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## Review title

The effectiveness of weight management interventions for families of children with overweight or obesity: an Umbrella Review

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# **The effectiveness of behavioral weight management interventions for families of children with overweight or obesity: an Umbrella Review**

## **Abstract**

### **Objectives**

To synthesize the effectiveness and strategies used in family-based behavioral childhood obesity interventions in improving child weight-related outcomes.

### **Introduction**

Family-based interventions are common practice in the treatment of childhood obesity. Research suggests that direct parental involvement can improve child weight-related outcomes. However, challenges remain in assessing the effectiveness of family-based interventions on child weight and weight-related behavior due to the lack of quality programs and diversity of treatment strategies.

### **Inclusion criteria**

Systematic reviews and/or meta-analyses of family-based behavioral interventions in children aged  $\leq 18$  who were classified as being overweight and/or obese, and reported child weight related outcomes, such as Body Mass Index (BMI), body fat percentage, and waist circumferences were included.

### **Methods**

Seven databases were searched from 1990 to May 2016 to identify English language publications. Reference lists of included reviews and relevant registers were also searched for additional reviews. All included systematic reviews were critically appraised by two reviewers independently. Data extraction including characteristics of included systematic reviews and weight-related outcomes reported. Data synthesis involved categorizing interventions into seven categories and presented findings in narrative and tabular format. Quality of evidence was assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach.

### **Results**

The umbrella review comprised 14 systematic reviews (low to moderate methodological quality), published between 2004 and 2015, including 47 independent trials ranging from one month to seven years follow up conducted in over 16 countries. The majority of reviews (93%) reported weight outcomes of children aged six to 13 years. All reviews except one indicated that family-based interventions were successful in improving child weight and/or weight-related behavior. Five reviews highlighted that

parent-only interventions have similar (n=4) or greater (n=1) effectiveness compared to parent-child interventions. Effective interventions employed parent-targeted strategies, including nutrition and physical activity education sessions, positive parenting skills, role modelling, and child behavior management to encourage positive healthy eating/exercise behaviors in children and/or whole family.

## **Conclusions**

Family-based interventions targeting parents, alone or with their child, are effective for child weight management. Due to the lack of high quality evidence, especially in the emerging parent-only interventions, further research are warranted. Health practitioners can work with parents as the agents of change and focus on fostering positive parenting skills, such as monitoring, reinforcement, role modelling, and providing a nurturing environment, in order to support health behaviors in their children. Future research needs to explore whether parent-only interventions are more cost-effective compared to parent-child interventions, and to include larger populations, longer intervention duration and follow-up.

## **Keywords**

Children; parent; intervention; obesity; umbrella review

## **Introduction**

The rising prevalence of childhood obesity has created a worldwide public health crisis.<sup>1</sup> According to the World Health Organization (WHO) approximately 41 million (6%) young children under the age of five years across the world were overweight or obese in 2014.<sup>1-3</sup> While global prevalence data available for obesity in older children are currently being verified by WHO,<sup>2</sup> the International Obesity Task Force (IOTF) (2000) estimated that approximately 155 million children aged five to 17 years were overweight (10%) or obese (3%).<sup>4, 5</sup> The Australian Health Survey (2011-12) showed that one in four Australian children were overweight (18%) or obese (7%) placing these children at increased risk of chronic disease from a young age.<sup>6</sup> The Australia Burden of Disease Study (2011) indicates that high Body Mass Index (BMI), related to overweight and obesity, was the second highest contributor to disease burden.<sup>7</sup> In Australia, overweight and obesity accounted for 5.5% of the total disease burden in 2011, including 49% of endocrine disease, and 21% of cardiovascular disease.<sup>7</sup> Early intervention for weight management is essential for disease prevention, as obesity tracks from childhood to adulthood.

Extensive research has been conducted in child obesity. This has included several systematic reviews (SRs)<sup>8-12</sup> in both obesity prevention and treatment in children and adolescents, with evidence suggesting that parental involvement (mainly for primary school aged children) has increased intervention effectiveness in relation to improved weight outcomes and lifestyle behaviors. Systematic reviews of childhood obesity show that family-focused behavioral lifestyle interventions, often with direct parental involvement, can lead to positive outcomes in weight, BMI and other measures of body fat

composition of the children.<sup>9, 13-19</sup> Behavioral interventions were classified as those that aim to change parents' and/or children's weight related thinking patterns and actions – including dietary intake, physical activity and sedentary behaviors – which go on to determine a family's food and physical environment.<sup>19</sup>

Parents' attitudes, beliefs and behaviors have an effect on their child's risk of being overweight.<sup>20</sup> Parental characteristics such as increased BMI, high alcohol intake, regular smoking, low socioeconomic status, and low education level have all been linked with greater possibility of their children being overweight.<sup>20</sup> Moreover, parents are the key mediator of the obesogenic environment within the family home; particularly for young children who consume most meals at home. Parents usually control decision making about the types of food that are available in the home and how food is prepared for family meals. Parental decisions can have an impact on the development of child food preferences and eating habits. Family meal times, if they occur, provide a potential opportunity for parents to model healthy food choices and food-related behaviors, while promoting a positive atmosphere around healthy eating for better diet quality. For these reasons, parents are often targeted in intervention for child weight management.

Despite increasing research into obesity, the prevalence of overweight and obesity has risen globally, in both developed and developing countries, over the last decade.<sup>1</sup> It remains a challenge for healthcare professionals to work effectively with the complex dynamics of family systems to improve child health outcomes; noting that this can require the active engagement of both parents to achieve effective behavior change.<sup>21-23</sup> There is an abundance of literature on childhood obesity interventions with parental involvement.<sup>24-26</sup> However, the effectiveness of interventions to reduce a child's weight and/or change their weight-related lifestyle behaviors has been inconsistent, due in part to the lack of high quality, effective programs<sup>27, 28</sup> which have included an array of diverse strategies.<sup>29</sup> A Cochrane review<sup>28</sup> acknowledged that the heterogeneity of current literature in the area of childhood obesity treatment makes it difficult to conclude that one intervention component is more effective than the other. As parental influences are closely associated with child's weight or weight-related behavior, especially in young children, the parental role in child obesity treatment is likely to be an essential element for effective intervention.<sup>24, 30</sup> However, there is limited evidence to inform how parents should be involved or targeted in interventions aiming to achieve behavior changes in their children.<sup>9, 18, 24</sup>

Given a number of SRs have already been completed in the area of parental involvement in childhood obesity intervention, a comprehensive review of these SRs is sensible to map and analyze the available evidence. This umbrella review summarized current strategies that are effective in supporting parents with an overweight child to better manage their child's weight and/or weight-related behavior change. To the authors' knowledge, this is the first systematic review of SRs on obesity interventions involving parents with overweight children.

## **Review questions**

What is the effectiveness of family-based behavioral or lifestyle weight management interventions for overweight children? What are the strategies or characteristics of effective interventions in combating child obesity?

## **Inclusion criteria**

### ***Types of participants***

Participants of interest were children aged 18 years and under who were classified as overweight or obese, based on WHO Child Growth Standards, Centers for Disease Control and Prevention (CDC) Growth Charts, or International Obesity Task Force (IOTF).<sup>31-33</sup> Systematic reviews were excluded where study participants included children of all weight status, and/or results were not reported separately for overweight children.

### ***Types of intervention(s)***

The umbrella review included SRs which had a focus on behavioral and/or lifestyle interventions for child weight management. Interventions of interest are those that aim for weight loss as a primary outcome through changes to behavioral or lifestyle habits, including, but not limited to, dietary intake, physical activity, sedentary behavior, mealtime patterns and sleep. Interventions were included if they were family-based, which was defined as the direct involvement (i.e. attendance or participation in intervention sessions) of first- or second-degree relatives or caregivers cohabiting under one roof in interventions adapted from McLean et al.<sup>34</sup> The interventions must have included a comparator group, such as a control group not receiving an intervention (usual care), or a control group receiving an alternative intervention. There were no limitations regarding frequency, duration, intensity, and setting of interventions.

### ***Types of outcomes***

Published systematic reviews that reported a synthesis of child weight outcomes were considered for inclusion in this review. Primary outcomes of interest include change in body weight or BMI of the index child, measured from baseline to intervention-end and/or post-intervention follow-up. Where available, "behavior change" such as dietary intake or physical activity were included as secondary outcomes of interest.

### ***Types of publications***

Systematic reviews and meta-analyses of quantitative studies (randomized controlled trials (RCTs), quasi-experimental, and pre-post design) were included in the umbrella review. Mixed-method studies (i.e. both quantitative and qualitative) were included if the quantitative component could be extracted clearly. Systematic reviews of solely qualitative studies or studies that did not include an active intervention (e.g. cohort study, case study and cross-sectional study) were excluded as these studies were unlikely to report quantitative results; which were the outcomes of interest. An eligible SR must

have a protocol describing the review question/s, search strategy, and inclusion criteria, which are often referred to as 'PICO' (Participants, Interventions, Comparisons, and Outcomes).<sup>35</sup> Therefore, narrative literature reviews were excluded. For SRs that did not explicitly limit inclusion criteria to intervention study designs, only results from relevant intervention trials were extracted for inclusion in the umbrella review. If results were not reported or not separable between intervention and non-intervention studies, the SR was excluded.

## **Methods**

The umbrella review was conducted according to the protocol which was developed based on the Methodology for JBI umbrella reviews<sup>36</sup> and published in September 2016 (doi: 10.11124/JBISRIR-2016-003082).<sup>37</sup>

### ***Search strategy***

Database searches were completed in May 2016 by an experienced academic medical librarian. Seven databases were searched, including MEDLINE, EMBASE, CINAHL, PsycInfo, Scopus, Database of Abstracts of Reviews of Effects, and the Cochrane Database of Systematic Reviews, using keywords and index terms (Appendix I) identified by several experienced authors (LKC, TB, CC). Searches were limited to English language, and publications between 1990 and May 2016. As there were very few SRs published prior to 1990,<sup>36</sup> the search period was deemed appropriate to capture existing SRs on family-based childhood obesity treatment given SRs only began to emerge from the year 2000.<sup>16</sup> Reference lists of included SRs and additional databases including PROSPERO and JBISRIR were searched to identify any existing SRs on the same topic. The authors believe that it is unlikely that a comprehensive SR in this area of research will have been undertaken and not be published. Therefore, the umbrella review did not search for unpublished/grey literature consistent with the previously published SR protocol,<sup>37</sup> as opposed to the JBI Umbrella Review methodology chapter.<sup>36</sup> All references were managed using EndNote X8 (Clarivate Analytics, Philadelphia, PA, USA).

### ***Study screening and selection***

Two reviewers (LKC, and one of either TB, CM, KB, DWS, CC) independently reviewed the titles and/or abstracts of all records retrieved from the search. All potentially relevant full texts were retrieved and assessed independently by two reviewers (LKC, and one of either TB, CM, CC). Any discrepancies were resolved through consensus or a third reviewer (TB, CC).

