Treatment of Overweight/Obesity in Children and Youth:

A Systematic Review with Meta-analyses

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Abstract

Background: Childhood obesity is an increasing public health concern. This review synthesizes the evidence of behavioural and pharmacological weight management interventions relevant to primary-care practitioners on body mass index, body mass index z-score, and prevalence of overweight/obesity in children/youth.

Methods: Systematic review and meta-analyses. Multiple databases were searched up to August, 2013. Studies had to be randomized trials and report changes in body mass index, body mass index z-score and/or prevalence of overweight/obesity; include children 2-18 years with a body mass index >85th percentile for age and sex; and use interventions feasible for conducting in primary care, potentially in conjunction with community resources. Standardized mean difference in body mass index/body mass index z-score was meta-analyzed.

Results: Thirty-one studies [29 behavioural (diet, exercise and/or lifestyle) and two pharmacological (orlistat) plus behavioural] were included. At post-intervention, both behavioural and pharmacological-plus-behavioural interventions reduced body mass index/body mass index z-score. Prevalence data could not be pooled, but studies reported no significant difference between intervention and control groups in the likelihood of reduced prevalence of overweight or overweight/obesity. The pooled effect estimates for systolic and diastolic blood pressure and overall quality of life showed small but statistically significant benefits in favour of the intervention group.

Interpretation: There is low to moderate quality evidence that available behavioural treatments for overweight/obesity in children and youth are associated with a medium treatment effect in terms of lowered body mass index/body mass index z-score as compared to a small treatment effect shown by combined pharmacological-behavioural interventions.

Introduction

A recent Canadian Health Measures Survey (2009-2011) reported obesity prevalence among 5-17 year olds at 11.7%, with an additional 19.8% classified as overweight.[1] In the United States, obesity prevalence among 2-19 year olds (2009-2010) was reported at 16.9%, with another 14.9% considered overweight.[2] Obesity that begins in childhood usually persists into adulthood [3] and is associated with adverse outcomes including metabolic, cardiovascular, musculoskeletal, neurological, gastrointestinal, respiratory, and psychosocial disturbances.[4-9] The predicted increase in childhood obesity has intensified the urgency of improving treatment approaches for the pediatric population.

Treatment of childhood and adolescent obesity is a very active area of research and a number of systematic reviews have been published recently.[10-16] Distinguishing this review, we aimed to provide an updated synthesis of the effectiveness of interventions appropriate for primary care practitioners to conduct in office or to offer in conjunction with community resources. The key question was: Do primary care relevant treatment interventions lead to short-term or sustained weight stabilization or reduction, and to other health benefits in overweight or obese children and adolescents?

Methods

The protocol was registered with PROSPERO (# CRD42012002754) (www.crd.york.ac.uk/prospero/).

Search Strategy

A preliminary search found a recent high quality review (9/11 AMSTAR [17] rating) by the United States Preventive Services Task Force that examined the effectiveness of weight management programs for overweight and obese children.[16] To avoid duplication, our protocol

was designed to update their search. We searched EMBASE, Medline, Cochrane Central Registry of Controlled Trials and PsychINFO from June 10, 2008 (the date of the last United States Preventive Services Task Force search) to August 28, 2013. The full search strategy is available in the supplemental *e*-File (*e*-Appendix 1). Reference lists of included studies and pertinent reviews were searched for relevant studies not captured by our search.

Population, Intervention, Comparator, Outcome and Setting Statement

Details regarding the population, intervention, comparator, outcomes and setting for this review are provided in Box 1.

Inclusion/Exclusion Criteria

Detailed inclusion/exclusion criteria are found in Box 2.

Study Selection, Quality Assessment and Data Abstraction

Titles and abstracts were reviewed in duplicate. Any citation marked for inclusion by either team member went to full text screening, which was also done independently by two people. One person completed full abstraction and a second person verified extractions. All data were checked again prior to analysis. Randomized controlled trials were assessed using the Cochrane Risk of Bias tool.[18] Overall strength of the evidence (identified as high, moderate, low or very low quality) was determined using the Grading of Recommendations Assessment, Development and Evaluation system.[19, 20] At all levels, inter-rater conflicts were resolved through discussion.

Data Analysis

For meta-analyses, means and standard deviations (SD) were utilized for continous outcomes (e.g., body mass index) while counts data were utilized for binary outcomes (i.e., prevalence, adverse events). Whenever possible, immediate post-treatment data were used, otherwise we

selected the data point closest to the end of the intervention which was at least six months past baseline assessment. The DerSimonian and Laird random effects model with inverse variance method [21] was utilized to generate the summary measures of effect in the form of standardized mean difference (SMD) for the primary outcome of body mass index/body mass index z-score (<0.2=very small effect; ≥0.2 and <0.5=small effect; ≥0.5 and <0.8=medium effect; ≥0.8=large effect) [22], mean difference (MD) for other continous outcomes, and risk ratio (RR) for binary outcomes. To help interpret SMD we converted values to body mass index and body mass index z-score units. Pooled SMD was multiplied by a typical among-person standard deviation for body mass index and body mass index z-score which yielded an estimate of the difference in mean outcome scores (intervention versus control). The SD for body mass index and body mass index z-score was obtained as the pooled SD of difference in change from baseline scores in one of the studies in the meta-analysis and to better reflect among-person variation, we selected a representative study with low risk of bias.[23] If studies reported data for both body mass index and body mass index z-score we included only the non-standardized data in the meta-analysis. In the forest plot a -z extension is used to indicate when the standardized scores were used. For studies that recruited a single gender or for mixed gender studies that reported results for boys and for girls, we entered this data separately into the meta-analyses, using alphabetical extensions (-M, -F) to identify gender. For studies with more than one intervention arm, we combined data from similar intervention groups (e.g., two lifestyle arms, one delivered to families, one delivered only to parents) to do a pair-wise comparison with the control group.[23] I^2 statistic was used to quantify statistical heterogeneity between studies. For the outcome of body mass index/body mass index z-score we did sensitivity analyses based on the primary focus of intervention [behavioural, pharmacological (orlistat) plus behavioural] and then only for the behavioural

approaches based on type of intervention (diet, exercise, diet plus exercise, lifestyle), intervention duration (≤12 months, >12 months), age group (2-12 years, 13-18 years), intervention target (individual, family), and study risk of bias rating (low, unclear, high).

Role of Funding Source

The Canadian Institutes of Health Research had no role in design, analyses, interpretation or decision to submit the paper for publication.

Results

Search and Selection

We were conducting four simultaneous reviews, one each for overweight/obesity prevention and treatment in children/youth and in adults. We started with a comprehensive search strategy that included both adults and children/youth and found 30,196 unique citations. After screening titles and abstracts for relevance and filtering for population and intervention focus, 675 citations remained for child/youth treatment. An update added 2,041 citations. A total of 319 studies remained for full-text screening. Fifteen studies from the 2010 United States Preventive Services Task Force review [16] were also examined. At the end of the search and selection process, 31 studies (37 papers) were included; nine were brought forward from the United States Preventive Services Task Force review that met our criteria [24-32] and 22 were found in the more recent literature.[33-54] The search and selection flow diagram appears in Figure 1. Characteristics of the included studies are presented in Table 1. Risk of bias information for each study is in the *e*-File (*e*-Table 1).

Change in Body Mass Index/Body Mass Index Z-Score

Thirty studies were included in the meta-analysis assessing change in body mass index/body mass index z-score.[24-53] Figure 2 shows a significantly lowered body mass index/body mass

index z-score in the intervention group compared to the control group with a medium magnitude of effect (also see Table 2). There was no difference in the reduction in body mass index/body mass index z-score observed across the 28 behavioural intervention studies compared to the reduction observed in the two pharmacological plus behavioural intervention studies (see Table 2). Sensitivity analyses for behavioural intervention studies showed no difference in reduction of body mass index/body mass index z-score across types of treatments, duration of intervention, participants age, or study risk of bias rating (see Table 2). There was however a difference in reduction in body mass index/body mass index z-score depending on the target of intervention; individually-focused treatments (e.g., classroom interventions with no parent involvement) had a large magnitude of effect whereas family-based approaches (active parent involvement) showed a small magnitude of effect (see Table 2). The one study that could not be pooled found no significant ($P<0.1$) treatment effect on body mass index z-score for a six month lifestyle intervention targeted at children aged 5-8 years.[54]

Change in Body Mass Index

Twenty-one trials were included in the meta-analysis assessing change in body mass index.[24, 25, 27-30, 32, 35, 38-46, 49-52] Intervention participants had a significantly greater reduction in body mass index as compared to the control group (see Table 3). There was no difference in reduction in body mass index in the 19 behavioural intervention trials compared to the two pharmacological plus behavioural intervention studies.

