

**Title:** Family-based childhood obesity interventions in the UK: a systematic review of published studies

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### **Key points:**

1. Family-based programmes have been shown to be effective in targeting childhood obesity.
2. There is some evidence that evaluates UK family-based obesity interventions at a local level, although no review, to date, has addressed this nationally.
3. Change in adiposity is a short-term benefit of participation in a child weight-management programme, but there is insufficient, robust evidence to indicate that this benefit is long lasting.

4. There is insufficient evidence to suggest how the inclusion of parents and the wider family may impact on the effectiveness of UK community-based weight management programmes.
5. Greater attention needs to be paid to evidencing the link between parental involvement and improved weight-related outcomes.

## **Abstract**

Family-based programmes, which emphasise lifestyle and behaviour change using psychological principles, have been shown to be effective in targeting childhood obesity. Whilst there is some evidence that evaluates UK family-based obesity interventions at a local level, no review to date has addressed this nationally. This review therefore presents the available evidence from UK family-based childhood obesity interventions. Published articles were identified using Academic Search Complete, PsycARTICLES, Medline and PubMed databases. Articles were included if they focused on children and adolescents aged 2-19 years and reported a family-based intervention for weight-management in a UK community setting and the primary outcome was weight change, evidenced by BMI, BMI percentile, BMI z-score or weight. Ten articles that met the inclusion criteria were included for review. The majority of programmes reviewed lasted 12 weeks with only three studies providing follow up data at 12 months or beyond. Change in adiposity may be a short-term benefit of participation in a child weight-management programme, but there is insufficient, robust evidence to indicate that this benefit is long lasting and many studies were methodologically weak with limited internal validity. There is insufficient evidence to suggest how the inclusion of parents and the wider family may impact on the effectiveness of UK community-based weight management programme for children and young people.

## **Background**

Childhood obesity has been described as a global epidemic and rising trends are apparent in both developed and developing countries (Flynn et al., 2006). Over the past two decades, there has been a marked increase in the prevalence of childhood obesity in the UK. Among boys aged 2 to 15, the proportion deemed overweight or obese increased overall from 11.1% in 1995 to 16.6% in 2011, and among girls from 12.2% to 15.9% (The Health and Social Care Information Centre, 2013). As a consequence of these rising trends, the number of obesity related diseases has also increased with the financial burden of child and adult obesity predicted to rise by £1.9 - 2 billion a year by 2030 (Wang et al., 2011). In response to this, numerous interventions with the potential to reduce obesity in children and adolescents have been implemented in a variety of settings. In 2008 approximately 375 weight management programmes for children and young people were running in England, including local and nationwide schemes (Aicken et al., 2008). Family-based programmes, which emphasise lifestyle and behaviour change using psychological principles, have received a good deal of attention (Berry et al. 2004; Knowlden & Sharma, 2012; Mclean et al. 2003; Sung-Chan et al., 2013), however a number of gaps in the evidence base exist.

Many studies have been conducted in clinical settings meaning there is a lack of evidence from community based programmes (Robertson et al., 2008). For example, Oude Luttikhuis et al., (2009) focused on lifestyle, drug and surgical interventions only. Furthermore, previous systematic reviews of family-based obesity programmes typically include Randomised Control Trials (RCTs). Whilst RCTs are recognised as the 'gold standard' in establishing whether an intervention works, this is not always feasible in a health promotion context which often requires a more pragmatic focus (CRD, 2008; National Obesity Observatory, 2009). Another significant gap is the absence of reviews focusing on UK based programmes. Whilst there is some evidence that evaluates UK family-based obesity interventions at a local level (Upton et al., 2013), no review to date has addressed this nationally. There is an urgent need for more UK-based research on successful strategies and programmes that work with families to tackle childhood obesity (Cullen, 2011). Finally, few studies examine the relationship between the effectiveness of family-based interventions and methodological rigour (Sung-Chan et al., 2013). The strength of research evidence is an important consideration when allocating resources and financial investment (Belsey, 2009)

and it is essential that funding is directed into interventions that are supported by robust evidence. Commissioners need to be aware of which programmes are both effective (i.e. produce clinically significant outcomes) and value for money.

