation was concealed. There are no major baseline differences to suggest a problem with randomisation. Randomisation occurred after	Low risk of bias	Participants likely knew they were in a trial because they provided verbal assent and their parents signed informed consent. There is nothing to suggest that there were deviations from the intended intervention due to the trial context. All intervention implementation strategies were	Low risk of bias	There is no information to suggest clusters dropped out of the study. The authors stated that 86% of the participants provided adiposity outcome data at 24 months. Sensitivity analysis found similar findings comparing	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by	Low risk of bias	A pre-s analysi reporte study p it does report detail b appear genera with m used/ r in the r paper. eviden sugges numeri result l have b selecte basis o from m

		recruitment of participants as the paper states it was following baseline data collection. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.		delivered as planned. Intention to treat analysis was used.		complete case to imputation.		knowledge of intervention, this is highly unlikely. According to the study protocol, the outcome was measured by researchers blinded to the group allocation.		eligible outcon measu There i sugges the sel the res based multipl analys

Risk of bias for analysis 2.7 Percentile medium term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of th reported result	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Suppo judger
Isensee 2018	Some concerns	Randomisation conducted with 2:3 ration using computer sequence generator. No details about concealment of allocation sequence. No baseline differences among schools. Schools were matched at ration of approximately 3:2 as specified in the methods. Slightly lower proportion of participants with consent in the control group, compared to the intervention (84% vs 89%). Parental consent was obtained after randomisation but prior to baseline measures collection; Parental consent could be affected by knowledge of assigned intervention; however, the number of non-participating children is	Low risk of bias	Participants likely knew they were in a trial because they provided verbal assent and their parents signed informed consent. The intervention group had an increase in out-of-school sports compared to baseline, but not the control, suggesting that the control group did not compensate with activities outside the trial suggestions; a modified intention to treat analysis was conducted.	High risk of bias	High concern over missing data (>10%) in both group but slightly higher in the control group; the authors reported that non completers had a less favourable weight status regarding BMI.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	No pre-specifiec statistica analysis protocol available evidence suggest numerica result lik have bee selected basis of from mu eligible outcome measure No sugge of select from mu analyses BMI but specifiec statistica analysis available compare

		similar in both group (5% difference).								

Risk of bias for analysis 3.1 BMI short term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Sele repo
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors judgeme
Bayne-Smith 2004	High risk of bias	There is not enough information given about the randomisation methods and whether there was allocation concealment to determine if it was appropriately conducted. No information is given about the order of recruitment and randomisation. It is unclear whether participants knew of the intervention assigned to the cluster. There were baseline imbalances, but these were primarily due to "Time constraints created by scheduling limitations in the schools limited the number of classes that could serve as controls"	Some concerns	Participants likely knew about the trial due to changes within their school day and intervention and control classes being in same school. Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention however there is no information to suggest that deviations to the intended intervention due to trial context occurred. No information about whether an intention to treat analysis was used but this is unlikely to have affected result as data are given for all participants and classes randomised.	Low risk of bias	There is no information to suggest clusters dropped out and data appears to be presented for all participants. Table 2 suggests data available for all participants	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Chen 2011	Some concerns	Randomisation by computer-generated random number assignment but convenience sampling used prior to randomisation. No information on concealment was reported. No baselines differences to suggest any issue with the randomisation method.	Some concerns	Participants were aware of intervention and not indication that researchers were not aware of assigned intervention. No indication of deviation but as researchers could monitor the login activity it is possible that any deviation due to lack of engagement with the assigned weekly activity would have been detected. No information regarding the	Some concerns	Some participants missing from intervention (3.7%) and from control (11%) but no baseline difference between participants loss to follow-up and the rest of the cohort. However, the trial is small, and we can't exclude that results are not biased given the difference in number of missing participants in intervention	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could	Some concerns

				analysis but it appears that all data were analysed according to the participants allocation group.		and control group.		be influenced by knowledge of intervention, this is highly unlikely.	
Dunker 2018	Some concerns	There is not enough information provided about randomisation to determine if the method used was appropriate, and allocation concealment is not detailed. Table 1 shows some baseline imbalances; however, these do not necessarily suggest a problem with the randomisation process. There were no significant differences between the intervention and control group in BMI, or between schools in BMI. Eligibility assessment and recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	Participants were aware of their participation in the trial and of the intervention and it is likely carers/those delivering it were too. There is no information to suggest deviations from intended interventions due to trial context took place. The study used an intention-to-treat analysis.	Some concerns	There is no information to suggest clusters dropped out of the study. Missing data was fairly balanced across groups (83% vs 86%) suggests it may not be due to the true value. There is no evidence the result was not biased by missing data. Missingness in the outcome could depend on its true value. However, the authors suggest it is likely to be explained by the program being offered after school hours and the fact that most teenagers in the sample come from low-income families. Other reasons listed in Figure 1 including changing schools, skipping school, declining to complete questionnaires.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Leme 2018	Low risk of bias	Randomisation was conducted by randomly selecting individual small, folded papers from a plastic bag; there are no details about allocation concealment, but this should not have affected the randomisation process as it was conducted by an individual not involved in the study; schools were match-paired (5 pairs of schools)	Low risk of bias	Participants knew about the trial from providing written informed consent. No deviation was reported, and some measures were taken to avoid contamination. An intention to treat analysis was conducted.	Some concerns	Al schools were retained at follow-up. All of the but 24.9% did not participate in the post-intervention assessments such that 75.4% and 74.8% girls were retained in intervention and control groups, respectively. Reasons are provided and we have no reason to suspect missingness	Low risk of bias	Outcome assessors were blinded to assigned allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI.	Low risk o bias

		based on geographic location, size, and demographics. Recruitment and baseline assessments were conducted prior to randomisation.				depended on true value of the outcome. No information about how missing data were handled.			
Neumark-Sztainer 2003	High risk of bias	No information about method of randomisation or concealment. No differences in the number of clusters in each group. Immediately following study school assignment, recruitment of intervention and control school participants began. Although schools were randomly assigned to conditions, because of logistical and scheduling issues, girls were recruited after the schools were randomised. Thus, girls in the intervention schools knew that they were enrolling in an alternative physical education class and this could have affected their decision to take part in the study. Girls were recruited based on their weight, and some difference was observed in baseline BMI, ethnicity and age between the two intervention groups.	Some concerns	Due to the nature of the intervention participants and carers were aware of their group assignment. No information on deviation from intended intervention, but we have no reason to suspect that deviation from intended intervention occurred. No information provided on whether statistical analysis was conducted according to an intention to treat base.	Some concerns	At the 8 months follow-up, 88% in control schools and 89% in intervention schools were retained. Reasons for attrition included moving out of the school district/state, suspension from school, drug rehabilitation, severe illness, and no shows/refusals. The author reported that responders and non-responders did not differ at baseline across age, race/ethnicity, and BMI. Missingness in the outcome could depend on its true value, as some people dropped out due to health problems.	High risk of bias	No information of methods of measurement of outcomes but weight and heights were self-reported. Girls with higher BMI may have reported lower values because of the stigma of being overweight/obese	Some concerns
Neumark-Sztainer 2010	Some concerns	The journal article states the study used a 'group-randomised controlled design' and 'high schools were recruited into the study on the condition that they would participate as either control or intervention	Low risk of bias	Participants knew they were in a trial due to signing assent/ consent. They also completed process evaluation. It is likely participants were aware of their assigned intervention due to receiving a new	Low risk of bias	There were no missing data from the participants in the intervention and data were available from 94% of the participants in the control group.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew	Some concerns

		sites and were randomised into these conditions'. The trial registry notes it is randomised. However, there is no description of the random component used or allocation concealment. There were no major baseline differences between groups, beyond what would be expected by chance. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.		curriculum for physical education on top of their normal classes (or not, in the case of the control) and signing consent to take part in the new class. No information is provided about deviations from the intended intervention due to the trial context but no reason to suspect these occurred. It seems like modified intention to treat analysis was used.				the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	
Peralta 2009	Some concerns	Randomisation conducted by computer-based number producing algorithm, no information about concealment implementation. No baseline differences were reported.	Low risk of bias	Participants knew they were in a trial due to signing assent/consent. Due to the nature of the intervention, students and staff were not blinded to their school's group allocation, however, the intervention components were not detailed specifically to them. No information is provided about deviations from the intended intervention due to the trial context but no reason to suspect these occurred. No details regarding whether an intention to treat analysis was used but we have no reason to suspect that participants data were not analysed in accordance to	Low risk of bias	One participant was loss-to follow up from the control group (97% retention), but a complete dataset was included in the analysis; it is not clear what method was used for imputation of the data from the missing participant, but the level of attrition is relatively low.	Low risk of bias	Trained independent assessors, blind to group allocation, conducted the measurements following standardized protocols. The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI.	Some concerns

				allocated intervention.					
Schreier 2013	Some concerns	Randomisation was conducted using an appropriate method but there is no information about allocation concealment. There were no baseline differences to suggest a problem with the randomisation process.	Low risk of bias	Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. There is no information to suggest that deviations to the intended intervention due to trial context occurred. The participants flow-chart suggests that a modified intention-to-treat analysis was used.	Some concerns	Data were available for 80% in intervention and 89% in control. There is no evidence the result was not biased by missing data. Missingness could depend on the true value. Slightly more participants dropped out from the intervention group than from the control, however most of these dropped out of school completely and one moved to another city, suggesting the majority of missing data would not have been due to BMI.	Low risk of bias	There is no mention of research assistants who measured height and weight being blinded to allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Singh 2009	Some concerns	Participants were randomised but no information provided about allocation concealment. There were some baseline differences, but these could be compatible with chance. Recruitment happened prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	Participants knew they were in a trial, and it is likely participants and those delivering interventions/ caring for participants were aware of at least some part of the assigned intervention due to additional elements to their classes. No deviations from the intended intervention are mentioned and the authors mentions teachers found it demanding but also that 'the compliance rate among adolescents was relatively high and possibly in part due to the motivation of the participating schools and teachers'. All analyses were performed	Some concerns	Data were missing from 6.9% of the participants in the intervention schools and 11.6% from participants in the control schools. There is no evidence the result was not biased by missing data. Missingness in the outcome could depend on its true value. Reasons given for missing data include: 'sick' (high proportion of people noted as having this reason for missing data), 'medical appointment', 'changed to a different school or class', 'refused to participate', 'unknown reason' (quite a high proportion of people noted as having this reason). This information is	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias

				according to the intention-to-treat principle. Missing values were not imputed.		not solid to rule out it is depending on its true value, particularly as some of these reasons are vague. However, we think it is probably unlikely that missing data is related to the true value, and it is also fairly balanced between groups.			
Wieland 2018	Some concerns	Randomisation was conducted by computer software; do details about concealment are reported. Randomisation status was revealed to participants and research staff only after completion of baseline measurements. There were some differences in the number of clusters (families: 25 and 19) but the number of participants in each group was similar. Randomisation status was revealed to participants and research staff only after completion of baseline measurements. Baseline reported for intervention and control group together. The authors reported that no significant demographic differences or baseline differences were found between the 2 groups for any primary or secondary outcome measure, with the exception of more Hispanic adolescents in the early intervention group, but such differences are	Low risk of bias	Participants were aware of being in the trial and the authors reported that the intervention group assignments could not be masked to interventionists and participants because of the logistical need for coordination among families. However, group assignments were masked to data managers and analysts throughout the study. It is unlikely that deviation from the intended intervention occurred. Based on the participants flow-chart, a modified intention to treat analysis was conducted as 2/25 families that did not receive the intervention were excluded from the analysis.	Some concerns	All families that received the intervention were included in the analysis and two families from control group were missing with no reason given. Data were missing from 11% of the participants. The author report that missing data imputation was performed but data are not presented "Missing data were managed with simple imputation methods, including last, minimum, average, or maximum value carried forward, followed by multiple imputation methods to assess the robustness of study results when data were missing."	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias

		presumably due to chance.							
Wilksch 2015	Some concerns	The article does not give details on the random component used, or any information regarding allocation concealment. The size of clusters differed, and the allocation ratio was not outlined. They note 'significant differences between groups for girls on regular eating and BMI'. However, it is possible this is due to chance. Recruitment took place prior to randomisation, students completed baseline measures, then allocation took place. Though there are baseline differences, it does not seem like these suggest differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	It is likely participants knew they were in a trial and were aware of their assigned intervention because their parents signed consent and they completed baseline questionnaires and health assessments, and they received their allocated intervention for four weeks. Those delivering the intervention were aware of participants' assigned intervention. No information given regarding deviation from the intended interventions due to trial context but no reason to suspect these occurred. Participants flowchart shows an intention to treat analysis was used.	Some concerns	Data appears to be available from all clusters. There is no information provided about the amount of missing data within clusters at 6-months. The authors do not use methods to correct for bias from missing data or conduct sensitivity analysis. They do note that 'The proportion of missing data was consistent across the four groups and logistic regression analyses showed there were no baseline differences on our primary outcome variables between participants who completed a minimum of three waves of data collection and those who did not." Due to this, although missingness could depend on its true value, it seems unlikely.	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

Risk of bias for analysis 3.2 BMI medium term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Sele repo
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors judgeme
Brito Beck da Silva 2019	Some concerns	The journal article states that schools were randomised but there is no information about the random component used, and no information about allocation concealment. Eligibility assessment and recruitment took place prior	Low risk of bias	Participants likely knew they were in a trial because they signed informed consent. There is no information to suggest deviations from intended interventions due to trial context took place. A modified intention-to-	Some concerns	It is not stated whether data were available from all clusters (12 schools) that recruited participants, and data were available for 66.6% and 67.2% of the participants in the intervention and control groups. There is no evidence the result was not biased by missing data. Missingness in the outcome	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking	Some concerns

		to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. Groups are similar in size. There were more obese participants in the intervention group at baseline, but this could be due to chance. Full classes were invited and randomised so unlikely to be differentially selected.		treat analysis was used.		could depend on its true value. The authors note that weight did differ significantly between dropouts and completers. However, missingness was even across groups. Also, school dropout is listed as a reason for missing data. It therefore seems unlikely to be linked to BMI.		place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	
Dewar 2013	Low risk of bias	Schools were paired-matched on their geographical location, size and demographics and then randomised to either the NEAT Girls intervention or a wait list control group by coin tossing. No information about concealment of allocation prior to start of the intervention, however randomisation was conducted by a researcher that was independent from the study and there is no reason to suspect that bias was introduced by lack of concealment. No difference in number of clusters allocated to each school and number of participants in each group is similar. Baseline assessments were conducted prior to randomisation	Low risk of bias	Due to the nature of the intervention participants and carers were aware of their group assignment. Not all students implemented the intervention but there is no reason to suspect that other forms of deviation arose from the trial context. Statistical analyses followed the intention-to-treat principle.	Some concerns	All schools and all students were included in the analysis, but no missing data imputation was performed. 85.5% and 79.2% girls were retained in the control and intervention groups, respectively. Reason for missingness in both groups was absence on testing day, leaving the school an refusal to be measured in both groups. Attrition due to refusal to be measured and absence on day of measurement was higher in intervention group (10.1%) than in the group (5.6%), and these that refused to be measured had higher BMI at baseline suggesting that missingness may be related to the outcome.	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Data collection took place in the study schools and was conducted by trained research assistants blinded to group allocation at baseline only. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias

		by research assistants who were blinded to treatment allocation. No baseline difference in individual participants.							
Haerens 2006	Some concerns	The article reports that the schools were randomly assigned to one of the two intervention groups or control group, but not details of randomisation method are provided, neither if the allocation was concealed. There was no unbalance in the number of clusters/groups. It is not clear if all students in each school were considered eligible to take part in the study before or after randomisation. Parents had to give consent for the children to participate in the study, but it is not clear if this was before or after randomisation. Some variability in size of the groups due to randomisation. Baseline difference in boys/girls ratio, SES (lower percent of low SES in control group) and in zBMI (lower in control group). All analysis were adjusted for baseline values, age and SES.	Low risk of bias	Consent was requested to the parents. Due to the nature of the intervention participants and carers were aware of their group assignment. Process evaluation measures were put in place to monitor the level of implementation of the interventions. No information provided on statistical analysis but no reason to suspect that deviation from intended intervention occurred.	Some concerns	Serious concerns over a higher proportion of missing data in the intervention group that may be related to the true value of the outcome. Data at follow-up are available from 73% of the intervention group and 89% of the control group. No reasons given for participants dropping out of study. Data from participants with no data at follow-up were not imputed in the analysis and there is no statistical evidence that results are not biased my missing data. Higher attrition in the intervention groups suggests that missing data may be related to BMI values at follow-up in this group.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Leme 2018	Low risk of bias	Randomisation was conducted by randomly selecting individual small, folded papers from a plastic bag; there are no details about allocation concealment, but this should not have	Low risk of bias	Participants knew about the trial from providing written informed consent. No deviation was reported, and some measures were taken to avoid contamination. An intention to	Some concerns	Al schools were retained at follow-up 62.7% and 49.6% of the girls were retained in the intervention and control groups at 12 months follow-up, respectively. High attrition in both groups and more than 10% difference	Low risk of bias	Outcome assessors were blinded to assigned allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The	Low risk o bias

		affected the randomisation process as it was conducted by an individual not involved in the study; schools were match-paired (5 pairs of schools) based on geographic location, size, and demographics. Recruitment and baseline assessments were conducted prior to randomisation.		treat analysis was conducted.		between the groups, however, no significant differences were found between retained and dropped girls in relation to sociodemographic characteristics.		height and weight measurements are used to produce BMI.	
Neumark-Sztainer 2010	Some concerns	The journal article states the study used a 'group-randomised controlled design' and 'high schools were recruited into the study on the condition that they would participate as either control or intervention sites and were randomised into these conditions'. The trial registry notes it is randomised. However, there is no description of the random component used or allocation concealment. There were no major baseline differences between groups, beyond what would be expected by chance. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	Participants knew they were in a trial due to signing assent/ consent. They also completed process evaluation. It is likely participants were aware of their assigned intervention due to receiving a new curriculum for physical education on top of their normal classes (or not, in the case of the control) and signing consent to take part in the new class. No information is provided about deviations from the intended intervention due to the trial context but no reason to suspect these occurred. It seems like modified intention to treat analysis was used.	Low risk of bias	Data were available from 97% of participants in the intervention and from 91% of participants in the control group.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Singh 2009	Some concerns	Participants were randomised but no information	Low risk of bias	Participants knew they were in a trial, and it is likely	Some concerns	Data were missing from 17% of the participants in the intervention	Low risk of bias	The measurements were conducted by	Low risk o bias

		provided about allocation concealment. There were some baseline differences, but these could be compatible with chance. Recruitment happened prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.		participants and those delivering interventions/ caring for participants were aware of at least some part of the assigned intervention due to additional elements to their classes. No deviations from the intended intervention are mentioned and the authors mentions teachers found it demanding but also that 'the compliance rate among adolescents was relatively high and possibly in part due to the motivation of the participating schools and teachers'. All analyses were performed according to the intention-to-treat principle. Missing values were not imputed.		schools and 15.4% from participants in the control schools. There is no evidence the result was not biased by missing data. Missingness in the outcome could depend on its true value. Reasons given for missing data include: 'sick' (high proportion of people noted as having this reason for missing data), 'medical appointment', 'changed to a different school or class', 'refused to participate', 'unknown reason' (quite a high proportion of people noted as having this reason). This information is not solid to rule out it is depending on its true value, particularly as some of these reasons are vague. However, we think it is probably unlikely that missing data is related to the true value, and it is also fairly balanced between groups.		researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	
Wieland 2018	Some concerns	Randomisation was conducted by computer software; do details about concealment are reported. Randomisation status was revealed to participants and research staff only after completion of baseline measurements. There were some differences in the number of clusters (families: 25 and 19) but the number of participants in each group was similar. Randomisation status was revealed to participants and research staff only after completion of	Low risk of bias	Participants were aware of being in the trial and the authors reported that the intervention group assignments could not be masked to interventionists and participants because of the logistical need for coordination among families. However, group assignments were masked to data managers and analysts throughout the study. It is unlikely that deviation from the intended intervention occurred. Based on the participants	Some concerns	All families that received the intervention were included in the analysis and two families from control group were missing with no reason given. Data were missing from 19% of the participants. The author report that missing data imputation was performed but data are not presented "Missing data were managed with simple imputation methods, including last, minimum, average, or maximum value carried forward, followed by multiple imputation methods to assess the robustness of study results when	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by	Low risk o bias

		baseline measurements. Baseline reported for intervention and control group together. The authors reported that no significant demographic differences or baseline differences were found between the 2 groups for any primary or secondary outcome measure, with the exception of more Hispanic adolescents in the early intervention group, but such differences are presumably due to chance.		flow-chart, a modified intention to treat analysis was conducted as 2/25 families that did not receive the intervention were excluded from the analysis.		data were missing."		knowledge of intervention, this is highly unlikely.	
Wilksch 2015	Some concerns	The article does not give details on the random component used, or any information regarding allocation concealment. The size of clusters differed, and the allocation ratio was not outlined. They note 'significant differences between groups for girls on regular eating and BMI'. However, it is possible this is due to chance. Recruitment took place prior to randomisation, students completed baseline measures, then allocation took place. Though there are baseline differences, it does not seem like these suggest differential identification or recruitment of individual participants between intervention groups.	Low risk of bias	It is likely participants knew they were in a trial and were aware of their assigned intervention because their parents signed consent and they completed baseline questionnaires and health assessments, and they received their allocated intervention for four weeks. Those delivering the intervention were aware of participants' assigned intervention. No information given regarding deviation from the intended interventions due to trial context but no reason to suspect these occurred. Participants flowchart shows an intention to treat analysis was used.	Some concerns	Data appears to be available from all clusters. There was 20% missing data in the intervention group as data available for 80% of Life Smart and 74% of control at the 12-month follow up. The authors do not use methods to correct for bias from missing data or conduct sensitivity analysis. They do note that 'The proportion of missing data was consistent across the four groups and logistic regression analyses showed there were no baseline differences on our primary outcome variables between participants who completed a minimum of three waves of data collection and those who did not: weight concerns. Due to this, although missingness could depend on its true value, it seems unlikely.	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

Risk of bias for analysis 3.3 BMI long term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Sele repo
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Author judgeme
Andrade 2014	Low risk of bias	The allocation conducted using a random number generation with random allocation of the intervention within each pair of school matched for important characteristics. There is no information provided about allocation concealment, but it is unlikely that allocation was known to trialist prior to assignment of the next pair. There were equal number of intervention and control schools with similar sample size, and comparable baseline characteristics. The 10 pairs of schools were randomly selected with random allocation of the intervention within each pair and two grades were randomly selected within each school and all students in those grades were invited to participate. It appears that individuals were invited to take part after randomisation of the clusters. It is not likely that selection of individual participants was affected by knowledge of the intervention assigned to the cluster. The whole grades were invited to take part, and there are no major differences in the groups. No major baseline	Low risk of bias	Participants were aware they were in a trial and signed informed assent "Only adolescents with a signed written consent from their parents/guardians and an informed assent signed by themselves were included in the final sample." Participants, carers and those delivering the intervention were likely aware of the assigned intervention due to the nature of it. However, they do say "Adolescents and school staff were not aware about the existence of a counterfactual school." There is no information to suggest that deviations to the intended intervention due to trial context occurred. "An intention-to-treat analysis was performed to evaluate the intervention effect."	Some concerns	Data available for all the schools that recruited participants. 22% and 24.5% of participants withdrew from intervention and control schools, respectively. However missing data analysis showed no major differences. Missingness in the outcome could potentially depend on its true value. However, it is unlikely because the reasons for missing data were primarily students changing school. One school had a high dropout rate related to poor academic performance and drug misuse, and this does not seem related to zBMI.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		imbalances to suggest differential identification or recruitment of individual participants between intervention groups. The 10 intervention and 10 control clusters had similar sample size. zBMI is similar in each at baseline so no suggestion that this influenced randomisation.							
Bonsergent 2013	Some concerns	No information is provided about allocation concealment or specific randomisation process, but due to it being a large 2x2x2 factorial cluster design it seems likely it would be computerised and concealed. There are no major baseline differences between intervention groups. It is unclear whether participants consented before or after randomisation and whether participants knew of the intervention assigned to the cluster. It is unlikely trial personnel were influenced by this as full grade in schools were randomised. No baseline imbalances to suggest these issues with randomisation.	Low risk of bias	No information provided to suggest whether there were deviations from the intended intervention due to trial context. A full analysis set was performed according to intention-to-treat including also non-completers.	Some concerns	All high schools included in the PRALIMAP trial completed the 2-year interventions. 66% of the participants gave data at the end of the interventions. A sensitivity analysis including also non-completers was conducted showing that the results were not biased by missing data.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk o bias
Dewar 2013	Low risk of bias	Schools were paired-matched on their geographical location, size and demographics and then randomised to either the NEAT Girls intervention or a wait list control group	Low risk of bias	Due to the nature of the intervention participants and carers were aware of their group assignment. Not all students implemented the intervention but there is no reason to suspect that other forms of deviation arose	Some concerns	All schools and all students were included in the analysis, but no missing data imputation was performed. 80.4% and 80.8% girls were retained in the control	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to	Low risk o bias

		by coin tossing. No information about concealment of allocation prior to start of the intervention, however randomisation was conducted by a researcher that was independent from the study and there is no reason to suspect that bias was introduced by lack of concealment. No difference in number of clusters allocated to each school and number of participants in each group is similar. Baseline assessments were conducted prior to randomisation by research assistants who were blinded to treatment allocation. No baseline difference in individual participants.		from the trial context. Statistical analyses followed the intention-to-treat principle.		and intervention groups, respectively. Reason for missingness in both groups was absence on testing day, leaving the school and refusal to be measured in both groups. Attrition due to refusal to be measured and absence on day of measurement was higher in intervention group (10.1%) than in the group (5.6%).		produce BMI. Data collection took place in the study schools and was conducted by trained research assistants blinded to group allocation at baseline only. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	
Ezendam 2012	Low risk of bias	The allocation sequence was random. No method of allocation concealment given but the author reported that 'Allocation was concealed until the start of the intervention'. This seems plausible due to the use of a random-number generator. Baseline differences were unlikely to suggest a problem with the randomisation process. There were more schools and participants in the intervention than the control (11 schools and 485 participants vs 9 schools and	Low risk of bias	Participants were aware they were in a trial. Participants and those delivering the interventions (mainly teachers) were aware of their assigned intervention during the trial because 'allocation was concealed until the start of the intervention'. No information provided about deviations from the intended intervention, but no reason to suspect these occurred. Appropriate analysis used because the journal article states they used 'complete case analyses and intention-to-treat analyses using baseline observation carried forward	Low risk of bias	Data was not available for 3 of the 23 schools randomised (13%). However, these clusters did not recruit participants because participants found 'the informed consent procedure as troublesome'. All other schools that had been recruited provided data. Therefore, we have marked that data was available for all clusters that recruited participants. BMI data not available for nearly all participants within clusters. An intention-to-treat	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

			398 participants) - due to 3 control schools dropping out after randomisation but before baseline measurement and before they knew of their group allocation. These imbalances could be due to chance and influenced by the 3 control schools dropping out pre-allocation due to not signing consent, rather than due to problems with randomisation. It is probable that individual participants were identified and recruited before randomisation of clusters, though it is not entirely clear. Figure 1 shows recruitment took place prior to randomisation of the 23 schools. However, 3 schools then dropped out of the control group after randomisation due to finding the informed consent process 'troublesome', which seems to suggest that some participants were still completing consent after randomisation, though they had been identified and recruitment started before. These participants did not know of their allocation. There are baseline imbalances, but these do not suggest differential identification/		and last observation carried forward procedures'.		analysis was conducted with imputation with BOCF and LOCF procedures. This found only few differences compared to complete case analysis, suggesting the result was not biased.				

		recruitment of individual participants between groups. It is likely to be more related to the 3 control schools dropping out.							
Haerens 2006	Some concerns	The article reports that the schools were randomly assigned to one of the two intervention groups or control group, but not details of randomisation method are provided, neither if the allocation was concealed. There was no unbalance in the number of clusters/groups. It is not clear if all students in each school were considered eligible to take part in the study before or after randomisation. Parents had to give consent for the children to participate in the study, but it is not clear if this was before or after randomisation. Some variability in size of the groups due to randomisation. Baseline difference in boys/girls ratio, SES (lower percent of low SES in control group) and in zBMI (lower in control group). All analysis were adjusted for baseline values, age and SES.	Low risk of bias	Consent was requested to the parents. Due to the nature of the intervention participants and carers were aware of their group assignment. Process evaluation measures were put in place to monitor the level of implementation of the interventions. No information provided on statistical analysis but no reason to suspect that deviation from intended intervention occurred.	High risk of bias	All Schools were included in the analysis. Missing data from each group due to absence on the day of measurements or due to school change. Attrition is balanced across the three groups: (22%;21%; and 22% of missing data), however, there was some difference between completers and not-completers at 2 years follow-up: "Pupils not participating at follow-up were significantly older and consumed significantly more soft drinks then pupils participating at follow-up."	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Singh 2009	Some concerns	Participants were randomised but no information provided about allocation concealment. There were some baseline differences, but these could be compatible with chance.	Low risk of bias	Participants knew they were in a trial and it is likely participants and those delivering interventions/ caring for participants were aware of at least some part of the assigned intervention due to additional	Some concerns	Data were missing from 21% of the participants in the intervention schools and 17.6% from participants in the control schools. There is no evidence the result was	Low risk of bias	The measurements were conducted by researchers who were not blinded to group assignment. They would have known the trial was taking place.	Low risk o bias

		Recruitment happened prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups.		elements to their classes. No deviations from the intended intervention are mentioned and the authors mentions teachers found it demanding but also that 'the compliance rate among adolescents was relatively high and possibly in part due to the motivation of the participating schools and teachers'. All analyses were performed according to the intention-to-treat principle. Missing values were not imputed.		not biased by missing data. Missingness in the outcome could depend on its true value. Reasons given for missing data include: 'sick' (high proportion of people noted as having this reason for missing data), 'medical appointment', 'changed to a different school or class', 'refused to participate', 'unknown reason' (quite a high proportion of people noted as having this reason). This information is not solid to rule out it is depending on its true value, particularly as some of these reasons are vague. However, we think it is probably unlikely that missing data is related to the true value, and it is also fairly balanced between groups.		The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 3.4 zBMI short term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Select report
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement
Leme 2018	Low risk of bias	Randomisation was conducted by randomly selecting individual small, folded papers from a plastic bag; there are no details about allocation concealment, but this should not have affected the randomisation process as it was conducted by an individual not involved in the study;	Low risk of bias	Participants knew about the trial from providing written informed consent. No deviation was reported, and some measures were taken to avoid contamination. An intention to treat analysis was conducted.	Some concerns	Al schools were retained at follow-up. All of the but 24.9% did not participate in the post-intervention assessments such that 75.4% and 74.8% girls were retained in intervention and control groups, respectively. Reasons are	Low risk of bias	Outcome assessors were blinded to assigned allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI.	Low risk of bias

		schools were match-paired (5 pairs of schools) based on geographic location, size, and demographics. Recruitment and baseline assessments were conducted prior to randomisation.				provided and we have no reason to suspect missingness depended on true value of the outcome. No information about how missing data were handled.			
NCT02067728 2014	High risk of bias	No details on randomisation or concealment and limited details on baseline characteristics. The study data are reported within the trial registration and limited information is provided. No description of timing of recruitment of participants in relation to randomisation of clusters. Participants were aware that their health care provider is giving them additional support on preventing obesity might engage more with the intervention. There were no differences in baseline data.	High risk of bias	Serious concern regarding the lack of information on deviation from intended intervention and on the analytical approach, as it not clear if an intention to treat analysis was conducted. Data reported in the trial register and details on the methodology are limited.	High risk of bias	Serious concerns over missing data from 50% of the participants but there are no details of the exact parent of missing data in the results of the older age group reported in this review.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	High risk of bias
Reesor 2019	High risk of bias	Serious concern over the randomisation method. No details given for Reesor 2019 study. Johnston 2007 reports the following but unclear if applies to current study: “statistical consultant generated the random allocation sequence using SPSS 13 statistical software (SPSS Inc, Chicago, IL). An unbalanced randomisation (ie, a greater	Some concerns	Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. Parents signed informed consent; children provided assent. There is no information to suggest that deviations to the intended intervention due to trial context occurred. No information is	High risk of bias	It is unclear whether there was missing data as there are no information about missing data is provided and there is no evidence the result was not biased by missing data	Low risk of bias	Measurements are unlikely to have differed because they were conducted by trained research staff using standardised protocols. There is no mention of research assistants who measured height and weight being blinded to allocation. The measurement of height and weight by researchers, using standardised measures, is relatively	Some concerns

		number of participants were assigned to the second condition) was used. This is an accepted strategy when the intervention is anticipated to have a positive benefit, thereby reducing the number of participants exposed to the control condition". zBMI score at baseline different between groups (higher in intervention group).		given about whether intention-to-treat analysis was used - no participants flow chart or information about no participants randomised at baseline. There could have been impact on the result if the participants were not analysed according to their allocated group, but it is unclear if this happened.				robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

Risk of bias for analysis 3.5 zBMI medium term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selec repor
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgemen
Black 2010	Some concerns	Participants were allocated to intervention or control groups by stratified randomisation but there is no information regarding method of randomisation or allocation concealment. It is unlikely that differences between intervention groups at baseline suggest a problem with the randomisation process - differences could be compatible with chance.	Low risk of bias	Participants would have been aware of their assigned intervention due to signing written assent and consent and taking part in the 12-session intervention: 'Written informed assent and consent were obtained and participants were compensated for evaluations'. Researchers were not aware of the assigned intervention: 'Research assistants were unaware of participants' intervention status or baseline findings'. Deviations arose as 'there was variability in adolescents' participation' but there no information given as to whether these were due to the trial context,	Some concerns	Missing outcome data for 25% of the intervention group and 18.4% of the control group, and there is no evidence that the result was not biased by this. Missingness could have been due to BMI, however the journal article states that 'there were no differences in retention by group assignment, baseline overweight/obese status, PA or dietary intake', therefore it is unlikely.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

				and no reason to suspect it was. Authors say intention-to-treat analyses were used. Table 2 suggests this was modified intention-to-treat.					
Dewar 2013	Low risk of bias	Schools were paired-matched on their geographical location, size and demographics and then randomised to either the NEAT Girls intervention or a wait list control group by coin tossing. No information about concealment of allocation prior to start of the intervention, however randomisation was conducted by a researcher that was independent from the study and there is no reason to suspect that bias was introduced by lack of concealment. No difference in number of clusters allocated to each school and number of participants in each group is similar. Baseline assessments were conducted prior to randomisation by research assistants who were blinded to treatment allocation. No baseline difference in individual participants.	Low risk of bias	Due to the nature of the intervention participants and carers were aware of their group assignment. Not all students implemented the intervention but there is no reason to suspect that other forms of deviation arose from the trial context. Statistical analyses followed the intention-to-treat principle.	Some concerns	All schools and all students were included in the analysis, but no missing data imputation was performed. 85.5% and 79.2% girls were retained in the control and intervention groups, respectively. Reason for missingness in both groups was absence on testing day, leaving the school and refusal to be measured in both groups. Attrition due to refusal to be measured and absence on day of measurement was higher in intervention group (10.1%) than in the group (5.6%), and these that refused to be measured had higher BMI at baseline suggesting that missingness may be related to the outcome.	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Data collection took place in the study schools and was conducted by trained research assistants blinded to group allocation at baseline only. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk of bias
French 2011	Some concerns	Journal article states that households were randomised but no information is provided about the random component used, nor the	Low risk of bias	Households volunteered to take part in the trial and would have been aware they were in a trial due to contact with trialists and the nature of the	Some concerns	One household in the control group and two households in the intervention group were lost to follow up and therefore data were not available. 96% of the households completed the	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight	Some concerns

			process of randomisation. No information regarding allocation concealment. No evidence to suggest baseline imbalances suggest problem with randomisation process. Participants were identified, assessed for eligibility, completed baseline measures and then households were randomised to the intervention or control groups. No baseline imbalances to suggest differential identification or recruitment of individual participants between intervention groups.		intervention delivered. It seems there was a primary contact at each household, so it is possible others in the household were not aware, though this is unlikely as they all needed to attend sessions and complete questionnaires. The households had to be willing to be randomised to active intervention or control group. The journal article states that 'HHs randomised to the control group were informed of their group assignment'. It is likely those in the intervention group were aware due to the components of the intervention such as weighing themselves and the limit on tv time. Some research staff would have been aware of participants' assigned intervention, as they informed households randomised to the control group of their group assignment. It is not clear if all people delivering the intervention components were aware (i.e. those running group sessions), but it seems likely as they were 'trained research intervention staff'. No information provided to determine if there were deviations from the intended intervention that arose because of trial		follow-up clinic data collection. There is no information provided about whether this means all adolescents within each household, or not. Individual adolescent data for zBMI at follow up not reported. There is no evidence that the result was not biased by missing data. Missingness in the outcome could depend on its true value. No information is provided regarding the reasons that households dropped out of the study. Missingness does not differ greatly between groups (1 cluster in control, 2 in intervention). It seems unlikely that it would be due to BMI. The authors suggested that it may be more likely to be because 'some were less enthusiastic than others about reducing TV viewing and changing eating habits.		measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	

				context. The journal article states 'about 20% of households had perfect attendance and home activity completion rates' however we would think this is likely to be due to real-world reasons rather than specifically due to trial context. Modified intention to treat analysis was used.					
Haerens 2006	Some concerns	The article reports that the schools were randomly assigned to one of the two intervention groups or control group, but not details of randomisation method are provided, neither if the allocation was concealed. There was no unbalance in the number of clusters/groups. It is not clear if all students in each school were considered eligible to take part in the study before or after randomisation. Parents had to give consent for the children to participate in the study, but it is not clear if this was before or after randomisation. Some variability in size of the groups due to randomisation. Baseline difference in boys/girls ratio, SES (lower percent of low SES in control group) and in zBMI (lower in control group). All analysis were adjusted for baseline values, age and SES.	Low risk of bias	Consent was requested to the parents. Due to the nature of the intervention participants and carers were aware of their group assignment. Process evaluation measures were put in place to monitor the level of implementation of the interventions. No information provided on statistical analysis but no reason to suspect that deviation from intended intervention occurred.	Some concerns	Serious concerns over a higher proportion of missing data in the intervention group that may be related to the true value of the outcome. Data at follow-up are available from 73% of the intervention group and 89% of the control group. No reasons given for participants dropping out of study. Data from participants with no data at follow-up were not imputed in the analysis and there is no statistical evidence that results are not biased my missing data. Higher attrition in the intervention groups suggests that missing data may be related to BMI values at follow-up in this group.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Leme 2018	Low risk of bias	Randomisation was conducted	Low risk of bias	Participants knew about the	Some concerns	Al schools were retained at follow-	Low risk of bias	Outcome assessors	Low risk of bias

		by randomly selecting individual small, folded papers from a plastic bag; there are no details about allocation concealment, but this should not have affected the randomisation process as it was conducted by an individual not involved in the study; schools were match-paired (5 pairs of schools) based on geographic location, size, and demographics. Recruitment and baseline assessments were conducted prior to randomisation.		trial from providing written informed consent. No deviation was reported and some measures were taken to avoid contamination. An intention to treat analysis was conducted.		up 62.7% and 49.6% of the girls were retained in the intervention and control groups at 12 months follow-up, respectively. High attrition in both groups and more than 10% difference between the groups, however, no significant differences were found between retained and dropped girls in relation to sociodemographic characteristics.		were blinded to assigned allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI.	
Reesor 2019	High risk of bias	Serious concern over the randomisation method. No details given for Reesor 2019 study. Johnston 2007 reports the following but unclear if applies to current study: “statistical consultant generated the random allocation sequence using SPSS 13 statistical software (SPSS Inc, Chicago, IL). An unbalanced randomisation (ie, a greater number of participants were assigned to the second condition) was used. This is an accepted strategy when the intervention is anticipated to have a positive benefit, thereby reducing the number of participants exposed to the control condition”. zBMI score at baseline	Some concerns	Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. Parents signed informed consent; children provided assent. There is no information to suggest that deviations to the intended intervention due to trial context occurred. No information is given about whether intention-to-treat analysis was used - no participants flow chart or information about no participants randomised at baseline. There could have been impact on the result if the participants were not analysed according to their allocated group, but it is	High risk of bias	It is unclear whether there was missing data as there are no information about missing data is provided and there is no evidence the result was not biased by missing data	Low risk of bias	Measurements are unlikely to have differed because they were conducted by trained research staff using standardised protocols. There is no mention of research assistants who measured height and weight being blinded to allocation. The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		different between groups (higher in intervention group).		unclear if this happened.					

Risk of bias for analysis 3.6 zBMI long term

Study	Bias								
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Sel rep
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Author judgem
Andrade 2014	Low risk of bias	The allocation conducted using a random number generation with random allocation of the intervention within each pair of school matched for important characteristics. There is no information provided about allocation concealment, but it is unlikely that allocation was known to trialist prior to assignment of the next pair. There were equal number of intervention and control schools with similar sample size, and comparable baseline characteristics. The 10 pairs of schools were randomly selected with random allocation of the intervention within each pair and two grades were randomly selected within each school and all students in those grades were invited to participate. It appears that individuals were invited to take part after randomisation of the clusters. It is not likely that selection of individual participants was affected by knowledge of the intervention assigned to the cluster. The whole grades	Low risk of bias	Participants completed informed assent forms and were aware of the interventions being undertaken. Medical doctors, nutritionists and health professionals involved in the study as outcome assessors were aware of the assigned intervention. The journal article does not state any blinding took place. No details are provided regarding deviations. It is unlikely deviations arose due to trial context because entire schools were randomised as clusters preventing contamination and research staff met with school staff every two to three weeks to monitor progress. 'An intention-to-treat analysis was performed to assess the intervention effect using mixed linear regression models with the pair matching as random effect'	Some concerns	Data available for all the schools that recruited participants. 150 and 207 participants withdrew from intervention and control schools, respectively. However missing data analysis showed no major differences. Missingness in the outcome could potentially depend on its true value. However, it is unlikely because the reasons for missing data were primarily students changing school. One school had a high dropout rate related to poor academic performance and drug misuse, and this does not seem related to zBMI.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		were invited to take part, and there are no major differences in the groups. No major baseline imbalances to suggest differential identification or recruitment of individual participants between intervention groups. The 10 intervention and 10 control clusters had similar sample size. zBMI is similar in each at baseline so no suggestion that this influenced randomisation.							
Black 2010	Some concerns	Participants were allocated to intervention or control groups by stratified randomisation but there is no information regarding method of randomisation or allocation concealment. It is unlikely that differences between intervention groups at baseline suggest a problem with the randomisation process - differences could be compatible with chance.	Low risk of bias	Participants would have been aware of their assigned intervention due to signing written assent and consent and taking part in the 12-session intervention: 'Written informed assent and consent were obtained and participants were compensated for evaluations'. Researchers were not aware of the assigned intervention: 'Research assistants were unaware of participants' intervention status or baseline findings'. Deviations arose as 'there was variability in adolescents' participation' but there no information given as to whether these were due to the trial context, and no reason to suspect it was. Authors say intention-to-treat analyses were used. Table 2 suggests this was modified	Some concerns	Missing outcome data from 26% and 21% of participants in the intervention and control groups respectively, and there is no evidence that the result was not biased by this. Missingness could have been due to BMI, however there were no differences in retention by group assignment, baseline overweight/obese status, physical activity or dietary intake, therefore it is unlikely.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

				intention-to-treat.					
Bonsergent 2013	Some concerns	No information is provided about allocation concealment or specific randomisation process, but due to it being a large 2x2x2 factorial cluster design it seems likely it would be computerised and concealed. There are no major baseline differences between intervention groups. It is unclear whether participants consented before or after randomisation and whether participants knew of the intervention assigned to the cluster. It is unlikely trial personnel were influenced by this as full grade in schools were randomised. No baseline imbalances to suggest these issues with randomisation.	Low risk of bias	No information provided to suggest whether there were deviations from the intended intervention due to trial context. A full analysis set was performed according to intention-to-treat including also non-completers.	Some concerns	All high schools included in the PRALIMAP trial completed the 2-year interventions. 66% of the participants gave data at the end of the interventions. A sensitivity analysis including also non completers was conducted showing that the results were not biased by missing data.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Low risk bias
Dewar 2013	Low risk of bias	Schools were paired-matched on their geographical location, size and demographics and then randomised to either the NEAT Girls intervention or a wait list control group by coin tossing. No information about concealment of allocation prior to start of the intervention, however randomisation was conducted by a researcher that was independent from the study and there is no reason to suspect that bias was introduced by	Low risk of bias	Due to the nature of the intervention participants and carers were aware of their group assignment. Not all students implemented the intervention but there is no reason to suspect that other forms of deviation arose from the trial context. Statistical analyses followed the intention-to-treat principle.	Some concerns	All schools and all students were included in the analysis, but no missing data imputation was performed. 80.4% and 80.8% girls were retained in the control and intervention groups, respectively. Reason for missingness in both groups was absence on testing day, leaving the school and refusal to be measured in both groups. Attrition due to refusal to be measured and absence on day of measurement was higher in intervention group (10.1%) than in the group (5.6%).	Low risk of bias	The measurement of height and weight by researchers, using standardised measures, is relatively robust. The height and weight measurements are used to produce BMI. Data collection took place in the study schools and was conducted by trained research assistants blinded to group allocation at baseline only. Although theoretically the recorded measures could be	Low risk bias

			lack of concealment. No difference in number of clusters allocated to each school and number of participants in each group is similar. Baseline assessments were conducted prior to randomisation by research assistants who were blinded to treatment allocation. No baseline difference in individual participants.						influenced by knowledge of intervention, this is highly unlikely.	
Haerens 2006	Some concerns	The article reports that the schools were randomly assigned to one of the two intervention groups or control group, but not details of randomisation method are provided, neither if the allocation was concealed. There was no unbalance in the number of clusters/groups. It is not clear if all students in each school were considered eligible to take part in the study before or after randomisation. Parents had to give consent for the children to participate in the study, but it is not clear if this was before or after randomisation. Some variability in size of the groups due to randomisation. Baseline difference in boys/girls ratio, SES (lower percent of low SES in control group) and in zBMI (lower in control group). All analysis were adjusted	Low risk of bias	Consent was requested to the parents. Due to the nature of the intervention participants and carers were aware of their group assignment. Process evaluation measures were put in place to monitor the level of implementation of the interventions. No information provided on statistical analysis but no reason to suspect that deviation from intended intervention occurred.	High risk of bias	All Schools were included in the analysis. Missing data from each group due to absence on the day of measurements or due to school change. Attrition is balanced across the three groups: (22%;21%; and 22% of missing data), however, there was some difference between completers and not-completers at 2 years follow-up: "Pupils not participating at follow-up were significantly older and consumed significantly more soft drinks then pupils participating at follow-up."	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		for baseline values, age and SES.							
Hovell 2018	Some concerns	Methods of randomisation and concealment are not reported. There are some baseline differences in the income of orthodontic office census, higher percent of offices that were below median for county in the control group. According to the participants flowchart, patients were recruited and screened prior to their allocation to intervention or control group. Baseline data seems consistent between the two group.	Low risk of bias	Participants likely knew they were in a trial because they provided verbal assent and their parents signed informed consent. No evidence of deviation from intended intervention and the analysis was conducted according to an intention to treat plan	High risk of bias	It is not clear how many offices were included in the study and int he final analysis (25% missing data in the intervention group; 39% missing data in the control group). No evidence of statistical analysis to test for bias introduced by missing data. The higher attrition in the control group could depend on true value of the outcome.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns
Kuhlemeier 2022	Some concerns	The authors only stated that each of the 8 school was randomised to either intervention or control but not further details on method used for randomisation is reported. There are no details on whether the allocation sequence was concealed. No baseline differences between the schools are reported and the number of participants in the prevention group and the respective control groups are similar. Based on the participants flowchart reported in the main article it is suggested that participants were identified and screened prior to randomisation.	Low risk of bias	It is likely that participants were aware if being in the trial as consent was obtained from a parent and assent from the participant. No deviation is reported, and we have no reason to suspect that any deviation from intended intervention arose because of the trial. No explicitly reported, but based on the participants flow-chart, participants data were analysed according to their allocated group and missingness was handled by single imputation method.	High risk of bias	Serious concerns due to high percent of missing data in both groups (29-30%), there is no statistical evidence that the results are not biased by missing data and the reason for missingness could be related to the true value of the outcome.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns

		No baseline differences between the participants in the preventive intervention and control group that suggest differential identification or recruitment of individual participants.							