Weight Loss Maintenance

Only four of the trials also reported follow-up data (6 to 12 months post intervention).[25, 34, 50, 53] Meta-analysis showed significantly lowered body mass index/body mass index z-score in the intervention group compared to the control group by the end of the treatment period, with a

medium magnitude of effect (see Table 2). However, there was no difference in body mass index/body mass index z-score between groups from the point of intervention completion to up to one year later.

Change in Prevalence of Overweight/Obesity

Three low quality randomized trials (downgraded for risk of bias and imprecision), provided results for change in prevalence of overweight/obesity that could not be pooled because they used different weight categories (overweight, overweight/obesity, obesity) and one study did not provide events data.[28, 29, 43] The two studies that included children aged 2-12 reported prevalence at nine months following completion of three month family-based diet and exercise approaches. No difference between intervention and control groups was observed in one study (n=242) [RR 0.93 (95% CI 0.82, 1.06)] [43] and in the second study (n=40) there was a 5-6% reduction in obesity prevalence in the intervention group.[29] The third study reported no significant difference in change in prevalence between intervention and control groups three months after a four month lifestyle program for overweight and obese youth (n=38) [RR 0.90 (95% CI 0.54, 1.46)].[28]

Change in Other Health Outcomes

We examined changes in cardio-metabolic outcomes associated with treatment at the post-intervention assessment point. Blood pressure outcomes were reported in five studies [24, 41, 44, 46, 48] and significant changes in both systolic and diastolic blood pressure were demonstrated (see Table 3). No differences in any lipid variables (total cholesterol, low or high density lipoproteins or triglycerides) were observed; although they were examined in six studies (see Table 3). [24, 25, 32, 34, 42, 48] Only one study provided data on fasting glucose levels and no

difference was observed (see Table 3).[24] None of the included studies reported physical fitness changes as measured by laps or stages of the multi-stage fitness test.[55]

Six trials examined changes in quality of life after treatment for obesity.[27, 34, 35, 37, 43, 48] Meta-analysis showed a significant improvement in overall quality of life score in the intervention group as compared to the control group (see Table 3).

Harms

One-third of the included studies provided data for adverse effects of treatments.[24, 32, 35, 39, 42, 43, 50-52] Most pooled and single study event rate comparisons between intervention and control groups showed no difference for any adverse events, serious adverse events (requiring hospitalization or urgent medical care) and study withdrawal due to adverse events, and a few studies [35, 43, 51] reported no adverse events occurred in either group (see Table 4). Many adverse events in the behavioural groups could not be attributed to the interventions. Gastrointestinal disturbances (e.g., bloating and diarrhea) were reported significantly more often in the orlistat treatment groups than in the control (see Table 4).[24, 32]

Interpretation

Main Findings and Comparison with Other Studies

There are several principal findings from this updated systematic review of primary-care relevant treatments for overweight/obesity in children and youth. First, the meta-analyses of body mass index and body mass index/body mass index z-score showed benefits for children/youth in the treatment arms compared to control. The finding that pediatric weight management programs can result in modest declines in body mass index is consistent with previous reviews. In contrast to weight loss of 5-10% in adults [56], the threshold associated with improved health outcomes has not been established for children. While limited in number of

studies, our review of cardio-metabolic outcomes suggests modest declines in body mass index are accompanied by declines in both systolic and diastolic blood pressure, with insufficient evidence to evaluate the impact on glycemic status. Improvement in quality of life scores was identified in the six studies that evaluated them and no adverse effects were reported for behavioural interventions. Kolotourou and colleagues argue that body mass index is too restrictive an outcome and others such as fitness, self-esteem, physical and sedentary activities are also important outcomes to measure.[57]

Four studies evaluated the sustainability of changes in body mass index after completion of weight management programs. Unfortunately, only six months after completion, no impact of the interventions on body mass index was identified. While consistent with known biological adaptations to weight loss, this finding highlights the challenge of introducing time delimited weight management interventions without follow-up. Although limited in terms of numbers of studies and participants, this finding highlights the need to continue to introduce innovative approaches to pediatric weight management and to identify ways of maintaining interventions over the long term. Studies are not yet available in the pediatric population, but it is apparent that sustained weight loss is possible in adults when interventions are maintained at a lesser intensity.[58]

Behavioural interventions demonstrated larger effects with less harm than trials that used orlistat as part of the treatment strategy; however, there were only two pharmacologic studies. Few behavioural studies reported adverse events and there were no differences between intervention and control when they were reported. There were more gastrointestinal disturbances in the pharmacological intervention participants than in controls.

There was surprisingly, a greater effect of interventions that targeted individuals rather than families. This finding is hard to explain, except perhaps it takes more coordination and effort for a family to attend and comply with interventions than individuals.

Limitations

First, most evidence was taken from studies assessed as having unclear risk of bias, primarily due to lack of information about or lack of procedures to ensure random sequence generation, allocation concealment and blinding of participants, personnel and outcome assessment. Potential reporting bias was also identified across a number of outcome/comparison-based study groupings. Second, in the main outcome of body mass index/body mass index-z-score, heterogeneity was high. This can be explained by the diversity, intensity and length of interventions and diversity in participants. Third, results presented for other health outcomes should be interpreted with caution as we only included studies that also reported one of our weight outcomes. Finally, we only included papers in English or French.

Conclusions and Implications for Practice and Future Research

In summary, behavioural interventions for treating overweight/obesity in children and youth are associated with a medium treatment effect in terms of lowered body mass index/body mass index z-score compared to a small treatment effect shown by combined pharmacological and behavioural interventions. The benefits of behavioural approaches are achieved with minimal or no adverse effects. Few studies followed participants after completion of the intervention, but those that did found that body mass index differences between intervention and controls were not maintained. Future research should evaluate more active maintenance interventions with longer follow-up.

References

1. Statistics Canada. Table 1: Percentage distribution of children and adolescents, by body mass index (BMI) category (based on World Health Organization cut-offs), age group and sex, household population aged 5 to 17, 2009 to 2011. 2009 to 2011 Canadian Health Measures Survey. 2012.http://www.statcan.gc.ca/pub/82-003-x/2012003/article/11706/tbl/tbl1-eng.htm.

2. Ogden CL, Carroll MD, Kit BK, and Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. JAMA: Journal of the American Medical Association. 2012; 307(5): 483-90. http://dx.doi.org/10.1001/jama.2012.40.

3. Whitaker RC, Wright JA, Pepe MS, Seidel KD, and Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med. 1997; 337(13): 869-73. http://dx.doi.org/10.1056/NEJM199709253371301.

4. Tirosh A, Shai I, Afek A, Dubnov-Raz G, Ayalon N, Gordon B, Derazne E, Tzur D, Shamis A, Vinker S, and Rudich A. Adolescent BMI trajectory and risk of diabetes versus coronary disease. N Engl J Med. 2011; 364(14): 1315-25. http://dx.doi.org/10.1056/NEJMoa1006992.

5. Juonala M, Juhola J, Magnussen CG, Würtz P, Viikari JS, Thomson R, Seppälä I, Hernesniemi J, Kähönen M, Lehtimäki T, Hurme M, Telama R, Mikkilä V, Eklund C, Räsänen L, Hintsanen M, Keltikangas-Järvinen L, Kivimäki M, and Raitakari OT. Childhood environmental and genetic predictors of adulthood obesity: the cardiovascular risk in young Finns study. J Clin Endocrinol Metab. 2011; 96(9): e1542-9. http://dx.doi.org/10.1210/jc.2011-1243.

6. Morrison JA, Friedman LA, and Gray-McGuire C. Metabolic syndrome in childhood predicts adult cardiovascular disease 25 years later: the Princeton Lipid Research Clinics Follow-up Study. Pediatrics. 2007; 120(2): 340-5. http://dx.doi.org/10.1542/peds.2006-1699.

7. Schwimmer JB, Burwinkle TM, and Varni JW. Health-related quality of life of severely obese children and adolescents. JAMA. 2003; 289(14): 1813-9. http://dx.doi.org/10.1001/jama.289.14.1813.

8. Wardle J and Cooke L. The impact of obesity on psychological well-being. Best Pract Res Clin Endocrinol Metab. 2005; 19(3): 421-40. http://dx.doi.org/10.1016/j.beem.2005.04.006.

9. Williams J, Wake M, Hesketh K, Maher E, and Waters E. Health-related quality of life of overweight and obese children. JAMA. 2005; 293(1): 70-6. http://dx.doi.org/10.1001/jama.293.1.70.