### ***Assessment of methodological quality***

All included SRs were critically appraised by two reviewers (LKC, TB) independently using the standard JBI Critical Appraisal Instrument for Systematic Reviews and Research Syntheses.<sup>36</sup> Conflicts were

resolved through discussions to reach consensus. All eligible SRs (based on PICO inclusion criteria) were included regardless of methodological quality in order to summarize the current literature and quality of existing studies within SRs to date.

### ***Data collection***

The JBI Data Extraction Form for Review for Systematic Reviews and Research Syntheses was used for extracting information including characteristics of included systematic reviews and weight-related outcomes.<sup>36</sup> Relevant information on characteristics of included SRs was extracted and presented in line with the study protocol which has been published previously.<sup>37</sup> As per the protocol, primary weight outcomes and weight-related anthropometric indicators were extracted. In addition, changes in child/parental weight outcomes or weight-related behaviors such as dietary intake, physical activity, sedentary behavior, were also extracted when they were reported as these were deemed important secondary outcomes in the context of family-based interventions with parental involvement. When results reported within SRs were not clear (e.g. values reported in narrative synthesis were different from results tables), the original primary studies were referred to extract the correct data in order to enhance the accuracy of umbrella review synthesis. Adverse consequences that arose as a result of interventions were also documented if reported in SRs. In cases where SRs included more detailed outcomes, such as population groups (e.g. children, adults), intervention contexts (e.g. family-, school-, clinical-based), and intervention components (e.g. behavioral, pharmacological, surgery), only that subset of relevant studies (e.g. children; family-based; behavioral) were extracted for synthesis; provided that the results of the subset of studies were reported separately in the SRs. In cases where an original research study was included in multiple SRs, the number of overlapping studies included in SRs were described in the report – full details of these are presented in Appendix II. For primary studies that were included in multiple reviews, results related to the primary study were cross-checked across multiple reviews for accuracy (when same outcomes were reported) and consolidated for reporting in the current umbrella review (when different outcomes were reported) to avoid duplicates of results.

### ***Data summary***

The effectiveness of interventions were extracted as results of meta-analyses conducted within the included SRs, or as reported in the results of included SRs. Quantitative findings were categorized by authors into seven intervention categories and presented in tables describing effect estimates within groups, and between groups, at the end of intervention and at the longest follow up time.

The seven intervention categories were:

1. Parent-child interventions vs. Waitlist/no intervention control
2. Parent-child interventions vs. Usual care
3. Parent-only interventions vs. Waitlist/no intervention control

4. Parent-only interventions vs. Usual care
5. Parent-only interventions vs. Parent-child interventions
6. Parent-only interventions vs. Child-only interventions
7. Parent-child interventions vs. Child-only interventions

The quality of evidence for each intervention category against weight-related outcomes was assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach.<sup>38</sup> The GRADE framework includes evaluation of the following five criteria: (i) quality of primary studies (e.g. risk of bias and methodological limitations); (ii) inconsistency (e.g. direction of intervention effects, magnitude of statistical heterogeneity measured by  $I^2$ ; low ( $I^2 < 40\%$ ), moderate ( $I^2 40-60\%$ ), high ( $I^2 > 60\%$ ); (iii) indirectness (e.g. direct comparisons with populations, interventions, and outcomes relevant to context); (iv) imprecision (e.g. magnitude of the number of included studies: large:  $> 10$  studies, moderate: 5-10 studies, small:  $< 5$  studies; and median sample size: high  $> 300$  participants, intermediate 100-300 participants, low  $< 100$  participants); and (v) publication bias.<sup>38, 39</sup>

The strengths of overall intervention effectiveness are presented in a table using a "stop-light" indicator, where green indicates an effective or beneficial intervention; amber indicates no intervention effect or no difference when compared to the comparator, or unclear effect due to insufficient information; and red indicates a detrimental or less-effective intervention when compared to the comparator.

## Results

### ***Study inclusion***

The process of study selection is presented as an adapted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram (Figure 1). The database searches identified 15755 records; 697 potentially relevant full texts were retrieved and assessed after excluding 15058 records following the examination of title and abstract against inclusion criteria. Of the 697 full texts, 14 SRs<sup>9-12, 15, 16, 18, 40-46</sup> met the inclusion criteria and were included. The majority of the excluded articles were primary studies and/or SRs with irrelevant study designs, such as cohort study, cross-sectional study, or intervention trials without family involvement. A list of excluded studies with reasons is summarized in Appendix III.

<insert Figure 1 here>

### ***Methodological quality***

Of the 11 quality appraisal criteria listed in the JBI Critical Appraisal Instrument for Systematic Reviews and Research Syntheses, seven criteria (64%) were met by all 14 included SRs (Table 1). The

remaining four criteria (item 5, 6, 7, 9) were not met or rated as unclear due to the lack of reporting in SRs. Six SRs<sup>16, 40-43, 46</sup> did not provide information on whether risks of bias were assessed by more than one reviewer independently, whereas one SR<sup>12</sup> was conducted by only one author with no second reviewer. Four SRs<sup>12, 42, 44, 46</sup> did not mention about risk of bias assessment tools used nor the results of the quality appraisal. One SR<sup>15</sup> mentioned that included studies had methodological weaknesses but did not specify the use of an appraisal instrument for formal quality assessment. Three SRs<sup>11, 15, 43</sup> did not provide information about the data extraction tool used or specify the pre-determined study characteristics to be extracted. Three SRs<sup>16, 40, 42</sup> did not mention whether two or more independent reviewers performed extraction or additional examinations. Only two SRs<sup>9, 16</sup> reported assessment for the likelihood of publication bias against weight outcomes, which found a low probability of publication bias as indicated by fail-safe N exceeded Rosenthal's recommendation ( $5k+10$ ; with  $k=n$  of included studies).<sup>16</sup>

**<insert Table 1 here>**

In general, trials included in the SRs were rated as being of low quality with a large proportion rated as unclear or at high risk of bias on individual risk of bias criteria due to not, or under-reporting within primary intervention trials. The high risk of bias was for incomplete outcome data due to higher dropout in parent-only interventions, failure to conduct intent-to-treat analysis, while most studies reported limited information about allocation concealment and randomization procedure. It was uncommon for trials to report power calculations. In a SR of eight trials, only three trials reported sample size calculations and of these trials, two did not meet target sample size.<sup>18</sup> This limited the power and sensitivity to detect significant differences between groups resulted from the interventions. GRADE assessment of the outcomes pooled in this umbrella review have led to trials being downgraded for risk of bias, and imprecision owing to the small number of trials and small sample sizes ( $n=8$  to 80). Therefore, the overall interpretation of the data was synthesized more cautiously. Further details on appraisal instrument used and methodological quality are presented in Table 2.

**<insert Table 2 here>**

### ***Characteristics of included studies***

The 14 included SRs<sup>9-12, 15, 16, 18, 40-46</sup> were published between 2004 and 2015 with four undertaking meta-analyses.<sup>9, 16, 41, 46</sup> The majority ( $n=13$  SRs) had searched at least three databases, with the databases most commonly searched being Medline, CINAHL, PsycINFO, and PubMed, and with publications retrieved from 1967 to May 2015. While all SRs included intervention studies, eight SRs<sup>9, 10, 12, 15, 18, 41, 44, 45</sup> specifically included RCTs only, with two SRs<sup>15, 18</sup> including only RCTs with at least six months follow up. Two SRs also incorporated specific inclusion criteria for countries including UK<sup>11</sup> and USA<sup>40</sup> or ethnicity such as African-American girls.<sup>40</sup> While the study populations were predominantly primary school age children, the most commonly included child age range was 6-13

years (n=13 SRs),<sup>9-12, 15, 16, 40-46</sup> with some also reporting on children aged less than six years (n=9 SRs)<sup>9-11, 16, 42-46</sup> or above 13 years (n=10 SRs).<sup>11, 12, 16, 18, 40-45</sup> One SR<sup>18</sup> specifically described results of children aged 8-11 years only. The included SRs<sup>9-12, 15, 16, 18, 40-46</sup> have included 47 independent trials that were relevant for the umbrella review. Of the 47 trials, which were conducted in over 16 countries and published between 1975 and 2015, 22 trials (47%) were included in two or more SRs included in the umbrella review. Two trials were included in seven SRs; one trial was included in five SRs; two trials were included in four SRs; three trials were included in three SRs; and 14 trials were included in two SRs. All four trials included in the meta-analysis conducted by Jull et al.<sup>41</sup> were also included in the SR by Loveman et al.<sup>9</sup> which included 20 trials (see Appendix II). Intervention durations ranged from one month to two years, with longest post-intervention follow up time points ranging between three months and seven years. The most common primary outcome measures reported were BMI z-scores (zBMI) (n=13 SRs),<sup>9-12, 16, 18, 40-46</sup> BMI (n=8 SRs),<sup>9, 11, 12, 15, 18, 40, 45, 46</sup> percent overweight (n=7 SRs),<sup>12, 16, 18, 42-44, 46</sup> BMI percentile (n=6 SRs),<sup>10, 16, 18, 42-44</sup> and body weight (n=6 SRs).<sup>9, 12, 15, 40, 45, 46</sup> Several SRs also reported on secondary outcomes related to behavioral changes such as diet (n=7 SRs),<sup>9, 12, 16, 40, 42-44</sup> physical activity (n=5 SRs),<sup>9, 12, 16, 40, 44</sup> sedentary behavior (n=2 SRs),<sup>16, 44</sup> and/or parental outcomes (n=4 SRs).<sup>9, 12, 43, 44</sup>

The majority of SRs evaluated family-based studies which targeted parents and children in the interventions and compared with a waitlist or no intervention control group<sup>10-12, 16, 18, 40, 42-45</sup> and/or usual care.<sup>10, 12, 42, 44</sup> Six SRs evaluated parent-only interventions in comparison with a waitlist or no intervention control group<sup>9, 10, 18, 43, 45</sup> and/or usual care.<sup>9</sup> Seven SRs<sup>9, 12, 16, 18, 41, 43, 44</sup> examined intervention studies which compared parent-only conditions with parent-child conditions. Six SRs assessed child-only interventions and compared them with parent-only intervention arms<sup>15, 18, 43, 44</sup> and/or parent-child intervention arms.<sup>15, 18, 40, 43</sup> Two SRs<sup>12, 42</sup> provided a summary of the effectiveness of parent-child interventions based on different settings: family-, school-, and clinic-based interventions, in the treatment of childhood obesity. Overall, interventions have aimed to change behavior of both the index child and their parents and/or family members through targeted intervention components including dietary change, physical activity and behavior modification or cognitive behavioral therapy;<sup>9, 11, 18</sup> and through intervention techniques, such as nutrition and physical activity education, and goal setting.<sup>11, 44</sup> Dietary interventions focused on increasing healthy food consumption through the use of traffic light dietary approaches (e.g. The Stoplight Diet) or similar strategies.<sup>16, 41, 44</sup> Physical activity interventions aimed to increase physical activity and reduce sedentary behaviors, either through specified targets, or through individualized goal setting.<sup>41, 44</sup> Detailed characteristics of included SRs were summarized in Appendix IV.

