Maintaining a healthy weight and preventing excess weight gain among children and adults: Evidence statements

This document lists the evidence statements that support the recommendations in NICE's draft guideline on 'Maintaining a healthy weight and preventing excess weight gain among children and adults – partial update of CG43'. For details of which evidence statements are linked to each recommendation see section 10 of the guidance. Only evidence statements linked to a recommendation are listed in this document.

The evidence statements are short summaries of evidence in a review. Evidence statements 1.X are from evidence review 1. Evidence statements 2.X are from evidence review 2.

Please note that the wording of some evidence statements has been altered slightly from those in the evidence review(s) to make them more consistent with each other and NICE's standard house style.

Evidence statements from review 1

Evidence Statement 1.1: Summary of behaviours assessed, and included systematic reviews

The review covered 64 individually modifiable behaviours relating to physical activity, diet, and other behaviours that could affect maintenance of a healthy weight and prevention of excessive weight gain. Seventy six systematic reviews met the inclusion criteria, each including between 1 and 56 relevant primary studies with between 29 and 623,922 participants in total for each factor. The reviews were in adults (35 reviews), children and young people (25 reviews), or both (16 reviews). The reviews included relevant randomised controlled trials (RCTs, 21 reviews), cohort studies (37 reviews), or both (18 reviews).

Applicability to the UK: The majority of included systematic reviews (65 out of 76) were conducted in OECD countries and are applicable to the UK. The remainder did not report where studies were undertaken, and applicability to the UK is therefore unclear.

Evidence Statement 1.2: Modifiable factors for which no relevant systematic review level evidence was identified

There was no systematic review level evidence published between 2005 and 2013 for a number of the modifiable factors of interest and weight related outcomes.

For all population groups, no review levels evidence was identified for: standing (also no relevant primary studies identified); breaks in sedentary time; other sedentary activities such as reading not covered as individual factors; watching what you eat; eating speed; portion size; grazing or gorging; meal planning (also no relevant primary studies identified); meal setting or distractions; drinks with meals; eating patterns (such as consistency of eating

across the week that were not covered as individual factors); holiday weight gain; stress minimising activities; avoiding screen advertising; monitoring (other than physical activity monitoring).

For adults no systematic review level evidence was identified for sport, more active screen time, breaks in sedentary time, or family meals.

For children and young people, no systematic review level evidence was identified for: walking; cycling; activities of daily living; incidental physical activity; sedentary time (other than screen time); breaks in sedentary time; consumption of tea and coffee, whole grains, meat, fish, legumes, nuts, a vegetarian/vegan diet, catechins, or caffeine; glycaemic index/load of the diet; eating pattern (e.g. timing during the day [including evening eating] or consistency during the week); physical activity monitoring, or support.

Evidence Statement 1.3: Relationship between leisure and recreational activity and weight related outcomes in adults and children

Adults: Moderate evidence from 1 high quality[1] review of cohort studies suggests that there may be an inverse relationship between leisure or recreational activity and weight related outcomes in adults.

The majority of studies (13/16) found significant inverse relationships. The association with weight tended to be moderate to large in size (range: OR ≥10lb weight gain over 7 years: 0.88, 95% CI 0.77 to 0.99; RR 5.7 year substantial weight gain: 1.9, 95% CI 1.5 to 2.3). Small associations were observed for BMI (e.g. 10-year BMI change ranged from -0.08 to -0.34 kg/m^2).

Children and young people: Inconclusive evidence from 1 high quality[1] and 1 moderate quality[2] review of small cohort studies was identified regarding the relationship between leisure and recreational activity and weight related outcomes in children and young people.

The findings of the individual studies in the reviews[1,2] varied: 3 studies found small to large inverse associations (4 year change in BMI: regression coefficient=-0.08, $p<0.05$; BMI change to ≥90th percentile: OR 2.14, 95% CI

0.96 to 4.77). One study found a small positive relationship (correlation between baseline LTPA level and subsequent BMI: 0.3 kg/m^2, p=0.04), 1 had mixed inverse and non-significant findings, and 1 found mixed positive and inverse directions of effect (different activities showed significant correlation with skinfold thickness, correlation coefficients ranging from r=-0.26 to r=0.32). Four studies reported no association between childhood or adolescence recreational or leisure sport participation and weight outcomes in children or later during adulthood.

Applicability to the UK: These results are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] te Velde et al. 2009 [+]

Evidence Statement 1.4: Relationship between sport and weight related outcomes

Adults: No reviews were identified on the relationship between sport and weight related outcomes in adults.

Children and young people: Inconclusive evidence was identified from 1 moderate quality review[1] regarding the relationship between sport and weight related outcomes in children and young people. The review[1] identified only 1 cohort study relevant to the scope of the current review, which had inconsistent findings across different age groups.

Applicability to the UK: These results are applicable to the UK.

[1] Nelson et al. 2011 [+]

Evidence Statement 1.5: Relationship between active travel and weight related outcomes

Adults: Inconclusive evidence was identified from 1 moderate quality review[1] of RCTs regarding the relationship between active travel and weight related outcomes in adults. Two small RCTs matched the scope of this review, neither of which found a significant effect of active travel interventions on weight. The review did not report whether the interventions increased overall physical activity.

Children and young people: Inconclusive evidence was identified from 1 high quality[2] and 1 moderate quality review[1] of cohort studies on the relationship between active travel and weight related outcomes in children. There was substantial overlap of individual studies between the 2 reviews.

One moderate quality[1] review of studies among normal and overweight children recruited from the general population identified 5 prospective cohort studies assessing weight outcomes. One of the studies found a significant large inverse relationship between those who continuously cycled to school and risk of overweight (OR 0.44, 95% CI 0.21 to 0.88). The remaining 4 studies reported no significant differences in active travel (cycling or walking) and BMI.

One high quality review[2] of cohort and cross sectional studies revealed no consistent association between active school travel and weight status in children. Across the 4 identified cohort studies, 1 study found no significant relationship, and the remaining 3 studies reporting inverse relationships (range in magnitude small: differences in mean BMI z-scores: 0.18, p=0.05; to large: OR for overweight among cyclists vs. non-cyclists: 0.63, 95% CI 0.45 to 0.89).

Applicability to the UK: These results are applicable to the UK.

[1] Saunders et al. 2013 [+]
[2] Schoeppe et al. 2013 [++]

Evidence Statement 1.6: Relationship between walking and weight related outcomes

Adults: Moderate evidence identified from 1 high quality review[1] (including meta-analysis) of RCTs suggests that regular brisk walking (an average of about 38 minutes on 5 days a week) may be effective at reducing weight by around 1.4% (-0.95 kg [standard deviation [SD] 0.61 kg], $p<0.001$), BMI by around 1.1% (-0.28 kg/m^2 [SD 0.2 kg/m^2], $p<0.001$) and percentage body fat by around 1.9% (-0.63% [SD 0.66%], $p=0.015$) among previously sedentary but otherwise healthy adults.

Children and young people: No reviews were identified on the relationship between walking and weight related outcomes in children and young people.

Applicability to the UK: The countries in which the studies included in the review were performed was not reported, therefore applicability to the UK is unclear.

[1] Murphy et al. 2007 [++]

Evidence Statement 1.7: Relationship between cycling and weight related outcomes

Adults: Weak evidence from 1 moderate quality review[1] suggests that there may be an inverse relationship between cycling and weight in adults.

The 1 prospective cohort study of women in the review relevant to the current review scope found a significant reduction in self-reported weight over 16 years for each 30 min/day increase in self-reported cycling time (-1.59 kg, 95% CI -2.0 to -1.08).

Children and young people: No reviews were identified on the relationship between cycling and weight related outcomes in children and young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1] Oja et al. 2011 [+]

Evidence Statement 1.8: Relationship between activities of daily living and weight related outcomes

Adults: Inconclusive evidence from 1 high quality review[1] of cohort studies was identified regarding the relationship between activities of daily living and weight related outcomes in adults. The studies identified by the review varied in terms of direction and significance of the association.

Three prospective cohort studies of household activities, 1 found non-significant positive associations between household and caregiving activities and 3 year change in weight (regression coefficient: 0.43, p=0.30) or WC in women (regression coefficient: 0.17, p=0.20). A second study in women found a large inverse relationship between obesity at 6 year follow-up among those who stood or walked at home for >40 hr/week vs. 0-1 hr/week (RR 0.77, 95% CI 0.61 to 0.96). The third cohort study found a small non-significant reduction in WC over 5 years in older men (regression coefficient: -0.03, p=0.07).

Children and young people: No evidence was identified on the relationship between activities of daily living and weight related outcomes in children and young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1] WCRF 2006 [++]

Evidence Statement 1.9: Relationship between incidental physical activity and weight related outcomes

Adults: There was inconclusive evidence from 1 high quality review[1] on the relationship between routine physical activity and weight related outcomes in adults.

The review identified 2 prospective cohort studies only; 1 small study found no significant association between the average stairs climbed per day and risk of gaining ≥10lbs over 10 years. One large study found a significant inverse association between mean levels of baseline routine PA (not further defined) and weight and WC increase at 4 year follow-up (regression coefficients -3.31, 95% CI -4.21 to -2.41, p<0.0001; and -0.92, 95% CI -1.21 to -0.63, p<0.0001, respectively).