10. Ho M, Garnett SP, Baur LA, Burrows T, Stewart L, Neve M, and Collins C. Impact of dietary and exercise interventions on weight change and metabolic outcomes in obese children and adolescents: a systematic review and meta-analysis of randomized trials. JAMA Pediatr. 2013; 167(8): 759-68. http://dx.doi.org/10.1001/jamapediatrics.2013.1453.

11. Hoelscher DM, Kirk S, Ritchie L, and Cunningham-Sabo L. Position of the Academy of Nutrition and Dietetics: interventions for the prevention and treatment of pediatric

overweight and obesity. J Acad Nutr Diet. 2013; 113(10): 1375-94. http://dx.doi.org/10.1016/j.jand.2013.08.004.

12. Kothandan SK. School based interventions versus family based interventions in the treatment of childhood obesity- a systematic review. Arch Public Health. 2014; 72(1): 3. http://dx.doi.org/10.1186/2049-3258-72-3.

13. Kelley GA and Kelley KS. Effects of Exercise in the Treatment of Overweight and Obese Children and Adolescents: A Systematic Review of Meta-Analyses. J Obes. 2013; 2013: 783103. http://dx.doi.org/10.1155/2013/783103.

14. Ewald H, Kirby J, Rees K, and Robertson W. Parent-only interventions in the treatment of childhood obesity: a systematic review of randomized controlled trials. J Public Health (Oxf). 2013; http://dx.doi.org/10.1093/pubmed/fdt108.

15. McDonagh MS, Selph S, Ozpinar A, and Foley C. Systematic review of the benefits and risks of metformin in treating obesity in children aged 18 years and younger. JAMA Pediatr. 2014; 168(2): 178-84. http://dx.doi.org/10.1001/jamapediatrics.2013.4200.

16. Whitlock EP, O'Connor EA, Williams SB, Beil TL, and Lutz KW. Effectiveness of primary care interventions for weight management in children and adolescents: an updated, targeted systematic review for the USPSTF. Evidence Synthesis Number 76. Rockville, MD: Agency for Healthcare Research and Quality; 2010. AHRQ Publication No. 10-05144-EF-1. Available at: http://www.ncbi.nlm.nih.gov/pubmed/20722175?dopt=Citation.

17. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, Porter AC, Tugwell P, Moher D, and Bouter LM. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol. 2007; 7: 10. http://dx.doi.org/1471-2288-7-10 [pii];10.1186/1471-2288-7-10 [doi].

18. Review Manager (RevMan) [computer program]. Version 5.1. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration; 2011 Available at: http://tech.cochrane.org/revman/download.

19. GRADEpro for Windows [computer program]. Version 3.2 2008 Available at: http://tech.cochrane.org/revman/other-resources/gradepro/download.

20. GRADE working group.; 2000. Available at: http://www.gradeworkinggroup.org/.

21. DerSimonian R and Laird N. Meta-analysis in clinical trials. Control Clin Trials. 1986; 7(3): 177-88. http://dx.doi.org/10.1016/0197-2456(86)90046-2.

22. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, NJ: Erlbaum; 1988.

23. Cochrane handbook for systematic reviews of interventions. Version 5.1.0 ed. New York, NY: John Wiley & Sons, Ltd. Publications; 2011.

24. Chanoine JP, Hampl S, Jensen C, Boldrin M, and Hauptman J. Effect of orlistat on weight and body composition in obese adolescents: a randomized controlled trial. JAMA. 2005; 293(23): 2873-83. http://dx.doi.org/293/23/2873 [pii];10.1001/jama.293.23.2873 [doi].

25. Savoye M, Shaw M, Dziura J, Tamborlane WV, Rose P, Guandalini C, Goldberg-Gell R, Burgert TS, Cali AM, Weiss R, and Caprio S. Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial. JAMA. 2007; 297(24): 2697-704. http://dx.doi.org/10.1001/jama.297.24.2697.

26. Golley RK, Magarey AM, Baur LA, Steinbeck KS, and Daniels LA. Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: a randomized, controlled trial. Pediatrics. 2007; 119(3): 517-25. http://dx.doi.org/10.1542/peds.2006-1746.

27. McCallum Z, Wake M, Gerner B, Baur LA, Gibbons K, Gold L, Gunn J, Harris C, Naughton G, Riess C, Sanci L, Sheehan J, Ukoumunne OC, and Waters E. Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity. Int J Obes (Lond). 2007; 31(4): 630-6. http://dx.doi.org/10.1038/sj.ijo.0803509.

28. Saelens BE, Sallis JF, Wilfley DE, Patrick K, Cella JA, and Buchta R. Behavioral weight control for overweight adolescents initiated in primary care. Obes Res. 2002; 10(1): 22-32. http://dx.doi.org/10.1038/oby.2002.4.

29. Nemet D, Barkan S, Epstein Y, Friedland O, Kowen G, and Eliakim A. Short- and long-term beneficial effects of a combined dietary-behavioral-physical activity intervention for the treatment of childhood obesity. Pediatrics. 2005; 115(4): e443-9. http://dx.doi.org/10.1542/peds.2004-2172.

30. Doyle AC, Goldschmidt A, Huang C, Winzelberg AJ, Taylor CB, and Wilfley DE. Reduction of overweight and eating disorder symptoms via the Internet in adolescents: a randomized controlled trial. J Adolesc Health. 2008; 43(2): 172-9. http://dx.doi.org/10.1016/j.jadohealth.2008.01.011.

31. Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, and Robinson TN. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. Arch Pediatr Adolesc Med. 2008; 162(3): 239-45. http://dx.doi.org/10.1001/archpediatrics.2007.45.

32. Maahs D, de Serna DG, Kolotkin RL, Ralston S, Sandate J, Qualls C, and Schade DS. Randomized, double-blind, placebo-controlled trial of orlistat for weight loss in adolescents. Endocr Pract. 2006; 12(1): 18-28. http://dx.doi.org/5M7NXE5T16TJGE6E [pii];10.4158/EP.12.1.18 [doi].

33. Bryant M, Farrin A, Christie D, Jebb SA, Cooper AR, and Rudolf M. Results of a feasibility randomised controlled trial (RCT) for WATCH IT: a programme for obese children and adolescents. Clin Trials. 2011; 8(6): 755-64. http://dx.doi.org/10.1177/1740774511424766.

34. DeBar LL, Stevens VJ, Perrin N, Wu P, Pearson J, Yarborough BJ, Dickerson J, and Lynch F. A primary care-based, multicomponent lifestyle intervention for overweight adolescent females. Pediatrics. 2012; 129(3): e611-20. http://dx.doi.org/10.1542/peds.2011-0863.

35. Croker H, Viner RM, Nicholls D, Haroun D, Chadwick P, Edwards C, Wells JC, and Wardle J. Family-based behavioural treatment of childhood obesity in a UK National Health Service setting: randomized controlled trial. Int J Obes (Lond). 2012; 36(1): 16-26. http://dx.doi.org/10.1038/ijo.2011.182.

36. Coppins DF, Margetts BM, Fa JL, Brown M, Garrett F, and Huelin S. Effectiveness of a multi-disciplinary family-based programme for treating childhood obesity (the Family Project). Eur J Clin Nutr. 2011; 65(8): 903-9. http://dx.doi.org/10.1038/ejcn.2011.43.

37. Wafa SW, Talib RA, Hamzaid NH, McColl JH, Rajikan R, Ng LO, Ramli AH, and Reilly JJ. Randomized controlled trial of a good practice approach to treatment of childhood obesity in Malaysia: Malaysian Childhood Obesity Treatment Trial (MASCOT). Int J Pediatr Obes. 2011; 6(2-2): e62-9. http://dx.doi.org/10.3109/17477166.2011.566340.

38. Taveras EM, Gortmaker SL, Hohman KH, Horan CM, Kleinman KP, Mitchell K, Price S, Prosser LA, Rifas-Shiman SL, and Gillman MW. Randomized controlled trial to improve primary care to prevent and manage childhood obesity: the High Five for Kids study. Arch Pediatr Adolesc Med. 2011; 165(8): 714-22. http://dx.doi.org/10.1001/archpediatrics.2011.44.

39. Maddison R, Foley L, Ni MC, Jiang Y, Jull A, Prapavessis H, Hohepa M, and Rodgers A. Effects of active video games on body composition: a randomized controlled trial. Am J Clin Nutr. 2011; 94(1): 156-63. http://dx.doi.org/10.3945/ajcn.110.009142.

40. Waling M, Lind T, Hernell O, and Larsson C. A one-year intervention has modest effects on energy and macronutrient intakes of overweight and obese Swedish children. J Nutr. 2010; 140(10): 1793-8. http://dx.doi.org/10.3945/jn.110.125435.