Risk of bias for analysis 3.7 Percentile short term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of reported res	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Sup judg
Rodearmel 2006	High risk of bias	There are no details about the method of randomisation or if the allocation sequence was concealed. There are some baseline differences between the intervention and control group in the number and characteristics of the "other" children. However, it is unlikely that this difference is arising from inadequate randomisation process. The authors reported that the participants were randomised - but they chose to enrol more households in the intervention than control, and it is not clear if this was planned and factored into randomisation.	Some concerns	Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. There is no information to suggest that deviations to the intended intervention due to trial context occurred. it is unclear whether the analysis used was conducted according to an intention to treat basis.	High risk of bias	Serious concerns over the high level of missing data and no reason for missingness being reported. Data at follow-up were available from 65% of the participants. No reasons were given for drop-out but seems likely it could be due to BMI percentile influencing decision to not complete the study.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	No pr speci statis analy proto availa evide sugge nume result have selec basis from eligib outco meas No su of sel from analy pre-sp statis analy availa comp

Risk of bias for analysis 3.8 Percentile long term

Study	Bias				
	Randomisation process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result

	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Suppor judgem
Bogart 2016	High risk of bias	Randomisation was stratified by matching schools on baseline characteristics, but data are not shown; there are no details regarding the method of concealment. Serious concerns over recruitment of the participants into the study. Based on the participants flow diagram it seems that recruitment of participants occurred after randomisation; one school refused participation after randomisation (based on text in methods section) and a higher number of students were recruited after consent in the control group schools suggesting that participation was influenced by knowledge of assigned intervention. We are unable to assess whether there were baseline imbalances that suggest differential identification or recruitment of individual participants between intervention groups as a table of baseline characteristics of the participants is not reported, and the authors only reported that there were no differences in age, gender, BMI, or NSLP eligibility, and Latino participants were more likely to be in	Low risk of bias	No concerns over deviation from intended intervention and data were analysed according to an ITT plan.	High risk of bias	Serious concerns over missing data: high attrition in both group with over 10% difference in missingness at follow-up between the two groups (higher in the control group), no reasons for missingness is reported suggesting that missingness may be related to the true value of BMI at follow-up.	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. Trialist measured BMI at baseline but obtained BMI data at follow up from the Fitnessgram records, a district required procedure. At follow-up, school staff were required by the district to assess height and weight in ninth grade as part of the Fitnessgram. It is likely outcome assessors knew the trial was taking place and the allocation but there is no reason for the recorded measures to be influenced by knowledge of intervention.	Some concerns	No pre-specified statistical analysis p protocol (outlining methods analysis, measures available. evidence suggest numerica result like have bee selected basis of re from mult eligible outcome measurer No sugge of selecti from mult analyses pre-speci statistical analysis p available compare

		the intervention group.								

Risk of bias for analysis 4.1 BMI short term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of the reported results	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support judgem
Jago 2006	Some concerns	Randomisation conducted using a coin toss by investigators; there is no information regarding allocation concealment. No baseline differences to suggest issues with randomisation. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. Education differed between groups, but it seems unlikely to be due to differential identification/ recruitment.	Low risk of bias	Participants knew about the trial and written informed consent was obtained for all participants. Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. There is no information to suggest that deviations to the intended intervention due to trial context occurred. Likely modified intention-to-treat analysis used but not clear from Figure 1 as seems one group may have crossed over.	High risk of bias	There is no information in the text to suggest clusters dropped out of the study. In Figure 1 however there were 21 troops in FFL intervention at baseline and 20 analysed, whilst there were 21 in control and 22 analysed - suggesting that one school may had crossed-over. Table 4 shows 76 participants contributed data in FFL intervention and 64 in control. There is no evidence the result is not biased by missing data. Missingness in the outcome could depend on the true value. Missingness was not even across treatment arms, with more dropping out in the intervention arm. Those who continued with the study to this timepoint had lower BMI, suggesting it could be related to this (higher	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	No pre-specified statistical analysis p protocol available. evidence suggest numerica result like have beer selected basis of re from mult eligible outcome measurer No sugge of selecti from mult analyses BMI but n specified statistical analysis p available compare

						BMI - dropping out).				

Risk of bias for analysis 4.2 Percentile short term

Study	Bias									
	Randomisation process		Deviations from intended interventions		Missing outcome data		Measurement of the outcome		Selection of the reported result	
	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Support for judgement	Authors' judgement	Suppor judgem
Jago 2006	Some concerns	Randomisation conducted using a coin toss by investigators; there is no information regarding allocation concealment. No baseline differences to suggest issues with randomisation. Recruitment took place prior to randomisation. There were no baseline imbalances that suggested differential identification or recruitment of individual participants between intervention groups. Education differed between groups, but it seems unlikely to be due to differential identification/ recruitment.	Low risk of bias	Participants knew about the trial and written informed consent was obtained for all participants. Participants, carers and those delivering the intervention would likely have been aware of allocation due to the nature of the intervention. There is no information to suggest that deviations to the intended intervention due to trial context occurred. Likely modified intention-to-treat analysis used but not clear from Figure 1 as seems one group may have crossed over.	High risk of bias	There is no information in the text to suggest clusters dropped out of the study. In Figure 1 however there were 21 troops in FFL intervention at baseline and 20 analysed, whilst there were 21 in control and 22 analysed, suggesting that one school may had crossed over. Table 4 shows 76 participants contributed data in FFL intervention and 64 in control. There is no evidence the result is not biased by missing data. Missingness in the outcome could depend on the true value. Missingness was not even across treatment arms, with more dropping out in the intervention arm. Those who continued with the study to this timepoint had lower BMI, suggesting it could be related to	Low risk of bias	The measurement of height and weight using standardised methods by researchers is relatively robust. The height and weight measurements are used to produce BMI. It is likely outcome assessors knew the trial was taking place and there is no mention in the journal article of outcome assessors being blinded. Although theoretically the recorded measures could be influenced by knowledge of intervention, this is highly unlikely.	Some concerns	No pre-specified statistical analysis p protocol available. evidence suggest numerica result like have beer selected basis of re from mult eligible outcome measurer No sugge of selecti from mult analyses BMI but n specified statistical analysis p available compare

						this (higher BMI - dropping out).				

Appendices

Appendix 1. Criteria for judging certainty in the evidence

We evaluated the five GRADE domains for assessing certainty in our results using the following criteria.

Domain	Explanation
Risk of bias	Based on results of our risk of bias assessments, we downgraded confidence in the evidence base if most evidence was from studies that we judged at high risk of bias, according to the following rules. • No serious concerns (no downgrade): contributing weight of evidence at high risk < 30%. • Serious concerns (one point down): contributing weight of evidence of high risk of bias > 30%. • Very serious concerns (two points down): contributing weight of evidence of high risk of bias > 60%.
Imprecision	We downgraded confidence in the evidence base if the estimate of the effect size from a meta-analysis was not precise, according to the following rules. • No serious concerns (no downgrade): > 3000 participants or clear evidence of an effect larger than ± 1/5 of a typical standard deviation (which corresponds to 0.2 for zBMI, 0.5 for BMI or 6 for BMI percentile). • Serious concerns (one point down): < 3000 participants without clear evidence of an effect larger than ± 1/5 of a typical standard deviation. • Very serious concerns (two points down): not applied.
Inconsistency	We downgraded confidence in the evidence base if there was unexplained heterogeneity or variability in results across studies, according to the following rules. • No serious concerns (no downgrade): estimated heterogeneity variance (tau) = 0 or results all in the same direction. • Serious concerns (one point down): estimated heterogeneity variance (tau) is high and the direction of the results is inconsistent. • Very serious concerns (two points down): not applied.
Indirectness	We downgraded confidence in the evidence base if we had concerns that the population was highly specific and reducing the generalisability of the results, according to the following rules. • No serious concerns (no downgrade): no study populations of concern, or contributing weight of studies in highly specific populations < 30%. • Serious concerns (one point down): contributing weight of studies in highly specific populations > 30%. • Very serious concerns (two points down): not applied.
Non-reporting bias	We downgraded our confidence in the evidence base due to within-study non-reporting if there was (i) evidence of outcome measurement and (ii) indication of unreported non-statistically-significant result(s) and (iii) potential for the missing result(s) to impact on the meta-analysis, according to the following rules. • No serious concerns (no downgrade): no missing outcome data, or studies with missing outcome data were not large enough to impact on meta-analyses. • Serious concerns (one point down): we had evidence of measured outcomes being missing and an indication that missing results were not statistically significant and able to affect the meta-analyses result. • Very serious concerns (two points down): not applied. We considered that any wholly missing studies were likely to be small, whereas many included studies are large. We therefore did not have strong reason to rate down for publication bias in addition to selective non-reporting within studies.

Appendix 2. Search strategies

1.1 Rolling Search (2021 update)

Ovid MEDLINE(R) ALL <1946 to September 24, 2021>

Date Limited: Mar-Sept 2021

1 exp overweight/ 238864

2 exp body weight changes/ 76584

3 body weight/ or ideal body weight/ or waist-height ratio/ or waist-hip ratio/ 198957

4 Body mass index/ or adiposity/ 146076

5 (obes* or adipos*).mp. 500168

6 (weight gain or weight loss).mp. 181416
7 (overweight or over weight or overeat* or over eat*).mp. 85000
8 weight change*.mp. 12443
9 ((bmi or body mass index) adj2 (alter* or measur* or gain or loss or change)).mp. 12092
10 or/1-9 830029
11 exp Behavior Therapy/ 81430
12 social support/ 74861
13 exp Psychotherapy, Group/ 27306
14 ((psychological or behavio?r*) adj (therapy or modif* or strateg* or intervention*)).mp. 85774
15 (group therapy or family therapy or cognitive therapy).mp. 17855
16 ((lifestyle or life style) adj (chang* or intervention*)).mp. 17670
17 counsel?ing.mp. 129697
18 social support.mp. 96918
19 (peer adj2 support).mp. 5992
20 (children adj3 parent* adj3 therapy).mp. 133
21 or/11-20 366576
22 exp Obesity/dh [Diet Therapy] 8132
23 exp Diet Therapy/ 58036
24 Fasting/ 36683
25 (diets or diet or dieting).mp. 527093
26 (diet* adj (modif* or therapy or intervention* or strateg*)).mp. 77944
27 (low calorie or calorie control* or healthy eating).mp. 12044
28 (fasting or modified fast*).mp. 130206
29 exp Dietary Fats/ 93688
30 (fruit or vegetable*).mp. 147052
31 (high fat* or low fat* or fatty food*).mp. 59146
32 formula diet*.mp. 700
33 or/22-32 807308
34 exp Exercise/ 217427
35 exp Exercise Therapy/ 56426
36 exercis*.mp. 417380
37 (aerobics or physical therapy or physical activity or physical inactivity).mp. 183405
38 (fitness adj (class* or regime* or program*)).mp. 977
39 (aerobics or physical therapy or physical training or physical education).mp. 76087
40 dance therapy.mp. 473
41 sedentary behavio?r.mp. 14736
42 or/34-41 591641
43 exp Complementary Therapies/ 239044
44 (alternative medicine or complementary therap* or complementary medicine).mp. 27279
45 (hypnotism or hypnosis or hypnotherapy).mp. 12696
46 (acupuncture or homeopathy or homoeopathy).mp. 36037
47 (chinese medicine or indian medicine or herbal medicine or ayurvedic).mp. 47638
48 or/43-47 282249
49 ((diet or dieting or slim*) adj (club* or organi?ation)).mp. 28
50 (weightwatcher* or weight watcher*).mp. 145
51 (correspondence adj (course* or program*)).mp. 93
52 (fat camp* or diet* camp*).mp. 27
53 or/49-52 293

54 exp Health Promotion/ 81232

55 exp Health Education/ 253760

56 (health promotion or health education).mp. 178600

57 (media intervention* or community intervention*).mp. 2649

58 health promoting school*.mp. 376

59 ((school* or community) adj4 program*).mp. 35625

60 School health services/ 17840

61 ((school* or community) adj4 intervention*).mp. 21247

62 (family intervention* or parent* intervention).mp. 2513

63 (parent* adj2 (behavio?r or involve* or control* or attitude* or educat*)).mp. 26219

64 or/54-63 365140

65 exp Health Policy/ 111172

66 ((health or school or food or nutrition*) adj3 (policy or policies)).mp. 120211

67 65 or 66 151124

68 exp Obesity/pc [Prevention & Control] 20422

69 exp Primary Prevention/ 162740

70 (primary prevention or secondary prevention).mp. 68528

71 (preventive measure* or preventative measure*).mp. 28824

72 (preventive care or preventative care).mp. 6173

73 (obesity adj2 (prevent* or treat*)).mp. 22250

74 or/68-73 281599

75 exp Cell Phones/ or Social media/ or Mobile Applications/ or Electronic Mail/ 37010

76 (app or apps or text messag* or texting or social media or facebook or mobile technolog* or e-mail* or email* or smartphone* or mobile phone*).ti,ab. 92063

77 75 or 76 103417

78 10 and (21 or 33 or 42 or 48 or 53 or 64 or 67 or 74 or 77) 286872

79 exp child/ or adolescent/ 3170185

80 (child or children or childhood or adolescen* or pediatr* or paediatr* or boy or boyhood or boys or girl or girlhood or girls or youth or youths or teenage* or young people or young person or schoolchild* or juvenile).tw. 1974681

81 79 or 80 3801892

82 78 and 81 64232

83 exp animals/ not humans.sh. 4890266

84 (animal* or rodent* or mouse or mice or rat or rats or murine).ti. 1593937

85 82 not (83 or 84) 62698

86 controlled clinical trial.pt. 94426

87 randomi#ed.ab. 639710

88 placebo.ab. 221714

89 randomly.ab. 366508

90 (clinical trials as topic or controlled clinical trials as topic).sh. 202924

91 trial.ti. 248175

92 exp randomized controlled trial/ or exp randomized controlled trials as topic/ 689840

93 or/86-92 1496200

94 85 and 93 9617

95 (202103* or 202104* or 202105* or 202106* or 202107* or 202108* or 202109*).ep,ez. 893938

96 ("2021 Mar*" or "2021 Apr*" or "2021 May*" or "2021 Jun*" or "2021 Jul*" or "2021 Aug*" or "2021 Sep*").dp. 678587

97 (2021 03* or 2021 04* or 2021 05* or 2021 06* or 2021 07* or 2021 08* or 2021 09*).dp. 234439

98 limit 94 to yr=2021- 388

99 95 or 96 or 97 1092323

100 94 and 99 303

101 98 or 100 391

****

Ovid Embase <1974 to 2021 September 24>

Date Limited: Mar-Sept 2021

1 *overnutrition/ or exp *obesity/ or childhood obesity/ or adolescent obesity/ 267785

2 *body weight/ or *body weight change/ or *body weight loss/ or *body weight control/ or *body weight fluctuation/ or *body weight gain/ or *ideal body weight/ 44609

3 *body mass/ or *waist to height ratio/ or *waist hip ratio/ 36395

4 (obes* or adipos*).mp. 742525

5 (weight gain or weight loss).mp. 308464

6 (overweight or over weight or overeat* or over eat*).mp. 121599

7 weight change*.mp. 26001

8 ((bmi or body mass index) adj2 (alter* or measur* or gain or loss or change)).mp. 19810

9 or/1-8 1019356

10 *Behavior Therapy/ 16388

11 *social support/ 24496

12 *family therapy/ 6717

13 *group therapy/ 10256

14 ((psychological or behavio?r*) adj (therapy or modif* or strateg* or intervention*)).mp. 111599

15 (group therapy or family therapy or cognitive therapy).mp. 74992

16 ((lifestyle or life style) adj (chang* or intervention*)).mp. 26120

17 counsel?ing.mp. 220349

18 social support.mp. 112851

19 (peer adj2 support).mp. 8315

20 (children adj3 parent* adj3 therapy).mp. 189

21 or/10-20 496871

22 exp *Diet Therapy/ 98711

23 (diets or diet or dieting).mp. 777251

24 (diet* adj (modif* or therapy or intervention* or strateg*)).mp. 75017

25 (low calorie or calorie control* or healthy eating).mp. 17252

26 (fasting or modified fast*).mp. 177877

27 exp *fat intake/ 17057

28 (fruit or vegetable*).mp. 230164

29 (high fat* or low fat* or fatty food*).mp. 86965

30 formula diet*.mp. 861

31 or/22-30 1095249

32 exp *Exercise/ 155651

33 exp *kinesiotherapy/ 35308

34 exercis*.mp. 570034

35 (aerobics or physical therapy or physical activity or physical inactivity).mp. 277386

36 (fitness adj (class* or regime* or program*)).mp. 1277

37 (aerobics or physical therapy or physical training or physical education).mp. 56302

38 dance therapy.mp. 708

39 sedentary behavio?r.mp. 8604

40 or/32-39 782671

41 exp *alternative medicine/ 35261

42 (alternative medicine or complementary therap* or complementary medicine).mp. 55867

43 (hypnotism or hypnosis or hypnotherapy).mp. 15869

44 (acupuncture or homeopathy or homoeopathy).mp. 57978

45 (chinese medicine or indian medicine or herbal medicine or ayurvedic).mp. 98826

46 or/41-45 208909

47 ((diet or dieting or slim*) adj (club* or organi?ation)).mp. 47

48 (weightwatcher* or weight watcher*).mp. 236

49 (correspondence adj (course* or program*)).mp. 81

50 (fat camp* or diet* camp*).mp. 30

51 or/47-50 394

52 exp *Health Education/ 117203

53 (health promotion or health education).mp. 226187

54 (media intervention* or community intervention*).mp. 3429

55 health promoting school*.mp. 450

56 ((school* or community) adj4 program*).mp. 45545

57 *school health service/ 7413

58 ((school* or community) adj4 intervention*).mp. 26744

59 (family intervention* or parent* intervention).mp. 3302

60 (parent* adj2 (behavio?r or involve* or control* or attitude* or educat*)).mp. 49137

61 or/52-60 369532

62 *health care policy/ 69961

63 ((health or school or food or nutrition*) adj3 (Policy or policies)).mp. 239520

64 62 or 63 239520

65 exp Obesity/pc [Prevention & Control] 16674

66 primary Prevention/ 42819

67 (primary prevention or secondary prevention).mp. 89810

68 (preventive measure* or preventative measure*).mp. 38213

69 (preventive care or preventative care).mp. 7719

70 (obesity adj2 (prevent* or treat*)).mp. 30589

71 or/65-70 175662

72 *mobile application/ or *text messaging/ or exp *mobile phone/ or *e-mail/ or *social media/ 35056

73 (app or apps or text messag* or texting or social media or facebook or mobile technolog* or e-mail* or email* or smartphone* or mobile phone*).ti,ab. 134604

74 72 or 73 142358

75 9 and (21 or 31 or 40 or 46 or 51 or 61 or 64 or 71 or 74) 363429

76 child/ or preschool child/ or school child/ or juvenile/ or adolescent/ 2957200

77 (child or children or childhood or adolescen* or pediatr* or paediatr* or boy or boyhood or boys or girl or girlhood or girls or youth or youths or teenage* or young people or young person or juvenile* or schoolchild*).tw. 2508471

78 76 or 77 3737806

79 75 and 78 70228

80 exp animal/ not human/ 4983435

81 (animal* or rodent* or mouse or mice or rat or rats or murine).ti. 1746540

82 79 not (80 or 81) 68027

83 randomized controlled trial/ or "randomized controlled trial (topic)"/ 884751

84 crossover procedure/ 68184

85 "double blind procedure"/ 187998

86 "single-blind procedure"/ 43827

87 ((doubl* or singl*) adj blind*).tw. 249100

88 placebo/ or placebo.tw. 478469

89 (cross adj over).tw. 34400

90 (random* or factorial* or crossover).tw. 1774825

91 or/83-90 2220300

92 82 and 91 10585

93 limit 92 to yr="2021" 535

94 (202103* or 202104* or 202105* or 202106* or 202107* or 202108* or 202109* or 2021*).dd,dc. 1876487

95 (spring 2021 or summer 2021 or autumn 2021).dp. 505

96 (mar* 2021 or 0* mar* 2021 or 1* mar* 2021 or 2* mar* 2021 or 3* mar* 2021 or apr* 2021 or 0* apr* 2021 or 1* apr* 2021 or 2* apr* 2021 or 3* apr* 2021 or may* 2021 or 0* may* 2021 or 1* may* 2021 or 2* may* 2021 or 3* may* 2021 or jun* 2021 or 0* jun* 2021 or 1* jun* 2021 or 2* jun* 2021 or 3* jun* 2021 or jul* 2021 or 0* jul* 2021 or 1* jul* 2021 or 2* jul* 2021 or 3* jul* 2021 or aug* 2021 or 0* aug* 2021 or 1* aug* 2021 or 2* aug* 2021 or 3* aug* 2021 or sep* 2021 or 0* sep* 2021 or 1* sep* 2021 or 2* sep* 2021 or 3* sep* 2021).dp. 841606

97 94 or 95 or 96 1903232

98 92 and 97 780

99 93 or 98 789

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Ovid APA PsycInfo <1806 to September Week 3 2021>

2019 - 2020

1 exp overweight/ 27609

2 weight control/ 5141

3 (obes* or adipos*).ti. 17415

4 obesity.tw. 37939

5 (weight loss or weight gain).ti. 4977

6 (overweight or over weight).tw. 16357

7 weight loss/ 4106

8 weight gain/ 3310

9 (overeat* or over eat*).tw. 2784

10 weight change*.tw. 2349

11 ((bmi or body mass) adj3 (alter* or measur* or gain or loss or change)).tw. 3069

12 or/1-11 55473

13 (adolescence 13 17 yrs or childhood birth 12 yrs or preschool age 2 5 yrs or school age 6 12 yrs).ag. 824848

14 (teenage* or young people or young person or juvenile or schoolchild*).tw. 75214

15 (child or children or childhood or adololescen*).tw. 714760

16 (pediatr* or paediatr*).mp. 53867

17 (boy or boys or boyhood or girl or girlhood or girls or youth or youths).tw. 209081

18 or/13-17 1194126

19 12 and 18 18989

20 exp treatment effectiveness evaluation/ 26596

21 clinical trials/ 11978

22 placebo/ 6085

23 placebo*.tw. 42334

24 ((singl* or doubl* or trebl* or tripl*) adj3 (blind* or mask*)).tw. 27668

25 random*.tw. 218305

26 trial.ti. 33645

27 ((clinical adj3 trial*) or (evaluat* adj3 stud*)).tw. 108150

28 or/20-27 346310

29 19 and 28 2505

30 limit 29 to yr="2019 - 2021" 371

31 (2019* or 2020* or 2021*).up,yr,an. 518276

32 29 and 31 474

33 30 or 32 474
34 (BMIz or (BMI* adj2 (z-scor* or zscor*))).tw. 942
35 ((bmi or body mass index) adj3 outcome?).tw. 515
36 34 or 35 1394
37 18 and 28 and 36 320
38 (33 or 37) 794
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1.2 Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library

Issue 9 of 12, 2021
Date Run: 26/09/2021

Rolling Search

Limited Mar-Sept 2021
ID Search Hits
#1 MeSH descriptor: [Obesity] explode all trees 14800
#2 MeSH descriptor: [Body Weight Changes] explode all trees 9217
#3 (obes*):ti,ab,kw 46134
#4 (“weight gain” or “weight loss”):ti,ab,kw 32868
#5 (overweight or “over weight” or overeat* or (over next eat*)):ti,ab,kw 18432
#6 (weight next change*):ti,ab,kw 4229
#7 ((bmi or “body mass index”) near (gain or loss or change*)):ti,ab,kw 4292
#8 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 69612
#9 MeSH descriptor: [Behavior Therapy] explode all trees 17646
#10 MeSH descriptor: [Social Support] explode all trees 3439
#11 MeSH descriptor: [Psychotherapy, Group] explode all trees 3560
#12 ((psychological or behavio?r*) near (therapy or modif* or strateg* or intervention*)):TI,AB,KW 53803
#13 (“group therapy” or “family therapy” or “cognitive therapy”):ti,ab,kw 10896
#14 ((lifestyle or “life style”) near (chang* or intervention*)):ti,ab,kw 10017
#15 counsel?ing:ti,ab,kw 22739
#16 “social support”:ti,ab,kw 8569
#17 (peer near2 support):ti,ab,kw 102294
#18 (children near/3 parent* near/3 therapy):ti,ab,kw 388
#19 #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 173694
#20 MeSH descriptor: [Obesity] explode all trees and with qualifier(s): [diet therapy - DH] 2003
#21 MeSH descriptor: [Diet Therapy] explode all trees 6228
#22 MeSH descriptor: [Fasting] this term only 3327
#23 (diets or diet or dieting):ti,ab,kw 67825
#24 (diet* near (modif* or therapy or intervention* or strateg*)):ti,ab,kw 28307
#25 (“low calorie” or (calorie next control*) or “healthy eating”):ti,ab,kw 4036
#26 (fasting or (modified next fast*)):ti,ab,kw 35052
#27 MeSH descriptor: [Dietary Fats] explode all trees 7743
#28 (fruit or vegetable*):ti,ab,kw 9710
#29 (high next fat*) or (low next fat*) or (fatty next food*):ti,ab,kw 7159
#30 (formula next diet*):ti,ab,kw 237
#31 #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 103927
#32 MeSH descriptor: [Exercise] explode all trees 26442
#33 MeSH descriptor: [Exercise Therapy] explode all trees 15023
#34 exercis*:ti,ab,kw 112202
#35 (aerobics or “physical therapy” or “physical activity” or “physical inactivity”):ti,ab,kw 44627

#36 (fitness near (class* or regime* or program*)):ti,ab,kw 1349
#37 (“physical training” or “physical education”):ti,ab,kw 4525
#38 “dance therapy”:ti,ab,kw 180
#39 (sedentary next behavio?r*):ti,ab,kw 2522
#40 #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 139600
#41 MeSH descriptor: [Complementary Therapies] explode all trees 20952
#42 (“alternative medicine” or (complementary next therap*) or “complementary medicine”):ti,ab,kw 3613
#43 (hypnotism or hypnosis or hypnotherapy):ti,ab,kw 1818
#44 (acupuncture or homeopathy or homoeopathy):ti,ab,kw 16425
#45 (“chinese medicine” or “indian medicine” or “herbal medicine” or ayurvedic):ti,ab,kw 11369
#46 #41 OR #42 OR #43 OR #44 OR #45 44532
#47 (diet* or slim*) near (club* or organi?ation):ti,ab,kw 128
#48 (weightwatcher* or (weight next watcher*)):ti,ab,kw 134
#49 (correspondence near (course* or program*)):ti,ab,kw 28
#50 ((fat or diet*) next camp*):ti,ab,kw 2
#51 #47 OR #48 OR #49 OR #50 291
#52 MeSH descriptor: [Health Promotion] explode all trees 6886
#53 MeSH descriptor: [Health Education] explode all trees 20741
#54 (“health promotion” or “health education”):ti,ab,kw 19796
#55 (“media intervention*” or “community intervention*”):ti,ab,kw 630
#56 (health next promoting next school*):ti,ab,kw 48
#57 ((school or community) near/2 program*):ti,ab,kw 2921
#58 ((school or community) near/2 intervention*):ti,ab,kw 4510
#59 ((family next intervention*) or (parent* next intervention*)):ti,ab,kw 1744
#60 (parent* near/2 (behavio?r* or involve* or control* or attitude* or educat*)):ti,ab,kw 5960
#61 #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 41158
#62 MeSH descriptor: [Health Policy] explode all trees 672
#63 ((health next polic*) or (school next polic*) or (food next polic*) or (nutrition next polic*)):ti,ab,kw 1462
#64 #62 OR #63 1595
#65 MeSH descriptor: [Obesity] explode all trees and with qualifier(s): [prevention & control - PC] 1761
#66 MeSH descriptor: [Primary Prevention] explode all trees 4376
#67 (“primary prevention” or “secondary prevention”):ti,ab,kw 10932
#68 (preventive next measure*) or (preventative next measure*):ti,ab,kw 1396
#69 (“preventive care” or “preventative care”):ti,ab,kw 581
#70 (obesity near/2 (prevent* or treat*)):ti,ab,kw 5220
#71 #65 OR #66 OR #67 OR #68 OR #69 OR #70 21508
#72 (#19 OR #31 OR #40 OR #46 OR #51 OR #61 OR #64 OR #71) 420107
#73 #8 AND #72 42842
#74 MeSH descriptor: [Child] explode all trees 58448
#75 MeSH descriptor: [Infant] explode all trees 33346
#76 (child* or adolescen* or infant*):ti,ab,kw 289920
#77 (teenage* or “young people” or “young person” or (young next adult*)):ti,ab,kw 91369
#78 (schoolchildren or “school children”):ti,ab,kw 12811
#79 (pediatr* or paediatr*):ti,ab,kw 37240
#80 (boys or girls or youth or youths):ti,ab,kw 17734
#81 MeSH descriptor: [Adolescent] this term only 106993
#82 #74 OR #75 OR #76 OR #77 OR #78 OR #79 OR #80 OR #81 345686
#83 #73 AND #82 12799

[Additional terms for BMI]

#84 (BMIz or (BMI* near/2 (z-scor* or zscor*))):ti,ab 1102

#85 ((bmi or "body mass index") near/3 (assess* or calculat* or change? or changing or differ* or increas* or decreas* or reduc* or post-intervention* or "follow* up*" or followup*)):ti,ab 8093

#86 ((bmi or "body mass index") near/3 outcome?):ti,ab 1927

#87 ((adiposity or fat or weight) near/3 (goal? or outcome?)):ti,ab 5101

#88 #84 OR #85 OR #86 OR #87 14422

#89 #88 AND #72 AND #82 3596

#90 #89 NOT #83 625

1.3 Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library

New Search (difference set)

Issue 9 of 12, 2021

Date Run: 26/09/2021

#91 MeSH descriptor: [Marketing] explode all trees 530

#92 MeSH descriptor: [Persuasive Communication] this term only 314

#93 MeSH descriptor: [Communications Media] explode all trees 12804

#94 (marketing or advert* or campaign* or "mass media" or "social media" or blog* or vlog*):ti,ab,kw 8893

#95 (persuasive or persuasion or persuader*):ti,ab,kw 860

#96 MeSH descriptor: [Food Packaging] this term only 37

#97 MeSH descriptor: [Food Labeling] explode all trees 169

#98 ((food? or drink? or product? or nutrition* or diet* or carb* or sugar* or fat? or calori* or warning) NEAR/3 (label* or packag*)):ti,ab,kw 1855

#99 "traffic light*":ti,ab,kw 193

#100 (#91 OR #92 OR #93 OR #94 OR #95 OR #96 OR #97 OR #98 OR #99) 23426

#101 MeSH descriptor: [Artificially Sweetened Beverages] this term only 5

#102 MeSH descriptor: [Beverages] this term only and with qualifier(s): [adverse effects - AE] 138

#103 MeSH descriptor: [Sweetening Agents] explode all trees 770

#104 (artificial* near/3 sweeten*):ti,ab,kw 248

#105 ((sugar* or sweeten* or unsweeten* or diet or "low calorie" or fizzy or carbonated) NEAR/3 (beverag* or drinks or juice? or cordial? or pop or smoothie? or snack?)):ti,ab,kw 1777

#106 (((fizzy or carbonated) near/3 (beverag* or drinks)) or soda?):ti,ab,kw 804

#107 ("low sugar" or "high sugar" or "high fat" or HFSS):ti,ab,kw 4083

#108 ((sugar or fat or food) near/2 (literacy or education)):ti,ab,kw 309

#109 (#101 OR #102 OR #103 OR #104 OR #105 OR #106 OR #107 OR #108) 7209

#110 MeSH descriptor: [Food Services] explode all trees 389

#111 MeSH descriptor: [Dietary Services] this term only 43

#112 (school* near/3 (breakfast? or catering or diet* or dinner? or dining or lunch* or meal? or food? or snack?)):ti,ab,kw 873

#113 ("breakfast club?" or "catering service?"):ti,ab,kw 173

#114 (mealtim* or "meal tim*" or "meal environment?"):ti,ab,kw 883

#115 ("packed lunches" or "tuck shops" or "snack shops"):ti,ab,kw 18

#116 "vending machine?":ti,ab,kw 23

#117 (#110 OR #111 OR #112 OR #113 OR #114 OR #115 OR #116) 2195

#118 ("after school" or out-of-school):ti,ab,kw 574

#119 MeSH descriptor: [Non-Medical Public and Private Facilities] explode all trees 5420

#120 MeSH descriptor: [Leisure Activities] explode all trees 19390

#121 MeSH descriptor: [Physical Education and Training] this term only 1621

#122 MeSH descriptor: [Sports and Recreational Facilities] explode all trees 118

#123 ((youth? or communit* or holiday* or vacation* or activit* or fitness or sport* or recreation* or leisure) near/3 (center? or centre? or camp? or club?)):ti,ab,kw 3740

#124 ((youth? or communit* or holiday* or vacation* or leisure) next based):ti,ab,kw 9610

#125 MeSH descriptor: [Movement] this term only 2461

#126 MeSH descriptor: [Fitness Trackers] this term only 123

#127 (((movement or activit* or fitness) near/2 (app or based or chang* or monitor* or measur* or track*)) or recreation* or sport* or play):ti,ab,kw 44174

#128 MeSH descriptor: [Sleep] explode all trees 6005

#129 sleep*:ti or ((sleep near/3 (duration or efficienc* or hygiene or problem* or quality)) or actigraph*):ti,ab,kw 25133

#130 (#118 OR #119 OR #120 OR #121 OR #122 OR #123 OR #124 OR #125 OR #126 OR #127 OR #128 OR #129) 101953

#131 ((parent* or family or families or guardian?) near/2 (advice or advisory or (behavi* near chang*) or coach* or educat* or focus* or intervention* or program* or project* or psychoeducat* or strateg* or study or support* or therap* or train* or trial)):ti,ab,kw 19851

#132 ((parent* or family or families or guardian?) next (based or centred or centered or focus* or tailored or target*)):ti,ab,kw 2863

#133 #131 OR #132 20617

#134 MeSH descriptor: [Religion] explode all trees 1271

#135 MeSH descriptor: [Culture] explode all trees 2923

#136 (religi* or church or spiritual or faith?):ti,ab,kw 3296

#137 ((cultur* or multicultur* or race or racial*) near/2 (adapted or appropriate or based or center* or centre* or competent or focus* or tailored or translat* or target*)):ti,ab,kw 2635

#138 #134 OR #135 OR #136 OR #137 9246

#139 MeSH descriptor: [Public Health] this term only 262

#140 "public health":ti,ab,kw 14709

#141 ((complex or co-ordinated or comprehensive or factorial or interdisciplinary or inter-disciplinary or multiple or "multi component?" or multicomponent? or multidisciplin* or "multi disciplin*" or multidimension* or "multi dimension*" or multifactor* or "multi factor*" or multifacet* or "multi facet*" or multilevel* or "multi level*" or multimodal* or "multi modal*" or multiparamet* or "multi paramet*" or multiecological or "multi* ecological") near (intervention? or program* or project? or strateg* or study or support* or system? or therap* or train* or trial)):ti,ab,kw 62757

#142 #139 OR #140 OR #141 76106

#143 MeSH descriptor: [Computer Communication Networks] explode all trees 4404

#144 MeSH descriptor: [Telecommunications] explode all trees 7443

#145 MeSH descriptor: [Mobile Applications] this term only 888

#146 MeSH descriptor: [Cell Phone] explode all trees 1992

#147 MeSH descriptor: [Therapy, Computer-Assisted] this term only 1358

#148 digital*:ti,kw OR (digital near/3 (assist* or based or deliver* or intervention? or pilot or platform? or program* or project? or strateg* or study or support* or system? or technolog* or therap* or train* or trial)):ab 5502

#149 (android or app or apps or avatar* or blog* or CD-ROM or "cell* phone*" or cellphone* or "chat room*" or chatroom* or cyber* or DVD or eHealth or e-health or "electronic health" or e-Portal or ePortal or ePsych* or e-Psych* or eTherap* or e-therap* or "electronic forum*" or gaming or "information technolog*" or "instant messag*" or ipad or i-pad or iphone or i-phone or ipod or i-pod or podcast or "smart phone" or smartphone or "social network* site*" or "social networking" or mHealth or m-health or multi-media or multimedia or "personal digital assistant" or PDA or SMS or smartwatch* or "smart watch*" or "social medi*" or telehealth* or tele-health* or telemed* or tele-med* or telemonitor* or tele-monitor* or telepsych* or tele-psych* or teletherap* or tele-therap* or texting):ti,ab,kw 27793

#150 (internet or technolog* or tele* or web):ti,kw or ((computer or e-mail* or email* or messaging or internet* or mobile or online* or on-line or software or technolog* or telecomm* or tele-comm* or "text messag*" or virtual* or web or WWW) near/3 (assist* or based or deliver* or intervention? or pilot or platform? or program* or project? or strateg* or study or support* or system? or technolog* or therap* or train* or trial)):ti,ab,kw 32308

#151 (gaming or gamification or "wearable device?" or wearables or videogame or "video game" or videoconferenc* or "video conferenc*"):ti,ab,kw 3342

#152 (synchronous or asynchronous or (electronic near/2 deliver*) or eLearning or e-learning or "blended learning"):ti,ab,kw 2642

#153 (screentime or "screen time"):ti,ab,kw 477

#154 ("self care" and (computers or internet or software)):kw 967

#155 #143 OR #144 OR #145 OR #146 OR #147 OR #148 OR #149 OR #150 OR #151 OR #152 OR #153 OR #154 60834

#156 #100 OR #109 OR #117 OR #130 OR #133 OR #138 OR #142 OR #155 255258

#157 MeSH descriptor: [Child] explode all trees 58448

#158 (child* or adolescen*):ti,ab,kw 260114

#159 (teenage* or “young people” or “young person” or (young next adult*)):ti,ab,kw 91369

#160 (schoolchildren or “school children”):ti,ab,kw 12811

#161 (pediatr* or paediatr*):ti,ab,kw 37240

#162 (boys or girls or youth or youths):ti,ab,kw 17734

#163 MeSH descriptor: [Adolescent] this term only 106993

#164 (#157 OR #158 OR #159 OR #160 OR #161 OR #162 OR #163) 318126

#165 ((#8 OR #88) AND #156 AND #164) 7331

#166 #165 NOT #83 1281

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1.4 New search of the education databases 1990 onwards

Australian Education Index (AEI) (ProQuest)

Searched 26-Sept-2021

Search History

[*Condition*]

#1 MAINSUBJECT.EXACT("Body weight") (85) or MAINSUBJECT.EXACT("Obesity") (215)

#2 (obes*) (249)

#3 (weight N/5 gain*) or (weight N/5 los*) (36)

#4 (overweight or “over weight”) (83)

#5 (overeat* or (over P/1 eat*)) (5)

#6 (weight N/5 chang*) (14)

#7 (bmi or bmiz or “body mass index”) (38)

#8 ((adiposity or fat or weight) AND (goal or goals or outcome or outcomes)) (117)

#9 (1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8) (433)

[*Study Design Filter*]

#10 MAINSUBJECT.EXACT("Intervention") (2177)

#11 (RCT or cRCT or randomized or randomised or (control* P/3 group*) or (control* P/3 trial*) or (control* P/3 stud*)) (1508)

#12 noft(random* or groups or trial or placebo or matched) (37,586)

#13 (10 OR 11 OR 12) (39233)

#14 (9 AND 13) (130)

(MAINSUBJECT.EXACT("Body weight") OR obes* OR ((weight N/5 gain*) or (weight N/5 los*)) OR (overweight or “over weight”) OR (overeat* or (over P/1 eat*)) OR (weight N/5 chang*) OR (bmi or bmiz or “body mass index”) OR ((adiposity or fat or weight) AND (goal or goals or outcome or outcomes))) AND (MAINSUBJECT.EXACT("Intervention") OR (RCT or cRCT or randomized or randomised or (control* P/3 group*) or (control* P/3 trial*) or (control* P/3 stud*)) OR noft(random* or groups or trial or placebo or matched))

Date Limited (1990-01-01 to 2021-09-26), n=126

[Record Type: Journal articles (43); Theses (41); Conference Papers (14); Journal Articles Overseas (13); Book Chapters (10); Research Reports (2); Books (1); Conference Proceedings (1); Government Reports (1)]

British Education Index (BEI) (EBSCOhost)

Searched 26-Sept-2021

Search History [Boolean Search]

[Condition]

S1 obes* (495)

S2 (weight N5 gain*) or (weight N5 los*) (58)

S3 (overweight or “over weight”) (138)

S4 (overeat* or (over W1 eat*)) (9)

S5 (weight N5 chang*) (21)

S6 (bmi or bmiz or “body mass index”) (169)

S7 ((adiposity or fat or weight) AND (goal or goals or outcome or outcomes)) (110)

S8 (S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7) (692)

[Study Design Filter]

S9 (RCT or cRCT or randomized or randomised) (1271)

S10 ((control* N3 group*) or (control* N3 trial*) or (control* N3 stud*)) (3365)

S11 (random* or groups or trial or placebo) (33,876)

S12 (matched N5 (class or classes or cluster or clusters or school or schools or community or communities or population or populations) (73)

S13 (S9 OR S10 OR S11 OR S12) (34370)

S14 (S8 AND S13) (238)

Date Limited (1990 onwards), n=238

[Record Type: Academic Journals (234); Magazines(4)]

ERIC (Education Resources Information Center) (EBSCOhost)

Searched 26-Sept-2021

Search History [Boolean Search]

[Condition]

S1 TI obes* OR AB obes* OR KW obes* OR SU obes* (3526)

S2 TI (weight N5 gain*) OR AB (weight N5 gain*) OR KW (weight N5 gain*) OR SU (weight N5 gain*) (326)

S3 TI (weight N5 los*) OR AB (weight N5 los*) OR KW (weight N5 los*) OR SU (weight N5 los*) (640)

S4 TI overeat* OR AB overeat* OR KW overeat* OR SU overeat* (73)

S5 TI (over W1 eat*) OR AB (over W1 eat*) OR KW (over W1 eat*) OR SU (over W1 eat*) (21)

S6 TI (weight N5 chang*) OR AB (weight N5 chang*) OR KW (weight N5 chang*) OR SU (weight N5 chang*) (266)

S7 TI ((bmi or bmiz or “body mass index”)) OR AB ((bmi or bmiz or “body mass index”)) OR KW ((bmi or bmiz or “body mass index”)) OR SU ((bmi or bmiz or “body mass index”)) (1278)

S8 TI (((adiposity or fat or weight) AND (goal or goals or outcome or outcomes))) OR AB (((adiposity or fat or weight) AND (goal or goals or outcome or outcomes))) OR KW (((adiposity or fat or weight) AND (goal or goals or outcome or outcomes))) OR SU (((adiposity or fat or weight) AND (goal or goals or outcome or outcomes))) (1320)

S9 (S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8) (5762)

[Study Design Filter]

S10 TI ((RCT or cRCT or randomized or randomised or randomization or randomisation or randomizing or randomising)) OR AB ((RCT or cRCT or randomized or randomised or randomization or randomisation or randomizing or randomising)) OR KW ((RCT or cRCT or randomized or randomised or randomization or randomisation or randomizing or randomising)) OR SU ((RCT or cRCT or randomized or randomised or randomization or randomisation or randomizing or randomising)) (7981)

S11 TI ((random* AND (administ* or allocat* or assign* or class* or control* or determine* or divide* or division or distribut* or expose* or fashion or number* or place* or recruit* or split or subsitut* or treat*)))) OR AB ((random* AND (administ* or allocat* or assign* or class* or control* or determine* or divide* or division or distribut* or expose* or fashion or number* or place* or recruit* or split or subsitut* or treat*)))) OR KW ((random* AND (administ* or allocat* or assign* or class* or control* or determine* or divide* or division or distribut* or expose* or fashion or number* or place* or recruit* or split or subsitut* or treat*)))) OR SU ((random* AND (administ* or allocat* or assign* or class* or control* or determine* or divide* or division or distribut* or expose* or fashion or number* or place* or recruit* or split or subsitut* or treat*)))) (29063)

S12 TI "at random" OR AB "at random" OR KW "at random" OR SU "at random" (14001)

S13 AB (control* N3 group*) (22313)

S14 TI trial OR AB trial OR KW trial OR SU trial (15512)

S15 TI trial OR AB trial OR KW trial OR SU trial (806)

S16 AB (matched N5 (class or classes or cluster or clusters or school or schools or community or communities or population or populations) (1057)

S17 (S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16) (62683)

S18 (S9 AND S17) (637)

S19 (child* or adolescen* or pediatr* or paediatr* or boys or girls or youth or youths or teenage* or "young people" or "young person" or "young adult*") (500,370)

S20 TI school* OR AB school* OR KW school* OR SU school* (708643)

S21 TI communit* OR AB communit* OR KW communit* OR SU communit* (224783)

S22 (S19 OR S20 OR S21) (1,062,371)

S23 (S18 AND S22) (462)

S24 Limiters - Date Published: 19900101-20211231 n=435

****

1.5 Pragmatic search for grey literature (theses – all years)

ProQuest Dissertations and Theses Global (www.proquest.com/pqdtglobal/dissertations/)

Date of search: 24-February-2022

[*Title*]ti((((randomised or randomized or "randomly allocated" or "randomly assigned" or "random assignment" or RCT or cRCT) AND (adolescent or adolescents or boys or girls or child or children or schoolchildren or childhood or parents or guardians or parental) AND (((obesity or overweight) and (prevent or preventing or prevention or promote or promotion or promoting)) or "weight management" or “weight gain” or “weight loss” or "physical activity" or "physical activities" or ((dietary or lifestyle) and (behaviours or behaviors or behavioural or behavioral or changes or intervention))) AND (cluster or cRCT or school or schools or schoolchildren or classroom or classrooms)))) OR
[*Abstract*] ab((((randomised or randomized or "randomly allocated" or "randomly assigned" or "random assignment" or RCT or cRCT) AND (adolescent or adolescents or boys or girls or child or children or schoolchildren or childhood or parents or guardians or parental) AND (((obesity or overweight) and (prevent or preventing or prevention or promote or promotion or promoting)) or "weight management" or “weight gain” or “weight loss” or "physical activity" or "physical activities" or ((dietary or lifestyle) and (behaviours or behaviors or behavioural or behavioral or changes or intervention))) AND (cluster or cRCT or school or schools or schoolchildren or classroom or classrooms)))) (214)

Electronic Theses Online Service (EThOS) - British Library (ethos.bl.uk/Home.do)

Date of search: 11-March-2022

Search terms (OR):

obesity and prevention and randomised (50)

obesity and prevention and randomized (14)

obesity and school(s) and randomised (18)

obesity and school(s) and randomized (9)

adiposity and randomised and children (9)

adiposity and randomized and children (4)

adiposity and randomised and school(s) (4)

adiposity and randomized and school(s) (0)

BMI and randomised and children (25)

BMI and randomized and children (11)

BMI and randomised and school(s) (13)

BMI and randomized and school(s) (7)

BMI and z-score and randomised (9)

BMI and z-score and randomized (3)

weight and randomised and children (50)

weight and randomized and children (25)

weight and randomised and school(s) (32)

weight and randomized and school(s) (24)

school-based and randomised (151)

school-based and randomized (159)

healthy and children and randomised (49)

healthy and children and randomized (17)

25 theses selected for screening (16 duplicates with PQDT)

9 new records to screen

DART - Europe e-theses Portal (https://www.dart-europe.org/basic-search.php)