### ***Findings of the review***

All reviews, except one,<sup>40</sup> found that family-based lifestyle interventions were effective, as indicated by a decrease in weight or weight-related outcomes (e.g. zBMI, percentage overweight) from baseline.

The one review<sup>40</sup> which targeted African-American girls only was unable to draw clear conclusions due to most included studies being pilot trials with small sample sizes (n participants<50) and short duration (12 weeks or less). Overall, no studies reported adverse events. Detailed findings and interventions included in each SRs are presented in Table 2. Key findings for each pre-defined intervention of interest are described below. Detailed results and GRADE quality of evidence (QOE) are presented in the Summary of Findings (GRADE tables) 1 to 7 for each intervention of interest respectively.

### ***Parent-child interventions vs Waitlist/no intervention control***

Detailed results and quality of evidence were presented in the Summary of Findings 1. Eight SRs<sup>11, 12, 18, 40, 42-45</sup> (eight trials; 581 children) and one meta-analysis<sup>16</sup> (three trials; 274 children) provided evidence supporting the effectiveness of parent-child interventions in reducing zBMI compared to waitlist controls after interventions ranged between three and 12 months (moderate QOE). Results from systematic reviews<sup>11, 12, 18, 40, 42-45</sup> found greater zBMI reduction in the active intervention groups for all but one trial and was consistent with the findings of the meta-analysis<sup>16</sup> of three trials. At post-intervention follow-up (ten months to two years; four trials; 288 children; low QOE) the zBMI reduction was maintained.<sup>10, 11, 18, 42-44</sup> Therefore, the strength of overall intervention effectiveness was awarded the color 'green'; indicating beneficial/positive intervention effects (Table 3). The overall QOE were rated as low to moderate quality.

BMI percentile was reported in a SR<sup>45</sup> (one trial; 105 children; moderate QOE) and a meta-analysis<sup>16</sup> (four trials; 230 children; moderate QOE). There was a greater reduction of BMI percentile by -0.5% in intervention groups (three trials), while one trial found no significant difference between groups.<sup>16, 45</sup> At post-intervention follow-up (three to six months; five trials; 328 children; low QOE) the BMI percentile reduction was maintained.<sup>10, 16</sup> The outcome overall was beneficial and consistent in SR and meta-analysis, hence, resulting in award of the color 'green'. The overall QOE were rated as low to moderate quality.

Percentage overweight was reported in a SR<sup>45</sup> (one trial; 40 children; moderate QOE) and a meta-analysis<sup>16</sup> (three trials; 167 children; moderate QOE). All four trials observed a greater reduction of percentage overweight by -0.3% in intervention groups.<sup>16, 45</sup> The strength of overall intervention effectiveness was awarded the color 'green'. The overall QOE were rated as moderate quality. Waist circumference was reported in four SRs<sup>11, 40, 42, 44</sup> (three trials; 324 children; moderate QOE), Two trials found intervention group had lower waist circumference at 6 months, and 12 months, respectively, while another trial found no difference between groups at 1 month.<sup>11, 40, 42, 44</sup> At post-intervention followup (12 months; one trial; 116 children; low QOE) the waist circumference remained significantly lower.<sup>11, 42</sup> The strength of overall intervention effectiveness was awarded the color 'green'. The overall QOE were rated as low to moderate quality.

There were no meta-analyses that evaluated dietary changes or physical activity levels as a result of

an intervention. Three SRs<sup>40, 42, 44</sup> (four trials; 210 children; low QOE) found interventions improve diet quality, however meta-analysis were not conducted due to the heterogeneity of the study methods as well as the dietary outcome measures used in reporting results (e.g. energy intake, nutrient intake, food groups servings). Two SRs<sup>40, 44</sup> (four trials; 253 children; low QOE) found physical activity levels and screen time were not different between groups (three trials) while one trial found the intervention increased physical activity levels. The overall QOE were rated as low quality.

**<insert Summary of Findings 1 here>**

#### ***Parent-child interventions vs. Usual care***

Additionally, when compared to a usual care control group (six trials from four SRs; 308 children (two trials did not report sample size); low QOE), which were usually mailed information or a workbook or minimal sessions, the parent-child interventions achieved a greater reduction in child's BMI, BMI percentile, percentage overweight, and/or weight.<sup>10, 12, 42, 44</sup> However, the overall QOE was rated as being of low quality, as each outcome was informed by only one trial with a small sample size (n=16 to 192). Mixed effects on zBMI were found between intervention and usual care control groups where one trial indicated intervention was effective, while another trial found no difference between the groups.<sup>42, 44</sup> Detailed results and quality of evidence were presented in the Summary of Findings 2.

**<insert Summary of Findings 2 here>**

#### ***Parent-only interventions vs Waitlist/no intervention control***

Detailed results and quality of evidence were presented in Summary of Findings 3. Four SRs (seven trials; 393 children) and one meta-analysis<sup>9</sup> (two trials; 153 children) provided evidence supporting the effectiveness of parent-only interventions in improving child weight outcomes. Overall, when compared to a waitlist control group, parent-only interventions reduced zBMI (three trials; 224 children; moderate QOE),<sup>9, 18, 43</sup> BMI (three trials; 55 children; low QOE)<sup>9, 43</sup> and BMI percentile (one trial; 98 children; low QOE),<sup>9, 10</sup> while mixed results were reported for parental BMI (two trials; 169 parents; low QOE).<sup>9</sup> Apart from zBMI (moderate QOE), evidence on these listed outcomes were rated as low quality due to small sample sizes, the small number of studies and/or inconsistent results.

Meta-analysis<sup>9</sup> (two trials; 153 children; moderate QOE) which reported outcome of parent-only interventions presented results for zBMI only, and indicated that parent-only interventions had significantly lower zBMI by -0.12 following interventions that ranged between three and four months, and the changes remained significant at six to 12 months post intervention. Results from two SRs<sup>18, 43</sup> (one trial; 71 children; low QOE) supported the meta-analysis of two trials where zBMI reduced by -0.13 in intervention group after four months intervention, and remained lower by -0.14 than control groups at 10 months. The outcome overall is beneficial and consistent in SRs and meta-analysis, hence,

resulting in award of the color 'green'. The overall QOE were rated as low to moderate quality.

**<insert Summary of Findings 3 here>**

#### ***Parent-only interventions vs. Usual care***

Detailed results and quality of evidence were presented in Summary of Findings 4. There was a smaller number of SRs that compared parent-only interventions with a usual care control group (seven trials from one SR; 925 children; moderate QOE) which were usually mailed information or a workbook or minimal sessions. Only one trial (170 children) reported zBMI and found no significant difference between groups after a three to six-month intervention (low QOE).<sup>9</sup> Five trials from one SR (648 children; moderate QOE) assessed BMI percentile while only one trial (107 children; low QOE) assessed BMI, and all reported a greater reduction in intervention groups.<sup>9</sup> Overall, no trial has reported negative effects (ineffective) on weight-related outcomes for parent-only interventions. At post-intervention follow up (six to 24 months), parent-only interventions had greater reduction in BMI (two trials; 614 children; moderate QOE) and BMI percentile (one trial; 60 children; moderate QOE); and no differences in zBMI (one trial; 165 children; low QOE) compared to usual care control groups.<sup>9, 18, 43</sup> The overall QOE were rated as low to moderate quality.

**<insert Summary of Findings 4 here>**

#### ***Parent-only vs Parent-child interventions***

Detailed results and quality of evidence were presented in the Summary of Findings 5. Three SRs<sup>9, 12, 18</sup> (three trials; 164 children) and three meta-analyses<sup>9, 16, 41</sup> (five trials; 402 children) reported zBMI at the end of the interventions (10 weeks to six months). Results from meta-analyses<sup>9, 16, 41</sup> showed no significant difference in zBMI (moderate QOE) between the two interventions. Systematic reviews<sup>9, 12, 18</sup> also reported consistent zBMI reduction in both groups (low QOE). Given there was no significant difference between parent-only interventions and parent-child interventions, the color 'amber' was awarded suggesting that both interventions are equally beneficial. The overall QOE were rated as low to moderate quality.

BMI percentile was reported in a SR,<sup>18</sup> parental BMI was reported in a SR,<sup>9</sup> and percentage of children who were overweight was reported in four SRs.<sup>9, 18, 43, 44</sup> Overall, there was no significant difference in child BMI percentile (one trial from one SR; 80 children; low QOE)<sup>18</sup> and parental BMI (three trials from one SR; 207 parents; low QOE)<sup>9</sup> between parent-only interventions and parent-child interventions. Mixed findings were reported for the percentage of children who were overweight (two trials from four SRs; 88 children; low QOE);<sup>9, 18, 43, 44</sup> with one trial reporting a greater reduction in parent-only intervention groups while the other trial found no difference between groups (percentage of children who were overweight reduced in both groups). No trial reported that parent-only interventions were less

effective in comparison to parent-child interventions on the above outcomes.

**<insert Summary of Findings 5 here>**

### ***Child-only vs parent-only or parent-child interventions***

For the purpose of comparing interventions with parental involvement to those without parental involvement, this section presented results of the two remaining intervention categories specified in the data summary section: 'Parent-only interventions vs. Child-only interventions', and 'Parent-child interventions vs. Child-only interventions'. Detailed results and quality of evidence were presented in the Summary of Findings 6 and Summary of Findings 7. There was limited evidence that compared parent-child and child-only interventions (10 trials from five SRs; 546 children; moderate to low QOE),<sup>15, 18, 40, 43, 45</sup> and even fewer studies that compared parent-only and child-only interventions (three trials from four SRs; 181 children; low QOE).<sup>15, 18, 43, 44</sup> Overall, no trial reported that child-only interventions were more effective than interventions with parental involvements. Parent-only and/or parent-child interventions have demonstrated positive improvement on weight (three trials from one SR; 91 children; low QOE),<sup>15</sup> zBMI (two trials from one SR; 236 children; low QOE),<sup>18</sup> BMI (one trial from one SR; 36 children; moderate QOE),<sup>40</sup> percentage overweight (six trials from five SRs; 288 children; moderate QOE),<sup>15, 18, 43-45</sup> parental weight (one trial from one SR; 76 parents; low QOE)<sup>15</sup> during follow up at one to seven year/s. The overall QOE were rated as low quality.

