NICE Guidance title: Managing overweight and obesity among children and young people: lifestyle weight management services

Review 1: Effectiveness and cost effectiveness of lifestyle weight management services for children and young people

REPORT

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List of Contents

APPENDICES (in separate document)

EXECUTIVE SUMMARY

1 INTRODUCTION

1.1 Aims of the review

To determine the effectiveness and cost-effectiveness of lifestyle weight management services in overweight and obese children and young people under the age of 18.

1.2 Research questions

Question 1	How effective and cost effective are lifestyle weight management programmes in helping overweight or obese children and young people to achieve and maintain a healthy weight?
Question 2	What are the essential components of an effective and cost-effective lifestyle weight management programme for overweight and obese children and young people?
Question 3	How does effectiveness and cost effectiveness vary for different population groups? (Examples may include children and young people from different black and minority ethnic groups, from low-income groups, of different ages or genders, or with special needs.)
Question 4	What are the most effective and cost effective ways of addressing and sustaining behavioural change among overweight and obese children and young people using community-based weight management programmes?
Question 5	How does the inclusion of parents, carers and the wider family impact on the effectiveness of community-based weight management programmes for children and young people?
Question 6	How can more overweight and obese children and young people be encouraged to join, and adhere to, lifestyle weight management programmes?

1.3 Background

The National Institute for Health and Clinical Excellence (NICE) has been asked by the Department of Health (DH) to develop guidance on managing overweight and obesity in children and young people through lifestyle weight management services.

The guidance will provide recommendations for good practice, based on the best available evidence of effectiveness and cost effectiveness. It will complement NICE guidance on: obesity; behaviour change; maternal and child nutrition; prevention of cardiovascular disease and promoting physical activity.

The guidance will be underpinned by three evidence reviews. This review (Review 1) considers the effectiveness and cost effectiveness of lifestyle weight management services in overweight and obese children and young people under the age of 18. Review 2 will be a companion to Reviews 1 and will look at barriers and facilitators to lifestyle weight management service approaches and the series will be completed with a health economic analysis.

2 METHODS

A systematic review of effectiveness evidence to address the above review questions was undertaken. A wide range of databases and websites was searched systematically, supplemented by identification of grey literature[1]. Searches were carried out in May 2012 to identify relevant studies in the English language published between 2000 and May 2012. Additionally, randomised controlled trials (RCTs) and economic evaluations published between 1990 and 1999 were identified using snowballing methods. All UK intervention studies of any design were included. However, because of the very large number of papers identified, for non-UK studies the review was restricted to RCTs and quasi-RCTs (randomisation method unclear) of 100 or more participants from countries with a high degree of applicability to the UK – the USA, Canada, Western Europe, Australia and New Zealand.

Study selection was conducted independently in duplicate. Quality assessment was undertaken by one reviewer and checked by a second, with 20% of papers being considered independently in duplicate. Both processes were tested for inter-rater reliability and monitoring. Data was extracted by one reviewer and checked by a second.

A narrative summary of the evidence was completed along with meta-analyses of anthropometric findings where feasible.

3. RESULTS

Seventy three papers providing data on 34 separate programmes met the inclusion criteria for the review. Associated cost effectiveness or economic evaluation data were available for 11 programmes.

In general, internal validity was moderate to good with eleven RCTs deemed to have high internal validity (++) and most of the remainder to be of moderate quality (+). Of the non-RCTs, all but one study was uncontrolled, and all studies were assessed as being of low quality (−).

The review was limited to countries with similar levels of child overweight and obesity and economic development. Additionally, interventions were either community-based or in hospital outpatient settings. Overall applicability of the interventions is likely to be high. Fourteen programmes were conducted in the UK, 11 in the USA, six in Australia, and three in Western Europe (Italy, Finland and Belgium).

Overall, the post intervention pooled standardised mean differences (SMD) indicated a small reduction in BMI/zBMI for children in the intervention compared to those control arm (SMD = −0.17; CI 95% = -0.30 to −0.04, p = 0.01). In the long term (≥ 6 months) the pooled SMD indicated a null effect on BMI/zBMI (SMD = -0.07; CI 95% = −0.15 to 0.02, p = 0.12).

[1] Technical or research reports, doctoral dissertations, conference papers and official publications.

4. Evidence Statements

Children-only interventions - anthropometric outcomes

1.1 There is weak evidence from one [+] and one [−] quasi-RCT[1,2], one [−] CBA[3] and one [−] UBA[4] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** over a period of two to six weeks was associated with significant **reductions in BMI z-score** amongst attendees by the end of camp attendance (range −0.25 to −0.37). (*Note: only one [−] CBA[3] evaluated the effectiveness of the camp programme against a control group. The [−] quasi-RCTs[1,2] evaluated the effectiveness of two diets within the camp setting*). The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian.

[1]Duckworth 2009, [2] Gately 2007, [3] Gately 2005, [4] King 2007

1.2 There is moderate evidence from one [++] RCT[1] and one [+] RCT[2] that **physical activity-only** interventions for children and young people aged **11-16 years** do not have a statistically significant effect of on **BMI z-score**. Interventions consisted of three physical therapy sessions per week for eight weeks for obese children delivered by the study authors and five weekly 20 or 40 minute exercise sessions for overweight children aged 7-11 (58% female and 59% black) over 13 weeks.

[1] Daley 2006, [2] Petty 2009

Applicability:

1.1: Directly applicable: studies of a UK-based residential programme conducted in school holidays.
1.2: Directly applicable: community studies conducted in dedicated facilities in a UK university[1] and a USA research centre[2].

Children-only interventions: physical activity outcomes

1.3 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** over a period of two to six weeks was associated with an increase in **aerobic fitness** [F(2,204) = 8.97; P<0 .001]. The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.4 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** over a period of two to six weeks was associated with an increase in **sports skills** of campers (p< 0.05). The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietician. The

majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.5 There is moderate evidence from one [++] RCT [1] that an **exercise only intervention** of three physical therapy sessions per week for eight weeks for obese children aged **11-16 years** was associated with a marginal improvement in **physical activity scores** (range of 5-40) with a mean difference at 28 weeks from baseline of 9.84 (p=0.002) .

[1] Daley 2006

Applicability:

1.3 Directly applicable: study of a UK-based residential programme conducted in school holidays

1.4 Directly applicable: study of a UK-based residential programme conducted in school holidays

1.5 Directly applicable: studies of a UK programmes conducted in dedicated facilities in a university

Children- only interventions - wellbeing outcomes

1.6 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** for a period of two to six weeks was associated with improvements in **self-esteem** (significant group-time interaction $F(2,213) = 4.15$; $p<0.012$]. The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.7 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9-18 years** for a period of two to six weeks was associated with an increase in **worrying** more frequently and intensely **about appearance** ((frequency F(6,88)=7.30, p=0.001; intensity F(6,87)=8.49, p=0.001). The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.8 There is moderate evidence from one [++] RCT[1] and one [+] RCT[2] that **exercise only interventions** were associated with improvements to children's **perceptions of well-being.** Physical self-worth score (p=0.04)[1]; global self-worth (p=0.003)[1], (p=0.02)[2] and depression score p=0.02[2]. The effects were observed with either 30[1] or 40[2] minutes of exercise 3[1] or 5[2] times per week for either 8[1] or at least 11.2[2] weeks. A race x group interaction showed only white children's global self-worth (GSW) improved, 59% of the sample were black[2] compared with 83% white[2]. The children varied in age from 8 -13 years and were 44%[1] and 42 %[2] male.

[1] Daley 2006, [2] Petty 2009

Applicability:

1.7 Directly applicable: study of a UK-based residential programme conducted in school holidays.

1.6 Directly applicable: study of a UK-based residential programme conducted in school holidays.

1.8 Directly applicable: conducted in a USA community setting[1] and in a UK community setting[2].

Child only interventions: other outcomes

1.9 There is weak evidence from one [+] and one [–] quasi-RCT[1,2] and one [–] UBA[3] that attendance at a **residential weight management camp** for overweight and obese children and young people aged variously between **9 to 18 years** for a period of between two and six weeks was associated with an increase in **subjective sensations of hunger**. The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of parents paid for their children's attendance (£370 per week) but approx 20% were funded by their PCT or social services department.

[1] Duckworth 2009, [2] Gately 2007, [3] King 2007

Applicability:

1.9 Directly applicable: study of a UK-based residential programme conducted in school holidays.

Child and parent/carer interventions – anthropometric outcomes

1.10 There is strong evidence from eight studies; three [++] RCTs[1-3], two [+] RCTs[4,5], two [–]quasi-RCTs[6,7] and one [–] UBA[8] that **child/adolescent and parent** interventions result in significant decreases in **BMI z-score** based on baseline to follow-up **within group measures**.

[1] DeBar 2012, [2] Collins 2011, [3] Shrewsbury 2009, [4] Savoye 2009, [5] Jelalian 2010, [6] Resnicow 2005, [7] Goldfield 2001, [8] Rudolf 2006.

Applicability:

1.10 Directly applicable. Carried out in community settings in the USA[1,4-7], Australia[2,3] and the UK[8].

Child and parent/carer interventions - diet outcomes

1.11 There is strong evidence from two [++] RCTs [1,2] that group-based **behaviour** change interventions directed at 208 and 151 overweight and obese **adolescents and parents** respectively can lead to **dietary** changes such as less 'fast-food' or a reduction in high fat food intake. Adolescents varied in age from 12-17 years. One group was all female[1] and the other 52% female [2]. Delivery was by nutritionists, health educators and clinical psychologists and by dieticians respectively. One programme ran for 5 months and the other for two years.

[1] DeBar 2012, [2] Shrewsbury 2009

1.12 There is moderate evidence from one [+] RCT [1] and one [–] quasi-RCT[2] that group-based **multi-component** interventions, including behaviour change, physical activity and diet, directed at

children and parents do not have any significant effects on **dietary intake**. Dieticians and PE teachers led a six month intervention for 165 children aged 5-9[1] and therapists delivered a 20 week programme for 31 children aged 8-12 years. Approximately 60% were female in both studies. Different dietary measures were used.

[1] Collins 2011, [2] Goldfield 2001.

Applicability:

1.11 Directly applicable: conducted in a USA[1] and an Australian community setting[2]

1.12 Directly applicable: conducted in an Australian[1] and USA community setting[2]

Child and parent/carer interventions - physical activity outcomes

1.13 There is strong evidence from three [++] RCTs[1-3] and one [+] RCT[4] that group-based interventions for obese and overweight containing a group-based **behaviour change** component directed at **parents and children[1]/ adolescents**[2-4] do not have any significant effects on **physical activity**. A range of physical activity measures were used.

Dieticians and PE teachers led a six month intervention for 165 children aged 5-9.[1] 208 overweight adolescent females aged 12-17 received a 5 month intervention delivered by nutritionists, health educators and clinical psychologists.[2] Dieticians delivered a 2 year intervention to 151 overweight and obese adolescents (52% female)[3]. 118 overweight weight adolescents aged 13 to 16 received a 16 week behavioural programme delivered by psychologists and a dietitian[4].

[1] Collins 2011, [2] DeBar 2012, [3] Shrewsbury 2009, [4] Jelalian 2010.

Applicability:

1.13 Directly applicable: Studies conducted in Australian[1,3] and USA community settings.[2,4]

Child and parent/carer interventions - wellbeing outcomes

1.14 There is strong evidence from two [++] RCTs[1, 2] that group-based **behaviour** change interventions directed at **children[2]/adolescents[1] and parents** have significant beneficial effects on some **psychosocial** outcomes. One [++] RCT [1] showed a group difference at 18 months for body satisfaction (p=0.026) and appearance (p=0.019) although no group differences on other psychosocial outcomes. A second [++] RCT [2] showed group difference at 12 months for scholastic competence (p=0.049), but not other psychosocial outcomes. 208 overweight adolescent females aged 12-17 received a 5 month intervention delivered by nutritionists, health educators and clinical psychologists.[1] Dieticians delivered a 2 year intervention to 151 overweight and obese adolescents (52% female)[2].

[1] DeBar 2012, [2] Shrewsbury 2009,

1.15 There is moderate evidence from one [+] RCT[1] that a group-based, multi-component cognitive **behavioural** intervention including physical activity directed at 118 overweight **adolescents and parents** had no significant effect on **psychosocial** outcomes. No significant effect of group for PEQ score (to assess peer rejection), self-concept or social anxiety. Adolescents were aged 13-16 years, were 68% female, 76% Caucasian and received the intervention from a

psychologist and a dietician.

[1] Jelalian 2010

Applicability:

1.14 Directly applicable: conducted respectively in USA, Australia and UK community settings

1.15 Directly applicable: conducted in a USA community setting

Family interventions – anthropometric outcomes

1.16 There is strong evidence from 18 papers of 17 studies; five [++] RCTs[1-5], four [+] RCTs[6-9], one [+] quasi-RCT[10], one [–] quasi-RCT[11] and six [–] UBAs[12-16] that, for overweight and obese children and adolescents, whole **family** interventions whether directed at individual families[1,4,6-9,16] or group-based[2,3,5,9-14,16-18] result in significant decreases in **BMI z-score** based on baseline to follow-up for **within group measures**. All but one –UBA[12] (which focused on diet and physical activity) and one –quasi-RCT (behaviour change only) assesses the effectiveness of multi-component interventions focusing on behaviour change.

[1] Ford 2010, [2] Kalarchian 2009, [3] Kalavainen 2007, [4] McCallum 2007, [5] Wake 2009, [6] Croker 2012, [7] Hughes 2008, [8] Nova 2001, [9] Sacher 2010, [10] Coppins 2011, [11] Berkowitz 2011 [12] Norton 2011, [13] Pittson 2011, [14] Rennie 2010, [15] Robertson 2011, [16] Sabin 2007, [17] Watson 2009, [18] Watson 2011.

1.17 There is inconsistent evidence for the effectiveness of whole **family** interventions versus no or minimal control outcomes. Two [+] RCTs [1,2] reported significant reductions in **BMI z-score** compared to control groups and six studies, comprising three [++] RCT [3-5], two [+] RCTs[6-7] and one [+] quasi-RCT[8] reported either no reduction or a non-significant effect.

[1] Sacher 2010, [2] Nova 2001, [3] Kalarchian 2009, [4] McCallum 2007, [5] Wake 2009, [6] Croker 2012, [7] Hughes 2008, [8] Coppins 2011

Applicability:

1.16 Directly applicable, all studies are community-based. Eleven were conducted in the UK[1,6,7,9,10,12-17], three in the USA[2,3,11], two in Australia[4,6] and one in Italy[8].

1.17 Directly applicable: all studies are community-based. Four[1,4,6,7] were conducted in the UK one in Italy[2], one in the USA[3] and two in Autralia[4,5].

Family Interventions - diet outcomes

1.18 There is inconsistent evidence from two [++] RCTs[1,2] and one [–] UBA[3] for the effectiveness of **behaviour change** interventions directed at individual **families** on **diet**ary outcomes. The two RCTs evaluated the same programme in populations of slightly different ages (5-9 years and 5-10 years respectively) but only one[2] reported significant improvements in dietary intake with an adjusted mean different in nutrition score at 15 months of 1.6 (0.9 to 2.3) $p<0.001$. The [–] UBA[3]reported less exposure to unhealthy foods in the home and improved eating style at 2 years with a change in questionnaire measure (lower is better) of -2.0 (-3.5 to -0.5). For all studies behaviour change focused on physical activity and diet.

[1] McCallum 2007, [2] Wake 2009, [3] Robertson 2011

1.19 There is weak evidence from one [+] quasi-RCT[1] that a group-based **multi-component** intervention directed at **families** of 65 obese and overweight children and adolescents aged 6-14 years had no significant effect on **diet**. The intervention involved two workshops for a total of 8 hours focusing on behaviour, diet and physical activity followed by twice weekly 1 hour physical activity sessions during term time. 66% were female.

[1] Coppins 2011

Applicability:

1.18 Directly applicable: studies conducted in community settings in Australia[1,2] and the UK[3].

1.19 Directly applicable: Study conducted in a UK community setting

Family interventions - physical activity outcomes

1.20 There is inconsistent evidence from two [++] RCT[1,2], two [+] RCTs3[3,4], one [+] quasi-RCT [5] and one [−] UBA[6] for the effect of **behaviour** change interventions directed at **families**, whether individual[1-3,5] or group[4,6], on **physical activity**. Only two [+] RCTs[2,4] reported significant improvements. One[2] found significant between group difference in a population of 134 overweight children aged 5-12 for change in total activity, p=0.009, percentage of time spent in sedentary behaviour, p=0.009, and light-intensity activity, p=0.02, from baseline to 6 months in favour of the intervention group. In a population of 116 obese children aged 8-12 years, the other identified a significant mean difference between groups in hours per week physical exercise 3.9 (0.1 to 7.8) p=0.04[4]. The [−] UBA [6] reported an overall reduction in sedentary behaviour in 29 participants. For all studies the behaviour change focused on physical activity and diet. A range of physical activity measures were used.

[1] McCallum 2007, [2] Wake 2009, [3] Hughes 2008, [4] Sacher 2010, [5] Nova 2001, [6] Robertson 2011

1.21 There is weak evidence from one [+] quasi-RCT[1] that a **multi-component** group intervention directed at **families** of 65 obese and overweight children and adolescents aged 6-14 years had no significant effect on **physical activity**. The intervention involved two workshops for a total of 8 hours focusing on behaviour, diet and physical activity followed by twice weekly 1 hour physical activity sessions during term time. 66% were female.

[1] Coppins 2011

Applicability:

1.20 Directly applicable: all conducted in community settings: Australia[1,3], UK [2,4,6] and Italy[5]

1.21 Directly applicable: conducted in a UK community setting

Family interventions - wellbeing outcomes

1.22 There is weak evidence from two small UK studies: one [+] RCT[1] and one [−] UBA[3] that group-based **behaviour change** interventions directed at **families** with obese and overweight children aged respectively 8-12 and 7-13 years have a significant effect on **quality of life** (PedsQL). The [+] RCT[1] in a population of 72 reported a significant improvement in quality of life in the intervention group versus the wait list control (p=0.05) and the [−] UBA[3] reported a mean difference in change from baseline of 11.8 (4.0 to 19.7) range 0-100, p=0.005 for 19/27

children followed up at two years. For both studies the behaviour change focused on physical activity and diet. In both studies over 60% of children were female.

[1] Croker 2012, [2] Robertson 2011

1.23 There is weak evidence from one [+] RCT[1] that a **multi-component behavioural** intervention directed at individual **families** of obese children and adolescents aged 5-16 years does not have a significant effect on **quality of life** (PedsQL scale) whether a child obesity programme takes place in a hospital outpatient clinic (HC) or in a primary care clinic (PCC). The PCC intervention involved an initial visit and offer of four further appointments at 3 monthly intervals for the family. A practice nurse discussed progress. The HC intervention involved an initial consultation with consultant and offer of four further appointments at 3-monthly intervals. Both interventions involved seeing a dietician and/or exercise specialist.

[1] Banks 2012

Applicability:

1.22 Directly applicable: all studies conducted in a UK community setting.

1.23 Directly applicable: study conducted in a UK hospital outpatient clinic and community-based primary care clinics.

Family interventions - other outcomes

1.24 There is weak evidence from one [+] RCT[1] that a **multi-component behavioural** intervention directed at individual **families** of obese children and adolescents aged 5-16 years led to slightly higher **service satisfaction** scores when the intervention took place in a primary (PCC) care clinic compared with a hospital outpatient clinic (HC), although all mean scores were between 1 and 3 (equivalent to ratings from 'excellent' to 'good'). The PCC intervention involved an initial visit and offer of four further appointments at 3 monthly intervals for the family. A practice nurse discussed progress. The HC intervention involved an initial consultation with consultant and offer of four further appointments at 3-monthly intervals. Both interventions involved seeing a dietician and/or exercise specialist.

[1] Banks 2012

Applicability:

1.24 Directly applicable: conducted in a UK community setting

Parent- only interventions – anthropometric outcomes

1.25 There is inconsistent evidence from two [++] RCTs[1,2] and one [–] cluster RCT[3] of similar group-based **behavioural** programmes directed to the **parents** of overweight and obese children aged respectively 6-9, 5-9 and 4-11 years. Although there were significant overall differences in BMI z-scores, neither [++] RCT found significant between group differences. However the [–] cluster RCT found significant improvements in **BMI z-score** for the intervention group (from 2.15, SD 0.43 at baseline to 2.04 (SD 0.44) at 12 weeks). The score was maintained at 12 months (1.96, SD 0.46). Two intervention were delivered over 6 months by dietitians [1,2] and one by a clinical psychologist over 12 weeks[3].

[1] Golley 2007, [2] Magarey 2011, [3] West 2010

1.26 There is weak evidence from a [+] RCT in 93 overweight and obese **8-14 year old** children (from 64 families) comparing **group-based behavioural therapy** for **parents** only and with a wait list control and parent/child groups. Parents focused on strategies and discussion, whilst children reviewed progress and took part in a physical activity and preparation of healthy snack. The parent-only intervention followed the same process as the parents in the parent and child study arm. At 4 months, children in parent-only intervention group versus wait list control demonstrated greater decrease in **BMI z score** (mean difference 0.127, 95% CI 0.027 to 0.226). At 10 months, children in the parent-only group had greater decreases compared to baseline than the control group. Mean differences in BMI z score were 0.115 (0.003 to 0.220). The intervention was delivered over 24 weeks by Family and Consumer Sciences agents and clinical psychologists.

[1] Janicke 2009

1.27 There is weak evidence from one [+] RCT[1] that a programme directed to the **parents** of overweight children has a significant effect on children's **BMI z-score**. The intervention compared three **behavioural** programmes for parents of overweight children aged 8-12 years (workbook (WB), workbook plus 2 small group sessions (WB+G) and workbook, group sessions, plus 10 automated interactive voice response-tailored counselling sessions (IVR). Group sessions delivered by a dietitian. Only children of parents assigned to the IVR intervention decreased BMI z-scores from baseline to 6 months (2.03 SD 0.04 to 1.96 SD 0.04, $p<0.05$) and from baseline to 12 months (2.03 SD 0.04 to 1.95 SD 0.04, $P<0.05$). The WG+G group significantly reduced BMI z-scores from baseline to 12 months only (2.04 SD 0.02 to 1.98 SD 0.03, $p<0.05$), 6 months = 1.99 SD 0.03. The WB group significantly reduced BMI z-scores from baseline to 6 months (2.06 SD 0.04 to 2.03 SD 0.04, $p<0.05$) but not to 12 months - 2.04 (0.04). Children of parents completing ≥ six of the ten IVR calls decreased BMI z-scores to a greater extent than children in the other groups at both 6 months ($p<0.05$) and 12 months ($p<0.01$).

[1] Estabrooks 2009

Applicability:

1. 25 Directly applicable: Trials were conducted in Australia in community settings.

1.26 Partially applicable: Conducted in a rural American setting

1.27 Trials were conducted in Australia and the USA in community settings.

Parent-only interventions - diet outcomes

1.28 There is moderate evidence from one [++] RCT[1] and one [+] RCT[2] that **behaviour change** interventions directed at **parents only** have no significant effect on **diet.** The [++] RCT[1] reported no significant group by time interaction or time effect for servings per day of breads and cereals, vegetables, fruit, dairy or meat and alternatives. The intervention focused on parenting skills for (weekly two hour sessions for 4 weeks, then monthly sessions, followed by 3 monthly 15-20 telephone sessions) and also involved intensive lifestyle education and was delivered by a research dietician. Children were 6-9 years and 64% were female. The [+] RCT[2] found no consistent pattern of change in food or drink consumption. The intervention involved

either: a workbook or a workbook plus 2 small group sessions or a workbook plus 2 small group sessions and 10 automated interactive voice response-tailored counselling sessions. The work book was provided by the study research assistants and the small group sessions by a dietician. The children's mean age was 10.7 years and 54% were male.

[1] Golley 2007, [2] Estabrooks 2009

Applicability:

1.28 Directly applicable: conducted respectively in Australian and USA community-based settings.

Parent only interventions: physical activity outcomes

1.29 There is inconsistent evidence from one [++]RCT[1] and one [+] RCT[2] that **behaviour change** interventions directed at **parents only** have a significant effect on **physical activity** .The [++] RCT[1] reported reductions in small screen use and increases in active play across all groups but no between group differences. The intervention focused on parenting skills (weekly two hour sessions for 4 weeks, then monthly sessions, followed by 3 monthly 15-20 telephone sessions) and also involved intensive lifestyle education and was delivered by a research dietician. . Children were 6-9 years and 64% were female. The [+] RCT[2] compared three behavioural programmes for parents of overweight children aged 8-12 years (workbook (WB), workbook plus 2 small group sessions (WB+G) and workbook, group sessions, plus 10 automated interactive voice response-tailored counselling sessions (IVR) . The IVR group reported a significant increase in the number of days their child participated in moderate physical activity from baseline to 6 months and baseline to 12 months, $p<0.05$. The work book was provided by the study research assistants and the small group sessions by a dietician. Different physical activity measures were used in the two studies.

[1] Golley 2007, [2] Estabrooks 2009

Applicability:

1.29 Directly applicable: conducted in community-based settings in Australia and the USA respectively.

Parent only interventions: other outcomes

1.30 There is moderate evidence from one [++] RCT[1] that **behaviour** change interventions directed at **parents only** resulted in **service satisfaction** rated as 'good to excellent'. The intervention focused on parenting skills (4 two-hour weekly sessions, then monthly sessions, followed by 3 monthly 15-20 telephone sessions) and also involved intensive lifestyle education and was delivered by a research dietician. . Children were 6-9 years and 64% were female.

[1] Golley 2007

Applicability:

1.30 Directly applicable: conducted in an Australian community setting

Meta-analyses: parent only interventions – anthropometric outcomes

1.31 A meta-analysis of one ++ RCT[1] and one –RCT[2] looking at the overall effectiveness of interventions targeted to **parents** of obese and overweight **children** (ages 5-9 and 4-11 respectively) did not find a significant difference in **BMI/zBMI standard mean difference (SMD)** at the end of the intervention: –0.03 (95% CI: –0.27, 0.21) p=0.516.

[1] Magarey 2011 ++, [2] West 2010 –

1.32 At six months or more post-information, a meta-analysis of two ++ RCTs[1,2] and one + RCT[3] looking at the overall effectiveness of interventions targeted to **parents** of obese and overweight children (ages 5-9 and 4-11 and 12-16 respectively) found that the results were non-significant for BMI/zBMI SMD: –0.08 (95% CI: –0.27 to 0.10).

[1] Magarey 2011 ++, [2]Golley 2007 ++[3] Estabrooks 2005 +

Applicability:

1.31 Directly applicable: both conducted in community settings in Australia

1.32 Directly applicable: conducted in community settings in Australia[1] and the USA[2]

Meta-analyses: child and parent or whole family interventions – anthropometric outcomes

1.33 A meta-analysis of 8 RCTs (four [++] RCTs[1-4], three [+] RCTs[5-7] and one [–] quasi-RCT[8]) estimated the overall effectiveness of interventions directed at **children and parents/carers or whole family** versus no or minimal control outcomes **immediately post intervention** as a significant reduction in BMI SMD of –0.22 (–0.33 to –0.10).

[1] DeBar 2012, [2] Kalarchian 2009, [3] Okely 2010 [4] Ford 2010, [5] Jelalian 2010, [6]Croker 2012, [7] Savoye 2009, [8] Resnicow 2005

1.34 A meta-analysis of eleven RCTs (seven [++] RCTs[1-7]; three [+] RCTs[8-10] and one [–] quasi-RCT[11]) estimated the overall effectiveness of interventions directed at **children and parents/carers or whole family** versus no or minimal control outcomes **at longer term follow up (≥6 months)** as a non-significant reduction in BMI SMD of –0.01 (–0.11 to 0.08)

[1] Collins 2011, [2] DeBar 2012, [3] Golley 2007, [4] Kalarchian 2009, [5] McCallum 2007, [6] Nguyen 2012, [7] Wake 2009, [8] Jelalian 2010, [9] Nova 2001, [10] Savoye 2009, [11] Resnicow 2005.

Applicability:

1.33 Direct applicability: conducted in the UK and other similar community-based settings.

1.34 Direct applicability: conducted in the UK or other similar community-based settings.

The cost effectiveness of lifestyle weight management programmes

1.35 Evidence from seven short-term health economic analyses[1-7] suggests that lifestyle weight management programmes will result in an increased cost to the NHS in terms of BMI z-score gains when compared to routine care in the short-term. However overall small (and in some cases non-significant) improvements in BMI z-scores can be achieved.

[1] Coppins 2011*, [2] Hughes 2008*, [3] Janicke 2009, [4] Kalavainen 2009, [5] Robertson 2011*, [6] Wake 2008, [7]Wake 2009.

Cost data only – no assessment of applicability or study limitations[1,2,5]
Study Limitations: Very serious[3,4,6,7]
Applicability: All studies were applicable in terms of setting and participants[1-7] , but data from short-term studies limited in its applicability to life-time cost estimates and assessed as partially applicable[3,4,6,7]

1.36 Three extrapolation models[1-3] of lifestyle weight management programmes suggest interventions that lead to even small reductions in BMI can be cost-effective in the long term at conventional cost-effectiveness thresholds, provided the short term effects on BMI, observed in trials, are sustained into adulthood.

[1] YHEC 2010, [2] Moodie 2008, [3] Hollingworth 2012

Study limitations: Potentially serious for all studies. Applicability: Directly applicable for all studies

Comparison of intervention component effects on BMI

2.1 **Behavioural target**: Results of the meta-analysis found no significant differences between improvements in BMI according to the behavioural target of the intervention but data are limited. Comparisons of interventions between studies provide strong evidence from one [++] RCT[1] that diet alone or diet and physical activity results in greater short term improvements (six months) than physical activity alone, but not longer term and weak evidence from one [+} and one [–] quasi-RCT [2,3] that a high protein energy restricted diet is no more effective than a standard restricted diet, when delivered in weight loss camps. There is also moderate evidence from one [+] RCT[4] that supervised exercise is no more effective in improving BMI or children's self-concept than peer-based exercise, when provided as part of a CBT programme and moderate evidence from one [+] RCT that higher intensity exercise is more effective than lower intensity exercise in improving physical activity levels, but neither intervention is effective in reducing BMI[5].

[1] Collins 2011, [2] Duckworth 2009,[3] Gately 2007, [4] Jelalian 2009, [5] Magarey 2011

2.2 **Parenting skills.** There is strong evidence from two [++] RCTs[1,2] that interventions involving **group-based parenting skills training** directed to the **parents** of overweight and obese children aged respectively 6-9 and 5-9 years are effective in improving BMI. However the addition of intensive lifestyle education did not lead to significantly greater improvements in **BMI z-scores**, food intake or physical activity measures (one [++] RCT[1]) or that the addition of parenting skills training to intensive lifestyle education alone was more beneficial to BMI z-scores or parenting outcomes (one [++] RCT)[2]. Both interventions were delivered over 6 months by dietitians.

[1] Golley 2007, [2] Magarey 2011

2.3 **Involvement of family.** There is strong evidence, **post intervention**, to suggest that targeting both parents and children (eight studies: three [++] RCTs[1-3], two [+] RCTs[4,5], two [–] quasi-RCTs[6-7], and one [–] UBA[8] or whole families (18 papers from 17 studies; five [++] RCTs[9-13], four [+] RCTs[14-17], one [+] quasi-RCT[18], one [–] quasi-RCT[19] and six [–] UBAs[20-26]) is effective in reducing **within group zBMI scores**. For those studies with follow up of six months or more there were no clear differences. Evidence from child-only interventions (one [++] RCT[27], one [+] RCT[28] and

one [–] CBA[29],) and parent- only interventions (two [++] RCTs[30,31], two [+] RCTs[32,33] and one [–] cluster RCT[34]) are limited and inconsistent.

[1] DeBar 2012, [2] Collins 2011, [3] Shrewsbury 2009, [4] Savoye 2009, [5] Jelalian 2010, [6] Resnicow 2005, [7] Goldfield 2001, [8] Rudolf 2006, [9] Ford 2010, [10] Kalarchian 2009, [11] Kalavainen 2007, [12] McCallum 2007, [13] Wake 2009, [14] Croker 2012, [15] Hughes 2008, [16] Nova 2001, [17] Sacher 2010, [18] Coppins 2011, [19] Berkowitz 2011 [20] Norton 2011, [21] Pittson 2011, [22] Rennie 2010, [23] Robertson 2011, [24] Sabin 2007, [25] Watson 2009, [26] Watson 2011. [27] Daley 2006, [28] Petty 2009, [29] Gately 2005, [30] Golley 2007, [31]Magarey 2011, [32] Janicke 2009, [33] Estabrooks 2009 [34] West 2010

2.4 **Referral method.** There is strong evidence from a meta-analysis of 12 studies[1-12], of which two studies examined specialist referral[2,10], to suggest that interventions which involve specialist medical referral to a programme compared to self, GP, school or a mixture of referral methods show greater improvements in BMI z-scores at end of intervention (SMD = -0.41; CI 95% = -0.64 to -0.17)

[1] DeBar 2012, [2] Ford 2010 [3] Kalarchian 2009, [4] Magrey 2011 [5] Okely 2010 (see Collins 2011), [6] Croker 2012, [7] Daley 2006, [8] Jelalian 2010, [9] Sacher 2010, [10] Savoye 2009, [11] West 2010, [12] Resnicow 2005

2.5 A meta-analysis of 15 studies[1-15], of which three studies examined specialist medical referral[3,9,14], also provides strong evidence that the effect is sustained at six months or more post-intervention (SMD = -0.30; CI 95% = -0.49 to -0.11).

[1] Collins 2011, [2] DeBar 2012, [3] Ford 2010, [4] Golley 2007, [5] Karlachian 2009, [6] Magarey 2011 [7] McCallum 2007, [8]Nguyen 2012 (see Shrewsbury 2009), [9]Wake 2009, [10] Estabrooks 2009 [11] Jelalian 2010, [12] Nova 2001, [13] Sacher 2010, [14] Savoye 2009, [15] Resnicow 2005

2.6 **Intensity of intervention.** A meta-analysis of ten RCTs (Five [++] RCTs[1-5]; four [+] RCTs[6-9] and one [–] quasi-RCT[10]) indicated that the overall effectiveness of **family** interventions at six or more months post-intervention tended to increase with the **intensity** of the intervention although none of the results was statistically significant. Changes in **BMI SDI** were +0.05 (-0.13 to 0.22)[5,7,8] for very low intensity (<10 hours family contact time), +0.14 (-0.18 to 0.46)[4] for low intensity (10 to <20 hours), -0.12 (-0.26 to 0.02)[1,2,3,6,10] for moderate intensity (20 to < 75 hours) and -0.22 (-0.53 to 0.08)[9] for high intensity (75+ hours).

[1] Collins 2011, [2] DeBar 2012, [3] Kalarchian 2009, [4] McCallum 2007, [5] Nguyen 2012 (see Shrewsbury 2009), [6] Wake 2009, [7]Jelalian 2010, [8] Nova 2001, [9] Savoye 2009, [10] Resnicow 2005

2.7 There is moderate evidence from one [–] RCT[1] and one [++] RCT[2] that children that attend 75% or more of the **high intensity** programme sessions offered, showed greater improvements in weight outcomes than those attending fewer sessions. One further ongoing [++] RCT[3] found that further addition of further therapeutic to CBT therapy was not more beneficial to BMI z-scores, diet, physical activity and psychosocial outcomes than CBT alone.

[1] Resnicow 2005, [2] Karlachian 2009 [3] Shrewsbury 2009

2.8 **Individual or group treatment.** There is weak evidence from one small quasi-RCT (–)[1] that individual treatment does not result in significantly different results for BMI or diet outcomes compared to group treatment.

[1] Goldfield 2001

2.9 **Length of intervention and attrition.** Within the 28 studies of family based interventions (9 [++] RCTs[1-9], 9 [+] RCTs[10-18], 4 quasi-RCTs (1 [+][19], 3 [–][20-22]), 6 [–] UBAs[23-28], there was no link between study length and attrition rate at the end of the study (correlation coefficient= 0.06, p=0.75). This evidence is directly applicable as the studies were conducted in community settings in the UK and similar countries.