Date of search: 31-March-2022

Search terms (OR):

obesity and prevention and children and randomised (7) (4 selected)

obesity and prevention and children and randomized (11) (4 selected)

obesity and prevention and adolescents and randomised (2) (2 duplicates)

obesity and prevention and adolescents and randomized (8) (4 selected, all duplicates)

obesity and randomised and schools (6) (3 selected; 2 duplicates)

obesity and randomized and schools (11) (5 selected; 3 duplicates)

adiposity and randomised and children (5) (4 selected; 2 duplicates)

adiposity and randomized and children (0 selected)

adiposity and randomised and adolescents (2) (1 selected)

adiposity and randomized and adolescents (3) (0 selected)

adiposity and randomised and schools (2) (2 selected, both duplicates)

adiposity and randomized and schools (0)

BMI and randomised and children (18) (3 selected, 2 duplicates)

BMI and randomized and children (23) (2 selected, both duplicates)

BMI and randomised and adolescents (10) (2 selected, all duplicates)

BMI and randomized and adolescents (15) (3 selected, 2 duplicates)

BMI and randomised and school(s) (5) (4 selected, all duplicates)

BMI and randomized and school(s) (11) (4 selected, all duplicates)

BMI and z-score and randomised and children (9) (2 selected, both duplicates)

BMI and z-score and randomised and adolescents (7) (2 selected, both duplicates)

BMI and z-score and randomized and children (15) (1 selected, 1 duplicates)

BMI and z-score and randomized and adolescents (12) (3 selected, all duplicates)

weight and randomised and children (46) (4 selected, 3 duplicates)

weight and randomized and children (71) (4 selected, 3 duplicates)

weight and randomised and adolescents (13) (1 duplicate)

weight and randomized and adolescents (24) (2 selected, both duplicates)

school-based and randomised (52) (4 selected, 2 duplicates)

school-based and randomized (81) (5 selected, 2 duplicates)

healthy and children and randomised (41) (5 selected, 4 duplicates)

healthy and children and randomized (82) (2 selected)

healthy and adolescents and randomised (12) (2 selected, 2 duplicate)

healthy and adolescents and randomized (27) (1 selected, 1 duplicate)

healthy and schools and randomised (12) (3 selected, 3 duplicates)

healthy and schools and randomized (10) (2 selected, both duplicates)

n=25 theses selected for screening

5 duplicates with PQDT and BL eTHOS

20 to screen

[Note. Several theses have also been retrieved from databases which index this type of literature, e.g. PsycINFO, Australian Education Index (AEI)]

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1.6 Search for retractions/errata

Date-of-search- 6-April-2022

Ovid multifile search

APA PsycInfo <1806 to April Week 1 2022>

Embase <1974 to 2022 April 06>

Ovid MEDLINE(R) ALL <1946 to April 06, 2022>

1 exp overweight/ or exp body weight changes/ or body weight/ or ideal body weight/ or waist-height ratio/ or waist-hip ratio/ or body mass index/ or adiposity/ 1789517

2 1 use medall 539949

3 *overnutrition/ or exp *obesity/ or childhood obesity/ or adolescent obesity/ or *body weight/ or *body weight change/ or *body weight loss/ or *body weight control/ or *body weight fluctuation/ or *body weight gain/ or *ideal body weight/ or *body mass/ or *waist to height ratio/ or *waist hip ratio/ 573049

4 3 use oemezd 340024

5 exp overweight/ or weight control/ or weight loss/ or weight gain/ 1035600

6 5 use psyh 35168

7 (2 or 4 or 6) 915141

8 (obes* or adipos* or weight gain or weight loss or overweight or over weight or overeat* or over eat* or weight change*).mp. 1737633

9 ((bmi? or body mass index) adj2 (alter* or assess* or calculat* or change? or changing or differ* or gain or increas* or decreas* or loss or reduc* or post-intervention* or postintervention* or follow* up* or followup*)).mp. 107069

10 (BMIz or BMI-z* or zBMI* or z-BMI*).mp. 14358

11 (BMI* adj2 (z-scor* or zscor*)).mp. 13076

12 or/7-11 2010782

13 exp child/ or preschool child/ or school child/ or adolescent/ 6930323

14 (child or children or childhood or adolescen* or pediatr* or paediatr* or boy or boyhood or boys or girl or girlhood or girls or youth or youths or teen* or young people or young person? or schoolchild* or youth or youths).tw. 5491742

15 (school? adj (based or setting student?)).tw. 53821

16 or/13-15 9153070

17 (12 and 16) 376094

18 exp randomized controlled trial/ 1271931

19 randomized controlled trial.pt. 563745

20 Randomization/ or Random Allocation/ 200537

21 (randomi#ed or randomi#ation or randomi#ing).mp. 2512633

22 (RCT or cRCT).tw. 80040

23 "at random".ab. 31601

24 (random* adj3 (administ* or allocat* or assign* or class* or cluster or crossover or cross-over or control* or determine* or divide* or division or distribut* or expose* or fashion or number* or place* or pragmatic or quasi or recruit* or selected or split or subsitut* or treat*)).tw. 1799071

25 ((single or double or triple or treble) adj2 (blind* or mask* or dummy)).mp. 632841

26 trial.ti. 650175

27 (prevention adj (study or trial)).tw. 16015

28 (intervention and trial).tw. 321931

29 program.ti. and trial.tw. 24533

30 ((intervention or program) and control* and (group? or school? or communit*)).tw. 500989

31 ((intervention or program) adj5 (control* or group? or study or trial)).tw. 481711

32 controlled clinical trial.mp. 604659

33 or/18-32 4070222

34 (17 and 33) 46661

35 (retracted publication or "retraction of publication").pt. 21796

36 Tombstone.pt. 3894

37 Retracted article/ 11134

38 (retracted or retraction).ti. 29282

39 (35 or 36 or 37 or 38) 51319

40 (17 and 39) 88

41 remove duplicates from 40 74

42 erratum.pt. 250070

43 published erratum.pt. 113022

44 (erratum or errata).ti. 209724

45 (42 or 43 or 44) 379603

46 (34 and 45) 59

47 remove duplicates from 46 48

48 (47 not 41) 45

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1.7 Search updates (Automated Searches; October 2022)

Sept. 2021 onwards

Cochrane Library

Search Name: Obesity-Living-Systematic-Review-1

#1 MeSH descriptor: [Obesity] explode all trees

#2 MeSH descriptor: [Body Weight Changes] explode all trees

#3 "body mass index":kw

#4 (obes* or adiposity):ti,ab,kw

#5 (“weight gain” or “weight loss” or (weight next change*) or (weight next fluctuat*)):ti,ab,kw

#6 (overweight or "over weight" or overeat* or (over next eat*) or overnutrition or "over nutrition"):ti,ab,kw

#7 ((fat or weight) near/3 (goal* or outcome*)):ti,ab,kw

#8 ((bmi or "body mass index") near/3 (assess* or calculat* or change* or changing or differ* or gain* or increas* or decreas* or reduc* or post-intervention* or (follow* next up*) or followup* or loss or outcome*)):ti,ab,kw

#9 (BMIz or BMI-z or zBMI or z-BMI or (BMI* near/2 (z-scor* or zscor*))):ti,ab

#10 ((waist near/2 height near/2 ratio*) or (waist near/2 hip* near/2 ratio*)):ti,ab,kw

#11 "weight control":ti,ab,kw

#12 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11)

#13 MeSH descriptor: [Child] this term only

#14 MeSH descriptor: [Child, Preschool] this term only

#15 MeSH descriptor: [Adolescent] this term only

#16 (child* or adolescen* or pediatr* or paediatr* or boy or boyhood or boys or girl or girlhood or girls or youth or youths or teen* or "young people" or (young next person*) or schoolchild* or (school next child*) or youth or youths):ti,ab,kw

#17 (school* next (based or setting or student*)):ti,ab,kw

#18 (#13 OR #14 OR #15 OR #16 OR #17)

#19 (#12 and #18)

Ovid multi-file search

APA PsycInfo <1806 to April Week 3 2022>

Embase <1974 to 2022 April 25>

Ovid MEDLINE(R) ALL <1946 to April 25, 2022>

1 exp overweight/ or exp body weight changes/ or body weight/ or ideal body weight/ or waist-height ratio/ or waist-hip ratio/ or body mass index/ or adiposity/

2 1 use medall

3 *overnutrition/ or exp *obesity/ or childhood obesity/ or adolescent obesity/ or *body weight/ or *body weight change/ or *body weight loss/ or *body weight control/ or *body weight fluctuation/ or *body weight gain/ or *ideal body weight/ or *body mass/ or *waist to height ratio/ or *waist hip ratio/

4 3 use oemezd

5 exp overweight/ or weight control/ or weight loss/ or weight gain/

6 5 use psyh

7 (2 or 4 or 6)

8 (obes* or adipos* or weight gain or weight loss or overweight or over weight or overeat* or over eat* or weight change*).mp.

9 ((bmi? or body mass index) adj2 (alter* or assess* or calculat* or change? or changing or differ* or gain or increas* or decreas* or loss or reduc* or post-intervention* or postintervention* or follow* up* or followup*)).mp.

10 (BMIz or BMI-z* or zBMI* or z-BMI*).mp.

11 (BMI* adj2 (z-scor* or zscor*)).mp.

12 or/7-11

13 exp child/ or preschool child/ or school child/ or adolescent/

14 (child or children or childhood or adolescen* or pediatr* or paediatr* or boy or boyhood or boys or girl or girlhood or girls or youth or youths or teen* or young people or young person? or schoolchild* or youth or youths).tw.

15 (school? adj (based or setting student?)).tw.

16 or/13-15

17 (12 and 16)

18 exp randomized controlled trial/

19 randomized controlled trial.pt.

20 Randomization/ or Random Allocation/

21 (randomi#ed or randomi#ation or randomi#ing).mp.

22 (RCT or cRCT).tw.

23 "at random".ab.

24 (random* adj3 (administ* or allocat* or assign* or class* or cluster or crossover or cross-over or control* or determine* or divide* or division or distribut* or expose* or fashion or number* or place* or pragmatic or quasi or recruit* or selected or split or subsitut* or treat*)).tw.

25 ((single or double or triple or treble) adj2 (blind* or mask* or dummy)).mp.

26 trial.ti.

27 (prevention adj (study or trial)).tw.

28 (intervention and trial).tw.

29 program.ti. and trial.tw.

30 ((intervention or program) and control* and (group? or school? or communit*)).tw.

31 ((intervention or program) adj5 (control* or group? or study or trial)).tw.

32 controlled clinical trial.mp.

33 or/18-32

34 (17 and 33)

35 remove duplicates from 34

****

Appendix 3. Information extracted from study reports

We collected the following data from study reports.

- Methods: study design (including number of clusters in cluster-RCTs); total duration of study; details of any 'run in' period; number of study centres and location; study setting; date of study.
- Participants: numbers randomised, lost to follow-up/withdrawn and analysed; age (mean and range); sex; exclusion criteria.
- Baseline zBMI, BMI and/or BMI percentile.
    - For studies that did not report any of these measurements we instead collected data on the prevalence of overweight/obesity at baseline (if available).
- Interventions: description of experimental and comparator interventions, such as type of intervention, duration of intervention, setting, theory behind the intervention, unit of intervention (who is targeted), who delivers the intervention.

- Outcomes: zBMI (mean and SD); BMI (mean and SD); BMI percentile (mean and SD); numbers of reported serious adverse events. For studies that did not report one of the three primary outcomes, we instead collected the prevalence of overweight/obesity at the follow up time (if available).
    - Time points: as described under Types of outcome measures in the methods section;
    - Measurement: we recorded whether BMI and zBMI were self-reported (by parent or child) or measured by researchers;
    - Effect estimates (contrast-level data): we collected contrast-level data on BMI, zBMI and BMI percentile according to these preferences:
        - post-intervention difference in means adjusted for baseline zBMI/BMI/BMI percentile from analysis of covariance; in preference to
        - difference in mean change from baseline; in preference to
        - post-intervention difference in means (unadjusted).
    - Follow up measurements (arm level data): we collected arm-level data on BMI, zBMI and BMI percentile according to these preferences:
        - post-intervention means adjusted for baseline BMI/zBMI/percentile; in preference to
        - change from baseline means (change scores); in preference to
        - post-intervention means (unadjusted)
    - Effect estimates from cluster-RCTs: we collected BMI, zBMI and BMI percentile results that were adjusted for clustering in preference to results that are not adjusted for clustering;
- PROGRESS factors;
- Information about the costs of interventions, for the purposes of secondary analysis by healthcare policymakers (we did not analyse costs in this review, but we have reported this information in a table);

Notes: funding for trial, and notable conflicts of interest of trial authors.

Abbreviations: RCT: randomized controlled trial; SD: standard deviation.

Appendix 4. Statistical details

3.1 Details of statistical method

3.1.1 Selecting outcome data

We aimed to combine data on mean differences between groups in change-from-baseline measures (of zBMI/BMI/percentile). Since most studies reported arm-level data rather than contrast-level data and because many contrast-level estimates came from models that were either not fully explained or involved a high level of covariate adjustment, we decided to prioritize arm-level data where available. Arm-level data were prioritized as follows (i) follow-up means adjusted for baseline values, (ii) mean change from baseline (change scores), (iii) unadjusted baseline and follow-up means, (iv) unadjusted follow-up means without baseline data. There were no instances of option (iv) in this data set. In the absence of arm-level data, we collected contrast-level data if they could be interpreted as a measure of mean difference in change from baseline.

3.1.2 Calculation of mean differences from arm level data

For options (i), (ii) and (iv) above, we calculate the mean difference (MD) and its standard error (SE) in the same way. We label the arm-level means as m_X, standard deviations (SDs) as s_X, and participant numbers (at follow-up) as n_X where $X \in (A, B)$ represent the two intervention groups. The MD and SE are then calculated as follows,

$$MD = m_A - m_B,$$

$$SE = \sqrt{(s_A^2/n_A + s_B^2/n_B)}.$$

For option (iii), we label the baseline variables with the subscript 0 and follow-up variables with the subscript 1. The MD and SE are then,

$$MD = (m_{A1} - m_{A0}) - (m_{B1} - m_{B0}),$$

$$SE = \sqrt{(s_{A0}^2/n_{A0} + s_{A1}^2/n_{A1} + s_{B0}^2/n_{B0} + s_{B1}^2/n_{B1} - 2\rho(s_{A0}s_{A1}/\sqrt{(n_{A0}n_{A1})} + s_{B0}s_{B1}/\sqrt{(n_{B0}n_{B1})}))},$$

where ρ is the correlation coefficient between baseline and follow-up measurements. Values for ρ are discussed in Section 3.1.2.1.

3.1.2.1 Correlation coefficient

The correlation coefficient between baseline and follow-up measurements is given by,

$$\rho = (s_0^2 + s_1^2 - s_{CS}^2)/2s_0s_1,$$

where s_0, s_1 and s_{CS} represent standard deviations on baseline, follow-up and change scores, respectively. We found four studies in which all three of these measurements were reported. For each group within these studies we calculated the associated correlation coefficient via the above equation. The mean of these values was 0.953 and the median was 0.951. We also looked at studies reporting baseline and change-from-baseline measurements. Assuming the follow-up SD was equal to the baseline SD in these studies ($s_1 = s_0$), we approximated the correlation coefficient using the same formula. These calculations gave a mean of 0.93 and a median of 0.94. Based on these results we chose to impute a value of ρ=0.95 in our calculations.

3.1.3 Cluster adjustment

The majority of studies were cluster randomised. For each result, we assessed whether the authors had adjusted for clustering in their reported precision. For those that had not, we accounted for the effect of clustering by adjusting the standard error on the mean difference via,

$SE' = SE\sqrt{(1+\text{ICC}(c-1))}$,

where SE' is the adjusted standard error, c is the mean cluster size (= number of participants divided by the number of clusters), and ICC is the intra-cluster correlation coefficient. We discuss choices for the value of ICC in Section 3.1.3.1. We decided not to adjust for clustering at the family level as the cluster sizes were very small.

3.1.3.1 Intra-cluster correlation coefficient

Most studies that required cluster adjustment did not report the relevant ICC. To choose a value to use for these studies we collected all the ICCs reported across the trials. There were no notable differences between ICCs reported on the classroom level compared with the school level. The median across all these values was 0.02. Based on these observations, we chose to use ICC=0.02 for all studies that required cluster adjustment but did not report their own ICC.

Some studies assumed an ICC value in their sample size calculations. These values were usually based on external evidence. The median across all the assumed ICCs was 0.03. This suggested that a sensitivity analysis using ICC = 0.04 was sensible. We also performed a sensitivity analysis with ICC = 0 (i.e. no cluster adjustment).

3.2 Data extraction and imputation

3.2.1 General methods

3.2.1.1 Combining results from subgroups

Five studies reported data on the subgroup level only. Usually this meant the results were stratified by sex. To use these results in the meta-analysis we had to combine the subgroup results. We label the mean, standard deviation, and number of participants in each subgroup as m_i, s_i and n_i where the subscript $i \in (a, b)$ labels subgroups a and b. The mean and standard deviation of the combined subgroups are calculated via (Higgins 2019b),

$m_{a+b} = (n_a m_a + n_b m_b)/(n_a+n_b)$,

$s_{a+b}^2 = ((n_a-1)s_a^2 + (n_b-1)s_b^2)/(n_a+n_b-1) + ((n_a n_b/(n_a+n_b))(m_a^2+m_b^2-2m_a m_b)/(n_a+n_b-1)$.

For results with more than two subgroups these equations can be applied sequentially.

3.2.1.2 Multiple follow-up times

Follow-up times were categorized into three groups: (i) short term [3 to < 9 months], (ii) medium term [9 to < 15 months], (iii) long term [≥ 15 months]. For any studies that reported more than one follow-up time within categories (i) and (ii), we chose the time point that was closest to the mid-point of the interval (6 and 12 months, respectively). For studies that reported more than one long term time point, we chose the longest follow-up time.

3.2.1.3 Estimating zBMI from proportions of children with overweight/obesity

In some studies, the only outcome data available were the proportion of participants classified as with overweight or obesity. Since definitions of overweight/obesity are based on zBMI or equivalent percentile cut offs, we used these data to estimate zBMI means. The Centers for Disease Control and Prevention (CDC) charts define a child as being overweight if their BMI exceeds the 85th percentile for their age and sex and define obesity as a BMI greater than or equal to the 95th percentile. The World Health Organization (WHO) classify an overweight child as one whose zBMI exceeds 1 and define obesity as zBMI > 2. We can convert between zBMI and percentile cut offs using the standard normal cumulative distribution,

$p_c = \Phi(z_c)$,

$z_c = \Phi^{-1}(p_c)$,

where z_c is the zBMI cut-off for overweight and obesity, p_c is the equivalent percentile cut-off and $\Phi(z) = \Pr(Z \leq z)$ is the cumulative distribution function (CDF) of a variable Z with a standard normal distribution. For each study, we used the zBMI or percentile cut-off reported by the growth chart or classification index used to define

overweight/obesity in that study. In the following, we use η_c to represent the proportion of participants whose zBMI exceeds the threshold z_c.

For a normally distributed variable $X = \mu + Z\sigma$ with mean μ and standard deviation σ the CDF is,

$\Pr(X \leq x) = \Pr(\mu + Z\sigma \leq x) = \Phi((x-\mu)/\sigma)$.

Furthermore, from the CDF we can write,

$\Pr(Z > z) = 1 - \Phi(z)$.

Therefore, to estimate mean zBMI from the proportion of participants classified as with overweight or obesity, we assume that zBMI sampled within a trial follows a (non-standard) normal distribution, $X \sim N(\mu_z, \sigma_z^2)$, with mean μ_z and standard deviation σ_z. The probability that a sampled value of zBMI exceeds the zBMI cut-off for overweight and obesity is then,

$\Pr(X > z_c) = \Pr(Z > (z_c-\mu_z)/\sigma_z) = 1 - \Phi((z_c-\mu_z)/\sigma_z)$,

where $Z \sim N(0,1)$ represents a standard, normal, random variable. The proportion of participants, η_c, with zBMI greater than z_c is an estimate of the probability $\Pr(X > z_c)$. Therefore, inserting this estimate into the above equation gives,

$\eta_c = 1 - \Phi((z_c-\mu_z)/\sigma_z)$,

$(z_c-\mu_z)/\sigma_z = \Phi^{-1}(1- \eta_c)$.

By definition, the population standard deviation of zBMI is equal to 1. Therefore, in order to estimate μ_z, we assume that the sample standard deviation is equal to the population standard deviation. Inserting σ_z=1 into the above equation gives,

$\mu_z \approx z_c - \Phi^{-1}(1- \eta_c)$.

This is the equation we used to convert proportions of participants with overweight and obesity into estimates of mean zBMI. If the study reported the proportions of participants with overweight and obesity separately then these values were summed to give the value of η_c. If the study only reported the prevalence of obesity then we used this as η_c and replaced z_c with the zBMI cut off for obesity.

3.2.1.4 Missing follow-up SDs and participant numbers

For any study that did not report standard deviations or any other measure of precision on their follow-up means, we set the follow-up SDs equal to the baseline SDs in each group. From inspection of other studies in the data set in which both baseline and follow-up precisions were reported, this was deemed a reasonable assumption, as these values tended to be very similar. For any study that reported no measure of precision on any of their zBMI means, we assumed a standard deviation of 1 (equal to the standard deviation of the population). This assumption was supported from inspection of studies that did report precision on zBMI as these SDs were approximately equal to 1. There were no instances of completely missing precisions on BMI or percentile data.

In a similar vein, for any study that did not explicitly report the number of participants at follow-up or the number of dropouts during the study, we assumed that the number of participants at follow-up was equal to the number at baseline.

3.2.1.5 Reading values from graphs

When studies only reported outcomes in the form of a graph, we used the Engauge Digitizer 4.1 software (Mitchell, Muftakhidinov and Winchen 2020) to extract the plotted values

3.2.2 Notes on specific trials

3.2.2.1 Andrade 2014

This study reports BMI and zBMI data. The two outcomes are reported in different papers and have slightly different participant numbers (NB: zBMI requires data on the age and sex of the participant). In the paper reporting zBMI, we are missing the number of participants per group at baseline (we are given the total number of participants at baseline and the number per group at follow-up). To impute these values, we use the BMI participant numbers to work out the ratio of dropout in each group relative to the overall dropout. Assuming these ratios are the same for the zBMI outcome, we use these along with the total drop out and number of participants at follow-up to estimate the baseline participant numbers per group for the zBMI outcome.

3.2.2.2 Arlinghaus 2021

This study reports means and SDs on zBMI at baseline per group. The only follow-up data are plotted in their Figure 3, which shows the change in zBMI per group stratified by weight status (healthy weight, overweight and obese). We read the zBMI change scores off the figure using the Engauge Digitizer software. The healthy weight and overweight subgroup change scores were combined using the methods described in 3.2.1.1. The baseline

and change score means were used to obtain follow-up means. Finally, we assumed that follow-up SDs were equal to the baseline SDs in each group.

3.2.2.3 El Ansari 2010

Results from the different subgroups (boys and girls) were combined using the methods outlined in Section 3.2.1.1.

3.2.2.4 French 2011

This is a study of households, some of which contain adolescents. The adolescent data are reported separately from the adult data. There is no information on the precision of zBMI means hence we assumed SDs of 1 (see Section 3.2.1.4). There is also no information on the number of adolescents per group (we have the total number of adolescents and the number of households per group). To impute these numbers we calculated the average number of adolescents per household and multiplied this by the number of households per group at baseline and follow-up.

3.2.2.5 Haerens 2006

Results from the different subgroups (boys and girls) were combined using the methods outlined in Section A3.1.1.

3.2.2.6 Hovell 2018

The follow-up data on zBMI are reported as the results of a regression analysis plotted in their Figure 4. In the figure predicted zBMI is plotted against time (from 0 to 1000 days) for each group and each sex. The study also reports the raw zBMI means and SDs per group at baseline. We read off the predicted zBMI means at baseline (0 months) and 24 months using the Engauge Digitizer software. We combined the subgroup values for boys and girls using the methods described in Section 3.2.1.1. We assumed the standard deviations on the predicted zBMI means at baseline and follow-up were equal to the SDs on the raw zBMI means at baseline. We chose to use the predicted baseline means over the raw baseline means so that the values were consistent with the follow-up values.

3.2.2.7 Jago 2006

Results from the different subgroups (spring wave and fall wave) were combined using the methods outlined in Section 3.2.1.1.

3.2.2.8 Neumark-Sztainer 2003

The study is missing precision on follow-up means. We assumed SD at follow-up was equal to SD at baseline.

3.2.2.9 Neumark-Sztainer 2010

The study is missing precision on follow-up means. We assumed SD at follow-up was equal to SD at baseline.

3.2.2.10 Ooi 2021

The study only reports BMI measurements for a "subset of year 7s". The number in this subset per group are reported at baseline but not at follow-up (we do have the total number of participants per group at baseline and follow-up). To calculate the number of participants at follow-up in the subset, we assume that the dropout rate per group in the subset is the same as the dropout rate per group in the total population.

3.2.2.11 Pfeiffer 2019

The study is missing precision on follow-up means. We assumed SD at follow-up was equal to SD at baseline.

3.2.2.12 Singh 2009

This study reports BMI data subgrouped by sex but we are missing the group-specific and sex-specific participant numbers at all time points except at randomization. The study does report the total number of participants at each time point. To impute the missing numbers we assumed that the proportion of participants per group (relative to the total sample) and the proportion of boys and girls in each group remained fixed from randomization across the subsequent time points.

Results from the different subgroups (boys and girls) were combined using the methods outlined in Section 3.2.1.1.

3.2.2.13 Takacs 2020

At baseline, the study reports the total number of participants per group and the number of participants per group for which there are BMI measurements. At follow-up they only report the total number of participants. To estimate the number of BMI measurements at follow-up we assume that the ratio of the number of measurements to total sample size remains fixed across the time points.

3.2.1.14 Weiland 2018

This study includes data from adults and adolescents. We are missing the adolescent-specific participant numbers at follow-up. We have the total number of participants per group (adults and adolescents) at baseline

and follow-up, and the number of adolescents per group at baseline. We assume the proportion of adolescents relative to the total population remains fixed from baseline to the subsequent follow-up times.

3.2.1.15 Wilksch 2015

The study reports data subgrouped by sex at two follow-up times. The study contains four arms (we label them A, B, C and D for simplicity). We only extract data on groups A and B as C and D do not target obesity prevention. A second paper reports extra information on two arms of the trial, A and D. Here, they report the proportion of boys and girls in each of these groups at baseline. Overall, we are missing all participant numbers at the first follow-up, the number of boys and girls in group B at all time points, and the number of boys and girls in group A at the two follow-up times. We make the following imputations.

1. To impute the total number of participants at the first follow-up time, we assume a linear dropout rate across the two time points and use the reported baseline and second follow-up participant numbers.
2. To impute the number of boys and girls in group A at the two follow-up times, we assume the ratio of boys to girls in group A remains fixed from baseline across the time points.
3. To impute the number of boys and girls in group B at baseline, we assume that the relative proportion of boys and girls in the two missing data groups (B and C) are the same. The proportion of girls/boys in the total population is simply a mean of the proportions in the four groups, weighted by the number of participants in each group. Therefore, we use proportions reported in groups A and D to work out what proportions are required in the other two groups in order to produce the overall proportions. We then assume that these ratios are fixed over the time points.

Results from the different subgroups (boys and girls) were combined using the methods outlined in Section 3.2.1.1.

Appendix 5. Supplementary data files for cluster adjustment

The following table lists all the cluster randomized trials along with values of unadjusted and adjusted standard errors plus the data used to calculate them.

Study	Outcome	Sample size	Number of clusters	Unadjusted SE	Is cluster adjustment required?	Mean cluster size	Reported ICC	ICC used in analysis	Cluster-adjusted SE
Amaro 2006	zBMI short term	241	16	0.0384	N	15.06	0.01	n/a	0.0384
Andrade 2014	zBMI long term	1060	20	0.0338	N	53.00	0.02	n/a	0.0338
Andrade 2014	BMI long term	1070	20	0.0607	N	53.50	0.21	n/a	0.0607
Bayne-Smith 2004	BMI short term	442	NR	0.1504	N	NA	n/a	n/a	0.1504
Bogart 2016	Percentile long term	1368	10	0.4774	Y	136.80	n/a	0.02	0.9202
Bonsergent 2013	zBMI long term	3538	24	0.0147	Y	147.42	n/a	0.02	0.0291
Bonsergent 2013	zBMI long term	3538	24	0.0146	Y	147.42	n/a	0.02	0.0290
Bonsergent 2013	zBMI long term	3538	24	0.0147	Y	147.42	n/a	0.02	0.0290
Bonsergent 2013	BMI long term	3538	24	0.0496	Y	147.42	n/a	0.02	0.0983
Bonsergent 2013	BMI long term	3538	24	0.0494	Y	147.42	n/a	0.02	0.0980
Bonsergent 2013	BMI long term	3538	24	0.0493	Y	147.42	n/a	0.02	0.0977
Brito Beck da Silva 2019	BMI medium term	602	12	0.1065	Y	50.17	n/a	0.02	0.1499
Dewar 2013	zBMI medium term	294	12	0.0435	Y	24.50	n/a	0.02	0.0527
Dewar 2013	zBMI long term	234	12	0.0558	Y	19.50	n/a	0.02	0.0653
Dewar 2013	BMI medium term	294	12	0.1746	Y	24.50	n/a	0.02	0.2116
Dewar 2013	BMI long term	234	12	0.2372	Y	19.50	n/a	0.02	0.2777
Dunker 2018	BMI short term	270	10	0.1899	N	27.00	n/a	n/a	0.1899
Ezendam 2012	BMI long term	728	23	0.0862	Y	31.65	0	0	0.0862
French 2011	zBMI medium term	73	90	0.0735	N	0.81	n/a	n/a	0.0735

Gustafson 2019	Percentile short term	411	8	1.0644	Y	51.38	n/a	0.02	1.5081
Haerens 2006	zBMI medium term	1787	10	0.0161	Y	178.70	n/a	0.02	0.0344
Haerens 2006	zBMI medium term	1509	10	0.0165	Y	150.90	n/a	0.02	0.0330
Haerens 2006	zBMI long term	1562	10	0.0166	Y	156.20	n/a	0.02	0.0336
Haerens 2006	zBMI long term	1320	10	0.0170	Y	132.00	n/a	0.02	0.0323
Haerens 2006	BMI medium term	1787	10	0.0539	Y	178.70	n/a	0.02	0.1151
Haerens 2006	BMI medium term	1509	10	0.0556	Y	150.90	n/a	0.02	0.1111
Haerens 2006	BMI long term	1562	10	0.0581	Y	156.20	n/a	0.02	0.1177
Haerens 2006	BMI long term	1320	10	0.0608	Y	132.00	n/a	0.02	0.1157
Harrington 2018	zBMI short term	1405	20	0.0200	Y	70.25	0.003	0.003	0.0220
Harrington 2018	zBMI medium term	1361	20	0.0288	Y	68.05	0.01	0.01	0.0372
Hollis 2016	zBMI medium term	1051	10	0.0346	N	105.10	n/a	n/a	0.0346
Hollis 2016	zBMI long term	985	10	0.0348	N	98.50	n/a	n/a	0.0348
Hollis 2016	BMI medium term	1051	10	0.1198	N	105.10	n/a	n/a	0.1198
Hollis 2016	BMI long term	985	10	0.1199	N	98.50	n/a	n/a	0.1199
Hovell 2018	zBMI long term	693	33	0.0265	Y	21.00	n/a	0.02	0.0313
Isensee 2018	Percentile medium term	1020	23	0.8780	N	44.35	0.04	n/a	0.8780
Jago 2006	BMI short term	416	42	0.1441	N	9.90	n/a	n/a	0.1441
Jago 2006	Percentile short term	403	42	0.8361	N	9.60	n/a	n/a	0.8361
Kennedy 2018	zBMI short term	503	16	0.0405	Y	31.44	n/a	0.02	0.0514
Kennedy 2018	zBMI medium term	464	16	0.0403	Y	29.00	n/a	0.02	0.0504
Kennedy 2018	BMI short term	505	16	0.1553	Y	31.56	n/a	0.02	0.1971
Kennedy 2018	BMI medium term	467	16	0.1553	Y	29.19	n/a	0.02	0.1942
Kuhlemeier 2022	zBMI long term	435	8	0.0432	Y	54.38	n/a	0.02	0.0621
Leme 2018	zBMI short term	194	10	0.0472	Y	19.40	n/a	0.02	0.0552
Leme 2018	zBMI medium term	144	10	0.0491	Y	14.40	n/a	0.02	0.0553
Leme 2018	BMI short term	194	10	0.1642	Y	19.40	n/a	0.02	0.1920
Leme 2018	BMI medium term	144	10	0.2345	Y	14.40	n/a	0.02	0.2640
Lubans 2021	zBMI short term	663	20	0.0403	Y	33.15	n/a	0.02	0.0517
Lubans 2021	zBMI medium term	663	20	0.0487	Y	33.15	n/a	0.02	0.0625
Melnyk 2013	BMI short term	627	11	0.1138	Y	57.00	n/a	0.02	0.1657
Melnyk 2013	BMI medium term	625	11	0.1557	N	56.82	n/a	NA	0.1557
NCT02067728 2014	zBMI short term	130	12	0.0486	Y	10.83	n/a	0.02	0.0532
Neumark-Sztainer 2003	BMI short term	180	6	0.9898	Y	30.00	n/a	0.02	1.2442
Neumark-Sztainer 2010	BMI short term	345	12	0.7322	N	28.75	n/a	n/a	0.7322
Neumark-Sztainer 2010	BMI medium term	336	12	0.7420	N	28.00	n/a	n/a	0.7420
Ooi 2021	zBMI short term	255	6	0.0393	Y	42.50	n/a	0.02	0.0532

Pate 2005	zBMI medium term	1539	24	0.0162	Y	64.13	n/a	0.02	0.0243
Pfeiffer 2019	zBMI short term	1386	24	0.0177	Y	57.75	0.0226	0.0226	0.0268
Prins 2012	zBMI short term	250	35	0.0401	Y	7.14	n/a	0.02	0.0425
Prins 2012	zBMI short term	268	37	0.0386	Y	7.24	n/a	0.02	0.0410
Singh 2009	BMI short term	1031	18	0.0618	Y	57.28	n/a	0.02	0.0901
Singh 2009	BMI medium term	920	18	0.0678	Y	51.11	n/a	0.02	0.0959
Singh 2009	BMI long term	875	18	0.0674	Y	48.61	n/a	0.02	0.0942
Smith 2014	BMI short term	361	14	0.1204	N	25.79	n/a	n/a	0.1204
Takacs 2020	BMI medium term	203	8	0.2236	Y	25.38	n/a	0.02	0.2727
Viggiano 2015	zBMI short term	2156	20	0.0128	N	107.80	0.006	n/a	0.0128
Viggiano 2015	zBMI long term	1045	20	0.0289	N	52.25	0.006	n/a	0.0289
Whittemore 2013	BMI short term	365	35	0.1829	Y	10.43	n/a	0.02	0.1994
Wieland 2018	BMI short term	72	44	0.7171	N	1.64	n/a	n/a	0.7171
Wieland 2018	BMI medium term	66	44	0.4069	N	1.50	n/a	n/a	0.4069
Wilksch 2015	BMI short term	722	54	0.0896	Y	13.37	n/a	0.02	0.1001
Wilksch 2015	BMI medium term	625	54	0.1222	Y	11.57	n/a	0.02	0.1345

Abbreviations: ICC: intra-cluster correlation coefficient; N: no; n/a: not applicable; NR: not reported; SE: standard error; Y: yes.

Appendix 6. Sensitivity analyses

6.1 Excluding high risk of bias studies

The following table shows the results of all meta-analyses in the main analysis (mean difference, 95% confidence interval, and I^2) alongside the equivalent results excluding studies evaluated as high risk of bias.

Comparison: Dietary interventions vs Control										
	Main analysis					Excluding high risk of bias studies				
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	n studies	n participants
BMI short term	-0.18	(-0.41, 0.06)	0	3	605	-0.11	(-0.49, 0.27)	0	2	145
BMI medium term	-0.65	(-1.18, -0.11)	88	3	900	-0.67	(-1.75, 0.41)	92	2	394
BMI long term	-0.3	(-1.67, 1.07)	n/a	1	44	-0.3	(-1.67, 1.07)	n/a	1	44
zBMI short term	-0.06	(-0.12, 0.01)	78	5	3154	-0.08	(-0.16, 0.01)	78	3	2439
zBMI medium term	0.02	(-0.17, 0.21)	n/a	1	112	0.02	(-0.17, 0.21)	n/a	1	112
zBMI long term	-0.14	(-0.38, 0.1)	75	2	1089	-0.14	(-0.38, 0.1)	75	2	1089
Percentile short term	-0.05	(-1.23, 1.13)	0	2	453	0.07	(-1.22, 1.36)	n/a	1	42
Percentile medium term	-1.89	(-3.95, 0.18)	0	2	421	-1.89	(-3.95, 0.18)	0	2	421
Percentile long term	-2.53	(-7.02, 1.96)	n/a	1	44	-2.53	(-7.02, 1.96)	n/a	1	44
Comparison: Activity interventions vs Control										
	Main analysis					Excluding high risk of bias studies				
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	n studies	n participants
BMI short term	-0.64	(-1.86, 0.58)	98	6	1780	-0.7	(-2.27, 0.88)	99	5	1153
BMI medium term	-0.32	(-0.53, -0.11)	33	3	2143	-0.24	(-0.44, -0.04)	0	2	1518
BMI long term	-0.28	(-0.51, -0.05)	n/a	1	985	-0.28	(-0.51, -0.05)	n/a	1	985
zBMI short term	0.02	(-0.01, 0.05)	0	7	4718	0.03	(0, 0.06)	0	5	3200
zBMI medium term	0	(-0.04, 0.05)	48	6	5335	0	(-0.05, 0.05)	58	5	4672
zBMI long term	-0.05	(-0.12, 0.02)	n/a	1	985	-0.05	(-0.12, 0.02)	n/a	1	985
Percentile medium term	-1.09	(-2.81, 0.63)	n/a	1	1020	n/a	NA	n/a	n/a	n/a
Comparison: Dietary and Activity interventions vs Control										
	Main analysis					Excluding high risk of bias studies				
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	n studies	n participants
BMI short term	0.03	(-0.07, 0.13)	0	11	3429	0.05	(-0.06, 0.16)	0	9	2807
BMI medium term	0.01	(-0.09, 0.11)	0	8	5612	0.01	(-0.09, 0.11)	0	8	5612

BMI long term	0.06	(-0.04, 0.16)	55	6	8736	0.07	(-0.05, 0.19)	60	5	6445
zBMI short term	-0.09	(-0.2, 0.02)	77	3	515	-0.22	(-0.33, -0.11)	n/a	1	194
zBMI medium term	-0.05	(-0.1, 0.01)	58	6	3511	-0.04	(-0.12, 0.03)	64	5	3320
zBMI long term	-0.02	(-0.05, 0.01)	30	7	8430	-0.02	(-0.05, 0.01)	9	4	5011
Percentile short term	-1.69	(-3.22, -0.16)	n/a	1	46	n/a	n/a	n/a	n/a	n/a
Percentile long term	-1.05	(-2.85, 0.75)	n/a	1	1368	n/a	n/a	n/a	n/a	n/a
Comparison: Activity interventions vs Dietary interventions										
	Main analysis					Excluding high risk of bias studies				
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	n studies	n participants
BMI short term	0	(-0.28, 0.28)	n/a	1	416	n/a	n/a	n/a	n/a	n/a
Percentile short term	-1.35	(-2.99, 0.29)	n/a	1	403	n/a	n/a	n/a	n/a	n/a

7.2 Different ICCs

The following table shows the results of all meta-analyses in the main analysis (mean difference, 95% confidence interval, and I^2) alongside the equivalent results using imputed ICC values of 0 and 0.04 (compared to 0.02 in the main analysis).

Comparison: Dietary interventions vs Control											
	Main analysis					Analysis with ICC = 0			Analysis with ICC = 0.04		
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	MD	95% CI	I^2
BMI short term	-0.18	(-0.41, 0.06)	0	3	605	-0.18	(-0.41, 0.06)	0	-0.18	(-0.41, 0.06)	0
BMI medium term	-0.65	(-1.18, -0.11)	88	3	900	-0.63	(-1.17, -0.1)	89	-0.66	(-1.2, -0.12)	87
BMI long term	-0.3	(-1.67, 1.07)	n/a	1	44	-0.3	(-1.67, 1.07)	n/a	-0.3	(-1.67, 1.07)	n/a
zBMI short term	-0.06	(-0.12, 0.01)	78	5	3154	-0.06	(-0.12, 0.01)	82	-0.06	(-0.13, 0)	77
zBMI medium term	0.02	(-0.17, 0.21)	n/a	1	112	0.02	(-0.17, 0.21)	n/a	0.02	(-0.17, 0.21)	n/a
zBMI long term	-0.14	(-0.38, 0.1)	75	2	1089	-0.14	(-0.38, 0.1)	75	-0.14	(-0.38, 0.1)	75
Percentile short term	-0.05	(-1.23, 1.13)	0	2	453	-0.14	(-1.24, 0.95)	0	-0.02	(-1.23, 1.2)	0
Percentile medium term	-1.89	(-3.95, 0.18)	0	2	421	-1.89	(-3.95, 0.18)	0	-1.89	(-3.95, 0.18)	0
Percentile long term	-2.53	(-7.02, 1.96)	n/a	1	44	-2.53	(-7.02, 1.96)	n/a	-2.53	(-7.02, 1.96)	n/a
Comparison: Activity interventions vs Control											
	Main analysis					Analysis with ICC = 0			Analysis with ICC = 0.04		
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	MD	95% CI	I^2
BMI short term	-0.64	(-1.86, 0.58)	98	6	1780	-0.64	(-1.72, 0.44)	98	-0.64	(-1.94, 0.67)	98
BMI medium term	-0.32	(-0.53, -0.11)	33	3	2143	-0.31	(-0.52, -0.09)	44	-0.33	(-0.54, -0.13)	25
BMI long term	-0.28	(-0.51, -0.05)	n/a	1	985	-0.28	(-0.51, -0.05)	n/a	-0.28	(-0.51, -0.05)	n/a
zBMI short term	0.02	(-0.01, 0.05)	0	7	4718	0.02	(0, 0.05)	0	0.02	(-0.01, 0.05)	0
zBMI medium term	0	(-0.04, 0.05)	48	6	5335	0	(-0.03, 0.04)	50	0	(-0.04, 0.05)	48
zBMI long term	-0.05	(-0.12, 0.02)	n/a	1	985	-0.05	(-0.12, 0.02)	n/a	-0.05	(-0.12, 0.02)	n/a
Percentile medium term	-1.09	(-2.81, 0.63)	n/a	1	1020	-1.09	(-2.81, 0.63)	n/a	-1.09	(-2.81, 0.63)	n/a
Comparison: Dietary and Activity interventions vs Control											
	Main analysis					Analysis with ICC = 0			Analysis with ICC = 0.04		
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	MD	95% CI	I^2
BMI short term	0.03	(-0.07, 0.13)	0	11	3429	0.02	(-0.06, 0.11)	0	0.03	(-0.08, 0.15)	0
BMI medium term	0.01	(-0.09, 0.11)	0	8	5612	0.02	(-0.05, 0.08)	0	0.01	(-0.11, 0.13)	0
BMI long term	0.06	(-0.04, 0.16)	55	6	8736	0.04	(-0.05, 0.13)	67	0.07	(-0.03, 0.18)	44
zBMI short term	-0.09	(-0.2, 0.02)	77	3	515	-0.09	(-0.21, 0.02)	83	-0.09	(-0.2, 0.02)	72
zBMI medium term	-0.05	(-0.1, 0.01)	58	6	3511	-0.05	(-0.11, 0.01)	72	-0.05	(-0.1, 0.01)	47
zBMI long term	-0.02	(-0.05, 0.01)	30	7	8430	-0.02	(-0.05, 0.01)	55	-0.02	(-0.05, 0.01)	7
Percentile short term	-1.69	(-3.22, -0.16)	n/a	1	46	-1.69	(-3.22, -0.16)	n/a	-1.69	(-3.22, -0.16)	n/a
Percentile long term	-1.05	(-2.85, 0.75)	n/a	1	1368	-1.05	(-1.99, -0.11)	n/a	-1.05	(-3.42, 1.32)	n/a
Comparison: Activity interventions vs Dietary interventions											
	Main analysis					Analysis with ICC = 0			Analysis with ICC = 0.04		
Meta-analysis outcome	MD	95% CI	I^2	n studies	n participants	MD	95% CI	I^2	MD	95% CI	I^2
BMI short term	0	(-0.28, 0.28)	n/a	1	416	0	(-0.28, 0.28)	n/a	0	(-0.28, 0.28)	n/a
Percentile short term	-1.35	(-2.99, 0.29)	n/a	1	403	-1.35	(-2.99, 0.29)	n/a	-1.35	(-2.99, 0.29)	n/a

Abbreviations: CI: confidence interval; ICC: intra-cluster correlation coefficient; MD: mean difference; n/a: not applicable.

Appendix 7. Funnel Plot

We reported only one meta-analysis with more than 10 studies (Dietary and activity interventions versus control for BMI short term). As planned in the protocol, we produced a funnel plot for this meta-analysis, which did not show notable asymmetry (Figure 6). An Egger test for funnel plot asymmetry gave P = 0.53, which does not indicate an important problem.

Appendix 8. Subgroup analyses

We conducted subgroup analyses by main setting of the interventions, country income status and participants socioeconomic status. Here we present the results of the tests for subgroup differences, all the meta-analysis results in summary forest plots, and for each analysis selectively highlight subgroups in which an effect was observed.

8.1 Test for subgroup analysis

The following table shows the results of the test for subgroup differences (P value) alongside the total number of studies and the number of studies in each subgroup.

Comparison: Dietary intervention vs Control							
		Setting		**Country income**		**Socioeconomic status**	
Meta-analysis outcome	**N of studies (total)**	**N of studies/subgroup (school/home/school + home/other)**	**P**	**N of studies/subgroup (high/non high)**	**P**	**N of studies/subgroup (low/mixed)**	**P**
BMI short term	3	0/1/0/2	0.82	3/0	n/a	0/3	n/a
BMI medium term	3	3/0/0/0	n/a	3/0	n/a	0/3	n/a
BMI long term	1	0/0/0/1	n/a	1/0	n/a	0/1	n/a
zBMI short term	5	3/0/0/2	0.44	5/0	n/a	1/4	0.27
zBMI medium term	1	0/0/1/0	NA	1/0	n/a	0/1	n/a
zBMI long term	2	1/0/0/1	0.04	2/0	n/a	0/2	n/a
Percentile short term	2	0/0/0/2	n/a	2/0	n/a	0/2	n/a
Percentile medium term	2	0/0/0/2	n/a	2/0	n/a	1/1	0.52
Percentile long term	1	0/0/0/1	n/a	1/0	n/a	0/1	n/a
Comparison: Activity intervention vs Control							
		Setting		**Country income**		**Socioeconomic status**	
Meta-analysis outcome	**N of studies (total)**	**N of studies/subgroup (school/home/school + home/other)**	**P**	**N of studies/subgroup (high/non high)**	**P**	**N of studies/subgroup (low/mixed)**	**P**
BMI short term	6	6/0/0/0	n/a	5/1	<0.00001	1/5	0.37
BMI medium term	3	2/0/1/0	0.8	3/0	n/a	1/3	0.80
BMI long term	1	0/0/1/0	n/a	1/0	n/a	1/0	n/a
zBMI short term	7	5/1/1/0	0.67	7/0	n/a	2/5	0.09
zBMI medium term	6	4/1/1/0	0.01	6/0	n/a	1/5	0.01
zBMI long term	1	0/0/1/0	n/a	1/0	n/a	1/0	n/a
Percentile short term	0	n/a	n/a	n/a	n/a	n/a	n/a
Percentile medium term	1	0/0/1/0	n/a	1/0	n/a	0/1	n/a
Percentile long term	0	n/a	n/a	n/a	n/a	n/a	n/a
Comparison: Dietary and Activity intervention vs Control							
		Setting		**Country income**		**Socioeconomic status**	
Meta-analysis outcome	**N of studies (total)**	**N of studies/subgroup (school/home/school + home/other)**	**P**	**N of studies/subgroup (high/non high)**	**P**	**N of studies/subgroup (low/mixed)**	**P**
BMI short term	11	7/1/12/1	0.12	9/2	0.33	3/8	0.52
BMI medium term	8	5/1/2/0	0.92	6/2	0.69	3/5	0.29
BMI long term	6	6/0/0/0	n/a	5/1	0.02	1/5	0.12
zBMI short term	3	1/0/1/1	0.01	2/1	0.003	2/1	0.37
zBMI medium term	6	3/2/1/0	0.09	5/0	0.03	4/2	0.003
zBMI long term	7	5/1/0/1	0.19	6/1	0.54	3/4	0.81

Percentile short term	1	0/1/0/0	n/a	1/0	n/a	0/1	n/a
Percentile medium term	0	n/a	n/a	n/a	n/a		n/a
Percentile long term	1	0/0/1/0	n/a	1/0	n/a	1/0	n/a
Comparison: Activity intervention vs Dietary intervention							
		Setting		**Country income**		**Socioeconomic status**	
Meta-analysis outcome	**N of studies (total)**	**N of studies/subgroup (school/home/school + home/other)**	**P**	**N of studies/subgroup (high/non high)**	**P**	**N of studies/subgroup (low/mixed)**	**P**
BMI short term	1	0/0/0/1	n/a	1/0	n/a	0/1	n/a
BMI medium term	0	n/a	n/a	n/a	n/a	n/a	n/a
BMI long term	0	n/a	n/a	n/a	n/a	n/a	n/a
zBMI short term	0	n/a	n/a	n/a	n/a	n/a	n/a
zBMI medium term	0	n/a	n/a	n/a	n/a	n/a	n/a
zBMI long term	0	n/a	n/a	n/a	n/a	n/a	n/a
Percentile short term	1	0/0/0/1	NA	1/0	n/a	0/1	n/a
Percentile medium term	0	n/a	n/a	n/a	n/a	n/a	n/a
Percentile long term	0	n/a	n/a	n/a	n/a	n/a	n/a

Abbreviations: n/a: not applicable

8.2 Subgroup analysis by setting

Summary forest plots for subgroup analyses by setting (school, home, school and home, other) are provided in Figure 7; Figure 8; Figure 9; Figure 10 for BMI; Figure 11; Figure 12; Figure 13 for zBMI; and Figure 14; Figure 15; Figure 16; Figure 17 for BMI percentile.