**<insert Summary of Findings 6 here>**

**<insert Summary of Findings 7 here>**

## **Summary of Evidence**

The strength of overall intervention effectiveness immediately post intervention is presented in the Summary of Evidence (Table 3) using a traffic-light visual indicator. Parent-child and parent-only interventions were awarded the color 'green' on most outcomes indicating interventions were effective or beneficial in improving weight-related outcomes. No intervention receives a 'red' indicator, meaning no intervention had a detrimental or less-effective impact when compared to the comparator group.

**<insert Table 3 here>**

In summary, family-based behavioral lifestyle interventions targeting parents, with or without child involvement can be effective in achieving successful weight change outcomes in children aged two to 18 years. When compared to a waitlist control group, parent-child interventions<sup>10, 12, 15, 16, 18, 40-44</sup> (one month to two years follow up) and parent-only interventions<sup>9, 10, 12, 15</sup> (10 weeks to 10 months follow up) were both effective in improving weight-related outcomes, such as a reduction in zBMI, BMI and BMI

percentile. However, these interventions did not result in an impact on parent outcomes, including parents' BMI, waist circumference, and/or weight.<sup>9, 41</sup> A smaller number of studies compared parent-child interventions<sup>12, 18, 41</sup> or parent-only interventions<sup>9</sup> to a usual care control group (mailed information or a workbook or minimal sessions) and the outcomes indicated that multi-component and more intensive interventions, defined as a high level of parental involvement and multiple treatment components such as intense dietary monitoring, physical activity, and behavioral techniques, with a focus on nutrition, physical activity and behavior modification had greater overall effectiveness.<sup>9, 12, 18, 41</sup> Both parent-child interventions and parent-only interventions showed greater effectiveness when compared to child-only interventions, despite the limited number of studies reporting such comparisons.<sup>10, 11, 15, 16, 41</sup> These overall findings are supported by evidence showing multi-component interventions with higher intensity or greater parental involvement were usually more effective in improving child weight outcomes.<sup>16, 46</sup>

While interventions for children often require parents to be involved, SRs and meta-analyses suggest that interventions with parents only are equally effective when compared to interventions with parents and children.<sup>9, 12, 18, 41, 44</sup> Five SRs indicated that parent-only interventions had similar (four SRs);<sup>9, 12, 18, 41</sup> or greater (one SR)<sup>44</sup> effectiveness compared to parent-child interventions. However, all 14 SRs have included interventions with parental involvement, but did not specify clearly whether mothers, fathers or both parents participated in the interventions. This has prevented the umbrella review from further synthesizing the results by sub-categories to compare intervention effectiveness by different parental roles (e.g. mother-child vs father-child interventions). There was an insufficient number of SRs reporting behavioral outcomes (secondary outcomes) such as dietary intake and physical activity to draw any conclusions regarding such parameters. Hence, intervention effectiveness in the present review mainly refers to improvement in weight, body composition, and weight-related anthropometric indicators.

## Discussion

The current umbrella review has systematically identified, synthesized, and graded a wide range of evidence on the effectiveness of targeting parents within individual-level treatment interventions for relative weight loss or weight maintenance in children aged 18 years and under who were overweight or obese. Results indicate that family-based behavioral interventions appear to be an effective strategy for weight management in children aged between two and 18 years, as indicated by a reduction in weight or weight-related outcomes (e.g. zBMI, percentage overweight) from baseline. The findings of the current umbrella review are similar to a previous umbrella review which assessed only RCTs with longer term intervention duration ( $\geq 6$  months) in child weight management.<sup>39</sup> The SRs found that a comprehensive multi-component intervention is effective in improving child metabolic and anthropometric measures, and appears to have the best overall outcomes when compared to single

component interventions focused on physical activity, diet, education, pharmacological, or surgical approach.<sup>39</sup> The effectiveness of a multi-component intervention combining dietary advice, physical activity, and behavior modification was also frequently mentioned in the SRs included in the current umbrella review.<sup>12, 46</sup> Evidence consistently supports the effectiveness of childhood obesity interventions that set goals for behavior change, such as consuming five servings of fruits and vegetables each day and replacing sugar sweetened beverages with sugar-free beverages.<sup>44</sup> Studies to date have recommended interventions that engage children in 60 minutes of moderate to vigorously intense physical activity on most days of the week, and limit screen time (leisure television and computer use) to no more than two hours per day.<sup>44</sup> These findings are consistent with the Australia's Physical Activity and Sedentary Behavior Guidelines for Children (five to 12 years).<sup>47</sup> The recent Australian 24-Hour Movement Guidelines for the Early Years recommend that preschoolers aged two to five years spend at least 60 minutes throughout the day in energetic play including; running, jumping, kicking, and throwing, and to limit screen time to no more than one hour per day.<sup>47</sup> However, within the included SRs, there was a lack of reporting on behavioral change such as dietary intake and physical activity as a result of the interventions.

Parents, as the gate keeper of the family food supply and as nutrition role models for their children, have a major influence on their children's eating habits.<sup>24, 30, 48, 49</sup> It is acknowledged that parents may play different roles as children age, however, the involvement of parents in intervention is essential and this is supported by evidence showing that parent's weight and lifestyle behavior are related to that of their children.<sup>20, 50, 51</sup> Family-based interventions included in the current umbrella review have directly involved one or both parents,<sup>12, 45</sup> and/or included family members or siblings<sup>15, 16</sup> in the treatment, and these interventions demonstrated greater effectiveness compared to control groups without parental or family involvement. Although the existing SRs suggest that including parents in weight management interventions enhances outcomes, they do not provide clear insights into which of the many possible aspects of parental influence were modified in the interventions and were key to achieving the desired weight outcomes (e.g. feeding practices, food parenting).<sup>46</sup> An SR of nine trials reported that no clear pattern emerged in terms of physical activity intervention effectiveness related to family member involvement (whole family, parents and the index child, or child only), goal of the family member, format of the intervention delivery (parents and child together or in separate groups) or age of child.<sup>40</sup>

Few weight management intervention trials had similar intervention characteristics and, together with the mixed outcomes assessed and reported results, it was difficult to establish whether there is any particular intervention type (parent-only vs parent-child) that is more likely to lead to a successful outcome in terms of change in child weight outcomes.<sup>9</sup> Nevertheless, the current umbrella review found that no intervention had a detrimental or not effective impact on child weight-related outcomes when compared to the comparator control group. Studies suggest that if parents recognize the importance of their child's weight, they will be motivated to influence their children in terms of lifestyle behaviors related to weight control.<sup>42</sup> Encouraging participating family members to change their own behaviors and

reduce their own body weight may be an effective strategy for overweight children in terms of reducing excess weight or preventing further weight gain.<sup>40</sup>

Evidence also indicates that low parental self-confidence predicts dropout rates in family-based behavioral treatment,<sup>42</sup> with one SR<sup>10</sup> of seven trials indicating potential predictors of program success (greater reduction in child BMI) included higher parental motivation, lower baseline BMI percentile in children, higher parental attendance, younger children, and lower socioeconomic status. Future interventions could include strategies targeting parents' self-confidence to actively engage them in interventions and to motivate and encourage them to be good role models for their children by improving their lifestyle behaviors.

There was emerging evidence indicating that parent-only interventions are as effective, if not more effective, in improving child weight and/or weight-related behavior as parent-child interventions.<sup>9, 12, 18, 41, 44</sup> The primary modality of intervention delivered to parents was through face-to-face educational sessions.<sup>44</sup> Key strategies targeting parents included providing education on healthy eating and physical activity, fostering the development of parenting skills to promote positive health behaviors in children, and coping with difficult situations.<sup>10, 41</sup> Interventions targeted nutrition and/or physical activity education along with parenting skills showed larger and more significant changes compared to interventions with education plus behavioral control components.<sup>16</sup> Effectiveness has been demonstrated in child weight management interventions that target parents as the agent of change through education sessions on nutrition and/or physical activity, authoritative parenting styles (setting boundaries, provide nurturing environment), positive parenting skills (self-monitoring, reinforcement, role modelling), and child behavior management strategies to encourage positive behaviors in weight management programs for overweight children.<sup>43</sup> Interventions targeting parents to improve self-efficacy and confidence in managing health behavior also assist in forming positive lifestyle habits within the family.<sup>50, 52, 53</sup> It is therefore important to note that interventions that involve parents only are likely to be less costly than interventions that involve the whole family, especially when parents and children are in separate groups.<sup>11</sup> However, the most commonly involved populations within the included SRs were children aged between 6-13 years when parents were usually the gate keeper of the family food supply. Parents' roles usually evolve as their children grow into adolescence and begin to gain more control and independence in making decisions including food preferences, such as lunchbox meals and snack choices, when eating at home or eating out with peers. Therefore, parent-only approaches for families with adolescents may be need to be different from those with younger children. Nevertheless, there are numerous issues to consider due to the lack of high quality evidence and high attrition rates in parent-only interventions. Further investigations are warranted to explore whether parent-only interventions are more cost-effective and sustainable,<sup>9, 18</sup> and to examine the barriers to participation and other complexities behind higher attrition rates in parent-only interventions through qualitative research.<sup>18</sup>

While previous research supports effective interventions that involve greater parental involvement as a whole, the majority of interventions targeting parents did not clearly specify whether mothers or fathers were involved.<sup>10</sup> Whenever mentioned, studies commonly refer only to maternal involvement, with the paternal role generally overlooked.<sup>54-57</sup> A recent systematic review seeking to assess father involvement in pediatric obesity prevention trials found that only 6% of parents in studies limited to one parent participation were fathers (N=123).<sup>23</sup> While only 2% of included studies identified a lack of paternal participation as a potential limitation, 99% included studies did not explicitly attempt to engage with fathers.<sup>23</sup> However, evidence shows that fathers are involved in child feeding, cooking, shopping and food choices,<sup>58</sup> as well as other aspects of child health and wellbeing.<sup>56</sup> Paternal BMI has been reported to be more strongly linked to childhood obesity than maternal BMI.<sup>59</sup> This suggests that the beliefs and behaviors of fathers need to be taken into account when implementing weight related lifestyle intervention within the family.<sup>60</sup> Future research should consider actively engaging both mothers and fathers in parent-targeted interventions for child weight management.