Children and young people: No evidence was identified on the relationship between incidental physical activity and weight related outcomes in children and young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1] Summerbell et al. 2009 [++]

Evidence Statement 1.10: Relationship between strength training and weight related outcomes

Adults: Inconclusive evidence was identified from 1 high quality review[1] of RCTs of strength training in adults.

Meta-analysis[1] of studies among obese and general populations found that resistance training did not significantly affect visceral fat compared with control over 3 months to 2 years (effect size 0.09, 95% CI -0.17 to 0.36; p=0.49). This finding was supported by 3 out of 4 RCTs of resistance training in healthy participants not selected based on weight status

Children and young people: Inconclusive evidence from 1 moderate quality review[2] of RCTs was identified regarding the relationship between strength (resistance) training and weight related outcomes in children and adolescents.

Only 1 small RCT included in the review was relevant to the current scope. This small study suggested that that resistance training (with or without aerobic exercise) may result in small increases body mass (reviewer calculated mean change body mass [units NR], intervention: 1.6 vs. control: 0.6; $p<0.05$) and WC (reviewer calculated mean change WC, intervention: 1.6 cm vs. comparator: 0.0 cm; $p<0.05$). These changes may represent changes in muscle mass.

Applicability to the UK: The results of 1 review[2] are applicable to the UK, the countries in which the studies in the other review were performed were not reported, therefore applicability of this reviews to the UK is unclear.

[1] Ismail et al. 2012 [++]
[2] Benson et al. 2008 [+]

Evidence Statement 1.11: Relationship between aerobic exercise and weight related outcomes

Adults: Weak evidence from 2 high quality systematic reviews[1,2] of RCTs suggests that aerobic exercise is inversely associated with weight related outcomes in adults.

One review[1] and meta-analysis of small RCTs suggests that 4 weeks or more of aerobic exercise interventions significantly reduce body weight (mean change: -3.4 kg, 95% CI -5.3 to -1.5) and percentage body fat (mean change: -1.4%, 95% CI -2.3 to -0.6). This was equivalent to a relative reduction of approximately 4% of body weight and body fat percentage in adults. The second review[2] and meta-analysis found that aerobic exercise interventions reduced visceral fat over 4 weeks to 1 year (effect size -0.33, 95% CI -0.52 to -0.14, $p<0.01$). Both reviews largely included RCTs in overweight and obese participants or people with type 2 diabetes. However, the RCTs among general populations included in the review tended to support this finding (they did not reach significance, but this may have been due to small sample sizes of these studies).

Children and young people: Weak evidence was identified from 2 moderate quality reviews[2,3] that aerobic exercise may be inversely associated with weight related outcomes in children and adolescents.

In 1 review[2] 1 RCT found that 90 minutes daily on 3 days a week for 28 weeks aerobic exercise decreased BMI (figures NR), but another found that 30 minutes daily on 3 days a week for 8 weeks did not change BMI or body composition (figures NR). The difference in session and intervention duration may account for the variation in significance. Two cohort studies in another review[3] also had similarly mixed findings; limited reporting of this review limits conclusions that can be drawn from this cohort study evidence.

Applicability to the UK: The results of 2 reviews[2,3] are applicable to the UK, while the countries in which the studies in 2 reviews were performed were not reported, therefore applicability of these reviews to the UK is unclear .

[1] Ismail et al. 2012 [++]
[2] Kelley and Kelley 2006 [++]
[3] Laframboise and Degraauw 2011 [+]
[4] te Velde et al. 2012 [+]

Evidence Statement 1.12: Relationship between physical activity (PA) intensity/frequency/duration and weight related outcomes in adults

Adults: Weak evidence from 1 high quality review[1] of cohort studies and 1 low quality review[2] of RCTs suggests that there is no association between PA frequency or duration (as isolated factors) and weight outcomes in adults, although there may be an inverse relationship between total PA volume and PA intensity and weight status in this population.

The review of RCTs[2] found that there was insufficient evidence to determine whether the same volume of exercise accumulated in shorter bouts is as effective as continuous bouts in terms of adiposity. Across all studies, PA interventions tended to be inversely associated with weight related outcomes compared to control.

Applicability to the UK: These results are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] Murphy et al. 2009 [-]

Evidence Statement 1.13: Relationship between physical activity intensity/frequency/duration and weight related outcomes in children and young people

Weak evidence from 1 high quality review[1] and 2 moderate quality reviews[2,3] of RCTs, cohort and cross sectional studies suggests that there may an inverse relationship between moderate to vigorous physical activity (MVPA) and weight outcomes in children. However, there were substantial variations in the size and significance of the association.

One review[1] of cohort studies found inconsistent direction of association: 3 studies reported significant inverse relationships, ranging in magnitude from medium sized (2 year BMI change regression coefficient -0.732, 95% CI -1.159 to -0.305, p=0.001) to large (excess weight gain least vs. most active OR 2.18, 95% CI 1.01 to 4.71). One study found that high levels of MVPA was associated with a small but significant increase in mean BMI compared to low MVPA levels (19.7 kg/m^2 vs. 19.4 kg/m^2, p=0.03).

Meta-analysis of 4 small prospective cohort studies in 1 review[2] found no significant association between MVPA and WC.

One review[3] of RCTs, cohorts, and other study designs concluded that there is strong and consistent evidence that as little as 2 to 3 hours of MVPA is associated with health benefits (both weight and non-weight health outcomes). No conclusions were drawn for weight outcomes separately.

Applicability to the UK: These results are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] Ekelund et al. 2012 [+]
[3] Janssen and Leblanc 2010 [+]

Evidence Statement 1.14: Relationship between amount of sedentary time and weight related outcomes

Adults: Inconclusive evidence was identified from 1 high quality review[1] of cohort studies and 1 moderate quality review[2] of cohort studies and cross sectional studies regarding the association between amount of sedentary time (mainly time spent sitting) and weight related outcomes; variations were seen in both the direction and significance of the association across the 2 reviews.

The size of effect in the 4 cohort studies where this was reported ranged from medium to large, with obesity or weight gain for longer periods (above about 6 to 8 hours a day) of sedentary behaviour versus shorter periods (below between about to 5 hours per day and 1 hour per week) associated with relative risks (RR) or odds ratios (OR) from 0.8 (i.e. a positive relationship) to 1.47 (i.e. an inverse relationship).

Sedentary behaviour was not assessed in the same way across studies, being variously assessed as sitting (any, occupational sitting, sitting split into at home or elsewhere), sitting or lying, or non-occupational sedentary behaviour.

Children and young people: The reviews of sedentary behaviour in children and young people identified mostly related to screen time, and are reviewed in the section on screen time.

Applicability to the UK: These results are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] van Uffelen et al. 2010 [+]

Evidence Statement 1.15: Relationship between TV and other screen time and weight related outcomes

Adults: Moderate evidence from 1 high quality review[1] of cohort studies suggests that there is a positive association between screen time (specifically TV) in adulthood and measures of overweight and obesity in adults. The associations in the 2 cohort studies identified ranged in size from relatively small (higher daily viewing [hours not reported] associated with a 0.30 cm increase in waist circumference, p=0.02) to relatively large (each additional 2 hours of TV viewing associated with a 23% [95% CI 17% to 30%] increase in risk of obesity).

Children and young people: Strong evidence from 5 high quality reviews[1,2,3,4,5] of RCTs, cohort studies, and other study designs, including cross sectional studies, suggests that there is a positive relationship between childhood screen time (primarily assessed as TV viewing time) and weight related outcomes in childhood and adulthood.

There was some suggestion that this is particularly for TV viewing exceeding 2 hours per day. Two hours per day was selected as the a priori threshold for categorical analysis in some included studies; it is unclear whether this reflects the true level at which positive associations emerge or whether the association also applies at lower levels of viewing.

One review[1] found that associations between childhood viewing and adult obesity in cohort studies ranged from relatively small (watching TV often at age 16 associated with 0.011 kg/m^2/year change in BMI up to middle age for men) to relatively large (each additional hour of TV associated with an 25% increase in risk of obesity in adulthood [OR 1.25, 95% CI 1.16 to 1.70]). Two meta-analyses of RCTs included in the reviews suggested that interventions aimed at reducing screen time could reduce mean BMI by up to 0.89 kg/m^2.

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] USDA 2010l [++]
[2] Costigan et al. 2013 [++]
[3] Leblanc et al. 2012 [++]
[4] Tremblay et al. 2011 [++]
[5] Wahi et al. 2011 [++]

Evidence Statement 1.16: Relationship between more active screen time and weight related outcomes

Adults: No reviews were identified assessing the effect of more active screen time in adults.

Children and young people: Inconclusive evidence was identified from 1 moderate quality review[1] of RCTs and other study designs regarding the relationship between more active screen time and weight related outcomes in children and young people.

Only 1 of 3 RCTs in the general population found a small beneficial effect of a 12 week active video gaming intervention compared with control (difference in mean change in waist circumference -1.4 cm, 95% CI -2.68 to -0.04, p=0.04; results for BMI not reported). No results were reported for the remaining RCTs in this population.

Applicability to the UK: The results of this review are applicable to the UK.