8.2.1 School

In studies in which the interventions were conducted at school, we found that dietary interventions may reduce BMI at medium-term follow-up (MD -0.65, 95% CI -1.18 to -0.11; 3 studies, 900 participants) and zBMI at long-term follow-up (MD -0.24, 95% CI -0.3 to -0.18; 1 study, 1045 participants), when compared with control.

8.2.2 Home

In one study in which the intervention was conducted at home, we found that a dietary and activity intervention mey reduce BMI percentile at medium-term follow-up (MD -1.69, 95% CI -3.22 to -0.16; 1 study, 46 participants), when compared with control.

8.2.3 School and home

In studies in which the interventions were conducted both at school and at home, we found that activity interventions may reduce BMI at medium-term (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 1051 participants) and long-term (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 985 participants) follow-up. We also found that activity interventions, when compared with control, may reduce zBMI at medium-term follow up (MD -0.08, 95% CI -0.15 to -0.01; 1 study, 1051 participants). Further, we found that dietary and activity interventions, when compared with control, may reduce zBMI at short-term (MD -0.22, 95% CI -0.33 to -0.11; 1 study, 194 participants) and at medium-term (MD -0.16, 95% CI -0.27 to -0.05; 1 study, 144 participants) follow-up.

8.2.4 Other

In one study in which the intervention was conducted in other setting (i.e. neither home or school), we found that dietary and activity intervention, when compared with control, may reduce zBMI at long-term follow-up (MD -0.07, 95% CI -0.13 to -0.01; 1 study, 693 participants).

8.1.5

8.3 Subgroup analysis by country income status

Summary forest plots for subgroup analyses by setting (high income versus non-high income) are provided in Figure 18; Figure 19; Figure 20; Figure 21 for BMI; Figure 22; Figure 23; Figure 24 for zBMI; and Figure 25; Figure 26; Figure 27; Figure 28 for BMI percentile.

8.3.1 High-income countries

In studies conducted in high income countries, we found that dietary interventions may reduce BMI at medium-term follow-up (MD -0.65, 95% CI -1.18 to -0.11; 3 studies, 900 participants); we also found that activity interventions may reduce BMI at medium-term follow-up (MD -0.32, 95% CI -0.53 to -0.11; 3 studies; 2143 participants), as well as BMI at long-term follow-up (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 985 participants), when compared with control. We also found that dietary and activity intervention, compared with control, may reduce BMI percentile at short-term follow-up (MD -1.69, 95% CI -3.22 to -0.16; 1 study, 46 participants).

8.3.2 Non-high-income countries

In studies conducted in non-high-income countries, we found that activity interventions, compared with control, may reduce BMI at short-term (MD -4.03, 95% CI -4.45 to -3.61; 1 study, 160 participants); we also found that dietary and activity intervention compared with control may reduce zBMI at short-term (MD -0.22, 95% CI -0.33 to -0.11; 1 study, 194 participants) and at medium-term follow-up (MD -0.16, 95% CI -0.27 to -0.05; 1 study, 144 participants).

8.4 Subgroup analysis by participants socioeconomic status

Summary forest plots for subgroup analyses by setting (high income versus non-high income) are provided in Figure 4, Figure 4 and Figure 4 for BMI; Figure 4, Figure 4 and Figure 4 for zBMI, and Figure 4, Figure 4, Figure 4 and Figure 4 for BMI percentile.

8.4.1 Low socioeconomic status

In studies in which participants were in a low socioeconomic status, we found that activity interventions compared with control may reduce BMI (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 1051 participants) and zBMI (MD -0.08, 95% CI -0.15 to -0.01; 1 study 1051 participants) at medium-short-term follow-up, as well as BMI (MD -0.28, 95% CI -0.51 to -0.05; 1 study, 985 participants) at long-term follow-up . We also found that dietary and activity interventions, compared with control, may reduce zBMI at mediumterm follow-up (MD -0.08; 95% CI: -0.12 to -0.04; 4 studies; 813 participants).

8.4.2 Mixed socioeconomic status

In studies in which participants were in a mixed socioeconomic status, we found that dietary interventions compared with control reduced BMI at medium-term follow-up (MD -0.65, 95% CI -1.18 to -0.11; 3 studies, 900 participants); also we found that dietary and activity intervention compared with control reduced BMI percentile at short-term (MD -1.69, 95% CI -3.22 to -0.16; 1 study, 46 participants).

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Additional tables

Table 1

Further details of the population

Comparison: Dietary interventions vs control						
Study ID	Meta-analysis outcome(s)	Were children with physical disabilities excluded?	Were children with mental disabilities excluded?	Supporting evidence on the exclusion of children with physical and/or mental disabilities	Does study specifically target disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area?	Supporting evidence on targeting disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area
Amaro 2006	zBMI short term	NR	NR	NR	No	NR
Ebbeling 2006	BMI short term	No	No	NR	No	NR
Gustafson 2019	BMI percentile short term	NR	NR	NR	No	NR
Kuroko 2020	zBMI medium term	Yes	Yes	Participants were excluded if they had a condition that prevented them from working in a kitchen	No	NR
Lappe 2017	BMI percentile medium term	No	Yes	Participants were excluded if they used ADHD, seizure or anti-depressants medication or were diagnosed with eating disorders	No	NR
Luszczynska 2016b	BMI medium term	No	No	NR	No	NR
Mihas 2010	BMI medium term	No	No	NR	No	NR
Ooi 2021	zBMI short term	Yes	Yes	Participants with special needs were excluded	Yes	The schools were recruited in the Hunter region of NSW which has a lower socio-

						economic status than the New South Wales average (5/6 schools were classified as disadvantaged)
Papadaki 2010	BMI short term; zBMI short term	Yes	Yes	Participants using prescription medication, with psychiatric disease (based on medical history only) or suffering from diseases or conditions that might influence the outcome of the study were excluded	No	NR
Shin 2015	BMI percentile medium term	No	No	NR	Yes	The study setting is a low-income area of Baltimore City
Shomaker 2019	BMI short term; BMI long term; zBMI short term; zBMI long term; BMI percentile short term; BMI percentile long term	No	Yes	Included participants were "free of psychiatric symptoms that would impede compliance and necessitate treatment (e.g., suicidal behavior)"	No	NR
Takacs 2020	BMI medium term	NR	NR	NR	No	NR
Viggiano 2015	zBMI short term; zBMI long term	No	No	NR	No	NR
Comparison: Activity interventions vs control						
Study ID	**Meta-analysis outcome(s)**	**Were children with physical disabilities excluded?**	**Were children with mental disabilities excluded?**	**Supporting evidence on excluded children with mental disabilities**	**Does study specifically target disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area?**	**Supporting evidence on targeting disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area**
Arlinghaus 2021	zBMI short term	No	No	NR	Yes	The purpose of this study was to compare weekday and weekend MVPA between low-income, Hispanic-American middle school students
El Ansari 2010	BMI short term	Yes	Yes	Participants taking any medications for any chronic disease, and reporting any cardio-respiratory complaints were excluded	No	NR
Harrington 2018	zBMI short term; zBMI medium term	NR	NR	NR	No	NR
Hollis 2016	BMI medium term; BMI long term; zBMI medium term; zBMI long term	Yes	Yes	Classes catering for students with severe physical and mental disabilities were excluded (from study protocol)	Yes	The 'Physical Activity 4 Everyone' (PA4E1) study tested a multi-component physical activity intervention in 10 secondary schools from socio-economically disadvantaged communities
Isensee 2018	BMI percentile medium term	NR	NR	Schools for disabled students were excluded, it is not reported if children in the included schools that had physical and/or mental disabilities were excluded from the study	No	NR
Kennedy 2018	BMI short term; BMI medium term; zBMI short	No	No	NR	No	NR

	term; zBMI medium term					
Lubans 2021	zBMI short term; zBMI medium term	Yes	Yes	Students that have a health or medical condition that would preclude participation in vigorous physical activity were excluded	No	NR
Melnyk 2013	BMI short term; BMI medium term	No	No	NR	No	NR
Pate 2005	zBMI medium term	NR	NR	NR	No	NR
Pfeiffer 2019	zBMI short term	No	No	NR	Yes	The study targeted schools in low-income areas
Prins 2012	zBMI short term	No	No	Schools were pupils have very low reading skills (i.e. pupils that are not able to fill in a questionnaire) were not included (from trial registry)	No	NR
Simons 2015	zBMI short term; zBMI medium term	No	No	NR	No	NR
Smith 2014	BMI short term	No	No	NR	Yes	The study setting is a low-income area of New South Wales, Australia
Velez 2010	BMI short term	No	No	NR	No	NR
Weeks 2012	BMI short term	Yes	Yes	Subjects were included if they were of sound general health, fully ambulatory. Subjects were excluded from the study if they had a endocrine disorder, metabolic disease, or chronic renal pathology, were taking medications known to affect the musculoskeletal system, were recovering from lower limb injury, or were affected by any condition not compatible with intense physical activity	No	NR
Comparison: Dietary and activity interventions vs control						
Study ID	**Meta-analysis outcome(s)**	**Were children with physical disabilities excluded?**	**Were children with mental disabilities excluded?**	**Supporting evidence on excluded children with mental disabilities**	**Does study specifically target disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area?**	**Supporting evidence on targeting disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area**
Andrade 2014	BMI long term; zBMI long term	Yes	Yes	Children with severe medical or physical disorder were excluded	No	NR
Bayne-Smith 2004	BMI short term	NR	NR	NR	No	NR
Black 2010	zBMI medium term; zBMI long term	No	No	NR	Yes	Eligibility criteria included being a resident of the low-income communities surrounding the medical center where the study was based
Bogart 2016	BMI percentile long term	No	No	NR	Yes	Only students eligible for the National School Lunch Program (NSLP) were included in the study. Eligibility criteria was to include schools with >50% NSLP-eligible students (a proxy for low-

						income). Quote: "The present study was an RCT that included 5 intervention schools and 5 wait-list control schools in the Los Angeles Unified School District (LAUSD), a primarily Latino school district in Los Angeles County in which 15% of seventh-graders (~12–13 years old) and 19% of ninth-graders (~14–15 years old) were estimated to be obese in the 2012–2013 school year, and 22% of seventh-graders and 25% of ninth-graders were estimated to be overweight"
Bonsergent 2013	BMI long term; zBMI long term	No	No	NR	No	NR
Brito Beck da Silva 2019	BMI medium term	NR	NR	NR	No	NR
Chen 2011	BMI short term	Yes	Yes	Students were included if they were in good health, defined as free of an acute or life-threatening disease	No	NR
Dewar 2013	BMI medium term; BMI long term; zBMI medium term; zBMI long term	Yes	Yes	Children with a medical condition or physical injury preventing testing or participation were excluded	Yes	To be eligible for the study, students were considered by their teachers to be disengaged in physical education and/or not currently participating in organized team or individual sports. The study is targeting girls from economically disadvantaged secondary schools
Dunker 2018	BMI short term	No	Yes	Participants that showed behaviors involving vomiting after meals or taking laxatives, both with the intent of losing weight, and occurring at least once a week were excluded	No	NR
Ezendam 2012	BMI long term	No	No	NR	No	NR
French 2011	zBMI medium term	Yes	Yes	Participants were excluded if they had conditions that would prevent their participation in intervention activities	No	NR
Haerens 2006	BMI medium term; BMI long term; zBMI medium term; zBMI long term	NR	NR	NR	No	NR
Hovell 2018	zBMI long term	Yes	Yes	Participants were excluded if they were unable to care for themselves, had been diagnosed with an eating disorder or severe depression	No	NR
Kuhlemeier 2022	zBMI long term	Yes	Yes	Children with inability to perform MVPA or that were not ambulatory were excluded from the study. Children with a score of 20 or more on Eating Attitudes Test (EAT)-26 screening measure, were under antipsychotics treatment, had developmental disorders that affect	Yes	Enrolled schools were located in high poverty areas

				weight or ability to understand the study procedures or counselling were excluded from the study		
Leme 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	No	No	NR	Yes	The study targeted adolescent girls from low-income backgrounds enrolled in high schools of the city of São Paulo, Brazil. Schools located in census tracts with medium human development index (HDI) were considered eligible. Public high schools located in different low-income areas of the city of São Paulo with medium HDI and at least 100 students in the target year bracket were eligible to participate in the study
NCT02067728 2014	zBMI short term	Yes	Yes	Participants with chronic medical conditions or developmental delays that precluded age-appropriate nutrition and physical activity habits were excluded (from study protocol)	No	NR
Neumark-Sztainer 2003	BMI short term	Yes	Yes	Girls with medically reported eating disorder and/or reported disordered eating behaviors were excluded	No	NR
Neumark-Sztainer 2010	BMI short term; BMI medium term	No	No	NR	No	NR
Peralta 2009	BMI short term	No	No	NR	No	NR
Reesor 2019	zBMI short term; zBMI medium term	No	No	NR	Yes	The purpose of this study was to examine seasonal weight patterns in low-income, urban, Hispanic middle school students
Rodearmel 2006	BMI percentile short term	No	No	NR	No	NR
Schreier 2013	BMI short term	Yes	Yes	Children with chronic medical illness were excluded	Yes	This school was chosen in part because many youths attending the school come from low socioeconomic backgrounds. It is unclear if the area is disadvantaged
Singh 2009	BMI short term; BMI medium term; BMI long term	No	No	NR	No	NR
Wieland 2018	BMI short term; BMI medium term	Yes	Yes	Participants that answered “yes” to the question “Do you know of any reason why you should not do physical activity?” were excluded from the study	Yes	The aim of the study was to develop and evaluate a sustainable, socio-culturally appropriate physical activity and nutrition intervention with and for immigrant and refugee families
Wilksch 2015	BMI short term; BMI medium term	NR	NR	NR	No	NR
Comparison: Activity intervention vs dietary interventions						
Study ID	**Meta-analysis outcome(s)**	**Were children with physical disabilities excluded?**	**Were children with mental disabilities excluded?**	**Supporting evidence on excluded children with mental disabilities**	**Does study specifically target disadvantaged children/families in a particular setting and/or a school/community within a**	**Supporting evidence on targeting disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area**

					disadvantaged area?	
Jago 2006	BMI short term; BMI percentile short term	No	No	NR	No	NR

Studies not included in meta-analyses

Study ID	Comparison	Were children with physical disabilities excluded?	Were children with mental disabilities excluded?	Supporting evidence on excluded children with mental disabilities	Does study specifically target disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area?	Supporting evidence on targeting disadvantaged children/families in a particular setting and/or a school/community within a disadvantaged area
Afam-Anene 2021	Dietary intervention *vs* Control	NR	NR	NR	NR	NR
Ahmed 2021	Dietary and Activity intervention *vs* Control	Yes	Yes	Participants with physical disability that hampered PA and/or participants that were mentally challenged were excluded from the study	No	NR
Barbosa Filho 2017	Activity intervention *vs* Control	No	No	NR	Yes	All schools were in areas with a low Human Development Index (a composite index ranging from zero to one - the closer of number one more developed is the neighbourhood - based on life expectancy, education level and standard of living)
Belton 2019	Activity intervention *vs* Control	No	No	NR	No	NR
Bernstein 2019	Dietary and Activity intervention *vs* Dietary and Activity intervention	Yes	Yes	Participants were excluded if they had serious cognitive or developmental comorbidities that might interfere with their ability to complete questionnaires	Yes	The study targeted minority, low SES middle school students. Quote: "The Expand, Connect, Thrive (ECT) program was designed specifically for a school-based health clinic operating within an urban middle school in south Florida that primarily serves low-income, minority adolescents"
Cohen 2021	Activity intervention *vs* Control	Yes	Yes	Participants were excluded if they had conditions that prevent them from, or put them at risk from, performing the evaluations or the training program	No	NR
Farias 2015	Activity intervention *vs* Control	Yes	No	Children with permanent or temporary physical disabilities that prevented anthropometric measurements and the performance of physical exercise were excluded	No	NR
Haire-Joshu 2015	Dietary and Activity intervention *vs* Control	No	No	NR	Yes	Low-income adolescent girl parent (less than one year postpartum) with ~90% participating in WIC (Special Supplemental Nutrition Program for Women, Infants, and Children assistance program for healthcare and nutrition of low-income pregnant women, breastfeeding women, and

						children under the age of five) were the target of the intervention
Lana 2014	Dietary intervention *vs* Control	No	No	NR	No	NR
Mauriello 2010	Dietary and Activity intervention *vs* Control	NR	NR	NR	No	NR
Nanney 2016	Dietary intervention *vs* Control	No	No	NR	No	NR
O'Connell 2005	Dietary intervention *vs* Control	Yes	Yes	Students with special education needs were excluded	No	NR
Patrick 2006	Dietary and Activity intervention *vs* Control	Yes	Yes	Adolescents were excluded if they had health conditions that would limit their ability to comply with PA or diet recommendations	No	NR
Razani 2018	Activity intervention *vs* Activity intervention	Yes	Yes	Children unable to walk (or be otherwise physically active), to attend the intervention park outings or to complete two follow-up visits over three months were excluded	Yes	The target population is low-income families living in urban areas
Sabino 2021	Dietary and Activity intervention *vs* Control	NR	NR	NR	No	NR
Slawson 2015	Dietary and Activity intervention *vs* Control	Yes	Yes	Participants were excluded if they presented an underlying condition affecting weight status such as hypothyroidism, Cushing's syndrome, or chronic steroid use, hypertension, diabetes, or severe orthopedic problems. Participants were excluded if they had diagnosed eating disorder such as anorexia nervosa and bulimia nervosa	No	NR
TenHoor 2018	Activity intervention *vs* Control	NR	NR	NR	No	NR
Whittemore 2013	Dietary and Activity intervention *vs* Dietary and Activity intervention	No	Yes	Students were excluded if cognitive functioning prohibited them from completing study questionnaires and program materials, as identified by teachers	No	NR
Zhou 2019	Dietary and Activity intervention *vs* Control; Activity intervention vs Control	Yes	No	Students that had a diagnosed physical disability were excluded from the study	No	NR
Zota 2016	Dietary intervention *vs* Dietary intervention	NR	NR	NR	Yes	The study targets students attending both elementary and secondary schools in areas of low socioeconomic status

Abbreviations: ADHD: attention deficit hyperactivity disorder; MVPA: moderate to vigorous physical activity; NR: not reported; NSLP: National School Lunch Program; PA: physical activity; RCT: randomized controlled trial; SES: socioeconomic status.

Short-term follow-up: 12 weeks from baseline to < 9 months. Medium-term follow-up: 9 months from baseline to < 15 months. Long-term follow-up: 15 months or more.

Table 2

Description of the interventions

Comparison: Dietary intervention vs Control						
Study ID	Meta-analysis outcome(s)	Setting of intervention	Intervention/study name	Intervention (short description)	Comparison type	Comparator (short description)
Amaro 2006	zBMI short term	School	Kaledo	The Kaledo intervention consisted in one play session (15–30 min) with the board game Kaledo, every week for 20 weeks. From Viggiano 2015: "A game session represents a journey through daily meals of the Mediterranean diet. At the start, each player receives four chips and sets the energy expenditure of his/her kaleidoscope on the value corresponding to his/her basal metabolic rate (BMR) (BMR is obtained by consulting a simple table on the kaleidoscope which is based on age and weight). The game allows each player to personalize the BMR according to the sex, the weight, and the age. During a game session, the players move their pawns on the 59 boxes on the board and, consequently, they receive nutrition cards (common food items of Mediterranean diet) or activity cards (common daily activity) as indicated in the destination boxes. A player can refuse to take a card by leaving one chip. In this way, he can try to balance the total energy intake (EI) given by the nutrition cards with the total energy expenditure (EE) given by the activity cards and the BMR. At the end of the game, the winner is the person with maximum points calculated on the bases of energy balance (maximum 5 points), best food items (maximum 4 points), and food variety (maximum 1 point). Seven special boxes on the board act as a punishment or a reward during the game and they are associated with specific dietary behavior in real life (e.g., a fast food lunch). Therefore, Kaledo could affect dietary behavior by a knowledge-based nutrition education and/or a behaviorally focused nutrition education." The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	Participants from the control group did not have any play sessions with Kalèdo
Ebbeling 2006	BMI short term	Home + Telehealth	BASH - Beverages and Student Health	The households in the BASH intervention group received weekly home deliveries of noncaloric beverages for 25 weeks. Each household was contacted by telephone during the first week of the intervention to provide an opportunity to reinforce instructions, answer questions, and address concerns. After, each subject was contacted by telephone on a monthly basis throughout the intervention period to assess satisfaction with beverage choices and deliveries, discuss beverage consumption, and provide motivational counselling. The intervention includes a home activity:	No active intervention	Participants in the control group were asked to continue their usual beverage consumption habits throughout the 25-week intervention period

					no The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: yes		
	Gustafson 2019	BMI percentile short term	Telehealth	Go Big and Bring it Home	Go Big and Bring It Home was a eight-week text-messaging intervention. The text messages were primarily affective messages, and included a weekly challenge related to consuming fruits, vegetables, or healthy/low-calorie beverages. Undergraduate nutrition students sent text messages on Tuesday and Saturday every week over the eight-week period via the "Group Me" mobile application. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	Controls received no information or text messages during the eight-week intervention
	Kuroko 2020	zBMI medium term	School (ASP) + Home + Web	COOK (Create Our Own Kai)	The COOK (Create Our Own Kai) intervention arm had two phases. Phase one (COOK week) was an intensive five-day practical cooking program during school holidays. Phase two (support phase) was a home-based, social media-led six-week period, when participants received weekly meal kits. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	Control participants completed study measurements only
	Lappe 2017	BMI percentile medium term	Community	NR	The dairy intervention group was asked to consume low-fat (skim, 1%, or 2%) milk or low-fat yogurt servings providing $1200 mg Ca/d. The girls were asked to avoid taking calcium supplements during the study. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies	No active intervention	The control group was asked to continue on their usual diet of ~600 mg calcium/day and to avoid taking calcium supplements during the study

					(three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	Luszczynska 2016b	BMI medium term	School	NR	All experimental conditions in this study included the initial session (filling the forms individually in groups + face-to-face component) and three sets of handouts for three following weeks. The face-to-face component was delivered within three days from filling the forms. Planning intervention: participants were asked to read the materials and fill in the forms provided. The introductory part included an abbreviated version of the education materials used in the control group. The planning materials and forms focused on (1) planning for FVI and (2) planning for the substitution behaviour (replacing energy dense foods with FVI). Self-efficacy intervention: the self-efficacy materials and forms focused on (1) self-efficacy for FVI and (2) self-efficacy for the substitution behaviour (replacing energy-dense foods with FVI). In the self-efficacy forms, participants were invited to read self-efficacy definitions. Participants were informed about the studies targeting self-efficacy and nutrition that helped people to lead a healthy life. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: no	Attention control	"The control group participants were asked to read the materials and fill in the forms provided. Participants received a set of educational materials (including crosswords) about healthy nutrition, which focused on FVI and consumption of energy dense foods. The materials excluded planning and self-efficacy statements."
	Mihas 2010	BMI medium term	School	VYRONAS (Vyronas Youth Regarding Obesity, Nutrition and Attitudinal Styles)	The VYRONAS intervention was a 12-week teacher-implemented intervention in combination with seminars organized for parents was aimed at improving children's diet and nutrition knowledge. Multi-component workbooks covering mainly dietary issues, but also dental health hygiene and consumption attitudes, were produced with each student being supplied a workbook. The health and nutrition components of the programme were conducted by the class home economics teacher supervised by a health visitor or a family doctor and incorporated 12 h of classroom material during 12 weeks. After the end of the baseline examinations, two meetings were organized whereby parents in the intervention group were given a file containing their child's screening results. During these meetings, presentations on the importance of topics relevant to the dietary habits of children were issued; a special comment was made for each obese child, although his/her identity was not revealed for privacy reasons. Parents were also encouraged to modify their dietary habits as well as those of their children.	No active intervention	"The control group received an envelope with all medical screening results plus some brief comments (mailed to the parents). The control group did not undertake any health education intervention and no parental educational sessions took place."

					The intervention includes a home activity: yes The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		
	Ooi 2021	zBMI short term	School	SwitchURsip	SwitchURsip is a multi-component intervention designed to reduce students' consumption of sugar-sweetened beverages (SSB). The intervention targeted modifiable factors including school SSB availability and convenience, pricing of SSBs, health-related self efficacy, peer influence, home SSB availability and parental intake of SSBs. Intervention components included: school guiding principles to supplement the school's existing plans; food outlet (school canteens) modifications based on principles of choice architecture; installation of water stations on school grounds; curriculum lessons targeting SSBs; peer-led school challenge designed and led by a student committee; six short fortnightly health messages to students; six short fortnightly health messages to parents; newsletter snippets to provide updates on the intervention. The intervention includes a home activity: yes The intervention is delivered: as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes	No active intervention	"Students attending schools allocated to the control group continued with their standard school programs and operations."
	Papadaki 2010	BMI short term; zBMI short term	Community	DiOGenes (diet, obesity, and genes)	Diogenes is a dietary intervention. Trained dieticians gave detailed instructions on the ad libitum diets. All diets were low in fat (25%–30% of energy). During the intervention, children were requested to attend 6 counselling sessions, accompanied by their parents, during which intensive guidance was provided. Dieticians advised on weight control and reinforced the diet composition messages through food-choice and behavior-modification advice. At two centres the families were provided dietary instruction plus free foods for 6 months followed by 6-month dietary instruction only. At the remaining six centres the families received dietary instruction only for 6 months. The four intervention diets were: LP/LGI: low protein (LP)/low glycaemic index (LGI) LP/HGI: low protein (LP)/high glycaemic index (HGI) HP/LGI: high protein (HP)/low glycaemic index (LGI) HP/HGI: high protein (HP)/ high glycaemic	No active intervention	"Control group followed a diet according to current national dietary guidelines in each of the countries, with a medium protein content and with no specific instructions on GI."

					index (HGI) The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		
	Shin 2015	BMI percentile medium term	Community	BHEZ (The Baltimore Healthy Eating Zones)	The Baltimore Healthy Eating Zones intervention aimed to increase availability and selection of healthful foods through nutrition promotion and education. During the 8-month intervention, materials and activities, such as taste tests, cooking demonstrations, giveaways, shelf labels, and point-of-purchase health communication materials such as posters and flyers, were introduced in intervention recreation centers, local corner stores, and carryout restaurants. Interventions in each venue were interconnected and reinforced each other. For instance, increased stocking of healthful foods at corner stores was reinforced by nutrition education at recreation centers by directing community residents to purchase the promoted healthful foods from the store. Venues were incentivised to stock additional healthier, affordable foods. Each of the intervention's five phases focused on a single aspect of healthful eating: healthful beverages, healthful breakfast, cooking at home/healthful lunch, healthful snacks, and selecting more healthful options at carryout restaurants. Youth peer educators were recruited from each intervention recreation center and trained by interventionists to assist in health promotions. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes	No active intervention	NR
	Shomaker 2019	BMI short term; BMI long term; zBMI short term; zBMI long term; BMI percentile short term; BMI percentile long term	Community + Home	Learning to BREATHE	Mindfulness-based group. Learning to BREATHE is a curriculum derived from mindfulness-based stress reduction and adapted for adolescents with experiential activities and guided discussions to teach standard mindfulness skills. Examples include breath awareness, body scanning, mindful eating, sitting meditation, loving-kindness practice, and gentle yoga. The original curriculum was designed to offer flexibility to facilitators in delivery timing and selection of exercises. A manualized version of BREATHE was used for consistency in timing and content, but the	Attention control	"The comparison group received health education that was drawn from a didactic program, "Hey Durham", as a control condition matched for instruction time and designed to parallel health knowledge presented in a middle/high school

					content was minimally modified from its original format. For instance, in session 1, a brief justification (~1 min) of how program participation may help adolescents to maintain a healthy weight over time was added. The amount of intervention time spent on eating was not increased from the standard program. Brief (~10 min/day) homework was assigned for practicing skills in daily life. Adolescents were given meditation audio recordings, a yoga mat, a meditation cushion, homework log, and worksheets. They reported homework completion at sessions 2–6 to facilitators. The intervention was co-facilitated by Master's graduate students in Marriage and Family Therapy who attended a workshop with the developer and reviewed/practiced material with the lead investigator, a licensed clinical psychologist. The intervention includes a home activity: yes The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: yes		health class. The comparison group received sessions that covered six topics including alcohol/drug use, nutrition/body image, domestic violence, gang violence/non-violent conflict resolution, sun safety, and major depression/signs of suicide. The section on nutrition/body image provided basic information on healthy eating and unhealthy eating (e.g., extreme dieting). This segment did not overlap with the content on mindful eating in the Learning to BREATHE intervention."
Takacs 2020	BMI medium term	School + School (ASP) + Web	NR	The intervention included three main components: 1) weekly classroom-based education (25 to 45 minutes long); 2) five sessions of after-school cooking classes (open to the entire family); and 3) online education materials distributed via e-mails and social media. The weekly classroom-based education developed in this study included both theoretical and practical parts and were led by the same trained dietician in each intervention class. A total of 27 interactive sessions were delivered over the period of 9 months. Sessions started with the theoretical part followed by a tasting or meal preparation activity. During the first academic semester tasted foods were prepared by the dietician in advance. In the second semester, children prepared the foods in the schools' small kitchen unit as part of the session with the help of the dietician. Topics covered within the education sessions included the principles of healthy nutrition, relation between nutrition and health, the role of different nutrients, importance of different meals (i.e. breakfast, lunch, dinner and snacks), healthy snacking, role and recommended amount of different food groups, labelling, and healthy party tips. Games and tasting were incorporated to reinforce main messages of each session. After-school cooking classes were offered five times in the second semester and were attended by children, parents and grandparents. They aimed to educate caregivers, and to increase the involvement of children in meal preparation and cooking. Similarly to classroom-based activities, these sessions had both theoretical and practical parts, but here more emphasis was put on practice. Activities were organized in the schools' small kitchen unit and typically lasted 1 or 2 hours. Recipes posted on Facebook or	No active intervention	Control classes continued their usual curriculum

				sent via e-mail completed the intervention and strengthened its family-involvement component. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
Viggiano 2015	zBMI short term; zBMI long term	School	Kaledo	The Kaledo intervention consisted in one play session (15–30 min) with the board game Kaledo, every week for 20 weeks. One play session (15–30 min) with the board game Kaledo, every week for 20 weeks. "A game session represents a journey through daily meals of the Mediterranean diet. At the start, each player receives four chips and sets the energy expenditure of his/her kaleidoscope on the value corresponding to his/her basal metabolic rate (BMR) (BMR is obtained by consulting a simple table on the kaleidoscope which is based on age and weight). The game allows each player to personalize the BMR according to the sex, the weight, and the age. During a game session, the players move their pawns on the 59 boxes on the board and, consequently, they receive nutrition cards (common food items of Mediterranean diet) or activity cards (common daily activity) as indicated in the destination boxes. A player can refuse to take a card by leaving one chip. In this way, he can try to balance the total energy intake (EI) given by the nutrition cards with the total energy expenditure (EE) given by the activity cards and the BMR. At the end of the game, the winner is the person with maximum points calculated on the bases of energy balance (maximum 5 points), best food items (maximum 4 points), and food variety (maximum 1 point). Seven special boxes on the board act as a punishment or a reward during the game and they are associated with specific dietary behavior in real life (e.g., a fast food lunch). Therefore, Kaledo could affect dietary behavior by a knowledge-based nutrition education and/or a behaviorally focused nutrition education." The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	The schools allocated to the control group did not participate to any game session with Kaledo
Comparison: Activity intervention vs Control						

Study ID	Meta-analysis outcome(s)	Setting of intervention	Intervention/study name	Intervention (short description)	Comparison type	Comparator (short description)
Arlinghaus 2021	zBMI short term	School	FLOW-PA (Family Lifestyle Overweight Prevention Program-Physical Activity)	The intervention consisted of the physical activity component of an obesity intervention with established efficacy at reducing standardized BMI amongst this population. Only the physical activity component of the obesity intervention was included. No nutrition education was provided as part of the current intervention. Intervention activities were rooted in Social Cognitive Theory. Trained research staff partnered with physical education teachers to facilitate lessons and undergraduate college students were trained to complete activities with participants. The exercise component was focused on incrementally increasing physical activity and decreasing sedentary activity. Students participated in 45-min physical activity training sessions four times per week. They learned to gradually increase their performance to become more comfortable with and more skilled at performing physical activity, eventually being encouraged to engage in physical activity for at least 60 min daily. Students were taught to regulate exertion/intensity by monitoring heart rate during physical activity. The first “phase” of these classes was designed to increase endurance, coordination, and overall confidence in physical activity, preparing for more applied activities. A circuit training approach was used that incorporated aerobic and strength training exercises as this has been shown to increase physical activity in children and adolescents. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child’s behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	The control group participated in physical education class as it was traditionally taught in the school district
El Ansari 2010	BMI short term	School (ASP)	NR	The PA intervention programme comprised an ‘after-school’ one hour of moderate exercise three times a week for three months. Both the controls and the intervention pupils attended the ‘normal’ exercise schedule provided by the school; in addition, the intervention group attended after-school PA programme from about 2–3 o’clock in the afternoon. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child’s behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	The control group attended the ‘normal’ exercise schedule provided by the school

Harrington 2018	zBMI short term; zBMI medium term	School	Girls Active	Active is focused on providing a support framework to schools to review their physical activity, sport and PE provision, culture and practices to ensure they are relevant and attractive to all adolescent girls but with a particular focus on 11–14-year-old girls (Key Stage 3). Furthermore, 'Girls Active' uses peer leadership and marketing to empower girls to influence decision-making in their school, develop as role models and 'sell' physical activity to other girls. This process is underpinned by teachers and girls working together to understand the preferences and motivations of girls to take part in physical activity, sport and PE. 'Girls Active' is designed to be a flexible process for delivery, but there are several key elements that underpin the programme. The elements included: self-evaluation and mission analysis; training for school leads; package of resources; peer leadership and marketing group; using the student 'voice' to develop and market ideas for change; on-going support and mentorship from the Health and Wellbeing School and the Youth Sport Trust ; peer review day; funding for capacity building within the school. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: yes	No active intervention	"Control arm schools were not given any specific guidance or advice and were assumed to carry on with their usual practice of PE and sport provision."
Hollis 2016	BMI medium term; BMI long term; zBMI medium term; zBMI long term;	School + Community + Home	PA4E (Physical Activity 4 Everyone)	The Physical Activity 4 Everyone intervention components targeted the school curriculum, school environment, and broader community and parental support in accordance with the WHO's Health Promoting Schools framework. School curriculum included: teaching strategies to maximise student physical activity in health and physical education lessons; development and monitoring of student physical activity plans within lessons; implementation of an enhanced school sports programme. School environment included: development and modification of school policies; physical activity programmes during school breaks. Partnership and services included: promotion of community physical activity providers; parent engagement (information was regularly sent to the parents). The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes	No active intervention	"Controls schools were requested to follow their usual physical activity and sport programmes during the study period and were offered all intervention materials, equipment packs and the findings at the conclusion of the study."

				– change the physical environment of the child: yes		
Isensee 2018	BMI percentile medium term	School + Home	The Lauft Program	The ‘‘lauft’’ program is a 12-week school-based PA program targeting students aged 12-15 years. To address students’ PA levels throughout the entire day, the program integrates different behavior change strategies such as self-monitoring, goal setting, and social support with pedometer use. All the students received pedometers to evaluate their daily PA. They could document their steps and experiences using an interactive user account on the project homepage. In addition to pedometers, main components of‘‘lauft’’ are 2 class competitions encompass the following: (1) in 3 selected weeks (1, 5, and 11), classes averaged all steps to a class mean. Classes with the highest means of steps/week as well as with the largest increase were awarded with cash prizes. (2) Classes were motivated to collect creative ideas on how to increase PA in everyday school life and to keep record of these ideas. Classes with the most creative class projects were awarded. In addition, classes participated in 4 educational lessons aimed at introducing both competitions, giving, and creating ideas how to integrate PA in everyday life and reflecting strategies to be more physically active. The headmaster and entire teaching staff of participating schools as well as parents received elaborated information material. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child’s behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	Usual curriculum with no further intervention
Kennedy 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	School + Web	Resistance Training for Teens	The Resistance Training for Teens intervention was guided by social cognitive theory and self-determination theory and included the following sex-targeted components: an interactive student seminar; a structured physical activity program, which focused on RT; lunchtime fitness sessions; and a Web-based smartphone app. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child’s behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: yes	No active intervention	"The control group participated in usual practice (regularly scheduled PE and cocurricular school sport) for the duration of the intervention and received the intervention after the 12-month assessments."
Lubans 2021	zBMI short term; zBMI	School + Web	B2L (Burn 2 Learn)	Teachers from the intervention schools were provided with training, resources and	No active intervention	"Students participate in usual

	medium term			support to facilitate the delivery of high-intensity activity breaks. In addition to the HIIT activity breaks (hereafter, referred to as B2L sessions), the B2L intervention also included: (i) information seminar for students delivered by teachers, (ii) purpose-built smartphone application and HR monitors to support B2L session delivery and (iii) newsletters for parents. We used a range of implementation strategies to support the delivery of the B2L programme in schools. Students were encouraged to reach 85% of their age-predicted HRmax using the B2L smartphone app and HR monitors. Teachers were provided with 11 different styles of HIIT, designed to appeal to the interest of students. The intervention includes a home activity: yes The intervention is delivered: as a group The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		school activities and external sports and exercise. Students allocated to the control condition received the intervention following the final assessments."
Melnyk 2013	BMI short term; BMI medium term	School + Home	COPE (Creating Opportunities for Personal Empowerment) Healthy Lifestyles TEEN (Thinking, Emotions, Exercise, Nutrition) Program	The COPE program is a manualized 15-session educational and cognitive–behavioral skills-building program guided by cognitive theory, with physical activity as a component of each session. Each session of COPE contains 15–20 minutes of physical activity (e.g., walking, dancing, kick-boxing movements), not intended as an exercise training program, but rather to build beliefs in the teens that they can engage in and sustain some level of physical activity on a regular basis. Pedometers were used throughout the intervention in order to reinforce the physical activity education component of COPE. Students were asked to increase their step counts by 10% each week regardless of baseline levels and to keep track of their daily steps on a tracking sheet so they could calculate a weekly average and determine if they met their weekly goal. Teens received a COPE manual with homework activities for each of the 15 sessions that reinforced the content and skills in the program. A parent newsletter describing the content of the COPE program also was sent home with the teens four times during the course of the 15-week program, and the teens were instructed to review each newsletter with their parent(s) as part of their homework assignments. The intervention includes a home activity: yes The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the	Attention control	"The Healthy Teens program was designed as a 15-week attention control program to control for the time the health teachers in the COPE group spent delivering the experimental content to their students. Health teachers received a full-day training workshop on the Healthy Teens content. The content was manualized and focused on safety and common health topics/issues for teens, such as road safety, dental care, infectious diseases, immunizations, and skin care. The control group also received a manual with homework assignments each week that focused on the topics being covered in class and were asked to review with his or her parent a newsletter that was sent home with the teens four times during the program."

				child: yes – change the physical environment of the child: no		
Pate 2005	zBMI medium term	School + Community + Home	LEAP (Lifestyle Education for Activity Program)	LEAP (Lifestyle Education for Activity Program) is a comprehensive school-based intervention on physical activity. The intervention was designed to change both the instructional practices and the school environment to increase support for physical activity among girls. It included six components: PE, health education, school environment, school health services, faculty/staff health promotion, and family/community involvement. The intervention was conducted through 2 primary channels: instruction and school environment. The LEAP PE component (LEAP PE) was designed (1) to enhance physical activity self-efficacy and enjoyment, (2) to teach the physical and behavioral skills needed to adopt and maintain an active lifestyle, and (3) to involve girls in moderate-to-vigorous physical activity during 50% or more of PE class time. Activities that girls and young women typically enjoy (e.g., aerobics, dance, walking, self-defence, martial arts, and weight training) were offered in addition to competitive sports and other traditional PE activities. The LEAP health education lessons taught girls the skills necessary for adopting and maintaining a physically active lifestyle. The environmental channel was designed to create a school environment that supported physical activity among girls. Environmental change activities included role modelling by faculty and staff, increased communication about physical activity, promotion of physical activity by the school nurse, and family- and community-based activities. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	No intervention
Pfeiffer 2019	zBMI short term	School + Web	Girls on the Move	Girls on the Move was a 17-week intervention designed to encourage insufficiently active middle school girls to increase time spent in MVPA. Girls on the Move included three major components: (a) 90-minute after-school PA club conducted by community-based instructors 3 days/week at each girl's school, (b) two face-to-face motivational interviewing sessions with a trained counsellor, and (c) one motivational, interactive Internet-based session shortly after the intervention midpoint. Community-based instructors (PA club leaders) attended a 4-hour training session pre-intervention and then a 6-hour booster session near the midpoint of the intervention. Accelerometers were fitted on a subset of girls to reflect actual PA (as opposed to just opportunity for PA, which was obtained by the direct observation). Girls were encouraged to engage in MVPA outside the PA club.	No active intervention	"Control schools had usual school offerings, some of which may have included physical education."