[1] Collins 2011, [2] Daley 2006, [3] DeBar 2012, [4] Ford 2010, [5] Kalarchian 2009, [6] Kalavainen 2007, [7] McCallum 2007, [8] Shrewsbury 2009, [9] Wake 2009, [10] Banks 2012, [11] Bryant 2011, [12] Coppins 2011, [13] Croker 2012, [14] Hughes 2008, [15] Janicke 2008a/b, [16] Jelalian 2010, [17] Sacher 2010, [18] Savoye 2007, [19] Nova 2001, [20] Berkowitz 2011, [21] Goldfield 2001, [22] Resnicow 2005, [23] Norton 2011, [24] Pittson 2011, [25] Rennie 2010, [26] Robertson 2011, [27] Sabin 2007, [28] Watson 2011.

Applicability:

2.1 Directly applicable: conducted in community settings in Australia[1,5], the UK[2,3] and the USA[5]

2.2 Directly applicable: conducted in community settings in Australia[1,2]

2.3 Directly applicable: studies informing the evidence statements are conducted in applicable community settings

2.4 Directly applicable: studies conducted in applicable community settings

2.5 Directly applicable: studies conducted in applicable community settings

2.6 Directly applicable: conducted in community settings in the USA, Italy and Australia

2.7 Directly applicable: conducted in community settings in the USA and Australia

2.8 Directly applicable: conducted in community settings in the USA

2.9 Directly applicable: conducted in community settings in the UK and similar countries.

Variations in cost-effectiveness related to intervention components

2.10 A single cost-effectiveness study[1] suggested that group therapy alone for families was more cost-effective than a combination of group and individual therapy.

[1] Goldfield 2001
Study Limitations: Very serious; Applicability: partial

2.11 A single cost-effectiveness study found that a parent-only intervention was more cost-effective than a parent and child intervention.

[1] Janicke 2009
Study Limitations: Very serious; Applicability: partial

Effects by ethnic groups – anthropometric outcomes

3.1 There is moderate evidence from one [+] RCT[1] that exercise-only interventions for children do not demonstrate a differential effect in ethnic groups. The intervention consisted of five weekly 20 or 40 minute exercise sessions for overweight children aged 7-11 (58% female and 59% black) over 13 weeks.

[1] Petty 2008

3.2 There is inconsistent evidence that family interventions are effective in diverse ethnic

populations. A [–] UBA study[1] observed a reduction at 6 weeks in average absolute BMI (−0.29 kg m−2 SD = 0.49, p = 0.000, CI = 95%) in a sample that was predominantly (86.7%) of SE Asian ethnicity. However, a [+] RCT[2] with a sample including 43% non-white participants did not observe significant between-group treatment effects for BMI and no overall change in BMI or BMI SDS (z-score) from 0–12 months was observed for the treatment group. Data were not provided separately for different ethnic groups

[1] Norton 2011, [2] Croker 2012,

Applicability:

3.1 Partially applicable: Study conducted in a research centre in the USA

3.2 Directly applicable: one UK study in a community-based setting in East London with a very large ethnic minority population.[1] One study in a London hospital outpatient setting.[2]

Lifestyle weight management programmes by age – anthropometric outcomes

3.3 There is strong evidence from a meta-analysis of 11 RCTs[1-11] that lifestyle weight management programmes may be more effective for younger age groups when measured immediately post intervention. SMDs of BMI z-scores for 6-12 and 13-17 years of age were -0.20 (-0.33 to -0.06) and -0.13 (-0.29 to 0.03) respectively.

[1] Resnicow 2005, [2] Karlachian 2009, [3] Magarey 2011, [4] Okely 2010 (see Collins 2011), [5] Savoye 2007, [6] Croker 2012, [7] West 2010, [8] Daley 2006, [9] DeBar 2012, [10] Ford 2010, [11] Jelalian 2010

However, a further meta-analysis of 14 studies with follow up of six months or greater indicated a trend to a greater effect long term for the older age group; 0.00 (-0.10 to 0.10) for ages 6-12 and -0.08 (-0.23 to 0.07) for ages 13-17.

[1] Collins 2011, [2] Estabrooks 2009, [3] Golley 2007, [4] Karlachian 2009, [5] Magarey 2011, [6] McCallum 2007, [7] Nova 2001, [8] Savoye 2007, [9] Wake 2009, [10] DeBar 2012, [11] Ford 2010, [12] Jelalian 2010, [13] Nguyen 2012 (see Shrewsbury 2009), [14] Resnicow 2005

3.4 There is weak evidence from three studies that young age groups experience a significantly greater reduction in BMI z-scores. One [–] UBA[1] found that the mean change at six months for participants aged 13 or under was -0.13 0.13 ± 0.14, p<0.01. A second [–] UBA[2] reported Younger age groups achieved significantly greater reductions in BMI z-score (p = 0.000) and BMI centile (p = 0.009). A third [–] UBA[3] found that age was the most important predictor with younger children achieving larger reductions in BMI SDS, P=0.013.

[1] Rudolf 2006, [2] Norton 2011, [3] Sabin 2007

3.5 No studies were identified of interventions directed specifically to children aged below six years of age. Although several programmes had a lower age limit of between 3 and 5 years[1-9], the mean age for all studies was ≥6 years and no studies provided data separately for this age group. Programmes targeted at very young children appear to be obesity prevention programmes that target all children rather than those who are obese or overweight.

[1] Banks 2012, [2] Collins 2011, [3] Hughes 2008, [4] Magarey 2011,[4] McCallum 2007, [5] Norton 2011, [6] Nova 2001, [7] Sabin 2007, [8] Wake 2009, [9] Watson 2011

Applicability

3.3	Directly applicable: studies all conducted in applicable community settings
3.4	Directly applicable: UK community-based studies
3.5	Directly applicable: studies all conducted in applicable community settings

Effects by gender – anthropometric outcomes

3.6 There is weak evidence from one [–] UBA[1] that that attendance at a **residential weight management camp** for overweight and obese **children** aged 9-17 years over a period of weeks does not result in a differential effect between boys and girls. Attendance was associated with reductions in BMI SDS for both boys and girls (−0.37 and −0.34 respectively) There is weak evidence from two [−] quasi-RCTs[1,2], one [−] CBA[3] and one [−] UBA[4] with significant **reductions in BMI z-score** amongst attendees by the end of camp . The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian.

[1] King 2007

3.7 There is weak evidence from one [+] RCT[1] that **exercise-only** interventions for **children** do not demonstrate a **differential effect between boys and girls**. The intervention consisted of five weekly 20 or 40 minute exercise sessions for overweight children aged 7-11 (58% female and 59% black) over 13 weeks.

[1] Petty 2009

3.8 There is very weak evidence that **parent and child interventions** are more effective in **girls**. A [–] UBA[1] reported that the change in **BMI SD** at 6 months was greater for girls (-0.07 ± 0.14, p=.02. The UBA was programme for obese 8-16 year olds and their parents from a socially-disadvantaged community comprising a combination of motivational interviews and physical activity delivered in the community by non-professional health trainers to encourage lifestyle change via weekly parent/child appointments. Initial commitment of three months, with an option of three-month renewals up to one year

[1] Rudolf 2006

3.9 There is inconsistent evidence that **family interventions** have a **differential effect in boys and girls**. A [++] RCT[1] reported a significant effect in girls compared with boys in BMI-SDS change (average 0.2 decrease in girls and no change in boys. p=0.05). A [**–**] UBA[4] reported a similar result with a significant decrease in the **BMI z-score** for girls (–0.12, SEM 0.03, p<0.001) but not for boys (–0.08, SEM 0.04, p=0.08). A further [**–**] UBA[3] did not observe a significant difference at 12 months between boys and girls. However, two [−] UBAs[4.5] reported greater differences in boys than girls. One [−] UBA[1] observed a significantly greater reduction in z-BMI (p = 0.046) in boys compared with girls and a second [−] UBA[2] identified that more boys than girls were likely to achieve target reductions in BMI SDS; although the differences did not reach significance. However two studies observed a greater effect in girls.

[1] Kalavainen 2007, [2] Rennie 2010, [3] Watson 2011, [4] Norton 2011, [5] Sabin 2007.

3.10 There is inconsistent evidence that interventions directed at **parents-only** demonstrate a

differential effect in boys and girls. One [++] RCT[1] observed that boys had significantly lower **BMI z-scores** at 6 and 12 months compared with baseline in both intervention groups but not the control group. For girls the only significant change was a reduction in BMI z-score However a second [++] RCT[2] noted that boys had higher BMI z-scores at baseline than girls but changes over time did not vary by gender. The interventions involved group-based parenting skills training directed to the parents of overweight and obese children aged respectively 6-9 and 5-9 years Both interventions were delivered over 6 months by dietitians.

[1] Golley 2007, [2] Magarey 2011

3.11 An examination of participant gender across the 34 included programmes identified considerably higher numbers of female participants in the majority of the 33 studies for which gender information was available. Only two studies had higher numbers of male participants and in more than half the programmes the imbalance was at least 20%.

Applicability:

3.6 Directly applicable: conducted in a UK short-term residential camp

3.7 Directly applicable: conducted in a community-based setting in the USA

3.8 Directly applicable: conducted in a UK community setting

3.9 Directly applicable: conducted in community-based settings in the USA[1] and the UK[2-4]

3.10 Directly applicable: conducted in an Australian community setting

3.11 Directly applicable: all studies conducted in community settings in the UK or other similar countries.

Effect by low-income groups – anthropometric outcomes

3.12 There is inconsistent evidence that family interventions are effective in low-income groups. Two UK studies did not identify an association between low socio-economic status and child outcomes. A [+] RCT[1] found no significant between-group treatment effects for BMI and no overall change in BMI or BMI SDS (z-score) from 0–12 months in a treatment group where 46% of parents had minimum levels of education. A [–] UBA[2] study conducted, in the UK indicated that socio-economic status (median Townsend Deprivation Index Quintile=3,1-5) did not appear to impact upon child outcomes. However, a USA-based [++] RCT[3] reported that a higher family income was associated with short-term decreases in percent overweight, p = 0.025. Programmes: [1] Seventy two families with overweight or obese children aged 8-12 years family-based behavioural treatment programme (FBBT) consisting of behavioural, diet and physical activity components. Delivered by clinicians, dietitians and family therapists over six months [2] Families with obese children aged 2-17 years attending a hospital outpatient obesity clinic were offered three-monthly appointments with a paediatrician, and a paediatric dietitian who encouraged goal setting and practical dietary changes. Advice was provided on physical activity and families invited to attend free 2-hour, weekly games session. [3] A year-long family-based behavioural intervention for severe obesity in 190 children aged 8-12 years (56.8% female and 73.4% white). It comprised dietary, behavioural and physical activity strategies, involved twenty 60-minute group meetings over six months separately for adult and child groups with complementary material, plus six booster sessions in months 6-12.

[1] Croker 2012, [2] Sabin 2007, [3] Kalarchian 2009

3.13 There is moderate evidence from one [++] RCT [1], that interventions directed at parents only do not demonstrate an association between change in BMI z -score from baseline to 12 months and indicators of socio-economic status. The intervention involved group-based parenting skills training directed to parents of overweight and obese children aged respectively 6-9 years Intervention delivered over 6 months by dietitians.

[1] Golley 2007

Applicability

3.12 Directly applicable: community-based studies conducted in the UK[1,2] and the USA[3]

3.13 Directly applicable: community based study conducted in Australia

Effect of BMI z score at baseline on end of intervention attrition

3.14 There is strong evidence from 22 studies of family-based interventions (8 [++] RCTs[1-8], 9 [+] RCTs[9-17], 1[–] RCT[18], 4 [–] UBAs[19-22]) that BMI z scores at baseline are associated with attrition rates at the end of the intervention. Attrition rates increased with increasing BMI z score (correlation coefficient =0.56, p=0.007). This evidence is directly applicable as all studies were conducted in community settings in the UK or other similar countries.

[1] Collins 2011, [2] Daley 2006, [3] DeBar 2012, [4] Ford 2010, [5] Kalavainen 2007, [6] McCallum 2007, [7] Shrewsbury 2009, [8] Wake 2009, [9] Banks 2012, [10] Bryant 2011, [11] Coppins 2011, [12] Croker 2012, [13] Hughes 2008, [14] Janicke 2008a, [15] Jelalian 2010, [16] Sacher 2010, [17] Savoye 2007, [18] Goldfield 2001, [19] Norton 2011, [20] Rennie 2010, [21] Robertson 2011, [22] Watson 2011.

Applicability

3.14 Directly applicable: all studies conducted in community settings in the UK or other similar countries

Variations in cost-effectiveness for different groups

3.15 No evidence was found exploring differential cost effects within different population groups

Most effective ways of sustaining long-term effects

4.1 There is inconsistent evidence as to whether the effects of weight management programmes are sustained long-term. There is strong evidence from meta-analyses of 18 programmes: 10 [++] RCTs[1-11](11 papers), 5 [+] RCTs[12-16], 3 quasi-RCTs (1 [+][17], 2 [–][18,19]) with BMI-z outcomes, indicating improvements decrease the longer the length of follow-up.

[1] Collins 2011, [2] Daley 2006, [3] DeBar 2012, [4] Ford 2010, [5] Golley 2007, [6] Karlachian 2009, [7] Magarey 2011, [8] McCallum 2007, [9] Nguyen 2012, [10] Okely 2010, [11] Wake 2009, [12] Croker 2012, [13] Estabrooks 2009, [14] Jelalian 2010, [15] Sacher 2010, [16] Savoye 2009, [17] Nova 2001, [18]Resnicow 2005, [19] West 2010

4.2 Considering BMI plus other outcomes, there is inconsistent evidence from five [++] RCTs[1-5], one [+] RCT[6] one [+] quasi-RCT[7] and one [–] UBA[8] as to whether the effects of weight

management programmes are sustained long term. It is not possible to determine which intervention components result in sustained outcomes.

[1] Collins 2011, [2] DeBar 2012, [3] Kalavainen 2007, [4] Magarey 2011, [5] McCallum 2007, [6] Savoye 2009, [7] Coppins 2011, [8] Robertson 2011

Applicability

4.1 Directly applicable: all studies conducted in community settings in the UK or other similar countries

4.2 Directly applicable: all studies conducted in community settings in the UK or other similar countries

Impact of parents/carers and the wider family– anthropometric outcomes

5.1 There is inconsistent evidence from two [++] RCTs and one [–] cluster RCT of similar group-based behavioural programmes directed to the parents of overweight and obese children aged respectively 6-9, 5-9 and 4-11 years. Although there were significant overall differences in BMI z-scores, neither [++] RCT found significant between group differences. However the [–] cluster RCT found significant improvements in BMI z-score for the intervention group (from 2.15, SD 0.43 at baseline to 2.04 (SD 0.44) at 12 weeks). The score was maintained at 12 months (1.96, SD 0.46). Two intervention were delivered over 6 months by dietitians [1,2] and one by a clinical psychologist over 12 weeks[3].

[1] Golley 2007, [2]Magarey 2011, [3] West 2010

5.2 There is very weak evidence from one [−] UBA[1] that parental involvement improved child BMI-z-scores. For children attending with adults who lost weight, the difference was −0.13±0.23 as compared with those attending with adults who maintained/increased weight for whom the difference was 0.05±0.25. The programme was a community-based, lifestyle change intervention for 65 obese children aged 6-14 and their families involving 18 sessions of 2 hours per week focusing on diet, physical activity and behaviour change. The programme was delivered by non-clinical staff trained by the developers.

[1] Watson 2011

5.3 No interventions directed at the whole family provided impact data.

Applicability

5.1 Directly applicable: studies conducted in community settings in Australia[1,2] and the USA[3]

5.2 Directly applicable: UK community-based study

Encouraging children and young people

6.1 No data were found to answer this question from intervention studies.

5. DISCUSSION

Overall, lifestyle weight management programmes for children and adolescents have a significant post- intervention effect on BMI z-scores.

Meta-analysis indicates the post- intervention pooled standardised mean differences (SMD) is a small reduction in BMI/zBMI for children in the intervention compared to those control arm (SMD = -0.17; CI 95% = -0.30 to -0.04, p = 0.01). In the long term (≥ 6 months) the pooled SMD indicated a null effect on BMI/zBMI (SMD = -0.07; CI 95% = -0.15 to 0.02, p = 0.12). These estimates are broadly comparable with the Cochrane review on the topic (Oude Luttikhuis 2009) but are lower than other recent reviews.

To maximise the likely effect size of the intervention and the sustainability of the effects the evidence from this efficacy review supports the inclusion of the following components:

- Targeting the whole family rather than children or parents only
- Providing dietary, physical activity and behavioural advice; particularly emphasising dietary components and behavioural support for parents.
- Providing a high intensity rather than low intensity intervention in terms of contact time and programme length

Results from the UK compared with the best evidence from large RCTs outside the UK are comparable, lending support to the overall effect estimates.

Programmes can result in other benefits such as dietary changes and, possibly improved quality of life, but improvements to physical activity and other psychosocial changes appear less likely. There is relatively little evidence for different social and ethnic groups, and inconsistent evidence for effects on boys and girls. Such evidence as is available suggests no major differences overall in these three domains.

Findings for age groups suggested greater effectiveness for younger age groups (6-12) versus older children (ages 13-17) immediately post intervention, although these differences do not appear to be sustained in the longer term. This finding is in direct contract to the Oude Littikuis review (2009) which concluded, from a much smaller number of studies, greater effectiveness at 12 months for children aged 12 or under.

There was a distinct gender disparity in the programmes with a majority of studies recruiting significantly greater percentages of female participants. In more than half the programmes this disparity was at least 20% which is a concern given that data from the National Child Measurement Programme indicates a higher prevalence of overweight and obesity in boys which increases with age.

The cost effectiveness studies suggest that programmes can be cost-effective in terms of BMI z-score gains in the long term at conventional cost-effectiveness thresholds, provided that short term (post-intervention) effects on BMI, observed in trials, are sustained into adulthood.

Strengths and limitations of this review:

This review was built on a comprehensive search strategy to find evaluations of UK-based child weight management interventions of all research designs, large randomised controlled trials completed outside the UK and all health economic evaluations. This approach ensured that the highest quality

global evidence was available for consideration, as well as all the UK-based studies to enhance the review's relevance for the UK setting.

No evidence was identified for the effectiveness of programmes in children aged six or under. Although several programmes were open to children in this age group, the mean age of participants in all studies was at least six years. There was also little data examining differential effects by groupings such as gender, socio-economic status, ethnicity and special needs.

Interventions were heterogeneous both in terms of intervention design and outcome measures. In particular, the wide array of physical activity, diet and well being measures, made it difficult to compare outcomes across studies.

As is common in these types of intervention, high levels of attrition were observed in many studies, often early in the programme. Unsurprisingly this meant that many studies were underpowered to detect effects.

The UK-based evidence included some RCTs but also a number of small uncontrolled studies with limited internal validity.

Nevertheless, the evidence provides clear pointers for the components to include in a weight management intervention, as outlined above.

Evidence from the barriers and facilitators review (Review 2) is likely to enrich the evidence available within this review.

ABBREVIATIONS

ANOVA	Analysis of variance
ANCOVA	Analysis of covariance
ATC	Additional therapeutic contact
BMI	Body mass index
BRHC	Bristol Royal Hospital for Children
C	Control group
CBA	Controlled before and after study
CBT	Cognitive behavioural therapy
DH	Department of Health
ET	Exercise therapy
EXER	Supervised exercise
FBBT	Family-based behavioural treatment
FC	Family Connections
FP	Family paediatrician
GP	General Practitioner
HDE	High dose exercise
HMO	Health Management Organisation
I	Intervention group
ITT	Intention to treat
IVR	Interactive voice response
LN	Life as normal
LDE	Low dose exercise
MANOVA	Multiple analysis of variance
MANCOVA	Multiple analysis of covariance
MPA	Moderate physical activity
MPVA	Moderate to vigorous physical activity
MRC	Medical Research Council
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
NIHR	National Institute for Health Research
NNT	Number needed to treat
NTIS	National Technical Information Service
NS	Not significant
OR	Odds ratio
PCC	Primary care clinic
PEAT	Peer enhanced adventure therapy
RCT	Randomised controlled trial
SA	Secondary analysis
SDS	Standard deviation score
SES	Socio-economic status
UBA	Uncontrolled before and after study
UC	Usual care

WLC	Wait list control
YHEC	York Health Economics Consortium
zBMI	Standardised body mass index

1 INTRODUCTION

1.1 Aims of the review

To determine the effectiveness and cost-effectiveness of lifestyle weight management services in overweight and obese children and young people under the age of 18.

1.2 Research questions

1. How effective and cost effective are lifestyle weight management programmes in helping overweight or obese children and young people to achieve and maintain a healthy weight?
2. What are the essential components of an effective and cost-effective lifestyle weight management programme for overweight and obese children and young people?
3. How does effectiveness and cost effectiveness vary for different population groups? (Examples may include children and young people from different black and minority ethnic groups, from low-income groups, of different ages or genders, or with special needs.)
4. What are the most effective and cost effective ways of addressing and sustaining behavioural change among overweight and obese children and young people using community-based weight management programmes?
5. How does the inclusion of parents, carers and the wider family impact on the effectiveness of community-based weight management programmes for children and young people?
6. How can more overweight and obese children and young people be encouraged to join, and adhere to, lifestyle weight management programmes?

1.3 Background

Around three out of every ten boys and girls aged 2 to 15 years in England in 2010 were either overweight or obese1[2] (NHS Information Centre 2012). The proportion that is overweight has remained largely unchanged since the mid-1990s. However, there has been a stark rise in childhood obesity (NHS Information Centre 2012) – by around one percentage point every 2 years up to 2007 (Department of Health 2011a). Although this increase now appears to be levelling off, in 2010 around 17% of boys and just below 15% of girls were classed as obese (NHS Information Centre 2012).

The 'National child measurement programme' (NCMP), part of the 'Healthy weight: healthy lives' strategy, aims to identify the prevalence of childhood obesity locally to help plan and deliver local support services (DH 2011b). Schoolchildren in reception (aged 4–5 years) and in year 6 (aged 10–11 years) have their height and weight measured (NHS Information Centre 2011). In the school year 2010/11, the NCMP showed that around 23% of children in reception and 33% in year 6 were either overweight or obese, and around 9% and 19%, respectively, were obese (NHS Information Centre 2011). The NCMP shows that obesity prevalence rises with increasing socioeconomic deprivation and is more prevalent in urban, compared with rural, areas. Obesity is also more prevalent among children from black, Asian, 'mixed' and 'other' minority ethnic groups than among their white counterparts (NHS Information Centre 2011).

[2] Several classification systems are used in the UK to define 'obesity' and 'overweight' in children. The 'National child measurement programme' (NCMP) and 'Health survey for England' use a gender- specific BMI chart (UK 1990 chart for children aged over 4 years). Children over the 85th centile, and on or below the 95th centile, are 'overweight'. Children over the 95th centile are 'obese'. In clinical practice, however, the 91st and 98th centiles may be used to define 'overweight' and 'obese' respectively.

Most of the longer-term health consequences of obesity such as type 2 diabetes, cardiovascular disease and some cancers are seen in adults. However, over the last decade, it has become increasingly common for children to develop type 2 diabetes (Diabetes UK 2011). Being overweight as a child has been associated with the development of cardiovascular risk factors in childhood or early adulthood (Craig et al 2008; Logue and Sattar 2011). Childhood obesity is also associated with an increased prevalence of asthma (Figueroa-Munoz et al. 2001) and with sleep-associated breathing disorders including sleep apnoea. In addition, overweight and obese children are likely to experience bullying and stigma (Griffiths et al. 2006) which can impact on their self-esteem. Some of these issues and conditions may, in turn, affect their performance at school (Caird et al. 2011).

Up to 79% of children who are obese in their early teens are likely to remain obese as adults (Chief Medical Officer 2008). Consequently, they will be at greater risk of conditions such as type 2 diabetes, coronary heart disease and some cancers in adulthood (Foresight 2007). Studies have also shown that a child with at least one obese parent is more likely to be obese themselves, and so there is a potential intergenerational effect (Perez-Pastor et al. 2009).

Unless obesity is addressed in childhood, most of the financial consequences are likely to be incurred when treating and managing the co-morbidities that arise in adulthood. However, there are examples of more contemporary costs – such as schools needing to purchase specialist classroom and gym equipment to accommodate the needs of obese and overweight children (Local Government Association 2008).

'Healthy lives: a call to action on obesity in England' (DH 2011a) states that a range of local interventions are needed to both prevent obesity and treat those who are already obese or overweight. The 'Healthy child programme for 5–19 year olds' recommends that overweight or obese children should be referred to appropriate weight management services to help them achieve and maintain a healthier weight (DH 2009a). In 2008, an estimated 314 to 375 weight management programmes for children were operating in England (Aicken et al. 2008). Some were small local schemes; others were available on a regional or national basis – such as those listed in the DH's 'Child weight management programme and training providers' framework' (Cross Government Obesity Unit 2009). In addition, some adult weight management programmes may accept children and young people. Local commissioners need to be able to determine which programmes are effective and provide good value for money.

The National Institute for Health and Clinical Excellence (NICE) has been asked by the Department of Health (DH) to develop guidance on managing overweight and obesity in children and young people through lifestyle weight management services.

The guidance will support a number of related policy documents including:

- 'Achieving equity and excellence for children' (DH 2010a)
- 'Equity and excellence: Liberating the NHS' (DH 2010b)
- 'Fair society, healthy lives: strategic review of health inequalities in England post 2010' (The Marmot Review 2010)
- 'Healthy child programme: from 5–19 years old' (DH 2009a)
- 'Healthy child programme: pregnancy and the first 5 years of life' (DH 2009b)
- 'Healthy child programme: the two year review' (DH 2009c)

- ‘Healthy lives, healthy people: our strategy for public health in England’ (DH 2010c)
- Healthy lives, healthy people: a call to action on obesity in England’ (DH 2011a)
- ‘Improving outcomes and supporting transparency. A public health outcomes framework for England 2013–2016’ (DH 2012)
- ‘National child measurement programme’ (DH 2011b).

The guidance will provide recommendations for good practice, based on the best available evidence of effectiveness and cost effectiveness. It is aimed at commissioners, health professionals and providers of weight management services. It will also be of interest to managers in local authorities, schools and early years' settings, as well as to young people, their parents, carers and families. It will complement NICE guidance on: obesity; behaviour change; maternal and child nutrition; prevention of cardiovascular disease and promoting physical activity.

The guidance will be underpinned by two evidence reviews and an economic analysis. This review (Review 1) considers the effectiveness and cost effectiveness of lifestyle weight management services in overweight and obese children and young people under the age of 18. Review 2 will be a companion to Review 1 and will look at barriers and facilitators to lifestyle weight management service approaches and the series will be completed with a health economic analysis.

2. METHODS

2.1 Literature search

A systematic review of the evidence of effectiveness and cost effectiveness to address the above review questions was undertaken.

A comprehensive literature search was undertaken to identify evidence in the English language that is:

- from the UK and/or applicable to the UK, from world-wide studies;
- publicly available, including trials in press ("academic in confidence")
- commercially sensitive data made available to NICE as a result of a call for evidence ("commercial in confidence")

A wide range of databases and websites was searched systematically; supplemented by grey literature[3] searches. Searches were carried out to identify relevant studies in the English language published between 2000 and May 2012 for both reviews. Additionally, RCTs, economic evaluations and views studies (for Review 2) published between 1990 and 1999 were identified and included using 'snowballing' methods ('unpicking' systematic reviews and reference list checking and citation tracking in Scopus and Science Citation Index databases).

The following study designs were identified:

- Systematic reviews, randomised controlled trials (RCTs), non-randomised trials (non-RCTs), controlled before and after studies (CBA), interrupted time series (ITS), uncontrolled before and after studies (UBA) and full economic evaluations based on decision analytical models or conducted alongside primary studies. As noted above, systematic reviews were unpicked for relevant studies.

2.1.1 Electronic sources (databases and websites)

The outline search strategy was developed for Ovid Medline [Appendix C] as a precise search strategy to identify research on lifestyle weight management services for children and young people including effectiveness (this review) and 'barriers and facilitators' (review 2) studies. The search was developed using search strategies in relevant systematic reviews and 20 primary research papers known to the review team. It was tested against a further 20 papers set to ensure a good sensitivity/precision balance. It was translated for use in all other sources detailed below.

Databases:

- ASSIA (Applied Social Science Index and Abstracts) - Proquest
- CEA registry [Cost Effectiveness Analysis] https://research.tufts-nemc.org/cear4/Home.aspx
- CINAHL (Cumulative Index of Nursing and Allied Health Literature) - EBSCO
- Cochrane Central Register of Controlled Trials - WIley
- Cochrane Database of Systematic Reviews – Wiley

[3] Technical or research reports, doctoral dissertations, conference papers and official publications.

- Database of Abstracts of Reviews of Effectiveness (DARE) - Wiley
- Econlit - EBSCO
- EconPapers http://econpapers.repec.org/
- EMBASE - Ovid
- HEED - Wiley
- HMIC - Ovid
- Medline and Medline in Process - Ovid
- NHS EED - Wiley
- PHICED [Public Health Interventions Cost Effectiveness Database] http://www.yhpho.org.uk/PHICED/
- PsycINFO - Ovid
- Social Policy and Practice - Ovid
- UK Clinical Research Network Portfolio Database
- *Citation tracking only*
    - Science Citation Index - Thomson Reuter
    - Scopus - Elsevier
    - Social Science Citation Index – Thomson Reuter
- *Specialist (public health) systematic review registers*
    - EPPI Centre DoPHER
    - Cochrane Public Health Group Specialized Register

Web sites:

- Association for the Study of Obesity http://www.aso.org.uk/
- Centre for Childhood Obesity Research http://www.hhdev.psu.edu/ccor/
- Centres for Disease Control and Prevention – Nutrition, physical activity and obesity http://www.cdc.gov/healthyyouth/npao/index.htm
- Current controlled trials http://www.controlled-trials.com
- Department of Health – obesity http://www.dh.gov.uk/en/Publichealth/Obesity/index.htm
- European Association of the Study of Obesity http://www.easo.org/ [including abstracts from the European Obesity Conference, Lyon, May 2012]
- ETHOS (dissertation search) http://ethos.bl.uk
- Food Standards Agency http://www.food.gov.uk/
- Health Evidence Canada http://health-evidence.ca/articles/search
- Joseph Rowntree Foundation http://www.jrf.org.uk/
- MEND http://www.mendcentral.org/aboutus/whoweare
- More Life http://www.more-life.co.uk/Default.aspx?PageName=Research
- National Technical Information Service http://www.ntis.gov/search/index.aspx
- National Obesity Forum http://www.nationalobesityforum.org.uk/
- National Obesity Observatory http://www.noo.org.uk/
- NHS Evidence http://http://www.evidence.nhs.uk/
- NICE http://www.nice.org.uk/
- Obesity Learning Centre http://www.obesitylearningcentre-nhf.org.uk/

- OpenGrey http://www.opengrey.eu/
- Public health observatories http://www.apho.org.uk/
- Scottish Government http://home.scotland.gov.uk/home
- Welsh Government http://wales.gov.uk/?lang=en

2.1.2 Additional searches

The electronic table of contents for the journals containing the greatest number of papers meeting the inclusion criteria (*International Journal of Obesity*, *Pediatrics*, *Obesity Reviews*, and *Obesity*) were hand searched for the previous twelve months. Reference lists of included studies were checked for additional studies and citation tracking was undertaken in Web of Knowledge and Scopus for systematic reviews and RCTs meeting the inclusion/exclusion criteria.

RCTs, economic evaluations and views studies (for Review 2) published between 1990 and 1999 were captured by unpicking systematic reviews and checking reference lists.

NICE issued a call for evidence from registered stakeholders in May 2012.

To identify additional published studies, research reported in the grey literature, unpublished work, research in progress first or corresponding authors of included studies and other topic specialists were contacted for papers of potential relevance to Review 2.

Results of the literature searches were imported into a single Reference Manager database that was then de- duplicated.

2.2 Inclusion/Exclusion criteria:

	Inclusion	Exclusion
Population	• Children and young people aged below 18 who are overweight or obese[4]. • The parents or carers and families of these children and young people	• Children and young people who are of a healthy weight or underweight • Young women under 18 who are pregnant • Adults (apart from the parents and carers of children and young people who are overweight or obese)
Interventions	Weight management programmes that take a lifestyle approach to helping overweight or obese children and young people achieve and maintain a healthy weight. Lifestyle approaches focus on diet, physical activity, behaviour change or any combination of these factors. They will include programmes, courses or	For children and young people aged under 18 who are overweight or obese: • Hospital or primary care clinical treatment of obesity which excludes lifestyle approaches, or which combines lifestyle approaches with drug or other treatments where it is not possible

[4] Definitions of overweight are as defined within the included studies. A child or young person whose weight is at or above the 98th BMI centile may be described as 'very overweight' or obese. See BMI healthy weight calculator.

	clubs (including online services) that are: • Specifically designed for overweight or obese children or young people • Designed for the parents, carers of families of obese or overweight children and young people • Designed primarily for adults but which accept, or may be used by, children and young people • Provided by the public, private or voluntary sector, in the community or in (or via) primary care or hospital settings.	to disaggregate data for lifestyle approaches. • Programmes that focus only on the primary prevention of overweight or obesity including: Universal programmes to promote healthy eating or physical activity which are aimed at all children and young people regardless of their weight; programmes which focus on policy or environmental changes in particular settings (such as early years, schools and further educational establishments). • The clinical treatment of mental or physical health conditions among children and young people which may be related to being overweight or obese • Pharmacological or surgical treatment; complimentary therapies such as acupuncture and hypnotherapy • Programmes based on very low calorie diets or meal replacements • Assessment of the definition of 'overweight' or 'obese'.
Comparison	All comparators	
Outcomes	Weight maintenance, changes in weight, body mass index (BMI) or waist circumference, adjusted for age and gender (eg via BMI or waist circumference z [standard deviation] scores or BMI centiles). Intermediate measures such as diet or physical activity outcomes Measures of wellbeing including: • Emotional wellbeing (including happiness, confidence and self-esteem) • Psychological wellbeing (including autonomy, problem-solving, resilience and attentiveness) • Social wellbeing (relationships with others, bullying or social isolation) Satisfaction with service, including	

	variations according to family circumstances, attendance and adherence rates, programme duration, completion and drop-out rates, follow-up of participants, sustainability of weight changes. All health economic outcomes in research papers (from NHS and all other perspectives) including • Health benefits via quality adjusted life years (QALYs) • Non health related benefits • Cost-consequence and other disaggregated data on health and non-health related costs and benefits. Any data relating to the 'intensity of the intervention' eg hours spent per participant	
Study design	All UK studies of any design. Randomised controlled trials of 100 or more participants conducted in Western Europe, North America or Australia/New Zealand. Randomised controlled trials with less than 100 participants with an associated cost-effectiveness study Randomised controlled trials of 40 or more participants conducted in Western Europe, North America or Australia/NZ where there is insufficient information from larger RCTs to answer a question.	Non-randomised controlled studies from outside the UK. RCTs conducted outside Western Europe, North America or Australia/New Zealand. RCTs with a population of less than 40.

Where interventions of interest were compared to or used in combination with excluded interventions, studies were included if the data for the interventions of interest could be disaggregated. Where studies included populations of all ages they were included if data for those aged below 18 could be disaggregated. Where disaggregation was not possible the studies were excluded. Where studies included populations up to and including age 18, they were included if a mean age was provided and it was clear most participants were under 18 years of age.

As the review process progressed, it became clear there were a very large number (circa 500) of potentially relevant papers. In discussion with NICE, the inclusion criteria were extended to include limitations based on study design as per the details above. A 'best evidence' approach was taken; using the highest quality evidence to answer each research question. It was agreed that, as there was a large number of RCTs with populations over 100, smaller RCTs (with populations between 40 and 100) would not be included unless they filled gaps in the evidence. However, for UK programmes, studies of all designs and sample sizes were included to maximise the

applicability of the review to UK practice. Additionally, RCTs of less than 100 participants with associated cost-effectiveness studies were included.

2.3 Study selection

Titles and abstracts were screened independently by two reviewers using the inclusion/exclusion criteria. Any disagreement was resolved by discussion with a third reviewer and, if in doubt, included. Full paper screening was undertaken independently by two reviewers, with recourse to a third to resolve any disagreements.