41. Reinehr T, Schaefer A, Winkel K, Finne E, Toschke AM, and Kolip P. An effective lifestyle intervention in overweight children: findings from a randomized controlled trial on "Obeldicks light". Clin Nutr. 2010; 29(3): 331-6. http://dx.doi.org/10.1016/j.clnu.2009.12.010.

42. Racine NM, Watras AC, Carrel AL, Allen DB, McVean JJ, Clark RR, O'Brien AR, O'Shea M, Scott CE, and Schoeller DA. Effect of conjugated linoleic acid on body fat accretion in overweight or obese children. Am J Clin Nutr. 2010; 91(5): 1157-64. http://dx.doi.org/10.3945/ajcn.2009.28404.

43. Wake M, Baur LA, Gerner B, Gibbons K, Gold L, Gunn J, Levickis P, McCallum Z, Naughton G, Sanci L, and Ukoumunne OC. Outcomes and costs of primary care surveillance and intervention for overweight or obese children: the LEAP 2 randomised controlled trial. BMJ. 2009; 339(7730): b3308. http://dx.doi.org/10.1136/bmj.b3308.

44. Weigel C, Kokocinski K, Lederer P, Dotsch J, Rascher W, and Knerr I. Childhood obesity: concept, feasibility, and interim results of a local group-based, long-term treatment program. J Nutr Educ Behav. 2008; 40(6): 369-73. http://dx.doi.org/10.1016/j.jneb.2007.07.009.

45. Bäcklund C, Sundelin G, and Larsson C. Effects of a 2-year lifestyle intervention on physical activity in overweight and obese children. Adv Physiother. 2011; 13(3): 97-109. http://dx.doi.org/10.3109/14038196.2011.562540.

46. Sacher PM, Kolotourou M, Chadwick PM, Cole TJ, Lawson MS, Lucas A, and Singhal A. Randomized controlled trial of the MEND program: A family-based community intervention for childhood obesty. Obesity (Silver Spring). 2010; 18(Suppl 1): S62-8. http://dx.doi.org/10.1038/oby.2009.433.

47. Janicke DM, Sallinen BJ, Perri MG, Lutes LD, Silverstein JH, and Brumback B. Comparison of program costs for parent-only and family-based interventions for pediatric obesity in medically underserved rural settings. J Rural Health. 2009; 25(3): 326-30. http://dx.doi.org/10.1111/j.1748-0361.2009.00238.x.

48. Vos RC, Huisman SD, Houdijk ECAM, Pijl H, and Wit JM. The effect of family-based multidisciplinary cognitive behavioral treatment on health-related quality of life in childhood obesity. Qual Life Res. 2012; 21(9): 1587-94. http://dx.doi.org/10.1007/s11136-011-0079-1.

49. Lisón JF, Real-Montes JM, Torró I, Arguisuelas MD, Alvarez-Pitti J, Martínez-Gramage J, Aguilar F, and Lurbe E. Exercise intervention in childhood obesity: a randomized controlled trial comparing hospital-versus home-based groups. Acad Pediatr. 2012; 12(4): 319-25. http://dx.doi.org/10.1016/j.acap.2012.03.003.

50. Ebbeling CB, Feldman HA, Chomitz VR, Antonelli TA, Gortmaker SL, Osganian SK, and Ludwig DS. A randomized trial of sugar-sweetened beverages and adolescent body weight. N Engl J Med. 2012; 367(15): 1407-16. http://dx.doi.org/10.1056/NEJMoa1203388.

51. Toulabi T, Khosh Niyat NM, Amini F, Nazari H, and Mardani M. The influence of a behavior modification interventional program on body mass index in obese adolescents. J Formos Med Assoc. 2012; 111(3): 153-9. http://dx.doi.org/10.1016/j.jfma.2011.05.007.

52. Wake M, Lycett K, Clifford SA, Sabin MA, Gunn J, Gibbons K, Hutton C, McCallum Z, Arnup SJ, and Wittert G. Shared care obesity management in 3-10 year old children: 12 month outcomes of HopSCOTCH randomised trial. BMJ. 2013; 346: f3092. http://dx.doi.org/10.1136/bmj.f3092.

53. Lochrie AS, Wysocki T, Hossain J, Milkes A, Antal H, Buckloh L, Canas JA, Bobo E, and Lang J. The effects of a family-based intervention (FBI) for overweight/obese children on health and psychological functioning. Clin Pract Pediatr Psychol. 2013; 1(2): 159-70. http://dx.doi.org/10.1037/cpp0000020.

54. O'Connor TM, Hilmers A, Watson K, Baranowski T, and Giardino AP. Feasibility of an obesity intervention for paediatric primary care targeting parenting and children: Helping

HAND. Child Care Health Dev. 2013; 39(1): 141-9. http://dx.doi.org/10.1111/j.1365-2214.2011.01344.x.

55. Leger LA, Mercier D, Gadoury C, and Lambert J. The multistage 20 metre shuttle run test for aerobic fitness. J Sports Sci. 1988; 6(2): 93-101. http://dx.doi.org/10.1080/02640418808729800.

56. Wing RR, Lang W, Wadden TA, Safford M, Knowler WC, Bertoni AG, Hill JO, Brancati FL, Peters A, and Wagenknecht L. Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. Diabetes Care. 2011; 34(7): 1481-6. http://dx.doi.org/10.2337/dc10-2415.

57. Kolotourou M, Radley D, Chadwick P, Smith L, Orfanos S, Kapetanakis V, Singhal A, Cole TJ, and Sacher PM. Is BMI alone a sufficient outcome to evaluate interventions for child obesity? Child Obes. 2013; 9(4): 350-6. http://dx.doi.org/10.1089/chi.2013.0019.

58. Look AHEAD Research Group. Eight-year weight losses with an intensive lifestyle intervention: the look AHEAD study. Obesity (Silver Spring). 2014; 22(1): 5-13. http://dx.doi.org/10.1002/oby.20662.

Box 1: Population, Intervention, Comparator, Outcomes and Setting

Population

- overweight or obese (body mass index >85th percentile for age and sex, or met previously accepted criteria for overweight based on ideal body weight) children and/or youth aged 2-18 years

Interventions

- behavioural (diet, exercise and/or lifestyle) and/or pharmacological (orlistat) treatments for weight loss or management

Comparator

- treatment effectiveness – no intervention, usual care, placebo or minimal intervention (e.g., newsletter or single information session on healthy living)
- treatment harms – any type of comparison group or no comparison group

Outcomes

- treatment effectiveness – primary weight outcomes: changes in body mass index, body mass index z-score and prevalence of overweight/obesity; secondary health outcomes: changes in total cholesterol, high and low density lipoproteins, triglycerides, fasting blood glucose, systolic and diastolic blood pressure, overall quality of life and physical fitness
- treatment harms – any adverse events, serious adverse events (requiring hospitalization or urgent medical care), gastrointestinal events, withdrawal from study due to adverse events

Settings

- generalizable to Canadian primary care or feasible for conducting in or referral from primary care; surgical and metabolic unit interventions were excluded as representing a level of obesity and comorbid conditions that would be less commonly used as referral point from primary care

Box 2: Inclusion and Exclusion Criteria

Studies were included if they met the following criteria:

- behavioural (diet, exercise and/or lifestyle strategies) and/or pharmacological (orlistat) trial of weight loss treatment or management
- intervention targeted children and youth aged 2-18 years who were overweight or obese (body mass index >85th percentile for age and sex, or met previously accepted criteria for overweight based on ideal body weight)
- randomized controlled trial with a no intervention, usual care, placebo or minimal component (e.g., single newsletter or information session on general health) comparison group – condition applied only to studies assessing treatment effectiveness
- reported data for one or more specified weight outcomes (change in body mass index, body mass index z-score or prevalence of overweight/obesity)
- reported data for outcomes of interest at least 6 months post baseline assessment
- no restrictions on study design, comparison group, weight outcome reporting, or timing of assessment were applied to studies that reported data for harms of treatment
- enrolled at least 10 participants in each group
- results were published in English or French

Studies were excluded if the:

- treatment involved changes in the built environment, surgery or a drugs other than orlistat
- study specifically enrolled participants who had an eating disorder or a condition in which weight gain was a cardinal manifestation (e.g., Prader-Willi syndrome, polycystic ovarian disease, pregnancy)
- intervention was conducted in an in-patient hospital setting or involved a faith-based program
- only available results were published in a language other than English or French