[1] Leblanc et al. 2013 [+]

Evidence Statement 1.17: Relationship between sugar sweetened beverage (SSB) consumption and weight related outcomes

Adults: Strong evidence from 2 high quality reviews[1,2] of RCTs and cohort studies suggests that there is a positive association between SSB consumption and weight related outcomes in adults.

One review[1] of cohort studies found each additional 355 ml serving of SSB per day was associated with a 0.22 kg increase in weight over a year (95% CI 0.09 to 0.34). One review[1] of RCTs found each additional 600mL to 1.1L of SSB per day compared with control over 3 weeks and 6 months was associated with a mean increase in body weight of 0.85 kg (95% CI 0.50 to 1.20). A second review[2] of RCTs found a mean increase in body weight of 0.28 kg (95% CI 0.12 to 0.44) compared to control with additional daily SSB (amount and timescale not stated).

Children and young people: Strong evidence from 4 high quality reviews[1,2,3,4] of RCTs and cohort studies suggests that there is a positive relationship between SSB consumption and weight related outcomes in children and young people.

One review of cohort studies found each additional 355 ml of SSB per day was associated with a 0.07 kg/m^2 increase in BMI over a year (95% CI 0.09 to 0.34).[1] Children who consumed at least 237 ml of SSBs per day were more likely to be overweight than their peers (OR 1.55, 95% CI 1.32 to 1.82).[3]

Applicability to the UK: The countries in which the included studies were performed was not reported for 2 reviews, therefore applicability to the UK is unclear.

[1] Malik et al. 2013 [++]
[2] Kaiser et al. 2013 [++]
[3] Te Morenga et al. 2012 [++]
[4] USDA 2010u [++]

Evidence Statement 1.18: Relationship between fruit juice consumption and weight related outcomes

Adults: Inconclusive evidence was identified from 1 high quality review[1] of cohort studies regarding the association between 100% unsweetened fruit juice consumption and weight related outcomes in adults. The review

identified no studies of unsweetened fruit juice. The 1 study of sweetened juice consumption found no association with weight after adjustment for confounders including total energy intake (TEI; exposure and results figures NR); adjustment for TEI may remove any association.

Children and young people: Inconclusive evidence was identified from 2 high quality reviews[1,2] of cohort studies on the relationship between 100% unsweetened fruit juice consumption and weight related outcomes in children and young people. The majority of studies included in the reviews had non-significant findings over 1 to 11 years of follow up, with mixed directions of effect. Some studies suggested a possible positive association between fruit juice and weight related outcomes in those at risk of overweight or obesity. However, the types of juice, including whether sweetened or not, and whether results were adjusted for energy intake were unclear for most of the included studies.

Effect sizes in individual studies were generally small, with regression coefficients ranging from 0.001 kg/m^2 for BMI per ounce per day over 8 months to 0.25 for change in fat mass per serving of juice (not further defined in the review) over 2 years.

Applicability to the UK: These results are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] USDA 2010s [++]

Evidence Statement 1.19: Relationship between water consumption and weight related outcomes

Adults: Inconclusive evidence was identified from 1 high quality review[1] of RCTs regarding relationship between water consumption and weight related outcomes. The 2 cross over RCTs included in the review both found very small (0.1 kg to 0.18 kg) non-significant effects of increased water consumption (685 mL additional water versus additional diet drink; or 2.1 L

water total daily versus no intervention) on body weight over 3 days to 2 weeks compared to alternative non-caloric drink or no intervention.

Children and young people: Inconclusive evidence was identified from 1 high quality review[2] of cohort studies on the association between water consumption and weight related outcomes in children. The single cohort study identified by this review found no association between servings of water (not further defined) consumed by children aged 5 or 7 years and change in fat mass at the age of 9 years (regression coefficients 0.25 [p=0.22] and 0.06 [p=0.58] respectively; fat mass units NR).

Applicability to the UK: The results of the reviews are applicable to the UK.

[1] Muckelbauer et al. 2013 [++]
[2] Summerbell et al. 2009 [++]

Evidence Statement 1.20: Relationship between tea and coffee consumption and weight related outcomes

Adults: Inconclusive evidence from 1 high quality review[1] of cohort studies was identified regarding the relationship between tea and coffee consumption and weight-related outcomes. One of the included cohort studies found no significant effect of hot drink consumption (including tea and coffee) on subsequent excess weight gain and obesity (not defined) over 2 years (OR 1.01 in women and OR 1 in men for highest vs. lowest consumption in g/day). The other cohort study found conflicting effects of coffee consumption (more than 8 cups a day versus less) on substantial weight gain (not defined) across genders (small significant positive relationship in women, inverse relationship in men – size and significance NR).

Children and young people: No evidence was identified that assessed the relationship between tea and coffee consumption and weight-related outcomes in children or young people.

Applicability to the UK: The results of the review are applicable to the UK.

[1] Summerbell et al. 2009 [++]

Evidence Statement 1.21: Relationship between alcohol consumption and weight related outcomes

Adults and young people: Inconclusive evidence was identified from 2 high quality reviews[1,2] and 2 moderate quality reviews[3,4] of RCTs and cohort studies regarding the relationship between alcohol consumption (total or of specific types of drinks) and weight related outcomes in adults and young people. Directions of effect identified in individual studies differed, as did the significance of findings, with no clear patterns emerging. This may reflect variation in association by level of alcohol intake.

There was some suggestion from 3 reviews[1,2,4] that heavier alcohol intake may be associated with weight gain. In 1 review this was based on 2 cohort studies where, compared with non-drinkers the odds of weight gain (>4% or ≥5 kg) over 5 to 8 years in light to moderate drinkers (up to about 3-4 units of alcohol per day [reviewer calculated]) were between 0.86 to 0.96 and in heavier drinkers 1.07 to 1.29.

Applicability to the UK: These results are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] USDA 2010x [++]
[3] Bendsen et al. 2013 [+]
[4] Sayon-Orea et al. 2011[+]

Evidence Statement 1.22: Relationship between milk and dairy consumption and weight related outcomes

Adults: Inconclusive evidence was identified from 2 high quality reviews[1,2] of RCTs and cohort studies on the effects of milk and dairy consumption in adults.

RCTs in 1 review[1] found that increasing dairy intake (mostly 3 to 5 servings of dairy per day) did not significantly impact weight change (WMD 0.33 kg, 95% CI: -0.35 to 1.00) or fat mass (WMD -0.16 kg, 95% CI -0.97 to 0.66) in adults not following a calorie controlled diet (energy intake not reported for meta-analysed RCTs). However, 2 of the 3 RCTs not solely in overweight or obese populations found that increased dairy consumption increased total energy intake and weight gain (figures NR).

Five of the 9 cohort studies in 1 dairy organisation funded review[2] found an inverse association (ORs for obesity or weight gain ranged from 0.70 to 0.85). Mixed directions of effect were observed across different dairy products in 3 studies. These studies largely adjusted for total energy intake, which may remove associations that result from changes in this variable.

Children and young people: Inconclusive evidence was identified from 1 high quality[2] and 1 moderate quality review[3] of RCTs and cohort studies on the relationship between milk and dairy and weight related outcomes in children and young people.

The majority of studies found no association (direction of effects mostly NR, varying in adjustment for energy intake). Some small cohort studies found an inverse association for milk or total dairy (0.35 to 0.91 kg reduction in body fat per serving over 3-4 years, or 1.8 kg/m^2 reduction in mean BMI for a difference of about 0.6 serving/day over 8 years), while the largest cohort study found a positive association (a 0.081 kg/m^2 to 0.093 kg/m^2 increase with >3 vs. ≤0.5 servings of milk/day). These differences may reflect lack of adjustment for total energy or fat intake in the study with a positive finding.

Applicability to the UK: These reviews are applicable to the UK.

[1] Abargouei et al. 2012 [++]
[2] Louie et al. 2011 [++]
[3] USDA 2010r [+]

Evidence Statement 1.23: Relationship between whole grain consumption and weight related outcomes

Adults: Moderate evidence from 3 high quality reviews[1,2,3] of RCTs and cohort studies suggested that whole grain consumption or dietary patterns rich in whole grains may be inversely associated with weight related outcomes in adults.

One review[2] found that adding whole grain to the diet (18.2 to 150 g/day) had no effect on body weight over 2 to 16 weeks in 26 small RCTs (0.06 kg, 95% CI -0.09kg to 0.20kg). It also found that consuming 18.2 to 150 g whole grain per day was associated with small reductions in body fat over up to 16 weeks (7 RCTs, WMD -0.48%, 95% CI -0.95% to -0.01%; p=0.04), but this may primarily have been in people trying to lose weight.

Cohort studies in the reviews[1,3] tended to find an inverse direction of effect for weight related outcomes although this was not consistently significant (effects small [40 g/day increase in wholegrain associated with 0.49 kg lower weight over 8 years] to medium [OR for obesity in highest vs. lowest quintile of intake 0.81, 95% CI 0.73 to 0.91]).

Children and young people: No evidence was identified that assessed the effects of whole grain consumption on weight related outcomes in children or young people.

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Bautista-Castano and Serra-Majem 2012 [++]
[2] Pol et al. 2013 [++]
[3] WCRF 2006 [++]

Evidence Statement 1.24: Relationship between refined grain consumption and weight related outcomes

Adults: Moderate evidence was identified from 2 high quality reviews[1,2] and 1 moderate quality review[3] of cohort studies of a small positive association between refined grain consumption and weight related outcomes in adults.