During the screening process records were tagged for relevance to specific questions and populations of interest for both reviews and for economic modelling.

2.4 Quality assessment

Quality assessment was conducted using the GATE checklists for quantitative studies and economic evaluations [NICE 2009]. Studies were assessed by one reviewer and checked by a second. Twenty percent of papers were assessed independently in duplicate and any disagreement resolved by discussion. The review team assessed each study's internal and external validity; where external validity measured how far the findings of the study might be generalised beyond the participants to a wider population from which the participants were drawn (eg from one community setting in the US to all US communities) but not to other populations. These ratings are included in the evidence tables. In addition, Appendix C provides a summary of the validity ratings for each element of the included studies. Where randomisation methods are unclear or methodologically insufficient, the study is described as being quasi-randomised.

2.5 Data extraction

Data were extracted as specified in Appendix K of the NICE Public Health Methods Manual and is presented in the Evidence Tables (Appendix A) with study characteristics, internal and external validity scores and outcome measures reported by the authors (with associated 95% confidence intervals (CI) and p-values where available).

All economic and cost data were extracted from research papers. Evidence tables for economic evaluations and cost effectiveness studies are presented in Appendix B.

Outcomes data from included studies were extracted and synthesised across studies for BMI and, where possible, a number needed to treat (NNT) was generated. Because of the time frame for completion of the review, authors of included studies were not contacted for additional data.

Intensity of intervention: The whole family interventions with outcomes for 6 or more months (Meta-analysis figure 4.2 p.69) were divided into very low, low, medium and high intensity interventions based on a slightly adapted version of the classification used in the Whitlock 2010 review which represents the natural groupings of the interventions:

< 10 hours =	Very low
10 to <20 hours =	Low
20 to <75 hours =	Moderate
75 hours + =	High

The contact hours with the whole family were counted even when the groups were separated - ie separate one hour sessions for parents and children were counted as one (family) hour. Where one part of the family had additional hours (eg children only), these additional hours were added to the total.

2.6 Data synthesis

The key findings of evidence are summarised in concise narrative summaries and evidence statements, supported by evidence tables. The statements indicate:

- the message given by the evidence;
- the strength of the evidence (based on a quality assessment of the source studies);
- applicability of the results to the UK.

BMI or zBMI (standardised body mass index) were the most consistently reported measures of effect across studies. The effects of the interventions on the prevalence of overweight or obesity were not analysed as no RCTs with more than 100 participants reported these data. For studies which reported more than one intervention arm, the data for each intervention arm compared with the control arm (or usual care) was presented, with the number of participants in the control arm halved to ensure no double counting. When studies reported using an intention to treat (ITT) analysis, the baseline sample size in each arm was used.

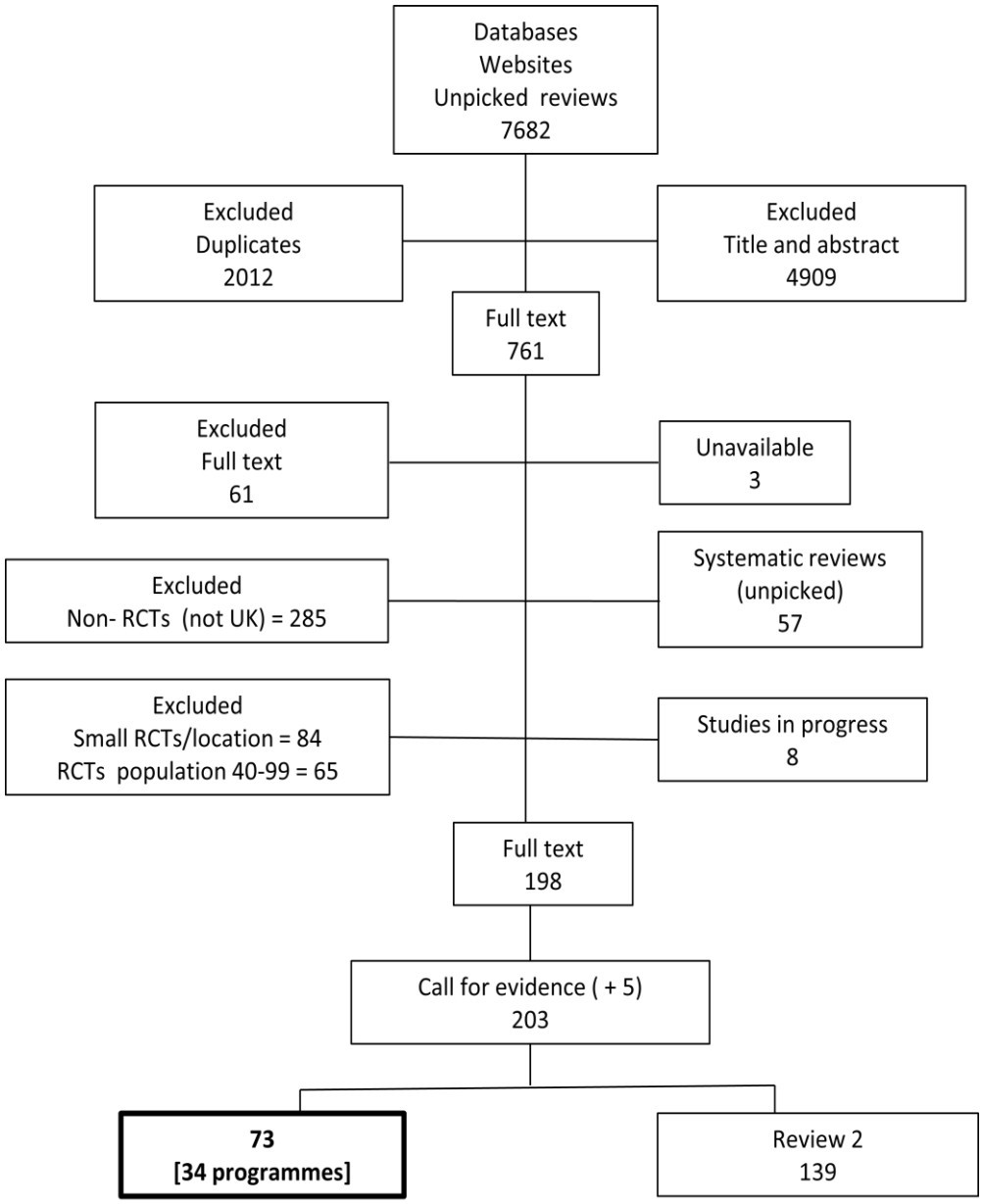
For the meta-analysis on BMI/zBMI, if not reported the standard deviation (SD) from the reported standard error (SE) of the mean was used, or 95% confidence intervals (CIs) using the equations provided in Chapter 9 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks, Higgins, & Altman, 2008). Means and SDs were then used to determine standardised mean differences (SMDs) between groups for use in the meta-analysis. Where no SD or SE was provided for follow-up data, the SD was imputed from either the baseline values or other included studies of similar size and target population (on four occasions). The I^2 statistic was used to provide a measure of heterogeneity. For studies not included in the meta-analyses, findings are described in tables and in the text. Unless otherwise stated, all data are presented in the format of SMD and 95% CIs.

Heterogeneity was explored by age group (6-12; 13-17 years), length of follow-up post intervention (0, ≥6 months (studies which reported effects at 1-5 months were excluded from the analysis)), behavioural target (diet, physical activity, diet and physical activity), level of family involvement (targeting just children, parents/ carers, or the whole family), referral method (self referral, GP referral, other health professional, school, or a mix of referral methods) and whether they were delivered in the UK or another country. A random effects meta analysis was conducted applying DerSimonian and Laird's method (DerSimonian & Laird, 1986), with fixed effects inverse variance method included for a comparison when I^2 values were < 50% (Deeks 2001). Publication bias was assessed by inspection of the funnel plot and by formal testing for funnel plot asymmetry using the Begg test and the Egger test (Begg & Mazumdar, 1994; Egger, Davey Smith, Schneider, & Minder, 1997). All analyses were conducted using Stata version 10 software (Harris 2008).

3. RESULTS

3.1 Search Results

The search strategy identified 7682 citations of which 6921 were excluded at title and abstract. Full details are provided in the flow diagram below (Figure 1). Because of the size of the evidence base, the decision was taken to limit inclusion to RCTs of 100 or more participants conducted in countries with a high degree of applicability to a UK setting (Western Europe, North America, Australia and New Zealand). RCTs of 40-99 participants from applicable countries would also be used where gaps in the evidence were identified. In addition, any UK study of any size or design was included. Some of the programmes identified in the search strategy (eg HENRY, Fit4Life) are obesity prevention not treatment interventions and therefore were not included.



Note: Nine papers are potentially relevant to both reviews

Figure 1: Flow diagram of search and inclusion process

Seventy three papers provided data on 34 separate programmes (see Table 4.1 for brief details of included studies). Associated cost effectiveness or economic evaluation data were available for 11 programmes (see Table 4.2)

3.2 Quality and applicability of studies

A summary of quality scores (internal and external validity) is provided for all included papers as Appendix C. Eleven RCTs: **Collins 2011 ++** (multiple papers), **Daley 2006 ++**, **DeBar 2010 ++**, **Ford 2010 ++**, **Golley 2007 ++**, **Karlachian 2009 ++**, **Kalavainen 2007 ++**, **Magarey 2011 ++**, **McCallum 2007 ++**, **Shrewsbury 2009 ++** (multiple papers) and **Wake 2009 ++** were found to have high internal validity. Four quasi-RCTs of three programmes (**Gately 2007 –**, **King 2007 –**, **Goldfield 2001 –**, **Resnicow 2005 –**) and one cluster RCT **West 2010 –** were assessed as being of low quality. The remaining RCTs and quasi RCTs were deemed to be of moderate internal validity. Of the non-RCTs, only one study was controlled and all were assessed as being of low quality (–).

The review was limited to countries with similar levels of child overweight and obesity and economic development (UK, Western Europe, USA, Canada, Australia and New Zealand). Additionally, interventions were either community- or in hospital outpatient settings. As a result, overall applicability of the interventions is likely to be high. Fourteen programmes were conducted in the UK, 10 in the USA, six in Australia, and three in Western Europe (Italy, Finland and Belgium).

3.3 Outcomes

Programmes measured a range of outcomes relating to adiposity, diet, physical activity, wellbeing and satisfaction with service. For consistency, the key measure of adiposity was deemed to be BMI-z or BMI (SDS).

3.4 Statistical analysis

Overall 31 effect sizes were derived from 19 studies. Effects were slightly larger immediately post follow-up than after ≥ 6 months, and there was greater heterogeneity across effect sizes in the post-intervention effects than those collected ≥ 6 months.

For immediate post intervention effects, 14 effect sizes were included from 12 studies in the analysis of the immediate post intervention effect. A moderate level of heterogeneity was found in the effect of interventions across studies (overall I2 = 36.7%; p = 0.08).

For effects at six months or more, 17 effect sizes were derived from 14 studies in the analysis of the immediate post intervention effect. A small amount of heterogeneity was found in the effect of interventions across studies (overall I^2 = 3.3%; p = 0.42).

Figures 4.1 to 4.6 and 4.8 to 4.9 show the forest plots with results of the meta-analyses for comparison

Risk of bias

Figure 2 shows the funnel plot for post intervention effects. No evidence of publication bias was observed, as indicated by a symmetric funnel plot and a non significant Begg test (z = 1.04; p = 0.30) and Egger test (coefficient = -0.05; 95% CI = -0.99 to 0.05, p = 0.07).

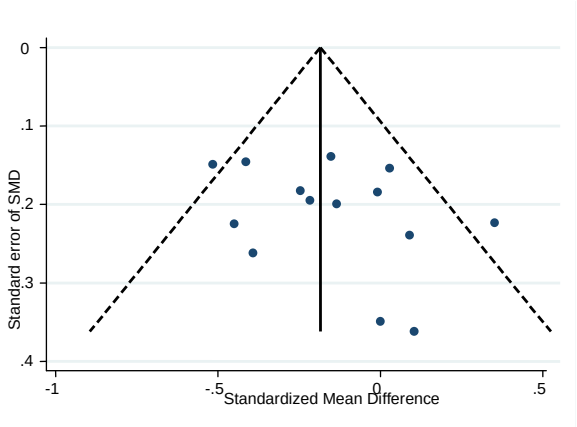


Figure 2. Funnel plot for post –intervention effects with pseudo 95% confidence limits

Figure 3 shows the funnel plot for intervention effects for ≥6 months. No evidence of publication bias was observed, as indicated by a symmetric funnel plot and a non significant Begg test (z = -0.33; p = 0.29) and Egger test (coefficient = -0.25; 95% CI = -2.73 to 2.22, p = 0.83).

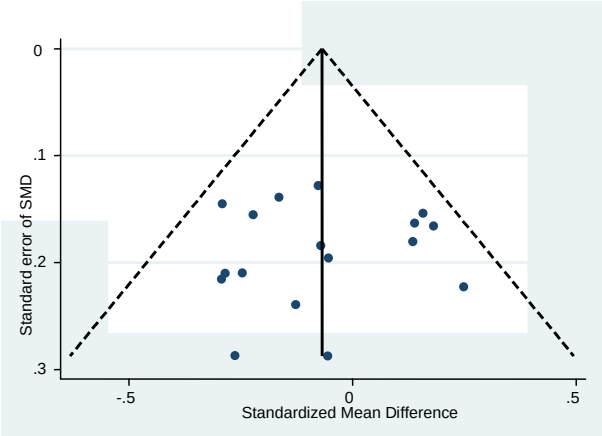


Figure 3. Funnel plot for ≥6 month's effects with pseudo 95% confidence limits

Table 4.1: Brief summary of included studies

* Studies are complex and this table can only give a flavour of each intervention. See Appendix A for more detailed summaries.

First Author(s), Year(s) Programme	**Location**	**Intervention**	**Target**	**Programme duration/Follow-up/ Attrition**
Banks 2012 + Sabin 2007 – COCO	UK - Bristol Hospital obesity clinic/Primary care Hospital obesity clinic (only)	RCT (Banks 2012); UBA (Sabin 2007). Behaviour change, diet and physical activity vs no intervention Number of children/adolescents = 76 (Banks 2012); 137 (Sabin 2007)	Family	Duration; up to 1 year **Banks**: Follow-up: to end of intervention Attrition: 39% (randomisation); 24% (baseline) at follow-up **Sabin**: Follow-up unclear (≥1 year) Attrition: 34% (baseline)
Berkowitz 2011 (abstract only)	USA – Philadelphia Primary care – two centres	Quasi-RCT. Behaviour change. Group vs self-directed lifestyle management change (LMP). 169 adolescents	Family	Study 1 year. No information on length of programme. Attrition 32.5%
Braet 1997 +	Belgium outpatient and camp	Quasi-RCT. Multiple interventions (advice, individual or group therapy, summer camp for "clinically obese") vs no treatment group (overweight but "non-clinically obese") 259 children or adolescents	Family	Duration: varied Follow up: to end of intervention Attrition: 19%
Bryant 2011 +, Rudolf 2006 – WATCH-IT	UK, Leeds Disadvantaged communities	UBA. Motivational interviews and physical activity to encourage lifestyle change 94 children or adolescents	Child and parents	(B = Bryant; R = Rudolph) Duration: 4 months (B); 3-12 months (R) Follow- up from baseline: 6, 12 months (B); 3, 6 months (R) Attrition: 20%, 24.3% (B); 28, 49% (R) at follow-ups:
Collins 2011, 2010 **Okely** 2010, ++ Burrows 2008, 2010, 2011, Cliff 2011, Jones 2011 HIKCUPS	Australia hospital outpatients	RCT. Behaviour change, diet and physical activity – diet versus physical activity versus 'diet + physical activity'. [*No usual care control*] 165 children	Child and parents	Duration: 6 months Follow-up from baseline: 6,12, 24 months Attrition: 31%, 36%, 44% at follow-ups
Coppins 2011 + Family Project	UK – Jersey Community (schools)	Quasi RCT. Behaviour change, diet and physical activity vs wait-list control (WLC) – 12 months 65 children/adolescents	Family	Duration: 1 year Follow-up from baseline: 6, 12, 18, 24 months Attrition: I = 11%, 20%, 40%; WLC = 10%, 17%, 23% at follow-ups

First Author(s), Year(s) Programme	**Location**	**Intervention**	**Target**	**Programme duration/Follow-up/ Attrition**
Croker 2012 + Edwards 2006, Murdoch 2011 Family-based behavioural treatment (FBBT)	UK, London hospital outpatient	RCT: Croker 2012; UBA: Murdoch 2011, Edwards 2006. Behavioural focusing on diet and physical activity vs wait-list control 72 children (Croker 2012); 28 children (Murdoch 2011) 37 children (Edwards 2006)	Family	Duration: 6 months Follow-up: to end of intervention; 6-month post-intervention data for treatment group completers only Attrition: I = 40.5%; WLC = 22.9%
Daley 2006, 2005 ++ SHOT	UK, Sheffield University	RCT. Exercise therapy (ET) - including exercise counselling vs exercise placebo (EP) vs 'life as normal' (LN) 81 adolescents	Child	Duration: 8 weeks Follow-up from baseline: 8,14, 28 weeks Attrition: ET = 14%; EP = 4%; LN = 16.6%
DeBar 2012 ++	USA, Pacific North West Primary care - Health Management Organisation (HMO)	RCT. Behaviour change focusing on diet (guideline of 1600-188 kcal daily) and physical activity, plus physical activity interventions (in-session yoga, provision of dance video games) vs usual care (UC) 208 female adolescents (aged 12 to 17)	Child and parent	Duration: 5 months Follow-up from baseline: 6, 18 months Attrition: I = 4.8%; UC = 7.8% and I = 14.3%; UC = 19.4% at follow-ups
Estabrooks 2009 + Family Connections	USA community	RCT. Behaviour change focusing on diet and physical activity: Workbook only (W) vs workbook and group intervention (WG) vs workbook, group and automated counselling (WGAC) [*No usual care control*] 220 families of overweight children.	Parents	Duration: Unclear Follow-up from baseline: 6, 12 months Attrition: W = 24%, 28%; WG = 25%, 34%; WGAC = 20%, 26% at follow-ups.
Ford 2010 ++ (Mandometer)	UK hospital obesity clinic	RCT. Family behavioural (standard obesity clinic treatment) plus Mandometer vs family behavioural [*No usual care control*] 106 children or adolescents	Family	Duration: 12 months Follow-up from baseline: 12, 18 months Attrition: 14%, 18% at follow-ups
Gately 2005 −, 2007 − King 2007 −, Duckworth 2009 + Carnegie International Camps/More Life	UK weight reduction camp	CBA; quasi-RCT, UBA, Quasi-RCT respectively. Physical activity, moderate dietary restrictions and behavioural education sessions vs usual summer activities. [Duckworth 2009 and Gately 2007 compared different diets with a camp setting] Children/adolescents = Gately 2005 = 223; Gately 2007 = 98); King 2007 = 38; Duckworth 2009 = 100	Child	Duration: 2-6 weeks Follow-up: to end of intervention Attrition: Gately 2005: not reported; Gately 2007: 10.2%; King: no data for 16%; Duckworth: 5%;

First Author(s), Year(s) Programme	**Location**	**Intervention**	**Target**	**Programme duration/Follow-up/ Attrition**
Goldfield 2001 – **Raynor** 2002	USA, Buffalo Community	Quasi-RCT. Behaviour change, diet and physical activity – individual & group vs group only [*No usual care control*] Families of 31 obese children	Child and parents	Duration: 20 weeks Follow-up from baseline: Attrition: missing data for: 22.6% (anthropometric) 35.5% (dietary)
Golley 2007, 2011 ++ Triple P	Australia hospital outpatient	RCT. Behavioural focusing on parenting skills and intensive lifestyle education vs parenting skills only vs usual care control. 111 children	Parents	Duration: 6 months Follow-up from baseline: 6, 12 months Attrition: 24% and 20% at follow-ups (2011 paper reports 18% at 12 months)
Hughes 2008 + SCOTT	UK, Glasgow and Edinburgh hospital outpatient	RCT. Behaviour change focusing on diet and physical activity vs usual (dietetic) care 134 children	Family	Duration: 26 weeks Follow-up from baseline: 6,12 months Attrition: I = 29%, 34.8%; C = 26.2%, 36.9% at follow-ups
Janicke 2008a, 2008b + Project STORY	USA rural community	Two intervention arms: behavioural change (based on diet and physical activity) plus either family-based intervention including diet and physical activity sessions for children or parent-only behavioural sessions. Additional wait list control. 93 children or adolescents and their parents	Parents and child or Parents	Duration: 24 weeks Follow-up from baseline: 10 months Attrition: 13% at end of intervention; 24% at follow-up
Jelalian 2010/2011, Sato 2011 +	USA Community	RCT. Group-based cognitive behavioural therapy (CBT) including prescribed diet (all groups), plus supervised aerobic exercise vs peer-based physical activity [*No usual care control*] 118 adolescents (Jelalian 2010); 95 adolescents (Jelalian 2011); 89 adolescents (Sato 2011)	Child and parents	Duration: 16 weeks Follow-up from baseline: 16 weeks, 12 months Attrition: 15% at end of intervention; 21% at follow-up
Kalarchian2009 ++	USA University medical centre	RCT. Family based behaviour change including physical activity plus nutrition plan vs nutrition plan [*No usual care control*] 192 children	Family	Duration: 12 months Follow-up from baseline: 6, 12, 18 months Attrition: I = 13.4%, 26.8%, 22.7%; C = 26.3%, 36.8%, 17.9% at follow-ups
Kalavainen 2007 ++ Also: Kalavainen 2011 and 2012	Finland health centres/ hospital outpatient clinics	RCT. Behavioural and solution-oriented therapy promoting healthy lifestyle and well-being vs usual school counselling Families of 70 obese children	Family	Duration: 6 months Follow-up: end of intervention and 6, 18, 30 months post-intervention Attrition: <3% at any period

First Author(s), Year(s) Programme	**Location**	**Intervention**	**Target**	**Programme duration/Follow-up/ Attrition**
Magarey 2011 ++ PEACH (Triple P +)	Australia children's hospital and medical centre	RCT. Behavioural – parenting skills and intensive lifestyle education (PS) vs healthy lifestyle alone (HL) [*No usual care control*] 169 children	Parents	Duration: 6 months Follow-up from baseline: 6, 12, 18, 24 months Attrition: PS: 22.4%, 30.6%, 38.8%; HL: 16.7%, 23.8%, 35.7% at follow up (no data for 18 months)
McCallum 2007, 2005 ++ LEAP 1	Australia Primary care GP practice	RCT. Behaviour change focusing on nutrition, physical activity and sedentary behaviour vs no intervention 163 children	Family	Duration: 12 weeks Follow-up from baseline: 9, 15 months Attrition: 6.2% and 10.4% at follow-ups
Norton 2011 **–** (Activ8) Abstract only	UK – East London Community	UBA. Diet and physiotherapy 133 children or adolescents	Family	Duration: 6 weeks Follow-up from baseline: 6 weeks Attrition:47%
Nova 2001 +	Italy Paediatrician's office	Quasi-RCT. Behavioural focusing on diet and physical activity plus parental commitment and diet plan vs general information (usual care) 186 children	Family	Duration: Ongoing Follow-up from baseline:6, 12 months Attrition I = 29%, 31%; C = 19%, 30% at follow-ups
Petty 2009 +	USA Community – intervention at research centre gymnasium	RCT. High dose exercise (HDE) vs low dose exercise (LDE) vs no intervention. 207 children	Child	Duration: 13 weeks Follow-up from baseline: 13 weeks Attrition: HDE = 4% LDE = 3%; C = 13%
Pittson 2010, 2011 – Y W8	UK, Telford and Wrekin, W Midlands Local education college	UBA. Behaviour change focusing on parenting skills, diet and physical activity 48 families of overweight or obese children	Child and parents	Duration: 12 weeks Follow-up from baseline: 12 weeks Attrition: 19%
Rennie 2010 **–** BeeZee Bodies Abstract only	UK Bedfordshire Community	UBA. Behaviour change to improve, diet, physical activity 53 children or adolescents	Family	Duration: 17 weeks Follow-up from baseline: Attrition:20.8%
Resnicow 2005 – Go Girls	USA, Atlanta Middle and upper income African-American churches	Quasi-RCT. Behavioural change, physical activity and diet – high intensity vs low intensity [*No usual care control*] 123 female adolescents	Child and parents	Duration: 6 months Follow-up from baseline: 6, 12 months Attrition:20% at 12 months
Robertson 2011, 2008 – Families for Health	UK leisure centres	UBA. Behaviour change focusing on physical activity and diet 27 children/adolescents and parents, from 21 families.	Family	Duration: 12 weeks Follow-up from baseline: 6, 12 months Attrition: 18.5% at both follow-ups

First Author(s), Year(s) Programme	**Location**	**Intervention**	**Target**	**Programme duration/Follow-up/ Attrition**
Sacher 2010 + (MEND)	UK, London Community	RCT. Behaviour change focusing on diet and physical activity plus physical activity sessions vs wait-list control 11 obese children and their families	Family	Duration: 6 months Follow-up from baseline: 6, 12 months Attrition: I = 38.5%, 32%; C = 20%, 30% at follow-ups
Savoye 2007 and 2011 + Bright Bodies	USA, New Haven Community (schools)	RCT. Intensive lifestyle behavioural programme vs usual care 209 children/adolescents (174 analysed)	Child and parents	Duration: 12 months Follow-up from baseline: 6, 12, 24 months Attrition: I = 18%, 29%, 57%; C = 29%, 36%, 55% at follow-ups
Shrewsbury 2009, 2010, 2011 **Nguyen** 2012 ++ Loozit	Australia Community	RCT. Behavioural (CBT) versus CBT plus additional therapeutic contact (ADT) [*No usual care control*] 151 adolescents	Adolescents and parents	Duration: 2 years Follow-up from baseline: 2, 12 months Attrition: CBT: 23.1%; CBT + ADT 12.3% at 12 months
Wake 2009 ++ LEAP 2	Australia Primary care GP practice	RCT. Behaviour change focusing on nutrition, physical activity and sedentary behaviour vs no intervention 258 children	Family	Duration: 12 weeks Follow-up from baseline: 6, 12 months Attrition: 3.1% and 6.2% at follow-ups
Watson 2011, 2009 − GOALS	UK, Liverpool Schools	UBA. Behavioural change, diet and physical activity 121 families of overweight and obese children/ adolescents	Family	Duration: 6 months Follow-up from baseline: 6, 12 months Attrition:56% (Watson 2009); 50% (Watson 2011)
West 2010 − Group Lifestyle Triple P	USA Community	Cluster RCT. Behaviour change vs wait-list control 101 families of overweight children or adolescents	Parents	Duration: 12 weeks Follow-up from baseline: 12 weeks, 1 year (intervention only) Attrition: I = 21.5%, C = 6% (12 weeks), I = 34.6% (1 year)

Table 4.2: Summary data from studies with health economic data

Brief overview information on each included study is provided. For details see Appendix B.

	Versus alternate intervention		Versus routine care/control (or before and after data)								
	Goldfield 2001 Raynor 2002 *Quasi-RCT*	Janicke 2009 **Project STORY** *RCT*	Coppins 2011 **Family Project** *Quasi-RCT*	Hollingworth 2012 *RCTs x10*	Hughes 2008 **SCOTT** *RCT*	Kalavainen 2009 *RCT*	Moodie 2008 **LEAP 1** *RCT*	Robertson 2011/2008 **Families for Health** *UBA*	Wake 2008 **LEAP 1** *RCT*	Wake 2009 **LEAP 2** *RCT*	YHEC 2010 Tchakehakij 2011 **MEND** *RCT **
Overview	Obese 8-12s USA 12 month data (7 mths post intervention) Cost-effectiveness	Overweight 8-14s USA 10 months (6 mths) Cost-effectiveness	Overweight/ Obese 6-14s UK 24 months (12 mths) Costs description	Ten RCTs of lifestyle interventions vs no/minimal intervention Cost-effectiveness	Overweight 5-11s UK 12 months (6 months) Costs description	Obese 7-9s Finland 12 months (6 mths) Cost-effectiveness	Overweight/ moderately obese 5-9s Australia Lifetime model Cost-effectiveness	Overweight/ Obese 7-13s UK 24 months (21 months) Cost-effectiveness	Overweight/ Obese 5-9s Australia 15 months (12 mths) Cost-consequence	Overweight/ Obese 5-10s Australia 12 months (9 mths) Cost-consequence	Obese 7-13s UK Lifetime model Cost-effectiveness
Effective-ness estimate	BMI z-score change = 19.16% (p<0.001) in both groups (i) individual/ group and (ii) group only interventions	Family: -0.115 BMI z Parents only: -0.090 BMI z Wait list control: + 0.02 BMI z	Intervention: -0.41 adj. BMI z (-0.71 to -0.11) Control (cross over at 12 months): +0.16 adj. BMI z (-0.43 to +0.11)	Median effect = difference in BMI z-score of -0.13 (0.04 to -0.60) at 12 months	Median between group difference in change from baseline: -0.04 BMI z (-0.17 to +0.07)	Intervention: -0.2 (-0.2 to -0.1) BMI z Control: -0.1 (-0.2 to 0.0)	Incremental saving of 2,300 BMI units (95% CI -1,100 to 6,000) = 511 DALYs (-90 to 1,156).	Difference in BMI z-score = -0.23 (p=0.027)	Adj. difference in BMI z-score = -0.03 (-0.17 to +0.1)	Adj. difference in BMI z-score = -0.11 (-0.45 to +0.22)	15.3% children become non-obese after intervention (International not UK def. of obesity)
Cost per child or family	Individual/group: US$ 1,391 (£894) Group only: US$492 (£316)	Family: US$ 872 (£561) Parents only: US$ 521 (£335)	Intervention: £403 Control: £45	From £108 to £662 per child	Intervention: £108 Control: £29	Intervention: €336 (£270) Control: €61 (£49) Per child	Total cost of programme = AUS$ 6.3m (5.3m to 7.4m)	Intervention: £517 per family £402 per child	Intervention: A$873 (£560) Control: A$64 (£41)	Intervention: A$1,317 (£845) Control: A$81 (£52)	Intervention: £415.77 per child - direct medical cost savings of £166 per child.
Incremen talcost-effective-ness estimate	Not calculated	Family vs wait list control US$ 758 (£487) Parents only: US$ 579 (£372) Per 0.1 decr. in	Not calculated	Base case: Discounted incremental cost per year of the interventions	Not calculated	Intervention vs control: : €2,750 (£2,210) per unit decrease in BMI z-score	Discounted incremental cost per DALY saved = AUS$ 4,670	Intervention vs hypothetical group with no change in BMI: £2,543 per unit reduction in	Not calculated (cost consequence analysis which reports that the	Not calculated (cost consequence analysis which reports that the intervention	Intervention versus hypothetical group with no change in BMI:

		z BMI score (compared to wait list control)		£13,589 Ranging from dominant to £66,567 in sensitivity analyses.		at 12 months		BMI z-score at 2 years.	intervention was more expensive and non-significantly more effective)	was more expensive and non-significantly more effective)	discounted incremental cost per QALY £1,671

* Note: the economic analysis is not based on Sacher 2010, but on data collected throughout the programme.

4. FINDINGS

Question 1: How effective and cost effective are lifestyle weight management programmes in helping overweight or obese children and young people to achieve and maintain a healthy weight?

The findings are grouped by target of intervention: children only, children and parents/carers, families or parent only. Anthropometric data are presented first, followed by diet, physical activity, wellbeing and other outcomes (including service satisfaction).

INTERVENTIONS DIRECTED AT CHILDREN ONLY

Residential weight-loss camps for children

Four studies (**Gately 2005 –**, **Gately 2007 –**, **Duckworth 2009 +**, **King 2007 –**) provided data on the efficacy of a residential weight management camp for children (Carnegie International Camp programme – now MoreLife) in the UK. The studies evaluated groups of first-time residents during different time periods. The camp intervention consisted of 2 to 6 weeks attendance at boarding school premises with a daily schedule of six 1-hour, skill-based, fun, physical activity sessions, moderate dietary restriction (energy intake of 1,300 to 3,300 kcal per day based on approx basal metabolic rate), and group-based educational sessions. One CBA (**Gately 2005 –**) and one UBA (**King 2007 –**) evaluated the effect of attending the camp. In addition, two quasi-RCTs (**Gately 2007 –**, **Duckworth 2009 +**) designed to compare the effect of providing different diets to campers, also reported changes in outcomes for all campers irrespective of diet. All studies found reductions in BMI SDS (z- scores) at the end of camp attendance. **Gately 2005 –** found a significant group-time interaction showing that campers decreased their BMI SDS (z-scores) compared to control groups. The remaining studies found that camp attendance was associated with reductions in BMI SDS (z-scores): **–**0.27 (SD 0.1) p<0.001 (**Gately 2007 –**); **–**0.25 p<0.001 (**Duckworth 2009 +);** and **–**0.37 or **–**0.34 for boys and girls respectively (**King 2007–**). Neither quasi-RCT identified a significant effect on BMI outcomes when comparing high protein diets (at levels of 25% or 22%) to usual restricted diets (**Gately 2007 –**, **Duckworth 2009 +**). The majority of attendees were funded by their parents (£370 per week) but approximately 20% were funded by their PCT or social services department.

Three of the four studies examined subjective appetite measures immediately following camp stays (**Gately 2007 –**, **Duckworth 2009 +**, **King 2007 –**). All three found desire to eat or subjective sensations of hunger increased over the camp duration. **Duckworth 2009 +**, **King 2007 –**, comparing subjective sensations of hunger in all campers and separately for campers receiving different protein level diets, found that subjective hunger or desire to eat increased significantly over the camp duration (p<0.001). However, no other changes in appetite or mood were observed and there were no significant differences between comparison groups with different diets.

One CBA (**Gately 2005 –**) found a significant group-time interaction showing that self-esteem improved in campers compared to control participants $F(2,213) = 4.15$, p<0.012. Also that campers worried significantly more frequently and intensely about appearance than control participants (frequency F(6,88)=7.30, P=0.001; intensity F(6,87)=8.49, P=0.001). There was a main effect of time on the intensity of appearance worries (F(6,86)=2.86, P=0.05), with worries decreasing from pre- to post-camp but no significant group by time interaction. Significant group-time interactions were observed

for aerobic fitness changes [F(2,204) = 8.97; P<0 .001]. There were also significant improvements in the sports skills of campers, P< 0.05.

Physical activity- only interventions for children

Two RCTs evaluated the of exercise only interventions for children on BMI, with mixed results (**Daley 2006 ++**, **Petty 2009 +**).

Daley 2006 ++ (SHOT - The Sheffield Obesity Trial), evaluated exercise therapy consisting of a range of aerobic exercise activities carried out intermittently and at moderate intensity for 30 minutes three times per week for eight weeks with exercise counselling for behaviour change in line with the Transtheoretical Model. The intervention group was compared to an exercise placebo group (defined in the study as 'exercise maintaining 40% of HR reserve') consisting of twenty four sessions over eight weeks, without exercise counselling or behavioural change advice. No significant changes in BMI were identified in either group at any time point.

The study identified a marginally statistically significant difference in physical activity scores between exercise therapy and usual care immediately after the 8 week intervention (p=0.06), followed by significant differences at later follow-up times (mean difference at 28 weeks: 9.84, p=0.002). The exercise therapy group also reported significantly higher scores than the exercise placebo group at 28 weeks (mean difference: 9.81, p=0.0016 a non-significant difference in adjusted mean physical activity scores between exercise therapy and usual care at all follow-up time points, and the mean difference at 28 weeks was 9.84 (p=0.002).

Daley 2006 ++ also observed significant differences in adjusted mean physical self-worth scores between the exercise therapy and usual care groups at each time point (by 28 weeks mean difference = 0.23; p=0.04) and between exercise placebo and usual care groups at 8 weeks (mean difference = 0.20; p=.02). There were significant differences in adjusted mean global self worth (GSW) scores between exercise therapy and exercise placebo at 14 weeks (mean difference= 0.49; p=0.002) and 28 weeks (mean difference: 0.42; p=0.003) and between exercise placebo and usual care at 14 weeks (mean difference= 0.36; p=0.008).