Figure 1: Search and Selection Flow Diagram

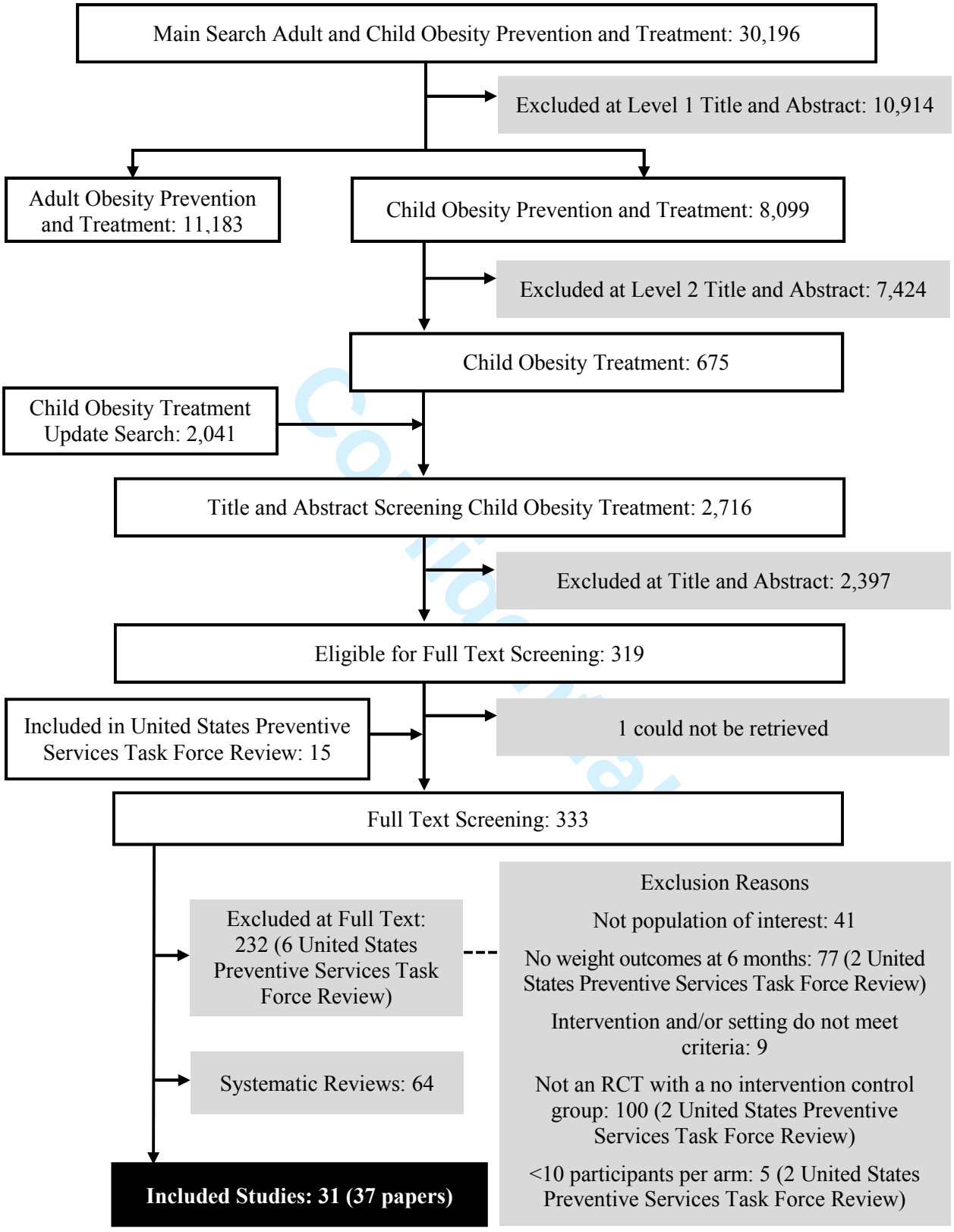

Figure 2: Forest Plot of Effect of Treatment Interventions on Body Mass Index/Body Mass Index Z-Score (Behavioural, Pharmacological plus Behavioural)