The current umbrella review had a number of limitations, as with any SR, including that potentially relevant studies may have been omitted as the review only included published SRs in English. The JBI manual recommends to include grey literature searches, however, this approach is often included in standard SRs. Therefore, unpublished grey literature would have been reported in the included SRs in the current umbrella review. There is the possibility that inherent bias existed in the reporting of this review where errors may have arisen in the initial appraisal and data extraction of the included SR or meta-analysis and they have been carried through in the current umbrella review.<sup>36</sup> In some of the included SRs, it was unclear whether there was more than one independent reviewer for study selection (n=7 SRs) and/or data extraction (n=4 SRs), unclear which quality appraisal or risk of bias instrument used (n=6 SRs), and unclear assessment of the presence of publication bias (n=12 SRs). There were a few occasions where results reported within SRs (narrative synthesis and results tables) were ambiguous. To address this, the original primary studies included in the SRs were referred to obtain information to enhance the accuracy of umbrella review synthesis. The umbrella review was also dependent on the reporting of the included research syntheses which may limit reporting of desirable details of interventions in the present report. For example, a limited number of SRs have reported dietary and physical activity outcomes which has impeded further synthesis of the intervention effectiveness on these behavioral outcomes of interests in the current umbrella review. Positive behavior change outcomes as a result of an intervention will provide an indication that an intervention is effective in modifying health behavior, which is likely to lead to weight loss in the longer term. Better reporting of behavior outcomes as a result of interventions would help to evaluate intervention effectiveness through preliminary impact on health behavior when weight change is usually not observed or is not significant within a short intervention duration generally between three and six months for most studies. As the majority of the included SRs did not adequately report on statistical significance (p-values) of the intervention trials, the umbrella review has not been able to synthesize a precise summary of intervention types which were significantly more effective than the other intervention types

on various outcomes of interest. However, using a systematic approach, the umbrella review is able to provide recommendations after grading the quality of evidence on a range of interventions and the strength of intervention effectiveness against numerous weight-related outcomes in children aged 18 years and under who were overweight or obese.

## **Conclusions**

Lifestyle behavior interventions targeting parents only, or parents with their child, are effective in achieving successful weight management outcomes in children aged two to 18 years. Multi-component family-based interventions combining dietary, physical activity, and behavior modification have consistently demonstrated effectiveness. Effective interventions employed parent-targeted strategies, including nutrition and physical activity education sessions, positive parenting skills, role modelling, and child behavior management.

### ***Implications for practice***

Health professionals can work with parents, as the key agents of change for their children, to encourage healthy eating and lifestyle behavior change across the family. It was not possible to recommend that one intervention component is more effective than the other. Therefore, the implications for practice includes a summary of strategies and interventions related to parental involvement within interventions. Parents can be provided with education on healthy eating and physical activity, not only to increase knowledge but to enhance self-efficacy and confidence in managing health behaviors within the home. Parent-targeted consultations can focus on fostering positive parenting skills in order to promote positive health behaviors in children and to cope with difficult situations related to health behavior change (e.g. family mealtime's challenges). Positive parenting skills, such as monitoring, reinforcement, role modelling, and provide nurturing environment, are relevant to support parents in facilitating healthy lifestyle change in family.

### ***Implications for research***

Future interventions need to examine whether engaging both parents within the parental component of interventions, especially fathers, can further enhance intervention effects. It is recommended for researchers to explicitly describe role of parents (e.g. mothers, fathers) involved in the interventions as opposed to using the term 'parents' when referring to the participants; who are often predominantly mothers. Future research should include larger and more diverse population groups, and examine the impact of interventions of longer duration and follow-up. There is a need for more comprehensive reporting of health behavior outcomes (e.g. dietary intake, physical activity levels) in order to assess which intervention components contribute to effectiveness and their relationship with change in health risk factors that are also associated with overweight and obesity.

## Conflicts of interest

The authors declare no conflict of interest.

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## Appendix I: Search strategy

Database: MEDLINE 1946 to Present with Daily Update (searched on 2<sup>nd</sup> May 2016)

#	Searches
1	systematic review.mp,pt.
2	systematic*.mp,pt.
3	review*.mp,pt.
4	meta analys*.mp,pt.
5	metaanalys*.mp,pt.
6	meta-analys*.mp,pt
7	1 or 2 or 3 or 4 or 5 or 6
8	lifestyle*.mp.
9	behavio?r*.mp.
10	family.mp.
11	families.mp.
12	family-based.mp.
13	parents.mp.
14	parent*.mp.
15	mother*.mp.
16	father*.mp.
17	carer*.mp.
18	guardian*.mp.
19	grandparent*.mp.
20	grandfather*.mp.
21	grandmother*.mp.
22	sibling*.mp.
23	coparent*.mp.
24	co-parent*.mp.
25	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
26	p?ediatric*.mp.
27	child*.mp.
28	kid*.mp.
29	toddler*.mp.
30	(preschooler* or preschooler*).mp.
31	adolescent*.mp.
32	teenager*.mp.
33	youth*.mp.
34	youngster*.mp.
35	26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34
36	overweight.mp.
37	obese.mp.
38	obes*.mp.
39	weight manag*.mp.
40	weight loss.mp.
41	weight control*.mp.
42	(overweight* adj5 intervention*).mp.
43	(overweight* adj5 treatment*).mp.
44	(overweight* adj5 program*).mp.

45	(weight* adj5 intervention*).mp.
46	(weight* adj5 treatment*).mp.
47	(weight* adj5 program*).mp.
48	(obes* adj5 intervention*).mp.
49	(obes* adj5 treatment*).mp.
50	(obes* adj5 program*).mp.
51	36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50
52	7 and 25 and 35 and 51
53	limit 52 to (english language and yr="1990 -Current")

Database: Embase 1974 to 2016 Week 18 (searched on 2<sup>nd</sup> May 2016)

#	Searches
1	systematic review.mp.
2	systematic*.mp.
3	review*.mp.
4	meta analys*.mp.
5	metaanalys*.mp.
6	1 or 2 or 3 or 4 or 5
7	lifestyle*.mp.
8	behavio?r*.mp.
9	family.mp.
10	families.mp.
11	family-based.mp.
12	parents.mp.
13	parent*.mp.
14	mother*.mp.
15	father*.mp.
16	carer*.mp.
17	guardian*.mp.
18	grandparent*.mp.
19	grandfather*.mp.
20	grandmother*.mp.
21	sibling*.mp.
22	coparent*.mp.
23	co-parent*.mp.
24	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
25	p?ediatric*.mp.
26	child*.mp.
27	kid*.mp.
28	toddler*.mp.
29	(preschooler* or pre-schooler*).mp.
30	adolescen*.mp.
31	teenager*.mp.

32	youth*.mp.
33	youngster*.mp.
34	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	overweight.mp.
36	obese.mp.
37	obes*.mp.
38	weight manag*.mp.
39	weight loss.mp.
40	weight control*.mp.
41	(overweight* adj5 intervention*).mp.
42	(overweight* adj5 treatment*).mp.
43	(overweight* adj5 program*).mp.
44	(weight* adj5 intervention*).mp.
45	(weight* adj5 treatment*).mp.
46	(weight* adj5 program*).mp.
47	(obes* adj5 intervention*).mp.
48	(obes* adj5 treatment*).mp.
49	(obes* adj5 program*).mp.
50	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49
51	6 and 24 and 34 and 50
52	limit 51 to (english language and yr="1990 -Current")

Database: PsycINFO 1806 to April Week 4 2016 (searched on 2<sup>nd</sup> May 2016)

#	Searches
1	systematic review.mp.
2	systematic*.mp.
3	review*.mp.
4	meta analys*.mp.
5	metaanalys*.mp.
6	1 or 2 or 3 or 4 or 5
7	lifestyle*.mp.
8	behavio?r*.mp.
9	family.mp.
10	families.mp.
11	family-based.mp.
12	parents.mp.
13	parent*.mp.
14	mother*.mp.
15	father*.mp.
16	carer*.mp.
17	guardian*.mp.
18	grandparent*.mp.

19	grandfather*.mp.
20	grandmother*.mp.
21	sibling*.mp.
22	coparent*.mp.
23	co-parent*.mp.
24	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
25	p?ediatric*.mp.
26	child*.mp.
27	kid*.mp.
28	toddler*.mp.
29	(preschooler* or pre-schooler*).mp.
30	adolescen*.mp.
31	teenager*.mp.
32	youth*.mp.
33	youngster*.mp.
34	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	overweight.mp.
36	obese.mp.
37	obes*.mp.
38	weight manag*.mp.
39	weight loss.mp.
40	weight control*.mp.
41	(overweight* adj5 intervention*).mp.
42	(overweight* adj5 treatment*).mp.
43	(overweight* adj5 program*).mp.
44	(weight* adj5 intervention*).mp.
45	(weight* adj5 treatment*).mp.
46	(weight* adj5 program*).mp.
47	(obes* adj5 intervention*).mp.
48	(obes* adj5 treatment*).mp.
49	(obes* adj5 program*).mp.
50	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49
51	6 and 24 and 34 and 50
52	limit 51 to (english language and yr="1990 -Current")

Database: CINAHL Complete (searched on 2<sup>nd</sup> May 2016)

#	Searches
S1	(MM "Systematic Review") OR (MH "Meta Analysis")
S2	TI 'systematic review' OR AB 'systematic review' OR PT 'systematic review'
S3	TI systematic* OR AB systematic* OR PT systematic*
S4	TI review* OR AB review* OR PT review*
S5	TI 'meta analys*' OR AB 'meta analys*' OR PT 'meta analys*'

S6	TI metaanalys* OR AB metaanalys* OR PT metaanalys*
S7	TI meta-analys* OR AB meta-analys* OR PT meta-analys*
S8	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7
S9	(MH "Life Style Changes") OR (MH "Life Style, Sedentary") OR (MH "Life Style") OR (MH "Health Behavior") OR (MH "Family Health") OR (MH "Family Services") OR (MH "Family Centered Care") OR (MH "Parents")
S10	TI lifestyle OR AB lifestyle
S11	TI behavio?r* OR AB behavio?r*
S12	TI family OR AB family
S13	TI families OR AB families
S14	TI family-based OR AB family-based
S15	TI parents OR AB parents
S16	TI parent* OR AB parent*
S17	TI mother* OR AB mother*
S18	TI father* OR AB father*
S19	TI carer* OR AB carer*
S20	TI guardian* OR AB guardian*
S21	TI grandparent* OR AB grandparent*
S22	TI grandfather* OR AB grandfather*
S23	TI grandmother* OR AB grandmother*
S24	TI sibling* OR AB sibling*
S25	TI coparent* OR AB coparent*
S26	TI co-parent* OR AB co-parent*
S27	S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26
S28	TI (p?ediatric*) OR AB (p?ediatric*)
S29	TI child* OR AB child*
S30	TI kid* OR AB kid*
S31	TI toddler* OR AB toddler*
S32	TI (preschooler* or pre-schooler*) OR AB (preschooler* or pre-schooler*)
S33	TI adolescen* OR AB adolescen*
S34	TI teenager* OR AB teenager*
S35	TI youth* OR AB youth*
S36	TI youngster* OR AB youngster*
S37	S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36
S38	(MM "Pediatric Obesity") OR (MM "Obesity+") OR (MH "Weight Control") OR (MH "Weight Reduction Programs")
S39	TI overweight OR AB overweight
S40	TI obese OR AB obese
S41	TI obes* OR AB obes*
S42	TI 'weight manag*' OR AB 'weight manag*'
S43	TI 'weight loss' OR AB 'weight loss'
S44	TI 'weight control*' OR AB 'weight control*'