An RCT conducted in the USA in a community setting (**Petty 2009 +**) examined the impact of a 13-week exercise programme for 207 overweight children aged 7-11 years on BMI, depressive symptoms and self worth. Two intervention groups: low dose exercise (LDE) of 20 minutes per school day and high dose exercise (HDE) of 40 minutes per school day were compared with a control group receiving no physical exercise intervention. At the end of the intervention, after adjusting for baseline, race, gender, the cohort showed a dose response reduction in BMI z-score with intervention (p<0.001) but no overall significant effect of the intervention. Separate results for black and white participants showed no significant difference.

Additionally, **Petty 2009 +** observed a dose-response benefit in global self-worth (GSW) (p<0.01) and depression (p<0.045) once controlling for baseline score and BMI z-score change. Results were significantly improved between the HDE and control groups, but differences between the LDE and control or LDE and HDE were not statistically significant.

Children-only interventions - anthropometric outcomes

1.1 There is weak evidence from one [+] and one [−] quasi-RCT[1,2], one [−] CBA[3] and one [−] UBA[4] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** over a period of two to six weeks was associated with significant **reductions in BMI z-score** amongst attendees by the end of camp attendance (range −0.25 to −0.37). (*Note: only one [−] CBA[3] evaluated the effectiveness of the camp programme against a control group. The [−] quasi-RCTs[1,2] evaluated the effectiveness of two diets within the camp setting*). The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian.

[1]Duckworth 2009, [2] Gately 2007, [3] Gately 2005, [4] King 2007

1.2 There is moderate evidence from one [++] RCT[1] and one [+] RCT[2] that **physical activity-only** interventions for children and young people aged **11-16 years** do not have a statistically significant effect of on **BMI z-score**. Interventions consisted of three physical therapy sessions per week for eight weeks for obese children delivered by the study authors and five weekly 20 or 40 minute exercise sessions for overweight children aged 7-11 (58% female and 59% black) over 13 weeks.

[1] Daley 2006, [2] Petty 2009

Applicability:

1.1: Directly applicable: studies of a UK-based residential programme conducted in school holidays.
1.2: Directly applicable: community studies conducted in dedicated facilities in a UK university[1] and a USA research centre[2].

Children-only interventions: physical activity outcomes

Children-only interventions: physical activity outcomes

1.3 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** over a period of two to six weeks was associated with an increase in **aerobic fitness** [F(2,204) = 8.97; P<0 .001]. The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.4 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese children and young people aged **9 to 18 years** over a period of two to six weeks was associated with an increase in **sports skills** of campers (p< 0.05). The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietician. The

majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.5 There is moderate evidence from one [++] RCT [1] that an **exercise only intervention** of three physical therapy sessions per week for eight weeks for obese children and young people aged **11-16 years** was associated with a marginal improvement in **physical activity scores** (range of 5-40) with a mean difference at 28 weeks from baseline of 9.84 (p=0.002) .

[1] Daley 2006

Applicability:

1.3 Directly applicable: study of a UK-based residential programme conducted in school holidays

1.4 Directly applicable: study of a UK-based residential programme conducted in school holidays

1.5 Directly applicable: studies of a UK programmes conducted in dedicated facilities in a university

Children- only interventions - wellbeing outcomes

1.6 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese **children** and young people aged 9-18 years for a period of two to six weeks was associated with improvements in **self-esteem** (significant group-time interaction $F(2,213) = 4.15$; $p<0.012$]. The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.7 There is weak evidence from one [−] CBA[1] that attendance at a **residential weight management camp** for overweight and obese **children** and young people aged 9-18 years for a period of two to six weeks was associated with an increase in **worrying** mor**e** frequently and intensely **about appearance** ((frequency F(6,88)=7.30, p=0.001; intensity F(6,87)=8.49, p=0.001). The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of participants were white, female (55.7%) and obese (86%).

[1] Gately 2005

1.8 There is moderate evidence from one [++] RCT[1] and one [+] RCT[2] that **exercise only interventions** were associated with improvements to children's **perceptions of well-being.** Physical self-worth score (p=0.04)[1]; global self-worth (p=0.003)[1], (p=0.02)[2] and depression score p=0.02[2]. The effects were observed with either 30[1] or 40[2] minutes of exercise 3[1] or 5[2] times per week for either 8[1] or at least 11.2[2] weeks. A race x group interaction showed only white children's global self-worth (GSW) improved, 59% of the sample were black[2] compared with 83% white[2]. The children varied in age from 8 -13 years and were 44%[1] and 42 %[2] male.

[1] Daley 2006, [2] Petty 2009

Applicability:

1.7 Directly applicable: study of a UK-based residential programme conducted in school holidays.

1.6 Directly applicable: study of a UK-based residential programme conducted in school holidays.

1.8 Directly applicable: conducted in a USA community setting[1] and in a UK community setting[2].

Child only interventions: other outcomes

1.9 There is weak evidence from one [+] and one [–] quasi-RCT[1,2] and one [–] UBA[3] that attendance at a **residential weight management camp** for overweight and obese children and young people aged variously between **9 to 18 years** for a period of between two and six weeks was associated with an increase in **subjective sensations of hunger**. The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian. The majority of parents paid for their children's attendance (£370 per week) but approx 20% were funded by their PCT or social services department.

[1] Duckworth 2009, [2] Gately 2007, [3] King 2007

Applicability:

1.9 Directly applicable: study of a UK-based residential programme conducted in school holidays.

INTERVENTIONS DIRECTED AT CHILDREN AND PARENTS/CARERS

An RCT (**Bryant 2011 +**) and a UBA (**Rudolf 2006 –**) both evaluated a UK programme (WATCH IT!) for obese 8-16 year olds from socially-disadvantaged communities. The programme consists of a combination of motivational interviews and physical activity delivered in the community by non-professional health trainers to encourage lifestyle change via weekly parent/child appointments. An initial commitment of four months (**Bryant 2011 +**)/three months (**Rudolf 2006 –**) with optional four-month /three-month renewals up to a year.

Bryant 2011 + a small feasibility study in 70 participants (53 completers) compared the intervention with a wait list control over 12 months. 50% of participants were from families with an income below £15,000 per annum and 60% of mothers were not educated beyond GCSE. Mean change in BMI SDS at 12 months from baseline was 0.03 (95% CI -0.05 to 0.11) in the intervention group and -0.03 (-0.12 to 0.06) in the control group.

Rudolf 2006 – reported six month post-baseline data in 48 completers. 71% showed a decrease in BMI SDS (z) scores with a mean change of -0.07 (± 0.16, $p<0.01$). Mean change in BMI SD at 6 months was reported as greater for girls (-0.07 ±0.14, $p=.02$) and for participants aged ≤13 years (-0.13 ± 0.14, $p<0.01$).

Collins 2011 ++ (HIKCUPS – multiple papers) was an Australian RCT of 165 overweight 5-9 year old children (92 completers) and a parent/carer, comparing 10 weeks of behavioural change across three

groups (i) diet, (ii) physical activity; (iii) diet plus physical activity. There was no usual care control group. At 24 month follow-up (circa 21.5 months post-intervention) the mean (95% CI) reduction in BMI z-score at 24 months from baseline was: Diet group -0.35 (-0.48, -0.22), Activity group -0.19 (-0.30, -0.07), and Diet + Activity group -0.24 (-0.35,-0.13). Thus the Diet and Diet + Activity groups were significantly more effective than the Activity group (p=0.02).

Over 24 months, a reduction was reported in daily energy intake for all participants: -85 kJ/kg/d [95% CI: -99 to -72] (p<.001); though a group-by-time interaction was not significant.

There was no significant change in physical activity in any group at 6, 12 or 24 months.

DeBar 2012 ++ was an RCT investigating lifestyle (behaviour change, physical activity and diet) versus usual care for 208 obese adolescent girls (mean percentile 97.1) aged 12 - 17 in a USA primary care setting. There were separate sessions for teens (16 sessions) and parents (12 sessions). 173 completed the 5 month intervention and 18 month follow up (13 months post intervention). Decrease in BMI z-score at 18 months was significantly greater for the intervention compared with usual care group: I = −0.15; UC = −0.08 p=0.012).

Intervention participants reported less 'reduction in frequency of family meals' and less fast-food intake but the two groups did not differ significantly on any physical activity outcomes, or psychosocial outcomes except body satisfaction (I = 2.93 (0.66), UC = 2.74 (0.74), p = 0.026) and appearance attitudes: I = 2.18 (0.93), UC = 2.43 (0.96) p = 0.019.

Goldfield 2001 – explored the provision of lifestyle weight management via group plus individual sessions versus individual sessions alone (13 sessions over 5 months). The quasi-RCT was carried out in the USA and did not include a usual care control group. 31 families with obese 8 - 12 year old children were enrolled and 24 families provided follow-up data at 12 months (7 months post intervention). Analyses of variance showed a highly significant change in percent overweight (F(2,88)=18.01, P<.001) and Z-BMI (F(2,88)=19.16, P<.001) over time.

There were no significant differences between groups in dietary intake at any time point.

An RCT conducted in rural USA populations (**Janicke 2008 +**) in 93 overweight and obese 8-14 year old children from 64 families compared group behavioural therapy for parent and child with a behavioural group for parents only and a wait list control. The parent/child intervention comprised separate weekly 90-minute group sessions for 8 weeks, then bi-weekly for 8 weeks (24 weeks total). Guidance was provided from treatment manuals on changes in dietary habits via a Stoplight diet and increased physical activity via a pedometer based programme. Parents focused on strategies and discussion, whilst children reviewed progress and took part in a physical activity and preparation of healthy snacks. Parents and children were then brought together to discuss goals and plans. The parent-only intervention followed the same process as the parents in the parent and child study arm.

At 4 months, children in parent-only intervention group versus wait list control demonstrated greater decrease in BMI z score (mean difference 0.127, 95% CI 0.027 to 0.226). There was no significant difference between parent/child-based and control conditions (0.065, -0.027 to 0.158). At 10 months, children in the parent-only and family-based intervention groups had greater decreases compared to baseline than the control group. Mean differences in BMI z score were 0.115 (0.003 to 0.220) and 0.136 (0.018 to 0.254) respectively. There was no significant difference between the parent-only and parent/child groups at either time point. Although there were statistically significant within-group

decreases from baseline to follow up in both intervention groups, there were no statistically significant between group differences.

Equally, there were no statistically significant between group differences in parent-reported measures of changes in child life style habits or in overall programme satisfaction which was very high (≥ 85%) in parents (both groups) and children.

Jelalian 2010 + (multiple papers) was an RCT exploring CBT with supervised exercise (EXER) versus CBT with peer enhanced adventure therapy (PEAT) amongst 118 overweight 13-16 year olds in the USA (93 participants completed the programme). There was no usual care control group. The 16 week intervention had 12 month (post baseline) follow up. Significant decreases were noted in z-BMI: CBT + PEAT = -0.21 and CBT + EXER = −0.16 at 12 months with no significant group by time interactions.

Both groups demonstrated significant improvements in self-concept with time (P < .01), with no significant differences between groups. Improvements in well-being measures (global self-worth and physical appearance-related self-worth) related to significant reductions in BMI at end of treatment (r = –0.25 and r = –0.28, respectively). A significant decrease in the PEQ score (to assess peer rejection) was observed over time, F (2,174)=4.33, p<0.05, with no effect of group. Reductions in social anxiety also observed over time, p<0.01.

No significant changes in amount of moderate to vigorous physical activity reported with time or between groups.

Resnicow 2005 – (Go Girls) looked at high intensity (20-26 sessions) versus moderate intensity (6 sessions) lifestyle weight management programme over six months (behaviour change, physical activity and diet) within a quasi-RCT for 147 adolescents aged 12-16 (BMI > 90th percentile) in African American churches. A total of 123 completed the intervention and follow up. Parents were encouraged to attend every other session. At six months (end of intervention), net difference between high and moderate intensity groups was 0.5 BMI units - not significant (p=0.20). One year (6 months post-intervention) follow-up results mirrored the previous results. Mean BMI baseline versus one year (SD) was I= 32.6 (5.7) to 33.3 (5.9); C= 33.2 (7.7) to 33.7 (8.4); p = 0.76.

Girls in the high-intensity condition, attending >75% of sessions had a significantly lower BMI relative than those attending fewer sessions. Mean BMI baseline vs 6 months (SD): high attendees: 31.6 (5.8) to 32.1 (5.8); low attendees: 32.5 (5.9) to 31.7 (5.3); p = 0.01.

Savoye 2009 + (Bright Bodies) was an RCT exploring intensive lifestyle behavioural management versus usual care for 209 obese (≥ 95th percentile) 8-16 year olds and their parents in the USA (174 completers). The intervention was for 12 months but treatment effect was sustained at 24 months post-baseline in the intervention versus control group with a BMI z-score difference of -0.16 (95% CI -0.23 to -0.09) for intervention versus clinic control group.

Shrewsbury 2009 ++ (Loozit – multiple papers) explored a two-year CBT treatment versus CBT plus additional therapeutic contact (ATC) in an RCT with 151 overweight/obese 13-16 year olds in Australia; of whom 124 completed. There were seven sessions for parents + adolescents followed by seven sessions for adolescents. The additional ATC component was telephone coaching and SMS and/or emails once a fortnight over 21 months (46 contacts in all). There was no (no-treatment) control group. Published data currently is only available for 12 months (24 months planned).

No difference in primary outcomes between groups has been measured to date. However, across all participants, ITT analyses showed significant reductions in mean BMI z-score (-0.09, 95% CI -0.12 to -0.06) and waist to height ratio (-0.02, 95% CI -0.03 to -0.01).

There were no between group differences in diet although all participants reported less frequent consumption of high-fat meat products (OR 0.34, 95% CI 0.21 to 0.54), potato crisps (OR 0.55, 95% CI 0.32 to 0.94), and lunch (OR 0.64, 95% CI 0.41 to 1.00).

No differences between groups or across time were found in physical activity levels. Participants across both groups reported less time spent in front of screens (-0.8 hours, 95% CI -1.0 to -0.7 hours) and less time watching television (-0.8 hours, 95% CI -1.0 to -0.7 hours).

There were no group differences in any psychosocial outcomes at 12 months except lower scholastic competence, where the CBT + ATC group had lower scores than the CBT only group (group difference -0.21, 95% CI -0.42 to 0.00, p=.049).

Child and parent/carer interventions – anthropometric outcomes

1.10 There is strong evidence from eight studies; three [++] RCTs[1-3], two [+] RCTs[4,5], two [–]quasi-RCTs[6,7] and one [–] UBA[8] that **child/adolescent and parent** interventions result in significant decreases in **BMI z-score** based on baseline to follow-up **within group measures**.

[1] DeBar 2012, [2] Collins 2011, [3] Shrewsbury 2009, [4] Savoye 2009, [5] Jelalian 2010, [6] Resnicow 2005, [7] Goldfield 2001, [8] Rudolf 2006.

Applicability:

1.10 Directly applicable. Carried out in community settings in the USA[1,4-7], Australia[2,3] and the UK[8].

Child and parent/carer interventions - diet outcomes

1.11 There is strong evidence from two [++] RCTs [1,2] that group-based **behaviour** change interventions directed at 208 and 151 overweight and obese **adolescents and parents** respectively can lead to **dietary** changes such as less 'fast-food' or a reduction in high fat food intake. Adolescents varied in age from 12-17 years. One group was all female[1] and the other 52% female [2]. Delivery was by nutritionists, health educators and clinical psychologists and by dieticians respectively. One programme ran for 5 months and the other for two years.

[1] DeBar 2012, [2] Shrewsbury 2009

1.12 There is moderate evidence from one [+] RCT [1] and one [–] quasi-RCT[2] that group-based **multi-component** interventions, including behaviour change, physical activity and diet, directed at **children and parents** do not have any significant effects on **dietary intake**. Dieticians and PE teachers led a six month intervention for 165 children aged 5-9[1] and therapists delivered a 20 week programme for 31 children aged 8-12 years. Approximately 60% were female in both studies. Different dietary measures were used.

[1] Collins 2011, [2] Goldfield 2001.

Applicability:

1.11 Directly applicable: conducted in a USA[1] and an Australian community setting[2]

1.12 Directly applicable: conducted in an Australian[1] and USA community setting[2]

Child and parent/carer interventions - physical activity outcomes

1.13 There is strong evidence from three [++] RCTs[1-3] and one [+] RCT[4] that group-based interventions for obese and overweight containing a group-based **behaviour change** component directed at **parents and children[1]/ adolescents**[2-4] do not have any significant effects on **physical activity**. A range of physical activity measures were used.

Dieticians and PE teachers led a six month intervention for 165 children aged 5-9.[1] 208 overweight adolescent females aged 12-17 received a 5 month intervention delivered by nutritionists, health educators and clinical psychologists.[2] Dieticians delivered a 2 year intervention to 151 overweight and obese adolescents (52% female)[3]. 118 overweight weight adolescents aged 13 to 16 received a 16 week behavioural programme delivered by psychologists and a dietitian[4].

[1] Collins 2011, [2] DeBar 2012, [3] Shrewsbury 2009, [4] Jelalian 2010.

Applicability:

1.13 Directly applicable: Studies conducted in Australian[1,3] and USA community settings.[2,4]

Child and parent/carer interventions - wellbeing outcomes

1.14 There is strong evidence from two [++] RCTs[1, 2] that group-based **behaviour** change interventions directed at **children[2]/adolescents[1] and parents** have significant effects on some **psychosocial** outcomes. One [++] RCT [1] showed a group difference at 18 months for body satisfaction (p=0.026) and appearance (p=0.019) although no group differences on other psychosocial outcomes. A second [++] RCT [2] showed group difference at 12 months for scholastic competence (p=0.049), but not other psychosocial outcomes. 208 overweight adolescent females aged 12-17 received a 5 month intervention delivered by nutritionists, health educators and clinical psychologists.[1] Dieticians delivered a 2 year intervention to 151 overweight and obese adolescents (52% female)[2].

[1] DeBar 2012, [2] Shrewsbury 2009,

1.15 There is moderate evidence from one [+] RCT[1] that a group-based, multi-component cognitive **behavioural** intervention including physical activity directed at 118 overweight **adolescents and parents** had no significant effect on **psychosocial** outcomes. No significant effect of group for PEQ score (to assess peer rejection), self-concept or social anxiety. Adolescents were aged 13-16 years, were 68% female, 76% Caucasian and received the intervention from a psychologist and a dietician.

[1] Jelalian 2010

Applicability:

1.14 Directly applicable: conducted respectively in USA, Australia and UK community settings

1.15 Directly applicable: conducted in a USA community setting

INTERVENTIONS DIRECTED AT FAMILIES

A quasi-RCT (**Berkowitz 2011 –**) described only in a conference abstract, compared a family-based lifestyle modification programme for 169 adolescents mean age 14.6 (SD 1.4). Approximately half the population was African American and 77% of participants were female. An intervention group received 17 group sessions whilst the control group were provided with materials to work on at home with their parents. Both groups met with a 'health coach' six times in a primary care clinic.

BMI Mean (SE) percentage change in initial BMI did not differ by condition being -1.31 (0.95)% and -1.17 (0.99)% for the group and self-guided interventions respectively.

A quasi-RCT (**Coppins 2011 +**) conducted in a UK community setting compared a multi-component family-focused education package with a wait list control group. Sixty five overweight and obese children aged 6-14 (66% female) attended two weekend workshops one or two weeks apart for a total of eight hours. The workshops focused on behaviour change and psychological well-being around healthy eating, physical activity and reducing sedentary behaviour. They were followed by twice-weekly 1-hour physical activity sessions during school terms. The intervention was delivered by a team comprising a dietitian, physical activity health promotion officer, educational or clinical psychologist and physical activity instructors. Parents and siblings (aged 6-14) were encouraged to attend and participate. Over 2 years the BMI z- score fell in the intervention group but not in WLC group. The unadjusted between group difference was 0.3 (95% CI -0.62 to 0.02, P=0.06). 33% of the intervention group and 12% of the WLC group achieved the target reduction of 0.5 BMI SDS (z-score).

No significant differences in diet or physical activity between groups were measured.

An RCT (**Croker 2012 +**) examined the acceptability and effectiveness of an intervention to change the whole family's lifestyle in an ethnically and socially diverse sample of UK families. 72 families with overweight or obese children aged 8-12 years were randomised to a family-based behavioural treatment programme (FBBT) consisting of behavioural, diet and physical activity components or a wait list control. Results for completers showed significant BMI SDS (z-score) changes (P=0.01) were observed for the treatment (n=33) and control (n=30) groups of - 0.11 (SD 0.16) and -0.10 (SD 1.6). However, between-group treatment effects for BMI and body composition were not significant and no overall change in BMI or BMI SDS (z-score) from 0–12 months was observed for the treatment group. For those with follow-up to 12 months (n=19), BMI SDS (z-score) at baseline, 6 months and 12 months were 3.14 SD 0.72, 2.98 SD 0.75, 3.03 SD 0.78,respectively, p<0.005 but not this was not an ITT analysis.

Significant improvements in quality of life and eating attitudes were observed in the intervention group, p=0.005. No significant between group differences were observed for psychosocial outcomes.

Ford 2010 ++ was a family-focused RCT conducted in a UK hospital outpatient obesity clinic to determine whether modifying eating behaviour with use of a feedback device facilitated weight loss in 106 obese children and adolescents aged 9 to 17. The intervention involved a computerised device (Mandometer), providing real time feedback to participants to slow down speed of eating and reduce total intake. Participants saw a research nurse (trained in Mandometer technology) weekly for six weeks, fortnightly for a further six weeks, and then every sixth week (with additional fortnightly telephone calls for support and encouragement). Dietary advice was provided with four dietetic consultations over 12 months. Four-monthly clinician consultations were also provided emphasising the need to change eating habits and improve physical activity as advocated in the standard clinic.

Of the 91 participants with a 12 month assessment, those in the Mandometer arm had significantly lower mean BMI SDS at 12 months (2.86 (0.72) versus 3.07 (0.57)). The baseline adjusted mean difference was 0.27 (95% CI 0.14 to 0.41), P<0.001.

Hughes 2008 + was an RCT conducted in a UK hospital outpatient setting to determine whether a best-practice behavioural intervention reduced BMI z-scores relative to standard dietetic care among overweight children aged 5-11 years. The intervention comprised a practical programme delivered by paediatric dietitians to 134 families on a one- to-one basis over 26 weeks in eight appointments (five hours total contact time) that focused on behavioural change with goals in physical activity, sedentary behaviour, motivation and lifestyle monitoring using a traffic lights system.

No between group differences were observed in BMI z-scores. Median difference at 6 and 12 months was 0.03 (-0.05 to 0.11) and -0.04 (-0.17 to 0.07) respectively. The BMI z-score decreased significantly and weight increased significantly in both groups from baseline to 6 and 12 months.

There was a significant between group difference for change in total activity (mean counts per minute), p=0.009, and percentage of time spent in sedentary behaviour, p=.0009, and light-intensity activity, p=0.02, from baseline to 6 months in favour of the intervention group. There was no group difference in child quality of life scores from baseline to 6 months.

Kalarchian 2009 ++ was a RCT conducted in a USA University medical centre to evaluate the efficacy of a year-long family-based behavioural weight control intervention in the management of severe paediatric obesity in 190 children aged 8-12 years (56.8% female and 73.4% white). The intervention which comprised dietary, behavioural and physical activity strategies, involved twenty 60-minute group meetings over the first six months. Adult and child groups met separately and were presented with complementary material. Six booster sessions were provided between months 6 and 12. The intervention was associated with significant decreases in child percent overweight relative to usual care at 6-months (I = -7.58 +/-1.59, UC= -0.66 +/-1.17; p=.0005) but the differences were not significant at 12 or 18 months. BMI at 6 months I = -0.68 +/-0.29, UC= 0.54 +/-0.21; p=.0007. Children who attended $\geq$ 75% of intervention sessions maintained decreases in percent overweight through 18-months. Lower baseline percent overweight, better attendance, higher income, and greater parent BMI reduction were associated with significantly greater reductions in child percent overweight at 6-months among intervention participants.

Kalavainen 2007 ++ was a RCT conducted in Finnish health centres and outpatient centres to compare the efficacy of group treatment stressing a health-promoting lifestyle with routine counselling in the treatment of childhood obesity. Seventy families with obese children aged 7-9 years were randomised to the programme or a modified counselling programme standard in Finnish schools. The intervention involved 15 sessions of 90 min duration held separately for parents and children, except one session on making healthy snacks. The group program was based on behavioural and solution-oriented therapy and focused on promoting healthy lifestyle and well-being instead of weight management. Decreases BMI SDS (z-score) for the group and routine counselling programmes were 0.3 vs 0.2 (P=0.022). The results remained similar in adjusted analyses. Both group and routine programs were feasible with a high, 87–99%, participation rate in sessions and appointments and very low, 3% or less, attrition rate from the programs. Kalavainen 2011 observed that there was no significant difference between the treatment arms in the changes of outcome measures from baseline to 2- or 3-years follow-up visits.

McCallum 2007 ++ was a RCT nested within a baseline cross-sectional BMI survey and conducted in an Australian primary care setting. The aim of the Live, Eat and Play (LEAP) family-based intervention was to reduce gain in body mass index (BMI) in 163 overweight and mildly obese children aged 5-9. The intervention involved four standard consultations over 12 weeks with a 'solution focused' approach to set and record lifestyle goals targeting change in nutrition, physical activity, and sedentary behaviour, supported by purpose designed family materials in form of personalised 20 page family folder. It was compared with a no intervention control. There was no significant difference between groups in BMI z-scores at 9 or 15 months (6 and 12 months from end of intervention. The adjusted difference at 15 months was (I-C) -0.03 (95%CI: -0.17 to 0.1).

A significant improvement in diet was observed at 15 months, (I-C) adjusted mean differences of 1.6 (0.9 to 2.3) p<0.001. No significant differences were reported between groups for health status, body satisfaction, appearance, self-worth or physical activity.

Another RCT , **Wake 2009 ++** (LEAP 2) involved the same setting and intervention components as those used in **McCallum 2007 ++** (LEAP 1); differing only on population(age 5-10) and aimed to determine whether ascertainment of childhood obesity by surveillance followed by structured secondary prevention in primary care improved outcomes in 258 overweight or mildly obese children. Primary care screening followed by brief counselling did not improve BMI z-scores in overweight or mildly obese 5-10 year olds. The adjusted difference at 12 months (I-C) was -0.11 (-0.45 to 0.22; p=0.5).

In contrast to **McCallum 2007 ++**, no significant differences in diet were measured. Nor did the study identify significant differences in any other secondary measure.

Norton 2011 – (conference abstract only) was a UBA study conducted in a community setting in the UK which evaluated the effect of the Activ8 intervention on anthropometry and body composition. The intervention consisted of six weekly one-hour sessions combining game based physical activities and nutritional education sessions. At 6 weeks, a reduction in average absolute BMI was observed (−0.29 kg m−2 SD = 0.49, p = 0.000, CI = 95%) which remained significant when converted to z-scores and percentiles. Reduction in BMI z-score was significantly greater (p = 0.046) in boys compared with girls. Younger age groups achieved significantly greater reductions in BMI z-scores (p = 0.000) and BMI centile (p = 0.009).

Nova 2001 + was a cluster quasi-RCT conducted in a primary care setting in Italy to compare two types of intervention intended to reduce weight in obese children. The intervention, which was carried out in the family paediatrician's office, compared routine care (general information) with enhanced care comprised of the following elements: diet; physical activity, active parental commitment and a family food diary with instructions for use.

Compared with starting values, a reduction in percentage overweight was observed in both groups. This reduction was significantly higher in the enhanced care group (–8.8% at 6 months; –8.5% at 12 months) than in routine care group (–2.9% at 6 months; –2.9% at 12 months). In the enhanced care group, the observed reduction in weight was associated with the changes in dietary behaviour and with the level of parental involvement. Mean (SD) BMI at baseline, 6 and 12 months respectively was 23.8 ± 2.7, 22.5 ± 2.5, 23.0 ± 2.4 for the enhanced care group and 22.4 ± 1.9; 22.2 ± 1.9; 22.7 ± 2.1 for the routine care group.

No significant changes in physical activity were noted in either group.

Rennie 2010 – (conference astract only) was a UBA study conducted in a community setting in the UK which investigated the changes in body weight measurements between the start and end of the BeeZee Bodies programme. The programme involved 17 weekly group sessions focusing on behaviour change to improve physical activity, diet and self-efficacy. At end of programme, there was a significant decrease in the BMI z-score for girls (–0.12, SEM 0.03, p<0.001) but not for boys (–0.08, SEM 0.04, p=0.08).

Pittson 2011 – (Y W8) was a UK-based UBA of a lifestyle weight management programme (12 weekly sessions targeting behaviour change, physical activity and diet) for 48 parent/child families (39 completers). Follow up was at 12 weeks, the end of the intervention. Both children (mean pre-BMI = 28.48 (±4.44), mean post-BMI = 27.48 (±4.45; p= .001) and parents (mean pre-BMI = 30.77 (±6.21), mean post-BMI = 30.41 (±6.17; p = 0.017) decreased their BMI over 12 week programme.

90% of children reported feeling healthier, happier, fitter and more confident, as well as making new friends.

A UBA study (**Robertson 2011 –**) conducted in a UK community setting, assessed long-term outcomes and costs of the 'Families for Health' programme for 27 overweight or obese children aged 7-13 years and their families. Approximately half the participating families reported parent(s)/carer(s) as 'routine manual' (43%) or 'never worked' (9%); 43% were single parent families and 14% step families; 57% had at least one obese parent. The programme involved a 2.5 hour session per week for 12 weeks with each week comprising parallel groups for children and parent(s)/carer(s). There were two elements: parenting tips from the UK based Family Links Nurturing Programme and a healthy eating component from the Food Standards Agency. At 3 months, 9 months and 2 years mean reductions in BMI z-score from baseline were -0.18 (-0.30 to -0.05), -0.21 (-0.35 to -0.07) and -0.23 (-0.42 to -0.03) respectively; p=0.027.

Less exposure to unhealthy foods in the home and improved eating style was reported at 2 years with a change in questionnaire measure (lower is better) of -2.0 (-3.5 to -0.5).

There was also a reduction in sedentary behaviour measured as inactivity/activity ratio (lower is better) -9.6 (-14.7 to -4.6).

A significant improvement in quality of life was measured from the child's perspective, 11.8 (4.0 to 19.7) range 0-100, p=0.005.

A UBA study (**Sabin 2007–**) evaluated the UK-based Care of Childhood Obesity (COCO) programme a family lifestyle intervention with behavioural, diet and physical activity components. Families with obese children aged 2-17 years attending a hospital outpatient obesity clinic were offered three-monthly appointments with a paediatrician, and a paediatric dietitian who encouraged goal setting and practical dietary changes. Advice was provided on physical activity and families invited to attend free 2-hour, weekly games session. Of the 112 children attending ≥2 appointments, mean reduction in BMI SDS (z-score) up to most recent recorded value was 0.24 (range −0.48 to 1.43); 70% of children achieved a z-score reduction and 18% the target reduction of 0.5 BMI SDS. In 58/126 attending for ≥1 year, mean reduction in BMI SDS was 0.30 (range −0.48 to 1.19); 83% showed a fall and 28% achieved target reduction.

More boys than girls achieved target reductions in BMI SDS but this was not statistically significant. Those with no parental history of obesity were more likely to achieve greater reductions in BMI SDS.

Socio-economic status did not appear to impact upon the child's level of success. Only 10% of children offered free, weekly exercise programme took up the offer. None achieved a reduction of 0.5 BMI SDS over a median (range) of 1.67 years (0.46 -2.3 years) follow-up, with the mean (SD) change in BMI SDS being −0.04 (0.34). In terms of wellbeing PEDSQL scores improved in both arms.

A subsequent RCT of the programme (**Banks 2012 +**) was carried out in the UK to examine the feasibility of undertaking a fully powered RCT and to gauge whether the COCO model could be effective as a nurse-led clinic in primary care settings. This version of the intervention was offered via hospital obesity clinic and primary care clinics. 77% children in both hospital and primary care arms improved BMI SDS scores and the mean BMI SDS reduction was 0.15 and 0.17 in the hospital and primary care arms respectively, difference in mean 0.02 (95% CI –0.12 to 0.17).

Quality of life scores rose in both arms over 12 months: 10 points in primary care arm (95% CI = 3 to 18 points, n = 23) and 8 points in hospital arm (95% CI = –2 to 18 points, n = 14). The primary care arm scored slightly higher for each aspect of satisfaction, although all mean scores were between 1 and 3, equivalent to ratings from 'excellent' to 'good'.

Sacher 2010 + was an RCT involving families of 116 obese children aged 8-12 years conducted in a UK hospital research centre to evaluate the effectiveness of the Mind, Exercise, Nutrition, Do it (MEND) Programme; s a multi-component healthy lifestyle programme of 18 two-hour sessions delivered early evenings over 9 weeks followed by a 12-week free family swim pass. The program comprised the following elements: nutrition; behaviour change and exercise. Children were followed up 12 months from baseline (0 and 6 months post-intervention for the control and intervention group, respectively).

Participants in the intervention group had a reduced waist circumference z-score (−0.37; $P < 0.0001$) and BMI z-score (−0.24; $P < 0.0001$) at 6 months when compared to the controls. At 12 months, children in the intervention group had reduced their waist and BMI z-scores by 0.47 ($P < 0.0001$) and 0.23 ($P < 0.0001$), respectively.

Significant mean differences between groups were observed in hours per week physical exercise: 3.9 (0.1 to 7.8) p=0.04 and wellbeing scores 0.3 (0.0 to 0.7) p=0.04.

Two UBA studies (**Watson 2009 –**, **Watson 2011 –**) conducted in a UK community setting, explored the relationship between adult BMI change and child BMI SDS (z-score) change following completion of a community-based, lifestyle change intervention for 65 overweight and obese children aged 6-14 and their families (GOALS). The intervention involved 18 sessions (19 sessions in early months, **Watson 2009 –**) of 2 hours per week focusing on diet, physical activity and behaviour change. **Watson 2011 –** observed at 12 months that the pre-post BMI z-score difference for completer children was −0.08±0.24, (−0.09±0.24 and −0.08±0.24 for boys and girls respectively. Active involvement of adults in the weight loss process improved child health z-score measures. In children attending with adults who lost weight, the difference was −0.13±0.23 and in children attending with adults who maintained/increased weight the difference was −0.05±0.25. **Watson 2009 –** reported that at post-treatment (6 months) and 12/16 months, the pre-post BMI z-score differences for completer children to post intervention were -0.09 (SD 0.2) and -0.08 (SD 0.28, $p<0.01$) respectively.

The authors did not report diet and physical activity outcomes as they deemed the results to be unreliable. Small improvements were noted to some wellbeing scores though only perceived social acceptance score significant, $p<0.05$.

family interventions – anthropometric outcomes

1.16 There is strong evidence from 18 papers of 17 studies; five[++] RCTs[1-5], four [+] RCTs[6-9], one [+] quasi-RCT[10], one [–] quasi-RCT[11] and six [–] UBAs[12-16] that, for overweight and obese children and adolescents, whole **family** interventions whether directed at individual families[1,4,6-9,16] or group-based[2,3,5,9-14,16-18] result in significant decreases in **BMI z-score** based on baseline to follow-up for **within group measures**. All but one –UBA[12] (which focused on diet and physical activity) and one –quasi-RCT (behaviour change only) assesses the effectiveness of multi-component interventions focusing on behaviour change.

[1] Ford 2010, [2] Kalarchian 2009, [3] Kalavainen 2007, [7] McCallum 2007, [5] Wake 2009, [6] Croker 2012, [7] Hughes 2008, [8] Nova 2001, [9] Sacher 2010, [10] Coppins 2011, [11] Berkowitz 2011 [12] Norton 2011, [13] Pittson 2011, [14] Rennie 2010, [15] Robertson 2011, [16] Sabin 2007, [17] Watson 2009, [18] Watson 2011.

1.17 There is inconsistent evidence for the effectiveness of whole **family** interventions versus no or minimal control outcomes. Two [+] RCTs [1,2] reported significant reductions in **BMI z-score** compared to control groups and six studies, comprising three [++] RCT [3-5], two [+] RCTs[6-7] and one [+] quasi-RCT[8] reported either no reduction or a non-significant effect.