To our knowledge, no systematic review, to date, has examined family-based community childhood obesity interventions in the UK. This review therefore presents the available evidence from UK family-based childhood obesity interventions, specifically to:

- Document extent of family involvement;
- Present evidence of short and long-term effectiveness;
- Assess the methodological rigour of the evidence.

## **Methods**

### ***Search strategy***

Articles were identified using Academic Search Complete, PsycARTICLES, Medline and PubMed databases. The following terms were searched as keywords anywhere within the article: child\*; paediatric\*; obesity; weight management; community; family; intervention; programme. The search was conducted for the period January 1990 to June 2013. Relevant articles were hand searched for additional references to ensure maximum capture.

### ***Inclusion and exclusion criteria***

Articles were included if they focused on children and adolescents aged 2-19 years and reported a family-based intervention for weight-management in a UK community setting. Family-based interventions were defined as those that included at least one family member in addition to the overweight or obese child (Berry et al., 2004; Sung-Chan et al., 2012). Included studies were RCTs and Non-RCTs and the primary outcome was weight change, evidenced by BMI, BMI percentile, BMI z-score/SDS or weight. The following exclusion criteria were applied: target population was adults or participants with specific medical conditions, the intervention was school-based, pharmacological, an inpatient programme or involved bariatric surgery or were theoretical papers reporting only the rationale behind the intervention. Retrieval was limited to UK based studies reported in peer-reviewed articles and published in the English language.

### ***Selection process***

Article titles and abstracts were independently screened by two researchers and full text versions that met the criteria were obtained and independently assessed for inclusion (see Figure 1). Inter rater agreement was calculated using Cohen's Kappa and was almost perfect, kappa = 0.84,  $p < 0.001$ . Disagreement (1 out of the 13 articles assessed) was resolved through discussion and a consensus reached. Articles excluded from the review and reasons for exclusion are shown in Table 1.

>>Insert Figure 1<<

>>Insert Table 1<<

### ***Data extraction***

The following information was recorded for each study:

1. Participant demographics: age range of children participating in the study;
2. Details of methods: study design, sample size, length of follow-up;
3. Description of intervention procedure(s);
4. Details of measures used: physical, behavioural and psychological measures.
5. Outcomes: Whilst all studies reported weight related outcomes, a quantitative synthesis (meta-analysis) was not appropriate due to heterogeneity in measures used (e.g. BMI, BMI z-score, waist circumference etc).

### ***Quality assessment of studies***

Methodological rigour was assessed using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative studies (EPHPP, 2010), a standardised quality assessment tool used in previous systematic reviews concerning children's health behaviours (Van Cauwenberghe et al., 2010) and found to have good content and construct validity (Jackson & Waters, 2005). The tool comprises six criteria: selection bias (i.e. the extent to which individuals were representative of the target population), study design, control of confounding variables, blinding, data collection method (including the reliability and validity of tools), and withdrawals and dropouts. Each criterion was rated as strong, moderate or weak and global ratings calculated for each paper. Studies with no weak ratings and at least four criteria rated as strong were given a global rating of 'strong', studies with one weak rating and less than four strong ratings were given a global rating of 'moderate' and studies with two or more weak ratings given a global rating of 'weak' (EPHPP, 2010). Studies were independently assessed by two researchers and disagreements between researchers were resolved through discussion and a consensus reached.

### ***Taxonomy***

A taxonomy, based on Hardeman et al. (2000), was developed to classify the ways in which family members were involved in the programmes. The taxonomy was divided into four components: family involvement, target of behaviour change techniques, intervention components and programme delivery.

## **Results**

The search strategy identified a total of 379 relevant publications, of which 10 met the inclusion criteria for review.

### ***Study characteristics***

Characteristics of the studies included in the review are shown in

Table 2. Two studies were RCTs (Coppins et al., 2011; Sacher et al., 2010), five employed a cohort design (Murdoch et al., 2011; Robertson et al., 2008; 2012; Rudolf et al., 2006; Watson et al., 2011) and three were programme evaluations (Fraser et al., 2010; Pitson & Wallace, 2011; Towey et al., 2011). Length of the intervention period ranged from 12 weeks to 1 year. All studies except three (Murdoch et al., 2011; Pitson & Wallace, 2011; Towey et al., 2011) included a follow-up period ranging from six months to two years. Programmes measured a variety of outcomes including adiposity, diet, physical activity, psychological well-being and participant satisfaction. The most commonly reported weight related outcomes were BMI and BMI  $-z$  (see

Table 2).