One moderate quality review[3] of cohort studies identified consistent evidence of a positive association with weight related outcomes, showing small effects of refined grains on weight gain (weight gain: 0.18 kg [95% CI 0.10 to 0.26] to 0.43 kg [reviewer calculated, 95% CI NR] difference between lower and higher intake groups [not further defined] at 2-4 years).

Two other high quality reviews[1,2] of overlapping cohort studies assessed consumption of refined grains, and tended to find positive associations for at least one comparison (4 of 8 unique studies), or non-significant associations of mixed direction (4 of 8 unique studies: 1 inverse, 2 reporting mixed directions across genders, and 1 not reporting the direction of association).

Children and young people: Inconclusive evidence was identified from 1 high quality review[2] of cohort studies regarding the relationship between refined grain consumption and weight related outcomes in children and young people. The review[2] identified a single cohort study, which found no association between bread and wheat consumption or high rice intake at age 3 and obesity in adolescents (bread and wheat: OR 0.87, 95% CI 0.65 to 1.16; rice: OR 1.20, 95% CI 0.78 to 1.84).

Applicability to the UK: The results of the reviews in adults are applicable to the UK, but the results for children and young people may not be applicable.

[1] Bautista-Castano and Serra-Majem 2012 [++]
[2] Summerbell et al. 2009 [++]
[3] Fogelholm et al. 2012 [+]

Evidence Statement 1.25: Relationship between fruit and vegetable consumption and weight related outcomes

Adults: Weak evidence from 1 high quality review[1] and 1 moderate quality review[2] of cohort studies suggests that fruit and vegetable consumption has an inverse association with weight related outcomes.

One review[2] found a significant inverse association between fruit and vegetable consumption and weight gain over 6.5 to 12 years in 3 cohort studies. The effect size ranged from small (each additional 100 g fruit and vegetable intake associated with -14 g [95% CI -19 to -9 g] weight change per year over 6.5 years) to relatively large (highest vs. lowest intake: RR of obesity 0.76 [95% CI 0.69 to 0.86] over 12 years; OR of weight gain ≥3.41 kg 0.22 [95% CI 0.06 to 0.81] over 10 years).

A second review[1] found that most (5/7) cohort studies found no significant association between fruit and/or non-starchy vegetable consumption and weight related outcomes, but 2 studies, including the largest study, found an inverse association for non-starchy or cruciferous vegetable consumption.

Children and young people: Weak evidence from 2 high quality reviews[1,3] of cohort studies suggests that fruit and vegetable consumption is not associated with weight related outcomes in children and young people.

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] USDA 2010e [+]
[3] USDA 2010t [++]

Evidence Statement 1.26: Relationship between meat consumption and weight related outcomes

Adults: Moderate evidence from 1 high quality review[1] and 2 moderate quality reviews[2,3] of cohort studies suggests that total meat consumption is positively associated with weight related outcomes.

The cohorts finding an association with weight found that this ranged in size from small (100 kcal/day increase in meat consumption associated with a 30 g [95% CI 24 to 36 g] annual increase in weight) to medium (440 g greater weight gain in highest vs. lowest tertile of meat consumption over 28 months [reviewer calculated]; further details NR).

Children and young people: No evidence was identified specifically on the effect of meat consumption on weight related outcomes in children or young people.

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] Fogelholm et al. 2012 [+]
[3] USDA 2010n [+]

Evidence Statement 1.27: Relationship between fish consumption and weight related outcomes

Adults: Weak evidence from 1 review[1] of cohort studies suggests that fish consumption is not associated with weight related outcomes over 2 to 6 years.

Children and young people: No evidence was identified specifically on the effect of fish consumption on weight related outcomes in children or young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1] Summerbell et al. 2009 [++]

Evidence Statement 1.28: Relationship between legume consumption and weight related outcomes

Adults: Inconclusive evidence was identified from 1 high quality review[1] and 1 moderate quality review[2] of RCTs and cohort studies regarding the relationship between legume consumption and weight related outcomes.

The 2 prospective cohorts identified by 1 high quality review[1] found mixed results: consumption of legumes was associated with weight loss in men but not women in 1 study, while the other found no effect, over about 2 to 2.3 years.

The prospective cohort identified by the moderate quality review[2] found that high soy food intake in childhood and adulthood was associated with lower BMI in adulthood among women. This review[2] also identified 2 small and short term RCTs that found no effect on weight of a chickpea-supplemented diet (140 g/day) compared with similar supplementation with wheat over 5 weeks.

Children and young people: No evidence was identified on the relationship between legume consumption and weight related outcomes in children and young people.

Applicability to the UK: The results of these studies are applicable to the UK.

[1] Summerbell et al. 2009 [++]
[2] USDA 2010o [+]

Evidence Statement 1.29: Relationship between nut consumption and weight related outcomes

Adults: Weak evidence from 1 high quality review[3] and 2 moderate quality reviews[1,2] of RCTs and cohort studies suggests that nut consumption may have an inverse association with weight related outcomes.

Meta-analysis[1] of RCTs found no significant effect of nut consumption (usually 35 to 120 g/day) on weight related outcomes compared to control

diets (usually isocaloric) at 2 weeks to 3 years (WMD -0.47 kg, 95% CI -1.17 to 0.22 kg).

Four of the 5 cohort studies from 2 reviews[2,3] found a significant inverse association between nut intake and weight, ranging from relatively small (eating nuts [not further defined] associated with 0.26 kg [95% CI 0.44 to 0.08] less weight gain over 4 years), to relatively large (OR for weight gain ≥5 kg over 2 years of 0.69 [95% CI 0.53 to 0.90] with frequent nut intake [50 g of nuts ≥ 2 times/week] vs. never or rarely). The cohort with non-significant findings had a negative direction of effect and was the only one which explicitly adjusted for energy intake.

Children and young people: No evidence was identified on the relationship between nut consumption and weight related outcomes in children and young people.

Applicability to the UK: The results of these studies are applicable to the UK.

[1]Flores-Mateo et al. 2013 [+]
[2]Fogelholm et al. 2012 [+]
[3]Summerbell et al. 2009 [++]

Evidence Statement 1.30: Relationship between Mediterranean diet and weight related outcomes in adults

Moderate evidence from 2 moderate quality reviews[1,2] of cohort studies suggests that adhering more closely to a Mediterranean dietary pattern may be inversely associated with weight related outcomes. Two large cohort studies in 1 review[1] suggested that adhering more closely to a Mediterranean dietary pattern is associated with less weight gain over 5 years (mean difference -0.059 kg/year, p for trend =0.02; or -0.16 kg, 95% CI -0.24 to -0.07). Two smaller cohorts in the reviews[1,2] found inverse directions of effect on weight or waist circumference that were either non-significant, or became non-significant after adjustment.

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Fogelholm et al. 2012 [+]
[2] Kastorini et al. 2011 [+]

Evidence Statement 1.31: Relationship between adherence to population dietary guidelines and weight related outcomes in adults

Weak evidence from 1 moderate quality review[1] of cohort studies suggests that greater adherence to population dietary guidelines may be inversely associated with weight gain.

The review included 2 cohorts: 1 found that a 1-unit improvement in adherence score was associated with 0.22 kg to 0.27 kg at 8 years (reviewer calculated, p for trend <0.01), and the other found 2.7 kg lower weight gain with high adherence (reviewer calculated; follow up period unclear, 7 or 20 years).

Applicability to the UK: The results of this review are applicable to the UK.

[1] Fogelholm et al. 2012 [+]

Evidence Statement 1.32: Relationship between other dietary patterns and weight related outcomes in adults

Inconclusive evidence was identified from 1 review[1] of cohort studies on the effect of greater dietary variety (eating more of 23 recommended foods at least weekly) and weight related outcomes. The 1 cohort study in this review relevant to the current scope found small significant effects on BMI in men and women over 8 to 12 years, but these conflicted in the direction of effect (difference between highest and lowest dietary variety quintiles: -0.2 kg/m^2 in men, 0.3 kg/m^2 in women, reviewer calculated, p for trends<0.001).

Applicability to the UK: The results of this review are applicable to the UK.

[1] Vadiveloo et al. 2013 [+]

Evidence Statement 1.33: Relationship between dietary pattern and weight related outcomes in children and young people

Inconclusive evidence from 1 moderate quality[1] and 1 low quality review[2] of cohort studies was identified regarding the relationship between dietary pattern on weight related outcomes in pre-school aged children (1 to 5 years).

Three cohort studies identified by the reviews[1,2] found that most dietary patterns assessed at age 1 to 3 years were not associated with BMI or fat mass at age 4 to 7. One study found that a pattern containing meat (not further specified) at age 3 was associated with increased odds of BMI>85th percentile at age 4 (OR 1.37, 95% CI 1.04 to 1.81).

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Smithers et al. 2011 [+]
[2] Kuhl et al. 2012 [-]

Evidence Statement 1.34: Relationship between vegetarian or vegan diet and weight related outcomes

Adults: Inconclusive evidence was identified from 1 moderate quality review[1] of cohort and cross-sectional studies on the relationship between vegetarian or vegan diets and weight related outcomes. One cohort study in this review found mean annual weight gain was slightly but significantly (about 120 g) lower in male and female vegans than in meat eaters, the difference between vegetarians and meat eaters was smaller (20 g for men and 31 g for women) and not statistically significant. Two additional studies found either no

difference in BMI or an inverse association between a vegetarian diet and BMI, but these analyses may have been cross-sectional.