[1] Sacher 2010, [2] Nova 2001, [3] Kalarchian 2009, [4] McCallum 2007, [5] Wake 2009, [6] Croker 2012, [7] Hughes 2008, [8] Coppins 2011

Applicability:

1.16 Directly applicable, all studies are community-based. Ten were conducted in the UK[1,5,6,9,10,12-17], three in the USA[2,3,11], two in Australia[4,6] and one in Italy[8].

1.17 Directly applicable: all studies are community-based. Four[1,4,6,7] were conducted in the UK one in Italy[2], one in the USA[3] and two in Autralia[4,6].

Family Interventions - diet outcomes

1.18 There is inconsistent evidence from two [++] RCTs[1,2] and one [–] UBA[3] for the effectiveness of **behaviour change** interventions directed at individual **families** on **diet**ary outcomes. The two RCTs evaluated the same programme in populations of slightly different ages (5-9 years and 5-10 years respectively) but only one[2] reported significant improvements in dietary intake with an adjusted mean different in nutrition score at 15 months of 1.6 (0.9 to 2.3) p<0.001. The [–] UBA[3]reported less exposure to unhealthy foods in the home and improved eating style at 2 years with a change in questionnaire measure (lower is better) of -2.0 (-3.5 to -0.5). For all studies behaviour change focused on physical activity and diet.

[1] McCallum 2007, [2] Wake 2009, [3] Robertson 2011

1.19 There is weak evidence from one [+] quasi-RCT[1] that a group-based **multi-component** intervention directed at **families** of 65 obese and overweight children and adolescents aged 6-14 years had no significant effect on **diet**. The intervention involved two workshops for a total of 8 hours focusing on behaviour, diet and physical activity followed by twice weekly 1 hour physical activity sessions during term time. 66% were female.

[1] Coppins 2011

Applicability:

1.18 Directly applicable: studies conducted in community settings in Australia[1,2] and the UK[3].

1.19 Directly applicable: Study conducted in a UK community setting

Family interventions - physical activity outcomes

1.20 There is inconsistent evidence from two [++] RCT[1,2], two [+] RCTs3[3,4], one [+] quasi-RCT [5] and one [−] UBA[6] for the effect of **behaviour** change interventions directed at **families**, whether individual[1-3,5] or group[4,6], on **physical activity**. Only two [+] RCTs[2,4] reported significant improvements. One[2] found significant between group difference in a population of 134 overweight children aged 5-12 for change in total activity, p=0.009, percentage of time spent in sedentary behaviour, p=0.009, and light-intensity activity, p=0.02, from baseline to 6 months in favour of the intervention group. In a population of 116 obese children aged 8-12 years, the other identified a significant mean difference between groups in hours per week physical exercise 3.9 (0.1 to 7.8) p=0.04[4]. The [−] UBA [6] reported an overall reduction in sedentary behaviour in 29 participants. For all studies the behaviour change focused on physical activity and diet. A range of physical activity measures were used.

[1] McCallum 2007, [2] Wake 2009, [3] Hughes 2008, [4] Sacher 2010, [5] Nova 2001, [6] Robertson 2011

1.21 There is weak evidence from one [+] quasi-RCT[1] that a **multi-component** group intervention directed at **families** of 65 obese and overweight children and adolescents aged 6-14 years had no significant effect on **physical activity**. The intervention involved two workshops for a total of 8 hours focusing on behaviour, diet and physical activity followed by twice weekly 1 hour physical activity sessions during term time. 66% were female.

[1] Coppins 2011

Applicability:

1.20 Directly applicable: all conducted in community settings: Australia[1,3], UK [2,4,6] and Italy[5]

1.21 Directly applicable: conducted in a UK community setting

Family interventions - wellbeing outcomes

1.22 There is weak evidence from two small UK studies: one [+] RCT[1] and one [−] UBA[3] that group-based **behaviour change** interventions directed at **families** with obese and overweight children aged respectively 8-12 and 7-13 years have a significant effect on **quality of life** (PedsQL). The [+] RCT[1] in a population of 72 reported a significant improvement in quality of life in the intervention group versus the wait list control (p=0.05) and the [−] UBA[3] reported a mean difference in change from baseline of 11.8 (4.0 to 19.7) range 0-100, p=0.005 for 19/27 children followed up at two years. For both studies the behaviour change focused on physical activity and diet. In both studies over 60% of children were female.

[1] Croker 2012, [2] Robertson 2011

1.23 There is moderate evidence from one [+] RCT[1] that a **multi-component behavioural**

intervention directed at individual **families** of obese children and adolescents aged 5-16 years does not have a significant effect on **quality of life** (PedsQL scale) whether a child obesity programme takes place in a hospital outpatient clinic (HC) or in a primary care clinic (PCC). The PCC intervention involved an initial visit and offer of four further appointments at 3 monthly intervals for the family. A practice nurse discussed progress. The HC intervention involved an initial consultation with consultant and offer of four further appointments at 3-monthly intervals. Both interventions involved seeing a dietician and/or exercise specialist.

[1] Banks 2012

Applicability:

1.22 Directly applicable: all studies conducted in a UK community setting.

1.23 Directly applicable: study conducted in a UK hospital outpatient clinic and community-based primary care clinics.

Family interventions - other outcomes

1.24 There is weak evidence from one [+] RCT[1] that a **multi-component behavioural** intervention directed at individual **families** of obese children and adolescents aged 5-16 years led to slightly higher **service satisfaction** scores when the intervention took place in a primary (PCC) care clinic compared with a hospital outpatient clinic (HC) , although all mean scores were between 1 and 3 (equivalent to ratings from 'excellent' to 'good'). The PCC intervention involved an initial visit and offer of four further appointments at 3 monthly intervals for the family. A practice nurse discussed progress. The HC intervention involved an initial consultation with consultant and offer of four further appointments at 3-monthly intervals. Both interventions involved seeing a dietician and/or exercise specialist.

[1] Banks 2012

Applicability:

1.24 Directly applicable: conducted in a UK community setting

INTERVENTIONS DIRECTED AT PARENTS ONLY

Four individual RCTs (**Golley 2007 ++**, **Magarey 2011 ++**, **Estabrooks 2009 +**, **Janicke 2009**) and one cluster RCT (**West 2010 –**) evaluated interventions looking at the effects of changing parental behaviour on a range of child-related outcomes.

Three RCTs evaluated interventions related to the Triple P programme providing parenting-skills training to parents of overweight or obese children: **Golley 2007 ++** (Triple P), **Magarey 2011 ++** (PEACH) and **West 2010 –** (Group Lifestyle Triple P).

Golley 2007 ++ compared group-based parenting skills training (P+DA) and intensive lifestyle education with parenting skills only (P) or a wait-list control in parents of overweight or obese children aged 6-9 years, delivered in the community in Australia.

At 12 months BMI z-score reduced by 9% (range -85 to 18%) in P+DA group, 6% (-48% to 49%) in P group and 5% (-78% to 16%) in WLC group. There were no statistically significant differences between groups. Boys had significantly lower BMI z scores at 6 and 12 months compared with baseline in both intervention groups but not the control group. For girls, the only significant time change was a reduction in BMI z score in the WLC group. There was no association between change in BMI z score from baseline to 12 months and indicators of SES.

At 6 and 12 months most reported food measures of food intake were unchanged, other than energy-dense nutrient poor foods which were lower in both intervention groups. Mean difference from control was -1.0 (95%CI -2.0 to 0.5) in P+DA group and -1 (-1.5 to 0.0) in P group. There were also reported reductions in small screen use and increases in active play across all groups but no between group differences. The interventions were well received in the few respondents who provided this information with all 36 respondents rating service quality as 'good to excellent'.

Magarey 2011 ++ compared 6 months parenting skills training and intensive healthy lifestyle education (P+HL) with health lifestyle education alone (usual care HL control) in Australia. At 24 months from baseline there were significant overall reductions in BMI z-score (0.26, 95% CI 0.22 to 0.30), but no significant between group differences. A 10% reduction in z-scores observed from baseline to 6 months was maintained to 24 months with no additional intervention.

Parenting outcome scores in both groups (P+HL or HL control) improved from baseline to 6 months and generally remained stable after that to 24 months, but there were no between group differences.

West 2010 – compared results of a group and telephone sessions delivering parenting skills training to the parents of overweight and obese children in Australia. Between baseline and 12 weeks (at the end of the intervention) there were significant improvements in BMI z-score for the intervention group (from 2.15, SD 0.43 at baseline to 2.04 (SD 0.44) at 12 weeks). The score was maintained at 12 months (1.96, SD 0.46). There were no significant changes between baseline and 12 weeks for the control group, and outcomes were not recorded at 12 months.

At 12 weeks from baseline (end of intervention) parents reported increased confidence in managing children's weight-related behaviour ($F(1,51)$ 29.70 ($P<0.001$), less frequent use of inconsistent or coercive parenting practices $F(1,51)$ 25.71 ($P<0.001$), and children's weight related problem behaviour $F(1, 51)$ 21.50 ($P<0.001$). The effects were maintained at 12 months. No significant improvements were observed for the control, 12 weeks after baseline (no post-intervention follow up).

An RCT conducted in rural USA populations (**Janicke 2008 +**) in 93 overweight and obese 8-14 year old children (from 64 families) compared group behavioural therapy for parent and child with a behavioural group for parents only and a wait list control. The parent/child intervention comprised separate weekly 90-minute group sessions for 8 weeks, then bi-weekly for 8 weeks (24 weeks total). Guidance was provided from treatment manuals on changes in dietary habits via Stoplight diet and increased physical activity via a pedometer based programme. Parents focused on strategies and discussion, whilst children reviewed progress and took part in a physical activity and preparation of healthy snack. Parents and children were then brought together to discuss goals and plans. The parent-only intervention followed the same process as the parents in the parent and child study arm.

At 4 months, children in parent-only intervention group versus wait list control demonstrated greater decrease in BMI z score (mean difference 0.127, 95% CI 0.027 to 0.226). At 10 months, children in the

parent-only group had greater decreases compared to baseline than the control group. Mean differences in BMI z score were 0.115 (0.003 to 0.220).

One other intervention was aimed at improving child-related outcomes by targeting parents only, **Estabrooks 2009 +** (Family Connections), an RCT conducted in the community with a population derived from families receiving care from Kaiser Permanente Colorado, USA. The study evaluated the relative effectiveness of three interventions to support parents of overweight or at-risk children aged 8-12 to change the home environment and to foster more healthful child eating and activity behaviours. The three interventions were: Family Connections workbook for parents (FC-workbook); workbook plus 2 small-group sessions with a registered dietitian (FC-group); workbook, 2 small group sessions & 10 automated interactive voice response-(IVR) tailored counselling sessions (FC-IVR). Only children assigned to the FC-IVR intervention decreased BMI z-scores from baseline to 6 months (2.03 SD 0.04 to 1.96 SD 0.04, $p<0.05$) and from baseline to 12 months (2.03 SD 0.04 to 1.95 SD 0.04, $P<0.05$). The FC-workbook group significantly reduced BMI z-scores from baseline to 12 months only (2.04 SD 0.02 to 1.98 SD 0.03, $p<0.05$), 6 months = 1.99 SD 0.03. The FC-group significantly reduced BMI z-scores from baseline to 6 months (2.06 SD 0.04 to 2.03 SD 0.04, $p<0.05$) but not to 12 months - 2.04 (0.04). Children of parents completing ≥ six of the ten IVR calls decreased BMI z-scores to a greater extent than children in the other groups at both 6 months ($p<0.05$) and 12 months ($p<0.01$).

No consistent pattern of change in food and drink consumption was reported. Participants in FC-IVR reported a significant increase in the number of days they participated in moderate physical activity from baseline to 6 months and baseline to 12 months, $p<0.05$. Regardless of the intervention condition, all children reported healthy behaviours in response to an eating disorder survey and no increases in unhealthy behaviours were detected over the course of the study.

Parent- only interventions – anthropometric outcomes

1.25 There is inconsistent evidence from two [++] RCTs and one [–] cluster RCT of similar group-based **behavioural** programmes directed to the **parents** of overweight and obese children aged respectively 6-9, 5-9 and 4-11 years. Although there were significant overall differences in BMI z-scores, neither [++] RCT found significant between group differences. However the [–] cluster RCT found significant improvements in **BMI z-score** for the intervention group (from 2.15, SD 0.43 at baseline to 2.04 (SD 0.44) at 12 weeks). The score was maintained at 12 months (1.96, SD 0.46). Two intervention were delivered over 6 months by dietitians [1,2] and one by a clinical psychologist over 12 weeks[3].

[1] Golley 2007, [2]Magarey 2011, [3] West 2010

1.26 There is weak evidence from a [+] RCT in 93 overweight and obese **8-14 year old** children (from 64 families) comparing **group-based behavioural therapy** for **parents** only and with a wait list control and parent/child groups. Parents focused on strategies and discussion, whilst children reviewed progress and took part in a physical activity and preparation of healthy snack. The parent-only intervention followed the same process as the parents in the parent and child study arm. At 4 months, children in parent-only intervention group versus wait list control demonstrated greater decrease in **BMI z score** (mean difference 0.127, 95% CI 0.027 to 0.226). At 10 months, children in the parent-only group had greater decreases compared to baseline than the control group. Mean differences in BMI z score were 0.115 (0.003 to 0.220). The

intervention was delivered over 24 weeks by Family and Consumer Sciences agents and clinical psychologists.

[1] Janicke 2009

1.27 There is weak evidence from one [+] RCT[1] that a programme directed to the **parents** of overweight children has a significant effect on children's **BMI z-score**. The intervention compared three **behavioural** programmes for parents of overweight children aged 8-12 years (workbook (WB), workbook plus 2 small group sessions (WB+G) and workbook, group sessions, plus 10 automated interactive voice response-tailored counselling sessions (IVR). Group sessions delivered by a dietitian. Only children of parents assigned to the IVR intervention decreased BMI z-scores from baseline to 6 months (2.03 SD 0.04 to 1.96 SD 0.04, $p<0.05$) and from baseline to 12 months (2.03 SD 0.04 to 1.95 SD 0.04, $P<0.05$). The WG+G group significantly reduced BMI z-scores from baseline to 12 months only (2.04 SD 0.02 to 1.98 SD 0.03, $p<0.05$), 6 months = 1.99 SD 0.03. The WB group significantly reduced BMI z-scores from baseline to 6 months (2.06 SD 0.04 to 2.03 SD 0.04, $p<0.05$) but not to 12 months - 2.04 (0.04). Children of parents completing ≥ six of the ten IVR calls decreased BMI z-scores to a greater extent than children in the other groups at both 6 months ($p<0.05$) and 12 months ($p<0.01$).

[1] Estabrooks 2009

Applicability:

1. 25 Directly applicable: Trials were conducted in Australia in community settings.

1.26 Partially applicable: Conducted in a rural American setting

1.27 Trials were conducted in Australia and the USA in community settings.

Parent-only interventions - diet outcomes

1.28 There is moderate evidence from one [++] RCT[1] and one [+] RCT[2]that **behaviour change** interventions directed at **parents only** have no significant effect on **diet.** The [++] RCT[1] reported no significant group by time interaction or time effect for servings per day of breads and cereals, vegetables, fruit, dairy or meat and alternatives. The intervention focused on parenting skills for (weekly two hour sessions for 4 weeks, then monthly sessions, followed by 3 monthly 15-20 telephone sessions) and also involved intensive lifestyle education and was delivered by a research dietician. Children were 6-9 years and 64% were female. The [+] RCT[2] found no consistent pattern of change in food or drink consumption. The intervention involved either: a workbook or a workbook plus 2 small group sessions or a workbook plus 2 small group sessions and 10 automated interactive voice response-tailored counselling sessions. The work book was provided by the study research assistants and the small group sessions by a dietician. The children's mean age was 10.7 years and 54% were male.

[1] Golley 2007, [2] Estabrooks 2009

Applicability:

1.28 Directly applicable: conducted respectively in Australian and USA community-based settings.

Parent only interventions: physical activity outcomes

1.29 There is inconsistent evidence from one [++]RCT[1] and one [+] RCT[2] that **behaviour change** interventions directed at **parents only** have a significant effect on **physical activity** .The [++] RCT[1] reported reductions in small screen use and increases in active play across all groups but no between group differences. The intervention focused on parenting skills (weekly two hour sessions for 4 weeks, then monthly sessions, followed by 3 monthly 15-20 telephone sessions) and also involved intensive lifestyle education and was delivered by a research dietician. . Children were 6-9 years and 64% were female. The [+] RCT[2] compared three behavioural programmes for parents of overweight children aged 8-12 years (workbook (WB), workbook plus 2 small group sessions (WB+G) and workbook, group sessions, plus 10 automated interactive voice response-tailored counselling sessions (IVR) . The IVR group reported a significant increase in the number of days their child participated in moderate physical activity from baseline to 6 months and baseline to 12 months, $p<0.05$. The work book was provided by the study research assistants and the small group sessions by a dietician. Different physical activity measures were used in the two studies.

[1] Golley 2007, [2] Estabrooks 2009

Applicability:

1.29 Directly applicable: conducted in community-based settings in Australia and the USA respectively.

Parent only interventions: other outcomes

1.30 There is moderate evidence from one [++] RCT[1] that **behaviour** change interventions directed at **parents only** resulted in **service satisfaction** rated as 'good to excellent'. The intervention focused on parenting skills (4 two-hour weekly sessions, then monthly sessions, followed by 3 monthly 15-20 telephone sessions) and also involved intensive lifestyle education and was delivered by a research dietician. . Children were 6-9 years and 64% were female.

[1] Golley 2007

Applicability:

1.30 Directly applicable: conducted in an Australian community setting

META-ANALYSIS BY TARGET POPULATION

A number of meta-analyses were conducted. The first (figure 4.1) combined studies by target population (parents/carers only and whole family or parents/carers and children interventions with outcome data for BMI/zBMI immediately post intervention. The second (figure 4.2) combined the same groups of studies with outcome data at six months or more.

There are no meta-analytic findings for interventions targeted at children/adolescents only.

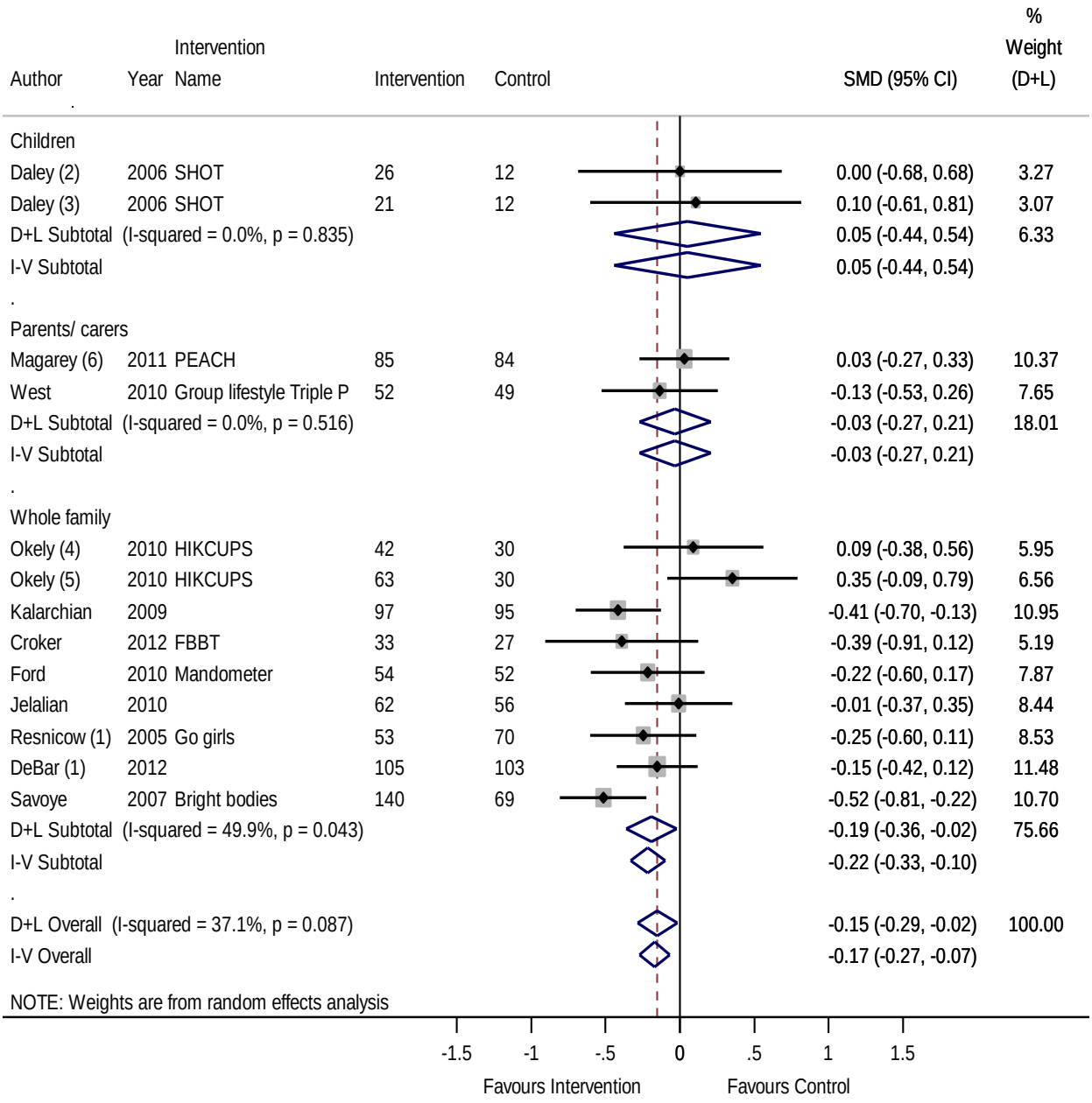
For interventions directed at parents/carers, a meta-analysis of two studies (**Magarey 2011 ++**, **West 2010** –) found no significant difference in BMI/zBMI at end of intervention: standardised mean difference (SMD) of –0.03 (95% CI: –0.27, 0.21) p=0.516.

At six months or more post-intervention in three studies (**Magarey 2011 ++**, **Estabrooks 2009 +, Golley 2007 ++**) the results were again non-significant: SMD was –0.08 (95% CI: –0.27 to 0.10) p=0.358.

For interventions targeted at whole families or parents/carers and child, a meta-analysis of eight studies (**Debar 2012 ++**, **Kalarchian 2009 ++**, **Okely 2010 ++** [see **Collins 2011 ++**] **Croker 2012 +**, **Sacher 2010 +**, **Savoye 2007 +**, **Resnicow 2005 –, Ford 2010 ++**) found a significant difference in BMI/zBMI scores at the end of the intervention. SMD was –0.22 (–0.33 to –0.10) p=0.043.

At six months or more post-post intervention, the effect in eleven studies (**Collins 2011 ++**, **Debar 2012 ++**, **Golley 2007 ++**, **Kalarchian 2010 ++**, **Nguyan 2012 ++** [see **Shrewsbury 2009++**] **Jelalian 2010 +**, **Nova 2001+**, **Savoye 2007 +**, **Resnicow 2005 –**) was non-significant. BMI/zBMI SMD was –0.01 (–0.11 to 0.08) p=0.130.

Figure 4.1. Forest plot of the standardized mean difference **post intervention** in Body Mass Index (BMI/zBMI) for childhood obesity interventions by the level of family involvement: targeting just children, parents/carers, or the whole family.

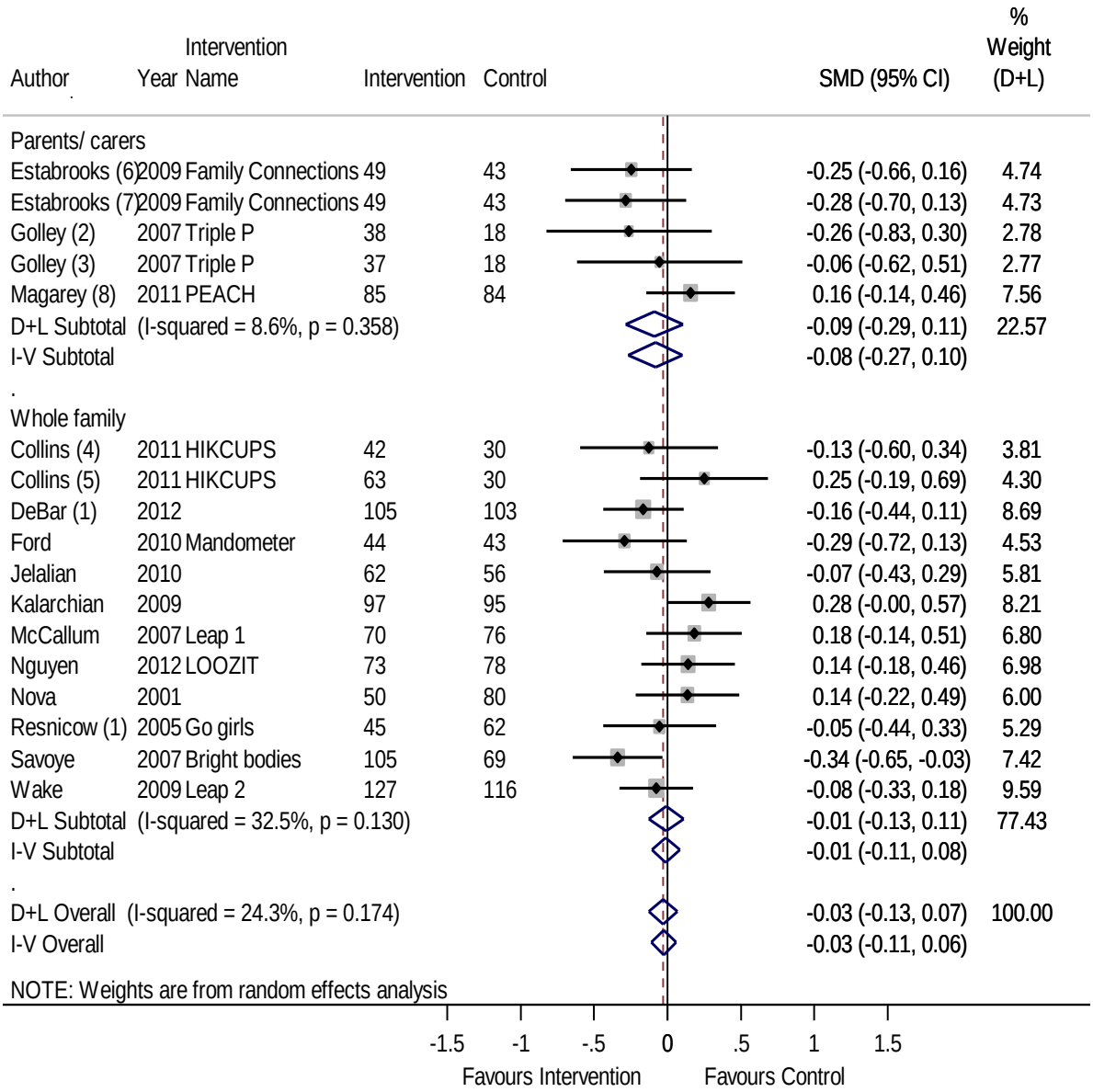


(1) Girls; (2) Exercise Therapy vs Usual Care; (3) Exercise Placebo vs Usual Care (4) Diet vs Diet and Physical Activity; (5) Activity vs Diet and Physical Activity (6) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Figure 4.2. Forest plot of the standardized mean difference in Body Mass Index (BMI/zBMI) **after ≥ 6 months** for childhood obesity interventions by the level of family involvement: targeting just children, parents/ carers, or the whole family.



(1) Girls; (2) Parenting plus lifestyle vs Waitlist control; (3) Parenting vs Waitlist control; (4) Diet vs. Diet plus activity; (5) Activity vs Diet plus activity; (6) Family connections counselling using a workbook vs. Family connections counselling using an interactive voice response resource; (7) Family connections counselling in a group vs. Family connections counselling using an interactive voice response resource; (8) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Meta-analyses: parent only interventions – anthropometric outcomes

1.31 A meta-analysis of one ++ RCT[1] and one –RCT[2] looking at the overall effectiveness of interventions targeted to **parents** of obese and overweight children (ages 5-9 and 4-11 respectively) did not find a significant difference in **BMI/zBMI** standard mean difference (SMD) at the end of the intervention: –0.03 (95% CI: –0.27, 0.21) p=0.516.

[1] Magarey 2011 ++, [2] West 2010 –

1.32 At six months or more post-information, a meta-analysis of two ++ RCTs[1,2] and one + RCT[3] looking at the overall effectiveness of interventions targeted to **parents** of obese and overweight children (ages 5-9 and 4-11 and 12-16 respectively) found that the results were non-significant for BMI/zBMI SMD: –0.08 (95% CI: –0.27 to 0.10).

[1] Magarey 2011 ++, [2]Golley 2007 ++[3] Estabrooks 2005 +

Applicability:

1.31 Directly applicable: both conducted in community settings in Australia

1.32 Directly applicable: conducted in community settings in Australia[1] and the USA[2]

Meta-analyses: child and parent or whole family interventions – anthropometric outcomes

1.33 A meta-analysis of 8 RCTs (four [++] RCTs[1-4], three [+] RCTs[5-7] and one [–] quasi-RCT[8]) estimated the overall effectiveness of interventions directed at **children and parents/carers or whole family** versus no or minimal control outcomes **immediately post intervention** as a significant reduction in BMI SMD of –0.22 (–0.33 to –0.10).

[1] DeBar 2012, [2] Kalarchian 2009, [3] Okely 2010 (see Collins 2011) [4] Ford 2010, [5] Jelalian 2010, [6]Croker 2012, [7] Savoye 2009, [8] Resnicow 2005

1.34 A meta-analysis of eleven RCTs (Six [++] RCTs[1-6]; four [+] RCTs[7-10] and one [–] quasi-RCT[11]) estimated the overall effectiveness of interventions directed at **children and parents/carers or whole family** versus no or minimal control outcomes **at longer term follow up (≥6 months)** as a non-significant reduction in BMI SMD of –0.01 (–0.11 to 0.08)

[1] Collins 2011, [2] DeBar 2012, [3] Golley 2007, [4] Kalarchian 2009, [5] Nguyen 2012 (see Shrewsbury 2009), [6] Wake 2009, [7] Jelalian 2010, [8] McCallum 2007, [9] Nova 2001, [10] Savoye 2009, [11] Resnicow 2005.

Applicability:

1.33 Direct applicability: conducted in the UK and other similar community-based settings.

1.34 Direct applicability: conducted in the UK or other similar community-based settings.

Cost effectiveness

Overview:

Eleven papers provided cost data for individual interventions (**Coppins 2011**, **Goldfield 2001**, **Hollingworth 2012**, **Hughes 2008**, **Janicke 2009**, **Kalavainen 2009**, **Moodie 2008**, **Robertson 2011**, **Wake 2008**, **Wake 2009**, **York Health Economics Consortium**, (YHEC) **2010**).

For two papers the control group was an alternate intervention (**Goldfield 2001**, **Janicke 2009**). **Janicke 2009** explored the relative cost-effectiveness of a whole family versus a parents-only intervention, compared to a waiting list control group. **Goldfield 2001** compared individual plus group treatment to group treatment alone and is only considered under Question 2.

The remaining analyses compared lifestyle weight management versus routine care. The majority of studies conducted a 'within trial' economic evaluation alongside a single RCT and did not attempt to extrapolate costs or outcomes beyond the end of the trial (**Coppins 2011**, **Hughes 2008**, **Goldfield 2001**, **Janicke 2009**, **Kalavainen 2009**, **Wake 2008**, **Wake 2009**). Three economic evaluations used a single RCT (**Moodie 2008**, **YHEC 2010**) or multiple RCTs (**Hollingworth 2012**) as the basis for an economic model estimating incremental costs and outcomes over the lifetime of children

Three studies provided very limited data on the cost of the intervention but did not attempt to calculate a cost-effectiveness ratio (**Coppins 2011**, **Hughes 2008**, **Goldfield 2001**). Two studies were cost-consequence analyses which provided more detailed information about the costs and outcomes of intervention, but tabulated them rather than trying to summarise them in a single ratio (Wake 2008, Wake 2009). Two studies were cost-effectiveness analyses (**Janicke 2009**, **Kalavainen 2009**) based on an intermediate outcome (for example cost per unit reduction in BMI z-score). The remaining three studies carried out long term evaluations using RCT(s) results to model cost per life year, DALY or QALY saved (**Hollingworth 2012**, **Moodie 2008**, **YHEC 2010**).

Applicability and study limitations

The economic evaluations were applicable in terms of study participants, interventions evaluated and setting as all were conducted in high income countries. However the applicability of most studies for judging the long-term cost-effectiveness of lifestyle weight management interventions was limited. Most provided 'within trial' estimates of cost-effectiveness based on an intermediate outcome (generally BMI z-score) up to 24 months after the intervention and did not extrapolate to adult or lifetime cost-effectiveness or health outcomes (e.g. QALYs). Only three studies evaluated long term cost-effectiveness. (Hollingworth 2012, Moodie 2008, YHEC 2010).

Summary of effectiveness data

Summary data for each paper are provided in Table 4.2. In each case, data are provided for the longest follow up period post intervention. See Appendix B for detailed information on each study.

Resource utlilisation and cost data for the intervention:

The costs of the lifestyle interventions (per child/family) varied hugely with a range from £108 (Hughes 2008, the UK SCOTT intervention) to US$ 1,390 (approx. £894) for the Goldfield (2001) 'individual + group' intervention. Unit costs in the range of £400-£550 were typical – see Table 3.2.

Cost effectiveness data: Short-term economic evaluations

Estimates of cost-effectiveness and cost-consequence for lifestyle interventions, compared to no intervention or routine care, varied. Two papers reported that the cost per unit reduction in BMI z-score ranged from £2,210 to £4,870, although uncertainty around these point estimates was likely to be large. In general, these studies could not reach definitive conclusions, regarding long term economic consequences, due to the short period of follow up.

Coppins 2011 was a crossover quasi-RCT in the UK providing two workshops and twice weekly physical activity sessions for parents and children versus wait-list control (8 hours in total). At 12 months (before crossover had occurred), the between group reduction in BMI z-score favoured the intervention by 0.9 (95% CI -0.09 to 0.026). The cost per child was estimated at £403 (based on running the intervention as a clinical service) compared with £45 for usual care of 1.5 h individual dietetic consultations. The authors provided limited cost data and did not attempt to calculate a cost-effectiveness ratio.

Hughes 2008 [SCOTT] was a UK-based RCT of specialist dietetic care over 26 weeks (5 hours contact time) compared to standard dietetic care (1.5 hours). No group differences were detected. Median difference in BMI z-score at 12 months slightly favoured the control group -0.04 (95% CI: -0.17 to 0.07). The cost per child of the intervention was £108 compared to £29 for the standard treatment. The authors provided limited cost data and did not attempt to calculate a cost-effectiveness ratio.

Janicke 2009 found that whole family therapy in the USA resulted in greater improvements in BMI than parent only therapy (-0.115 versus -0.090 BMI z-score difference) while children in the waitlist control exhibited an increase of 0.022 BMI z-score units. The incremental cost effectiveness of family and parent-only intervention, compared to the waitlist control were $7,580 and $5,790 per unit reduction in BMI z-score respectively.

The **Kalavainen 2009** RCT compared 14 family sessions with routine care and measured a BMI-SDS (z-score) change of -0.2 (-0.3 to -0.1) for the intervention group programme, and -0.1 (-0.2 to 0) for the routine programme (group difference p=.081) at 12 months. The incremental cost of the family group programme at 12 months was €275 per child treated, resulting in an ICER estimate of €2750 per unit decrease in BMI-SDS; however, because of the lack of a statistically significant effect size, in the worst-case scenario the two interventions were nearly equally effective.

Evaluations of the LEAP 1 and LEAP 2 RCTs in Australia (**Wake 2008**, **Wake 2009**) found that the intervention, which cost a great deal more than routine care costs (AUS$ 873 vs 64 for LEAP 1 and AUS$ 845 vs 52 for LEAP 2), did not yield a statistically significant improvement in BMI z-score compared to routine care.