					The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	Prins 2012	zBMI short term	School + Home + Web	YouR Action	YouRAction intervention: All three lessons consisted of one or more self-regulatory phases (i.e. monitoring, motivational, goal setting, active goal pursuit and evaluation phases). In the first lesson the focus was on improving knowledge about MVPA and how much activity adolescents should engage in. Subsequently awareness of one's own PA level was increased (monitoring phase). In the second and third lesson the adolescents were motivated (by targeting attitudes, self-efficacy, subjective norm) to make a change in one of the PA sub-behaviours (active transport, leisure time activity or sports), depending on the feedback on their personal PA level (motivational phase). Subsequently, adolescents could state a goal and form an action plan for how they wanted to improve their PA level (goal setting phase). In a week in between two lessons adolescents could evaluate whether they had enacted their plans and achieved their goals (phase of active goal pursuit). They could also make plans for how to deal with difficult situations they had encountered and state a new goal (evaluation phase). Most elements in the YouRAction intervention were theory based and translated in written feedback, cartoons, quizzes and web-movies. YouRAction+e intervention: the content of the YouRAction+e is identical to the basic YouRAction intervention, but in addition provides feedback on the availability of PA facilities in the residential neighbourhood of the adolescent via GoogleMaps. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	Attention control	"The Generic Information group received a non-tailored website containing general information on PA and healthy eating. This website was designed for 3 lessons and was also implemented in a class setting by teachers. The visual design of this website was identical to the design of the YouRAction and YouRAction+e interventions. This intervention was also called YouRAction."
	Simons 2015	zBMI short term; zBMI medium term	Home	MyGame	The adolescents assigned to the intervention group received a PlayStation Move upgrade package to play the active video games on a PlayStation 3 console in their homes. The PlayStation Move uses a handheld motion controller wand, a motion-capture PlayStation Eye camera that tracks the player's position and inertial sensors in the wand that detect its motion. Thus, every movement of the player is mimicked on-screen in the game. The	No active intervention	"Adolescents in the control group were asked to continue their normal gaming behavior. They received PlayStation Move starter packs at the end of the study as an incentive for their participation.

					following active video games were provided during the intervention: Sport Champions, Move Fitness, Start the Party and Medieval Moves, Dance Star Party and Sorcery. A detailed description of these Move video games can be found at: http://nl.playstation.com/ps3/games/. We included three elements to support continuing active video game play: 1) because variation in video games is important, the participants in the intervention group received four active Move video games with different game genres (Sport Champions, Move Fitness, Start the Party and Medieval Moves) at the beginning of the study and two additional video games (Dance Star Party and Sorcery) after four months; 2) because social and family play is important, we provided two controllers to promote playing together with family and friends; and 3) at each contact moment we explicitly asked and encouraged the participants to substitute non-active gaming with active gaming as much as possible and for at least one hour per week. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: yes		They also received a small gift (e.g., a magazine, lanyard, or pen) as an incentive after participation at each measure moment."
Smith 2014	BMI short term	School + Web	ATLAS (Active Teen Leaders Avoiding Screen-time)	ATLAS is a multicomponent intervention designed to prevent unhealthy weight gain by increasing physical activity, reducing screen-time, and lowering SSB consumption amongst adolescent boys attending schools in low-income areas. ATLAS was a 20-week school-based intervention and included the following key components: teacher professional learning (2 × 5 h workshops); provision of fitness equipment to schools (1 × pack/school valued at ~ $1500); researcher-led seminars for students (3 × 20 min); face-to-face physical activity sessions delivered by teachers during the school sport period (20 × ~90 min, in addition to regular PE lessons); lunch-time physical activity leadership sessions run by students (6 × 20 min); pedometers for physical activity self-monitoring (17 weeks); parental strategies for reducing recreational screen-time (4 × newsletters); and a purpose-built web-based smartphone application (15 weeks). The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the	No active intervention	"The control group participated in usual practice (i.e., regularly scheduled school sports and physical education lessons) for the duration of the intervention and received an equipment pack and a condensed version of the program after the 18-month assessments."

				child: yes – change the physical environment of the child: no		
Velez 2010	BMI short term	School	NR	The Resistance Training group followed a structured resistance training program. Subjects were exposed to a familiarization session that included instruction on warming up, equipment use, exercise performance, and rating of perceived exertion. All resistance training sessions took place in the high school weight room. Each session began with a 5-minute systemic warm-up to increase body temperature and reduce the chance of injury. Workouts were divided into upper body and lower body days. The participants performed 2–3 sets of 10–15 repetitions on a subset of upper body exercises including bench press, seated row, shoulder press, lat pulldowns, flies, bicep curls, and tricep pushdowns or lower body exercises including squats, Romanian dead lift, leg extensions, leg curls, lunges, and calf raises. Between each of the sets they were allowed to rest for 60–90 seconds (5) permitting an adequate amount of time for recovery. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	The control group was limited to their regularly scheduled physical education and health class
Weeks 2012	BMI short term	School	POWER PE (Preventing Osteoporosis With Exercise Regimes in Physical Education)	The POWER PE intervention group participated in ten minutes of supervised jumping activity at the start of each physical education (PE) class, that is, twice per week for eight months, excluding holidays. Each bout of jumping comprised at least some of the following manoeuvres: jumps, hops, tuck-jumps, jump-squats, stride jumps, star jumps, lunges, side lunges, and skipping. The instructor (BW) demonstrated all jumping activities and co-ordinated the routine at each session. Jumping sessions were occasionally supplemented with upper limb strengthening activities, such as push-ups and exercises with resistive bands The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	"Control group subjects undertook regular PE warm-ups and stretching directed by their usual PE teacher at a time that corresponded with intervention group activities (i.e. at the beginning of every PE class), twice per week for a period of eight months, excluding holidays. Control activities were focused on improving flexibility and general preparedness for physical activity. Activities typically included brisk walking, light jogging, and stretching. All subjects regrouped for normal PE activities directly after the diverse warm-ups had been completed."
Comparison: Dietary and Activity intervention vs Control						
Study ID	Meta-analysis outcome(s)	Setting of intervention	Intervention/study name	Intervention (short description)	Comparison type	Comparator (short description)

Andrade 2014	BMI long term; zBMI long term	School	ACTIVITAL (actividad y vitalidad)	ACTIVITAL is a school-based health promotion intervention that aimed at improving diet and physical activity. From Verstraeten 2014: "The individual classroom-based component included an interactive educational toolkit on dietary and physical activity risk behaviours, and consisted of 12 sessions. The toolkit included workbooks for teachers and adolescents with detailed instructions on how to deliver each session. They were accompanied by different resources developed especially for these sessions including puzzles, bingo, games, etc. This allowed teachers to implement the toolkit with minimum effort. The intention was to integrate this package into the existing curriculum through the Ministry of Education. However, this appeared to be a challenge. Instead, we obtained a letter of support from the Ministry of Education requesting intervention schools to temporarily include the intervention into their current curriculum. The toolkit was hence delivered during regular school hours. / The environmental component of the intervention included a parenting and a school programme. The parenting programme covered 6 interactive sessions with parents and/or legal guardians for which sheets with tips, flyers and activities were developed. The school programme involved school tuck shops, changes in the physical environment and social events. Professional development and training was delivered for tuck shop managers and/or their employees by the research staff. In total, 10 training sessions and 3 workshops were carried out. The training sessions were developed in a participatory manner and content was adapted to their needs. This enabled us to develop the sessions as per individual characteristics and the potential of each tuck shop. In addition, school events targeting dietary and PA behaviour were implemented in each intervention school, and included preparing a healthy breakfast and talks from famous young athletes. Finally, in all intervention schools participants were introduced to a walking trail of 10,000 steps and a number of promotional materials such as posters and leaflets." The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes	No active intervention	The control schools received the standard curriculum as determined by the Ecuadorian government
Bayne-Smith 2004	BMI short term	School + Home	PATH (Physical Activity and Teenage Health	The PATH curriculum was taught as a personal wellness course that integrated vigorous exercise, health and nutrition education, and behavior modification. PATH student manuals were developed to provide students with information about the anatomy and physiology of the heart, cardiovascular risk factors, the heart disease process, proper exercise and nutrition, stress management, cigarette smoking avoidance and cessation	No active intervention	"The control group received traditional physical education (PED) consisting of volleyball, basketball, and other sports activities. The frequency and duration of traditional PED

					techniques, and strategies for modifying high-risk health behaviors. PATH teacher manuals were provided to physical education teachers containing instructions for teaching the program curriculum and assessing outcomes. The PATH program consisted of 30-minute classes conducted 5 days per week for 12 weeks. Individual classes began with a brief 5- to 10-minute lecture and discussion featuring a topic on cardiovascular health and fitness and suggestions for modifying health behaviors. In addition, students frequently were given homework assignments designed to enhance or clarify lecture material through use of the PATH manuals. The lecture and discussion were followed by 20 to 25 minutes of vigorous physical activity in the form of either resistance exercise to improve muscular strength and endurance or aerobic exercise to improve cardiovascular fitness. Students alternated resistance and aerobic training each day. The intervention includes a home activity: yes The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		classes were identical to those of PATH classes. Since PED classes did not have lecture and discussion, they had approximately 5 minutes more physical activity per class than PATH classes."
	Black 2010	zBMI medium term; zBMI long term	Home + Community	Challenge!	The Challenge! intervention included a rap music video promoting healthy eating and physical activity, motivational interviewing and mentorship by a college student. Parents were welcome to participate, and mentors left recipes and information for the family. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	"Control adolescents did not receive a mentor or any contact between baseline and follow-up evaluations."
	Bogart 2016	BMI percentile long term	School + Home	SNaX (Students for Nutrition and Exercise)	The SNaX program is a 5-weeks, middle school intervention combining school-wide food environmental changes with a seventh-grade peer leader club that incorporated social marketing. The environmental changes included offering a greater variety of sliced/bite-sized food and freely available chilled filtered water at lunch; posters promoting physical activity, cafeteria food, and healthy eating; and nutritional postings about cafeteria food. A main goal of the club was to increase student advocacy. The social marketing aspect included taste tests of cafeteria foods, delivered by peer leaders, and a short film shown to the entire seventh-grade class that encouraged physical	No active intervention	The control group received the intervention two years later

					activity (e.g., through a dance video) and healthy eating. Participants were given take-home activities to do with their parents during each week of the program. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: yes		
	Bonsergent 2013	BMI long term; zBMI long term	School + Health Service + Community	PRALIMAP (PRomotion de l'ALIMentation et de l'Activité Physique)	Education strategy: Nutrition and physical activity lectures, students perform collaborative work, a 1-day or half-a-day PRALIMAP party. Environmental strategy: This strategy aims at extending the range of students' nutritional choices and consists in increasing the availability of fruits, vegetables, bread and dairy products, water and physical activity. Screening and care strategy: Weight, height and waist circumference of students are measured twice in a single session by high school nurses in the nurse's office, and the Eating Attitudes Test 40 (EAT-40) and Hospital Anxiety and Depression (HAD) questionnaires are complete. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: yes	Attention control	No education strategy: No educational intervention, some participants will have received the environmental and/or the screening intervention No environmental strategy: No educational intervention, some participants will have received the environmental and/or the screening intervention No screening and care strategy: No screening intervention, some participants will have received the educational and/or the environmental intervention
	Brito Beck da Silva 2019	BMI medium term	School + Home + Web	StayingFit Brazil	StayingFit is an online program organized to encourage and guide weight control and healthy eating habits. The adapted version was made available in the computer labs of each school in the intervention group, and a nutritionist and assistant (i.e., nutrition student) supervised the implementation of the program. The program also includes the participation of parents and teachers. Parents received printed material with the content of the program sessions. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the	No active intervention	StayingFit Brazil was made available to the participants in the control group after it was implemented in the intervention schools.

				child: yes – change the social environment of the child: yes – change the physical environment of the child: no		
Chen 2011	BMI short term	Community + Web	Web ABC (Web-Based Active Balance Childhood)	The Web-ABC is a web-based program consists of activities to enhance adolescents' self-efficacy and facilitated their understanding and use of problem-solving skills related to nutrition, physical activity, and coping. Information related to nutrition and healthy lifestyles was modified and used as the curriculum for the intervention. Adolescents also used an interactive dietary preparation software program (The Wok) tailored to common Chinese foods that was developed by Joslin Diabetes Center. Participants could develop a dish and checked on the nutritional information on The Wok program. In addition, participants learned to set up a realistic goal and plan each week to help improve their behaviors including food intake and physical activity. Information presented over the Internet included text, graphics, comics, and voice. Participants could log on to the program from home, library or community center. Physical activity was also included in the program, with the goal being to increase adolescents' energy expenditure. Subjects were encouraged to engage in different types of non-competitive activities (e.g., dance, brisk walking), learn types of activities that they can do during recess and at home, and learn alternatives to watching television. Each subject also received a pedometer and completed an online activity diary to monitor their activity levels. Adolescents could enter the average number of steps they took and the average number of servings of fruits and vegetables they had consumed on a daily basis on the Web site. These numbers were converted to two graphics that indicated the subject's progress. All information presented to the adolescents was in English. Each lesson lasted about 15 minutes. To increase healthy environment in the family, we designed three short Internet sessions (15 minutes each) aimed to coach parents the skills to help with their adolescent in improving healthy lifestyle and healthy weight. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	Attention control	"Participants in the control group logged on to the web site by using a pre-assigned username and password. Every week for 8 weeks, adolescents received general health information related to nutrition, dental care, safety, skin care, and risk-taking behaviours, not tailored."
Dewar 2013	BMI medium term; BMI long term; zBMI medium term; zBMI long term;	School	NEAT Girls (Nutrition and Enjoyable Activity for Teen Girls)	NEAT Girls was a 12-month multi-component school-based intervention developed in reference to Social Cognitive Theory and includes enhanced school sport sessions, interactive seminars, nutrition workshops, lunch-time physical activity (PA) sessions, PA and nutrition handbooks, parent newsletters, pedometers for self-monitoring and text messaging for social support.	No active intervention	"Following the completion of 24-month assessments the control schools received the equipment packs and intervention materials. A condensed version

				The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		of the NEAT Girls intervention was offered to the schools at this time."
Dunker 2018	BMI short term	School (ASP)	BNMP (Brazilian New Moves program)	The Brazilian New Moves program (BNMP) incorporates principles learned in previous research in the fields of eating disorders and obesity, having demonstrated a positive impact on eating patterns, levels of physical activity, and participants' self-image. Of importance, the program does not focus on weight loss as an isolated goal but targets behavioral changes associated with the long-term maintenance of a healthy weight. Students from schools assigned to the intervention arm participated in a series of activities related to the NMP, including: (1) group physical education sessions entitled "Be active," with two one-hour sessions weekly for nine weeks. (2) Interactive group educational sessions with dieticians and psychologists, entitled respectively 'Be Fueled' and "Be Fabulous," with one weekly session lasting one hour for eight weeks. (3) Two sessions of individual counselling using motivational interviewing techniques. Additionally, students were provided lunch on the days of the NMP activities, as well as additional one-hour weekly group lunch meetings in the maintenance phase for nine weeks after the end of the main activities." The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"In schools assigned to the observation arm, teachers were instructed to run their classes as usual."
Ezendam 2012	BMI long term	School + Web	FATaintPHAT	FATaintPHAT is a computer-tailored intervention is to help prevent excessive weight gain amongst adolescents aged 12 to 13 years by improving dietary behaviors (reducing the consumption of sugar-sweetened beverages and high-energy snacks and increasing the intake of fruit, vegetables, and whole wheat bread), reducing sedentary behavior (reducing screen time), and increasing physical activity (increasing active transport to school, leisure time activities, and sports). The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically:	No active intervention	The control school implemented the regular curriculum

					yes The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	French 2011	zBMI medium term	Home + Community + Telehealth	Take Action	Take action intervention program was 1 year in duration and included 6 monthly face-to-face group sessions, monthly newsletters, and 12 home-based activities. The intervention included both household environment and individual-level behavioral components. The household environment intervention included: (i) placement of TV time-limiting devices on all household TV sets; (ii) provision of guidelines about household food availability; and (iii) provision of a home scale for daily self-weighing (adults only). The individual behavioral intervention component promoted specific individual behavior changes related to weight control that were consistent with the HH-level intervention. The intervention was delivered using face-to-face group meetings, telephone calls, and monthly newsletters. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes	No active intervention	Control households received no intervention
	Haerens 2006	BMI medium term; BMI long term; zBMI medium term; zBMI long term;	School	NR	Intervention only: The program included environmental modifications and interventions on personal and social levels related to food choices and physical activity behavior. The aim of the intervention was to help children to create a physically active lifestyle, together with a healthy diet. Intervention + parents involvement: Three times a year, information on healthy food and physical activity was published in the school paper and newsletters for the parents. In addition, all parents received a free CD-ROM with the adult computer tailored intervention for fat intake and physical activity to complete at home. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the	No active intervention	No intervention (no further details)

					child: yes – change the physical environment of the child: yes		
	Hovell 2018	zBMI long term	Primary care clinic	Healthy Smiles	"At each office visit, staff provided the children in the PAN (physical activity and nutrition) group with “prescriptions” for improving diet and exercise behaviors. The interventions consisted of three main components: health message “prescriptions” and related discussion, office media, and parent education materials. The prescriptions were personalized for each orthodontic office, included space for the patient's name and doctor's signature, and for the PAN condition, space for a personal goal and a rating of the achievement of the last goal set. Prescription messages changed with each topic rotation). Twelve different prescription health messages were available for distribution, with the goal of one prescription being delivered at each patient visit, approximately every six to eight weeks. Orthodontic staff were instructed to have brief discussions with their patients regarding the health topic, to assist patients with goal setting, and to reinforce positive behavioral changes as each prescription was being delivered. Office media consisted of brochures, posters, counter-top displays, 3-D models, and related patient giveaways. Parent education materials were available in the waiting area of each office and included information relating to each health topic and suggestions as to how to create physical and social environments supportive of the desired behavior changes. Patients enroled at PAN offices in the US additionally received newsletters through the mail, once every 3–4 months." The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child’s behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes	Attention control	"The control group received parallel prescriptions on reducing tobacco use initiation and second-hand smoke exposure in the control condition."
	Kuhlemeier 2022	zBMI long term	School	ACTION-PAC	From trial registry: Adolescents enrolled in ACTION PAC will meet with school-based health center (SBHC) providers. SBHC providers will use Motivational Interviewing to motivate students to adopt strategies for improving nutrition and increasing physical activity. All participants will receive annual BMI results discussion with providers. The parents of all students (intervention and control in both the intensive and prevention samples) received letters mailed home at baseline, midpoint (1 year later), and endpoint (2 years later) with the child’s health results. Letters outlined anthropometric measurements, blood pressure (BP) and cardiometabolic labs, highlighted normal or expected parameters for each marker, and healthy behaviors recommended by the American Academy of Pediatrics. The intervention includes a home activity: no	No active intervention	Participants in control schools did not receive any intervention. From trial registry: "Annual BMI results will not be discussed with participants in comparison schools; however, a letter containing BMI results and obesity prevention recommendations will be sent to parent/guardians."

					The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	Leme 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	School + Home	H3G-Brazil (Healthy Habits, Healthy Girls–Brazil)	The H3-G-Brazil intervention was based on ten nutrition and physical activity messages to support healthy eating and regular physical activity. Additional program components were designed to reinforce healthy dietary and physical activity behaviors and included enhanced physical education sessions, school-break physical activity sessions, nutrition and physical activity handbooks, interactive seminars, nutrition workshops, weekly nutrition and physical activity key messages, parental newsletters, weekly health messages using WhatsApp®, and diet and physical activity diaries for self-monitoring The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: as a minor component The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	The control schools received a condensed version of the program after follow-up assessments that included professional learning workshops for control schools teachers and the H3G-Brazil intervention materials
	NCT02067728 2014	zBMI short term	Primary care clinic	FNPA (Family nutrition physical activity tool)	FNPA (Family nutrition physical activity tool) practice intervention comprising two components: 1) FNPA assessment which screens for obesogenic behaviors; 2) Brief Action Planning conversation designed to assist the family develop a health behavior change goal based on obesogenic risks on the assessment tool. Intervention practice will train to use FNPA screening paired with Brief Action Planning. They will implement this approach during well-child visits. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"Practices not undergoing intervention with FNPA tool providde usual care to patients during well-child visits."
	Neumark-Sztainer 2003	BMI short term	School	New Moves	The main components of the New Move program included physical activity that was offered four times a week, and nutrition and social support sessions that were each	Attention control	Participants in the control schools received a minimal intervention that

					offered every other week on alternating weeks throughout a 16-week semester they participated in New Moves for one semester (5 days week/16 weeks). The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		included written materials on healthy eating and physical activity that were distributed at the baseline assessment
	Neumark-Sztainer 2010	BMI short term; BMI medium term	School (ASP)	New Moves	New Moves is implemented within schools, as an all-girls physical education class, with supplementary group and individual activities. The program strives to provide a supportive environment in which all girls feel comfortable being physically active and discussing weight-related issues, regardless of their size, shape, or level of physical activity. The underlying program philosophy is that if girls feel good about themselves, they will want to take care of their bodies. New Moves targeted girls in the pre-contemplation, contemplation, and preparation stages for physical activity and aimed to move girls forward in their stages of change for physical activity and other behaviors. Motivational interviewing was used as it takes into account readiness for change. Eight behavioral objectives, targeted throughout the program, include: (1) be more physically active; (2) limit sedentary time; (3) increase fruit and vegetable intake; (4) limit sugar-sweetened beverages; (5) eat breakfast every day; (6) pay attention to portion sizes and your body's signs of hunger and satiety; (7) avoid unhealthy weight control behaviors; and (8) focus on your positive traits. New Moves program components included: (1) the New Moves physical education class, which incorporated nutrition and social support/self-empowerment sessions; (2) individual counselling sessions using motivation interviewing techniques; (3) lunch get-togethers (lunch bunches) once a week during the maintenance period; and (4) minimal parent outreach activities. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"Girls in the control group participated in an all-girls physical education class but did not receive additional components offered in the intervention such as individual coaching." (from trial registry)
	Peralta 2009	BMI short term	School	FILA (Fitness Improvement Lifestyle	The FILA intervention included 16 program weeks, with each week comprising one 60-minute curriculum session and two 20-minute lunchtime physical activity	No active intervention	"The active comparison group participated in 16×60-minute

				Awareness) Program	sessions. Each 60- minute curriculum session included practical and/or theoretical components. The theoretical components focused on promoting physical activity through increasing physical self-esteem and self-efficacy, reducing time spent in small screen recreation on weekends, decreasing sweetened beverage consumption, and increasing fruit consumption and the acquisition and practice of self-regulatory behaviors such as goal setting, time management, and identifying and overcoming barriers. Behavior modification techniques (e.g. group goals converting time spent in physical activity to kilometers to reach a specified destination, and the use of incentives such as small footballs)were used throughout the program. The practical component of the intervention comprised of modified games and activities. The researcher primarily facilitated the intervention; however school staff, 11th Grade students and parents were also involved. A Program Champion (Physical Education [PE] teacher) was responsible for liaising with School Executive and other staff to promote the program within the school and assist with logistical requirements, such as room bookings and availability of equipment. Eleventh Grade students peer facilitated the lunchtime sessions. The peer facilitators were chosen by the Program Champion based on their potential to be positive role models for participants. They attended one 20-min training session. Parents were emailed six newsletters throughout the program, which informed them of the program content, motivated them to help their son achieve their goals, suggested strategies to engage the entire family in healthy behaviors and created a stronger connection between parents and the school. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		curricular physical activity sessions at the same time as the intervention group."
Reesor 2019	zBMI short term; zBMI medium term	School	FLOW (Family Lifestyle Overweight Prevention Program)	Students randomized to the program condition participated in an instructor-led weight management program. Throughout the program period, students engaged in 2 or more days of instructor lead physical activity, 1 day per week of weight management education (i.e., nutrition, goal setting, and self-monitoring) and were provided with a healthy nutritionally dense snack such as vegetables with peanut butter, cereal, or a granola bar. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes	Attention Control	"Students in the control condition received 1 of 3 conditions depending on the cohort: self-help condition using Trim Kids, a book encouraging increased physical activity and improved diet (N = 49), a standard physical education (PE) class led by a PE teacher (N = 76), or a standard PE class led by an instructor trained in

				The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		weight management techniques (N = 70)."
Rodearmel 2006	BMI percentile short term	Home	NR	Members of the experimental families were asked to increase walking, to consume 2 servings cereal/day, one at breakfast and one for a snack, and were provided with fun, creative, family-oriented, educational logs to record steps per day and cereal servings consumed per day. The intervention includes a home activity: yes The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"Control families were asked to maintain their usual eating and step patterns throughout the 14-week study."
Schreier 2013	BMI short term	School (ASP)	NR	Students in the intervention group were assigned to volunteer at a nearby public elementary school from the beginning of October through December (10 weeks) of 1 school year. Intervention group students were placed at 1 of 5 participating elementary schools that had after-school programs. The after-school programs that students volunteered for included homework club, sports programs, science, cooking, cards and games, and arts and crafts. While there was a relatively wide range of programs, all programs were similar in that they involved volunteering with elementary school–aged children. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"The wait-list control group started the program the following school term."
Singh 2009	BMI short term; BMI medium term; BMI long term	School	DOiT (Dutch Obesity Intervention in Teenagers)	The aim of DOiT was to increase awareness and to induce behavioral changes concerning energy intake and energy output. Behaviors targeted with regard to energy intake were consumption of sugar-containing beverages and high-energy snacks. Behaviors targeted with regard to energy output were physical activity and screen-viewing behavior. The intervention consisted of an individual component (i.e., an educational program covering 11 lessons for the courses of biology and physical education) and an environmental component (i.e., encouraging schools to offer additional physical education classes and advice for	No active intervention	Control schools were asked to maintain their regular curriculum

					schools on changes in and around school cafeterias). We developed the DOiT program by applying the Intervention Mapping protocol, which facilitates a systematic process of designing health promotion interventions and is based on theory and empirical evidence. The development and content of the DOiT program are described in more detail elsewhere. Control schools were asked to maintain their regular curriculum. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: yes		
Wieland 2018	BMI short term; BMI medium term	Home + Telehealth	HIF (The Healthy Immigrant Families study)	The study team of community and academic partners created an intervention manual with 12 content modules: 6 for healthful eating (increasing fruit and vegetable consumption, healthful beverages, reducing dietary fats, healthful snacks, portion control, and smart shopping strategies), 4 to address physical activity (increasing physical activity, muscle strength, and flexibility, reducing screening time, and overcoming barriers to physical activity), and 2 to synthesize and reinforce the content (exercise/food/work–life balance and celebrating accomplishments). In the HIF (Healthy Immigrant Families) study, family health promoters delivered the intervention through 12 home visits (30-90 minutes each) over 6 months. At each visit, family health promoters assessed content knowledge and current behaviors related to each module topic, delivered the information, engaged in an interactive activity (e.g., working with food models), discussed barriers and potential solutions with the family, and engaged in individual (with each participating adult and adolescent) and family goal setting. Family health promoters included counselling strategies consistent with social cognitive therapy, including role modelling, feedback, reinforcement, and social support to enrich self-efficacy and behavior change. Furthermore, family health promoters modelled healthful behaviors with the families. An important aspect of this intervention involved family health promoters working with participants to adapt solutions for each family. Following the completion of home visits, family health promoters began biweekly 15-minute telephone calls to each family (up to 12 calls within 6 months). During these calls with an adult family member, family health promoters obtained a verbal progress report regarding the family's diet and physical activity relative to their stated goals. They ended each call with a content summary related to 1 of 12 modules. The intervention includes a home activity: no The intervention is delivered: individually	No active intervention	Delayed intervention

				The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes		
Wilksch 2015	BMI short term; BMI medium term	School	Life Smart	Life Smart is a eight-lesson program for early-adolescent girls and boys, was developed and pilot tested in preparation for the current RCT as a program to reduce obesity risk factors. A central theme is that health comprises more than just weight, eating and exercise, including content related to physical activity, sleep, thinking styles, managing emotions and social support, thus addressing weight gain risk factors beyond the traditional targets. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	Control students participated in their usual class lessons
Comparison: Activity intervention vs Dietary intervention						
Study ID	Meta-analysis outcome(s)	Setting of intervention	Intervention/study name	Intervention (short description)	Comparison type	Comparator (short description)
Jago 2006	BMI short term; BMI percentile short term	Community + Web	Fit for Life Badge Programme	The Fit for Life physical activity badge included skill building activities at troop meetings and Internet-based role modelling, goal setting, goal review and problem-solving. Trained study staff led 20-min physical activity sessions during troop meetings. Participants were encouraged to engage in these activities outside the troop meetings and were provided with a Boy Scout "drills booklet" to help them do so. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	Dietary	"The control group received a "mirror image" fruit and vegetable intervention."
Studies not included in the MA						
Study ID	Comparison	Setting of intervention	Intervention/study name	Intervention (short description)	Comparison type	Comparator (short description)
Afam-Anene 2021	Dietary intervention vs Control	School	NR	Nutrition education was administered to the subjects at 3 weeks intervals for a period of 3 months.	No active intervention	NR

					The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	Ahmed 2021	Dietary and Activity intervention vs Control	School	NR	A 12-week multi-component intervention. The school curriculum included 30 min of supervised circuit session comprising different exercises, and a health education session, each lasting for 10 min that were delivered in classroom by the researcher in each intervention school during the physical education class once a week. The weekly class content focussed on physical activity, sedentary behaviour, and healthy eating behaviours, and it took place before the circuit session. Lunchtime activities were offered by the researcher. The students were encouraged to participate in a supervised sports activity once a week for 20 min during lunchtime, using the sports equipment. Additionally, the participating students received a certificate (as an incentive) at the end of the intervention for their participation. The researcher distributed educational materials (infographics) to the students to take home for their parents and other family members in promoting an active lifestyle. The "infographic" included information on benefits of physical activity, recommended physical activity levels, healthy eating, and screen-based behaviours including their health consequences. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes	No active intervention	No intervention was provided to the control groups
	Barbosa Filho 2017	Activity intervention vs Control	School	Fortaleça sua Saúde	The intervention schools had four main component strategies. The first component involved training and activities in the general curriculum. The second component included a four-hour physical education teacher-specific training conducted at the beginning of the school semester. The third component included opportunities in the school environment to engage in physical activity. Supervised 10 to 15-min sessions called "Gym in School" were performed twice a week. These sessions were composed of activities in small and large groups in order to involve young people in PA during free-time at school. The last component involved health education in the school community. The materials produced in the classroom and PE classes (e.g., posters, newsletters and	No active intervention	Control schools had no intervention

					flyers on health issues) were available in schools. In addition, pamphlets were directed at students and parents. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes		
	Belton 2019	Activity intervention vs Control	School	Y-PATH (Youth-Physical Activity Towards Health)	The Y-PATH intervention is a whole-school multi-component intervention programme, aimed at reducing the age-related decline of MVPA in adolescents. The different components target students, teachers and parents, with a PE component, a whole-school teacher component and a parent component. PE Component: Y-PATH PE has a strong focus on physical literacy development (developing student motivation, self-confidence, FMS mastery, physical fitness, and Health-Related Activity knowledge) within the PE class, with the school's qualified PE teacher trained to deliver Y-PATH PE over the full academic year. Whole-School Component: The whole-school component included two 'PA Promotion' workshops for teachers delivered by a Y-PATH-trained facilitator, as well as the development and implementation of a school 'charter' for physical activity with specific targets agreed by the school community. All teachers within the school are encouraged to be 'active role models' for students. Parent Component: This included an information evening delivered by a Y-PATH-trained facilitator, and a parents' PA information leaflet distributed periodically through the school newsletter. Both the information evening and the information leaflets highlight key strategies for promoting PA beyond the school environment which are discussed with parents and emphasized periodically. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"Control schools were asked to continue with usual care (regular delivery of the Irish Junior Cycle PE curriculum, and their broader school curricula) without any researcher input over the academic year."
	Bernstein 2019	Dietary and Activity intervention vs Dietary and Activity intervention	School (ASP)	ECT (Expand, Connect, Thrive)	Expand, Connect, Thrive + Motivational interviewing (ECT + MI): The Components of the ECT program were designed to promote the types of behaviors that are necessary to establish and maintain a healthy lifestyle. The specific behaviors identified were healthy eating, physical activity, and the use of coping skills. Adolescents were split into 4 groups and	Dietary and Activity intervention	Expand, Connect, Thrive (ECT): Expand, Connect, Thrive component only

rotated through the activities/sessions assigned for each day. Each group was assigned a social worker or nurse who was a regular member of clinic staff and stayed with the group during each activity. A point system was used for behavior management. Active, appropriate participation in each activity, cleaning up after themselves, and being helpful beyond what was expected were avenues through which groups earn points. Rewards were offered for various “levels” of point earned, included choosing activities and the field trip at the end of each week, In addition to rotating through each of the basic intervention components, adolescents also participated in a variety of arts and crafts activities, team-building activities, and a science project. The social worker or nurse assigned to that group also helped the adolescents who rotated responsibility for meals and clean-up after meals. Each intervention component of the ECT program was offered by advanced students trained in that area (e.g., Clinical Psychology students taught mental health and coping techniques, MD/MPH students taught nutrition and physical fitness). Nutrition: The nutrition education component of the intervention was designed and implemented by two MD/MPH students. Nutrition education was accomplished using didactic and interactive techniques. Physical Fitness: In addition to receiving instruction regarding recommendations for healthy physical activity, adolescents were expected to complete a minimum of one hour of physical activity each day. The type of physical activity varied each day and included a selection of activities chosen by the adolescents, as well as mandatory activities. In addition, new physical activity types were also introduced on a regular basis (e.g., yoga, Tae Kwon Do). Cognitive Behavioral Therapy (CBT): A broad range of techniques were taught aimed at addressing a variety of stressors, including emotional and situational stressors. The CBT component of the intervention was administered by Clinical Psychology PhD students who had completed a minimum of one year of clinical training. Doctoral students were supervised by an advanced graduated student and a licenced psychologist

The Motivational interviewing (MI) intervention is based in 4 core tenants: (1) express empathy, (2) develop discrepancy, (3) roll with resistance, and (4) support clients’ self-efficacy. For the purpose of this study, MI was evaluated as an enhanced intervention to improve the effects of the primary intervention. Half of the adolescents were randomized to receive regular sessions of MI, aimed at increasing their intrinsic motivation towards target change behaviors. MI sessions consisted of the establishment of goals, pros and cons of changing and not changing, checking in regarding progress, and adjusting goals based on progress and barriers.

The intervention includes a home activity: no
The intervention is delivered: as a group
The intervention is delivered electronically:
The intervention uses multiple strategies (three or more): yes
The intervention has an explicit component

					aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
Cohen 2021	Activity intervention vs Control	School (ASP)	SIMAC (Fuerza muscular y capacidad aero´bicarelacio´n SImbio´tica en escolares con bajo peso al nacer y riesgo MetAbo´liCo)	Resistance training: 16 weeks of twice-weekly supervised aerobic activity performed on non-consecutive days. Aerobic training: 16 weeks of twice-weekly supervised aerobic activity performed on non-consecutive days. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	"The control group continued to participate in weekly 2-hours PE class of 120 min and were also asked to not begin a new structured exercise program for the period of the study."
Farias 2015	Activity intervention vs Control	School	NR	The students in the intervention group underwent programmed physical activity with heart rate monitoring, consisting of three parts: aerobic activity (exercises for flexibility, muscular strength, jumping rope, walking, alternating running, continuous jumping, recreational games), lasting 30 minutes; sports games (volleyball, soccer, handball), lasting 20 minutes; and with stretching, lasting 10 minutes. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	"Students in the control group performed the usual physical activity at school (recreation and games through exercises, calisthenics, learning the fundamentals of sports, and sports activities)."
Haire-Joshu 2015	Dietary and Activity intervention vs Control	Home + School + Web	BALANCE (Balance Adolescent Lifestyle Activities and Nutrition Choices for Energy)	BALANCE comprised three components to be delivered during the academic school year: home visits, school based classroom-group meetings, and internet activities. Home visits: parent educators were provided materials to conduct up to five 60-min BALANCE home visits focusing on a different behavior. School based classroom-group meetings: The parent educator was provided materials to conduct up to five 60 min BALANCE classroom sessions focused on one behavior for teen moms. BALANCE website: the teen was able to engage in a variety of 'virtual' interactive lessons delivered via the BALANCE web-based medium. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically:	No active intervention	"Control adolescents received standard child development information."

					yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	Lana 2014	Dietary intervention vs Control	School + Web	PREVENCANADOL program	PREVENCANADOL EG students had free access to all sections of the website, which was adapted to school curriculum and the features of each country (i.e. www.alertagrumete.com in Spain; www.alertagrumete.com.mx in Mexico). The website included several sections to learn how to prevent and treat main cancer risk behaviors using the theoretical framework of the A.S.E. model, that is: a) emphasizing advantages of following the recommendations and disadvantages of risk behaviors, b) creating a healthy online social environment and c) strengthening the skills to avoid risk behaviors. The section with the highest educational capacity contained problems or challenges that students had to solve. They were related both with subjects of their curriculum (e.g. Math, Literature or Science) and with the risk behavior prevention. The website also provided other services, such as expert dietetic advice after analysing common homemade recipes and 24-hour food recalls, peer-starred educational videos, forums and chat lines to discuss cancer-related topics, documents and web links with selected information and online educational games. Moreover, adolescents who had provided a cell phone number received weekly text messages to encourage compliance with healthy behaviors. For instance, a text message focused on a healthy diet was the following: 'Don't be fooled! The best way to be pretty on the outside is by being pretty on the inside. Fruits and vegetables are your best makeup'. All behaviors were promoted equally. Consequently, the EG was formed by two EGs: EG1 (exclusively online) and EG2 (online intervention plus text messages). The described educational intervention lasted an entire academic year (9 months). After that, participants of both the CG and EG were required to complete another questionnaire (post-test assessment). The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	"Participants in the control group had limited access to the described sections, and they do not receive the messages." (From Trial Registry)
	Mauriello 2010	Dietary and Activity intervention vs Control	School + Web	Health in Motion	Health in Motion is a computer tailored obesity prevention intervention. This program enhances the existing evidence by relying solely on interactive technology to provide individually tailored messages to	No active intervention	No intervention

					high school students. Health in Motion addresses recommended guidelines for three target energy balance behaviors related to obesity risk: physical activity (PA; at least 60 minutes on at least 5 days per week), fruit and vegetable consumption (FV; at least 5 servings of fruits and vegetables each day), and limited TV viewing (TV; 2 hours or less of TV each day; USDHHS, 2001). The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: no		
Nanney 2016	Dietary intervention vs Control	School	Project breakFAST	Project BreakFAST intervention aimed to improve student school breakfast programs participation by ameliorating the following environmental factors in the high school setting that potentially moderate student intention to eat school breakfast: 1) increasing availability and easy access to the SBP through school-wide policy changes 2) addressing normative and attitudinal beliefs through a school-wide SBP marketing campaign 3) providing opportunities for positive interactions that encourage eating school breakfast with social. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: no – change the physical environment of the child: yes	No active intervention	"The delayed treatment group served as a non-interventional control for the first year of follow-up for the primary comparison with the treatment group at the end of the first year of follow-up but implemented a modified form of the intervention in the second year of follow-up."
O'Connell 2005	Dietary intervention vs Control	School	HEROS (Healthy Eating to Reduce Obesity through Schools)	The HEROS intervention had three components: 1) cafeteria environment: nutrition education and food availability, 2) nutrition education: family/school staff, and 3) nutrition education: classroom. Component 1. Cafeteria Environment. Intervention components delivered through the cafeteria environment included nutrition education, increasing the availability of fruits, vegetables, and dairy products, taste-testings, and giveaways. Component 2. Nutrition Education: Family/School Staff. Free, healthy dinners were given after school to families and school staff with educational speakers discussing the obesity epidemic and healthy eating. Two events were held per school. To increase participation, especially from families/staff not motivated to seek nutrition information, the events were coupled to other school events (i.e., basketball game, literacy tutoring, Parent Teacher Association meeting). Sending	No active intervention	Control schools received no intervention

					flyers home with students and making school announcements also advertised the events. Component 3. Nutrition Education: Classroom. To further impact knowledge, attitudes, and behaviors of students regarding fruit, vegetable, and dairy product consumption, a nutrition educator taught a 45-minute nutrition lesson to all seventh grade students through their science curriculum. A pre- and post-lesson activity accompanied the science lesson. Prior to the nutrition lesson, a nutrition educator quizzed students on fruit, vegetable, and dairy product knowledge and gave away merchandise (i.e., got milk and 5 A Day) in the school cafeteria. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: yes		
Patrick 2006	Dietary and Activity intervention vs Control	Home + Health care service + Telehealth + Web	PACE+ (Patient-centered Assessment and Counseling for Exercise + Nutrition)	The PACE+ intervention was designed to promote adoption and maintenance of improved eating and physical activity behaviors through a computer-supported intervention initiated in primary health care settings. This was coupled with a printed manual to take home and 12 months of stage-matched telephone calls and mail contact. There was a parent intervention intended to help parents encourage behavior change attempts through praise, active support, and positive role-modelling. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically: yes The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	Attention control	"Adolescents randomized to the comparison condition received an adaptation of the SunSmart sun protection behavior program developed at the University of Rhode Island, Kingston."
Razani 2018	Activity intervention vs Activity intervention	Primary care clinic	SHINE (Stay Healthy In Nature Everyday)	Supported park prescription group. Parents randomized to the supported park prescription group received counselling by a pediatrician about nature according to the script above, a postcard with the map of local parks, journal, and pedometer. After randomization, they were advised to attend group nature outings on three consecutive Saturdays, and were invited to bring their families. Participants received phone reminders on the Wednesday before outings and a text on the Friday before the Saturday outing. The intervention includes a home activity: no The intervention is delivered: individually The intervention is delivered electronically:	Activity intervention	"The independent park prescription group received counselling by a pediatrician about nature according to the script above, the postcard with a map of local parks, journal, pedometer, and no further intervention after randomization."

					no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: no – change the social environment of the child: yes – change the physical environment of the child: no		
	Sabino 2021	Dietary and Activity intervention vs Control	School	PANPAs (Physical Activity and Nutrition Program for Adolescents)	The PANPAs was a 10-months intervention designed to develop changes in school physical activity habits by training teachers, delivering physical activity and health education and creating more school physical activity opportunities at physical education and recess. The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	NR
	Slawson 2015	Dietary and Activity intervention vs Control	School	Team Up for Healthy Living	Team Up for Healthy Living2 is a peer-based health education program (addressing body mass status, healthy eating, and physical activity [PA] and sedentary behaviors) administered through high school Lifetime Wellness classes. For each of two semesters, nine undergraduates majoring in public health, nutrition, and kinesiology were selected and trained as facilitators to lead the peer-based intervention. The eight 40-minute sessions each included a lesson overview, lesson objectives, lesson activities, materials needed, facilitators preparation, and lesson activities. The curriculum included weekly challenges to foster teamwork and critical thinking. Each Lifetime Wellness class was divided into small teams of four to six students. In-class team activities were conducted to promote collaboration. Specific activities were conducted in class or assigned to be completed at home. Incentives (e.g., water bottles, and Frisbees) were given to the team based on a variety of performance variables. The peer facilitators assumed a mentoring role during team activities with students on each individual team. They provided feedback regarding performance of the activity, served as role models, and provided feedback and guidance to enhance students' self-esteem and self-efficacy. Two peer facilitator were assigned to each LifetimeWellness class at each partnering intervention school to deliver the 8- week curriculum. The Lifetime Wellness teachers at the five schools assigned to intervention were present during the intervention sessions, helping with classroom management, and providing assessments of perceived peer facilitator effectiveness at the conclusion of the 8 week program. The intervention includes a home activity:	No active intervention	"These students were enroled in the Lifetime Wellness course and received the standard curriculum provided by Lifetime Wellness teachers."

					yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no		
	TenHoor 2018	Activity intervention vs Control	School	Focus on Strength	The Focus on Strength intervention group received both a strength exercise intervention and a motivational intervention to promote after school physical activity. The PE teachers integrate strength exercises in their PE lessons. To motivate students to be more physically active after school, and to improve the determinants of their physical activity behaviour, the basic principles of Motivational Interviewing are applied. All students receive a workbook and once-a-month lessons to increase their motivation to be physically active outside school. The motivational intervention challenges students to make their own decisions and choices, herewith appealing to their feeling of autonomy. The intervention includes a home activity: yes The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): no The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no	No active intervention	The control group continued with their usual curriculum
	Whittemore 2013	Dietary and Activity intervention vs Dietary and Activity intervention	School + Home	HEALTH(e)TEEN	The major components of the HEALTH[e]TEEN program were lessons, goal setting, self-monitoring, health coaching, and social networking. There were eight lessons on the topics of nutrition, physical activity, metabolism, and portion control. Lessons were highly interactive, and students received individualized feedback via self-assessments and questions on content. Students were encouraged to record their food intake and physical activity each time they logged on, and the program provided a visual display of their progress. Students also set goals and monitored progress with completing goals. A blog by a "coach," the opportunity to interact with a health coach (graduate nursing student) and other students, and a personal journal section were other components of the program. The HEALTH[e]TEEN + CST included all the aforementioned components and the addition of four lessons on coping skills training (total of 12 lessons). CST lessons included social problem-solving, stress reduction, assertive communication, and conflict resolution. The intervention includes a home activity: yes	Dietary and Activity intervention	HEALTH[e]TEEN program only

					The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes – change the social environment of the child: no – change the physical environment of the child: no		
	Zhou 2019	Dietary and Activity intervention vs Control; Activity intervention vs Control	School + School (ASP)	CHAMPS (Childhood Health; Activity and Motor Performance Study)	School physical education (SPE): Modification of school policy, an enhanced PE curriculum and a mandatory after-school PA program. The environment for PA was modified by provision of PE equipment and teacher training that added novelty and enjoyment in children's PA. The intervention also engaged the parents in providing a supportive environment for an active lifestyle and healthy eating at home using a mobile health-based (mHealth) campaign. School physical education (SPE) intervention modified the PE policy to offer 3 PE classes a week and daily 15-min PA-based recess to increase the amount of time for PA. After school program intervention (ASP): it was a mandatory extracurricular activity that used the physical conditioning exercises similar to those designed for the PE classes. School Physical Education Intervention + After school program intervention. The intervention includes a home activity: no The intervention is delivered: both individually and as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: yes – provide education/information for the child: yes – change the social environment of the child: yes – change the physical environment of the child: no	No active intervention	"The schools in the control condition agreed to participate in the study without receiving any intervention while conducting their PE program as usual. The PE teachers were aware that their classes were involved in a physical fitness study but did not receive any training nor made changes to the curriculum."
	Zota 2016	Dietary intervention vs Dietary intervention	School + Home	DIATROFI program	Multicomponent intervention: DIATROFI program (daily free healthy meals) + Health nutrition education program. All students enroled in a school participating in the DIATROFI Program received a boxed fresh meal at 10 a.m. every school day. In the schools assigned to the multicomponent intervention group, a healthy nutrition educational program was also implemented, including educational material and activities for each target group (students of different ages, parents and school staff). The intervention includes a home activity: no The intervention is delivered: as a group The intervention is delivered electronically: no The intervention uses multiple strategies (three or more): yes The intervention has an explicit component aiming to: – modify the child's behaviour: no – provide education/information for the child: yes	Dietary intervention	Environmental intervention: DIATROFI program (daily free healthy meals) only

				– change the social environment of the child: yes – change the physical environment of the child: no		

Abbreviations: ASP: after school program; BMR: basal metabolic rate; CBT: Cognitive Behavioral Therapy; EE: energy expenditure; EI: energy intake; FMS: fundamental movement skills; FVI: fruit and vegetable intake; HIIT: high intensity interval training; HR: heart rate; MVPA: moderate to vigorous physical activity; NR: not reported; PA: physical activity; PE: physical education; RCT: randomised controlled trial; RT: Resistance Training; SSB: sugar-sweetened beverages.

Short-term follow-up: 12 weeks from baseline to < 9 months. Medium-term follow-up: 9 months from baseline to < 15 months. Long-term follow-up: 15 months or more.

Table 3

Description of serious adverse events

Comparison: Dietary interventions vs control				
Study ID	**Meta-analysis outcome(s)**	**Any data on serious adverse events reported**	**Serious adverse events (related to participation in the study) observed**	**Serious adverse events details as reported by authors**
Amaro 2006	zBMI short term	No	n/a	n/a
Ebbeling 2006	BMI short term	Yes	No	"There were no serious adverse events or adverse effects among adolescents in the intervention group."
Gustafson 2019	BMI percentile short term	No	n/a	n/a
Kuroko 2020	zBMI medium term	No	n/a	n/a
Lappe 2017	BMI percentile medium term	Yes	No	"If any participants showed a BMC (bone mineral content) z score ≤2.0, they were withdrawn from study and referred to their primary care provider, but no participant fell to ≤2.0." There were no study-related adverse events reported
Luszczynska 2016b	BMI medium term	No	n/a	n/a
Mihas 2010	BMI medium term	No	n/a	n/a
Ooi 2021	zBMI short term	No	n/a	n/a
Papadaki 2010	BMI short term; zBMI short term	No	n/a	n/a
Shin 2015	BMI percentile medium term	No	n/a	n/a
Shomaker 2019	BMI short term; BMI long term; zBMI short term; zBMI long term; BMI percentile short term; BMI percentile long term	No	n/a	n/a
Takacs 2020	BMI medium term	No	n/a	n/a
Viggiano 2015	zBMI short term; zBMI long term	No	n/a	n/a
Comparison: Activity interventions vs control				
Study ID	**Meta-analysis outcome(s)**	**Any data on serious adverse events reported**	**Serious adverse events (related to participation in the study) observed**	**Serious adverse events details as reported by authors**
Arlinghaus 2021	zBMI short term	No	n/a	n/a
El Ansari 2010	BMI short term	No	n/a	n/a
Harrington 2018	zBMI short term; zBMI medium term	Yes	No	"No serious adverse events/reactions were reported in this study."
Hollis 2016	BMI medium term; BMI long term; zBMI medium term; zBMI long term	Yes	No	"There was no evidence that the intervention had an adverse effect on underweight students as the proportion of underweight students decreased during the study, from 7.3% at baseline to 2.5% at 24 months."
Isensee 2018	BMI percentile medium term	No	n/a	n/a
Kennedy 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	Yes	No	"No injuries or adverse events were recorded by any of the teachers involved in the study."
Lubans 2021	zBMI short term; zBMI medium term	Yes	No	"No injuries or adverse events were recorded by the school champions."
Melnyk 2013	BMI short term; BMI medium term	No	n/a	n/a
Pate 2005	zBMI medium term	No	n/a	n/a

Pfeiffer 2019	zBMI short term	No	n/a	n/a
Prins 2012	zBMI short term	No	n/a	n/a
Simons 2015	zBMI short term; zBMI medium term	Yes	Yes	"At T10m, 20% of the intervention group reported having experienced an injury (the most frequently mentioned injuries were bruises or strained muscles/tendons) while playing the Move video games."
Smith 2014	BMI short term	Yes	No	"No adverse events or injuries were reported during the school sports sessions, lunchtime leadership sessions, or assessments."
Velez 2010	BMI short term	No	n/a	n/a
Weeks 2012	BMI short term	No	n/a	n/a
Comparison: Dietary and activity interventions vs control				
Study ID	**Meta-analysis outcome(s)**	**Any data on serious adverse events reported**	**Serious adverse events (related to participation in the study) observed**	**Serious adverse events details as reported by authors**
Andrade 2014	BMI long term; zBMI long term	No	n/a	n/a
Bayne-Smith 2004	BMI short term	No	n/a	n/a
Black 2010	zBMI medium term; zBMI long term	No	n/a	n/a
Bogart 2016	BMI percentile long term	No	n/a	n/a
Bonsergent 2013	BMI long term; zBMI long term	No	n/a	n/a
Brito Beck da Silva 2019	BMI medium term	No	n/a	n/a
Chen 2011	BMI short term	No	n/a	n/a
Dewar 2013	BMI medium term; BMI long term; zBMI medium term; zBMI long term	No	n/a	n/a
Dunker 2018	BMI short term	Yes	No	"No harm or unintended effects were observed in either group that could be directly attributed to the intervention."
Ezendam 2012	BMI long term	No	n/a	n/a
French 2011	zBMI medium term	No	n/a	n/a
Haerens 2006	BMI medium term; BMI long term; zBMI medium term; zBMI long term;	No	n/a	n/a
Hovell 2018	zBMI long term	No	n/a	n/a
Kuhlemeier 2022	zBMI long term	No	n/a	n/a
Leme 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	Yes	No	"No injuries or adverse effects were reported during the activity sessions or assessments."
NCT02067728 2014	zBMI short term	Yes	No	"One enrolled patient (control group) death occurred during the study period; however, the death was in no way related to participation in this research study. The patient's death occurred following 1 month data collection, but prior to the 6 months data collection."
Neumark-Sztainer 2003	BMI short term	No	n/a	n/a
Neumark-Sztainer 2010	BMI short term; BMI medium term	No	n/a	n/a
Peralta 2009	BMI short term	No	n/a	n/a
Reesor 2019	zBMI short term; zBMI medium term	No	n/a	n/a
Rodearmel 2006	BMI percentile short term	No	n/a	n/a
Schreier 2013	BMI short term	No	n/a	n/a
Singh 2009	BMI short term; BMI medium term; BMI long term	No	n/a	n/a
Wieland 2018	BMI short term; BMI medium term	No	n/a	n/a
Wilksch 2015	BMI short term; BMI medium term	Yes	Yes	"Of participants with 12-month follow-up data (653 girls, 365 boys), a total of 82 girls (12.5%) developed clinical levels of concern about shape and weight by the 12-month follow-up, while just seven boys (1.9%) experienced such an increase. Table 4 provides the frequency and percentage of participants from each condition that developed these concerns by the 12-month follow-up."
Comparison: Activity interventions vs dietary interventions				
Study ID				

	Meta-analysis outcome(s)	Any data on serious adverse events reported	Serious adverse events (related to participation in the study) observed	Serious adverse events details as reported by authors
Jago 2006	BMI short term; BMI percentile short term	No	n/a	n/a
Studies not included in meta-analyses				
Study ID	**Comparison**	**Any data on Serious Adverse Events reported**	**Serious Adverse Events (related to participation in the study) observed**	**Serious adverse events details as reported by authors**
Afam-Anene 2021	Dietary intervention vs control	No	n/a	n/a
Ahmed 2021	Dietary and Activity intervention vs control	No	n/a	n/a
Barbosa Filho 2017	Activity intervention vs control	No	n/a	n/a
Belton 2019	Activity intervention vs control	Yes	Yes	"The lower numbers at T2 compared to T1 are explained by i) children's absence from school on the day of testing, ii) children choosing to withdraw from the study, and iii) injury/illness that prevented them from completing the protocol."
Bernstein 2019	Dietary and Activity intervention vs dietary and activity intervention	No	n/a	n/a
Cohen 2021	Activity intervention vs control	No	n/a	n/a
Farias 2015	Activity intervention vs control	No	n/a	n/a
Haire-Joshu 2015	Dietary and activity intervention vs control	No	n/a	n/a
Lana 2014	Dietary intervention vs control	No	n/a	n/a
Mauriello 2010	Dietary and activity intervention vs control	No	n/a	n/a
Nanney 2016	Dietary intervention vs control	No	n/a	n/a
O'Connell 2005	Dietary intervention vs control	No	n/a	n/a
Patrick 2006	Dietary and activity intervention vs control	No	n/a	n/a
Razani 2018	Activity intervention vs activity intervention	Yes	No	Note: no serious adverse events (including all causes mortality) were reported in the trial registry, but it is not clear if these results refer to the parents or the children or both
Sabino 2021	Dietary and activity intervention vs control	No	n/a	n/a
Slawson 2015	Dietary and activity intervention vs control	No	n/a	n/a
TenHoor 2018	Activity intervention vs control	No	n/a	n/a
Whittemore 2013	Dietary and activity intervention vs dietary and activity intervention	No	n/a	n/a
Zhou 2019	Dietary and activity intervention vs control; activity intervention vs control	No	n/a	n/a
Zota 2016	Dietary intervention vs dietary intervention	No	n/a	n/a

Abbreviations: n/a; not applicable

Short term follow-up: 12 weeks from baseline to < 9 months. Medium term follow-up: 9 months from baseline to < 15 months. Long term follow-up: 15 months or more.