***Child*ren and young people:** No evidence on the effects of vegetarian or vegan diets was identified specifically in children or young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1] USDA 2010v [+]

Evidence Statement 1.35: Relationship between total fat consumption and weight related outcomes

Adults: Moderate evidence from 2 high quality reviews[1,2] of RCTs and cohort studies suggests that total fat consumption may be positively associated with weight related outcomes in adults; this may relate to fat increasing overall energy intake.

One review[1] found that reducing total fat intake (by <5% to >15% energy from fat) reduced body weight at 6 months to over 8 years' follow up (pooled mean difference in RCTs in healthy individuals: -0.98 kg [95% CI -1.56 to -0.41]). Each 1% reduction in energy from total fat weight reduced weight by 0.19 kg during follow up (95% CI −0.33 to −0.06, p=0.006).

Meta-analysis of 4 cohort studies[2] found no association between total fat intake and change in weight (regression slope +0.07, 95% CI -0.03 to +0.16).

Children and young people: Moderate evidence from 3 high quality reviews[1,2,3] of RCTs and cohort studies suggested that total fat consumption may be positively associated with weight related outcomes in children and young people. This may be related to fat increasing overall energy intake.

One review[2] included 1 RCT relevant to the current scope, which found that a reduction in fat intake from before the age of 1 year (to 30-35% in the

intervention group) was associated with reduced risk of obesity at age 10 in girls but not boys.

The cohort studies identified by the reviews had mixed results. The review[3] including the largest number of cohort studies found that just over half (11/20) showed a positive association in all or a sub-sample of the population; the remainder showed no significant effect (direction NR).

The most recent review[1] included 3 cohorts, all showing positive associations). The oldest review[2] concluded that there was no association (11 cohorts included: 5 with positive associations, 1 negative, and 5 no significant effect).

The size of the effects seen varied where reported, with 1 review[2] reporting regression coefficients ranging between 0.07 kg/m^2 reduction in BMI per unit increase in % energy from fat intake (p=0.044) to a 178.7 g increase in body fat per unit increase in fat intake in g/day over 70 months (p=0.01).

Applicability to the UK: These results are applicable to the UK.

[1] Hooper et al. 2012 [++]
[2] Summerbell et al. 2009 [++]
[3] USDA 2010y [++]

Evidence Statement 1.36: Relationship between total protein consumption and weight related outcomes

Adults: Moderate evidence from 3 high quality reviews[1,2,3] of RCTs and cohort studies suggested that total protein intake may not be associated with weight related outcomes.

Two meta-analytic reviews[1,2] of RCTs (mostly in overweight or obese individuals and including interventions aimed specifically at weight loss) suggested that high protein vs. low protein diets (median 27% vs. 18% energy from protein) resulted in greater weight reduction in the short term (1.21 kg,

[95% CI -1.88 to -0.57] greater weight loss)[1] , but this difference is non-significant at longer term follow-up (WMD -0.39 kg, 95% CI -1.43 to +0.6). The findings of this meta-analysis may not apply to the general population and those not aiming to lose weight.

Cohort studies in a third review[3] mostly had non-significant findings over 1 to 12 years (3 of 8 reported a non-significant positive association, 1 of 8 a non-significant inverse association, and 3 of 8 did not report direction of non-significant effect); one study showed a significant positive association. These results may be more indicative of the effects of protein intake in the general population.

Children and young people: Weak evidence from 1 review[3] of cohort studies suggested that total protein intake may be positively associated with weight related outcomes in children and young people.

The review included 11 cohort studies, which either found a significant positive association between protein intake and at least 1 weight-related outcome, or no significant effect (effects mainly in a positive direction where reported) over 1 to 9 years. Associations ranged from a small non-significant inverse association of kJ/g protein intake with skinfold thickness (the only inverse association reported, regression coefficient -0.001, p=0.79) to a large association between high protein intake at 12 months and BMI above the 75th percentile at 7 years (BMI OR 2.39, 95% CI 1.14 to 4.99, p=0.02).

Applicability to the UK: Two of the reviews[1,3] were applicable to the UK; the countries in which the included studies in one review[2] were performed were not reported, therefore applicability of this review to the UK is unclear.

[1] Santesso et al. 2012 [++]
[2] Schwingshackl and Hoffmann 2013 [++]
[3] Summerbell et al. 2009 [++]

Evidence Statement 1.37: Relationship between total carbohydrate consumption and weight related outcomes

Adults: Weak evidence from one high quality review[1] of cohort studies suggests that total carbohydrate intake is not associated with weight related outcomes in adults, but results are inconsistent.

Four of 7 cohort studies found no significant associations of varying direction, while 2 found an inverse association with weight over 4 to 10 years, and 1 small study found a positive association with change in body weight and body fat (correlation coefficient range: 0.30 to 0.35).

Magnitude of associations ranged from a 0.001 reduction in body weight (units NR, 95% CI -0.0024 to -0.0004) for each g/day change in total carbohydrate intake over 4 years, to a non-significant 0.599 increase in body weight [units NR] for each g increase in carbohydrate over 12 years (p=0.94).

Children and young people: Weak evidence from one high quality review[1] of cohort studies suggests that carbohydrate intake is not associated with weight or obesity in children or young people, but results are inconsistent.

Six of the 9 cohort studies found no association between carbohydrate intake and weight related outcomes (positive and inverse directions of effect), while 3 found inverse associations over 1 to 15 years. Magnitude of the relationships ranged from a large significant inverse association between energy intake from carbohydrates and BMI (regression coefficient: −11.70, 95% CI −20.5 to −2.9) to a small non-significant positive association (0.02 kg/m^2 BMI change per 1 g increase in carbohydrate intake, p=0.33).

Applicability to the UK: The results of this review are applicable to the UK.

[1] Summerbell et al. 2009 [++]

Evidence Statement 1.38: Relationship between glycaemic index/load and weight related outcomes

Adults: Inconclusive evidence from 1 moderate quality review[1] of RCTs and cohort studies was identified regarding the relationship between glycaemic load/index and weight related outcomes in adults.

The review found that glycaemic index (GI) and/or glycaemic load is not associated with body weight. One small RCT found no significant difference in weight change between a low GI diet and a high GI diet over 18 months (35-40 units difference in GI between diets; mean weight change: -0.41kg vs. -0.26kg respectively; p=0.93). One small cohort study found no effect of GI or glycaemic load on weight related outcomes in men over 6 years, but found that in women a 10-unit increase in baseline GI was associated with a 2% increase in body weight (95% CI 0.1% to 4%) and a 0.9% increase in percentage body fat (95% CI 0.04% to 1.7%).

Children and young people: No evidence was identified on the relationship between glycaemic load/index and weight related outcomes specifically in children or young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1]USDA 2010j [+]

Evidence Statement 1.39: Relationship between dietary fibre consumption on healthy weight maintenance

Adults: Weak evidence from 1 high quality review[1] and 2 moderate quality reviews[2,3] of RCTs and cohort studies suggested that dietary fibre consumption may have an inverse association with weight related outcomes.

Three of 4 cohort studies from 2 reviews[1,2] found an inverse association between fibre intake and weight or obesity over 8 to 12 years. The

associations ranged from relatively small (mean difference [MD] in weight change, women: 0.76 kg, men: 1.01 kg; significance NR) to large (obesity OR, highest vs. lowest intake quintile: 0.66, 95% CI 0.58 to 0.74). One cohort found a small significant positive association between fibre and 4 year weight gain (regression coefficient 0.006 for dietary fibre intake).

A moderate quality review[3] of RCTs lasting 11 weeks on average, mainly among overweight and obese participants, found that fibre (using food or supplements) reduced body weight by an average of 0.014% per 4 weeks per gram increase of fibre intake compared with control (significance NR; equivalent to an average 0.72 kg over the mean 11 week follow-up period).

Children and young people: Weak evidence from 2 high quality reviews[1,4] of cohort studies suggested that fibre consumption is not associated with weight related outcomes in children and young people. The 4 cohort studies in these reviews consistently found no significant association with weight related outcomes (mixed direction of non-significant effects).

Applicability to the UK: The results of 2 reviews are applicable to the UK, but the country of origin of included studies in the other 2 reviews are not reported so their applicability to the UK is unclear.

[1] Summerbell et al. 2009 [++]
[2] Ye et al. 2012 [+]
[3] Wanders et al. 2011 [+]
[4] USDA 2010w [++]

Evidence Statement 1.40: Relationship between energy density (ED) and weight related outcomes

Adults: Moderate evidence from 2 moderate quality reviews[1,2] of cohort studies suggests that energy density (ED) of the diet may be positively

associated with waist circumference (WC) in adults; evidence on the relationship with weight is inconclusive.

One review[1] found a positive association between food only ED and WC over 5.5 to 6.5 years, but the size of this effect varied (1 kcal/g increase in ED associated with: 0.09 cm [95% CI 0.05 to 0.13] increase for men and 0.15 cm [95% CI 0.09 to 0.21] increase for women over 5.5 years).