Cost effectiveness data: Long-term economic evaluations

In a lifetime model analysis of the LEAP 1 intervention, **Moodie 2008** estimated that the net cost per DALY saved was AUS$4,670 (ca £3,004) compared to a 'no intervention' control group although the authors noted that the uncertainty intervals were very wide. The authors noted that a key question related to the long-term sustainability of the small incremental weight loss reported in the 9 month follow up to LEAP.

YHEC 2010 evaluating the UK MEND programme found the estimated incremental cost effectiveness ratio (ICER) to be £1,671 per QALY gained but the authors noted that the international rather than UK

definitions of obesity were used in the model, suggesting that 15.3% of participants were non-obese at programme end. If the UK definition had been used then 9.1% of participants would have been deemed non-obese and the intervention would have been less cost-effective.

Hollingworth 2012 used the NHF Foresight model to estimate lifetime cost-effectiveness based on 10 RCTs of hospital or community-based lifestyle interventions targeted at overweight or obese primary school aged children. The median effect size was a difference in BMI SDS (z-score) of -0.13 (range 0.04 to -0.60) at 12 months. Indicative intervention costs per child ranged from £108 to £662.

For obese children aged 10-11 years, an intervention that resulted in a median reduction in BMI SDS at 12 months at a moderate cost of £400 per child, increased life expectancy by 0.19 years and intervention costs were offset by subsequent undiscounted savings in treatment costs (net saving of £110 per child), though this saving did not emerge until the sixth or seventh decade of life. The discounted cost per life year gained was £13,589.

These three studies are not directly comparable as they used three different outcome measures: life years, DALYs and QALYs. However all three studies concluded that the initial costs of intervention could be justified by subsequent healthcare savings on treating obesity-related diseases and benefits to the population's health and longevity.

The cost effectiveness of lifestyle weight management programmes

1.35 Evidence from seven short-term health economic analyses[1-7] suggests that lifestyle weight management programmes will initially result in an increased cost to the NHS when compared to routine care. However small (and in some cases non-significant) improvements in BMI z-scores can be achieved.

[1] Coppins 2011*, [2] Hughes 2008*, [3] Janicke 2009, [4] Kalavainen 2009, [5] Robertson 2011*, [6] Wake 2008, [7]Wake 2009.

Cost data only – no assessment of applicability or study limitations[1,2,5]
Study Limitations: Very serious
Applicability: All studies were applicable in terms of setting and participants[1-7] , but data from short-term studies limited in its applicability to life-time cost estimates and assessed as partially applicable[3,4,6,7]

1.36 Three extrapolation models[1-3] of lifestyle weight management programmes suggest interventions that lead to even small reductions in BMI can be cost-effective in the long term at conventional cost-effectiveness thresholds, provided the short term effects on BMI, observed in trials, are sustained into adulthood.

[1] YHEC 2010, [2] Moodie 2008, [3] Hollingworth 2012

Study limitations: Potentially serious for all studies. Applicability: Directly applicable for all studies

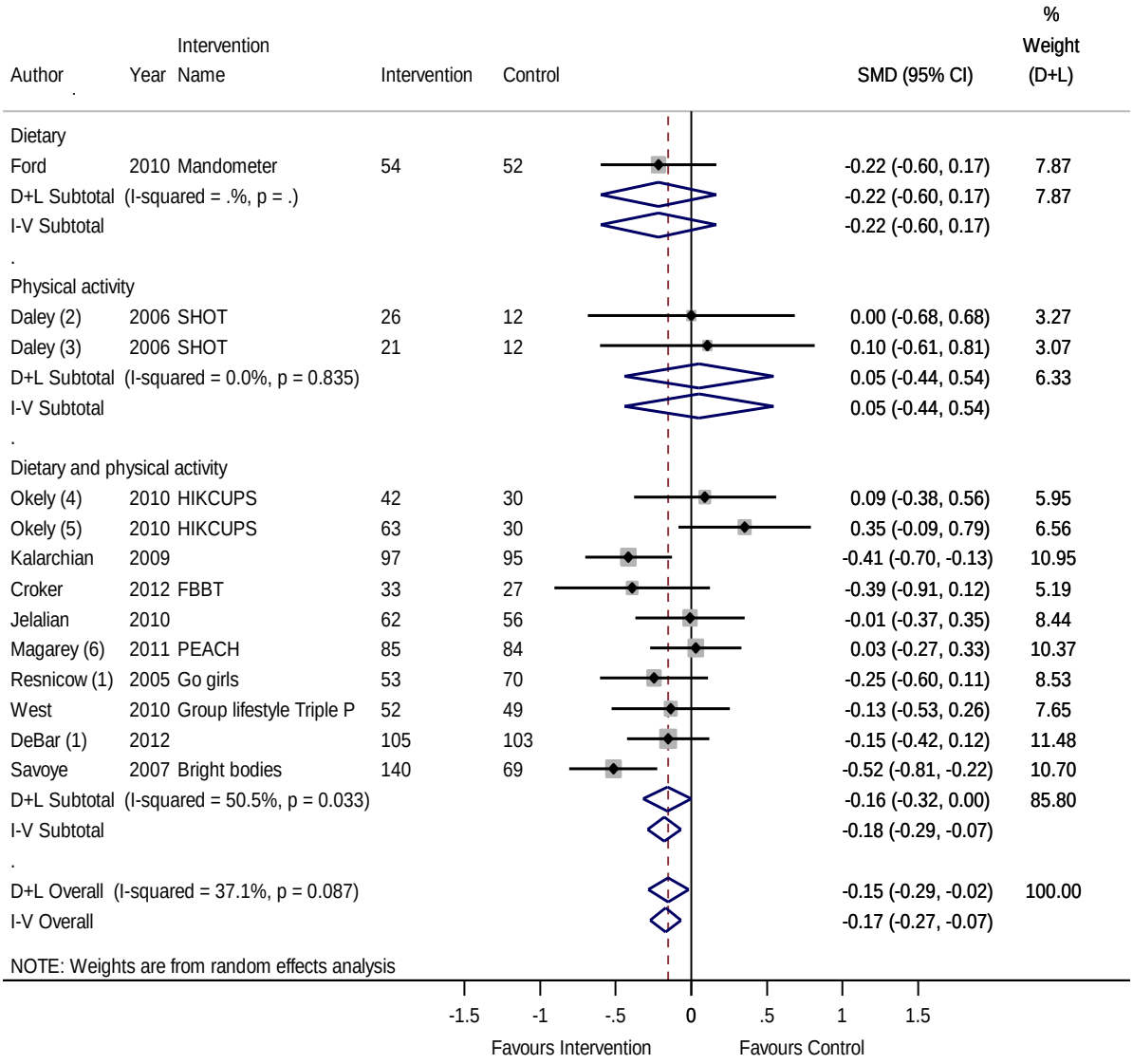
Question 2: What are the essential components of an effective and cost-effective weight management programme for overweight and obese children and young people?

Comparison of intervention component effects on BMI across studies

Behavioural Target

The forest plot summarising the effects according to the level of family involvement (Figure 4.3) shows that there is not enough evidence to confirm the best behavioural targets although there is a trend that favours dietary advice or mixed advice over physical activity advice only.

Figure 4.3. Forest plot of the standardized mean difference **post intervention** in Body Mass Index (BMI/zBMI) for childhood obesity interventions by behavioural target: diet, physical activity, and diet and physical activity.



(1) Girls; (2) Exercise Therapy vs Usual Care; (3) Exercise Placebo vs Usual Care (4) Diet vs Diet and Physical Activity; (5) Activity vs Diet and Physical Activity (6) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Several studies also compared the effect of different interventions within individual studies. Comparisons of the effects for all relevant outcomes are described below.

Several studies also compared the effect of different interventions within individual studies. Comparisons of the effects for all relevant outcomes are described below.

Behavioural target

Collins 2011 ++ reported outcomes for an RCT of the HIKCUPS programme. The study compared three interventions: i) parent-centred dietary modification programme ii) child centred physical activity programme iii) combination of the diet and physical activity programme. Results indicated that all three interventions reduced BMI, but compared with the activity group, participants in the diet group or diet and activity group had a greater reduction in BMI z-score (P=0.02) at 12 months. At 24 months, the diet group showed the greatest reduction in BMI z-score compared to activity group (P=0.04): diet group -0.35 (95%CI -0.48 to -0.22), activity group -0.19 (-0.30 to -0.07) and diet and activity -0.24 (-0.35 to -0.13). Daily energy intake was significantly improved in all interventions whereas physical activity was not. There were no significant differences in daily energy intake reductions or physical activity detected between the groups at 6, 12 or 24 months.

Gately 2007 – and **Duckworth 2009 +** respectively compared standard camp diet to energy-restricted high protein diets of 22.5% protein level or 25% protein level using quasi-RCT designs. Both interventions led to significant reductions in BMI z-scores, and increased hunger ratings, yet there was no significant differences identified between high protein or standard diets on any physical or subjective outcome.

Jelalian 2010 +, an RCT, compared group based cognitive behavioural therapy (CBT) including a prescribed diet with the addition of either supervised aerobic exercise vs peer-based physical activity. Whilst both interventions resulted in significant decreases in BMI, there were no significant group by time interactions. Both groups also demonstrated significant improvements in self-concept, with no significant differences between groups. There were no significant changes in the amount of moderate to vigorous physical activity and no significant differences between groups.

An RCT (**Daley 2006 ++**) of the SHOT programme compared exercise therapy (including behaviour change exercise counselling and moderate intensity exercises) to an exercise only placebo involving lower intensity exercise and a control 'life as normal' group. There were no significant changes in BMI among any group at any time point. Physical activity however was significantly improved at 28 weeks, with a significant difference between exercise therapy and exercise placebo groups: mean difference 9.81, p= 0.0016). There were also significant differences between the exercise therapy and exercise placebo at 14 weeks and 28 weeks for global health scores (mean difference 0.49, p=0.002; and 0.42, p=0.003; respectively).

Parenting skills

Two studies compared the effect of interventions to improve parenting skills to other interventions. The comparison of effects on all relevant outcomes are described below.

Golley 2007 ++ an RCT, compared behavioural therapy focusing on parenting skills and intensive lifestyle education (P+DA) with behavioural therapy for parenting skills only (P), and a wait list control (WLC). There were no significant differences in effect of between either intervention group. At 12 months, BMI z-score was reduced in all groups but there was no statistically significant difference between groups. At 6 and 12 months, most reported measures of food intakes unchanged other than energy-dense nutrient-poor foods were lower in both intervention groups: 12 months mean difference from control in P+DA group was -1.0

(95% CI -2.0 to -0.5) and -1.0 (-1.5 to 0.0) in P group. There were also reported reductions in small screen use and increases in active play across all groups but no between group differences.

Magarey 2011 ++ an RCT, using a modified form of TRIPLE P, compared behavioural therapy to improve parenting skills and intensive lifestyle education to healthy lifestyle education alone without parenting skills. At 24-months, there were overall reductions in BMI z-score (0.26, 95% CI 0.22 to 0.30) and waist z-score (0.33, 0.26 to 0.40) across both groups but no significant between group differences. Parenting outcome scores in both groups improved from baseline to 6 months ($p<0.05$) and generally remained stable after that to 24 months. There were no between group differences.

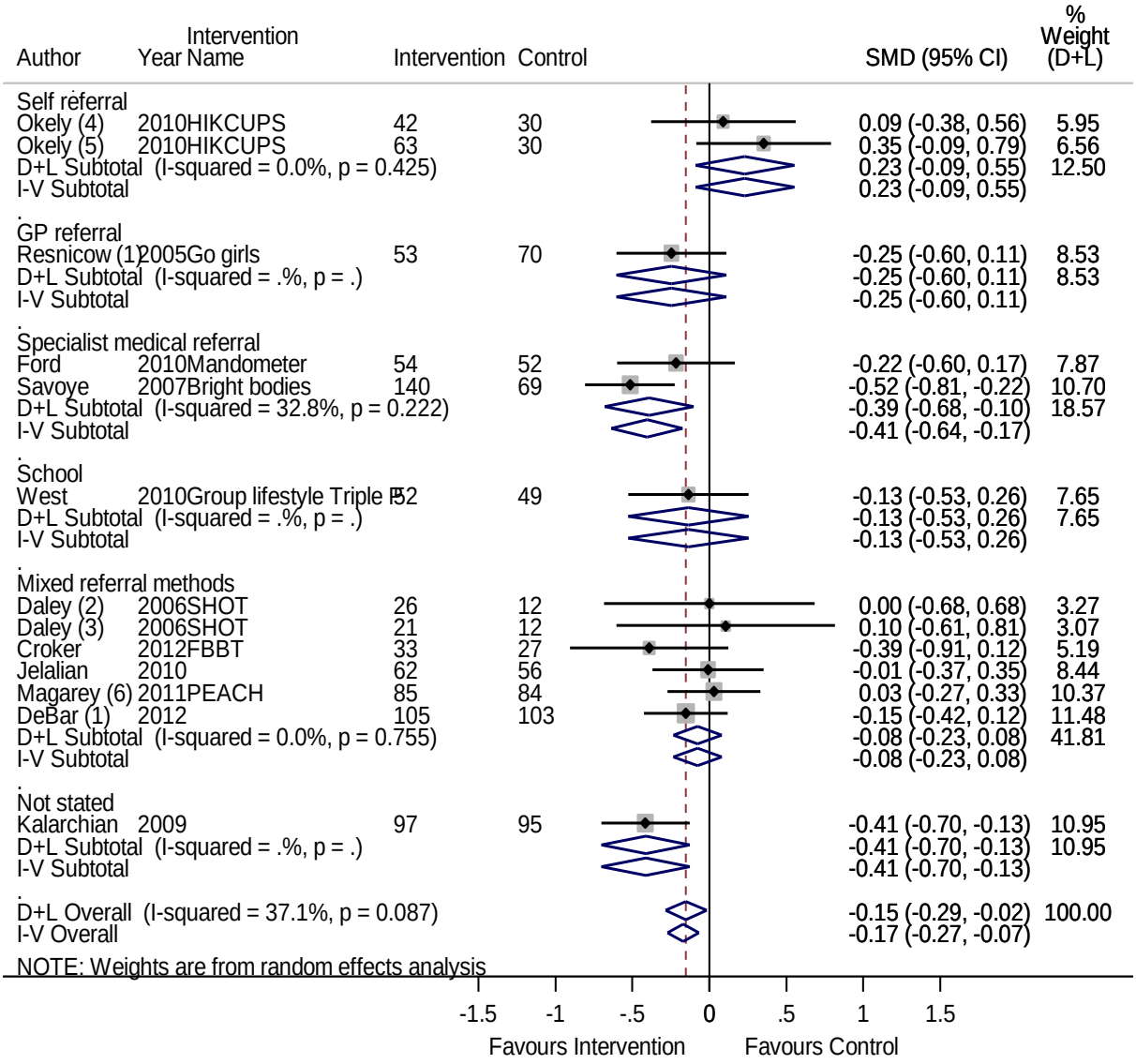
Involvement of parent or family

Overall, the evidence favours parental or whole family involvement over involving the child only (see Q1).

Referral Method

Meta-analyses summarising the effects according to the referral method (Figures 4.4 and 4.5) show that specialist medical referral was associated with the larger effects compared to self, GP, school or a mixture of referral methods both post-intervention and in the longer term. It is possible that these findings could be explained by a higher baseline BMI in children referred by specialists. However, across all studies, there was no difference between mean BMI z score at baseline by referral method. The mean BMI z score at baseline for specialist medical referral was 2.58, compared with 2.73 for GP or specialist medical referral and 2.70 for self-referral or mixed referral methods.

Figure 4.4. Forest plot of the standardized mean difference **post intervention** in Body Mass Index (BMI/zBMI) for childhood obesity interventions comparing different methods of referral: self referral, GP referral, other health professional, school, or a mix of referral methods.

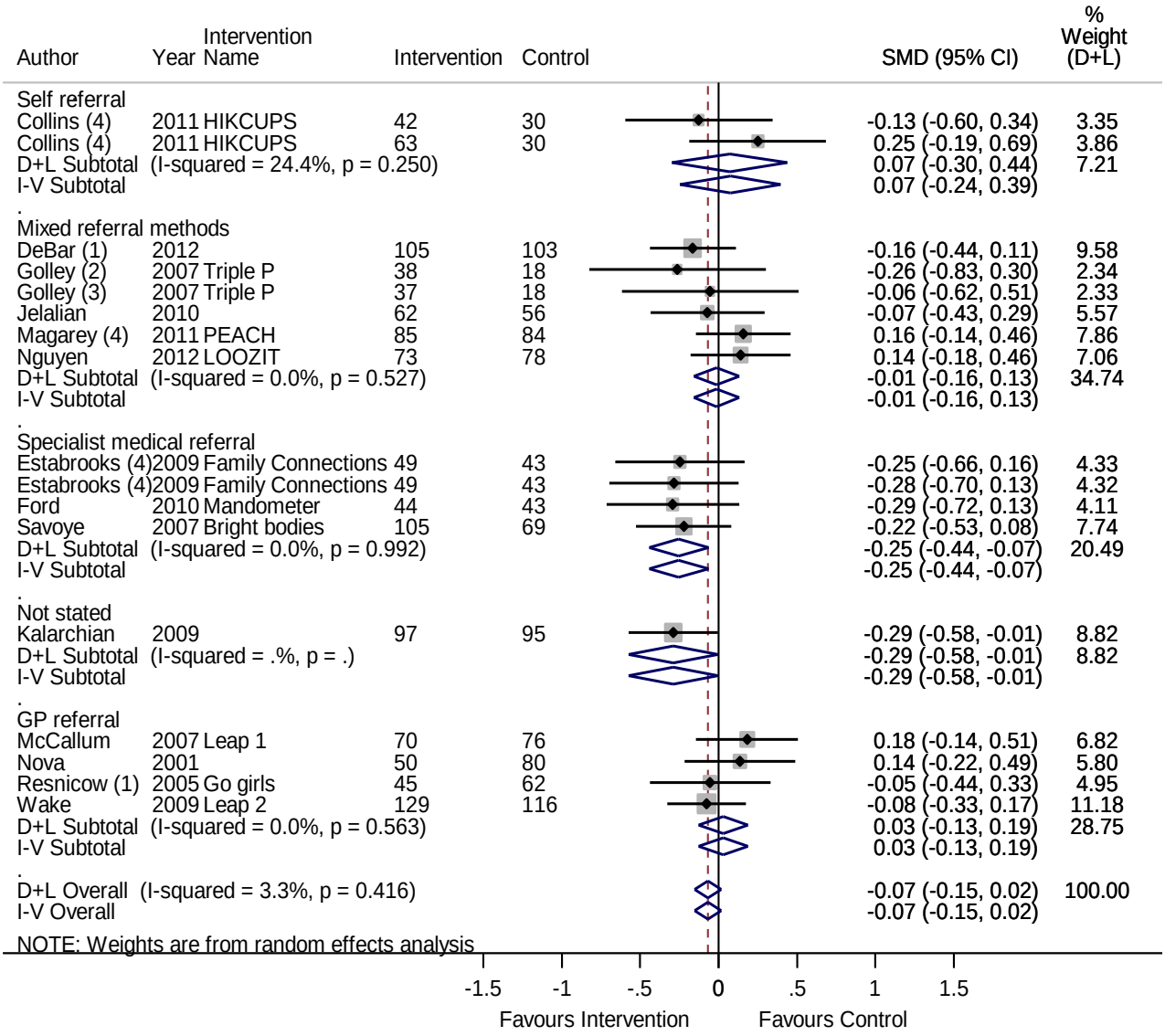


(1) Girls; (2) Exercise Therapy vs Usual Care; (3) Exercise Placebo vs Usual Care (4) Diet vs Diet and Physical Activity; (5) Activity vs Diet and Physical Activity (6) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Figure 4.5. Forest plot of the standardized mean difference Body Mass Index (BMI/zBMI) **after ≥ 6 months** for childhood obesity interventions comparing different methods of referral: self referral, GP referral, other health professional, school, or a mix of referral methods.



(1) Girls; (2) Parenting plus lifestyle vs Waitlist control; (3) Parenting vs Waitlist control; (4) Diet vs. Diet plus activity; (5) Activity vs Diet plus activity; (6) Family connections counselling using a workbook vs. Family connections counselling using an interactive voice response resource; (7) Family connections counselling in a group vs. Family connections counselling using an interactive voice response resource; (8) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Intensity

Three studies examined the effect of high or low intensity interventions on a range of relevant outcomes. These are described below.

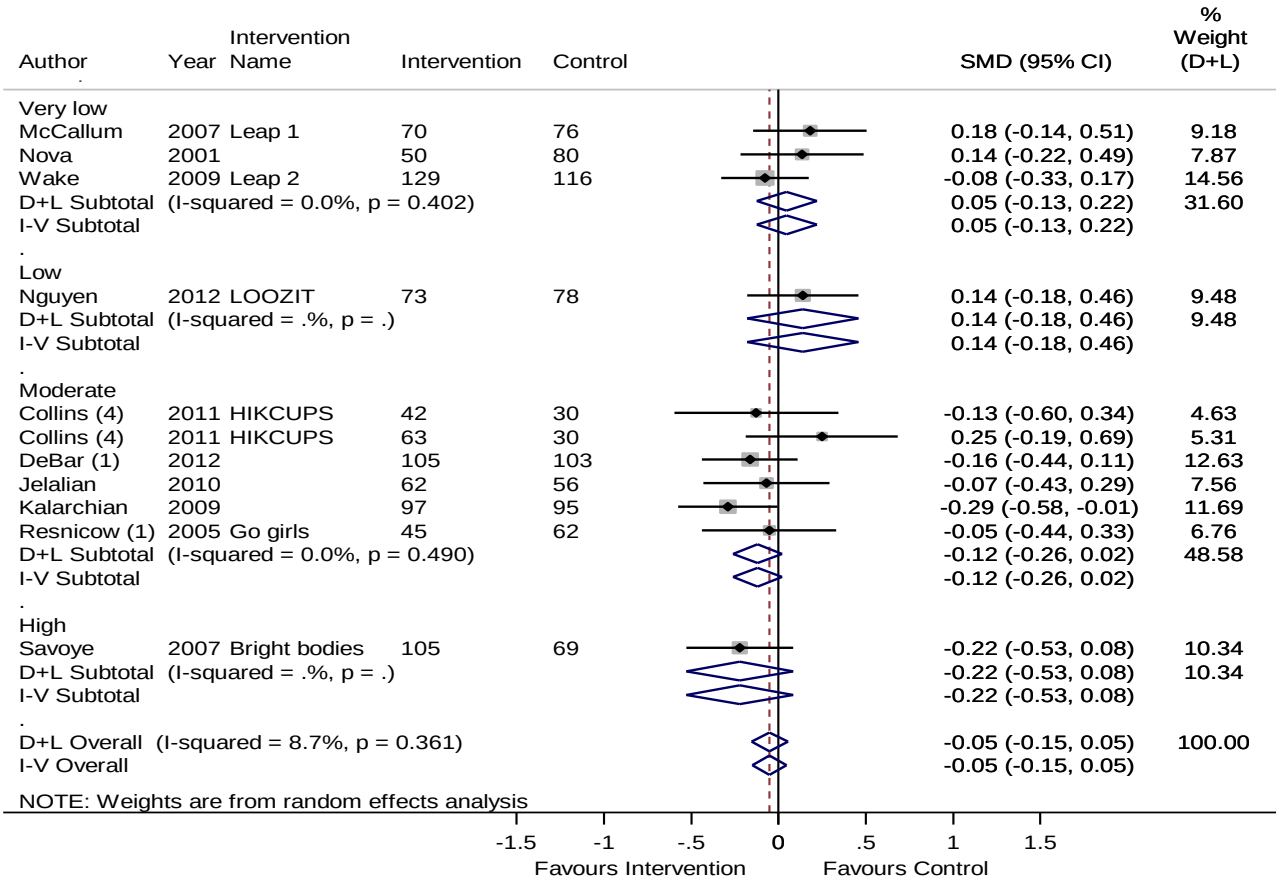
Resnicow 2005 –, an RCT in a population of African-American girls from middle and upper income churches, compared behavioural therapy, physical activity and diet interventions delivered at high intensity (20 to 26 sessions over 6 months) or moderate intensity (six sessions over 6 months). There were no significant improvements in BMI at 6- and 12-months in either group and no significant between-group differences. However, girls in the high-intensity condition who attended 75% or more sessions had significantly lower mean BMI relative than those attending fewer sessions at 6 months (high attendees 31.6 (SD 5.8) to 32.1 (SD 5.8); low attendees: 32.5 (SD 5.9) to 31.7 (SD 5.3), P=0.01.

Shrewsbury 2009 ++ , an RCT of the Loozit programme, compared Behavioural (CBT) to CBT plus additional therapeutic contact via telephone consultations and interactive technologies. Whilst both interventions resulted in significant improvements in BMI z-scores, diet, physical activity and psychosocial outcomes at 12 months, the additional therapeutic contact did not result in significantly greater improvements than the standard CBT intervention. The study is ongoing, so the 12-month data represent interim outcomes of a 21 month intervention, with 24 month outcomes planned).

Kalarchian 2009 ++ was an RCT of a year-long family-based behavioural intervention for severe obesity in 190 children aged 8-12 years (56.8% female and 73.4% white). It comprised dietary, behavioural and physical activity strategies, involved twenty 60-minute group meetings over six months separately for adult and child groups with complementary material, plus six booster sessions in months 6-12. The study found that family based behaviour change including physical activity and nutrition plan delivered in 20 group meetings held separately for adults and children, was more effective than just two diet consultations up to 6 months. BMI and parent rated health related quality of life (HRQL) were significantly reduced in the intervention group at 6 months, but were not maintained at 12 or 18 months. The study revealed that those who attended 75% or more of the intervention sessions offered, maintained their reductions in percent overweight through 18-months. The control group did not significantly reduce BMI or HRQL at any time-point.

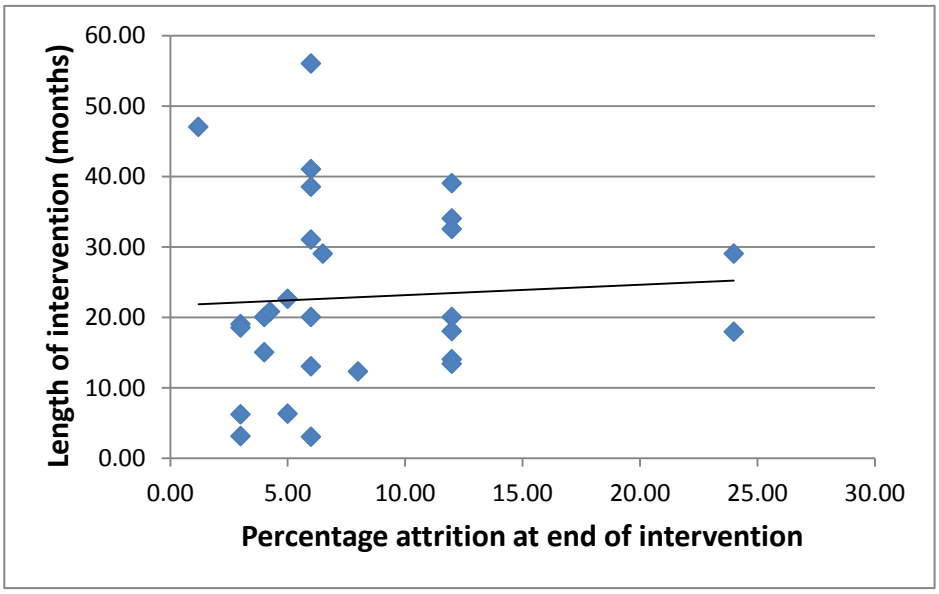
A meta-analysis of ten RCTs [**Collins 2011 ++**, **DeBar 2012 ++**, **Kalarchian 2009 +**, **Shrewsbury 2009 ++**, **Wake 2009 ++**, **Jelalian 2010 ++**, **McCallum 2007 ++**, **Nova 2001 +**, **Savoye 2009 +**] and one quasi-RCT [**Resnicow 2005 –**] of family interventions (Figure 4.6) indicated that the overall effectiveness of the interventions at 6+ months post-intervention showed a trend to increase with the intensity of the intervention. Changes in BMI SDI were +0.05 (-0.13 to 0.22) for very low intensity (<10 hours family contact time) [**McCallum 2007 ++**, **Nova 2001 +**, **Wake 2009 ++**], +0.14 (-0.18 to 0.46) for low intensity (10 to <20 hours) [**Nguyen 2012 ++** - see Shrewsbury 20009 ++], -0.12 (-0.26 to 0.02)[1,2,3,6,10] for moderate intensity (20 to < 75 hours) [**Collins 2011 ++**, **DeBar 2012 ++**, **Jelalian 2010 ++**, **Kalarchian 2009 +**, **Resnicow 2005 –**] and -0.22 (-0.53 to 0.08)[9] for high intensity (75+ hours) [**Savoye 2007 ++**].

Figure 4.6. Changes in BMI SDI with intensity for family based interventions



From 28 family based interventions (**Banks 2012 +, Berkowitz 2011 –, Bryant 2011 +, Collins 2011 ++, Coppins 2011 +, Croker 2012 +, Daley 2006 ++, DeBar 2012 ++, Ford 2010 ++, Goldfield 2001 –, Hughes 2008 +, Janicke 2008a/b +, Jelalian 2010 +, Kalarchian 2009 ++, Kalavainen 2007 ++, McCallum 2007 ++, Norton 2011 –, Nova 2001 +, Pittson 2011 –, Rennie 2010 –, Resnicow 2005 –, Robertson 2011 –, Sabin 2007 –, Sacher 2010 +, Savoye 2007 +, Shrewsbury 2009 ++, Wake 2009 ++, Watson 2011 –**) no link was detected between study length and attrition rate at the end of the study (correlation coefficient= 0.06, p=0.75).

Figure 4.7 Percentage attrition by length of child obesity intervention for family studies (n=28)



Comparison of intervention component effects on BMI

2.1 **Behavioural target**: Results of the meta-analysis found no significant differences between improvements in BMI according to the behavioural target of the intervention but data are limited. Comparisons of interventions between studies provide strong evidence from one [++] RCT[1] that diet alone or diet and physical activity results in greater short term improvements (six months) than physical activity alone, but not longer term and weak evidence from one [+} and one [–] quasi-RCT [2,3] that a high protein energy restricted diet is no more effective than a standard restricted diet, when delivered in weight loss camps. There is also moderate evidence from one [+] RCT[4] that supervised exercise is no more effective in improving BMI or children's self-concept than peer-based exercise, when provided as part of a CBT programme and moderate evidence from one [+] RCT that higher intensity exercise is more effective than lower intensity exercise in improving physical activity levels, but neither intervention is effective in reducing BMI[5].

[1] Collins 2011, [2] Duckworth 2009,[3] Gately 2007, [4] Jelalian 2009, [5] Magarey 2011

2.2 **Parenting skills.** There is strong evidence from two [++] RCTs[1,2] that interventions involving group-based parenting skills training directed to the parents of overweight and obese children aged respectively 6-9 and 5-9 years are effective in improving BMI. However the addition of intensive lifestyle education did not lead to significantly greater improvements in BMI z-scores, food intake or physical activity measures (one [++] RCT[1]) or that the addition of parenting skills training to intensive lifestyle education alone was more beneficial to BMI z-scores or parenting outcomes (one [++] RCT)[2]. Both interventions were delivered over 6 months by dietitians.

[1] Golley 2007, [2] Magarey 2011

2.3 **Involvement of family.** There is strong evidence, **post intervention**, to suggest that targeting both parents and children (eight studies: three [++] RCTs[1-3], two [+] RCTs[4,5], two [–] quasi-RCTs[6-7], and one [–] UBA[8] or whole families (18 papers from 17 studies; five [++] RCTs[9-13], four [+] RCTs[14-17], one [+] quasi-RCT[18], one [–] quasi-RCT[19] and six [–] UBAs[20-26]) is effective in reducing **within group zBMI scores**. For those studies with follow up of six months or more there were no clear differences. Evidence from child-only interventions (one [++] RCT[27], one [+] RCT[28] and one [–] CBA[29],) and parent- only interventions (two [++] RCTs[30,31], two [+] RCTs[32,33] and one [–] cluster RCT[34]) are limited and inconsistent.

[1] DeBar 2012, [2] Collins 2011, [3] Shrewsbury 2009, [4] Savoye 2009, [5] Jelalian 2010, [6] Resnicow 2005, [7] Goldfield 2001, [8] Rudolf 2006, [9] Ford 2010, [10] Kalarchian 2009, [11] Kalavainen 2007, [12] McCallum 2007, [13] Wake 2009, [14] Croker 2012, [15] Hughes 2008, [16] Nova 2001, [17] Sacher 2010, [18] Coppins 2011, [19] Berkowitz 2011 [20] Norton 2011, [21] Pittson 2011, [22] Rennie 2010, [23] Robertson 2011, [24] Sabin 2007, [25] Watson 2009, [26] Watson 2011. [27] Daley 2006, [28] Petty 2009, [29] Gately 2005, [30] Golley 2007, [31]Magarey 2011, [32] Janicke 2009, [33] Estabrooks 2009 [34] West 2010

2.4 **Referral method.** There is strong evidence from a meta-analysis of 12 studies[1-12], of which two examined specialist referral[2,10], to suggest that interventions which involve specialist medical referral to a programme compared to self, GP, school or a mixture of referral methods show greater improvements in BMI z-scores at end of intervention (SMD = -0.41; CI 95% = -0.64 to -0.17)

[1] DeBar 2012, [2] Ford 2010 [3] Kalarchian 2009, [4] Magrey 2011 [5] Okely 2010 (see Collins 2011), [6] Croker 2012, [7] Daley 2006, [8] Jelalian 2010, [9] Sacher 2010, [10] Savoye 2009, [11] West 2010, [12] Resnicow 2005

2.5 A meta-analysis of 15 studies[1-15], of which three examined specialist medical referral[3,9,14], also provides strong evidence that the effect is sustained at six months or more post-intervention (SMD = -0.30; CI 95% = -0.49 to -0.11).

[1] Collins 2011, [2] DeBar 2012, [3] Ford 2010, [4] Golley 2007, [5] Karlachian 2009, [6] Magarey 2011 [7]Nguyen 2012 (see Shrewsbury 2009), [8] Wake 2009, [9] Estabrooks 2009 [10] Jelalian 2010, [11] McCallum 2007, [12] Nova 2001, [13] Sacher 2010, [14] Savoye 2009, [15] Resnicow 2005

2.6 **Intensity of intervention.** A meta-analysis of ten RCTs (Five [++] RCTs[1-5]; four [+] RCTs[6-9] and one [–] quasi-RCT[10]) indicated that the overall effectiveness of family interventions at six or more months post-intervention tended to increase with the intensity of the intervention although none of the results was statistically significant. Changes in BMI SDI were +0.05 (-0.13 to 0.22)[5,7,8] for very low intensity (<10 hours family contact time), +0.14 (-0.18 to 0.46)[4] for low intensity (10 to <20 hours), -0.12 (-0.26 to 0.02)[1,2,3,6,10] for moderate intensity (20 to < 75 hours) and -0.22 (-0.53 to 0.08)[9] for high intensity (75+ hours).

[1] Collins 2011, [2] DeBar 2012, [3] Kalarchian 2009, [4] Nguyen 2012 (see Shrewsbury 2009), [5] Wake 2009, [6] Jelalian 2010, [7] McCallum 2007, [8] Nova 2001, [9] Savoye 2009, [10] Resnicow 2005

2.7 There is moderate evidence from one [–] RCT[1] and one [++] RCT[2] that children that attend 75% or more of the high intensity programme sessions offered, showed greater improvements in weight outcomes than those attending fewer sessions. One further ongoing RCT (++)[5] found that further addition of further therapeutic to CBT therapy was not more beneficial to BMI z-scores, diet, physical activity and psychosocial outcomes than CBT alone.

[1] Resnicow 2005, [2] Karlachian 2009 [3] Shrewsbury 2009

2.8 **Individual or group treatment.** There is weak evidence from one small quasi-RCT (–)[1] that individual treatment does not result in significantly different results for BMI or diet outcomes compared to group treatment.