Table 4

Description of costing information

Comparison: Dietary interventions vs control					
Study ID	**Meta-analysis outcome(s)**	**Costing data recorded?**	**Intervention cost reported?**	**Trial cost reported?**	**Economic evaluation conducted (reference)**
Amaro 2006	zBMI short term	No	n/a	n/a	No

Ebbeling 2006	BMI short term	Yes	No	Yes	No
Gustafson 2019	BMI percentile short term	Yes	Yes	Yes	No
Kuroko 2020	zBMI medium term	Yes	No	Yes	No
Lappe 2017	BMI percentile medium term	No	n/a	n/a	No
Luszczynska 2016b	BMI medium term	No	n/a	n/a	No
Mihas 2010	BMI medium term	No	n/a	n/a	No
Ooi 2021	zBMI short term	No	n/a	n/a	No
Papadaki 2010	BMI short term; zBMI short term	No	n/a	n/a	No
Shin 2015	BMI percentile medium term	Yes	No	Yes	No
Shomaker 2019	BMI short term; BMI long term; zBMI short term; zBMI long term; BMI percentile short term; BMI percentile long term	No	n/a	n/a	No
Takacs 2020	BMI medium term	No	n/a	n/a	No
Viggiano 2015	zBMI short term; zBMI long term	No	n/a	n/a	No
Comparison: Activity interventions vs control					
Study ID	**Meta-analysis outcome(s)**	**Costing data reported?**	**Intervention cost reported?**	**Trial cost reported?**	**Economic evaluation conducted (reference)**
Arlinghaus 2021	zBMI short term	No	n/a	n/a	No
El Ansari 2010	BMI short term	No	n/a	n/a	No
Harrington 2018	zBMI short term; zBMI medium term	Yes	Yes	Yes	Yes (Harrington 2019)
Hollis 2016	BMI medium term; BMI long term; zBMI medium term; zBMI long term	Yes	Yes	No	Yes (Sutherland 2016)
Isensee 2018	BMI percentile medium term	No	n/a	n/a	No
Kennedy 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	No	n/a	n/a	No
Lubans 2021	zBMI short term; zBMI medium term	Yes	Yes	No	No
Melnyk 2013	BMI short term; BMI medium term	No	n/a	n/a	No
Pate 2005	zBMI medium term	Yes	No	Yes	No
Pfeiffer 2019	zBMI short term	Yes	No	Yes	No
Prins 2012	zBMI short term	No	n/a	n/a	No
Simons 2015	zBMI short term; zBMI medium term	No	n/a	n/a	No
Smith 2014	BMI short term	Yes	Yes	No	No
Velez 2010	BMI short term	No	n/a	n/a	No
Weeks 2012	BMI short term	Yes	n/a	n/a	No
Comparison: Dietary and activity interventions vs control					
Study ID	**Meta-analysis outcome(s)**	**Costing data reported?**	**Intervention cost reported?**	**Trial cost reported?**	**Economic evaluation conducted (reference)**
Andrade 2014	BMI long term; zBMI long term	Yes	Yes	Yes	No
Bayne-Smith 2004	BMI short term	No	n/a	n/a	No
Black 2010	zBMI medium term; zBMI long term	No	n/a	n/a	No
Bogart 2016	BMI percentile long term	Yes	Yes	Yes	Yes (Ladapo 2016)
Bonsergent 2013	BMI long term; zBMI long term	No	n/a	n/a	No
Brito Beck da Silva 2019	BMI medium term	No	n/a	n/a	No
Chen 2011	BMI short term	Yes	No	Yes	No
Dewar 2013	BMI medium term; BMI long term; zBMI medium term; zBMI long term	Yes	Yes	No	No
Dunker 2018	BMI short term	No	n/a	n/a	No
Ezendam 2012	BMI long term	No	n/a	n/a	No
French 2011	zBMI medium term	Yes	Yes	No	No
Haerens 2006	BMI medium term; BMI long term; zBMI medium term; zBMI long term;	No	n/a	n/a	No
Hovell 2018	zBMI long term	Yes	Yes	Yes	No
Kuhlemeier 2022	zBMI long term	No	n/a	n/a	No
Leme 2018	BMI short term; BMI medium term; zBMI short term; zBMI medium term	No	n/a	n/a	No
NCT02067728 2014	zBMI short term	No	n/a	n/a	No
Neumark-Sztainer 2003	BMI short term	No	n/a	n/a	No
Neumark-Sztainer 2010	BMI short term; BMI medium term	No	n/a	n/a	No
Peralta 2009	BMI short term	No	n/a	n/a	No
Reesor 2019	zBMI short term; zBMI medium term	No	n/a	n/a	No
Rodearmel 2006	BMI percentile short term	No	n/a	n/a	No
Schreier 2013	BMI short term	No	n/a	n/a	No
Singh 2009		No	n/a	n/a	No

	BMI short term; BMI medium term; BMI long term				
Wieland 2018	BMI short term; BMI medium term	No	n/a	n/a	No
Wilksch 2015	BMI short term; BMI medium term	No	n/a	n/a	No
Comparison: Activity interventions vs dietary interventions					
Study ID	**Meta-analysis outcome(s)**	**Costing data reported?**	**Intervention cost reported?**	**Trial cost reported?**	**Economic evaluation conducted (reference)**
Jago 2006	BMI short term; BMI percentile short term	Yes	No	Yes	No
Studies not included in meta-analyses					
Study ID	**Comparison**	**Costing data reported?**	**Intervention cost reported?**	**Trial cost reported?**	**Economic evaluation conducted (reference)**
Afam-Anene 2021	Dietary intervention vs control	No	n/a	n/a	No
Ahmed 2021	Dietary and activity intervention vs control	No	n/a	n/a	No
Barbosa Filho 2017	Activity intervention vs control	No	n/a	n/a	No
Belton 2019	Activity intervention vs control	No	n/a	n/a	No
Bernstein 2019	Dietary and activity intervention vs dietary and activity intervention	Yes	Yes	No	No
Cohen 2021	Activity intervention vs control	No	n/a	n/a	No
Farias 2015	Activity intervention vs control	No	n/a	n/a	No
Haire-Joshu 2015	Dietary and activity intervention vs control	Yes	No	Yes	No
Lana 2014	Dietary intervention vs control	No	n/a	n/a	No
Mauriello 2010	Dietary and activity intervention vs control	No	n/a	n/a	No
Nanney 2016	Dietary intervention vs control	Yes	Yes	No	Yes (Shanafelt 2019)
O'Connell 2005	Dietary intervention vs control	No	n/a	n/a	No
Patrick 2006	Dietary and activity intervention vs control	Yes	No	Yes	No
Razani 2018	Activity intervention vs activity intervention	Yes	No	Yes	No
Sabino 2021	Dietary and activity intervention vs control	No	n/a	n/a	No
Slawson 2015	Dietary and activity intervention vs control	No	n/a	n/a	No
TenHoor 2018	Activity intervention vs control	No	n/a	n/a	No
Whittemore 2013	Dietary and activity intervention vs dietary and activity intervention	Yes	No	Yes	No
Zhou 2019	Dietary and activity intervention vs control; Activity intervention vs control	No	n/a	n/a	No
Zota 2016	Dietary intervention vs dietary intervention	Yes	Yes	No	No

Abbreviations: n/a: not applicable.

Short-term follow-up: 12 weeks from baseline to < 9 months. Medium-term follow-up: 9 months from baseline to < 15 months. Long-term follow-up: 15 months or more.

Table 5

Description of PROGRESS characteristics

				Comparison: Dietary interventio
Study ID	**PROGRESS characteristics reported at baseline**	**PROGRESS characteristics analysed for impact on outcome***	**Place of residence (including school location)**	**Race/Ethnicity/Culture/Language**
Amaro 2006	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	Caucasian: 100%
Ebbeling 2006	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	NR	Ethnicity: intervention: White: 34%, Non-white: 66%; control: White: 38%; Non-White: 62% Race: intervention: Hispanic: 21%; Non-Hispanic: 79%; control: Hispanic: 14%; Non-Hispanic: 86%
Gustafson 2019	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex	NR	Rural	Intervention: White: 72%; Other (African American/ Hispanic): 28%; control: White: 55%; Other (African American/ Hispanic): 45%
Kuroko 2020	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic	NR	NR	Intervention: Maori: 14%; New Zealand European and Other: 86%;

	status			control: Maori: 15%; New Zealand European and Other: 85%
Lappe 2017	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	Intervention: Caucasian: 87.5%; African American: 9.6%; Other: 2.9%; control: Caucasian: 75.4%; African American: 13.8%; Other: 10.8%
Luszczynska 2016b	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	Rural schools: 3 schools (36% of participants); urban areas: seven schools (64% of participants)	White: 96%
Mihas 2010	Place of residence; Gender/Sex; Socioeconomic status	NR	Medium-sized municipality	NR
Ooi 2021	Gender/Sex; Socioeconomic status	NR	NR	NR
Papadaki 2010	Gender/Sex	NR	NR	NR
Shin 2015	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex	Gender/Sex	Urban	African-American: 100%

Shomaker 2019	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	Intervention: Non-Hispanic White: 66%; Hispanic: 28%; American Indian: 3%; Asian: 3%; control: Non-Hispanic White: 72%; Hispanic: 28%; American Indian: 0%; Asian: 0%
Takacs 2020	Place of residence; Gender/Sex	Gender/Sex	Urban (town)	NR
Viggiano 2015	Gender/Sex	NR	NR	NR

Comparison: Activity interventio

Study ID	PROGRESS characteristics reported at baseline	PROGRESS characteristics analysed for impact on outcome*	Place of residence (including school location)	Race/Ethnicity/Culture/Language
Arlinghaus 2021	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	Gender/Sex	NR	Hispanic-American: 100% (all students in the study self-identified as Hispanic-American)
El Ansari 2010	Gender/Sex	Gender/Sex	NR	NR
Harrington 2018	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	NR	White European: 76.8%; South Asian: 11.7%; Other: 11.6%
Hollis 2016	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	Gender/Sex	Intervention: metropolitan: 53%; rural: 47%; control: metropolitan: 47%; rural: 53%;	Aboriginal and Torres Strait Islander: intervention: 8.4%; control: 8/8% English Language: intervention: 99%; control: 97%
Isensee 2018	Gender/Sex; Education (parents)	NR	NR	See Comments on PROGRESS characteristics column
Kennedy 2018	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	Gender/Sex; Socioeconomic status	NR	Cultural background: Australian: 65.6%; European: 8.4%; African: 0.8%; Asian: 12.4%; Middle Eastern: 1.7%; Other 11.1% English spoken at home: 90.7% Indigenous descent overall: 7.3%
Lubans 2021	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	See Comments on PROGRESS characteristics column	Cultural background: Australian: 70.4%; European: 10.1%; African: 0.9%; Asian: 5.9%; Middle Eastern: 1.1%; other: 11.6% Born in Australia: 88.1% English spoken at home: 92.8% Indigenous descent: 9.2%

Melnyk 2013	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status;	Socioeconomic status;	Large metropolitan city	Ethnicity: Hispanic or Latino: 68.30% Race: American native: 3.5%, Asian 4%; Black: 9.90%; White: 14.10%; Hispanic: 67.5%; Other: 1%
Pate 2005	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex	NR	Schools were paired by urban/suburban or rural location	African-American: 48.7%; White: 46.7%
Pfeiffer 2019	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	Race/Ethnicity/Culture/Language; Socioeconomic status	Urban schools	Ethnicity: Hispanic or Latino: intervention: 15.5%; control: 12.5% Race: intervention: Black: 45.2%; White: 28.4%; Other: 26.4%; control: Black 54.3%, White 25.8%, Other 19.8%;
Prins 2012	Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents)	NR	NR	Non-Western: 21.4%
Simons 2015	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex	NR	Urban	Dutch origin: 83%
Smith 2014	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	NR	Cultural background: Australian: 77.2%; European: 14.8%; African 1.9%; Asian 1.9%; Middle eastern: 0.6%; Other; 3.6% Born in Australia: 94.7% Speake English language at home: 95.6%
Velez 2010	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	Hispanic: 100%
Weeks 2012	Gender/Sex	Gender/Sex	NR	NR

Comparison: Dietary and activity inter

Study ID	PROGRESS characteristics reported at baseline	PROGRESS characteristics analysed for impact on outcome*	Place of residence (including school location)	Race/Ethnicity/Culture/Language
Andrade 2014		NR	Urban	NR

	Place of residence; Gender/Sex; Education (parents); Socioeconomic status			
Bayne-Smith 2004	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	NR	Urban	PATH group: 13% White: 13%; African American: 46%; Hispanic 29%; Asian American: 12% PED group: White: 5%; African American: 45%; Hispanic: 28%; Asian American: 22%
Black 2010	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	Gender/Sex	Resident in low-income communities surrounding a mid-Atlantic urban, University Medical Centre	African American: 97%

Bogart 2016	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	NR	Asian/Pacific/Islander: 5.5%; Latino: 74.7%; Black: 14.2%; White: 5.7% English as second language: 40.7% Born in the United States: 60.7%
Bonsergent 2013	Place of residence; Race/Ethnicity/Culture/Language; Occupation (parents); Gender/Sex; Socioeconomic status	NR	Rural: completers: 40.5%; non-completers: 39.2%; urban: completers: 59.5%; non-completers: 60.8%	At least one parent born outside of France: completers: 16.36%; non-completers: 19.10%
Brito Beck da Silva 2019	Gender/Sex; Education (parents); Socioeconomic status	NR	NR	NR

Chen 2011	Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	NR	NR	Chinese or of Chinese origin: 100% (all participants self-identified ethnicity as Chinese or of Chinese origin by both subject and parent)
Dewar 2013	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	NR	Participants born in Australia: 97.8% Participants who speak English at home: 98.6% Cultural background: Australian: 85.4%; Asian: 1.1%; European: 10.1%; other: 3.1%
Dunker 2018	Gender/Sex; Socioeconomic status	NR	NR	NR

Ezendam 2012	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	Intervention: Western: 66%; Non-western: 34%; control: Western: 78.9%; Non-Western: 21.1%
French 2011	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	NR	Residence in a private house or apartment within 20 miles of the University	White: 73.6%
Haerens 2006	Gender/Sex; Socioeconomic status	Gender/Sex	NR	NR
Hovell 2018	Race/Ethnicity/Culture/Language; Occupation (parents);	Gender/Sex	NR	Non-Hispanic White: 41%; Hispanic: 40%; Non-Hispanic Asian/Pacific

	Gender/Sex; Education (parents); Socioeconomic status			Islander: 50%; Non-Hispanic multi-racial: 5%; Non-Hispanic Black or African American: 2%; White with no ethnicity reported: 3%; unknown race or ethnicity: 3%
Kuhlemeier 2022	Race/Ethnicity/Culture/Language; Occupation (parents); Gender/Sex; Education (parents); Socioeconomic status	Race/Ethnicity/Culture/Language; Occupation (parents); Gender/Sex; Education (parents); Socioeconomic status	NR	Intervention: Latinx: 88%; White: 10%; Black: 4%; American Indian: 3%; control: Latinx: 83%; White: 16%; Black: 4%; American Indian 2%
Leme 2018	Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents)	NR	See Comments on PROGRESS characteristics column	Ethnic background: Afro descent: 11.54%; Asian: 0.8%; Caucasian: 62.8%; Brown: 24.1%; Native Indian: 0.8% Participants born in São Paulo city: 89.7%
NCT02067728 2014	Gender/Sex	NR	NR	NR
Neumark-Sztainer 2003	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	White: 41.9%; African American: 28.6%; Asian American: 21.1%; Hispanic: 4.4%; Native American: 1%; Mixed/other 3%
Neumark-Sztainer 2010	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	School in urban and first-ring sub-urban areas	African American/Black: 28.4%; White: 24.4%: Asian; 23%; Hispanic: 14.3%; Mixed/other: 7.2%; American Indian: 2.5%

Peralta 2009	Gender/Sex	NR	NR	NR
Reesor 2019	Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	NR	NR	Hispanic: 95%
Rodearmel 2006	Gender/Sex	Gender/Sex	NR	NR
Schreier 2013	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	Urban public schools	Intervention: Chinese: 46.2%; 'Other Asian': 17.3%; European: 17.2%; Other: 19.2%; control: Chinese: 37%; 'Other Asian': 24.1%; European: 16.7%; Other: 22.2%
Singh 2009	Place of residence; Gender/Sex	Race/Ethnicity/Culture/Language; Gender/Sex	Urban and rural	See Comments on PROGRESS characteristics column
Wieland 2018	Place of residence; Race/Ethnicity/Culture/Language; Occupation (parents); Gender/Sex; Education (parents); Socioeconomic status	NR	Urban	Ethnicity/Race: Hispanic: 45.7%; Somali: 49.4%; Sudanese: 4.9% Born in the United States: 44.4% Time living in the United States (mean years): 4.5 English as the language at home: 48.1% Limited English language proficiency: 12.3% Participants that are from immigrant and refugee populations: 100% (all participants were recruited from immigrant and refugee populations)
Wilksch 2015	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	Gender/Sex	NR	Predominantly Caucasian sample

				Comparison: Activity intervention vs di
Study ID	**PROGRESS characteristics reported at baseline**	**PROGRESS characteristics analysed for impact on outcome***	**Place of residence (including school location)**	**Race/Ethnicity/Culture/Language**
Jago 2006	Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents)	NR	NR	Spring wave Fit for life: Anglo-American: 68.1%; African American: 3.3%; Hispanic: 18.7%; Mixed/Other: 9.9%; Spring wave control: Anglo-American: 78.1%; African American: 4.7%; Hispanic: 7.8%; Mixed/Other: 9.4% Fall wave Fit for life: Anglo-American: 79.2%; African American: 2.0%; Hispanic: 12.1%; Mixed/Other: 6.7%; Fall wave control: Anglo-American: 68.9%; African American: 4.8%; Hispanic: 14.4%; Mixed/Other: 12.0%
				Studies not included in meta
Study ID	**PROGRESS characteristics reported at baseline**	**PROGRESS characteristics analysed for impact on outcome***	**Place of residence (including school location)**	**Race/Ethnicity/Culture/Language**
Afam-Anene 2021	NR	NR	NR	NR
Ahmed 2021	Place of residence; Gender/Sex; Education (parents); Socioeconomic status	NR	Urban	NR

Barbosa Filho 2017	Place of residence; Gender/Sex; Socioeconomic status	NR	Schools were geographically dispersed	NR
Belton 2019	Gender/Sex	NR	NR	NR
Bernstein 2019	Place of residence; Race/Ethnicity/Culture/Language; Occupation (parents); Gender/Sex; Education (parents); Socioeconomic status	NR	Urban	Hispanic: 16.7%; Haitian/Creole: 56.3% Race: 14.6% White; 85.4% Black
Cohen 2021	Gender/Sex	NR	NR	NR
Farias 2015	Gender/Sex; Socioeconomic status	NR	NR	NR
Haire-Joshu 2015	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic	NR	NR	Intervention: Non-Hispanic White: 50.4%; Non-Hispanic Black: 27.8%;

	status			White or Black Hispanic: 19.4%; Other: 13.3%; control: Non-Hispanic White: 51.6%; Non-Hispanic Black: 27.3%; White or Black Hispanic: 18.4%; Other: 9.7%
Lana 2014	Gender/Sex; Education (parents)	NR	NR	NR
Mauriello 2010	Race/Ethnicity/Culture/Language; Gender/Sex	NR	NR	American Indian or Alaskan Native: 0.5%; Asian/Other Pacific Islander: 7.1%; Black, not Hispanic: 10.5%; Hispanic: 5.5%; White, not Hispanic: 71.5%; Combination: 3.4%; Other: 1.4%
Nanney 2016	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	High school location: rural/town fringe: 44%; town/rural: 50%; city: 6%	Non-Hispanic White: 8.1%
O'Connell 2005	Race/Ethnicity/Culture/Language; Gender/Sex; Socioeconomic status	NR	NR	Intervention: White: 54.7%; African American: 33.8%; Other: 11.4%; control: White: 62.3%; African American: 28.1%; Other: 9.6%
Patrick 2006	Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents)	NR	NR	Asian/Pacific Islander: 3.2%; African-American: 6.6%; Native American: 0.7%; Hispanic: 13.1%; White: 58.4%; Multi-ethnic/Other: 18%
Razani 2018	Place of residence; Race/Ethnicity/Culture/Language; Education (parents); Socioeconomic status	NR	Urban	Parent Race/Ethnicity: African-American: 67%; Non-Latino White: 5%; Latino: 15%; Other (Native American, Middle Eastern, API): 13% Parent Primary Language: English: 79%; Spanish: 9%; Arabic 4%; Other (Nepali, Tongan, Mandinka, Fulani, Amharic, French, Farsi): 8% Parent Country of birth: United States: 82%; Not United States: 17%; Missing: 1%
Sabino 2021	NR	NR	See Comments on PROGRESS characteristics column	NR
Slawson 2015	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex	NR	Rural	White Caucasian Non-Hispanic: 93.4%; American Indian or Alaska Native: 1%; Asian: 0.3%; Black or African-American: 0.8%; Hispanic or

				Latino: 2.7%; Native Hawaiian or Other Pacific Islander: 0.1%; Other: 1.9%
TenHoor 2018	Gender/Sex	Gender/Se	NR	NR
Whittemore 2013	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	NR	Type of school: Two public urban schools (31.5% of participants); one public suburban (68.5% of participants)	HEALT[e]TEEN + CST: White, Non-Hispanic: 37.3%; White, Hispanic/Latino: 21.6%; African-American: 28.9%; Other: 12.3%; HEALT[e]TEEN: White, Non-Hispanic: 33.9%; White, Hispanic/Latino: 23.8%; African-American: 25%; Other: 17.3%
Zhou 2019	Place of residence; Gender/Sex; Education (parents); Socioeconomic status	NR	Metropolitan areas (small to large cities)	NR
Zota 2016	Place of residence; Race/Ethnicity/Culture/Language; Gender/Sex; Education (parents); Socioeconomic status	NR	Living in the Attica region: Multicomponent intervention: 55.9%; Environmental intervention: 33.4%; School near Roma establishments: Multicomponent intervention: 14.5%; Environmental intervention: 2%	Greece as maternal country of birth: Multicomponent intervention: 76.7%; Environmental intervention: 79.9% Greece as paternal country of birth: Multicomponent intervention: 79.4%; Environmental intervention: 84.7% Greece as child country of birth: Multicomponent intervention: 91.8%; Environmental intervention: 92.2%

*Including test for effect modification/interaction and/or sub-group analysis.

Abbreviations: FAS: Family Affluence Scale; FPL: Federal Poverty Level; GDP: gross domestic product; GED: General Equivalency Diploma; HSC: High School Certificate; IMD: Index of Multiple Deprivation; NR: not reported; NSLP: National School Lunch Program; SEIFA: Socio-Economic Indexes for Australia; SEIFA: Socio-Economic Indexes for Australia; SES: socioeconomic status; SSC: Secondary School Certificate.

Short-term follow-up: 12 weeks from baseline to < 9 months. Medium-term follow-up: 9 months from baseline to < 15 months. Long-term follow-up: 15 months or more.

Table 6

Description of studies and/or outcome(s) not included in meta-analyses

Narrative results						
Study ID	**Comparison**	**Reported outcome(s)**	**Outcome(s) not included in meta-analyses**	**Results as reported by authors**	**Direction of effect**	**Comments**
Afam-Anene 2021	Dietary vs control	Proportion of children that were obese	zBMI short term[a]	"72.6% of the control group and 70.4% of treatment group had normal BMI. In the treatment group 5.5% were obese but reduced after nutrition education to 2.1%"	Unclear	The intervention decreased the percent of children with obesity, the effect in the control group is not reported
Cohen 2021	Activity vs control	BMI	BMI short term[a]	"During the present study, BMI changes were trivial with little difference between intervention and control groups, indicating that the measure was not able to detect to exercise induced improvements in body composition identified by skinfolds and bioelectrical impedance analysis."	No effect	NR
Nanney 2016	Dietary vs control; Diet vs diet (year 2)	BMI	BMI medium term[b]	"There was no significant change in body mass index between schools/students in the intervention and comparison groups. Weight is difficult to impact, as the school environment is only one influence upon a student's overall diet and activity behaviors."	No effect	NR
Patrick 2006	Dietary and activity vs control	zBMI	zBMI medium term[b]	"No differences were found at 12 months between groups for BMI z scores, which were normed for age and sex in models controlling for baseline BMI z score, age, and ethnicity."	No effect	NR
Sabino 2021	Dietary and activity vs control	BMI	BMI medium term[b]	"Both intervention and control groups showed an increase in all body measures after the intervention"	No effect	NR
Non-usable data						
Study ID	**Comparison**	**Reported outcome**	**Outcome(s) not included in meta-analyses**	**Results as reported by authors**	**Direction of effect**	**Comments**
Farias 2015	Activity intervention vs control	zBMI	n/a	n/a	Beneficial effect	Outlier study, results are excluded from the meta-analysis. It is apparent that there is a typo in the results and the transformation of the data from proportion of children who are obese or overweight to zBMI looks implausible.
Haire-Joshu 2015	Dietary and activity vs control	Odds ratio (OR) of BMI success	BMI medium term[b]; BMI long term[c]	12-months follow-up: "BALANCE adolescents were not more likely than controls to maintain a normal BMI or improve an overweight/ obese BMI in intent to treat or per protocol models overall (OR: 1.27; 95% CI: 0.87-1.86)." 24-months follow-up: "BALANCE adolescents were not significantly more likely to maintain a normal BMI or improve an overweight/obese BMI by follow-up than controls (OR: 1.13; 95% CI: 0.78-1.62) though the odds ratios were in the positive direction."	No effect	Data are reported as Odds ratio (OR) of BMI success adjusted for age, race, baseline BMI, and baseline postpartum status. BMI success was defined as maintaining normal BMI at baseline, decreasing overweight BMI at baseline to normal BMI, or decreasing obese BMI at baseline to overweight or normal BMI (%)
		zBMI				

Slawson 2015	Dietary and activity vs control		zBMI short term[a]	"Findings showed a positive impact on standardized Body Mass Index (zBMI) at 3 months post-baseline for the treatment arm (b = -0.02348, p=0.01)."	Beneficial effect	Outcome incompletely reported
The comparison is not eligible for meta-analyses (the comparison is between the same type of intervention)						
Study ID	**Comparison**	**Reported outcome**	**Outcome(s) not included in meta-analyses**	**Results as reported by authors**	**Direction of effect**	**Comments**
Bernstein 2019	Dietary and activity intervention vs dietary and activity intervention	BMI percentile	n/a	"While not originally proposed, an additional repeated-measures ANOVA was run with BMI percentile entered as the outcome to determine if the ECT intervention prevented weight gain during the summer. No significant change was noted from pre- to post-intervention ($F(1, 46) = 0.357$, $p = .553$) or at long-term follow-up, ($F(3, 135) = 1.197$, $p = .314$), indicating that there was no significant increase in weight during the summer or during the school year. Examination of the means demonstrated that, while not significant, there was a slight decrease in BMI percentile over the long-term follow-up."	No effect	NR
Razani 2018	Activity vs activity	BMI	n/a	NA (measurement of the outcome at follow-up(s) was planned but results are not reported (there is no evidence that it was measured))	n/a	From the study protocol: "Body mass index (BMI)—BMI be measured in clinic at baseline, one month, and three months out by using weight and an average of three measurements of height." Note that the comparison is not eligible as the study is comparing two activity interventions.
Whittemore 2013	Dietary and activity intervention vs dietary and activity intervention	BMI	n/a	"There was a marginally significant decrease in weight (p=0.05) but not BMI (p=0.86)."	n/a	NR
Zota 2016	Dietary vs dietary	Odds ratios (OR) of changing weight status from overweight/obese to normal weight	n/a	"OR refer to the comparison of multicomponent versus environmental intervention groups. All variables presented in Table 2 were taken into account as possible confounders in the logistic regressions. Results: There was no statistically significant difference in the % of participants that changed from overweight/obese to normal (MI 24.6 % vs. EI 27.0 %, p = 0.716). The probability to improve from overweight/obese to normal in adolescents did not differ among the two groups.	No effect	Outcome at follow-up reported as Odds ratios (OR) of changing weight status from overweight/obese to normal weight where obesity and overweight definition was based on BMI.
The outcome(s) was measured at follow-up(s) but results are not reported						
Study ID	**Comparison**	**Measured outcome**	**Outcome(s) not included in meta-analyses**	**Results as reported by authors**	**Direction of effect**	**Comments**
Belton 2019	Activity vs control	BMI	BMI medium term	n/a	n/a	NR
Lana 2014	Dietary vs control	BMI	BMI medium term	n/a	n/a	Outcome reported as proportion of children that are overweight or obese but the definition of overweight and obesity is not reported. "Prevalence of being overweight also decreased significantly (about 20%) in this group; while in the other

						ones it rose during the same period."
Mauriello 2010	Dietary and activity vs control	Proportion of children that are overweight	zBMI short term[a]; zBMI medium term[b]	n/a	n/a	NR
O'Connell 2005	Dietary vs control	BMI	BMI medium term[b]	n/a	n/a	Note: Results are reported as proportion of children that are overweight or obese; classification of overweight was based on BMI and classification of obesity was based on BMI and triceps skin fold (TSF). "Participants were classified as overweight if their BMI-for-Age was > 85th percentile and obese if their BMI-for-Age and TSF-for-Age were > 85th percentile."

Measurement of the outcome at follow-up(s) was planned but results are not reported (there is no evidence that it was measured)

Study ID	Comparison	Planned outcome	Follow-up	Results as reported by authors	Direction of effect	Comments
Ahmed 2021	Dietary and activity vs control	BMI	Short term[a]	n/a	n/a	From trial Registry: "Secondary outcome: Anthropometric measurement is a composite secondary outcome. That is why an anthropometric measurement (e.g., height, weight, BMI) will be assessed by the researcher. Height and weight will be measured using height scale, weighing machine and the measurement tape. Timepoint: At baseline (before the intervention-Wave 1), mid-point (Wave 2) and immediately after the 12-weeks intervention (Wave 3)."
Barbosa Filho 2017	Activity vs control	BMI	Short term[a]	n/a	n/a	From Trial Registry: "Change from baseline in the body mass index at 4 months [Time Frame: baseline and after 4-months of intervention]. Body weight (kg) and height (m) will be used to calculate the body mass index (weight/height^2, kg/m^2). Difference between baseline and after 4 months of intervention will be calculated."
TenHoor 2018	Activity vs control	zBMI	Medium term[b]	n/a	n/a	zBMI listed as outcomes in the Trial Registry: "Secondary Outcome(s): daily physical activity, social cognitive determinants (including motivations), BMIz-scores, strength." From the study protocol: "Body Mass Index (BMI) is calculated as weight/height squared (kg/m^2) and Z scores from age- and sex specific reference values."
Zhou 2019	Dietary and activity vs control; activity vs control	BMI and zBMI	Medium term[b]	n/a	n/a	In the study protocol, Table 4. Description of study outcome measurement, the authors report that weight and height will be measured to calculate BMI and the zBMI score as a proxy measure of adiposity

Missing evidence from studies included in meta-analyses

Study ID	Comparison	Measured outcome	Outcome(s) not reported	Results as reported by authors	Direction of effect	Comments

Bonsergent 2013	Dietary and activity vs control	BMI and zBMI	BMI medium term[b]; zBMI medium term[b]	n/a	n/a	BMI and zBMI medium term were measured but results are not reported. BMI long term and zBMI long term results are included in the meta-analyses
Isensee 2018	Activity vs control	Percentile	Percentile short term[a]	n/a	n/a	BMI percentile short term was measured but results are not reported. BMI percentile medium term results are included in the meta-analysis
Kuhlemeier 2022	Dietary and activity vs control	zBMI (medium term)	zBMI medium term[b]	"At one year, there were no significant differences between the prevention or intensive intervention and control groups in the average change in continuous weight related outcomes."	No effect	zBMI medium term results are reported narratively. zBMI long term results are included in the meta-analysis
Lappe 2017	Dietary vs control	Percentile	Percentile short term[a]	n/a	n/a	BMI percentile short term was measured but results are not reported. BMI percentile medium term results are included in the meta-analysis

Abbreviations: n/a: not applicable; NR: not reported.

[a]Short-term follow-up: 12 weeks from baseline to < 9 months.

[b]Medium-term follow-up: 9 months from baseline to < 15 months.

[c]Long-term follow-up: 15 months or more.

Table 7

Risk of bias due to missing evidence

Comparison: Dietary interventions vs control		
Meta-analysis outcome	**Risk of bias**	**Supporting statement**
BMI short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI medium term	High risk of bias	Serious concerns over results missing from included studies. Data are missing from 1990 participants. In Nanney 2016 narrative results from 1253 participants show no effect of the intervention. In Lana 2014 results from 900 participants are not reported and no information regarding the direction of the effect is reported. The meta-analysis of results from 900 participants shows an effect of intervention on reducing BMI and there is potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
BMI long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
zBMI short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No concerns over missing results in the included studies. In Afam-Anene 2021 narrative results from 346 participants show unclear effect of the intervention. Meta-analysis of results from 3154 participants shows no effect of the intervention on zBMI and there is unlikely to be a notable change to the synthesized effect estimate due to missing results.
zBMI medium term	High risk of bias	Serious concerns over results missing from included studies. In O'Connell 2005 results from 489 participants are not reported and no information regarding the direction of the effect is reported. Meta-analysis of results from 112 participants shows no effect of the intervention and there is potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
zBMI long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile short term	Some concerns	Some concerns over missing results in the included studies. In Lappe 2017 results from 274 participants are not reported and no information regarding the direction of the effect is reported. Meta-analysis of results from 453 participants shows no effect of the intervention and there is some potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
BMI percentile medium term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
Comparison: Activity interventions vs control		
Meta-analysis outcome	**Risk of bias**	**Supporting statement**
BMI short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No concerns over missing results in the included studies. In Cohen 2021 narrative results from 110 participants show no effect of the

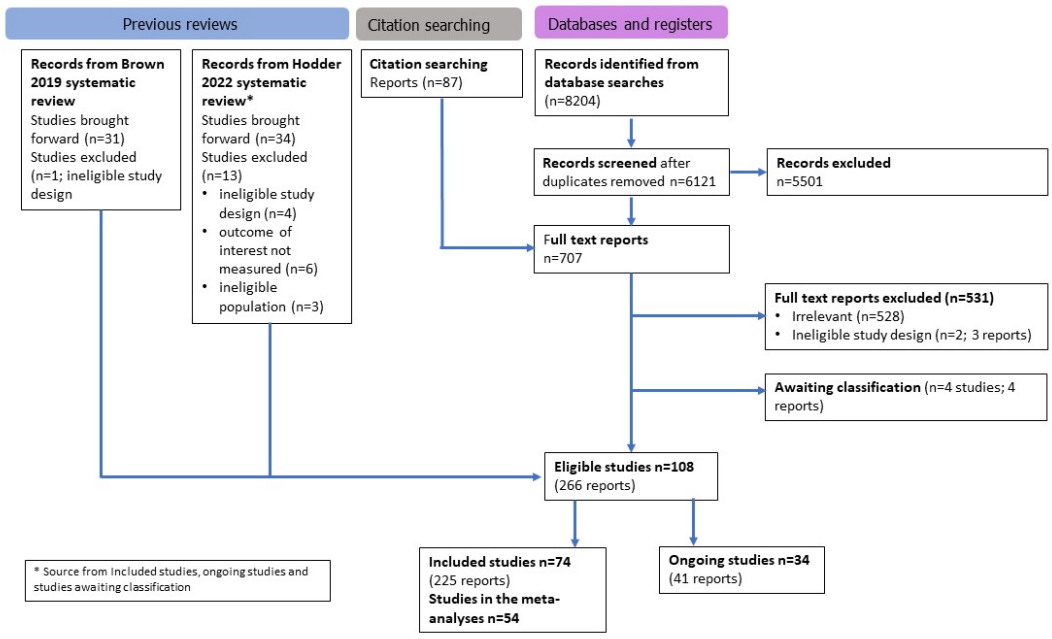
		intervention. The meta-analysis of results from 1780 participants shows no effect of the intervention on BMI and there is unlikely to be a notable change to the synthesized effect estimate due to missing results.
BMI medium term	Some concerns	Some concerns over missing results in the included studies. In Belton 2019 results from 490 participants are not reported and no information regarding the direction of the effect is reported. Meta-analysis of results from 2143 participants shows a positive effect of the intervention; although the proportion of missing data is relatively small (<30%), there is some potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
BMI long term	High risk of bias	Serious concerns over results missing from included studies. In Belton 2019 results from 490 participants are not reported and no information regarding the direction of the effect is reported. The meta-analysis of results from 945 participants shows an effect of intervention on reducing BMI and there is potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
zBMI short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
zBMI medium term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
zBMI long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile short term	n/a	No meta-analysis was conducted
BMI percentile medium term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile long term	n/a	No meta-analysis was conducted
Comparison: Dietary and activity interventions vs control		
Meta-analysis outcome	**Risk of bias**	**Supporting statement**
BMI short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI medium term	High risk of bias	Serious concerns over results missing from included studies. Narrative results are reported in Haire-Joshu 2015 (1184 participants) and in Sabino 2021 (1458 participants) show no effect of the intervention. In Bonsergent 2013 results from 3538 participants are not reported and no information regarding the direction of the effect is reported. The meta-analysis of results from 5612 participants shows no effect of the intervention on BMI and there is potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
BMI long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No concerns over missing results in the included studies. In Haire-Joshu 2015 narrative results from 1184 participants show no effect of the intervention on BMI (though the odds ratios of maintaining a normal BMI or improving an overweight/obese BMI were in the direction of a positive effect of the intervention); in Wieland 2018 results from 81 participants are not reported and no information regarding the direction of the effect is reported. Meta-analysis of results from 8736 participants shows no effect of the intervention and there is unlikely to be a notable change to the synthesized effect estimate due to missing results.
zBMI short term	High risk of bias	Serious concerns over results missing from included studies. In Mauriello 2010 results from 1741 are not reported. In Slawson 2015 results from 1509 show a positive effect of the intervention but data are unsuitable for inclusion on the meta-analysis. Meta-analysis of results from 515 participants shows no effect of the intervention and there is potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
zBMI medium term	High risk of bias	Serious concerns over results missing from included studies. Results are missing from 8110 participants. In Bonsergent 2013, Mauriello 2010, and Slawson 2015, results are not reported from 3538, 1741 and 1509 participants, respectively, and no information regarding the direction of the effect is reported. Narrative results in Kuhlemeier 2022 (503 participants) and Patrick 2006 (819 participants) show no effect of the intervention. Meta-analysis of results from 515 participants shows no effect of the intervention and there is potential for missing results to impact on the synthesised effect estimate. Some concerns over potential for missing studies that are likely to have eligible results.
zBMI long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile medium term	n/a	No meta-analysis was conducted
BMI percentile long term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
Comparison: Activity interventions vs dietary intervention		
Meta-analysis outcome	**Risk of bias**	**Supporting statement**

BMI short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI medium term	n/a	No meta-analysis was conducted
BMI long term	n/a	No meta-analysis was conducted
zBMI short term	n/a	No meta-analysis was conducted
zBMI medium term	n/a	No meta-analysis was conducted
zBMI long term	n/a	No meta-analysis was conducted
BMI percentile short term	Some concerns	Some concerns over potential for missing studies that are likely to have eligible results. No missing results in the included studies.
BMI percentile medium term	n/a	No meta-analysis was conducted
BMI percentile long term	n/a	No meta-analysis was conducted

Abbreviations: n/a: not applicable.

Short-term follow-up: 12 weeks from baseline to < 9 months. Medium-term follow-up: 9 months from baseline to < 15 months. Long-term follow-up: 15 months or more.

Figure 1



PRISMA flow diagram. Date of last search February 2023.

Figure 2

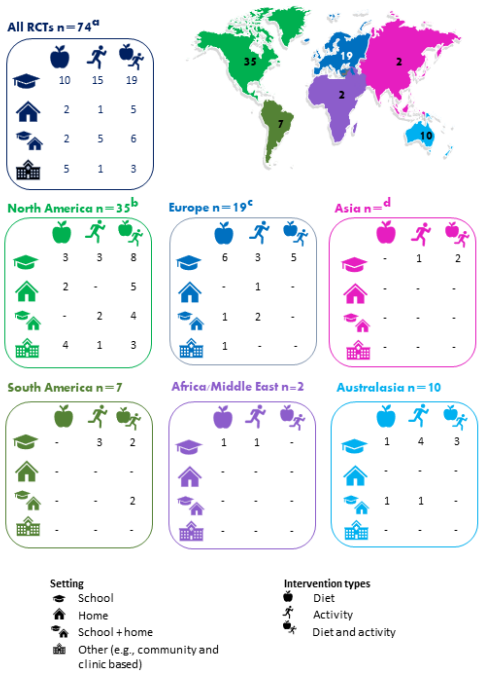


Figure 2. Distribution of studies by location, type of intervention and setting.

[a]Total n=74 RCTs and n=77 active intervention arms. Two RCTs included treatment arms for more than one intervention type (Jago 2006; Zhou 2019) and one had sites on more than continent (Lana 2014).

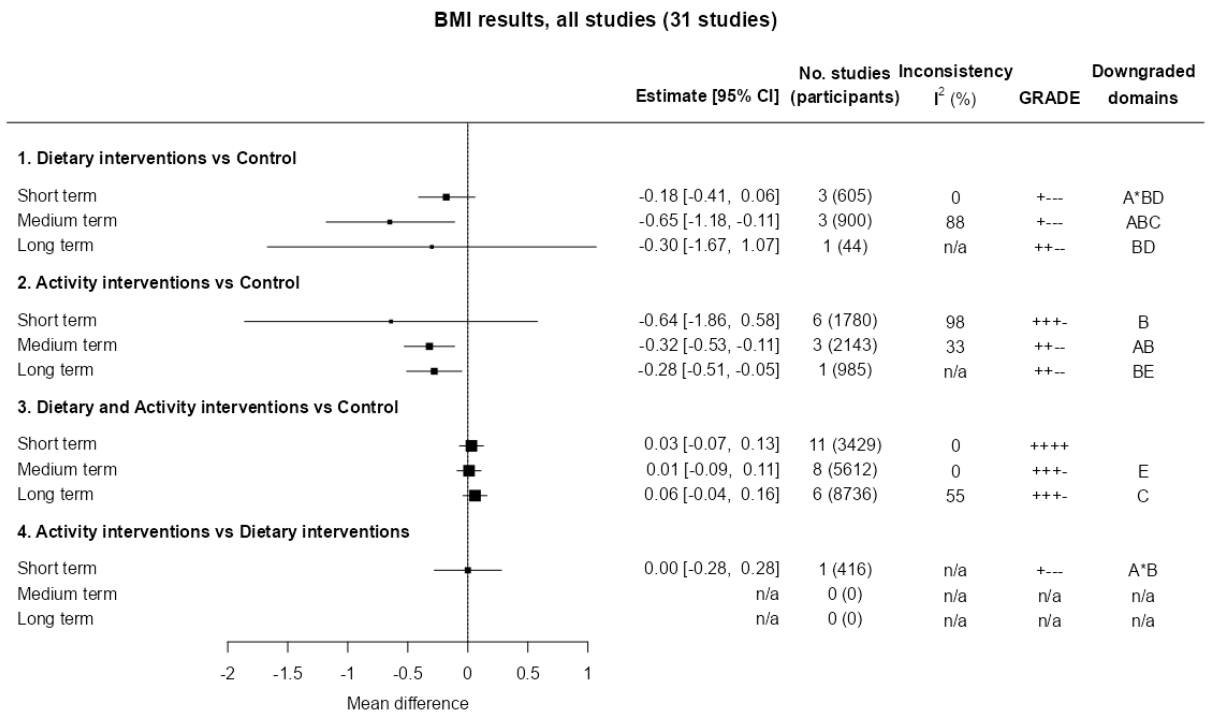
[b]34 RCTs were conducted in North America; one RCT had centres in both Europe and North America ((Lana 2014).

[c]19 RCTs were conducted in Europe; one RCT had centres in both Europe and North America (Lana 2014); one RCT included treatment arms for more than one intervention type (Jago 2006).

[d] Three RCTs were conducted in Asia; one RCT included treatment arms for more than one intervention type (Zhou 2019).

Abbreviations: RCT: randomized controlled trial.

Figure 3



Summary of meta-analysis results for BMI.