>>Insert Table 2<<

### ***Extent of family involvement***

Seven studies (Coppins et al., 2011; Murdoch et al., 2011; Robertson et al., 2008; 2012; Sacher et al., 2010; Towey et al., 2011; Watson et al., 2011) targeted the whole family, i.e. those living under one roof and three targeted parents and children (Fraser et al., 2010; Pitson & Wallace, 2011; Rudolf et al., 2006). The format of session varied between the interventions and included individual face-to-face sessions (Coppins et al, 2011 & Sacher et al., 2010), sessions for parent-child dyads, parallel sessions and whole family sessions. All studies aimed to change behaviour of the index member, i.e. child or adolescent and seven studies aimed to change both the index member's and family's behaviour (Murdoch et al., 2011; Robertson et al., 2008; 2012; Rudolf et al., 2006; Sacher et al., 2010; Towey et al., 2011; Watson et al., 2011). As shown in Table 3 studies incorporated a range of intervention components, however the most frequently used techniques were education (n=5) and goal setting (n=5). Activity sessions were also included by four programmes (Pitson & Wallace, 2011; Rudolf et al., 2006; Sacher et al., 2010; Watson et al., 2011) and three programmes included parenting sessions (Robertson et al., 2008; 2012; Rudolf et al., 2006). Programme delivery varied between interventions (see Table 3).

### ***Short-term changes in weight-related outcomes for children and young people***

Five studies showed short term reductions in measures of adiposity either immediately post intervention (Pitson & Wallace, 2011; Towey et al., 2011) or at 6 (Rudolf et al., 2006; Sacher et al., 2010; Watson et al., 2011) or 9 month follow-up (Robertson et al., 2008). Only one study reported no change in BMI-z scores post intervention (Murdoch et al., 2011) however it was found that BMI-z was maintained following the programme.

Pitson and Wallace (2011) found that both children and parents significantly decreased their BMI over 12 weeks (-1.00kg/m<sup>2</sup> and -0.36kg/m<sup>2</sup> respectively). Similarly, Towey et al. (2011) found significant reductions in children's percentage body fat (-3.20%, p=0.033), BMI percentile (-1.82%, p=0.007) and waist circumference (-1.56%, p=0.002) at the end of the programme compared to baseline; however the authors state the scale of improvements were small and unlikely to be clinically significant (Towey, et al., 2011). Three studies (Rudolf

et al., 2006; Sacher et al., 2010; Watson et al., 2011) reported reductions in BMI SDS and BMI-z scores at 6 month follow-up ranging from -0.07 (Rudolf et al., 2006) to -0.24 (Sacher et al., 2010). Reduced waist circumference (-0.37cm,  $p < 0.001$ ) was also reported by Sacher et al., (2010) at 6 month follow-up for children in the intervention compared to controls. Robertson et al., (2008) found significant decreases in BMI z-score ( $p = 0.027$ ) at 3 and 9 month follow-up from baseline, -0.18 (CI= -0.30 to -0.05) and -0.21 (CI= -0.35 to -0.07) respectively.

### ***Long-term changes in weight-related outcomes for children and young people***

Five studies (Coppins et al., 2011; Fraser et al., 2010; Robertson et al., 2012; Sacher et al., 2010; Watson et al., 2011) evidenced longer term changes in weight related outcomes ranging from 12 months (Sacher et al., 2010; Watson et al., 2011) to 24 month follow-up (Coppins et al., 2011; Fraser et al., 2010; Robertson et al., 2012).

Sacher et al., (2010) reported a significant decrease in waist circumference and BMI z-scores at 12 month follow-up (-0.47cm,  $p < 0.0001$  and -0.23,  $p < 0.0001$  respectively). One study, Watson et al., (2011), found that active involvement of adults improved child weight related outcomes reporting a strong correlation between adult BMI change and child BMI SDS change between baseline and 12 month follow-up ( $r = 0.72$ ,  $p < 0.001$ ). Children whose parent/carer showed a large decrease in BMI from baseline showed a significant decrease in BMI SDS at 12 month follow-up ( $-0.24 \pm 0.18$ ) than children whose parent/carer who maintained or increased BMI ( $0.03 \pm 0.20$ ,  $p < 0.001$ ).