The reviews[1,2] found mixed associations with weight across 4 cohort studies: 2 found a significant positive association, and 2 found no association (direction of effect NR). Within studies assessing food only (the most commonly used method) results varied as well.

Children and young people: Weak evidence from 1 moderate quality review[2] of cohort studies suggested that food only ED of the diet is positively associated with adiposity in children and young people, although the significance of this association varied across studies.

The review[2] found a positive associations of varying statistical significance, between ED of food only and adiposity over 2 to 8 years, (OR for excess adiposity at age 9 per kJ/g ED at age 7: 1.36, 95% CI 1.09 to 1.69; at age 5: 1.12, 95% CI 0.90 to 1.40. These findings are limited by the small number and size of the studies. The links between ED of food and drink and weight or adiposity were non-significant (mixed directions of effect).

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Fogelholm et al. 2012 [+]
[2] Johnson et al. 2009 [+]

Evidence Statement 1.41: Relationship between non-nutritive sweeteners and weight related outcomes

Adults: Inconclusive evidence was identified from 2 high quality[1,3] reviews and 1 moderate quality[2] review of RCTs, cohort studies, and cross sectional studies on the prospective relationship between non-nutritive sweeteners and weight related outcomes in adults.

The reviews of observational evidence[1,2] suggested that non-nutritive sweeteners are positively associated with weight, but that this is likely to reflect reverse causality. Associations in cohort studies ranged from relatively small (weight change r=0.0024, 95% CI 0.00176 to 0.0030) to large (OR 2.03 for obesity for those consuming 21 non-nutritively sweetened beverages/week vs. none, CI NR).

This was not supported by the RCT relevant to the current scope identified in another review[3]. This small RCT found a non-significant inverse association with BMI change over 4 weeks (aspartame vs. sucrose, mean difference: -0.3 kg/m^2, 95% CI -1.1 to 0.5). The RCT may have been too small and short to detect an effect.

Children and young people: Inconclusive evidence was identified from 1 low quality review[4] of cohort studies regarding the relationship between non-nutritive sweeteners and weight related outcomes in children and young people.

Three of 6 cohort studies found a positive association, 1 found an inverse association, and 2 found no association (figures NR).

Applicability to the UK: The results of 3 reviews are applicable to the UK. The country in which included studies were performed was not reported in the fourth[4] so its applicability to the UK is unclear.

[1] Summerbell et al. 2009 [++]
[2] USDA2010c [+]
[3] Wiebe et al. 2011 [++]
[4] Brown et al. 2010 [-]

Evidence Statement 1.42: Relationship between dietary sugar consumption (sucrose, glucose, fructose, high fructose corn syrup) and weight related outcomes

Adults: Strong evidence from 3 high quality reviews[1,2,3] of RCTs and cohort studies suggests that consumption of dietary sugars increases body weight if total energy intake (TEI) is increased, but has no effect if TEI remains the same.

Two meta-analysis[1,2] of RCTs and non-randomised trials found that changing sugar intake and TEI was positively associated with weight change (reducing sugar up to 14% TEI reduced weight by 0.80 kg [95% CI 0.39 to 1.21], and increasing sugar 6.6% to 23% TEI increased weight by 0.75 kg [95% CI 0.30 to 1.19]).[1] This positive association was supported by 10/16 cohort studies in the review. Isocaloric sugar intake (substituting 17% to 20% of energy from sugars with other energy sources) did not affect body weight.

One meta-analysis[2] of RCTs and non-randomised trials of fructose found a significant positive association when TEI increased, but no significant effect in isocaloric comparisons (hypercaloric: 0.37kg, 95% CI 0.15 to 0.58; isocaloric: -0.13 kg, 95% CI -0.37 to 0.10). RCTs included in a third review[3] which compared different sugars or sugars versus other sweeteners found no difference in weight related outcomes between them.

Children and young people: Moderate evidence from 1 high quality review[1] of cohort studies and RCTs suggests that there is a positive relationship between intake of dietary sugars and weight related outcomes in children.

The conclusion is based on cohort studies that assessed of sugar sweetened beverages. Meta-analysis of RCTs found no significant effect of interventions aimed at reducing sugar intake and change in BMI or BMI z-scores over 16 weeks to 8 months (WMD 0.09, 95% CI -0.14 to 0.32). This may have been due to poor compliance with the largely educational interventions.

Applicability to the UK: The results of 2 reviews are applicable to the UK. The country in which included studies were performed was not reported in one review so its applicability to the UK is unclear.

[1] Te Morenga et al. 2013 [++]
[2] Sievenpiper et al. 2012 [++]
[3] Wiebe et al. 2011 [++]

Evidence Statement 1.43: Relationship between catechin intake and weight related outcomes

Adults: Weak evidence from 1 high quality review[1] of RCTs suggests that catechins may be associated with reduced body weight and related outcomes in the short term.

Meta-analysis of small, short-term RCTs found that green tea catechins with caffeine significantly reduced BMI (-0.55 kg/m^2, 95% CI -0.65 to -0.40), body weight (-1.38 kg, 95% CI -1.70 to -1.06), and waist circumference (-1.93 cm, 95% CI -2.82 to -1.04), but not waist to hip ratio compared with a caffeine at 3 to 12 weeks. These analyses include some RCTs solely in overweight and obese individuals or individuals with health conditions, and may not reflect effects that might be seen in the general population.

Children and young people: No evidence was identified specifically about the effects of catechins on weight related outcomes in children or young people.

Applicability to the UK: The country of origin of included studies in the review was not reported, so its applicability to the UK is unclear.

[1]Phung et al. 2010 [++]

Evidence Statement 1.44: Relationship between caffeine intake and weight related outcomes

Adults: Weak from 1 high quality review[1] of cohort studies suggests that caffeine intake is not associated with weight related outcomes in adults.

Two out of 3 cohort studies found no significant association between caffeine intake and weight gain, while the smallest cohort study found no association in men, but that caffeine consumption was more common in women who had BMI increases over 1 year (OR 0.2, 95% CI 0.04 to 0.94).

Children and young people: No evidence was identified on caffeine and weight related outcomes specifically in children or young people.

Applicability to the UK: The results of the review are applicable to the UK.

[1] Summerbell et al. 2009 [++]

Evidence Statement 1.45: Relationship between eating meals prepared outside of home (eating out/fast food/takeaway meals) and weight related outcomes

Adults: Strong evidence from 2 high quality[1,2] reviews and 3 moderate quality reviews[3,4,5] of cohort studies and RCTs suggests there is a positive association between eating food prepared outside of the home (mainly 'fast food') and weight related outcomes in adults. One review[5] noted that the strongest relationship between fast food and obesity has been observed for consuming one or more fast food meals per week.

The majority of relevant included cohort studies in adults found a significant positive associations over 1 to 15 years. Effects on weight ranged from 0.09 units increase (units NR) for each additional restaurant eating occasion over 13 years (p=0.04) to 4.5 kg difference in weight gain between those eating fast food more than twice a week over 15 years and those eating fast food less than once a week (p=0.0054).

Children and young people: Moderate evidence from 1 high quality[2] review and 3 moderate quality reviews[3,4,5] of cohort studies suggests there is a positive association between eating food prepared outside of the home (mainly fast food) and weight related outcomes in children and young people.

All or the majority of relevant included studies found a significant positive association, but 1 study did find an inverse association.

Effects on BMI z score ranged from a beta value for the association between eating fast foods at baseline and BMI z-score after 5 years of 0.02 ($p<0.05$) to a mean difference in BMI z-score of 0.54 (reviewer calculated) between girls who ate fast food >2 times/week and those who never ate fast food ($p=0.0023$).

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Bezerra et al. 2012 [++]
[2] Summerbell et al. 2009 [++]
[3] Mesas et al. 2012 [+]
[4] Rosenheck et al. 2008 [+]
[5] USDA 2010i [+]

Evidence Statement 1.46: Relationship between eating occasions (eating/meal/snack frequency) and weight related outcomes

Adults: Inconclusive evidence was identified from one moderate quality review[1] of cohort studies.

The 2 cohort studies in adults included in the review had differing results. One study, which adjusted for total energy intake, found no association with weight change over 8 years (small non-significant positive direction of effect). The second, which did not adjust for total energy intake, found eating 4 or ≥5 meals a day was associated with a higher risk of 5 kg weight gain after 10 years compared to eating 3 meals a day (HR 1.07, 95% CI 1.02 to 1.14; HR 1.15, 95% CI 1.06 to 1.25, respectively).

Children and young people: Inconclusive evidence was identified from 1 moderate quality review[1] of cohort studies about eating frequency and weight related outcomes in children.

The 2 cohort studies in children included in the review both found an association between more frequent eating and lower BMI, although 1 found no significant association with overweight. One study found eating 3 or more meals a day was significantly associated with lower BMI z scores (beta -0.0472; adjusted for energy intake) compared to eating fewer than 3 meals a day. The other study found eating 4 to 5 meals a day was significantly associated with an increase in BMI z score after 10 years (beta 0.24; not adjusted for energy intake) compared to eating 6 times or more a day.

Applicability to the UK: The results of this reviews are applicable to the UK.

[1] Mesas et al. 2012 [+]

Evidence Statement 1.47: Relationship between eating in the evening and weight related outcomes

Adults: Weak evidence from one high quality review[1] of cohort studies suggests that there is no association between eating in the evening and weight change in adults.