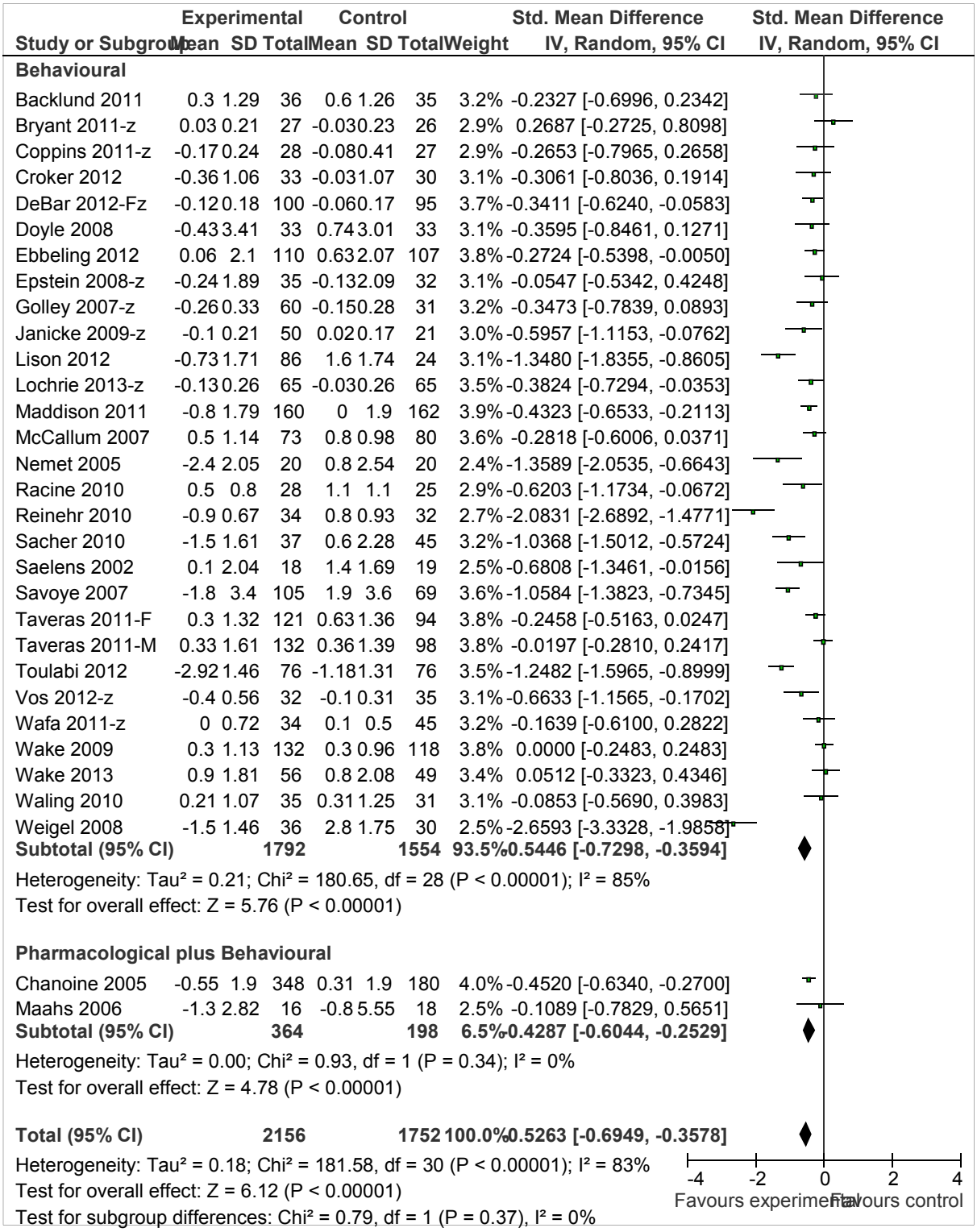

Table 1: Characteristics of Included Studies

Study	Gender	Age	Sample Size	Baseline Weight	Intv Type	Intv Target	Comparator	Intv Length (m)	Location	Date	Risk of Bias
Bäcklund [45]	Mixed	2-12	105	Ov+Ob	Lifestyle	Family	No Intv	24	Sweden	2011	Unclear
Bryant [33]	Mixed	2-12	70	Obese	Lifestyle	Family	Wait List	12	UK	2011	High
Chanoine [24]	Mixed	13-18	539	Obese	Orlistat, Diet+Exercise	Indv	Placebo	12	US + Canada	2005	Unclear
Coppins [36]	Mixed	2-12	65	Ov+Ob	Lifestyle	Family	No Intv	12	UK	2011	Unclear
Croker [35]	Mixed	2-12	72	Obese	Lifestyle	Indv	Wait List	6	UK	2012	Unclear
DeBar [34]	Girls	13-18	208	Ov+Ob	Lifestyle	Indv	Min Comp	5	US	2012	Unclear
Doyle [30]	Mixed	13-18	83	Ov+Ob	Lifestyle	Indv	Min Comp	4	US	2008	Low
Ebbeling [50]	Mixed	13-18	224	Ov+Ob	Diet	Indv	No Intv	12	US	2012	Unclear
Epstein [31]	Mixed	2-12	70	Ov+Ob	Lifestyle	Family	Min Comp	24	US	2008	Unclear
Golley [26]	Mixed	2-12	111	Ov+Ob	Lifestyle	Family	Min Comp	12	Australia	2007	Low
Janicke [47]	Mixed	2-12	93	Ov+Ob	Lifestyle	Family	Wait List	4	US	2009	Unclear
Lisón [49]	Mixed	2-12	110	Ov+Ob	Diet+Exercise	Indv	Usual Care	6	Spain	2012	High
Lochrie [53]	Mixed	2-12	130	Ov+Ob	Lifestyle	Family	Min Comp	6	US	2013	Unclear
Maahs [32]	Mixed	13-18	40	Ov+Ob	Orlistat, Diet+Exercise	Indv	Placebo	6	US	2006	Unclear
Maddison [39]	Mixed	2-12	322	Ov+Ob	Exercise	Indv	No Intv	6	New Zealand	2011	Low
McCallum [27]	Mixed	2-12	163	Ov+Ob	Lifestyle	Family	No Intv	3	Australia	2007	Unclear
Nemet [29]	Mixed	2-12	54	Obese	Diet+Exercise	Family	Usual Care	3	Israel	2005	Unclear
O'Connor [54]	Mixed	2-12	40	Ov+Ob	Lifestyle	Family	Wait List	6	US	2011	Unclear
Racine [42]	Mixed	2-12	62	Ov+Ob	Diet	Indv	Placebo	6	US	2010	Unclear
Reinehr [41]	Mixed	2-12	71	Overweight	Lifestyle	Indv	No Intv	6	Germany	2010	Unclear
Sacher [46]	Mixed	2-12	116	Obese	Lifestyle	Family	Usual Care	6	UK	2010	Unclear
Saelens [28]	Mixed	13-18	44	Ov+Ob	Lifestyle	Indv	Usual Care	4	US	2002	Unclear
Savoye [25]	Mixed	2-12	174	Obese	Lifestyle	Family	Usual Care	12	US	2007	Unclear
Taveras [38]	Mixed	2-12	445	Ov+Ob	Lifestyle	Family	Usual Care	12	US	2011	Unclear
Toulabi [51]	Mixed	13-18	152	Obese	Diet+Exercise	Indv	No Intv	24	Iran	2012	Unclear
Vos [48]	Mixed	13-18	81	Obese	Lifestyle	Family	Wait List	3	Netherlands	2011	Unclear
Wafa [37]	Mixed	2-12	107	Obese	Lifestyle	Family	No Intv	6	Malaysia	2011	Unclear
Wake [43]	Mixed	2-12	258	Ov+Ob	Diet+Exercise	Family	Usual Care	3	Australia	2009	Unclear
Wake [52]	Mixed	2-12	118	Obese	Lifestyle	Family	No Intv	12	Australia	2013	Unclear
Waling [40]	Mixed	2-12	105	Ov+Ob	Diet+Exercise	Family	No Intv	12	Sweden	2010	Unclear
Weigel [44]	Mixed	2-12	73	Obese	Diet+Exercise	Indv	No Intv	12	Germany	2008	High

Intv=Intervention; Ov=Overweight, Ob=Obese; Indv=Individual; Min Comp=Minimal Component; (m)=months

Table 2: Overall and Sub-group Analyses for Change in Body Mass Index/Body Mass Index Z-Score

Group or Sub-group	Meta-analysis, Standard Mean Difference (95% CI)	Statistical Heterogeneity (Within Group) P-Value, I^2-Value	Test for Between Group Differences P-Value, I^2-Value	No. Participants	No. Studies	*Quality of Evidence Rating
Outcome: Change in Body Mass Index/Body Mass Index Z-Score (Baseline to Immediate Post)						
Overall	-0.53 (-0.69, -0.36)	<0.00001, 83%	na	3,908	30	Moderate
Converted to Body Mass Index Units	-0.97 kg/m^2 (-1.28, -0.66)					
Converted to Body Mass Index Z-Score Units	-0.26 (-0.34, -0.18)					
Behavioural	-0.54 (-0.73, -0.36)	<0.00001, 85%	0.37, 0%	3,346	28	Low
Converted to Body Mass Index Units	1.01 kg/m2 (-1.35, -0.66)					
Converted to Body Mass Index Z-Score Units	-0.27 (-0.36, -0.18)					
Pharmacological + Behavioural	-0.43 (-0.60, -0.25)	0.34, 0%		562	2	Moderate
Converted to Body Mass Index Units	-0.86 kg/m^2 (-1.19, -0.52)					
Behavioural – Diet	-0.36 (-0.65, -0.06)	0.27, 19%	0.36, 6.8%	270	2	Moderate
Behavioural – Exercise	-0.43 (-0.65, -0.21)	na		322	1	High
Behavioural – Diet + Exercise	-1.09 (-1.84, -0.34)	<0.00001, 94%		684	6	Moderate
Behavioural – Lifestyle	-0.42 (-0.61, -0.23)	<0.00001, 76%		2,070	19	Moderate
Behavioural ≤12 Months	-0.54 (-0.73, -0.35)	<0.00001, 84%	0.97, 0%	3,056	25	Low
Behavioural >12 Months	-0.53 (-1.31, 0.26)	<0.0001, 9%		290	3	Low
Behavioural – Aged 2-12 Years	-0.54 (-0.76, -0.32)	<0.00001, 86%	0.81, 0%	2,612	22	Low
Behavioural – Aged 13-18 Years	-0.59 (-0.92, -0.25)	0.0004, 78%		734	6	Moderate
Behavioural – Individually-Focused	-0.90 (-1.27, -0.53)	<0.00001, 89%	0.007, 86.2%	1,347	11	Moderate
Converted to Body Mass Index Units	-1.66 kg/m^2 (-2.34, -0.98)					
Converted to Body Mass Index Z-Score Units	-0.44 (-0.62, -0.26)					
Behavioural – Family-Based	-0.34 (-0.52, -0.16)	<0.00001, 73%		1,999	17	Moderate
Converted to Body Mass Index Units	-0.62 kg/m^2 (-0.96, -0.29)					
Converted to Body Mass Index Z-Score Units	-0.17 (-0.25, -0.08)					
Behavioural – Low Risk of Study Bias	-0.41 (-0.59, -0.22)	0.92, 0%	0.51, 0%	479	3	High
Behavioural – Unclear Risk of Study Bias	-0.49 (-0.68, -0.30)	<0.00001, 81%		2,638	22	Low
Behavioural – High Risk of Study Bias	-1.24 (-2.79, 0.32)	<0.00001, 96%		229	3	Very Low
Outcome: Weight Loss Maintenance - Change in Body Mass Index/Body Mass Index Z-Score						
Baseline to Immediate Post	-0.51 (-0.86, -0.16)	0.001, 81%	na	716	4	Moderate

Group or Sub-group	Meta-analysis, Standard Mean Difference (95% CI)	Statistical Heterogeneity (Within Group) P-Value, I^2-Value	Test for Between Group Differences P-Value, I^2-Value	No. Participants	No. Studies	*Quality of Evidence Rating
Immediate Post to 6-12 Months Follow-up	0.08 (-0.07, 0.23)	0.44, 0%		686	4	Low

*High=no downgrades; Moderate=downgrade: risk of bias; Low=downgrade: risk of bias, imprecision; Very Low=downgrade: risk of bias (x2), imprecision

Table 3: Overall and Sub-group Analyses for Change in Body Mass Index and Other Health Outcomes