S45	TI (overweight* N5 intervention*) OR AB (overweight* N5 intervention*)
S46	TI (overweight* N5 treatment*) OR AB (overweight* N5 treatment*)
S47	TI (overweight* N5 program*) OR AB (overweight* N5 program*)
S48	TI (weight* N5 intervention*) OR AB (weight* N5 intervention*)
S49	TI (weight* N5 treatment*) OR AB (weight* N5 treatment*)
S50	TI (weight* N5 program*) OR AB (weight* N5 program*)
S51	TI (obes* N5 intervention*) OR AB (obes* N5 intervention*)
S52	TI (obes* N5 treatment*) OR AB (obes* N5 treatment*)
S53	TI (obes* N5 program*) OR AB (obes* N5 program*)
S54	S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53
S55	S8 AND S27 AND S37 AND S54 (Limiters - Published Date: 19900101-; English Language)

Database: Cochrane Library – DARE and CDSR (searched on 2<sup>nd</sup> May 2016)

#	Searches
#1	"systematic review":ti,ab,kw or "systematic review":pt (Word variations have been searched)
#2	"systematic":ti,ab,kw or "systematic":pt (Word variations have been searched)
#3	"review":ti,ab,kw or "review":pt (Word variations have been searched)
#4	"meta analys*":ti,ab,kw and "meta analys*":pt (Word variations have been searched)
#5	metaanalys*:ti,ab,kw or metaanalys*:pt (Word variations have been searched)
#6	meta-analys*:ti,ab,kw or meta-analys*:pt (Word variations have been searched)
#7	MeSH descriptor: [Review] explode all trees
#8	MeSH descriptor: [Meta-Analysis] explode all trees
#9	MeSH descriptor: [Meta-Analysis as Topic] explode all trees
#10	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9
#11	lifestyle:ti,ab,kw (Word variations have been searched)
#12	behaviour:ti,ab,kw (Word variations have been searched)
#13	family:ti,ab,kw (Word variations have been searched)
#14	"families":ti,ab,kw (Word variations have been searched)
#15	family-based:ti,ab,kw (Word variations have been searched)
#16	parents:ti,ab,kw (Word variations have been searched)
#17	"parent":ti,ab,kw (Word variations have been searched)
#18	mother:ti,ab,kw (Word variations have been searched)
#19	"father":ti,ab,kw (Word variations have been searched)
#20	carer:ti,ab,kw (Word variations have been searched)
#21	guardian:ti,ab,kw (Word variations have been searched)
#22	grandparent:ti,ab,kw (Word variations have been searched)
#23	grandfather:ti,ab,kw (Word variations have been searched)
#24	grandmother:ti,ab,kw (Word variations have been searched)
#25	sibling:ti,ab,kw (Word variations have been searched)
#26	coparent:ti,ab,kw (Word variations have been searched)
#27	co-parent:ti,ab,kw (Word variations have been searched)
#28	MeSH descriptor: [Life Style] this term only

#29	MeSH descriptor: [Behavior] this term only
#30	MeSH descriptor: [Family] this term only
#31	MeSH descriptor: [Parents] explode all trees
#32	MeSH descriptor: [Siblings] explode all trees
#33	#11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32
#34	"p*ediatric*":ti,ab,kw (Word variations have been searched)
#35	child:ti,ab,kw (Word variations have been searched)
#36	kid:ti,ab,kw (Word variations have been searched)
#37	toddler:ti,ab,kw (Word variations have been searched)
#38	"preschooler":ti,ab,kw or "pre-schooler":ti,ab,kw (Word variations have been searched)
#39	adolescen*:ti,ab,kw (Word variations have been searched)
#40	teenager:ti,ab,kw (Word variations have been searched)
#41	youth:ti,ab,kw (Word variations have been searched)
#42	youngster:ti,ab,kw (Word variations have been searched)
#43	#34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42
#44	overweight:ti,ab,kw (Word variations have been searched)
#45	obese:ti,ab,kw (Word variations have been searched)
#46	"obes*":ti,ab,kw (Word variations have been searched)
#47	"weight manag*":ti,ab,kw (Word variations have been searched)
#48	"weight loss":ti,ab,kw (Word variations have been searched)
#49	"weight control*":ti,ab,kw (Word variations have been searched)
#50	overweight* near intervention*:ti,ab,kw (Word variations have been searched)
#51	overweight* near treatment*:ti,ab,kw (Word variations have been searched)
#52	overweight* near program*:ti,ab,kw (Word variations have been searched)
#53	weight* near intervention*:ti,ab,kw (Word variations have been searched)
#54	weight* near treatment*:ti,ab,kw (Word variations have been searched)
#55	weight* near program*:ti,ab,kw (Word variations have been searched)
#56	obes* near intervention*:ti,ab,kw (Word variations have been searched)
#57	obes* near treatment*:ti,ab,kw (Word variations have been searched)
#58	obes* near program*:ti,ab,kw (Word variations have been searched)
#59	MeSH descriptor: [Pediatric Obesity] explode all trees
#60	MeSH descriptor: [Weight Loss] explode all trees
#61	MeSH descriptor: [Weight Reduction Programs] explode all trees
#62	MeSH descriptor: [Body Weight Changes] explode all trees
#63	#44 or #45 or #46 or #47 or #48 or #49 or #50 or #51 or #52 or #53 or #54 or #55 or #56 or #57 or #58 or #59 or #60 or #61 or #62
#64	#10 and #33 and #43 and #63
#65	#10 and #33 and #43 and #63 Publication Year from 1990 (Word variations have been searched)

Database: Scopus (searched on 2<sup>nd</sup> May 2016)

#	Searches
#1	( TITLE-ABS-KEY ( "systematic review" ) OR TITLE-ABS-KEY ( systematic* ) OR TITLE-ABS-KEY ( review* ) OR TITLE-ABS-KEY ( "meta analys*" ) OR TITLE-ABS-KEY ( metaanalys* ) OR TITLE-ABS-KEY ( meta-analys* ) )
#2	TITLE-ABS-KEY ( lifestyle* ) OR TITLE-ABS-KEY ( behavio?r* ) OR TITLE-ABS-KEY ( family ) OR TITLE-ABS-KEY ( families ) OR TITLE-ABS-KEY ( "family-based" ) OR TITLE-ABS-KEY ( parents ) OR TITLE-ABS-KEY ( parent* ) OR TITLE-ABS-KEY ( mother* ) OR TITLE-ABS-KEY ( father* ) OR TITLE-ABS-KEY ( carer* ) OR TITLE-ABS-KEY ( guardian* ) OR TITLE-ABS-KEY ( grandparent* ) OR TITLE-ABS-KEY ( grandfather* ) OR TITLE-ABS-KEY ( grandmother* ) OR TITLE-ABS-KEY ( sibling* ) OR TITLE-ABS-KEY ( coparent* ) OR TITLE-ABS-KEY ( "co-parent*" )
#3	TITLE-ABS-KEY ( p?ediatric* ) OR TITLE-ABS-KEY ( child* ) OR TITLE-ABS-KEY ( kid* ) OR TITLE-ABS-KEY ( toddler* ) OR TITLE-ABS-KEY ( preschooler* ) OR TITLE-ABS-KEY ( pre-schooler* ) OR TITLE-ABS-KEY ( adolescen* ) OR TITLE-ABS-KEY ( teenager* ) OR TITLE-ABS-KEY ( youth* ) OR TITLE-ABS-KEY ( youngster* )
#4	TITLE-ABS-KEY ( overweight ) OR TITLE-ABS-KEY ( obese ) OR TITLE-ABS-KEY ( obes* ) OR TITLE-ABS-KEY ( "weight manag*" ) OR TITLE-ABS-KEY ( "weight loss" ) OR TITLE-ABS-KEY ( "weight control*" ) OR TITLE-ABS-KEY ( overweight* W/5 intervention* ) OR TITLE-ABS-KEY ( overweight* W/5 treatment* ) OR TITLE-ABS-KEY ( overweight* W/5 program* ) OR TITLE-ABS-KEY ( weight* W/5 intervention* ) OR TITLE-ABS-KEY ( weight* W/5 treatment* ) OR TITLE-ABS-KEY ( weight* W/5 program* ) OR TITLE-ABS-KEY ( obes* W/5 intervention* ) OR TITLE-ABS-KEY ( obes* W/5 treatment* ) OR TITLE-ABS-KEY ( obes* W/5 program* )
#5	#1 AND #2 AND #3 AND #4 AND PUBYEAR > 1989
#6	#5 AND ( LIMIT-TO ( EXACTKEYWORD , "Child" ) )

## Appendix II: List of relevant primary studies included in systematic reviews

Primary studies included in systematic reviews (n=47)	Included systematic reviews (n=14)													
	Barr-Anders on (2013)	Berge (2011)	Berry (2004)	Ewald (2014)	Jang (2015)	Jull (2013)	Kelisha di (2014)	Kitzma n-Ulrich (2010)	Knowl den (2012)	Kothan dan (2014)	Lovem an (2015)	Sung Chan (2013)	Upton (2014)	Young (2007)
Aragona 1975											v	v		
Bean 2012							v							
Beech 2003		v												v
Boutelle 2001				v		v					v			
Coates 1982			v					v						
Collins 2011				v							v			
Coppins 2011													v	
Danielsen 2013							v							
Epstein 2000		v					v							
Epstein 2001		v												
Esfarjani 2013											v			
Estabrooks 2009					v						v			
Golan 1998		v		v					v					
Golan 2004		v							v					
Golan 2006		v		v		v		v	v	v	v			
Golley 2007		v									v			
Gunnarsdottir 2012							v							
Hughes 2008							v							
Janicke 2008		v		v		v		v		v	v	v		
Janicke 2011	v													
Jansen 2011					v						v			
Jiang 2005		v					v			v		v		
Kalarchian 2009										v				

Primary studies included in systematic reviews (n=47)	Included systematic reviews (n=14)													
	Barr-Anderson (2013)	Berge (2011)	Berry (2004)	Ewald (2014)	Jang (2015)	Jull (2013)	Kelishadi (2014)	Kitzmann-Ulrich (2010)	Knowlden (2012)	Kothandan (2014)	Loveman (2015)	Sung Chan (2013)	Upton (2014)	Young (2007)
Kalavainen 2007		v					v							
Kalavainen 2012							v							
MacDonell 2011	v													
Mazzeo 2012					v									
Mazzeo 2014					v						v			
Munsch 2008				v				v			v			
Nowicka 2008								v						
Okely 2010				v										
Raman 2010	v													
Resnick 2009											v			
Resnicow 2015	v										v			
Rodearmel 2006												v		
Sacher 2010							v						v	
Savoye 2011							v							
Shelton 2007					v			v	v			v		
Small 2013											v			
Stark 2011							v		v					
van Grieken 2013											v			
Vos 2012							v							
Wadden 1990	v													
West 2010					v		v		v		v	v		
Wheeler 1976												v		
White 2004												v		
Williamson 2006	v													

Note: 'v' indicates a primary study was included in a systematic review.