Three studies (Coppins et al., 2011; Fraser et al., 2010; Robertson et al., 2012) reported reductions in BMI-z scores or BMI SDS at 24 month follow-up. Coppins et al., 2011 found that thirty three per cent of children in the intervention group reached the target reduction of 0.5 BMI SDS compared to 12% of those in the waitlist control group. However, the unadjusted between group difference was 0.3 and did not reach statistical significance (CI = -0.62 to 0.02,  $p = 0.06$ ). A physical activity and nutritional education programme which targeted parents and children (Fraser et al., 2012) found a mean decrease in BMI of  $-0.09 \text{ kg/m}^2$  between baseline and the end of the evaluation period (significance testing not reported). Another study, Robertson et al., (2012) found significant decreases in BMI z-score ( $p = 0.027$ ) at 24 month follow-up from baseline, -0.23 (CI= -0.42 to -0.03).

***Methodological rigour***

Methodological quality of included studies is shown in

Table 4. None of the studies reviewed fulfilled all of the quality criteria and four studies received moderate global ratings (Coppins et al., 2011; Robertson et al., 2008; 2012; Sacher et al., 2010). Confounders and blinding scores were given only to those studies which were RCTs. Sacher et al., 2010 acknowledged the lack of blinding for measurement of outcomes (due to the waiting list control design) thus was given a weak rating for this criterion therefore reducing the global rating from 'strong' to 'moderate'. Data collection methods received moderate or strong ratings, except one study (Rudolf et al., 2006) which used non-validated measures. All studies reported withdrawals and drop-outs except two studies (Murdoch et al., 2011; Pitson & Wallace, 2011).

>>Insert Table 3 and Table 4<<

## **Discussion**

This review aimed to evaluate family-based child obesity programmes implemented in community settings in the UK to: document extent of family involvement; present evidence of short and long-term effectiveness and assess the methodological rigour of the evidence.

### ***Extent of family involvement***

Variations in parental involvement were found in the studies reviewed. Whilst seven programmes targeted the family as a whole (Coppins et al., 2011; Murdoch et al., 2011; Robertson et al., 2008; 2012; Sacher et al., 2010; Towey et al., 2011; Watson et al., 2011) only one of these (Watson et al., 2011) reported that active parental involvement significantly improved child BMI z-score post intervention or specified that parental involvement was mandatory for all sessions (Sacher et al., 2010). Although all the studies reviewed evidenced significant differences in weight related outcomes, there is insufficient evidence to suggest *how* the inclusion of parents and the wider family may impact on the effectiveness of community-based weight management programme for children and young

people. Greater attention needs to be paid to evidencing the link between parental involvement and improved weight-related outcomes.

### ***Effectiveness of child family-based programmes on weight-related outcomes***

All family-based weight management programmes included in the review were shown to be effective on a number of weight related outcomes and either targeted the parent and child only or the family as a whole. Seven studies including moderate evidence from one RCT (Sacher et al., 2010), one quasi-RCT (Coppins et al., 2011) and two cohort studies (Robertson et al., 2008; 2012) suggested that whole family interventions resulted in significant decreases in BMI z-scores between baseline and follow-up. However, many studies were methodologically weak i.e. uncontrolled studies with limited internal validity (Murdoch et al., 2011; Rudolf et al., 2006; Watson et al., 2011) or were programme evaluations (Fraser et al., 2010; Pitson & Wallace, 2011; Towey et al., 2011).

The majority of programmes reviewed lasted 12 weeks and only three studies (Coppins et al., 2011; Robertson et al., 2012; Sacher et al., 2010) provided moderate evidence of long-term benefits to participating children and families on weight related outcomes. Change in adiposity may be a short-term benefit of participation in a child weight-management programme, but there is insufficient, robust evidence to indicate that this benefit is long lasting. Whilst two other studies reported long-term changes in BMI or BMI SDS (Fraser et al., 2010; Watson et al., 2011), neither included a control group and, in the case of one study (Watson et al., 2011) had a fifty percent attrition rate at follow-up from baseline. Of the five studies that included a follow-up period of at least 12 months, only two studies (Robertson et al., 2012; Sacher et al., 2010) reported significant positive changes in physiological measures.