[1] Goldfield 2001

2.9 **Length of intervention and attrition.** Within the 28 studies of family based interventions (9 [++] RCTs[1-9], 9 [+] RCTs[10-18], 4 quasi-RCTs (1 [+][19], 3 [–][20-22]), 6 [–] UBAs[23-28], there was no link between study length and attrition rate at the end of the study (correlation coefficient= 0.06, p=0.75). This evidence is directly applicable as the studies were conducted in community settings in the UK and similar countries.

[1] Collins 2011, [2] Daley 2006, [3] DeBar 2012, [4] Ford 2010, [5] Kalarchian 2009, [6] Kalavainen 2007, [7] McCallum 2007, [8] Shrewsbury 2009, [9] Wake 2009, [10] Banks 2012, [11] Bryant 2011, [12] Coppins 2011, [13] Croker 2012, [14] Hughes 2008, [15] Janicke 2008a/b, [16] Jelalian 2010, [17] Sacher 2010, [18] Savoye 2007, [19] Nova 2001, [20] Berkowitz 2011, [21] Goldfield 2001, [22] Resnicow 2005, [23] Norton 2011, [24] Pittson 2011, [25] Rennie 2010, [26] Robertson 2011, [27] Sabin 2007, [28] Watson 2011.

Applicability:

[5] Loozit ++ (Nguyen 2012, Shrewsbury 2009,2010,2011),

2.1	Directly applicable: conducted in community settings in Australia[1,5], the UK[2,3] and the USA[5]
2.2	Directly applicable: conducted in community settings in Australia[1,2]
2.3	Directly applicable: studies informing the evidence statements are conducted in applicable community settings
2.4	Directly applicable: studies conducted in applicable community settings
2.5	Directly applicable: studies conducted in applicable community settings
2.6	Directly applicable: conducted in community settings in the USA, Italy and Australia
2.7	Directly applicable: conducted in community settings in the USA and Australia
2.8	Directly applicable: conducted in community settings in the USA
2.9	Directly applicable: conducted in community settings in the UK and other comparable countries.

Cost effectiveness

One cost-effectiveness study (**Goldfield 2001**) compared a combination of **group plus individual lifestyle weight management therapy with group therapy alone** and found a similar BMI z-score reduction in both groups. Thus, the group only intervention, being cheaper to deliver, was likely to be more cost-effective (resulting in a reduction in z BMI of 0.001 versus 0.0004 for each dollar spent).

Another cost-effectiveness study exploring treatment **for parents only versus whole family treatment** (**Janicke 2009**) found that whole family therapy resulted in greater improvements in BMI (-0.115 versus -0.090 BMI z-score difference). In comparison to a waitlist control group, parent-only treatment was more cost effective with a cost of US$ 5,790 (ca £3720) for each unit decrease in z BMI score compared to US$758 (ca £4,870) for family-treatment.

Variations in cost-effectiveness related to intervention components

2.10 A single cost-effectiveness study[1] suggested that group therapy alone for families was more cost-effective than a combination of group and individual therapy.

[1] Goldfield 2001
Study Limitations: Very serious; Applicability: partial

2.11 A single cost-effectiveness study found that a parent-only intervention was more cost-effective than a parent and child intervention.

[1] Janicke 2009
Study Limitations: Very serious; Applicability: partial

Question 3. How does effectiveness and cost effectiveness vary for different population groups? Examples may include children and young people from different black and minority ethnic groups, from low-income groups, of different ages or genders, or with special needs.)

Ethnic groups

An RCT conducted in the USA in a community setting (**Petty 2009 +**) examined the impact of a 13-week exercise programme for 207 overweight children aged 7-11 years on BMI, depressive symptoms and self worth. Two intervention groups: low dose exercise (LDE) of 20 minutes per school day and high dose exercise (HDE) of 40 minutes per school day were compared with a control group receiving no physical exercise intervention. The study reported there was no interaction of the intervention group (low dose exercise, high dose exercise or control) with ethnicity on BMI.

Resnicow 2005 – looked at high intensity (20-26 sessions) versus moderate intensity (6 sessions) lifestyle weight management (behaviour change, physical activity and diet) within a quasi-RCT of the Go Girls intervention for 147 overweight African-American girls aged 12-16 years old in middle income churches in the USA, 123 completed the intervention and follow up. Parents were encouraged to attend every other session. There was no usual care control group. The intervention was 6 months with 12 month outcomes (6 months post intervention). There was no comparison between different populations within the study. Net difference between high and moderate intensity groups was 0.5 BMI units - not significant (p=0.20). 1 year follow-up results mirrored those at 6 months. Mean BMI baseline versus 1 year (SD) was I= 32.6 (5.7) to 33.3 (5.9); C= 33.2 (7.7) to 33.7 (8.4); p = 0.76

Norton 2011 – was a UBA study conducted in a community setting in the UK which evaluated the effect of the Activ8 intervention on anthropometry and body composition. The intervention consisted of 6 weekly 1-h sessions combining game based physical activities and nutritional education sessions. At 6 weeks, a reduction in average absolute BMI was observed (−0.29 kg m^{-2} SD = 0.49, p = 0.000, CI = 95%) which remained significant when converted to z-scores and percentiles. The sample comprised a significant number (86.7%) of children from ethnic minorities.

Croker 2012 + was an RCT which examined the acceptability and effectiveness of 'family-based behavioural treatment' (FBBT) for childhood obesity in an ethnically and socially diverse sample of families in a UK National Health Service (NHS) setting. FBBT aims at changing the whole family's lifestyle with a behavioural weight control programme consisting of behavioural, diet and physical activity components. Significant BMI SDS (z-score) changes (P=0.01) were observed for the treatment (n=33) and control (n=30) groups of - 0.11 (SD 0.16) and -0.10 (SD 1.6). Though between-group treatment effects for BMI and body composition were not significant and no overall change in BMI or BMI SDS (z-score) from 0–12 months was observed for the treatment group. For those with follow-up to 12 months (n=19), BMI SDS (z-score) at baseline, 6 months and 12 months was 3.14 SD 0.72, 2.98 SD 0.75, 3.03 SD 0.78,respectively, p<0.005 but not this was not an ITT analysis. The results indicate that the FBBT approach may not be appropriate for ethnically and socially diverse populations.

Effects by ethnic groups – anthropometric outcomes

3.1	There is moderate evidence from one [+] RCT[1] that exercise-only interventions for children do not demonstrate a differential effect in ethnic groups. The intervention consisted of five weekly 20 or 40 minute exercise sessions for overweight children aged 7-11 (58% female and 59% black) over 13 weeks. [1] Petty 2008
3.2	There is inconsistent evidence that family interventions are effective in diverse ethnic populations. A [−] UBA study[1] observed a reduction at 6 weeks in average absolute BMI (−0.29 kg m−2 SD = 0.49, p = 0.000, CI = 95%) in a sample that was predominantly (86.7%) of SE Asian ethnicity. However, a [+] RCT[2] with a sample including 43% non-white participants did not observe significant between-group treatment effects for BMI and no overall change in BMI or BMI SDS (z-score) from 0–12 months was observed for the treatment group. Data were not provided separately for different ethnic groups [1] Norton 2011, [2] Croker 2012,
Applicability:	
3.1	Partially applicable: Study conducted in a research centre in the USA
3.2	Directly applicable: one UK study in a community-based setting in East London with a very large ethnic minority population.[1] One study in a London hospital outpatient setting.[2]

Age

Rudolf 2006 – a UK UBA study reported that the mean change in BMI SD at 6 months was as greater for participants aged ≤13 years (-0.13 ± 0.14, p<0.01).

Norton 2011 – was a UBA study conducted in the UK which evaluated the effect of the Activ8 intervention on anthropometry and body composition. The intervention consisted of 6 weekly 1-hour sessions combining game based physical activities and nutritional education sessions. Younger age groups achieved significantly greater reductions in BMI z-score (p = 0.000) and BMI centile (p = 0.009).

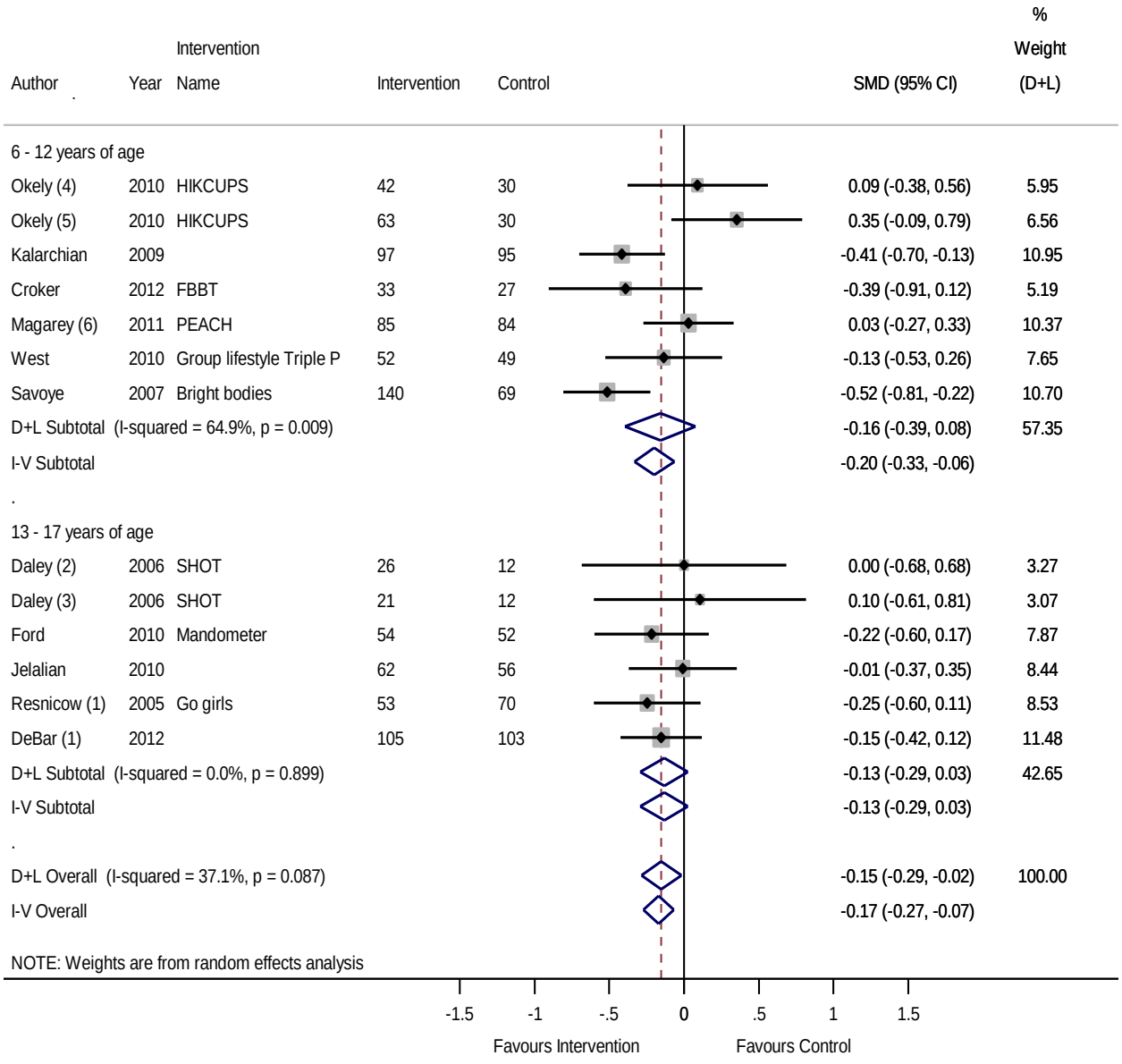
A UK-based UBA (**Sabin 2007 –**) aimed to identify factors important in determining whether an obese child achieves significant reductions in BMI SDS, age was identified as the most important predictor with younger children achieving larger reductions in BMI SDS, P=0.013.

Although papers reported a number of programmes included children aged below six (**Banks 2012 +**, **Collins 2011 ++**, **Hughes 2008 +**, **Magarey 2011 ++**, **McCallum 2007 ++**, **Norton 2011 –**, **Nova 2001** +, **Sabin 2007 –**, **Wake 2009 ++**, **Watson 2009, 2011 –**), no data were available separately for this population. When selecting studies for inclusion in the review, it was noted that interventions aimed at young children tended to be 'prevention' programmes for the general population, rather than interventions targeted to overweight and obese children of six years or below – HENRY and Mini-MEND are two examples.

Meta-analysis of interventions comparing age groups 6-12 and 13-17 years of age

A meta-analysis of RCTs with sample sizes greater than 100, or conducted in the UK suggest that programmes may be more effective for younger children immediately post intervention (Figure 4.8). This effect does not appear to be sustained and there may even be a trend towards improved results for the older age group at long term follow up (≥6 months) although outcomes are not significant for either age group (Figure 4.9).

Figure 4.8. Forest plot of the standardized mean difference **post intervention** in Body Mass Index (BMI/zBMI) for childhood obesity interventions comparing: age groups 6 – 12 and 13 – 17 years of age.

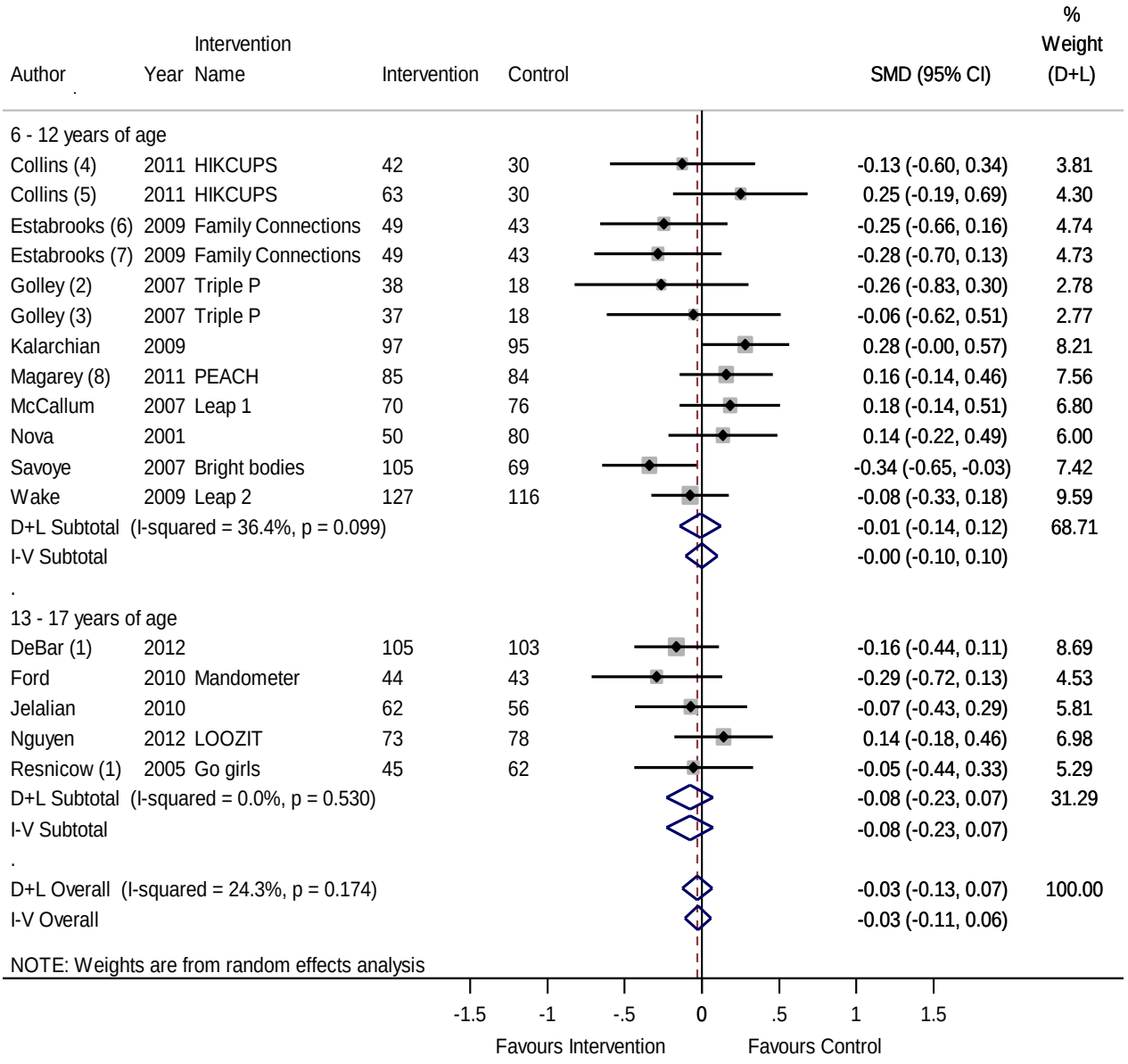


(1) Girls; (2) Exercise Therapy vs Usual Care; (3) Exercise Placebo vs Usual Care (4) Diet vs Diet and Physical Activity; (5) Activity vs Diet and Physical Activity (6) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Figure 4.9. Forest plot of the standardized mean difference in Body Mass Index (BMI/zBMI) **after ≥ 6 months** for childhood obesity interventions comparing: age groups 6 – 12 and 13 – 17 years of age.



(1) Girls; (2) Parenting plus lifestyle vs Waitlist control; (3) Parenting vs Waitlist control; (4) Diet vs. Diet plus activity; (5) Activity vs Diet plus activity; (6) Family connections counselling using a workbook vs. Family connections counselling using an interactive voice response resource; (7) Family connections counselling in a group vs. Family connections counselling using an interactive voice response resource; (8) Healthy Lifestyle and Parenting vs. Healthy Lifestyle

Note: D+L = DerSimonian and Laird random effects method; I-V overall = Fixed effects inverse variance method;

Referral methods: Specialist medical referral = from medical records, from patients referred into an obesity clinic, from university paediatric obesity clinic; Mixed referral = paediatricians from a children's hospital or responded to a community advertisement; local professional networks in primary and secondary care, from schools and local media; media, schools, health professionals, and community organisations; via local newspaper advertisements and referral from local paediatricians; via media publicity and school newsletters.

Effects by age – anthropometric outcomes

3.3 There is strong evidence from a meta-analysis of 11 RCTs[1-11] that lifestyle weight management programmes may be more effective for younger age groups when measured immediately post intervention. SMDs of BMI z-scores for 6-12 and 13-17 years of age were -0.20 (-0.33 to -0.06) and -0.13 (-0.29 to 0.03) respectively.

[1] Resnicow 2005, [2] Karlachian 2009, [3] Magarey 2011, [4] Okely 2010 (see Collins 2011), [5] Savoye 2007, [6] Croker 2012, [7] West 2010, [8] Daley 2006, [9] DeBar 2012, [10] Ford 2010, [11] Jelalian 2010

However, a further meta-analysis of 14 studies with follow up of six months or greater indicated a trend to a greater effect long term for the older age group; 0.00 (-0.10 to 0.10) for ages 6-12 and -0.08 (-0.23 to 0.07) for ages 13-17.

[1] Collins 2011, [2] Estabrooks 2009, [3] Golley 2007, [4] Karlachian 2009, [5] Magarey 2011, [6] McCallum 2007, [7] Nova 2001, [8] Savoye 2007, [9] Wake 2009, [10] DeBar 2012, [11] Ford 2010, [12] Jelalian 2010, [13] Nguyen 2012 (see Shrewsbury 2009), [14] Resnicow 2005

3.4 There is weak evidence from three studies that young age groups experience a significantly greater reduction in BMI z-scores. One [–] UBA[1] found that the mean change at six months for participants aged 13 or under was -0.13 0.13 ± 0.14, p<0.01. A second [–] UBA[2] reported Younger age groups achieved significantly greater reductions in BMI z-score (p = 0.000) and BMI centile (p = 0.009). A third [–] UBA[3] found that age was the most important predictor with younger children achieving larger reductions in BMI SDS, P=0.013.

[1] Rudolf 2006, [2] Norton 2011, [3] Sabin 2007

3.5 No studies were identified of interventions directed specifically to children aged below six years of age. Although several programmes had a lower age limit of between 3 and 5 years, no studies provided data separately for this age group. Programmes targeted at very young children appear to be obesity prevention programmes that target all children rather than those who are obese or overweight.

[1] Banks 2012, [2] Collins 2011, [3] Hughes 2008, [4] Magarey 2011,[4] McCallum 2007, [5] Norton 2011, [6] Nova 2001, [7] Sabin 2007, [8] Wake 2009, [9] Watson 2011

Applicability

3.3 Directly applicable: studies all conducted in applicable community settings

3.4 Directly applicable: UK community-based studies

3.5 Directly applicable: studies all conducted in applicable community settings

Gender

King 2007 –, a UBA study evaluated the effect of attending a residential weight loss camp for a period of six weeks (Carnegie International Camp now More Life) on 38 children and adolescents aged between 9 and 17. The camp intervention, delivered by physical education teachers and a dietitian, consisted of 2 to 6 weeks residence at boarding school premises with a daily schedule of six 1-hour, physical activity sessions, moderate dietary restriction (energy intake of 1,300 to 3,300 kcal per day based on approx basal metabolic rate), and group-based educational sessions. Camp attendance was associated with similar reductions in BMI SDS for both boys and girls (-0.37 and -0.34 respectively).

An RCT conducted in the USA in a community setting (**Petty 2009 +**) examined the impact of a 13-week exercise programme for 207 overweight children aged 7-11 years on BMI, depressive symptoms and self worth. Two intervention groups: low dose exercise (LDE) of 20 minutes per school day and high dose exercise (HDE) of 40 minutes per school day were compared with a control group receiving no physical exercise intervention. The study reported there was no interaction of either intervention groups with gender on BMI.

Rudolf 2006 – a UBA study evaluated the WATCH IT! programme for obese 8-16 year olds and their parents from a socially-disadvantaged community. The programme consists of a combination of motivational interviews and physical activity delivered in the community by non-professional health trainers to encourage lifestyle change via weekly parent/child appointments. There was an initial commitment of three months, with an option of three-month renewals up to a year. The study reported that the change in BMI SD at 6 months was greater for girls (-0.07 +/- 0.14, p=.02) although this is very similar to the overall reduction of -0.07 +/- 0.16, p<0.01 and for participants aged ≤13 years (-0.13 +/- 0.14, p<0.01).

Five papers from four uncontrolled before and after studies of family interventions (**Norton 2011 –**, **Rennie 2010 –**, **Sabin 2007 –**, **Watson 2009 –, Watson 2011 –**) provided data by gender.

Norton 2011 – evaluated the effect of the Activ8 family-based intervention on anthropometry and body composition in overweight children and young people aged 5 to 18. The intervention consisted of six weekly 1-hour sessions combining game-based physical activities and nutritional education sessions. The study found a significantly greater reduction in z-BMI (p = 0.046) in boys compared with girls.

Rennie 2010 – investigated changes in body weight measurements between the start and end of the BeeZee Bodies programme for overweight or obese children aged 6 to 15. The programme involved 17 weekly group sessions focusing on behaviour change to improve physical activity, diet and self-efficacy. At end of programme, there was a significant decrease in the BMI z-score for girls (–0.12, SEM 0.03, p<0.001) but not for boys (–0.08, SEM 0.04, p=0.08).

Sabin 2007 – aimed to identify factors important in determining whether an obese child achieves significant reductions in BMI SDS. From a population aged 4 to 17 attending a hospital outpatient weight management programme (COCO), it was identified that more boys than girls were likely to achieve target reductions in BMI SDS, however the differences did not reach significance.

Watson 2009 – and **Watson 2011 –** explored the relationship between adult BMI change and child BMI SDS (z-score) change following completion of a community-based, lifestyle change intervention for obese children aged 4 to 16 years and their families (GOALS). The intervention involved 18 sessions (19 sessions in early months, **Watson 2009 –**) of 2 hours per week focussing on diet, physical activity and behaviour change. At 12 months **Watson 2011 –** observed that the pre-post BMI z-score difference for boys and girls was −0.09±0.24 and −0.08±0.24 respectively (p=0.08).

An RCT (**Kalavainen 2007++**) conducted in Finnish health centres and outpatient centres compared group treatment stressing a health-promoting lifestyle with routine counselling in 70 obese children aged 7-9 years and their families. Fifteen group sessions of 90 min duration were held separately for parents and children, except one session on making healthy snacks. The programme was based on behavioural and solution-oriented therapy and focused on promoting healthy lifestyle and well-being

instead of weight management. Post-intervention, gender was significantly associated with a change of weight for height (average 4.8% decrease in girls versus 0.9% in boys; p<.016) but not significantly associated with BMI-SDS (average 0.3 decrease in girls versus 0.1 decrease in boys). At 6 month follow-up, there was a significant association between gender and BMI-SDS change (on average, a 0.2 decrease in girls and no change in boys. p=0.05).

Two RCTs (**Golley 2007 ++**, **Magarey 2011 ++**) evaluating interventions of parenting-skills training to parents/carers of overweight or obese children provided information on the effectiveness of the programme by gender. **Golley 2007 ++** compared parenting skills training (P+DA) and intensive lifestyle education with parenting skills only (P) or wait-list control, delivered in the community in the USA. It was observed that boys had significantly lower BMI z-scores at 6 and 12 months compared with baseline in both intervention groups but not the control group. For girls the only significant change was a reduction in BMI z-score. **Magarey 2011 ++**, compared 6 months parenting skills training and intensive healthy lifestyle education (P+HL) with health lifestyle education alone (usual care HL control) in Australia. It was observed that boys had higher BMI z-scores at baseline than girls but changes over time did not vary by gender. There was also a gender effect for intervention satisfaction, involvement and positive parenting, and better scores for boys in the HL group compared to girls.

Across all the studies included in the review, there was a notable gender imbalance with considerably higher numbers of females in most programmes (see Table 4.1). Only two of the 33 programmes for which gender information was available had more males than females (**Estabrooks 2009 +**, **Nova 2001 +**). Seven programmes had roughly equal numbers by gender, but in more than half the programmes disparity was at least 20%. This is a particular concern given that the National Child Measurement Programme found that more boys than girls were overweight and obese at both reception (age 4-5) and Year 6 (10-11). The latest prevalence data (2010/11) indicated male and female children respectively considered overweight to be 13.8% to 12.6% at reception; 14.3% to 14.4% at Year 6 and obese to be 10.1% to 8.8% at reception and 20.6% to 17.4% at Year 6.[6]

Table 4.1 Gender differences in included study participants

Study	Differential	
	F	M
Banks 2012	≥20%	
Berkowitz 2011	≥20%	
Braet 1997	≥20%	
Bryant 2011	≥20%	
Collins 2011	≥10%	
Coppins 2011	≥20%	
Croker 2012	≥20%	
Daley 2006	≥10%	
Debar 2012	ALL FEMALE	
Estabrooks 2009		≥10%
Ford 2010	≥20%	
Gately 2005	≥10%	
Gately 2007	≥20%	

[6] National Child Measurement Survey 2010/11. http://www.ic.nhs.uk/statistics-and-data-collections/health-and-lifestyles/obesity/national-child-measurement-programme-england-2010-11-school-year

King 2007	≥10%	
Duckworth 2009	≥20%	
Goldfield 2001	≥20%	
Golley 2007	≥20%	
Hughes 2008	≥10%	
Janicke 2008	≥20%	
Jelalian 2010	≥20%	
Kalarchian 2009	≥10%	
Kalavainen 2007	≥20%	
Magarey 2011	≥10%	
McCallum 2007	Roughly equal	
Norton 2011	Roughly equal	
Nova 2001		≥10%
Petty 2009	≥10%	
Pittson 2011/2010	No gender data	
Rennie 2010	≥20%	
Resnicow 2005	ALL FEMALE	
Robertson 2011	≥20%	
Rudolf 2006	Roughly equal	
Sabin 2007	Roughly equal	
Sacher 2010	Roughly equal	
Savoye 2007	≥10%	
Shrewsbury 2009	Roughly equal	
Wake 2009	≥20%	
Watson 2009	Roughly equal	
Watson 2011	≥10%	
West 2010	≥20%	

Effects by gender – anthropometric outcomes

3.6 There is weak evidence from one [–] UBA[1] that that attendance at a **residential weight management camp** for overweight and obese **children** aged 9-17 years over a period of weeks does not result in a differential effect between boys and girls. Attendance was associated with reductions in BMI SDS for both boys and girls (−0.37 and −0.34 respectively) There is weak evidence from two [–] quasi-RCTs[1,2], one [–] CBA[3] and one [–] UBA[4] with significant **reductions in BMI z-score** amongst attendees by the end of camp . The programme consisted of six 1-hour physical activity sessions daily, moderate dietary restriction (1,300 to 3,300 kcal per day based on approx basal metabolic rate) and group-based educational sessions delivered by physical education teachers and a dietitian.

[1] King 2007

3.7 There is moderate evidence from one [+] RCT[1] that exercise-only interventions for children do not demonstrate a differential effect between boys and girls. The intervention consisted of five weekly 20 or 40 minute exercise sessions for overweight children aged 7-11 (58% female and 59% black) over 13 weeks.

[1] Petty 2009

3.8 There is very weak evidence that parent and child interventions are effective in girls.. A [–]

UBA[1] reported that the change in BMI SD at 6 months was greater for girls (-0.07 ± 0.14, p=.02. The UBA was programme for obese 8-16 year olds and their parents from a socially-disadvantaged community comprising a combination of motivational interviews and physical activity delivered in the community by non-professional health trainers to encourage lifestyle change via weekly parent/child appointments. Initial commitment of three months, with an option of three-month renewals up to one year

[1] Rudolf 2006

3.9 There is inconsistent evidence that family interventions have a differential effect in boys and girls. A [++] RCT[1] reported a significant effect in girls compared with boys in BMI-SDS change (average 0.2 decrease in girls and no change in boys. p=0.05). A [–] UBA[4] reported a similar result with a significant decrease in the BMI z-score for girls (–0.12, SEM 0.03, p<0.001) but not for boys (–0.08, SEM 0.04, p=0.08). A further [–] UBA[3] did not observe a significant difference at 12 months between boys and girls. However, two [–] UBAs[4.5] reported greater differences in boys than girls. One [–] UBA[1] observed a significantly greater reduction in z-BMI (p = 0.046) in boys compared with girls and a second [–] UBA[2] identified that more boys than girls were likely to achieve target reductions in BMI SDS; although the differences did not reach significance. However two studies observed a greater effect in girls.

[1] Kalavainen 2007, [2] Rennie 2010, [3] Watson 2011, [4] Norton 2011, [5] Sabin 2007.

3.10 There is inconsistent evidence that interventions directed at parents-only demonstrate a differential effect in boys and girls. One [++] RCT[1] observed that boys had significantly lower BMI z-scores at 6 and 12 months compared with baseline in both intervention groups but not the control group. For girls the only significant change was a reduction in BMI z-score However a second [++] RCT[2] noted that boys had higher BMI z-scores at baseline than girls but changes over time did not vary by gender. The interventions involved group-based parenting skills training directed to the parents of overweight and obese children aged respectively 6-9 and 5-9 years Both interventions were delivered over 6 months by dietitians.

[1] Golley 2007, [2] Magarey 2011

3.11 An examination of participant gender across the 34 included programmes identified considerably higher numbers of female participants in the majority of the 33 studies for which gender information was available. Only two studies had higher numbers of male participants and in more than half the programmes the imbalance was at least 20%.

Applicability:

3.6 Directly applicable: conducted in a UK short-term residential camp
3.7 Directly applicable: conducted in a community-based setting in the USA
3.8 Directly applicable: conducted in a UK community setting
3.9 Directly applicable: conducted in community-based settings in the USA[1] and the UK[2-4]
3.10 Directly applicable: conducted in an Australian community setting
3.11 Directly applicable: all studies conducted in community settings in the UK or other similar countries.

Low-income groups

Croker 2012 + was an RCT which examined the acceptability and effectiveness of 'family-based behavioural treatment' (FBBT) for childhood obesity in an ethnically and socially diverse sample of families in a UK NHS setting. The programme aimed to change the whole family's lifestyle with a weight control programme consisting of behavioural, diet and physical activity components. Significant BMI SDS (z-score) changes (P=0.01) were observed for the treatment (n=33) and control (n=30) groups of - 0.11 (SD 0.16) and -0.10 (SD 1.6). Though between-group treatment effects for BMI and body composition were not significant and no overall change in BMI or BMI SDS (z-score) from 0–12 months was observed for the treatment group. For those with follow-up to 12 months (n=19), BMI SDS (z-score) at baseline, 6 months and 12 months was 3.14 SD 0.72, 2.98 SD 0.75, 3.03 SD 0.78,respectively, p<0.005 but not this was not an ITT analysis. The results indicate that the FBBT approach may not be appropriate for ethnically and socially diverse populations.

Sabin 2007 – was a UBA study conducted in the UK which aimed to identify factors important in determining whether an obese child achieves significant reductions in BMI SDS. From a population aged 4 to 17 attending a hospital outpatient weight management programme (COCO). It indicated that socio-economic status did not appear to impact upon child outcomes.

Kalarchian 2009 ++ was a RCT conducted in a USA University medical centre to evaluate the efficacy of a family-based behavioural weight control programme in the management of severe paediatric obesity. The intervention involved 20 group meetings (60 minutes each) over 6 months. Adult and child groups met separately and were presented with complementary material and six booster sessions were provided between months 6 and 12. The intervention comprised of dietary, behavioural and physical activity strategies. It was reported that a higher family income was associated with short-term decreases in percent overweight, p = 0.025.

Golley 2007 ++ compared parenting skills training (P+DA) and intensive lifestyle education with parenting skills only (P) or wait-list control, delivered in the community in the USA, no association was found between change in BMI z -score from baseline to 12 months and indicators of socio-economic status.

Effect by low-income groups – anthropometric outcomes

3.12 There is inconsistent evidence that family interventions are effective in low-income groups. Two UK studies did not identify an association between low socio-economic status and child outcomes. A [+] RCT[1] found no significant between-group treatment effects for BMI and no overall change in BMI or BMI SDS (z-score) from 0–12 months in a treatment group where 46% of parents had minimum levels of education. A [–] UBA[2] study conducted, in the UK indicated that socio-economic status (median Townsend Deprivation Index Quintile=3,1-5) did not appear to impact upon child outcomes. However, a USA-based [++] RCT[3] reported that a higher family income was associated with short-term decreases in percent overweight, p = 0.025. Programmes: [1] Seventy two families with overweight or obese children aged 8-12 years family-based behavioural treatment programme (FBBT) consisting of behavioural, diet and physical activity components. Delivered by clinicians, dietitians and family therapists over six months [2] Families with obese children aged 2-17 years attending a hospital outpatient obesity clinic were offered three-monthly appointments with a paediatrician, and

a paediatric dietitian who encouraged goal setting and practical dietary changes. Advice was provided on physical activity and families invited to attend free 2-hour, weekly games session. [3] A year-long family-based behavioural intervention for severe obesity in 190 children aged 8-12 years (56.8% female and 73.4% white). It comprised dietary, behavioural and physical activity strategies, involved twenty 60-minute group meetings over six months separately for adult and child groups with complementary material, plus six booster sessions in months 6-12.

[1] Croker 2012, [2] Sabin 2007, [3] Kalarchian 2009

3.13 There is moderate evidence from one[++] RCT [1], that interventions directed at parents only do not demonstrate an association between change in BMI z -score from baseline to 12 months and indicators of socio-economic status. The intervention involved group-based parenting skills training directed to parents of overweight and obese children aged respectively 6-9 years Intervention delivered over 6 months by dietitians.