Group or Sub-group	Meta-analysis, Mean Difference (95% CI)	Statistical Heterogeneity (Within Group) P-Value, I^2-Value	Test for Between Group Differences P-Value, I^2-Value	No. Participants	No. Studies	*Quality of Evidence Rating
Outcome: Change in Body Mass Index (kg/m^2) (Baseline to Immediate Post)						
Overall	-1.12 (-1.52, -0.72)	<0.00001, 92%	na	3,100	21	Moderate
Behavioural	-1.15 (-1.59, -0.72)	<0.00001, 93%	0.29, 10.4%	2,538	19	Moderate
Pharmacological + Behavioural	-0.86 (-1.19, -0.52)	0.81, 0%		562	2	Moderate
Outcome: Change in Systolic Blood Pressure (mmHg) (Baseline to Immediate Post)						
Overall	-3.42 (-6.65, -0.29)	0.003, 75%	na	808	5	Moderate
Outcome: Change in Diastolic Blood Pressure (mmHg) (Baseline to Immediate Post)						
Overall	-3.39 (-5.17, -1.60)	0.11, 47%	na	808	5	Moderate
Outcome: Change in Total Cholesterol (mmol/L) (Baseline to Immediate Post)						
Overall	-0.06 (-0.19, 0.07)	0.03, 63%	na	904	5	Low
Outcome: Change in Low Density Lipoprotein Cholesterol (mmol/L) (Baseline to Immediate Post)						
Overall	0.01 (-0.11, 0.13)	0.009, 70%	na	904	5	Low
Outcome: Change in High Density Lipoprotein Cholesterol (mmol/L) (Baseline to Immediate Post)						
Overall	-0.02 (-0.05, 0.01)	0.16, 37%	na	971	6	Low
Outcome: Change in Triglycerides (mmol/L) (Baseline to Immediate Post)						
Overall	-0.02 (-0.12, 0.09)	0.19, 35%	na	937	5	Low
Outcome: Change in Fasting Glucose (mmol/L) (Baseline to Immediate Post)						
Overall	0.06 (-0.29, 0.17)	na	na	528	1	Low
Outcome: Change in Overall Quality of Life (Pediatric Quality of Life Inventory or DISAKIDS Questionnaire) (Baseline to Immediate Post)						
Overall	2.10 (0.60, 3.60)	0.37, 8%	na	777	6	Moderate

*Moderate=downgrade: risk of bias; Low=downgrade: risk of bias, imprecision

Table 4: Sub-group Analyses for Harms (Any Adverse Events, Serious Adverse Events, Gastrointestinal Events, Withdrawal from Study due to Adverse Events)

Sub-group	Effect			Statistical Heterogeneity (Within Group) P-Value, I^2-Value	Test for Between Group Differences P-Value, I^2-Value	No. Participants	No. Studies	*Quality of Evidence Rating
	RR (95% CI)	Absolute Risk Increase	Number-Needed-to-Harm (95% CI)					
Outcome: Any Adverse Events								
Behavioural	Not estimable: 0 events reported in both groups in all studies	-	-	na	na	482	3	Moderate
Pharmacological + Behavioural	1.03 (0.99, 1.08)	-	-	na		533	1	Low
Outcome: Serious Adverse Events								
Behavioural	0.51 (0.09, 2.73)	-	-	na	0.37, 0%	322	1	Moderate
Pharmacological + Behavioural	1.25 (0.46, 3.35)	-	-	0.56, 0%		573	2	Low
Outcome: Gastrointestinal Events								
Pharmacological + Behavioural	3.77 (2.56, 5.55)	36.74%	3 (2, 5)	na	na	533	1	Moderate
Outcome: Study Withdrawal due to Adverse Events								
Pharmacological + Behavioural	2.49 (0.79, 7.87)	-	-	0.45, 0%	na	573	2	Low

*Moderate=downgrade: risk of bias; Low=downgrade: risk of bias, imprecision

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Contributors

Conceptualization, data interpretation, writing and manuscript review: Leslea Peirson, Donna Fitzpatrick-Lewis, Katherine Morrison, Rachel Warren, Parminder Raina. Methods, data collection and project coordination: Leslea Peirson and Donna Fitzpatrick-Lewis. Data analysis: Ali Usman.

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Competing Interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3, Box 1
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Boxes 1&2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental *e*-File *e*-Appendix 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4, 5 and Box 1
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	5

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on p9age #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8, Tables 2, 3, 4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5, 6
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Table 1, e-File *e*-Table 1
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Figure 2, pp 6-9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Figure 2, Tables 2 to 4, pp 6-9
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8, Tables 2 to 4
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	6-9, Tables 2 to 4
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9-11
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	11
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	11
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	12

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

PRISMA 2009 Checklist

e-File for Child/Youth Overweight/Obesity Treatment

Peirson, Fitzpatrick-Lewis, Morrison et al.

e-Appendix 1: Search Strategies for Key Questions (KQ)

Medline-OVID

Search Last Run August 28, 2013

1. exp obesity/
2. weight-gain/
3. weight-loss/
4. (obesity or obese).mp.
5. (weight gain or weight loss).mp.
6. (overweight or over weight or overeat* or over eat*).mp.
7. weight change*.mp.
8. ((bmi or body mass index) adj2 (gain or loss or change)).mp.
9. weight maintenance.mp.
10. or/1-9
11. limit 10 to "child (6 to 12 years)"
12. limit 10 to "adolescent (13 to 18 years)"
13. limit 10 to "preschool child (2 to 5 years)"
14. (child* or adolescen*).mp.
15. (teenage* or young people or young person or young adult*).mp.
16. (schoolchildren or school children).mp.
17. (pediatr* or paediatr*).ti,ab.
18. (boys or girls or youth or youths).mp.
19. or/11-18
20. exp behavior-therapy/
21. social support/
22. family-therapy/
23. exp psychotherapy-group/
24. ((psychological or behavio?r*) adj (therapy or modif* or strateg* or intervention*)).mp.
25. (group therapy or cognitive therapy or family therapy).mp.
26. ((lifestyle or life style) adj (chang* or intervention*)).mp.
27. counsel?ing.mp.
28. (peer adj2 support).mp.
29. ((child* adj3 parent*) and therapy).mp.
30. social support.mp.
31. or/20-30
32. exp obesity/dt
33. exp anti-obesity agents/
34. lipase inhibitor*.mp.
35. (orlistat or xenical or tetrahydrolipstatin).mp.
36. (appetite adj (suppressant* or depressant*)).mp.
37. sibutramine.mp. or meridia.ti,ab.
38. (dexfenfluramine or fenfluramine or phentermine).mp.
39. bulking agent$.mp.
40. (methylcellulose or celevac).mp.
41. ((antiobesity or anti obesity) adj (drug$ or agent$)).mp.
42. guar gum.mp.

43. (metformin or glucophage).mp.
44. (fluoxetine or prozac).mp.
45. (Sertraline or zoloft).mp.
46. Diethylpropion.mp.
47. zonisamide.mp.
48. topiramate.mp.
49. (Octreotide or somatostatin or sandostatin).mp.
50. (Amantadine or symmetrel).mp.
51. (Glucagon-Like Peptide 1 or glp-1).mp.
52. (rimonabant or acomplia).mp.
53. (SLV 319 or SLV319).mp.
54. exenatide.mp.
55. liraglutide.mp.
56. vildagliptin.mp.
57. sitagliptin.mp.
58. (qnexa or contrave or excalia).mp.
59. exp OBESITY/dh [Diet Therapy]
60. "Diet-Fat-Restricted"/
61. "Diet-Reducing"/
62. "Diet-Therapy"/
63. "Fasting"/
64. (diet or diets or dieting).mp.
65. (diet$ adj (modif$ or therapy or intervention$ or strateg$)).mp.
66. (low calorie or calorie control$ or healthy eating).mp.
67. (fasting or modified fast$).mp.
68. exp "Dietary-Fats"/
69. (fruit or vegetable$).mp.
70. (high fat$ or low fat$ or fatty food$).mp.
71. formula diet$.mp.
72. or/59-71
73. "Exercise"/
74. "Exercise-Therapy"/
75. exercis$.mp.
76. (aerobics or physical therapy or physical activity or physical inactivity).mp.
77. (fitness adj (class$ or regime$ or program$)).mp.
78. (physical training or physical education).mp.
79. dance therapy.mp.
80. sedentary behavio?r reduction.mp.
81. or/73-80
82. exp OBESITY/su [Surgery]
83. "Surgical-Staplers"/
84. "Surgical-Stapling"/
85. "Lipectomy"/
86. "Gastric-Bypass"/
87. "Gastroplasty"/
88. (dental splinting or jaw wiring).mp.