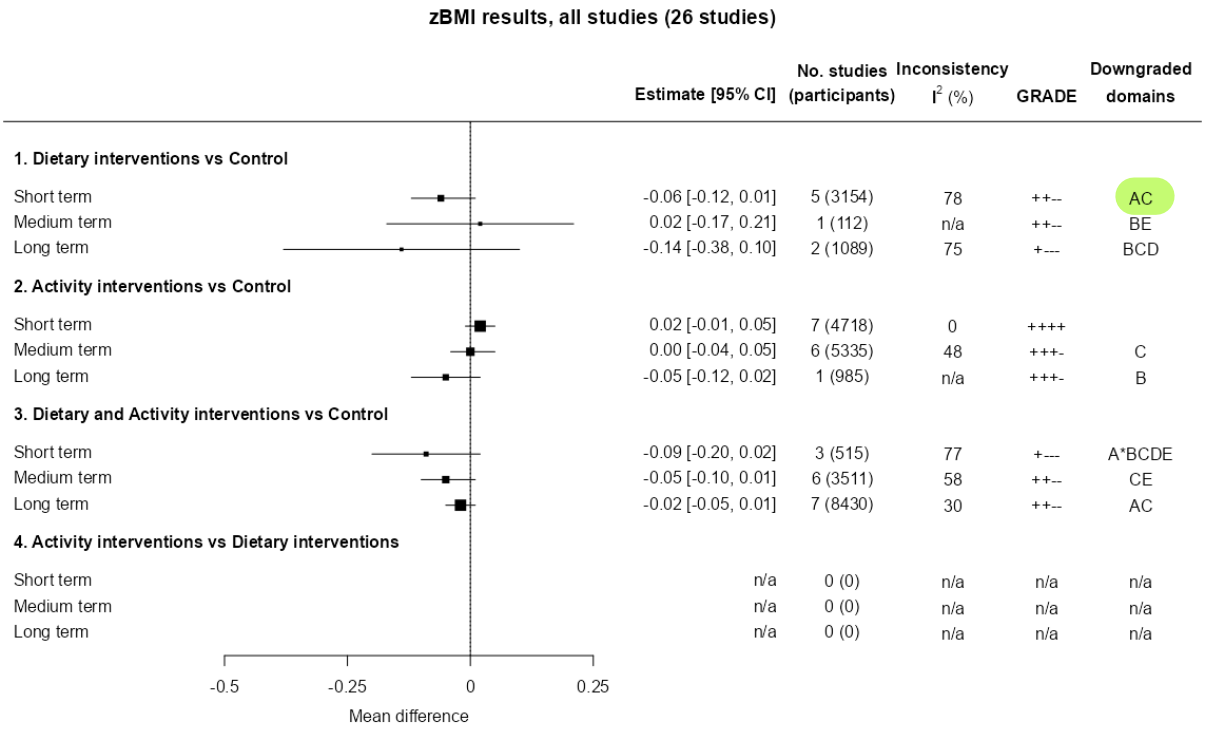
Certainty of the evidence(GRADE): ++++ = high; +++- = moderate; ++-- = low; +--- = very low;

GRADE domains: A=risk of bias; B=imprecision; C=inconsistency; D=indirectness; E=publication bias;

*Downgraded two levels.

Abbreviations: CI: confidence interval; n/a: not applicable

Figure 4



Summary of meta-analysis results for zBMI

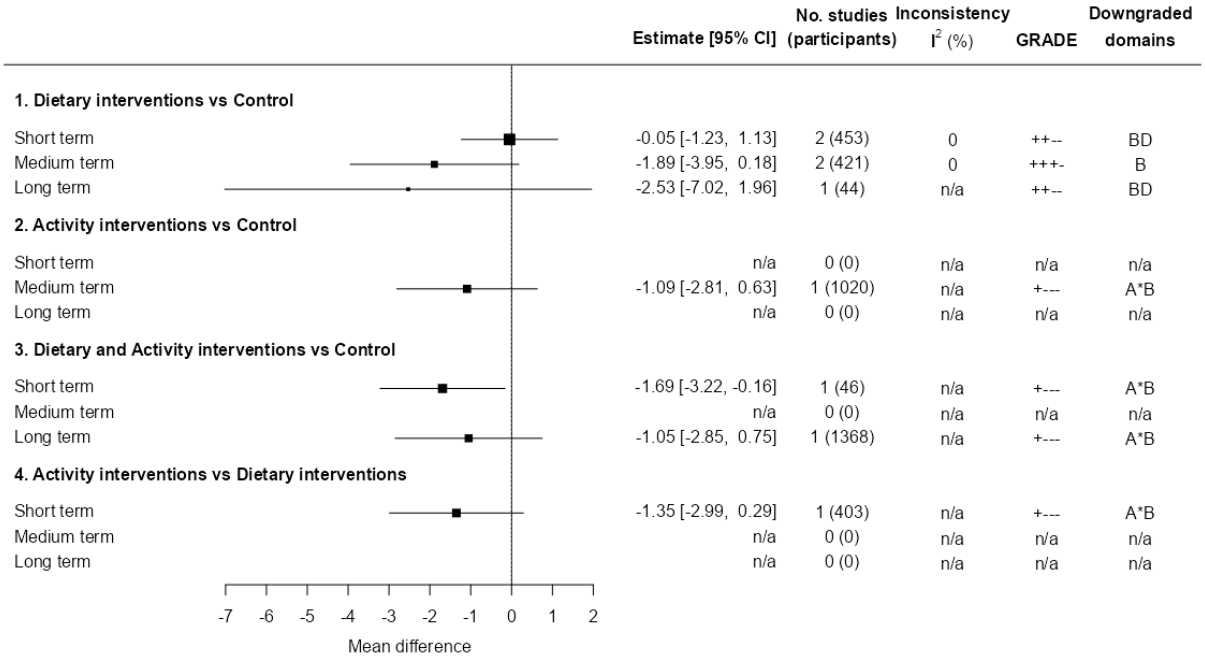
Certainty of the evidence(GRADE): ++++ = high; +++- = moderate; ++-- = low; +--- = very low;

GRADE domains: A=risk of bias; B=imprecision; C=inconsistency; D=indirectness; E=publication bias;

*Downgraded two levels.

Abbreviations: CI: confidence interval; n/a: not applicable

Figure 5



Summary of meta-analysis results for BMI percentile.

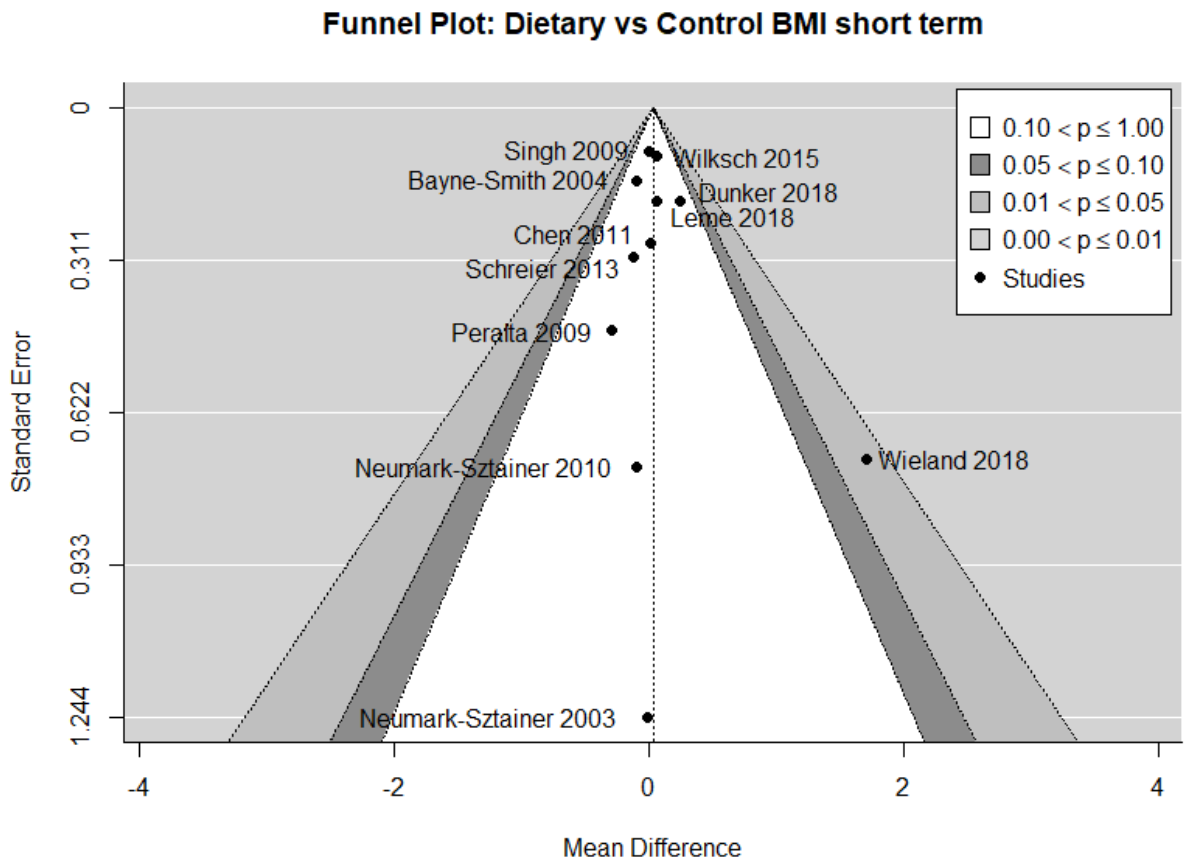
Certainty of the evidence(GRADE): ++++ = high; +++- = moderate; ++-- = low; +--- = very low;

GRADE domains: A=risk of bias; B=imprecision; C=inconsistency; D=indirectness; E=publication bias;

*Downgraded two levels.

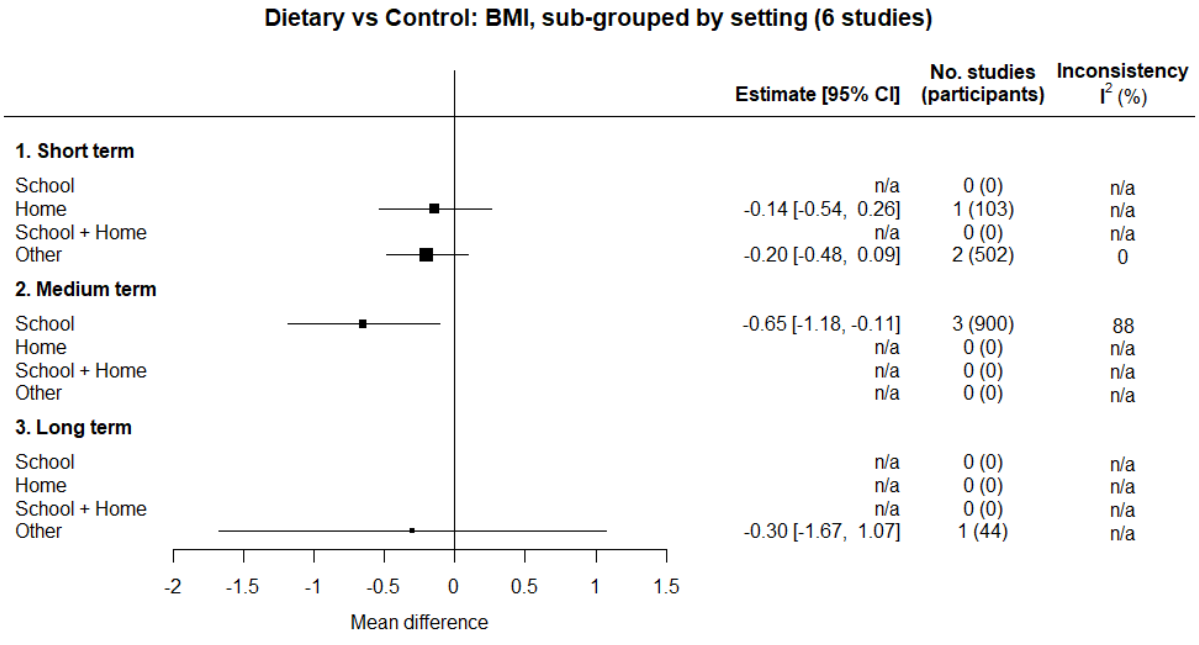
Abbreviations: CI: confidence interval; n/a: not applicable

Figure 6



Funnel plot to invetsigate small study effects in the meta-analysis of Dietary intervention vs Control for BMI short term.

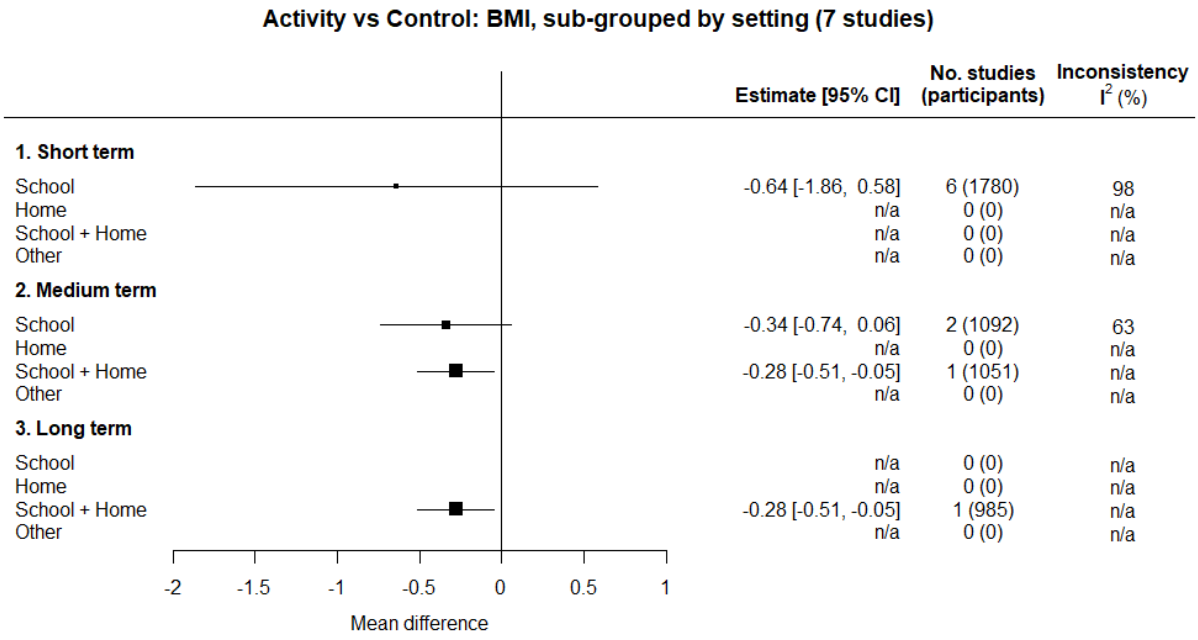
Figure 7



Summary of meta-analysis results for dietary intervention vs control on BMI subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

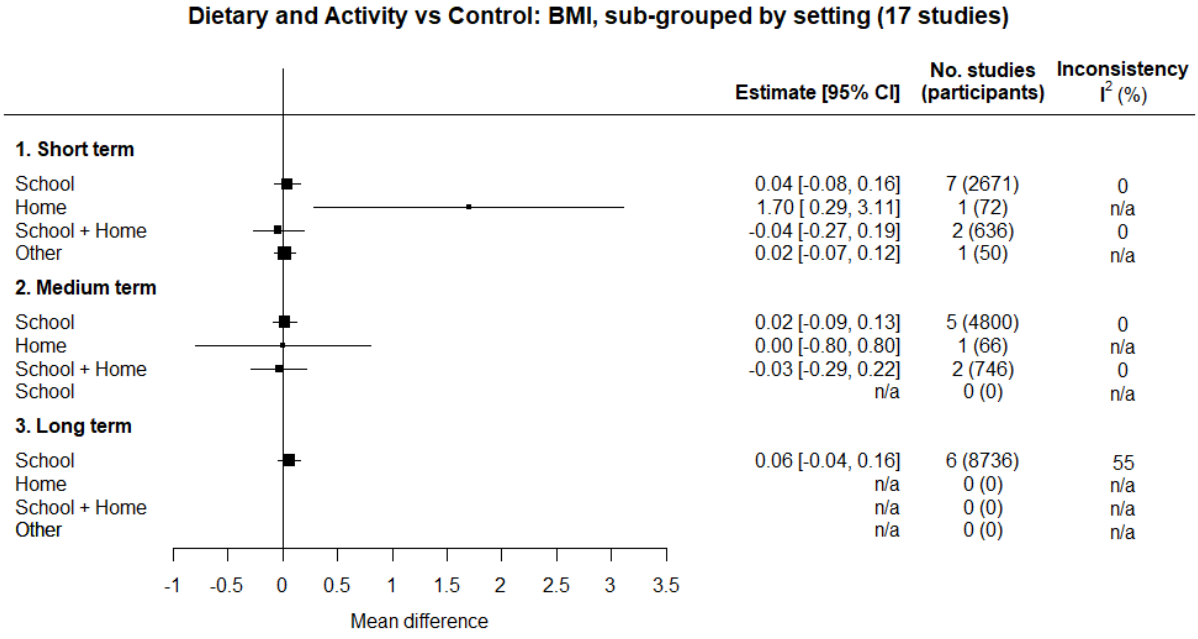
Figure 8



Summary of meta-analysis results for activity interventions vs control on BMI subgrouped by setting.

Abbreviations: CI= confidence interval; n/a = not applicable

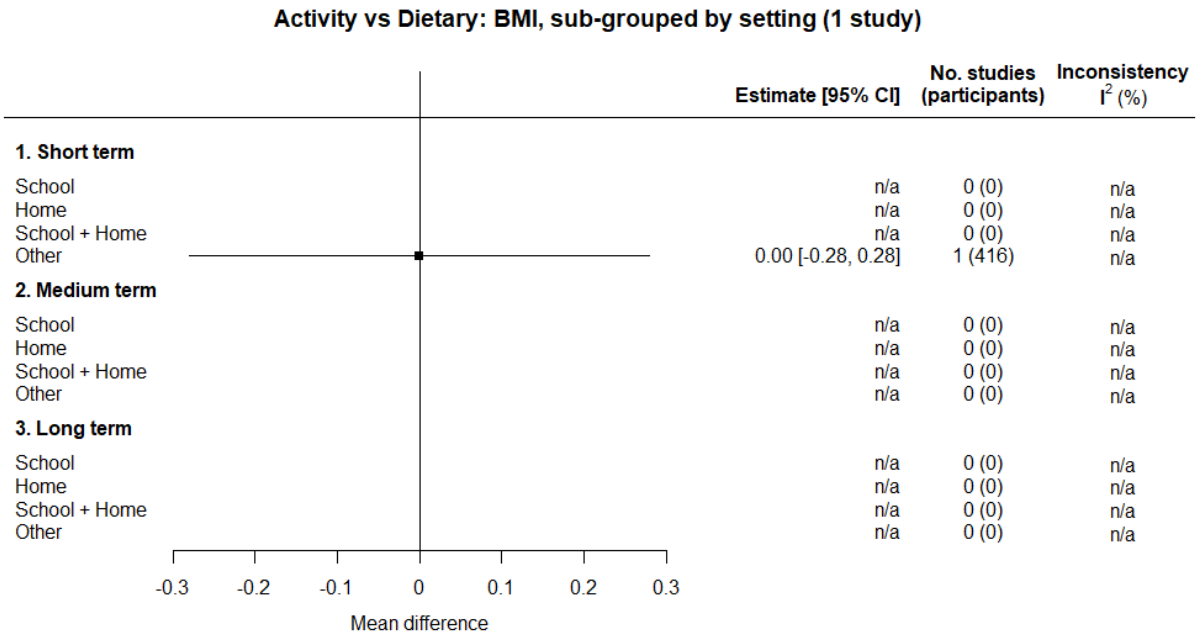
Figure 9



Summary of meta-analysis results for dietary and activity interventions vs control on BMI subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

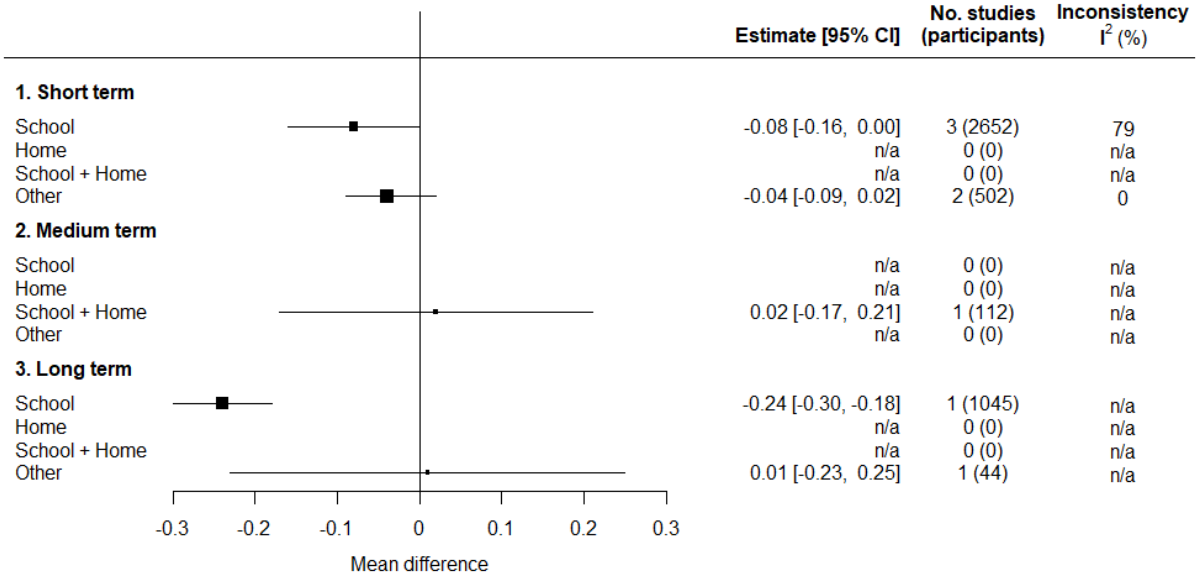
Figure 10



Summary of meta-analysis results for activity interventions vs dietary interventions on BMI subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

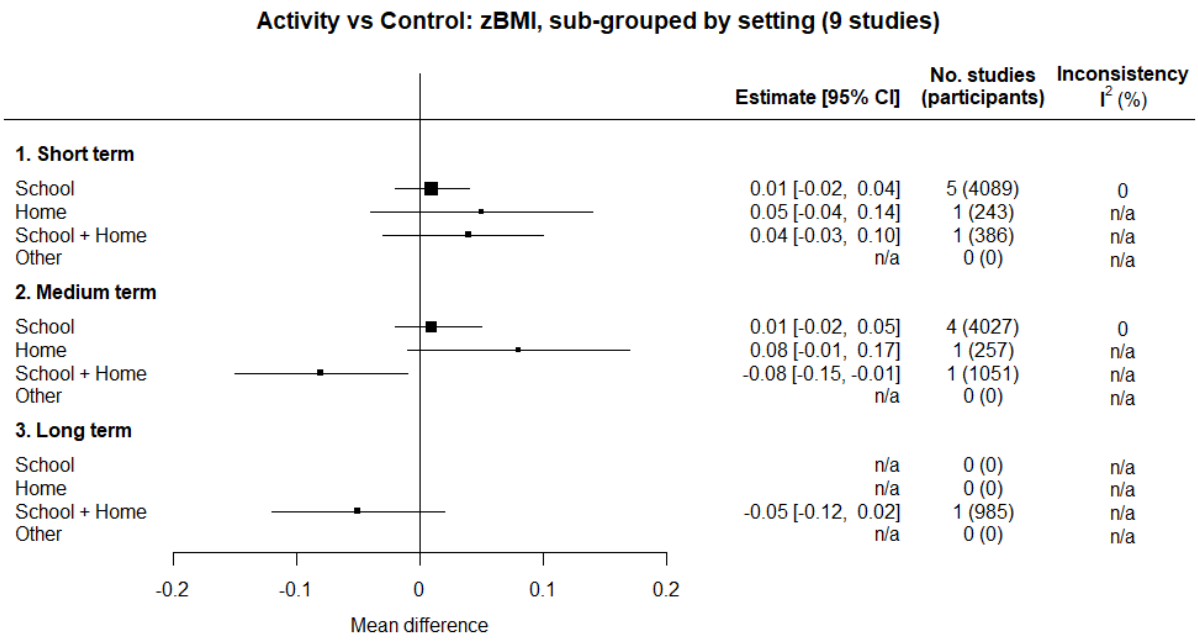
Figure 11



Summary of meta-analysis results for dietary interventions vs control on zBMI subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

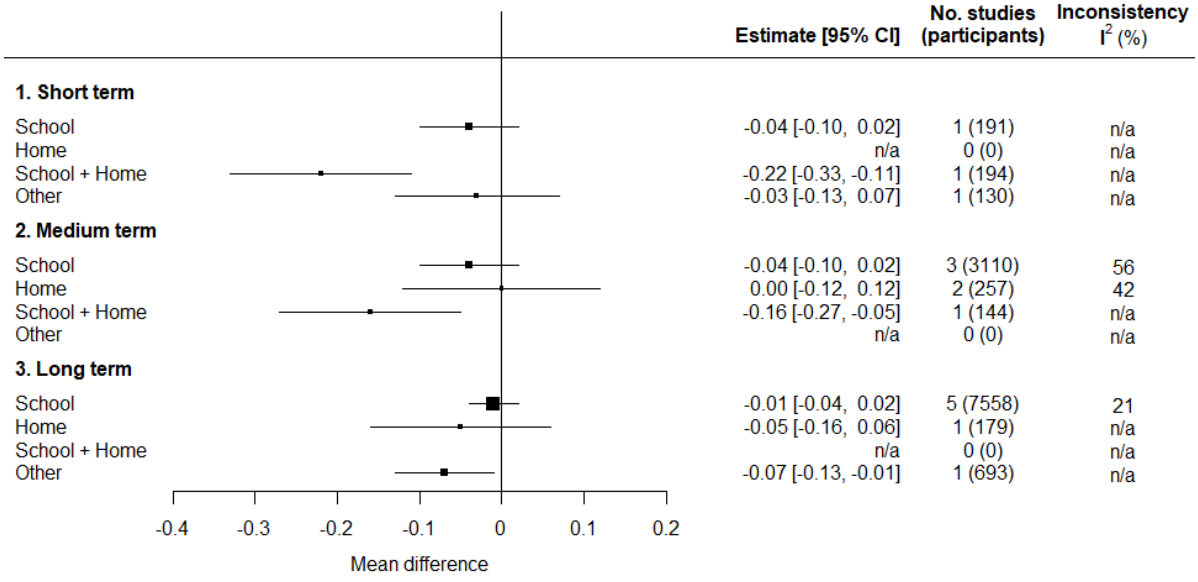
Figure 12



Summary of meta-analysis results for activity interventions vs control on zBMI subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

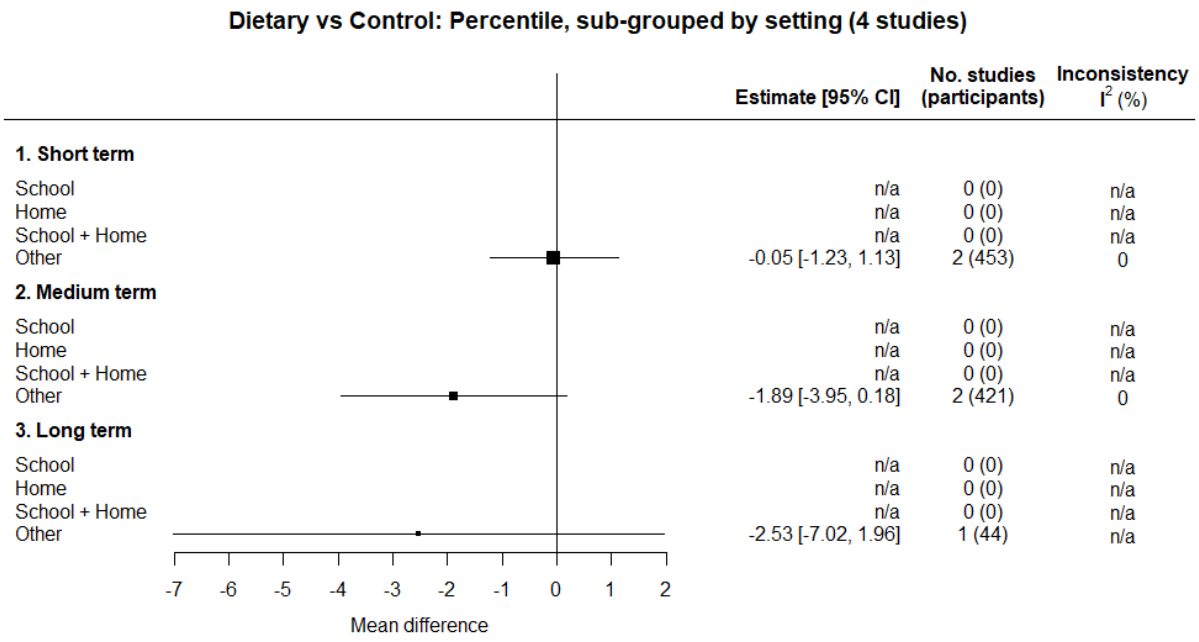
Figure 13



Summary of meta-analysis results for dietary and activity interventions vs control on zBMI subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

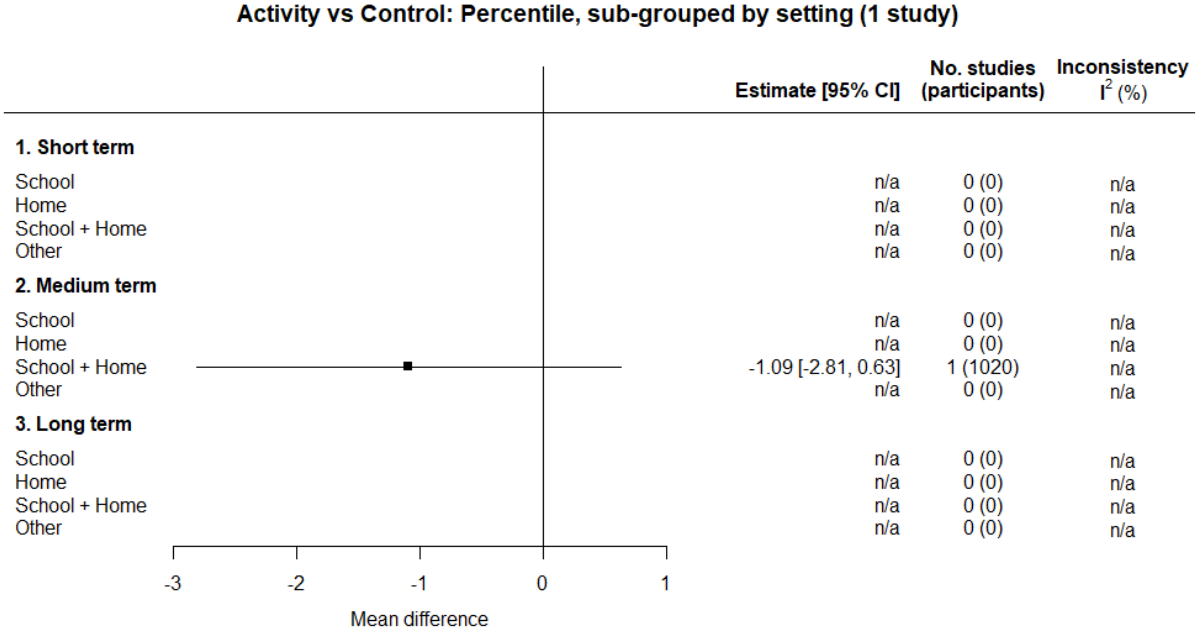
Figure 14



Summary of meta-analysis results for dietary interventions vs control on BMI percentile subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

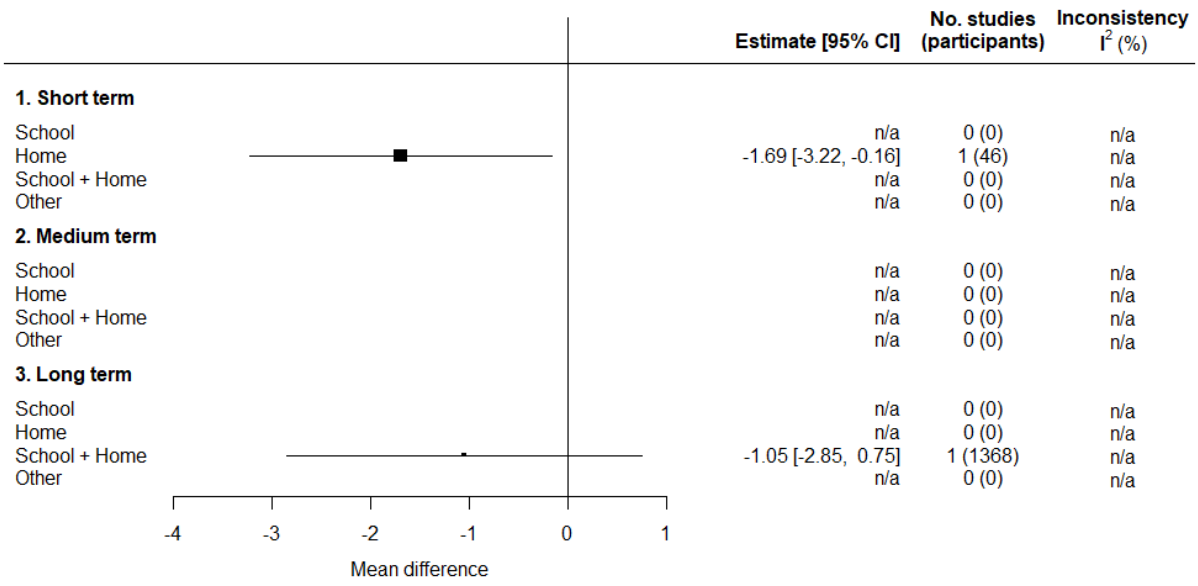
Figure 15



Summary of meta-analysis results for activity interventions vs control on BMI percentile subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

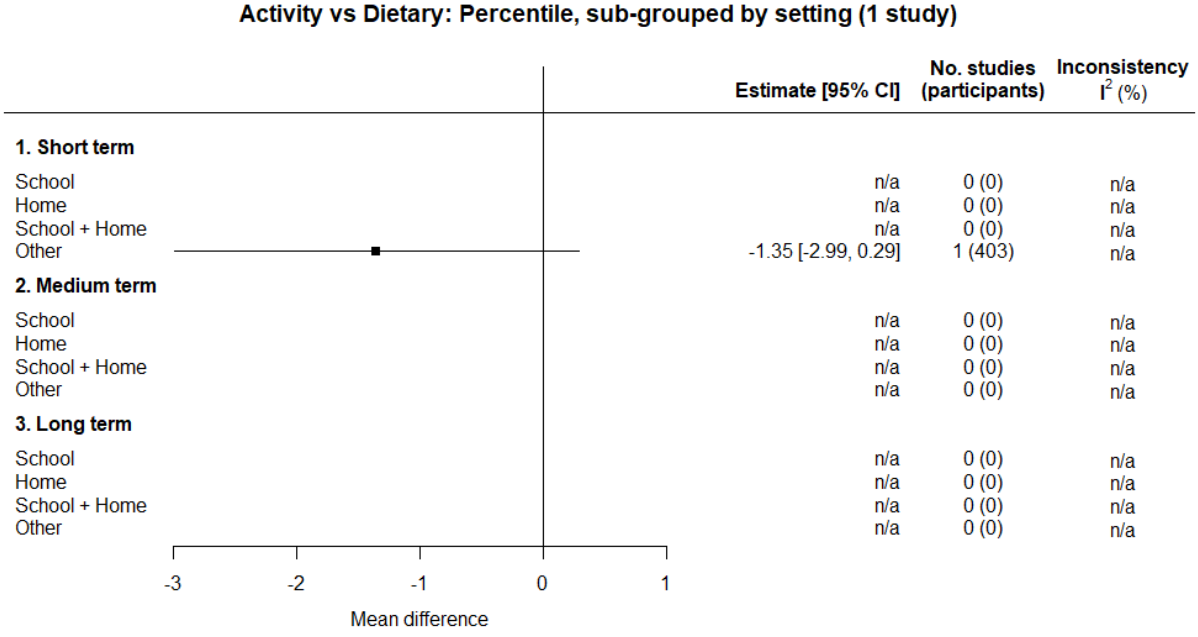
Figure 16



Summary of meta-analysis results for dietary and activity interventions vs control on BMI percentile subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

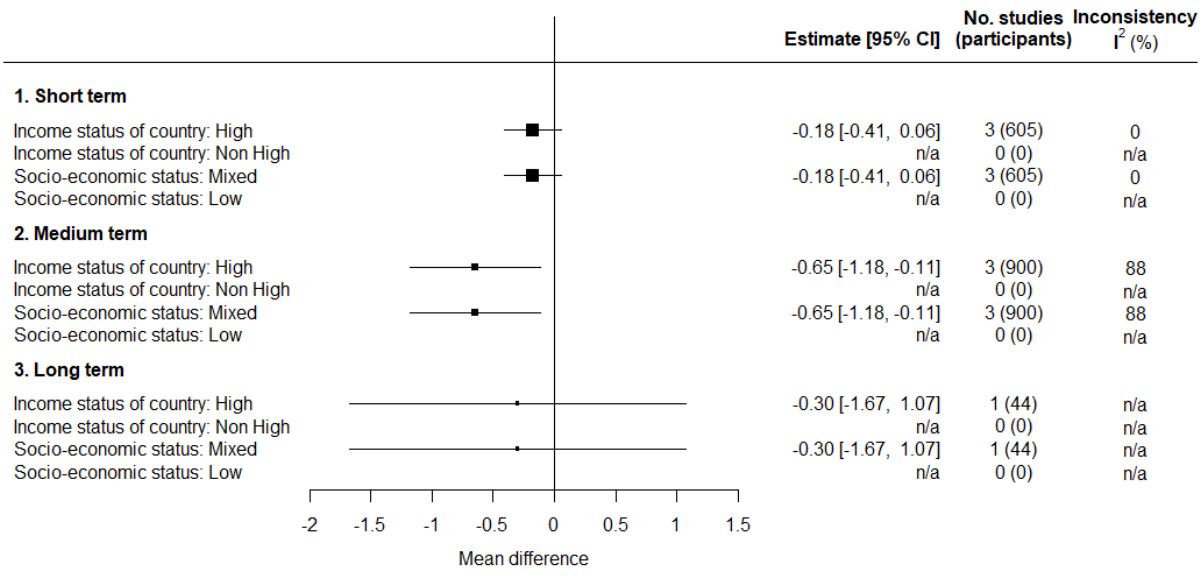
Figure 17



Summary of meta-analysis results for activity interventions vs dietary interventions on BMI percentile subgrouped by setting.

Abbreviations: CI: confidence interval; n/a: not applicable

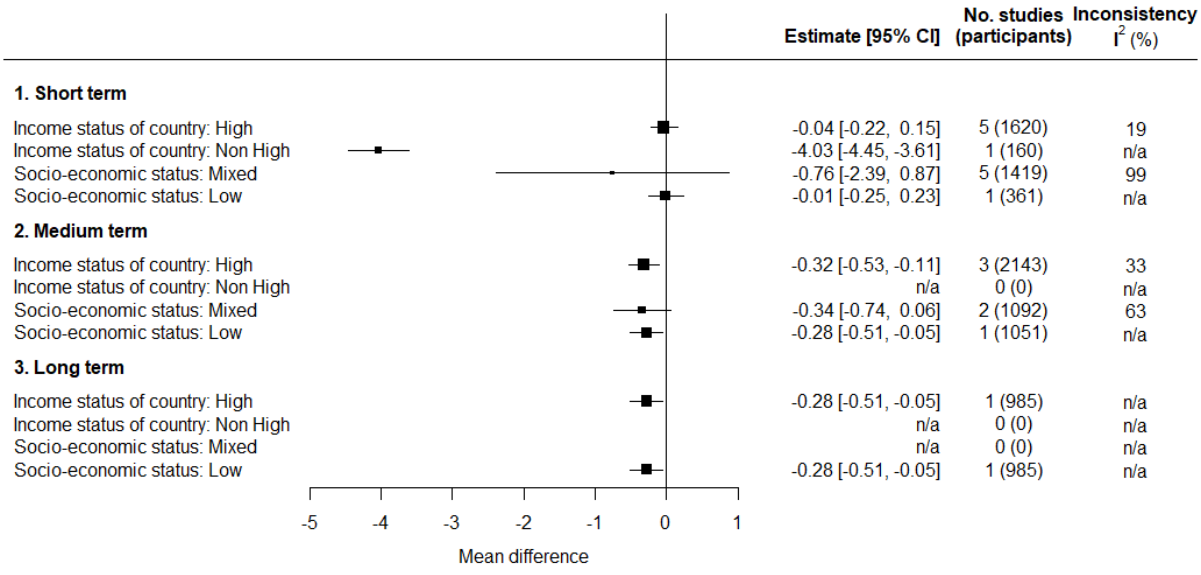
Figure 18



Summary of meta-analysis results for dietary intervention vs control on BMI subgrouped by income status of country and socio-economic status (SES).