### **Conclusions**

Family-based weight management programmes implemented in community settings can be effective on a number of weight related outcomes. However, whilst some of the evidence was from RCTs, many studies were methodologically weak i.e. uncontrolled studies with limited internal validity. Whilst programmes need to be piloted before they can be further tested on a larger scale, study design needs to be strengthened and reporting of information improved to enhance the evidence base further (Waters et al., 2011). Programmes should

also include longer follow-up periods and clearly address the link between parental involvement and improved weight-related outcomes.

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Table 1 Articles excluded for review and reasons for exclusion

Reason for exclusion	Study
Not delivered in a community setting	<p data-bbox="606 291 1412 459">Banks, J, Sharp, D, Hunt, L, &amp; Shield, J. (2012) Evaluating the transferability of a hospital-based childhood obesity clinic to primary care: a randomised controlled trial. <i>British Journal of General Practice</i>, <b>62</b>, 6-12.</p> <p data-bbox="606 481 1412 694">Hughes, A, Stewart, L, Chapple, J, McColl, ., Donaldson, M, Kelnar, C, &amp; ... Reilly, J. (2008) Randomized, controlled trial of a best-practice individualized behavioral program for treatment of childhood overweight: Scottish Childhood Overweight Treatment Trial (SCOTT). <i>Pediatrics</i>, <b>121</b>, e539-546.</p>
Theoretical paper reporting only the rationale behind the intervention.	<p data-bbox="606 784 1412 907">Wolman, J, Skelly, E. Kolotourou, M, Lawson, M, &amp; Sacher, P. (2008) Tackling toddler obesity through a pilot community-based family intervention. <i>Community Practitioner</i>, <b>81</b>, 28-31.</p>

Table 2 Study characteristics

Study	Setting	Target age	Sample size (baseline)	Study design	Control group	Intervention duration	Length of follow up	Outcome measure(s)
Coppins et al (2011) <i>The Family Project</i>	Community schools	6-14	65	Quasi RCT	Yes	1 year	24 months	BMI SDS Waist circumference Body fat Lifestyle (diet and physical activity)
Fraser et al (2010) <i>Newtown Kids Programme</i>	Community	5-16	325	Programme evaluation	No	48 weeks	24 months	BMI Self-esteem Attitudes to physical activity Physical activity (type and frequency) Participant satisfaction
Murdoch et al (2011) <i>Family-based behavioural treatment</i>	Community	7.5-14	28 children/17 families	Cohort	No	15 sessions over 6 months	NA	BMI-z score Physical activity Self-esteem Depression Dietary behaviours
Pitson & Wallace (2011) <i>YW8?</i>	Community	8-13	48	Programme evaluation	No	12 weeks	NA	BMI BMI percentile (children only) Self-esteem Physical activity Dietary behaviours Participant satisfaction
Robertson et al (2008) <i>Families for Health</i>	Community, leisure centre	7-13	27 children/21 families	Cohort	No	12 weeks	3 and 9 months	BMI-z score Quality of life Self-esteem Parent-child relationships Parental mental health Physical activity Dietary behaviours Attendance Participant satisfaction
Robertson et al (2012)	Community, leisure centre	7-13	27 children/21	Cohort	No	12 weeks	24 months	BMI-z score Quality of life

<i>Families for Health</i>			families						Self-esteem Parent-child relationships Parental mental health Physical activity Dietary behaviours Attendance Participant satisfaction
Rudolf et al (2006) <i>WATCH IT!</i>	Sports or community centres	8-16	94	Cohort	No	12 weeks	6 months		BMI SDS Self-esteem Quality of life Dietary behaviours Physical activity
Sacher et al (2010) <i>MEND</i>	MRC Childhood Nutrition Centre	8-12	116	RCT	Yes	6 months (9 week intervention plus 12 week family swim pass)	6 and 12 months		BMI Waist circumference Body composition Cardiovascular fitness Level of physical activity Sedentary activities Self-esteem
Towey et al (2011) <i>One Body One Life</i>	Community	7-16	272 children / 182 adults	Programme evaluation	No	10-12 weeks	NA		BMI (adult) BMI percentile (child) Body fat percentage Waist circumference Heart rate Systolic blood pressure Diastolic blood pressure Healthy eating knowledge Level of physical activity
Watson et al (2011) <i>GOALS</i>	Sports or community centres	4-16	121 families	Cohort	No	18 sessions over 6 months	6 and 12 months		BMI (Adult) BMI SDS (child)