### Appendix III: List of excluded studies

Studies excluded	†
Acosta MC, Manubay J, Levin FR. Pediatric obesity: parallels with addiction and treatment recommendations. <i>Harvard Review of Psychiatry</i> . 2008;16(2):80-96.	B
Agras WS, Mascola AJ. Risk factors for childhood overweight. <i>Current Opinion in Pediatrics</i> . 2005;17(5):648-52.	B
Aguilar Cordero MJ, Ortégón Piñero A, Mur Vilar N, Sánchez García JC, García Verazaluce JJ, García García I, et al. Physical activity programmes to reduce overweight and obesity in children and adolescents; a systematic review]. <i>Nutricion Hospitalaria</i> . 2014;30:727-40 14p.	A
Aikenhead A, Knai C. Child obesity: Is surgery effective and cost-effective? A literature review. <i>Obesity Reviews</i> . 2010;11:253-4.	B
Ajie WN, Chapman-Novakofski KM. Impact of computer-mediated, obesity-related nutrition education interventions for adolescents: a systematic review. <i>Journal of Adolescent Health</i> . 2014;54(6):631-45.	E
Al Marzooqi MA, Christine Nagy M. Childhood obesity intervention programs: A systematic review. <i>Life Science Journal</i> . 2011;8(4):45-60.	D
Allender S, Cowburn G, Foster C. Understanding participation in sport and physical activity among children and adults: a review of qualitative studies. <i>Health Education Research</i> . 2006;21(6):826-35.	B
Allison DB, Faith MS, Gorman BS. Publication bias in obesity treatment trials? <i>International Journal of Obesity</i> . 1996;20(10):931-7.	B
Allison DB, Pi-Sunyer FX. Obesity treatment: Establishing goals, improving outcomes, and reviewing the research agenda. <i>Obesity treatment: Establishing goals, improving outcomes, and reviewing the research agenda</i> . 1995.	B
Al-Shawwa BA, Al-Huniti NH, DeMattia L, Gershan W. Asthma and insulin resistance in morbidly obese children and adolescents. <i>Journal of Asthma</i> . 2007;44(6):469-73.	B
Altman M, Wilfley DE. Evidence update on the treatment of overweight and obesity in children and adolescents. <i>Journal of Clinical Child and Adolescent Psychology</i> . 2015;44(4):521-37.	E
Alustiza E, Aranceta J. Prevention and treatment of childhood obesity in primary health care. <i>Revista Espanola de Nutricion Comunitaria</i> . 2004;10(4):192-6.	A
Amendoeira J, Godinho C, Candido A. Intervention programs to prevent obesity in childrens and adolescents. a systematic literature review. <i>Atencion Primaria</i> . 2013;45:22.	B
American Dietetic A. Position of the American Dietetic Association: individual-, family-, school-, and community-based interventions for pediatric overweight. <i>Journal of the American Dietetic Association</i> . 2006;106(6):925-45.	E
Amini M, Djazayeri A, Majdzadeh R, Taghdisi MH, Jazayeri S. Effect of school-based interventions to control childhood obesity: A review of reviews. <i>International Journal of Preventive Medicine</i> . 2015;2015(AUGUST).	B
Ammerman AS, Ward DS, Benjamin SE, Ball SC, Sommers JK, Molloy M, et al. An intervention to promote healthy weight: Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) theory and design. <i>Preventing Chronic Disease</i> . 2007;4(3):A67.	B
An JY, Hayman LL, Park YS, Dusaj TK, Ayres CG. Web-based weight management programs for children and adolescents: a systematic review of randomized controlled trial studies. <i>Advances in Nursing Science</i> . 2009;32(3):222-40.	E
Anand SG, Adams WG, Zuckerman BS. Specialized care of overweight children in community health centers. <i>Health Affairs</i> . 2010;29(4):712-7.	B

Andersen CJ, Fernandez ML. Dietary strategies to reduce metabolic syndrome. <i>Reviews in Endocrine &amp; Metabolic Disorders</i> . 2013;14(3):241-54.	B
Anderson BJ, Cullen K, McKay S. Quality of life, family behavior, and health outcomes in children with type 2 diabetes. <i>Pediatric Annals</i> . 2005;34(9):722-9.	B
Anderson LM, Phelps L. School-wide healthy weight behaviors: Promoting Universal Longevity via School-Family Ecologies (PULSE). <i>Special Issue: Obesity in the schools</i> . 2009;46(8):748-55.	B
Anderson YC, Cave TL, Cunningham VJ, Pereira NM, Woolerton DM, Grant CC, et al. Effectiveness of current interventions in obese New Zealand children and adolescents. <i>Obesity Research and Clinical Practice</i> . 2014;8:2.	B
Antwi F, Fazylova N, Garcon MC, Lopez L, Rubiano R, Slyer JT. The effectiveness of web-based programs on the reduction of childhood obesity in school-aged children: A systematic review. <i>JBIC Database of Systematic Reviews and Implementation Reports</i> . 2012;10:S177-S90.	B
Antwi FA, Fazylova N, Garcon MC, Lopez L, Rubiano R, Slyer JT. Effectiveness of web-based programs on the reduction of childhood obesity in school-aged children: A systematic review. <i>JBIC Database of Systematic Reviews and Implementation Reports</i> . 2013;11(6):1-44.	E
Anzman-Frasca S, Stifter CA, Birch LL. Temperament and childhood obesity risk: a review of the literature. <i>Journal of Developmental &amp; Behavioral Pediatrics</i> . 2012;33(9):732-45.	B
Apovian CM, Baker C, Ludwig DS, Hoppin AG, Hsu G, Lenders C, et al. Best practice guidelines in pediatric/adolescent weight loss surgery. <i>Obesity Research</i> . 2005;13(2):274-82.	D
Ara I, Vicente-Rodríguez G, Moreno LA, Gutin B, Casajus JA. Child obesity can be better reduced through vigorous physical activity rather than through energy intake restriction. <i>Apunts Medicina de l'Esport</i> . 2009;44(163):111-8.	B
Arai L, Panca M, Morris S, Curtis-Tyler K, Lucas PJ, Roberts HM. Time, monetary and other costs of participation in family-based child weight management interventions: Qualitative and systematic review evidence. <i>PLoS ONE</i> . 2015;10(4).	B
Arce ABG, Jay M, Bruzzese JM. Treatment-seeking overweight preschoolers have reduced health-related quality of life compared with nonclinical preschoolers. <i>Journal of Clinical Outcomes Management</i> . 2013;20(1):9-11.	B
Arden MR. The office diagnosis and treatment of pediatric and adolescent obesity. <i>Children's Hospital Quarterly</i> . 1993;5(2):107-11.	B
Ariza AJ, Greenberg RS, Unger R. Childhood overweight: management approaches in young children. <i>Pediatric Annals</i> . 2004;33(1):33-8.	B
Askie L, Baur L, Campbell K, Daniels L, Taylor B, L MW, et al. Generating evidence of reduced rates of overweight/ obesity in children: Value adding to four established Australasian early intervention trials. <i>Obesity Facts</i> . 2012;5:258-9.	B
Askie L, Martin A, Espinoza D, Campbell K, Daniels LA, Hesketh K, et al. What does the EPOCH (early prevention of obesity in childhood) prospective meta-analysis tell us about early life obesity prevention? <i>Obesity Research and Clinical Practice</i> . 2014;8:3-4.	B
Atlantis E, Barnes EH, Singh MAF. Efficacy of exercise for treating overweight in children and adolescents: A systematic review. <i>International Journal of Obesity</i> . 2006;30(7):1027-40.	E
Audrey S, Batista-Ferrer H. Healthy urban environments for children and young people: A systematic review of intervention studies. <i>Health and Place</i> . 2015;36:97-117.	E
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†Reasons for exclusion - A: Not in English (68); B: Not a systematic review (440); C: Irrelevant population (12); D: Not behavioural obesity treatment intervention (48); E: Not targeting family involvement in interventions (112); F: Not reporting child's weight or BMI outcome (3).

#### Appendix IV: Table of included study characteristics (systematic reviews)

Author (Year)	Search strategy for identifying relevant studies	Inclusion criteria for study selection	Characteristics of included primary trials
Barr-Anderson (2013)	<ul style="list-style-type: none"> <li>• 26 databases: including PubMed, Medline, PsycINFO, Embase, Cochrane Library, CINAHL</li> <li>• Searched in March 2012</li> <li>• Retrieved publications from 1887 to Mar 2012</li> </ul>	<p><i>Population:</i> African–American girls aged 5–18 years.</p> <p><i>Interventions:</i> Some degree of family involvement at home or community setting (i.e. school, local theatre, clinic, park or recreational centre, etc.) with intervention strategies targeting physical activity, eating/nutrition or weight.</p>	<p><i>Included trials and year range:</i> 6 of 27 included trials were relevant* (1990-2011)</p> <p><i>Study designs and countries of interventions:</i> RCT (n=5) and NRCT (n=1), conducted in USA only as per inclusion criteria.</p> <p><i>Participants:</i> Children aged 6-17 years (sample size ranged from n=36-165; overall total n=465). 3 trials included male and female children, while 3 trials included female children only.</p>
Berge (2011)  Meta-analysis	<ul style="list-style-type: none"> <li>• 6 databases: PubMed, Medline, PsycINFO, Cochrane Library, CINAHL, Social Science Abstracts</li> <li>• Searched between Dec 2009 and Apr 2010</li> <li>• Retrieved publications from 2000 to 2009</li> </ul>	<p><i>Population:</i> Children aged 5-18 years.</p> <p><i>Interventions:</i> Include parent/family member in intervention (direct engage or support child behaviour change).</p>	<p><i>Included trials and year range:</i> 11 of 20 included trials were relevant* (2011-2008)</p> <p><i>Study designs and countries of interventions:</i> RCT (n=10) and NRCT (n=1). Countries not reported.</p> <p><i>Participants:</i> Children aged 6-15 years.</p>
Berry (2004)	<ul style="list-style-type: none"> <li>• 3 databases: Medline, CINAHL, and PSYCLIT</li> <li>• Searched date not provided,</li> <li>• Retrieved publications from Jan 1980 to Jan 2004</li> </ul>	<p><i>Population:</i> Children (age not specified).</p> <p><i>Interventions:</i> Include child and at least one parent for nutrition, exercise, or behavioural changes with duration follow up at least 6 months.</p>	<p><i>Included trials and year range:</i> 13 included trials (1981-2000)</p> <p><i>Study designs and countries of interventions:</i> RCT with at least 6-month follow-up as per inclusion criteria. Countries not reported.</p> <p><i>Participants:</i> Children aged 5-17 years.</p>
Ewald (2014)	<ul style="list-style-type: none"> <li>• 6 databases: Medline, PsycINFO, Embase, Cochrane Library, CINAHL, ASSIA</li> <li>• Searched in July 2012 and updated in March 2013</li> </ul>	<p><i>Population:</i> Overweight/obese children aged 5-12 years.</p> <p><i>Interventions:</i></p>	<p><i>Included trials and year range:</i> 6 of 8 included trials were relevant* (1998-2011)</p> <p><i>Study designs and countries of interventions:</i></p>