No evidence was identified on the association between eating patterns other than night eating and weight related outcomes in adults.

Children and young people: No evidence was identified on eating in the evening or other eating patterns and weight related outcomes in children or young people.

Applicability to the UK: The results of the review are applicable to the UK.

[1] Summerbell et al. 2009 [+]

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Evidence Statement 1.48: Relationship between family meals and weight related outcomes

Adults: No evidence was identified on the relationship between family meals and weight related outcomes in adults.

Children and young people: Weak evidence from 1 moderate quality review[1] of cohort and cross sectional studies suggests that family meal frequency is inversely associated with weight related outcomes.

Meta-analysis of cohort and cross sectional studies[1] found that having at least 3 shared family meals per week was associated with a reduced risk of overweight compared with fewer shared meals (OR 0.88, 95% CI 0.81 to 0.97). Restricting the analysis to cohort studies reduced the size of the effect, but it remained significant (OR 0.93, 95% CI 0.90 to 0.95; frequency of family meals being compared not reported). Definitions of family meals varied, and only 1 cohort study adjusted for total energy intake.

Applicability to the UK: The results of the review are applicable to the UK.

[1] Hammons and Fiese 2011 [+]

Evidence Statement 1.49: Relationship between breakfast consumption or skipping and weight related outcomes

Adults: Weak evidence from 2 moderate quality reviews[1,2] of cohort studies suggests there may be an inverse association between breakfast consumption and weight related outcomes in adults.

This is based on the cohort studies, which found effect sizes ranging from small (regression coefficient=-0.021, 95% CI -0.035 to -0.007, p=0.004 for the association between % of daily energy consumed at breakfast and weight gain), to large (frequently skipping breakfast vs. not, OR for ≥5% increase in BMI after 1 year: 1.34, 95% CI 1.12 to 1.61, p value not reported).

Children and young people: Weak evidence from 2 moderate quality reviews[1,2] of cohort studies suggests there may be an inverse association between breakfast consumption and weight related outcomes in children and young people.

The studies (based on 8 cohorts) included in the reviews[1,2] had inconsistent results in terms of significance and direction of effect, although most found a significant inverse association in at least one analysis. The size of effect seen in the studies ranged from a small but non-significant positive association (eating breakfast ≥1 day a week associated with a beta for change in BMI z score in normal weight girls over 10 years of 0.02, 95% CI -0.01 to 0.05) to a large inverse association (OR for overweight or obesity in boys who skipped breakfast in adolescence of 1.37 at 6 year follow up compared to those who did not, $p<0.05$).

Applicability to the UK: The results of the reviews are applicable to the UK.

[1] Mesas et al. 2012 [+]
[2] USDA 2010f [+]

Evidence Statement 1.50: Relationship between snacking/snacks and weight related outcomes

Adults: Weak evidence was identified from 1 moderate quality review[1] of cohort studies suggested that snacking or snacks are positively associated with body weight related outcomes in adults.

The review[1] found consistent positive associations between snacking and weight related outcomes over 4 to 9 years, ranging from relatively small (every 60 kcal of snack food consumption associated with 0.06 cm increase [95% CI 0.003 to 0.11] in WC over 5 years in women) to large (OR for gaining ≥5 kg/year over 4.6 years for usual snacking between meals vs. no usual snacking: 2.75, 95% CI 1.17 to 6.50).

The studies differed in their definitions of snacking (e.g. eating between meals, or defining certain foods as snack foods).

Children and young people: Inconclusive evidence was identified from 1 high quality review[4] and 3 moderate quality reviews[1,2,3] of cohort studies regarding the relationship between snacking or snacks and body weight and related outcomes in children and young people.

One review[3] found a positive association between snacking and weight related outcomes in 2 cohort studies, an inverse association in 2 cohort studies (1 of these associations were for reduced fat snack foods), and no association in 3 studies.

The other reviews[1,2] found inconsistent results in terms of significance and direction associations, this may be due to varied ways in which snacking was defined and analysed, and may also be affected by reverse causality or biased reporting of snack intake.

Applicability to the UK: The results of the reviews are applicable to the UK.

[1] Mesas et al. 2012 [+]
[2] USDA 2010m [+]
[3] Larson and Story 2013 [+]
[4] Summerbell et al. 2009 [++]

Evidence Statement 1.51: Relationship between sleep and weight related outcomes

Adults: Inconclusive evidence was identified from 1 moderate quality review[1] of cohort studies regarding the relationship between sleep duration and weight related outcomes in adults. Variation was seen across individual studies in terms of the significance, direction and size of the effect.

Four cohort studies found a significant inverse relationship, 4 found a significant U-shaped relationship and 5 found no significant relationship (mixed directions of effect, mostly inverse).

Children and young people: Moderate evidence from 2 moderate quality reviews[1,2] of cohort, cross sectional and case control studies suggests that there is an inverse relationship between sleep duration and subsequent risk of overweight or obesity in children.

One review[1] of cohort studies found that shorter sleep duration was consistently inversely associated with weight change in children, with associations ranging from relatively small (beta=-0.061 for 1 hour greater sleep duration in young children and overweight 5 years later) to large (OR overweight/obesity at age 6 years: 4.2, 95% CI 1.6 to 11.1 in persistent short sleepers [<10 hours] up to 2.5 years of age). Most studies tended to find large effects.

One meta-analyses[2] found that sleeping ≤1, 1-2, or more than 2 hours less than age-specific recommendations was associated with 43%, 60%, and 92% increase in the odds of overweight/obesity, respectively. However, this review included mostly cross sectional studies and therefore reverse causality cannot be excluded.

Applicability to the UK: The results of these reviews are applicable to the UK.

[1] Magee and Hale 2012 [+]
[2] Chen et al. 2008 [+]

Evidence Statement 1.52: Relationship between physical activity monitoring and weight related outcomes

Adults: Weak evidence from one moderate quality review[1] of RCTs and cohort studies suggests that self-monitoring of physical activity with a pedometer, especially in combination with a step goal, is associated with reductions in BMI in adults.

Regression analysis of 18 RCTs and prospective cohort studies found that BMI significantly decreased from baseline in individuals who self-monitored

physical activity with a pedometer (mean change -0.38 kg/m^2, 95% CI -0.05 to -0.72, p=0.03). The decrease was associated with having a step goal (p=0.04).

Children and young people: No reviews specifically on the relationship between physical activity monitoring and weight related outcomes were identified in children and young people.

Applicability to the UK: The results of this review are applicable to the UK.

[1] Bravata et al. 2007 [+]

Evidence Statement 1.53: Relationship between support and weight related outcomes

Adults: Inconclusive evidence was identified from 1 moderate quality review[1] of cohort studies about the association between communication with friends regarding weight and weight related behaviours and an individual's BMI. The 1 cohort study relevant to the current scope found mixed non-significant and significant positive associations between different types of communication supportive or non-supportive of unhealthy eating or physical activity behaviours.

Children and young people: No evidence on the effect of support on weight related outcomes in children and young people was identified.

Applicability to the UK: The results of this review are applicable to the UK.

[1] Cunningham et al. 2012 [+]

Evidence statements from review 2

Evidence Statement 2.1: Underlying characteristics

Evidence from 7 UK primary studies (2 [++][1,2], 5 [+][,3,4,5,6,7]) and 2 (+) non-UK systematic reviews[8,9] provided limited insight into how views on message acceptability might vary by age, gender, or personal weight status.

Two studies[1,8] briefly commented there might be variation in the acceptability of messages by age but neither explored this in any depth. For example, 1 (++) study[1] reported younger participants in particular recognised the term "obese" as a clinical or medical term that did not necessarily equate with the negative perceptions usually associated with the term, but opinion was divided among older people.

Applicability to the UK: The primary studies[1,2,3,4,5,6,7] are directly applicable to the UK. One systematic review[8] included predominantly non-UK studies potentially limiting its UK applicability. The second review [2] did not report the country in which included studies took place, so its UK applicability is unclear.

[1] Gray *et al.* 2008 (++)
[2] Croker *et al.* 2009 (++)
[3] NHS Somerset 2011 (+)
[4] Marno 2011 (+)
[5] Tailor and Ogden 2009 (+)
[6] Department of Health 2008 (+)
[7] Newlove and Crawshaw 2009 (+)
[8] Boylan *et al.* 2012 (+)
[9] Latimer *et al.* 2010 (+)

Evidence Statement 2.2: Language (weight status sensitivity)

Evidence from 3 UK primary studies (1 [++][1], [+][2,3]) indicated communicating weight status can be a sensitive issue socially[1] and for health professionals[2,3]. For example, some overweight or obese adults reacted negatively to being described as ‘fat’ or ‘obese’ socially because the terms were perceived to be associated with laziness or greed[1]. Health professionals also reported that telling parents their child was overweight might be taken as an insult[2]. Another study indicated health professionals might not be able to rely on a single “one size fits all” approach to discussing excess weight with people because individuals react differently to different terminology[1] (See Evidence Statement 3).

Applicability to the UK: All 3 studies are directly applicable to the UK.

[1] Gray *et al.* 2008 (++)
[2] NHS Somerset 2011 (+)
[3] Marno 2011 (+)

Evidence Statement 2.3: Language (weight status terminology)

Evidence from 4 UK primary studies (1 [++][1], 3 [+][2,3,4]) and 1 (+) non-UK systematic review[5] indicated that specific terminology to describe weight status can affect the acceptability of messages about maintaining a healthy weight or preventing excess weight gain.