[1] Golley 2007

Applicability

3.12 Directly applicable: community-based studies conducted in the UK[1,2] and the USA[3]

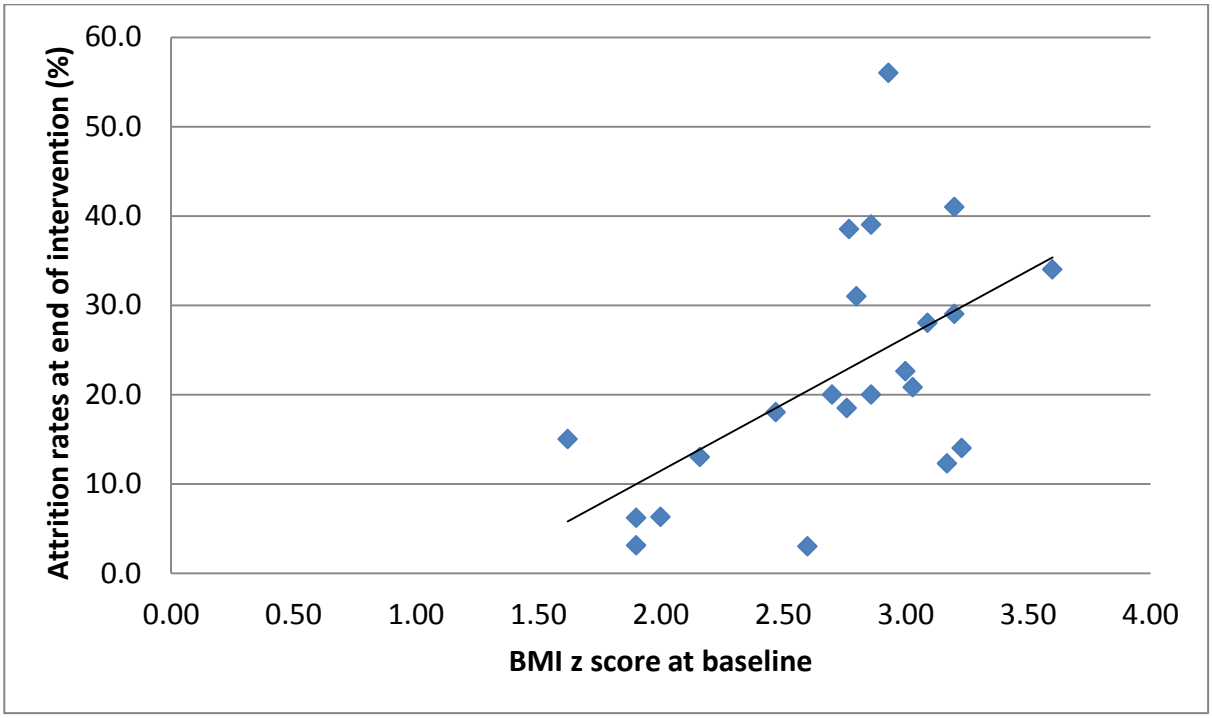
3.13 Directly applicable: community based study conducted in Australia

Effect of baseline BMI z score on attrition

An analysis of baseline BMI z score on attrition was examined within the family based interventions (Banks 2012, Bryant 2011, Collins 2011, Coppins 2011, Croker 2012, Daley 2006, DeBar 2012, Ford 2010, Goldfield 2001, Hughes 2008, Janicke 2008a, Jelalian 2010, Kalavainen 2007, McCallum 2007, Norton 2011, Rennie 2010, Robertson 2011, Sacher 2010, Savoye 2007, Shrewsbury 2009, Wake 2009, Watson 2011).

There is evidence that BMI z scores at baseline were positively associated with attrition rates at the end of the intervention; Attrition rates increased with increasing BMI z score (correlation coefficient =0.56, p=0.007). (Figure 4.10)

Figure 4.10 Attrition rates at end of intervention and BMI z score at baseline for family studies



Effect of BMI z score at baseline on end of intervention attrition

3.14 There is strong evidence from 22 studies of family-based interventions (8 [++] RCTs[1-8], 9 [+] RCTs[9-17], 1[–] RCT[18], 4 [–] UBAs[19-22]) that BMI z scores at baseline are associated with attrition rates at the end of the intervention. Attrition rates increased with increasing BMI z score (correlation coefficient =0.56, p=0.007). This evidence is directly applicable as all studies were conducted in community settings in the UK or other similar countries.

[1] Collins 2011, [2] Daley 2006, [3] DeBar 2012, [4] Ford 2010, [5] Kalavainen 2007, [6] McCallum 2007, [7] Shrewsbury 2009, [8] Wake 2009, [9] Banks 2012, [10] Bryant 2011, [11] Coppins 2011, [12] Croker 2012, [13] Hughes 2008, [14] Janicke 2008a, [15] Jelalian 2010, [16] Sacher 2010, [17] Savoye 2007, [18] Goldfield 2001, [19] Norton 2011, [20] Rennie 2010, [21] Robertson 2011, [22] Watson 2011.

Applicability

3.14 Directly applicable: all studies conducted in community settings in the UK or other similar countries

Variations in cost-effectiveness for different population groups

None of the health economic analyses found explored differential cost effects for different population groups.

Variations in cost-effectiveness for different groups

3.15 No evidence was found exploring differential cost effects within different population groups

Question 4. What are the most effective and cost effective ways of addressing and sustaining behavioural change among overweight and obese children and young people using community-based weight management programmes?

Overall, the pooled SMDs indicate a very small reduction in BMI/zBMI for children in the intervention compared to those control arm (SMD = -0.06; CI 95% = -0.12 to -0.01, p = 0.02). Figure X shows the effect of interventions was smaller as the length of follow-up increased.

Eight studies evaluated the effect of interventions at 12 months follow-up or more for BMI and/or other outcomes. Three RCTs (**Collins 2011 ++**, **DeBar 2012 ++**, **Savoye 2009 +**) and one quasi-RCT (**Coppins 2011 +)** showed small improvements in BMI at long term follow-up compared to the control group. Of these improvements were slightly greater than short term effects in two studies (**Savoye 2009 +, Coppins +**) and slightly less in two studies (**DeBar ++**, **Collins 2011 ++**). In addition, a UBA study showed long-term improvements in outcomes that were slightly greater than short-term effects (**Robertson 2011 –**). All four studies involved behavioural training that targeted both diet and physical activity and involved parents or the wider family in addition to children. The intervention duration ranged between three and 12 months.

Three further RCTs did not find a significant long-term effect of the intervention on BMI compared to usual care control groups (**McCallum 2007 ++**, **Magarey 2011 ++, Kalavainen 2007 ++**). Interventions lasted between three to six months, and involved behavioural therapy and targeted diet and physical activity. **Magarey 2011 ++** was delivered only to parents, whereas **Kalavainen 2007 ++** and **McCallum 2007 ++** were delivered to the family. However, **McCallum 2007 ++** did however show better diet and physical activity measures at 12 months (I-C) adjusted mean differences of 1.6 (95% CI 0.9 to 2.3) and 0.2 (95% CI -0.0 to 0.3).

The results of individual studies are described below:

Collins 2011 ++ was an RCT comparing 10 weeks of behavioural change with three groups (i) diet, (ii) physical activity; (iii) 'diet plus physical activity' with overweight 5-9 year olds in Australia. There was no usual care control group. At circa 21.5 months post intervention the mean (95% CI) reduction in BMI z-score from baseline was: Diet group -0.35 (95% CI -0.48, -0.22), Activity group -0.19 (95% CI -0.30, -0.07), and Diet + Activity group -0.24 (95% CI -0.35,-0.13). Thus the diet and diet+activity groups were significantly more effective than physical activity- only groups (p=0.02). Energy intake reduced in all groups but there was no significant change in physical activity in any group.

Coppins 2011 + was a quasi-RCT conducted in a UK community setting to determine if a family focused education package consisting of behavioural therapy, diet and physical activity interventions is more effective than a waiting list control (WLC) group in treating overweight and obese children. The two year study showed that children given active intervention for 12 months followed by 12 months of body composition monitoring alone were able to sustain BMI loss, such that by the end of the study they had statistically significantly lower BMI SDS score and the proportion of children with a BMI centile above 99.6th fell from 57% to 19%. Long-term results should be viewed more cautiously, as waitlist children received the intervention after the first 12 months. The groups also reduced their BMI SDS throughout, but not as much as in the group that had the intervention first. Change in BMI SDS from baseline to end of intervention period, I = -0.17(95% CI -0.26 to -0.08), C = -0.08(95% CI -0.24 to 0.07); change from baseline to 12 months follow-up I = -0.44 (95% CI -0.7 to – 0.18); C = -0.14 (95% CI -0.0.35 to – 0.06).

This suggests that a modest programme of family-based interventions (two half days of family activity, followed by weekly activity during term time although attendance was poor at these weekly sessions) followed by a period of body composition monitoring was effective.

DeBar ++, an RCT in the USA compared a five month behavioural intervention focusing on diet and physical activity with additional physical activity interventions to control (usual care) in female adolescents. At 13 months post-intervention follow-up the decrease in BMI z-score observed at 1 month continued over time, with the intervention group showing significantly greater improvements compared with usual care (I = −0.15; UC = −0.08 P=0.012). Similarly dietary behaviour was also improved at 13 months, with intervention participants reporting less reduction in frequency of family meals (Family meals times/wk, I = 3.51 (2.60), UC = 3.29 (2.49) p = 0.028) and less fast food intake (Fast food times/wk, I = 1.00 (1.01), UC = 1.55 (1.39) p = 0.021). Physical activity outcomes were not improved compared to the control group, whereas body satisfaction (I = 2.93 (0.66), UC = 2.74 (0.74), p = 0.026) and appearance attitudes (I = 2.18 (0.93), UC = 2.43 (0.96) p = 0.019) were significantly improved at 13 months.

Kalavainen ++ an RCT examined a 6 month behavioural and solution-oriented intervention promoting healthy lifestyle and well-being compared to usual school counselling. The intervention resulted in significant reductions in BMI SDS (z-scores) at the end of the treatment (I = -0.3 SD 0.3, C = -0.2 SD 0.3, significance of difference between groups p=0.022) but these improvements were not sustained at 18 or 30 months.

Magarey 2011 ++ compared parenting skills training and intensive healthy lifestyle education (P+HL) with health lifestyle education alone (usual care HL control) in Australia. At 18 months from baseline there were significant overall reductions in BMI z-score (0.26, 95% CI 0.22 to 0.30), but no significant between group differences. The 10% reduction in z-scores observed from baseline to intervention end at 6 months was maintained, 18 months later with no additional intervention. Parenting outcome scores in both groups improved from baseline to intervention end ($p<0.05$) and generally remained stable after that to 24 months. There were no between group differences. Healthy lifestyle education improved BMI and parenting outcomes at 18 months, with or without the addition of parenting skills.

McCallum 2007 ++ was a RCT nested within a baseline cross-sectional BMI survey conducted within an Australian primary care setting with the aim to reduce gain in body mass index (BMI) in overweight/mildly obese children. The 3 month intervention compared behaviour therapy focusing on nutrition, physical activity and sedentary behaviour to no intervention. There was no significant difference between intervention and control in BMI z-scores at six or 12 months. The adjusted difference at 12 months was (I-C) -0.03 (95%CI: -0.17 to 0.1). However better diet and physical activity measures were noted at 12 months (I-C) adjusted mean differences of 1.6 (95% CI 0.9 to 2.3) and 0.2 (95% CI -0.0 to 0.3).

Robertson 2011 – (Families for Health) describe a UBA study conducted in a UK community setting to assess long-term outcomes and costs of a behavioural 'Families for Health' programme. The programme involved a 2.5 hour session per week for 12 weeks with each week comprising parallel groups for children and parent(s)/carer(s). It consisted of two elements: parenting tips from the UK based Family Links Nurturing Programme and a healthy eating component from the Food Standards Agency. End of the intervention, and 21 months post-intervention follow-up, mean reductions in BMI

z-score from baseline were, -0.18 (95% CI -0.30 to -0.05), and -0.23 (95% CI -0.42 to -0.03), respectively; p=0.027.

At all time points less exposure to unhealthy foods in the home (stimulus exposure) and improved eating style were observed, but there was no statistically significant difference in eating related to hunger or fruit and vegetable consumption. Results for stimulus exposure at end of intervention and 21 months respectively were (Golan questionnaire, lower is better): -3.1 (95% CI -4.6 to -1.6) and -2.0 (95% CI -3.5 to -0.5). There was also a significant reduction in sedentary behaviour at all time points. Inactivity/activity ratios for post intervention and 21 months follow-up were (Golan, lower is better): -8.5 (95% CI -13.9 to -3.2) and -9.6 (95% CI -14.7 to -4.6). Children's quality of life improved significantly from both the children's and parents' perspectives at 21 months: 11.8 (95% CI 4.0 to 19.7) and 11.9 (95% CI 4.8 to 19.0) respectively (range 0-100).

Savoye 2009 + an RCT conducted in the USA, compared a 12 month intensive lifestyle behavioural programme to usual care. At 12 months post-intervention follow-up the treatment effect (intervention – control) was sustained at 24 months in the intervention versus control group for BMI z-score -0.16 95% CI -0.23 to -0.09, P value <0.001. At the end of the 6 month intervention the mean BMI z-score treatment effect was -0.18, 95%CI -0.24 to -0.12, p <0.001.

Most effective ways of sustaining long-term effects

4.1 There is inconsistent evidence as to whether the effects of weight management programmes are sustained long-term. There is strong evidence from meta-analyses of 18 programmes: 10 [++] RCTs[1-11](11 papers), 5 [+] RCTs[12-16], 3 quasi-RCTs (1 [+][17], 2 [–][18,19]) with BMI-z outcomes, indicating improvements decrease the longer the length of follow-up.

[1] Collins 2011, [2] Daley 2006, [3] DeBar 2012, [4] Ford 2010, [5] Golley 2007, [6] Karlachian 2009, [7] Magarey 2011, [8] McCallum 2007, [9] Nguyen 2012, [10] Okely 2010, [11] Wake 2009, [12] Croker 2012, [13] Estabrooks 2009, [14] Jelalian 2010, [15] Sacher 2010, [16] Savoye 2009, [17] Nova 2001, [18]Resnicow 2005, [19] West 2010

4.2 Considering BMI plus other outcomes, there is inconsistent evidence from five [++] RCTs[1-5], one [+] RCT[6] one [+] quasi-RCT[7] and one [–] UBA[8] as to whether the effects of weight management programmes are sustained long term. It is not possible to determine which intervention components result in sustained outcomes.

[1] Collins 2011, [2] DeBar 2012, [3] Kalavainen 2007, [4] Magarey 2011, [5] McCallum 2007, [6] Savoye 2009, [7] Coppins 2011, [8] Robertson 2011

Applicability

4.1 Directly applicable: all studies conducted in community settings in the UK or other similar countries.

4.2 Directly applicable: all studies conducted in community settings in the UK or other similar countries.

Question 5. How does the inclusion of parents, carers and the wider family impact on the effectiveness of community-based weight management programmes for children and young people?

The forest plots summarising the effects according to the level of family involvement (Figures 4.1 and 4.2) show little difference in the size and precision of the effect of interventions according to level of family involvement (interventions targeted to just parents/carers or to the whole family).

No parent/carer and child interventions reported data on this topic.

Seventeen programmes targeted the family as a whole [**Banks 2012 +**, **Berkowitz 2011**, **Braet 1997 +**, **Coppins 2011 +**, **Croker 2012 +**, **Ford 2010 ++**, **Hughes 2008** +, **Kalarchian 2009 ++**, **Kalavainen 2007 ++**, **McCallum 2007 ++**, **Norton 2011** −, **Nova 2001 +**, **Rennie 2010 −**, **Robertson 2011 −**, **Sabin 2007 −**, **Sacher 2010**, **Wake 2009 ++**, **Watson 2009**, **Watson 2011.** All but one programme (**Norton 2011** −) included a behavioural component that aimed to change family behaviours around diet and physical activity.

Of these, only one programme (**Watson 2011 −**) specifically indicated that parental/carer involvement improved child BMI-z-score outcomes. In the GOALS programme active involvement of adults in the weight loss process improved child health z-score measures: children attending with adults who lost weight, difference = −0.13±0.23 as compared with those attending with adults who maintained/ increased weight = −0.05±0.25.

Three studies in parents only compared the effect of interventions to improve parenting skills with other interventions (**Triple P ++**, **PEACH ++**, **Group Lifestyle Triple P −**).

Golley 2007 ++ an RCT, compared behavioural therapy focusing on parenting skills and intensive lifestyle education (P+DA) with behavioural therapy for parenting skills only (P), and a wait list control (WLC). There were no significant differences in effect of between the groups in BMI z-scores At 12 months BMI z-score reduced by 9% (range −85% to 18%) in P+DA group, 6% (−48% to 49%) in P group and 5% (−78% to 16%) in WLC group. At 12 months, BMI z-score was reduced in all groups but there was no statistically significant difference between groups. At 6 and 12 months, most reported measures of food intake were unchanged other than that energy-dense nutrient-poor foods were lower in both intervention groups: 12 months mean difference from control in P+DA group was −1.0 (95% CI −2.0 to −0.5) and −1.0 (−1.5 to 0.0) in P group. There were also reported reductions in small screen use and increases in active play across all groups but no between- group differences.

Magarey 2011 ++ an RCT compared behavioural therapy to improve parenting skills and intensive lifestyle education to healthy lifestyle education alone without parenting skills. At 24-months, there were overall reductions in BMI z-score (0.26, 95% CI 0.22 to 0.30) and waist z-score (0.33, 0.26 to 0.40) across both groups but again no significant between group differences. Parenting outcome scores in both groups improved from baseline to 6 months ($p<0.05$) and generally remained stable after that to 24 months. There were no between group differences.

West 2010 – compared results of a group and telephone sessions delivering parenting skills training with a waitlist control in the USA. Between baseline and 12 weeks (at the end of the intervention) there were significant improvements in BMI z-score for the intervention group (from 2.15, SD 0.43 at baseline to 2.04 (SD 0.44) at 12 weeks). The score was maintained at 12 months (1.96, SD 0.46).

There were no significant changes between baseline and 12 weeks for the control group, and outcomes were not recorded at 12 months.

Impact of parents/carers and the wider family– anthropometric outcomes

5.1 There is inconsistent evidence from two [++] RCTs and one [–] cluster RCT of similar group-based behavioural programmes directed to the parents of overweight and obese children aged respectively 6-9, 5-9 and 4-11 years. Although there were significant overall differences in BMI z-scores, neither [++] RCT found significant between group differences. However the [–] cluster RCT found significant improvements in BMI z-score for the intervention group (from 2.15, SD 0.43 at baseline to 2.04 (SD 0.44) at 12 weeks). The score was maintained at 12 months (1.96, SD 0.46). Two intervention were delivered over 6 months by dietitians [1,2] and one by a clinical psychologist over 12 weeks[3].

[1] Golley 2007, [2]Magarey 2011, [3] West 2010

5.2 There is very weak evidence from one UBA [−] that parental involvement improved child BMI-z-scores. Children attending with adults who lost weight, difference was −0.13±0.23 as compared with those attending with adults who maintained/ increased weight was 0.05±0.25. The programme was a community-based, lifestyle change intervention for 65 obese children aged 6-14 and their families involving 18 sessions of 2 hours per week focusing on diet, physical activity and behaviour change. The programme was delivered by non-clinical staff trained by the developers.

[1] Watson 2011

5.3 No interventions directed at the whole family provided impact data.

Applicability

5.1 Directly applicable: studies conducted in community settings in Australia[1,2] and the USA[3]

5.2 Directly applicable: UK community-based study

Question 6. How can more overweight and obese children and young people be encouraged to join, and adhere to, lifestyle weight management programmes?

No data were found to answer this question. It is anticipated that information to answer this question will be identified in Review 2

Encouraging children and young people

6.1 No data were found to answer this question from intervention studies.

Comparison with six previous systematic reviews

Five recent reviews published between 2009 and 2012, with a *specific* focus or section on lifestyle weight management schemes for children or adolescents, were examined (Bond 2011, Kitzmann 2010, Knowlden 2012, Oude Luttikhuis 2009, Whitlock 2010). Three provided synthesised outcome data (Kitzmann 2010, Oude Luttikhuis 2009, Whitlock 2010) and are summarised in detail below. Of a number of reviews published in 2008, one (McGovern 2008) was also included as the analysis looked at parental involvement and age group effects; providing additional information for two of this review's sub-questions.

Kitzmann (2010) was a meta-analytic review (rather than a full systematic review) examining the effect of lifestyle interventions – defined as those that include some combination of diet, exercise or other weight-related behaviour change - on overweight youth. The literature search dates were not stated. Studies, randomised and non-randomised, included subjects from age 6 onwards with some 18 and 19 year olds. 66 treatment-no treatment control and 59 treatment-alternate treatment comparisons were included from 40 and 36 studies respectively. An average effect size (Cohen's d) was calculated for each study for weight and/or BMI. When both weight and BMI were reported in a study the average effect size was used.

The overall weight/BMI effect size d for the treatment-no treatment control comparisons was a reduction of 0.41 (95% CI 0.26 to 0.55). The authors noted that there was more heterogeneity in the effect sizes than would be expected through random variation. Randomization within the study was not found to be a significant moderator of effect size. Nor did this vary greatly depending on recruitment method (major methods being community advertisement, large-group screenings and physician referral).

The authors did not explore the effect of ethnicity, social status, age, gender or special needs on outcomes or the individual components (diet, exercise, both).

Programme length: In the 31 programmes lasting 0-4 months the average effect size was d=0.48 (SE 0.09), compared to 0.28 (SE 0.13) for 11 programmes lasting 4-8 months (excluding one study with a significantly negative effect size and methodological weaknesses).

Parental involvement: It appeared that programmes with higher parental involvement (involvement in all aspects of treatment) had outcomes about ¾ standard deviation better than controls and about ¼ standard deviation better than alternative programmes with low parent involvement (where youth had primary responsibility for most of the treatment). This translated into a 21-pound difference between participants and controls and a 7-pound difference between high-low parental involvement groups. Effect sizes did not vary significantly with the degree of parent weight management as part of the programme.

Parent training in general behaviour management was associated with significantly better outcomes; translating to a one standard deviation or about 28-pounds between treatment and control groups. Programmes from recent decades produced effect sizes that were similar to those produced in older studies.

Oude Luttikhuis (2009) was a Cochrane Review that explored all types of interventional RCT (lifestyle, drug and surgical) for treating obesity in children with a mean age of under 18 years with a minimum 6 month follow up. The literature search covered the period 1985 to May 2008. Lifestyle interventions were defined as those with dietary, physical activity and/or behavioural components. Interventions that specifically dealt with the treatment of eating disorders or type 2 diabetes, or included participants with a secondary or syndromic cause of obesity were excluded. 54 lifestyle interventions were included of which 12 focused on

physical activity and sedentary behaviour, 6 on diet and 36 on behavioural-orientated treatment programmes.

A reduction in overweight was noted at 6 and 12 months for children (under 12; n=37) and adolescents (12 years and over; n=17). In terms of validity, a number of the studies had small sample sizes, a likelihood of small study biases, relatively high drop-out rates and unadjusted outcome measurements.

Only those studies with similar analyses based on intention-to-treat principles were combined in meta-analyses. For children under 12 years the effect sizes for change in BMI-SDS at 6 and 12 months follow up (IV fixed) were -0.06 (95% CI -0.12 to -0.01; 4 studies) and -0.04 (-0.12 to 0.04; 3 studies) respectively. For children aged 12 years and over, the changes in BMI-SDS (BMI z-score) at 6 and 12 months were -0.14 (-0.17 to -0.12; 3 studies) and -0.14 (-0.18 to -0.10; 2 studies). Since there were so few studies, change in BMI was also explored and at 6 and 12 months the effect sizes were -3.04 (-3.14 to -2.94; 4 studies) and -3.27 (-3.38 to -3.17; 2 studies).

Overall, the authors concluded that family-based, lifestyle interventions, with a behavioural programme aimed at changing diet and physical activity thinking patterns, provide a significant and clinically meaningful decrease in overweight in both children and adolescents compared to standard care or self-help in the short- and long-term. There was a noticeable absence of information on adverse effects.

The authors noted that the practicality of delivering effective programmes would vary with the wide span of social, ethnic and economic circumstances but they did not specifically analyse the included studies for any differential effects.

McGovern 2008 looked at RCTs of overweight 2-18 year olds (literature search to February 2006) and included 30 combined lifestyle interventions, of which 23 were synthesised within a meta-analysis. The results were consistent with a small to moderate treatment effect. The standardised mean difference (SMD and 95% CI) were provided where SMD <0.2 was regarded as a small effect, 0.5 as moderate and ≥0.8 as large. The largest effects were associated with parental involvement in delivering the intervention, when the parents were either targeted individually or with the child.

Results for targeting the family (parents only or children + parents, n=11), for targeting children alone (n=12) and for comparing the effects of family versus children (n=2) were -0.64 (-0.88 to -0.39), -0.17 (-0.40 to 0.05) and -0.64 (-1.80 to 0.52).

The authors did not find a significant interaction between the age of participants and the effect of lifestyle interventions with parental involvement, but there was a trend toward a larger treatment effect in children aged 8 years or less. The SMDs (95% CI) for studies with the majority of children 8 years of less (n=2) and those where the majority were aged 9-18 (n=10) were -0.70 (-1.00 to -0.40) and -0.49 (-0.81 to -0.18).

Whitlock (2010) was a targeted review to support updated US Preventive Services Task Force recommendations. Based on 15 fair to good quality behavioural trials (literature search from 2005 to June 2008) for age groups 2-18 the authors concluded that comprehensive behavioural interventions of medium-to-high intensity were the most effective behavioural approach.

Inclusion criteria were specific including: RCTs or controlled clinical trials with minimal intervention or placebo control; primary care population, outcomes for at least 6 months beyond baseline; "high" human development countries; with appropriate adiposity or weight outcome. Most participants were >95th percentile for height and weight. Trials were considered comprehensive if they included (1) weight-loss or

healthy diet counselling; (2) physical activity counselling or participation; and (3) behavioural management techniques.

From 3 moderate (26-75 hours) to high-intensity (>75 hours) comprehensive weight-management programmes a 1.9 to 3.3 kg/m^2 difference was seen in intervention versus control groups at 6 to 12 months. More limited evidence suggested that improvements could be maintained over 12 months after the end of treatments. Across 11 behavioural intervention trials of varying intensities, all were consistent with benefits but not all results were statistically significant. At 6 to 12 months follow-up intervention groups were 0.3 to 3.3 kg/m^2 lighter.

Meta-analysis confirmed that, among comprehensive weight management programmes, moderate to high-intensity interventions had a homogeneous, significantly larger, effect on weight outcomes (standardised mean difference -1.01 (95% CI -1.24 to -0.78; n=3) than very low intensity interventions (<10 hours; -0.39 [-0.66 to -0.11]; n=3).

The overall weight loss was estimated, varying with age, as within a range of 13-23 lbs after 12 months. This is compatible with the estimate by Kitzmann (2010).

The authors did not explore the effect of ethnicity, social status, age, gender or special needs on outcomes or the individual components (diet, exercise, both). Fewer than half the trials explored adverse events but no evidence of harms such as effects on height, eating-disorder pathology or depression was found other than possible increase in injury rates from exercise in two trials.

Two further recent reviews did not provide synthesised outcome data:

Bond (2011) looked at the effectiveness of weight management schemes for the under fives reported in controlled trials with objective measures. They included schemes delivered in any setting, including home-based, and 'normal practice', non-diet and non-exercise interventions. Schemes for overweight or obese children had to have a minimum 3 month follow-up period. From their literature review, 1990 to March 2009, they found no treatment or cost-effectiveness studies.

Knowlden (2012) carried out a narrative summary of family and home-based English language RCTs aimed at treating overweight and obesity in children aged 2-7 years. The search covered January 2001 to August 2011 and 9 unique RCTs met the inclusion criteria. The review focused largely on research recommendations. No analyses were undertaken and the recommendations for practice do not appear to be directly derived from the included studies.

In summary from four reviews with many shared primary studies (Kitzman 2010, Oude Luttikhuis 2009, McGovern 2008, Whitlock 2010), reviewers were in agreement that lifestyle weight management schemes for children and adolescents are effective. Outcomes are briefly summarised below for lifestyle weight management versus minimal intervention/placebo control group:

Systematic Review[7]	Included studies	Summary outcome: Intervention versus control
Kitzmann 2010	40 randomised and non-randomised studies Ages 6-19	BMI average effect size d = −0.41 (95% CI -0.26 to −0.55)
Oude Luttikhuis	54 RCTs	BMI z-score at 12 months=

[7] Note: there was a high degree of overlap of included studies.

2009	Mean age <18	−0.04 (−0.12 to 0.04) for ages <12 (n=3) −0.14 (−0.18 to −0.10) for ages ≥12 (n=2)
McGovern 2008	30 RCTs Ages 2-18	Standardised mean difference in BMI = −0.70 (−1.00 to −0.40) for ages ≤ 8 (n=2) −0.49 (−0.81 to −0.18) for ages 9-18 (n=10)
Whitlock 2010	15 fair to good quality RCTs/controlled trials Ages 2-18	Standardised mean difference in BMI at 12 months = −1.01 (−1.24 to −0.78) for moderate to high intensity interventions (n=3) −0.39 (−0.66 to −0.11) for very low intensity interventions (n=3)

Much better outcomes were likely from programmes that involve parents with or without children, as opposed to those that are designed for children alone (Kitzman 2010, McGovern 2008), approximating to a 0.25 difference in z-score (Kitzman 2010). Higher intensity programmes (in terms of hours of treatment) gave better results, approximating to a standardised mean difference of 0.6 for moderate-high versus very low intensity (Whitlock 2010).

No clear conclusions emerge in terms of differential effects by age group. Oude Luttikhuis (2009) found larger effects for children aged 12+ as opposed to under-12s, while McGovern (2008) found better outcomes for children aged 8 or under as opposed to 9-18 year olds. There were no data on effects by ethnicity, social status, gender, special needs, or the importance of individual dietary and exercise components.

Local service evaluations in the UK describing costs and outcomes

Jinks (2010) looked at programmes offered within the Burnley area of the UK: Obesity Support for Children and Relatives (OSCAR), Mind, Exercise, Nutrition, Do it (MEND), the Burnley Food and Fitness Aimed at Lowering Obesity (BUFFALO), of which BUFFALO is a prevention not treatment intervention and is not considered further in this section. The authors did not explore cost effectiveness but provided estimated annual costs which were £1,059 per child for OSCAR (based on 40 children per year) and £536 per child for MEND (based on 60 children per year). The authors concluded that the programmes offered a tiered approach to providing services and had different emphases, all of which were necessary within the Burnley area.

Formally published evaluation studies of MEND have been included in this review for NICE.

The only outcome data available for OSCAR, to our knowledge, were reported in this review and relate to seven families (26 individuals). Five families (18 individuals) participated in the programme and anthropometric data were available for 12 participants. This very small, uncontrolled project has not been formally evaluated. Details are given below in Table 4.3.

Robertson 2011 described the costs and outcomes of the Families for Health programme, a family-based group programme delivered at a leisure centre in Coventry. The 12-week manualised programme involved a 2.5 hour session per week, comprising parallel groups for overweight or obese children aged 7-11 years and their parent(s)/carer(s). The average cost-effectiveness of was estimated to be £2,543 per unit reduction in BMI z-score.

Upton (2010) evaluated a number of child weight management programmes for children aged 6-18 in the West Midlands: Fun 4 Life, Fitter Families, Goals, MEND, One Body One Life, Watch It! and YW8?. The authors explored effectiveness in terms of health improvement and behaviour change, possible barriers to change and the cost-effectiveness of each intervention. A systematic review of the literature (search date January 1996 to December 2009) found that only the MEND and Watch It! programmes had been written up as journal publications.

Summary findings were based on routinely collected data from participants in each programme during the period 1 July 2007 to 1 July 2009. BMI SD (z-score) decreased in four programmes (by 0.1 to 0.2 points) and remained unchanged in two programmes. Details are given below in Table **.

Previous review of economic evaluations conducted alongside trials

John (2010) provided a summary of five economic evaluations of lifestyle weight management programmes for children and adolescents (Janicke 2009, Kalavainen 2009, Moodie 2008, Wake 2008, Wake 2009). The studies were not synthesised further within the review and all have been unpicked and considered individually in section 4.

Table 4.3: Summary economic data for UK studies from Jinks 2010 and Upton 2010

UK studies	Fun 4 Life Upton 2010	Fitter Families Upton 2010	GOALS Upton 2010	MEND Upton 2010	MEND Jinks 2010	One Body One Life Upton 2010	Watch It! Upton 2010	YW8? Upton 2010	OSCAR Jinks 2010
Target group	Aged 8-16[i] Walsall area	Aged 6-16 [i] Stoke area	Aged 8-13[i] Sandwell	Aged 7-13[i] West Midlands	Aged 7-13 [i] Burnley	Aged 7-16[ii] Coventry	Aged 8-16[iii] Birmingham area	Aged 8-13[i] Telford & Wrekin area	Aged 7-14[iv] NHS East Lancashire
No. children recruited (completed)	86 (45)	45 (40)	7 (6)	421 (252)	59 (35)	N/A (123)	161(53)	70 (46)	18 (12)
BMI SD (z-score) change [completers]	No change	No change	Not available	-0.2	-1.1 (-2.4 to 0.1)	-0.1	-0.1	-0.1	Not provided
Cost per child (2008/9) **£**	342-677	857-1,071	-	682-1,139	536	321-408	798-2,424	555-845	1,059

i. All children were overweight or obese
ii. One or more members of the family an unhealthy weight. Analysis was on children who completed the programme.
iii. All children were obese
iv. Children were obese with complex health and/or social needs

5. DISCUSSION

Overall, lifestyle weight management programmes for children and adolescents have a significant post- intervention effect on BMI z-scores.

Meta-analysis indicates the post- intervention pooled standardised mean differences (SMD) is a small reduction in BMI/zBMI for children in the intervention compared to those control arm (SMD = -0.17; CI 95% = -0.30 to -0.04, p = 0.01). In the long term (≥ 6 months) the pooled SMD indicated a null effect on BMI/zBMI (SMD = -0.07; CI 95% = -0.15 to 0.02, p = 0.12). These estimates are broadly comparable with the Cochrane review on the topic (Oude Luttikhuis 2009) but are lower than other recent reviews.

To maximise the likely effect size of the intervention and the sustainability of the effects the evidence from this efficacy review supports the inclusion of the following components:

- Targeting the whole family rather than children or parents only
- Providing dietary, physical activity and behavioural advice; particularly emphasising dietary components and behavioural support for parents.
- Providing a high intensity rather than low intensity intervention in terms of contact time and programme length

Results from the UK compared with the best evidence from large RCTs outside the UK are comparable, lending support to the overall effect estimates.

Programmes can result in other benefits such as dietary changes and, possibly improved quality of life, but improvements to physical activity and other psychosocial changes appear less likely. There is relatively little evidence for different social and ethnic groups, and inconsistent evidence for effects on boys and girls. Such evidence as is available suggests no major differences overall in these three domains.

Findings for age groups suggested greater effectiveness for younger age groups (6-12) versus older children (ages 13-17) immediately post intervention, although these differences do not appear to be sustained in the longer term. This finding is in direct contract to the Oude Littikuis review (2009) which concluded, from a much smaller number of studies, greater effectiveness at 12 months for children aged 12 or under.

There was a distinct gender disparity in the programmes with a majority of studies recruiting significantly greater percentages of female participants. In more than half the programmes this disparity was at least 20% which is a concern given that data from the National Child Measurement Programme indicates a higher prevalence of overweight and obesity in boys which increases with age.

The cost effectiveness studies suggest that programmes can be cost-effective in terms of BMI z-score gains in the long term at conventional cost-effectiveness thresholds, provided that short term (post-intervention) effects on BMI, observed in trials, are sustained into adulthood.

Strengths and limitations of this review:

This review was built on a comprehensive search strategy to find evaluations of UK-based child weight management interventions of all research designs, large randomised controlled trials completed outside the UK and all health economic evaluations. This approach ensured that the highest quality

global evidence was available for consideration, as well as all the UK-based studies to enhance the review's relevance for the UK setting.

No evidence was identified for the effectiveness of programmes in children aged six or under. Although several programmes were open to children in this age group, the mean age of participants in all studies was at least six years. There was also little data examining differential effects by groupings such as gender, socio-economic status, ethnicity and special needs. The one notable

Interventions were heterogeneous both in terms of intervention design and outcome measures. In particular, the wide array of physical activity, diet and well being measures, made it difficult to compare outcomes across studies.

As is common in these types of intervention, high levels of attrition were observed in many studies, often early in the programme. Unsurprisingly this meant that many studies were underpowered to detect effects.

The UK-based evidence included some RCTs but also a number of small uncontrolled studies with limited internal validity.

Nevertheless, the evidence provides clear pointers for the components to include in a weight management intervention, as outlined above.

Evidence from the barriers and facilitators review (Review 2) is likely to enrich the evidence available within this review.

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