Author (Year)	Search strategy for identifying relevant studies	Inclusion criteria for study selection	Characteristics of included primary trials
	<ul style="list-style-type: none"> <li>Retrieved publications up to Jun 2013</li> </ul>	Targeting parents only compared with interventions including the child for the treatment of child overweight/obesity	<p>RCT (n=6) with at least 6-month follow-up as per inclusion criteria, conducted in USA (n=2), Australia (n=1), Israel (n=2), Switzerland (n=1).</p> <p><i>Participants:</i> Children aged 8-11 years (overall sample n=466). All trials included male and female children and both parents, apart from one trial, which was restricted to only mothers due to recruitment issues.</p>
Jang (2015)	<ul style="list-style-type: none"> <li>4 databases: PubMed, PsycINFO, CINAHL, SCOPUS</li> <li>Searched date not provided</li> <li>Retrieved publications from Jan 1990 to Apr 2015</li> </ul>	<p><i>Population:</i> Not specified.</p> <p><i>Interventions:</i> Treatment of childhood overweight or obesity that targeted only parent(s)/guardian(s).</p>	<p><i>Included trials and year range:</i> 7 included trials (2007-2014)</p> <p><i>Study designs and countries of interventions:</i> RCT only as per inclusion criteria, conducted in USA (n=3), Australian (n=2), Netherlands (n=1), Belgium (n=1).</p> <p><i>Participants:</i> Children aged 3-13 years (sample size ranged from n=43-220). Limited information was provided about which parent participated or whether both parents participated in the trial.</p>
Jull (2013) Meta-analysis	<ul style="list-style-type: none"> <li>5 databases: Medline, PsycINFO, Embase, Cochrane Controlled Trials Register, CINAHL</li> <li>Searched in Dec 2011</li> <li>Date range included in searches not reported</li> </ul>	<p><i>Population:</i> Children up to age 14 years with overweight or obesity.</p> <p><i>Interventions:</i> Weight loss interventions that compared a parent-only condition to a parent[s] and child condition.</p>	<p><i>Included trials and year range:</i> 4 included trials (2006-2011)</p> <p><i>Study designs and countries of interventions:</i> RCT only as per inclusion criteria, conducted in USA (n=2), Israel (n=1), Switzerland (n=1).</p> <p><i>Participants:</i> Children aged 6-14 years (overall sample n=266; 56% female).</p>
Kelishadi (2014)	<ul style="list-style-type: none"> <li>4 databases: PubMed, Medline, ISI Web of Science, and Scopus scientific databases</li> <li>Searched date not provided</li> </ul>	<p><i>Population:</i> Children aged 2-18 years with overweight or obesity.</p> <p><i>Interventions:</i></p>	<p><i>Included trials and year range:</i> 26 of 104 included trials were relevant* (2005-2013)</p> <p><i>Study designs and countries of interventions:</i> RCT (n=26), conducted in USA (n=9), UK (n=3), Sweden (n=3), Australia (n=2), Finland (n=2), Turkey (n=1),</p>

Author (Year)	Search strategy for identifying relevant studies	Inclusion criteria for study selection	Characteristics of included primary trials
	<ul style="list-style-type: none"> <li>Retrieved publications from 2000 to 2002</li> </ul>	<p>Family-based interventions within community, family, school, and clinic settings or a combination of them conducted among obese/overweight children</p>	<p>Scotland (n=1), China (n=1), Norway (n=1), Holland (n=1), Iceland (n=1), and one study involved European countries of interventions (authors from Netherlands, Denmark, UK, Greece, Germany, Spain, Bulgaria, and Crezch Republic).</p> <p><i>Participants:</i> Children aged 2-18 years.</p>
Kitzman-Ulrich (2010)	<ul style="list-style-type: none"> <li>2 databases: PubMed, PsycINFO, and Google Academic Search</li> <li>Searched date not provided</li> <li>Date range included in searches not reported</li> </ul>	<p><i>Population:</i> Youth from elementary school through adolescence.</p> <p><i>Interventions:</i> Targeted parent behaviours; inclusion of the family in innovative formats (e.g., incorporating the family in school-based programs); inclusion of family functioning or family therapy components (e.g., promoting cohesion, family warmth, healthy communication styles, and reductions in family conflict); inclusion of parent training, parenting styles, or child-management principles (e.g., encouraging authoritative parenting, setting appropriate boundaries, providing reinforcement of positive behaviours).</p>	<p><i>Included trials and year range:</i> 21 included trials (1981-2008)</p> <p><i>Study designs and countries of interventions:</i> RCT (n=20) and NRCT (n=1). Countries not reported.</p> <p><i>Participants:</i> Children aged 5-19 years.</p>
Knowlden (2012)	<ul style="list-style-type: none"> <li>5 databases: Medline, CINAHL, Education Resources Info Center (ERIC), Psychology and Behavioural Sciences Collection and CENTRAL databases</li> <li>Searched date not provided</li> <li>Retrieved publications from 2001 to 2011.</li> </ul>	<p><i>Population:</i> Children 2-7 years old in any weight category.</p> <p><i>Interventions:</i> Tertiary prevention studies that included home-based component (home visit, home-based activities) and at least one parent/caregiver.</p>	<p><i>Included trials and year range:</i> 9 included trials (2003-2011)</p> <p><i>Study designs and countries of interventions:</i> RCT only as per inclusion criteria, conducted in USA (n=2), Australian (n=5), Israel (n=2).</p> <p><i>Participants:</i> Children aged 2-16 years with overweight or obesity. One study evaluated outcomes at 7-year follow up and children had mean age of 16 years.</p>

Author (Year)	Search strategy for identifying relevant studies	Inclusion criteria for study selection	Characteristics of included primary trials
Kothandan (2014)	<ul style="list-style-type: none"> <li>5 databases: PubMed, Medline, CINAHL, Science Direct, DARE.</li> <li>Searched date not provided</li> <li>Retrieved publications from Jan 2000 to Aug 2010.</li> </ul>	<p><i>Population:</i> Children aged less than 18 years with obesity.</p> <p><i>Interventions:</i> School- and family-based interventions for treatment of childhood obesity through two comparing strategies. Results for school-based and family-based were separable.</p>	<p><i>Included trials and year range:</i> 8 of 13 included trials were relevant* (2001-2010)</p> <p><i>Study designs and countries of interventions:</i> RCT only as per inclusion criteria. Countries not reported.</p> <p><i>Participants:</i> Children aged 6-14 years (overall sample n=721; males and females)</p>
Loveman (2015)  Meta-analysis	<ul style="list-style-type: none"> <li>9 databases: Medline, PsycINFO, Embase, Cochrane Library (CDSR, CENTRAL, DARE, HTA), and LILACS as well trial registers.</li> <li>Searched date not provided</li> <li>Retrieved publications up to Feb/March 2015.</li> </ul>	<p><i>Population:</i> Children aged 5-11 years with overweight or obesity.</p> <p><i>Interventions:</i> Directed at parents as the agents of change; lifestyle intervention to treat overweight/obesity in children, intervention involved parents only (without children), duration of intervention/follow up at least 6 months, parents as agent of change</p>	<p><i>Included trials and year range:</i> 20 included trials (1975-2015)</p> <p><i>Study designs and countries of interventions:</i> RCT only as per inclusion criteria, conducted in USA (n=10), Australia (n=4), Israel (n=1), Switzerland (n=1), Iran (n=1), Belgium (n=1), Netherlands (n=2).</p> <p><i>Participants:</i> Children aged 4-13 years. The proportion of girls in the trials ranged from 40% to 70% where reported (except 4 trials did not report this), and 1 study included girls only.</p>
Sung Chan (2013)	<ul style="list-style-type: none"> <li>6 databases: PubMed, PsycINFO, CINAHL, Cumulative Index to Nursing and Allied Health Literature, Family &amp; Society Studies Worldwide, Social Work Abstracts, and SocINDEX.</li> <li>Searched date not provided</li> <li>Retrieved publications from 1975 to Jun 2012.</li> </ul>	<p><i>Population:</i> Children aged 2-19 years with overweight or obesity.</p> <p><i>Interventions:</i> At least one family member in addition to the overweight child in a weight loss or weight control intervention</p>	<p><i>Included trials and year range:</i> 15 included trials (1975-2010)</p> <p><i>Study designs and countries of interventions:</i> RCT only as per inclusion criteria. Countries not reported.</p> <p><i>Participants:</i> Children aged 5-15 years.</p>
Upton (2014)	<ul style="list-style-type: none"> <li>4 databases: PubMed, Medline, Academic search, and PsycARTICLES.</li> <li>Searched date not provided</li> </ul>	<p><i>Population:</i> Children aged 2-19 years with overweight or obesity.</p>	<p><i>Included trials and year range:</i> 5 of 10 included trials were relevant* (2008-2012)</p> <p><i>Study designs and countries of interventions:</i></p>

Author (Year)	Search strategy for identifying relevant studies	Inclusion criteria for study selection	Characteristics of included primary trials
	<ul style="list-style-type: none"> <li>Retrieved publications from Jan 1990 to Jun 2013.</li> </ul>	<p><i>Interventions:</i> Family-based, include at least one family member in addition to the overweight child for weight management intervention</p>	<p>RCT (n=4) and NRCT (n=1), conducted in UK only as per inclusion criteria.</p> <p><i>Participants:</i> Children aged 4-16 years.</p>
<p>Young (2007)</p> <p>Meta-analysis</p>	<ul style="list-style-type: none"> <li>3 databases: Medline, PsycINFO, CINAHL.</li> <li>Searched date not provided</li> <li>Retrieved publications from 1967 to present (no further details reported).</li> </ul>	<p><i>Population:</i> Children aged 5-12 years.</p> <p><i>Interventions:</i> Family involvement was defined as having a minimum of one parent or guardian involved in at least one aspect of treatment. Behavioural treatment was determined by a study's use of behavioural or cognitive-behavioural techniques, defined as the authors' inclusion of any combination of the following methods: psychoeducation, stimulus control, developing behavioural awareness, identifying problematic behaviour, modifying current behaviour, and maintaining behaviour change. Weight loss treatment was defined as a program conducted with the primary goal of child weight-loss.</p>	<p><i>Included trials and year range:</i> 16 included trials (1982-2004)</p> <p><i>Study designs and countries of interventions:</i> All trials had at least 2 groups (intervention, control, and alternate condition) except for 1 trial (which was a single-group trial). No further details provided for study designs and countries.</p> <p><i>Participants:</i> Children aged 5-13 years.</p>

RCT: randomized controlled trial; NRCT: non-randomized controlled trial.