Abbreviations: CI: confidence interval; n/a: not applicable

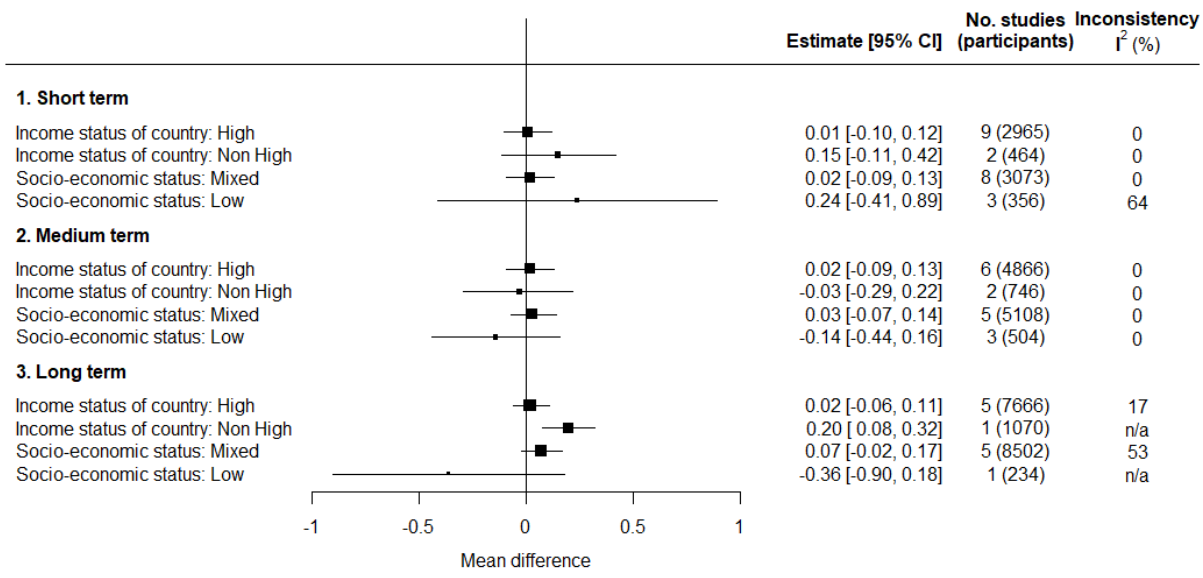
Figure 19



Summary of meta-analysis results for activity intervention vs control on BMI subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

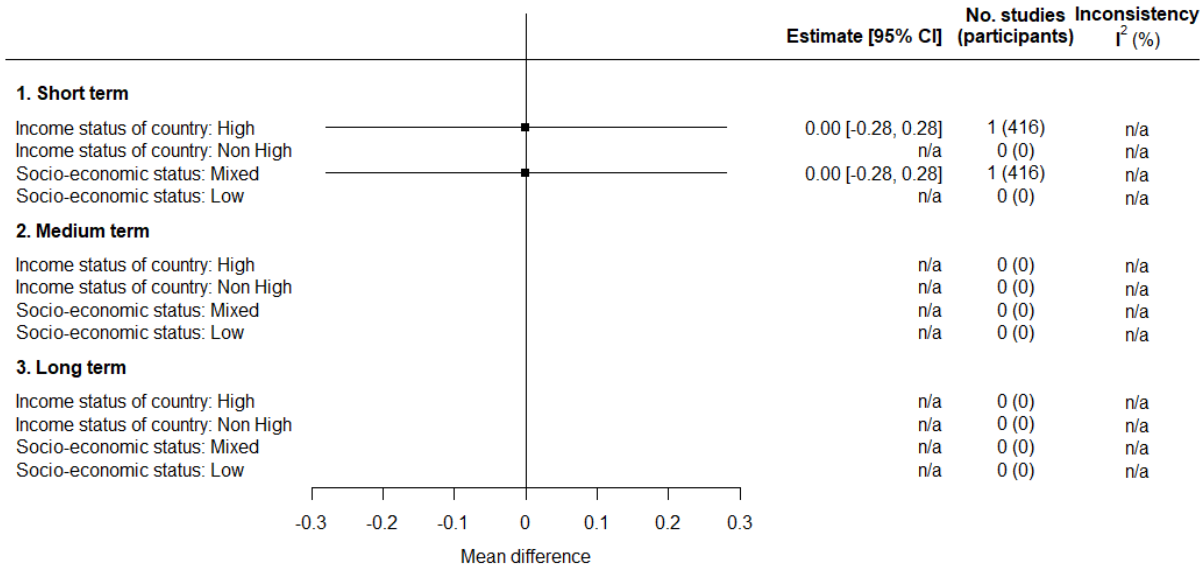
Figure 20



Summary of meta-analysis results for dietary and activity intervention vs control on BMI subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

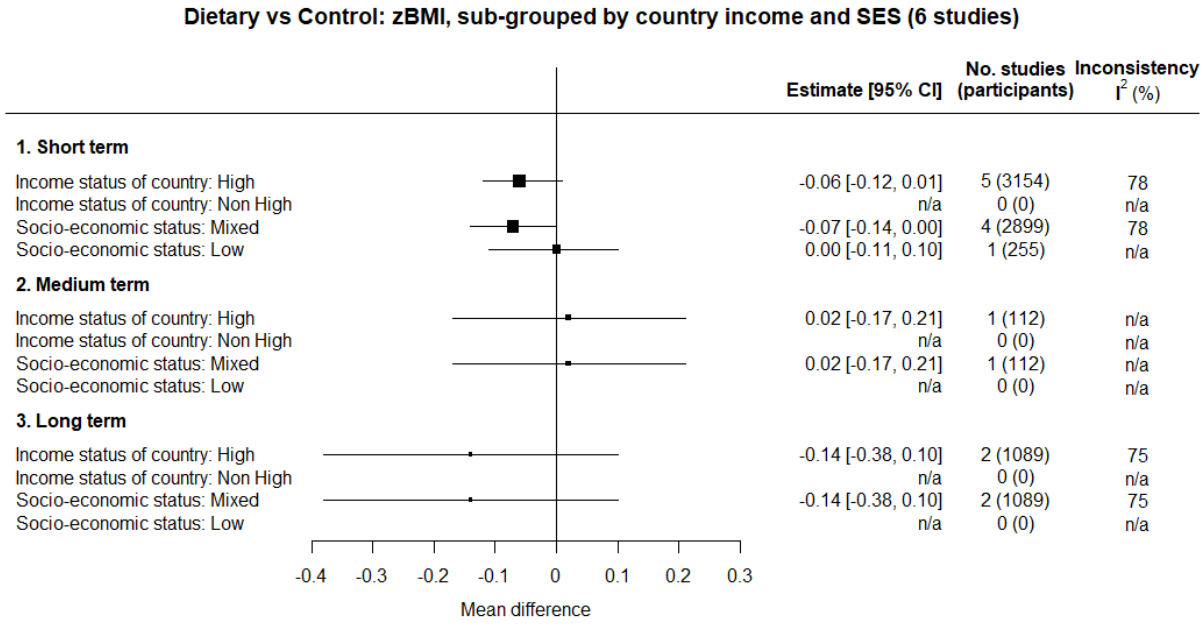
Figure 21



Summary of meta-analysis results for dietary intervention vs activity interventions on BMI subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

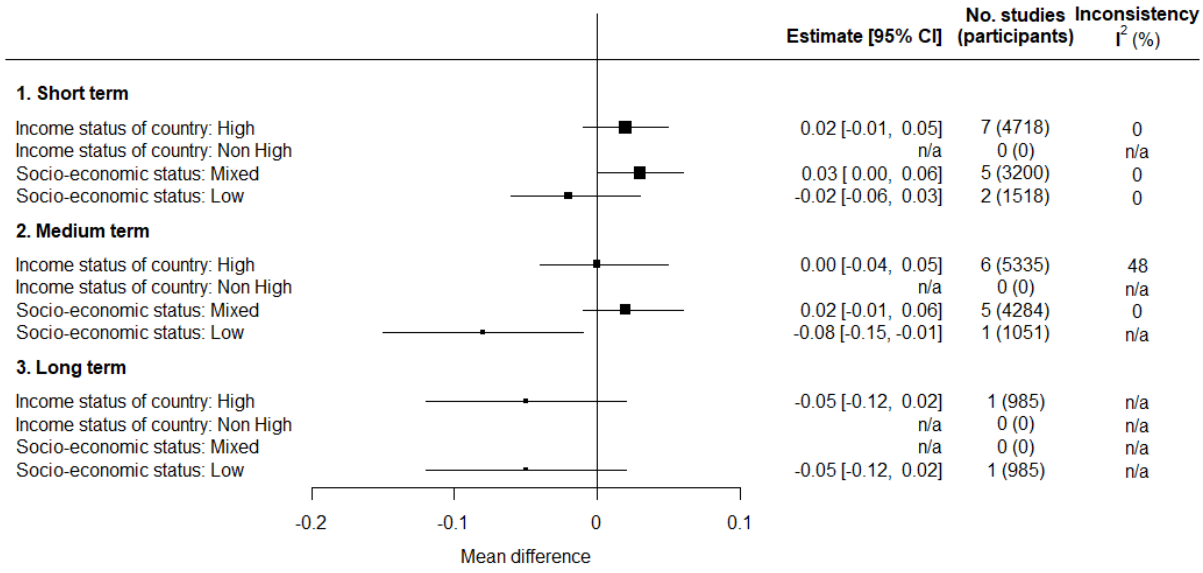
Figure 22



Summary of meta-analysis results for dietary intervention vs control on zBMI subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

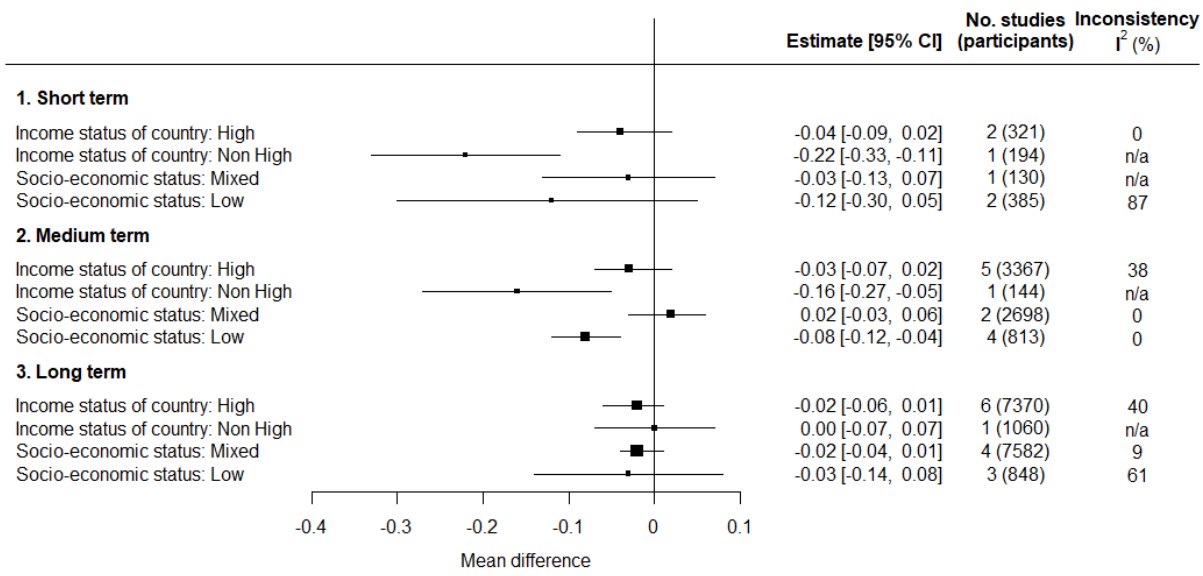
Figure 23



Summary of meta-analysis results for activity interventions vs control on zBMI subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

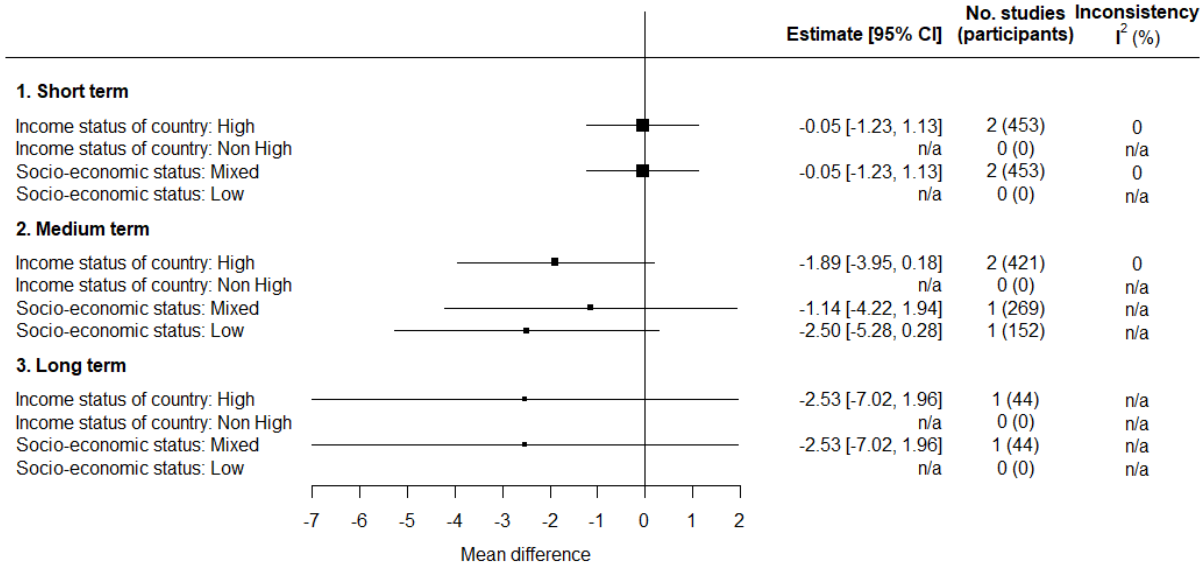
Figure 24



Summary of meta-analysis results for dietary and activity interventions vs control on zBMI subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

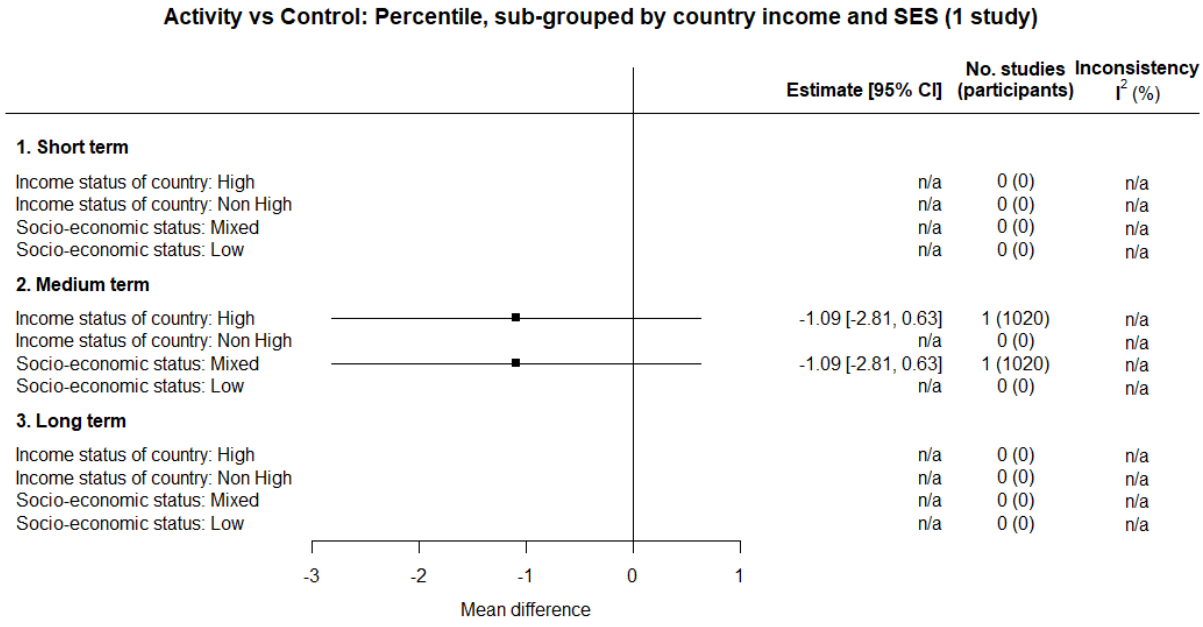
Figure 25



Summary of meta-analysis results for dietary interventions vs control on BMI percentile subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

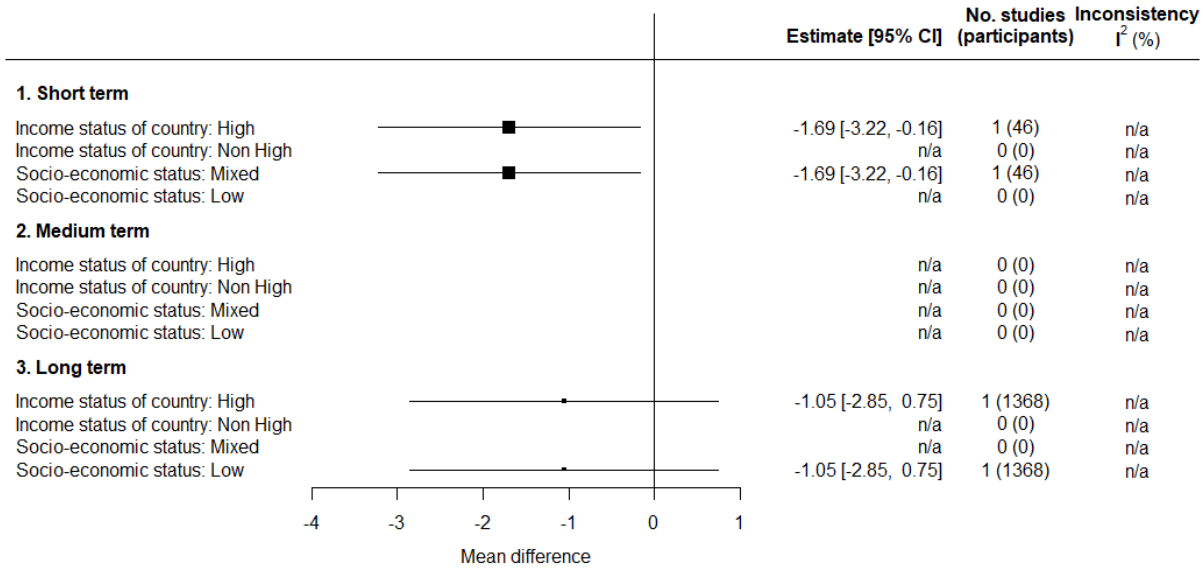
Figure 26



Summary of meta-analysis results for activity interventions vs control on BMI percentile subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

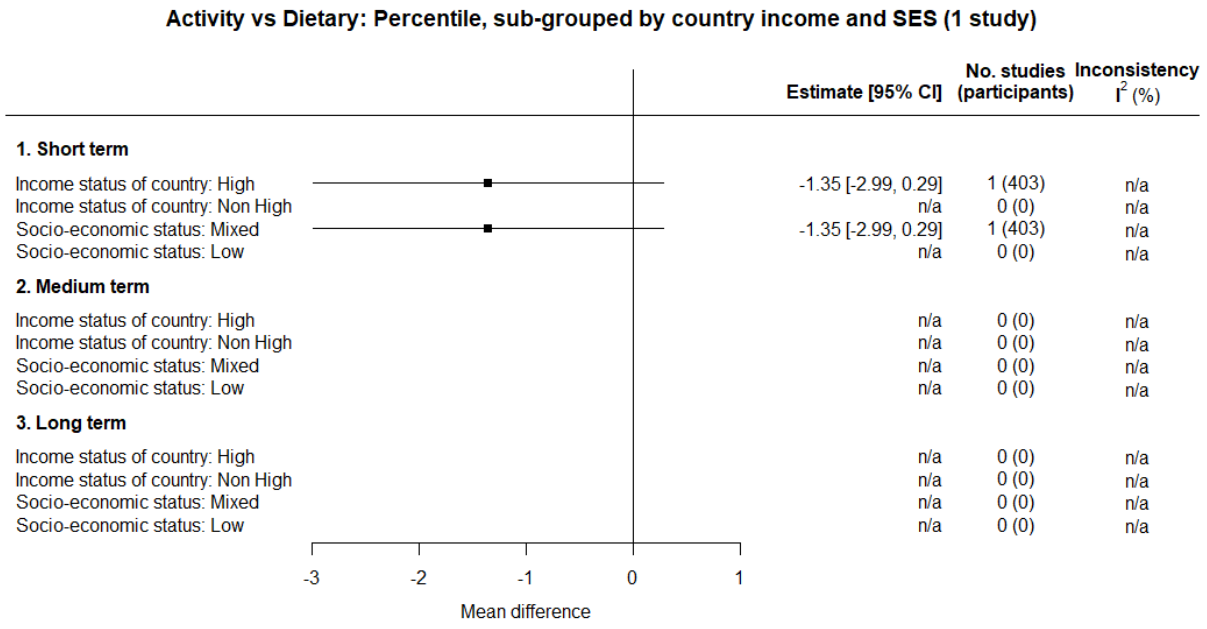
Figure 27



Summary of meta-analysis results for dietary and activity interventions vs control on BMI percentile subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

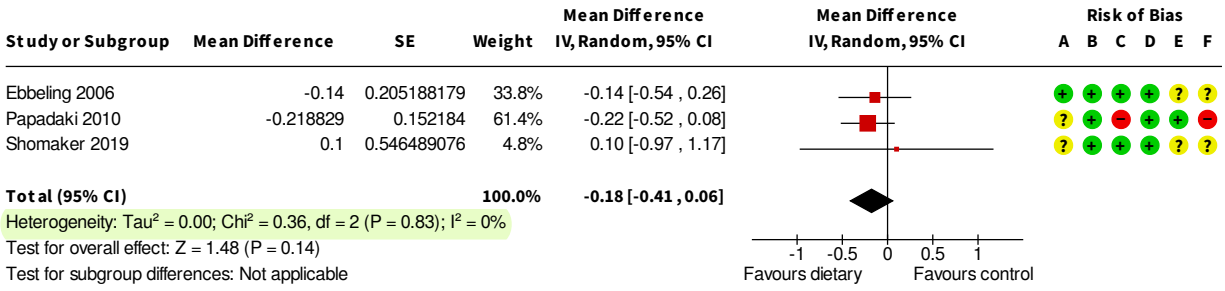
Figure 28



Summary of meta-analysis results for activity vs dietary interventions vs control on BMI percentile subgrouped by income status of country and socio-economic status.

Abbreviations: CI: confidence interval; n/a: not applicable; SES: socio-economic status

Analysis 1.1

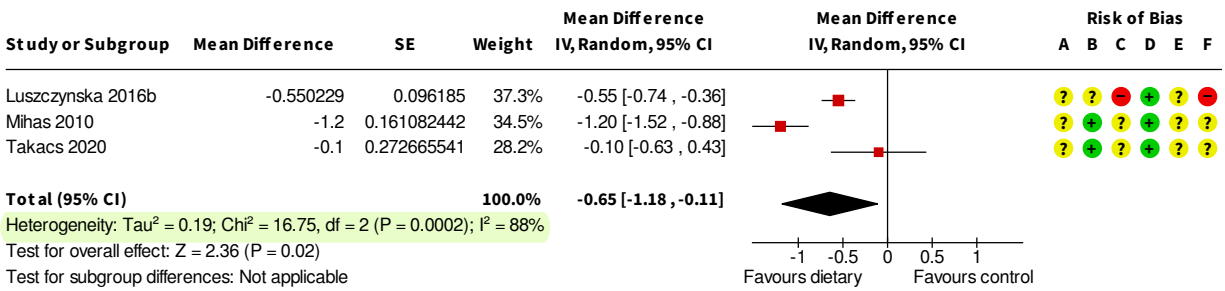


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 1: BMI short term

Analysis 1.2

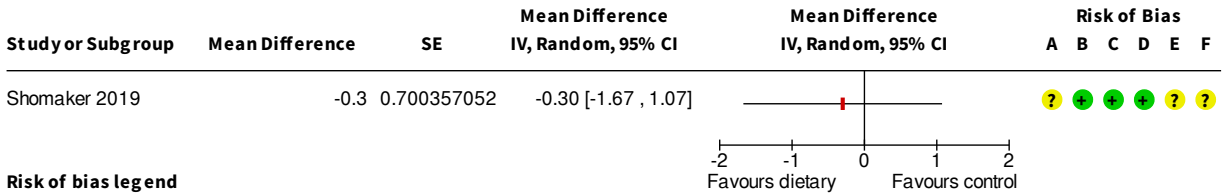


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 2: BMI medium term

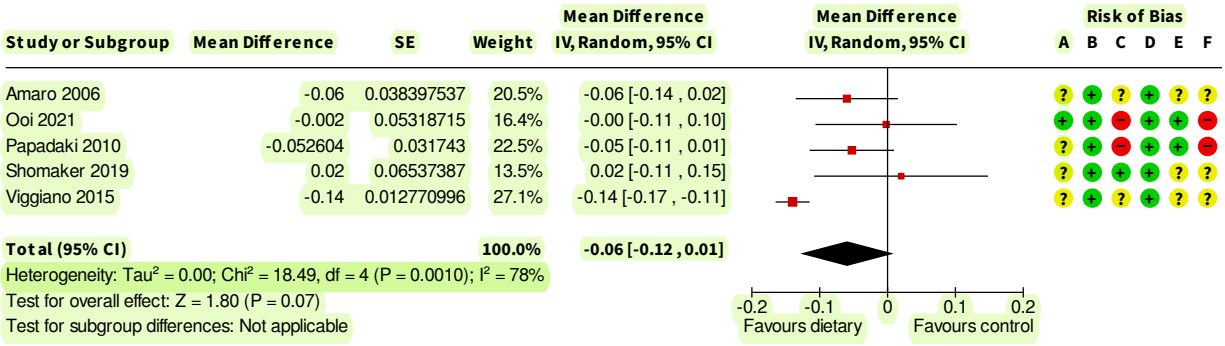
Analysis 1.3



Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 3: BMI long term

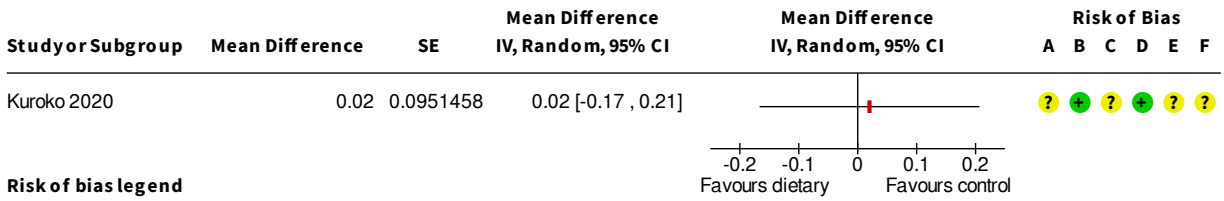
Analysis 1.4



Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 4: zBMI short term

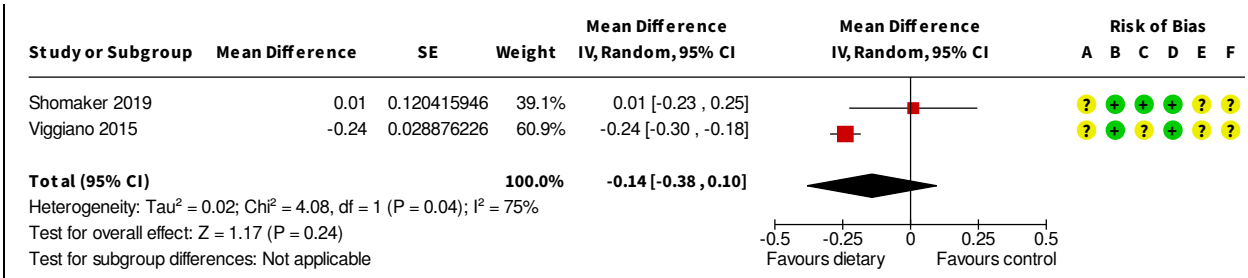
Analysis 1.5



Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 5: zBMI medium term

Analysis 1.6

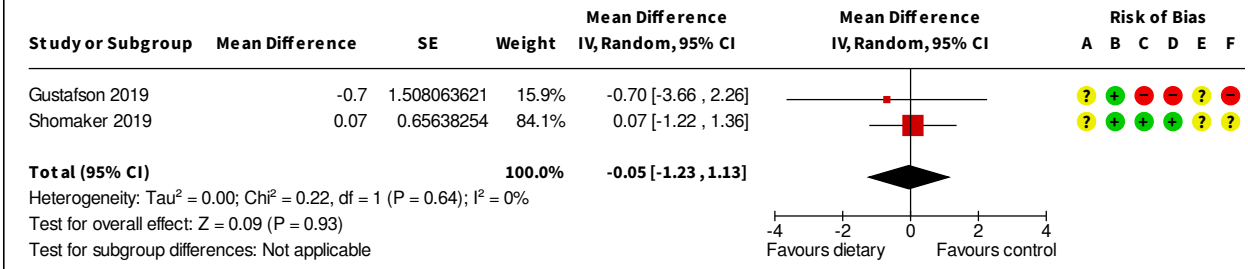


Heterogeneity: Tau² = 0.02; Chi² = 4.08, df = 1 (P = 0.04); I² = 75%
Test for overall effect: Z = 1.17 (P = 0.24)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 6: zBMI long term

Analysis 1.7

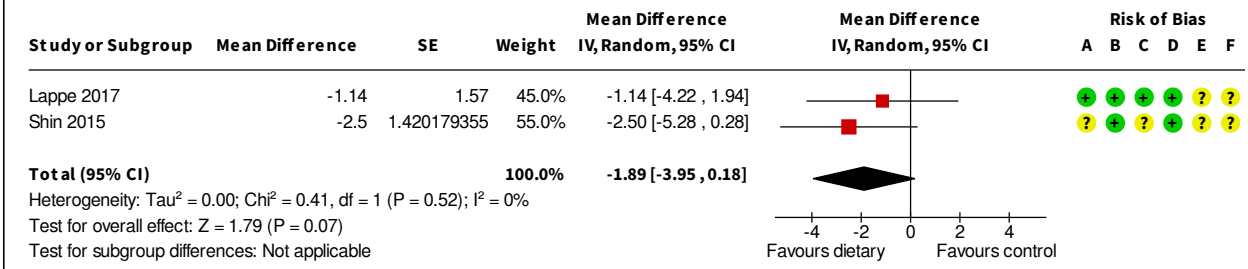


Heterogeneity: Tau² = 0.00; Chi² = 0.22, df = 1 (P = 0.64); I² = 0%
Test for overall effect: Z = 0.09 (P = 0.93)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 7: Percentile short term

Analysis 1.8

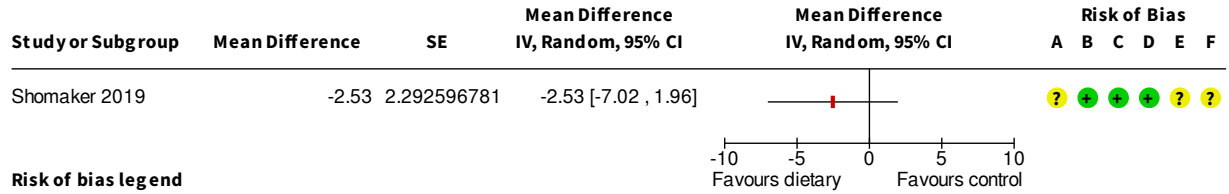


Heterogeneity: Tau² = 0.00; Chi² = 0.41, df = 1 (P = 0.52); I² = 0%
Test for overall effect: Z = 1.79 (P = 0.07)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 8: Percentile medium term

Analysis 1.9

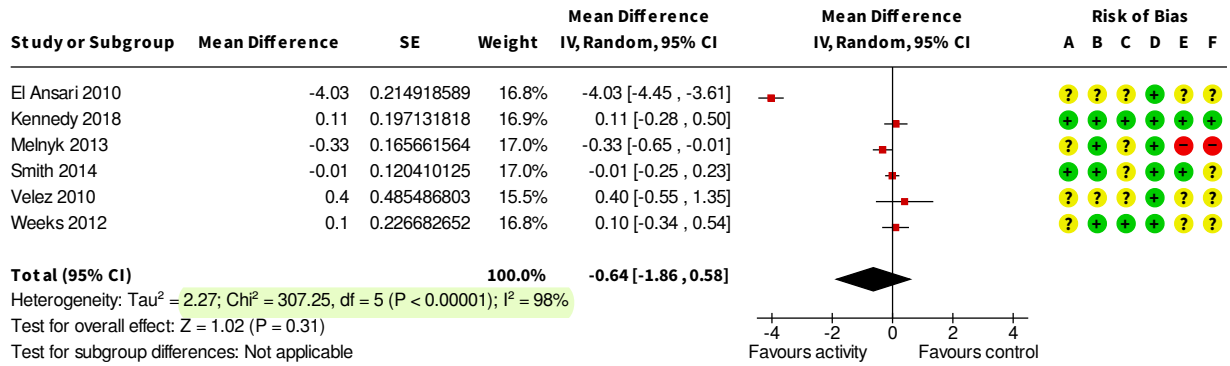


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 1: Dietary vs control (all studies), Outcome 9: Percentile long term

Analysis 2.1

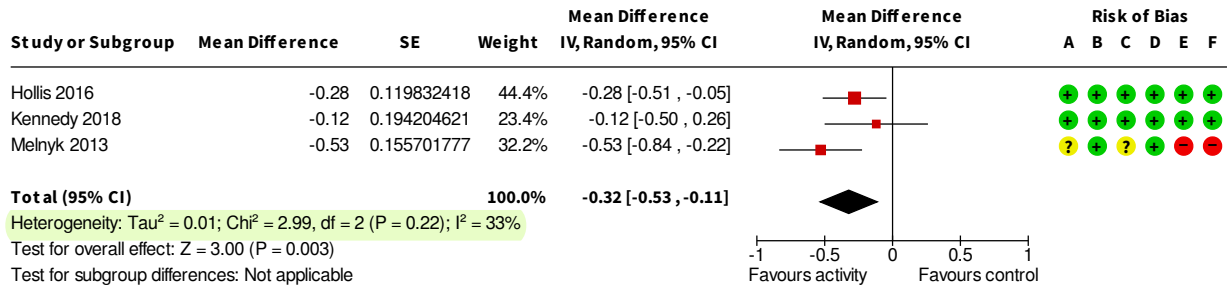


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 1: BMI short term

Analysis 2.2



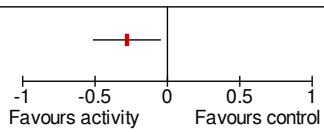
Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 2: BMI medium term

Analysis 2.3

Study or Subgroup	Mean Difference	SE	Mean Difference IV, Random, 95% CI	Mean Difference IV, Random, 95% CI	Risk of Bias A B C D E F
Hollis 2016	-0.28	0.119878236	-0.28 [-0.51 , -0.05]		



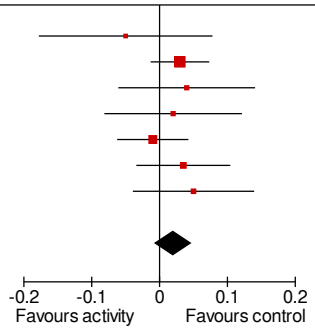
Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 3: BMI long term

Analysis 2.4

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI	Mean Difference IV, Random, 95% CI	Risk of Bias A B C D E F
Arlinghaus 2021	-0.05	0.065279593	4.1%	-0.05 [-0.18 , 0.08]		
Harrington 2018	0.03	0.022008949	36.0%	0.03 [-0.01 , 0.07]		
Kennedy 2018	0.04	0.051416123	6.6%	0.04 [-0.06 , 0.14]		
Lubans 2021	0.02	0.051715167	6.5%	0.02 [-0.08 , 0.12]		
Pfeiffer 2019	-0.01	0.026787013	24.3%	-0.01 [-0.06 , 0.04]		
Prins 2012	0.035	0.035316	14.0%	0.04 [-0.03 , 0.10]		
Simons 2015	0.05	0.045626842	8.4%	0.05 [-0.04 , 0.14]		
Total (95% CI)			**100.0%**	**0.02 [-0.01 , 0.05]**		

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.37$, df = 6 (P = 0.76); $I^2 = 0\%$
Test for overall effect: Z = 1.47 (P = 0.14)
Test for subgroup differences: Not applicable



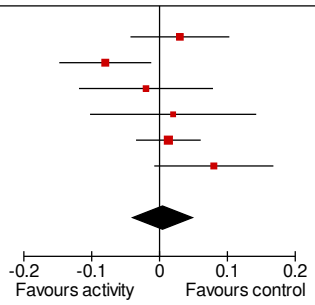
Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 4: zBMI short term

Analysis 2.5

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI	Mean Difference IV, Random, 95% CI	Risk of Bias A B C D E F
Harrington 2018	0.03	0.037169927	18.1%	0.03 [-0.04 , 0.10]		
Hollis 2016	-0.08	0.034580845	19.4%	-0.08 [-0.15 , -0.01]		
Kennedy 2018	-0.02	0.05038351	12.8%	-0.02 [-0.12 , 0.08]		
Lubans 2021	0.02	0.062481386	9.5%	0.02 [-0.10 , 0.14]		
Pate 2005	0.013	0.024317608	25.3%	0.01 [-0.03 , 0.06]		
Simons 2015	0.08	0.04478589	14.8%	0.08 [-0.01 , 0.17]		
Total (95% CI)			**100.0%**	**0.00 [-0.04 , 0.05]**		

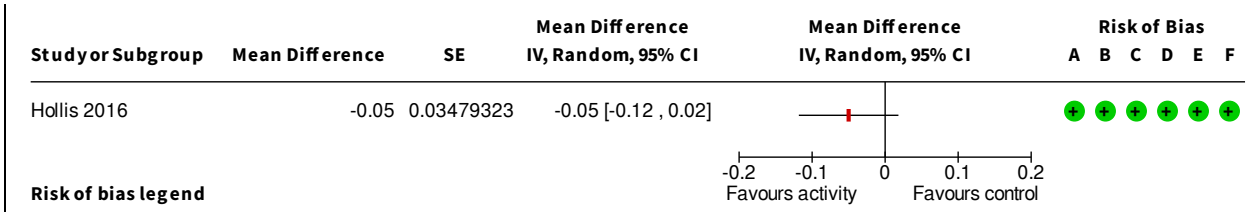
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 9.70$, df = 5 (P = 0.08); $I^2 = 48\%$
Test for overall effect: Z = 0.19 (P = 0.85)
Test for subgroup differences: Not applicable



Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 5: zBMI medium term

Analysis 2.6

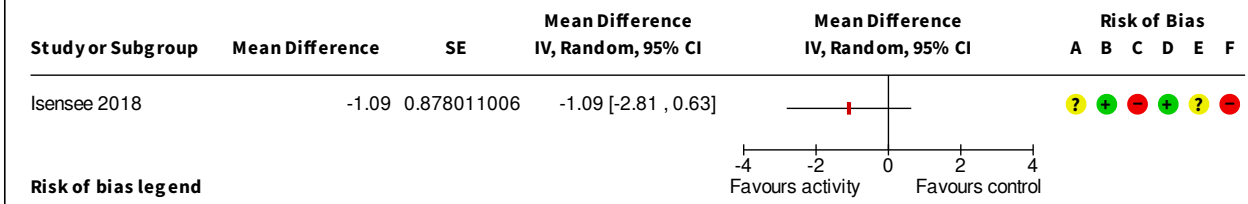


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 6: zBMI long term

Analysis 2.7

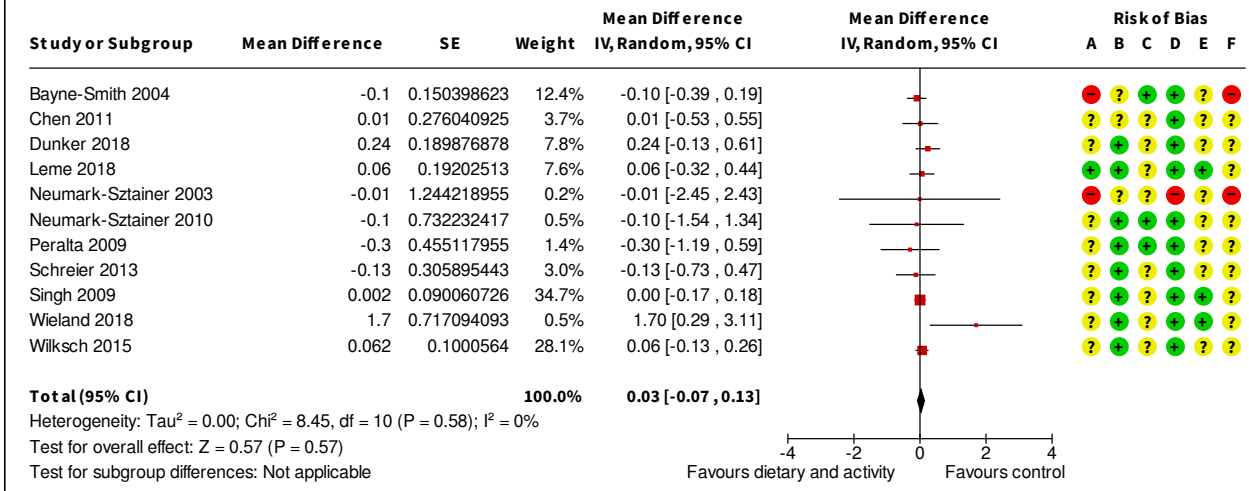


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 2: Activity vs control (all studies), Outcome 7: Percentile medium term

Analysis 3.1



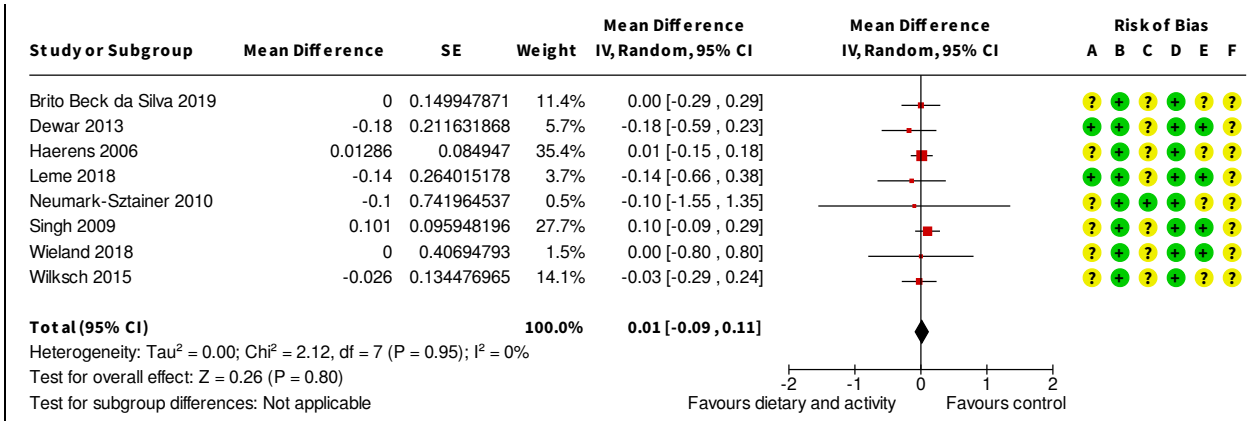
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 8.45$, df = 10 (P = 0.58); $I^2 = 0\%$
Test for overall effect: Z = 0.57 (P = 0.57)
Test for subgroup differences: Not applicable

Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 1: BMI short term

Analysis 3.2

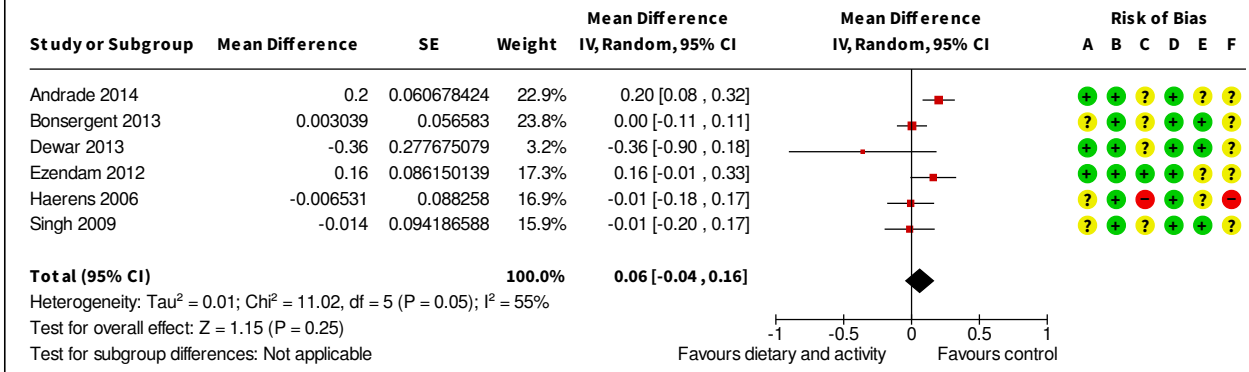


Heterogeneity: Tau² = 0.00; Chi² = 2.12, df = 7 (P = 0.95); I² = 0%
Test for overall effect: Z = 0.26 (P = 0.80)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 2: BMI medium term

Analysis 3.3

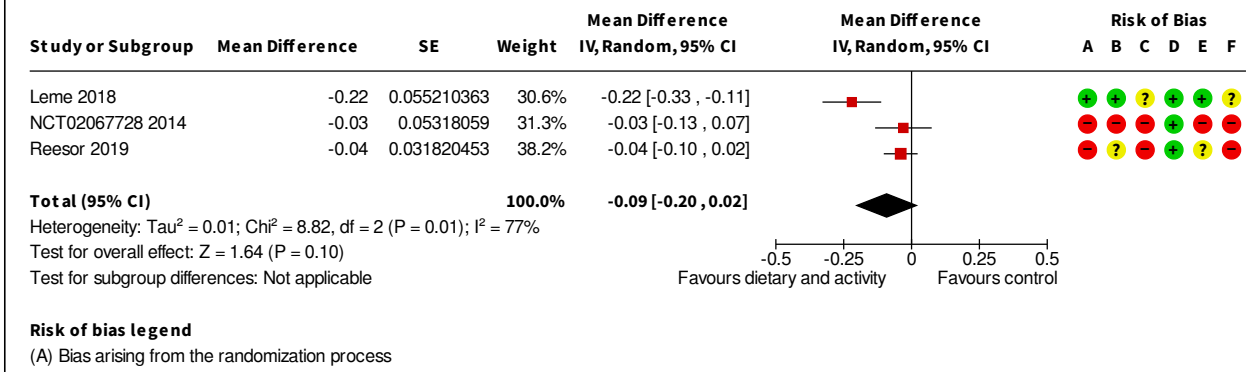


Heterogeneity: Tau² = 0.01; Chi² = 11.02, df = 5 (P = 0.05); I² = 55%
Test for overall effect: Z = 1.15 (P = 0.25)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 3: BMI long term

Analysis 3.4

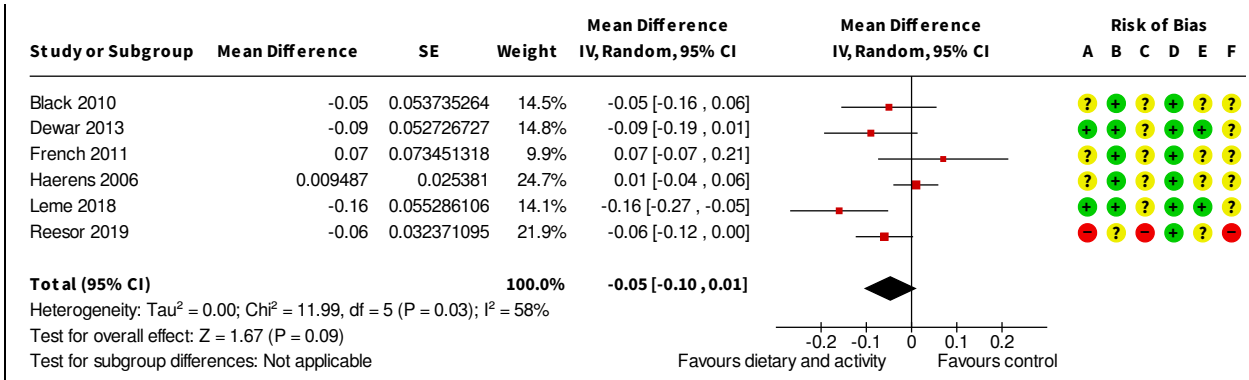


Heterogeneity: Tau² = 0.01; Chi² = 8.82, df = 2 (P = 0.01); I² = 77%
Test for overall effect: Z = 1.64 (P = 0.10)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 4: zBMI short term

Analysis 3.5

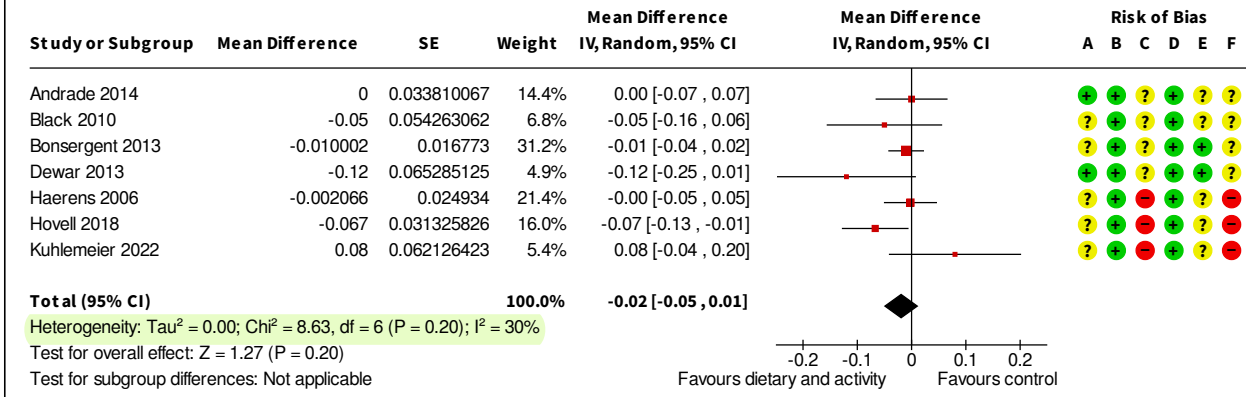


Heterogeneity: Tau² = 0.00; Chi² = 11.99, df = 5 (P = 0.03); I² = 58%
Test for overall effect: Z = 1.67 (P = 0.09)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 5: zBMI medium term

Analysis 3.6

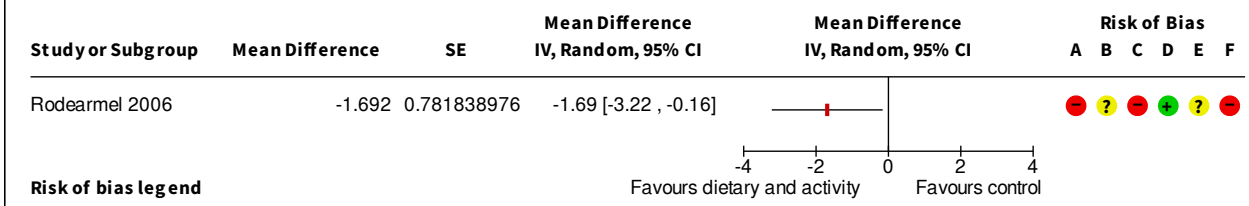


Heterogeneity: Tau² = 0.00; Chi² = 8.63, df = 6 (P = 0.20); I² = 30%
Test for overall effect: Z = 1.27 (P = 0.20)
Test for subgroup differences: Not applicable

Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 6: zBMI long term

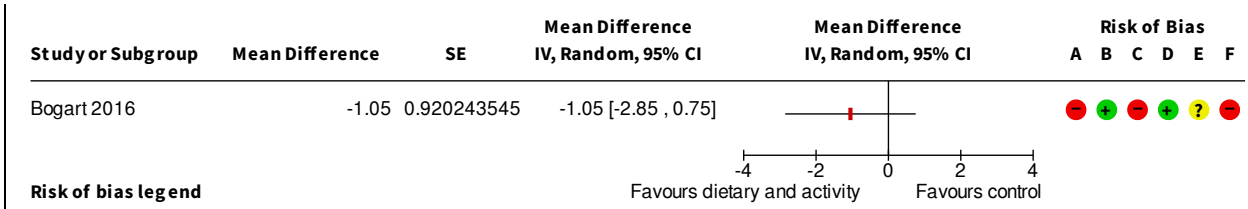
Analysis 3.7



Risk of bias legend
(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 7: Percentile short term

Analysis 3.8

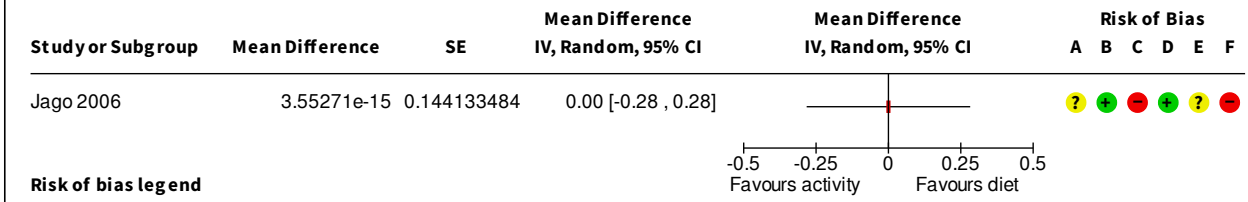


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 3: Dietary and activity vs control (all studies), Outcome 8: Percentile long term

Analysis 4.1

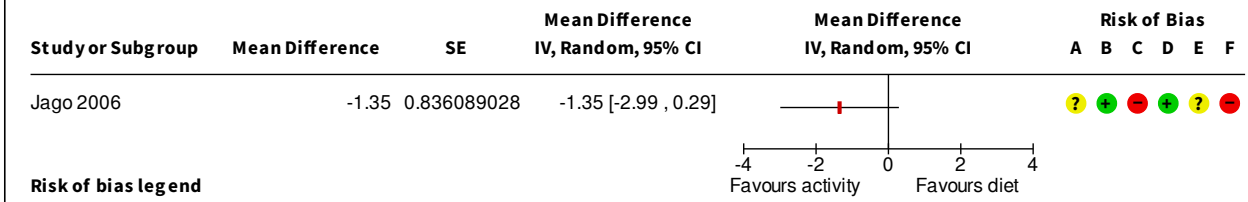


Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 4: Activity vs dietary (all studies), Outcome 1: BMI short term

Analysis 4.2



Risk of bias legend

(A) Bias arising from the randomization process
(B) Bias due to deviations from intended interventions
(C) Bias due to missing outcome data
(D) Bias in measurement of the outcome
(E) Bias in selection of the reported result
(F) Overall bias

Comparison 4: Activity vs dietary (all studies), Outcome 2: Percentile short term