Terms described as broadly unacceptable included obesity[2,3,5] , obese[1], fat[1], excessive fat[1] and fatness[5]. Acceptable terms included overweight, heavy, large, high BMI, unhealthy BMI and excessive weight[1]. Some acceptable terms (such as overweight and large) were not perceived to be likely to motivate weight loss[1]. Two studies provided inconsistent views on whether the term "weight" was acceptable[2,5] . Using the phrase "your weight may be damaging your health" influenced the emotional impact and comprehension of consequences compared with being told, "you are obese" [4].

Applicability to the UK: Only the results of the systematic review[5] are not directly applicable to the UK as it contained predominantly non-UK research.

[1] Gray *et al.* 2008 (++)
[2] Department of Health 2008 (+)
[3] Marno 2011 (+)
[4] Tailor and Ogden 2009 (+)
[5] Boylan *et al.* 2012 (+)

Evidence Statement 2.4: Language style and terminology

Language style

Evidence from 2 (+) UK primary studies[1, 2] suggested that telling people what to do could provoke a negative reaction.

One (+) study[1] suggested communication about childhood weight (targeting overweight families) needed to be clear, simple and non-judgemental. Parents required specific, supportive messages that empower them to make changes that were applicable, actionable, easily adaptable to normal family life, and presented in a down-to-earth way[1].

One (+) non-UK systematic review found people who were overweight or obese reported feeling stigmatised by the simplicity of guideline messages as they do not recognise the complexity of obesity[3].

Specific terminology

Two studies[1,3] suggested positive, empathic, suggestive terms (e.g. “we” rather than “us” or “you”; “could happen” rather than “will happen”; “choose occasionally”; “could”, and “how about?”) may be acceptable in communication with overweight families[1] and weight related guideline consumers[3]. The terms “health” and “balance” can be ambiguous and interpreted differently by message recipients[3].

Applicability to the UK: Only the results of the systematic review[3] are not directly applicable to the UK as it contained predominantly non-UK research.

[1] Department of Health 2008 (+)
[2] Newlove and Crawshaw 2009 (+)
[3] Boylan *et al.* 2012 (+)

Evidence Statement 2.5: Message framing

Evidence from 3 (+) UK primary studies[1,2,3] and 1 (+) systematic review[4] provided consistent views that positive, gain-framed messages were acceptable.

For physical activity messages only focussing on positive, non-health-related benefits, such as creating happy family memories, were acceptable to parents of overweight and obese families (ethnicity not specified) but parents specifically from Bangladeshi, Pakistani and Black African families found them too soft and emotional[2]. These parents preferred messages emphasising benefits to their children's learning, education and future success[2].

For health messages generally, some long term unemployed men thought using shock tactics could be effective for stimulating behaviour change, a stop smoking example was used, but others viewed them as "emotional blackmail" or "propaganda"[3]. These men indicated humorous health messages could be memorable but risked being stigmatising[3]. Three studies indicated telling people what to do in relation to their diet, physical activity or body weight was unacceptable and messages seen as forcing a particular behaviour are likely to be resisted[1,2,3].

Applicability to the UK: results from the primary literature[1,2,3] are applicable to the UK. The review[4] did not report what country included studies were from, so its applicability is unclear.

[1] NHS Somerset 2011 (+)
[2] Department of Health 2008 (+)
[3] Newlove and Crawshaw 2009 (+)
[4] Latimer *et al.* 2010 (+)

Evidence Statement 2.6: Attitudes to receiving more information on diet

Evidence from 1 (++) UK focus group study[1] indicated some mothers of 8 to 11 year olds felt they were already bombarded with too much information and advice on parenting, and that information on weighing and measuring portions would not be helpful as this was not something they would be prepared to do and may ignore this advice. The study included 14 mothers, 12 of whom were white British (weight status not reported).Evidence from 1 (+) non-UK systematic review[2] identified studies supporting this observation; adults and children suggested they were tired of hearing about what foods they should eat. The study concluded that overloading individuals with advice might lead to rejection of guidelines rather than adoption of new information[2].

Applicability to the UK: The results from the primary literature[1] are applicable to the UK. The results of the review[2] are potentially less applicable as they contain predominantly non-UK research and views.

[1] Croker *et al.* 2009 (++)
[2] Boylan *et al.* 2012 (+)

Evidence Statement 2.7: Combining messages for diet and physical activity

Evidence from 1 (+) UK study[1] showed that when aspects of diet and physical activity are combined in the same message diet messages dominate and the activity component is ignored, regardless of the order in which they are presented.

Combined messages indicating a “balance” of diet and physical activity can be misinterpreted. Combined messages also have the potential to reinforce the belief that “it doesn’t matter what children eat as long as they are active”, serving to perpetuate unhealthy diets[1]. This was supported by a (+) systematic review[2] that also identified the belief that if food consumption was low, physical activity was not needed[2].

Applicability to the UK: The primary study[1] was directly applicable although it was primarily views of parents from overweight or obese families, potentially limiting transferability to other groups. The systematic review[2] may be less applicable as it contained predominantly non-UK research and views.

[1] Department of Health 2008 (+)
[2] Boylan *et al.* 2012 (+)

Evidence Statement 2.8: Conflicting messages

Evidence from 2 UK (+) focus group studies[1,2] and 1 (+) systematic review[3] indicated health messages are not viewed or comprehended in isolation. Conflicting messages from non-health sources (mainstream media, relatives and wider social networks)[1,2] abound with nutritional messages in health promotion and commercial sources being perceived by consumers as conflicting. This conflict potentially reduces the credibility of health promotion messages. One systematic review[3] suggested that those responsible for developing weight-related guidelines could engage with communication or media professionals to assist accurate and effective communication of messages, thereby improving consumer comprehension of such guidelines.

Applicability to the UK: The results from the primary studies[1,2] are applicable to the UK. The results of the systematic review[3] are potentially less applicable as they contain predominantly non-UK research and views.

[1] NHS Somerset 2011 (+)
[2] Marno 2011 (+)
[3] Boylan *et al.* 2012 (+)

Evidence Statement 2.9: Health consequences

Evidence from 1 (+) UK study[1] showed parents preferred messages that explained how the long term health consequences of an unhealthy diet (death and disease) outweighed the short term costs around changing their child's diet (e.g. the fuss of denying them unhealthy snacks).

Using phrases such as 'killing with kindness' that shocked parents with the long-term negative health consequences of failing to change diet related behaviour was motivating when parents understood it mean long-term, cumulative damage to children's health. Using "killing" on its own was seen as scaremongering by some. The study advised testing the exact wording of messages with representative focus groups before messages are used widely[1].

Applicability to the UK: The results are applicable to the UK although it was primarily views of parents from overweight or obese families, potentially limiting transferability to other populations.

[1] Department of Health 2008 (+)

Evidence Statement 2.10: General content

Evidence from 1 (+) systematic review[1] assessing adult and child reactions to weight related guidelines made the following summary suggestions relevant to content acceptability:

- guidelines can be confusing. Consumers need simple, clear, specific and realistic guidelines
- guideline consumers desired positive and suggestive terminologies; however, negative messages may be more persuasive
- flexible guidelines (acknowledging unhealthy behaviour occurs and allows room for it) may be needed to prevent endorsing a sense of failure if people cannot live up to them
- terminology plays an important role in an individual's understanding and acceptance of guidelines.

Some participants felt guidelines should be more specific about the types of food to eat and the amounts[1]. For example, specifying cups of vegetables or minutes of physical activity instead of less precise language around servings or sedentary behaviour. This appeared inconsistent with a (++) UK study[2] indicating UK mothers would not welcome diet guidelines involving measuring (or weighing) portion sizes for their children in Evidence Statement 6.

Applicability to the UK: The review included 46 quantitative or qualitative studies. Just 3 were based in the UK potentially limiting applicability to the UK. For example, using cups as a measure of food volume is more common in the US than the UK.

[1] Boylan *et al.* 2012 (+)

[2] Croker *et al.* 2009 (++)

Evidence Statement 2.11: Message tailoring

Evidence from 2 (+) systematic reviews[1,2] indicated message tailoring may increase the acceptability[1] and or effectiveness[2] of healthy weight communications.

The perception of weight related guideline recommendations differed by age, gender, weight and socioeconomic status[1], furthermore, religious practices, traditional food preparation and preferences may also influence perceptions. One review on physical activity messages only[2], concluded strong evidence to support definitive recommendations for message content and structure was lacking. However, there was evidence that tailoring messages to individuals' stage of change (transtheoretical model of behaviour change) may have some advantages over generic messages. It suggested that when messages can be tailored easily and with little additional financial cost, tailoring should be considered[2]. It was suggested that the internet and mobile phones might make mass tailoring more achievable and limited tailoring resources could be focussed on groups most in need[1], there is no reason to suspect this should be different for physical activity.

Applicability to the UK: One review[1] included mainly non-UK studies potentially limiting applicability to the UK whereas the second[2] did not report country of origin of the included studies so applicability was unclear.

[1] Boylan *et al.* 2012 (+)
[2] Latimer *et al.* 2010 (+)