NB. BMI = Body Mass Index, BMI SDS = Body Mass Index Standard Deviation Score, BMI-z score = also referred to as BMI SDS, are measures of relative weight adjusted for child age and sex.

Table 3 Taxonomy of family involvement (studies in parentheses)

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*Family involvement*

- a) Parent-child (2,4,7)
- b) Whole family (Those living under one roof) 1,3,5,6,8,9,10

*Target of behaviour change techniques*

- a) Taught to child alone (1, 2)
- b) Taught to parent and child (3, 4, 5, 6, 7, 8, 9, 10)

*Intervention components*

- a) Education (1, 2, 3, 8, 10)
- b) Parenting (5, 6, 7)
- c) Relationship skills (5, 6)
- d) Emotional and social development (4, 5, 6)
- e) Motivational counselling (7)
- f) Activity sessions (4, 7, 8, 10)
- g) Goal setting (3, 4, 8, 9, 10)
- h) Stimulus control (3, 8)
- i) Reinforcement (3, 4, 8)
- j) Response prevention (3, 8)
- k) Self-monitoring (3,4, 9)
- l) Problem solving (3,4)
- m) Homework (3)

*Programme delivery*

- a) Dietician (1, 3, 5, 7)
- b) Psychologist (1, 3, 7)
- c) Paediatrician (7)
- d) Physical activity instructor (1)
- e) Health promotion officer (1, 2)
- f) Health visitor (5)
- g) Mental health worker (5)
- h) School nurse (5)
- i) Volunteers/trainers without professional qualifications (3, 7)
- j) Facilitators – not specified (4, 6, 8, 9, 10)

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NB. Key to studies: 1= Coppins et al (2011), 2= Fraser et al (2010), 3= Murdoch et al (2011), 4= Pitson & Wallace (2011), 5= Robertson et al (2008), 6= Robertson et al (2012), 7= Rudolf et al (2006), 8= Sacher et al (2010), 9= Towey et al (2011), 10= Watson et al (2011)

Table 4 Methodological quality assessment

Study	Selection bias	Study design	Confounders*	Blinding*	Data collection method(s)	Withdrawals and drop-outs	Global rating
Coppins et al., (2011)	Moderate	Strong	Strong	Weak	Moderate	Strong Intervention 11%: 6 month follow-up 20%: 12 month follow-up 37%: 18 month follow-up	Moderate
Fraser et al., (2012)	Weak	Weak	NA	NA	Moderate	Moderate 32% (end of programme)	Weak
Murdoch et al., (2011)	Weak	Weak	NA	NA	Moderate	Weak Not reported	Weak
Pitson & Wallace (2011)	Weak	Weak	NA	NA	Strong	Weak Not reported	Weak
Robertson et al., (2008)	Weak	Moderate	NA	NA	Strong	Strong 19% at 3 and 9 month follow-up	Moderate
Robertson et al., (2012)	Weak	Moderate	NA	NA	Moderate	Strong 14%: 2 year follow-up	Moderate
Rudolf et al., (2006)	Weak	Weak	NA	NA	Weak	Weak 28%: 3 month follow-up 48%: 6 month follow-up Reasons not reported	Weak
Sacher et al., (2010)	Strong	Strong	Strong	Weak	Strong	Strong <i>Intervention</i> 38%: 6 month follow-up 30%: 12 month follow-up <i>Control</i> 20%: 6 month follow-up 32%: 12 month follow-up	Moderate
Towey et al., (2011)	Weak	Weak	NA	NA	Moderate	Strong 21%: (end of programme)	Weak
Watson et al., (2011)	Weak	Moderate	NA	NA	Strong	Weak 50%: 12 month follow-up Reasons not reported	Weak