89. (gastroplasty or gastric band$ or gastric bypass).mp.
90. (intragastric balloon$ or vertical band$).mp.
91. (stomach adj (stapl$ or band$ or bypass)).mp.
92. biliopancreatic diversion$.mp.
93. liposuction.mp.
94. or/82-93
95. exp "Alternative-Medicine"/
96. (alternative medicine or complementary therap$ or complementary medicine).mp.
97. (hypnotism or hypnosis or hypnotherapy).mp.
98. (acupuncture or homeopathy).mp.
99. (chinese medicine or indian medicine or herbal medicine or ayurvedic).mp.
100. or/95-99
101. ((diet or dieting or slim$) adj (club$ or organi?ation$)).mp.
102. (weightwatcher$ or weight watcher$).mp.
103. (correspondence adj (course$ or program$)).mp.
104. (fat camp$ or diet$ camp$).mp.
105. or/101-104
106. (family intervention$ or parent$ intervention$).mp.
107. (parent$ adj2 (behavio?r or involve$ or control$ or attitude$ or educat$)).mp.
108. or/106-107
109. (systematic$ review$ or systematic$ overview$).mp.
110. (quantitative$ review$ or quantitative$ overview$).mp.
111. Evidence-Based Medicine/
112. evidence based review$.mp.
113. exp clinical trial/
114. exp "Research-Design"/
115. ((singl$ or doubl$ or trebl$ or tripl$) adj5 (blind$ or mask$)).mp.
116. (CONTROLLED-CLINICAL-TRIAL or RANDOMIZED CONTROLLED TRIAL or META-ANALYSIS).pt.
117. (control$ and (trial$ or stud$ or evaluation$ or experiment$)).ti,ab.
118. (comparison group$ or control group$).mp.
119. random$.ti,ab.
120. matched pairs.mp.
121. (outcome study or outcome studies).mp.
122. (quasiexperimental or quasi experimental or pseudo experimental).mp.
123. (nonrandomi?ed or non randomi?ed or pseudo randomi?ed).mp.
124. cohort studies/
125. (cohort adj (study or studies)).ti,ab.
126. cohort analys$.ti,ab.
127. case series.ti,ab.
128. longitudinal studies/
129. longitudinal$.ti,ab.
130. follow-up studies/
131. (follow up adj (study or studies)).ti,ab.
132. prospective studies/
133. prospective$.ti,ab.

134. or/109-133
135. 10 and 19
136. or/32-58
137. 134 and 135 and 136
138. limit 137 to ed=20080610-20130828
139. 31 or 35 or 37 or 72 or 81 or 94 or 100 or 105 or 108
140. 134 and 135 and 139
141. limit 140 to ed=20080610-20130828
142. 138 or 141
143. animals/ not humans/
144. 142 not 143
145. limit 144 to (english or french)

Embase-OVID

Search Last Run August 28, 2013

1. exp obesity/
2. weight gain/
3. weight reduction/
4. (obesity or obese).mp.
5. (weight gain or weight loss).mp.
6. (overweight or over weight or overeat* or over eat*).mp.
7. weight change*.mp.
8. ((bmi or body mass index) adj2 (gain or loss or change)).mp.
9. weight maintenance.mp.
10. or/1-9
11. limit 10 to school child <7 to 12 years>
12. limit 10 to adolescent <13 to 17 years>
13. limit 10 to (child or preschool child <1 to 6 years>)
14. (child* or adolescen*).mp.
15. (teenage* or young people or young person or young adult*).mp.
16. (schoolchildren or school children).mp.
17. (pediatr* or paediatr*).ti,ab.
18. (boys or girls or youth or youths).mp.
19. or/11-18
20. exp behavior therapy/
21. social support/
22. family therapy/
23. group therapy/
24. ((psychological or behavio?r*) adj (therapy or modif* or strateg* or intervention*)).mp.
25. (group therapy or cognitive therapy or family therapy).mp.
26. ((lifestyle or life style) adj (chang* or intervention*)).mp.
27. counsel?ing.mp.
28. social support.mp.
29. (peer adj2 support).mp.
30. ((child* adj3 parent*) and therapy).mp.
31. exp obesity/dt
32. antiobesity agent/

33. lipase inhibitor*.mp.
34. (orlistat or xenical or tetrahydrolipstatin).mp.
35. (appetite adj (suppressant* or depressant*)).mp.
36. sibutramine.mp. or meridia.ti,ab.
37. (dexfenfluramine or fenfluramine or phentermine).mp.
38. bulking agent$.mp.
39. (methylcellulose or celevac).mp.
40. ((antiobesity or anti obesity) adj (drug$ or agent$)).mp.
41. guar gum.mp.
42. (metformin or glucophage).mp.
43. (fluoxetine or prozac).mp.
44. (Sertraline or zoloft).mp.
45. Diethylpropion.mp.
46. zonisamide.mp.
47. (Octreotide or somatostatin or sandostatin).mp.
48. (Amantadine or symmetrel).mp.
49. (Glucagon-Like Peptide 1 or glp-1).mp.
50. (rimonabant or acomplia).mp.
51. (SLV 319 or SLV319).mp.
52. exenatide.mp.
53. liraglutide.mp.
54. vildagliptin.mp.
55. sitagliptin.mp.
56. (qnexa or contrave or excalia).mp.
57. exp diet therapy/
58. (diet or diets or dieting).mp.
59. (diet$ adj (modif$ or therapy or intervention$ or strateg$)).mp.
60. (low calorie or calorie control$ or healthy eating).mp.
61. (fasting or modified fast$).mp.
62. exp fat intake/
63. exp edible oil/
64. (fruit? or vegetables).mp.
65. (high fat$ or low fat$ or fatty food$).mp.
66. formula diet$.mp.
67. or/57-66
68. exp exercise/
69. exercis$.mp.
70. (aerobics or physical therapy or physical activity or physical inactivity).mp.
71. (fitness adj (class$ or regime$ or program$)).mp.
72. (physical training or physical education).mp.
73. dance therapy.mp.
74. sedentary behavio?r reduction.mp.
75. or/68-74
76. exp OBESITY/su [Surgery]
77. stapler/
78. surgical stapling/

79. lipectomy/
80. stomach bypass/
81. gastroplasty/
82. (dental splinting or jaw wiring).mp.
83. (gastroplasty or gastric band$ or gastric bypass).mp.
84. (intragastric balloon$ or vertical band$).mp.
85. (stomach adj (stapl$ or band$ or bypass)).mp.
86. exp bariatric surgery/
87. biliopancreatic diversion$.mp.
88. liposuction.mp.
89. or/76-88
90. exp alternative medicine/
91. (alternative medicine or complementary therap$ or complementary medicine).mp.
92. (hypnotism or hypnosis or hypnotherapy).mp.
93. (acupuncture or homeopathy).mp.
94. (chinese medicine or indian medicine or herbal medicine or ayurvedic).mp.
95. or/90-94
96. ((diet or dieting or slim$) adj (club$ or organi?ation$)).mp.
97. (weightwatcher$ or weight watcher$).mp.
98. (correspondence adj (course$ or program$)).mp.
99. (fat camp$ or diet$ camp$).mp.
100. or/96-99
101. (family intervention$ or parent$ intervention$).mp.
102. (parent$ adj2 (behavio?r or involve$ or control$ or attitude$ or educat$)).mp.
103. or/100-101
104. evidence based medicine/ or meta analysis/ or "systematic review"/
105. (systematic$ review$ or systematic$ overview$).mp.
106. (quantitative$ review$ or quantitative$ overview$).mp.
107. evidence based review$.mp.
108. exp "clinical trial (topic)"/
109. ((singl$ or doubl$ or trebl$ or tripl$) adj5 (blind$ or mask$)).mp.
110. (control$ and (trial$ or stud$ or evaluation$ or experiment$)).ti,ab.
111. (comparison group$ or control group$).mp.
112. random$.ti,ab.
113. matched pairs.mp.
114. (outcome study or outcome studies).mp.
115. (quasiexperimental or quasi experimental or pseudo experimental).mp.
116. (nonrandomi?ed or non randomi?ed or pseudo randomi?ed).mp.
117. cohort analysis/
118. (cohort adj (study or studies)).ti,ab.
119. cohort analys$.ti,ab.
120. case series.ti,ab.
121. longitudinal study/
122. longitudinal$.ti,ab.
123. follow up/
124. (follow up adj (study or studies)).ti,ab.

125. prospective study/
126. prospective$.ti,ab.
127. or/104-126
128. 10 and 19
129. or/31-56
130. 10 and 19
131. 31 or 32 or 33 or 35 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 or 51 or 52 or 53 or 54 or 55 or 56
132. 129 and 130 and 131
133. 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30
134. 34 or 36 or 67 or 75 or 89 or 95 or 100 or 103 or 133
135. 129 and 130 and 134
136. 132 or 135
137. limit 136 to (english or french)
138. limit 137 to em="200816-201334"

PsycINFO-OVID
Search Last Run August 28, 2013
1. overweight/ or obesity/
2. weight loss/ or weight control/
3. exp Weight Gain/
4. (obesity or obese).mp.
5. (weight gain or weight loss).mp.
6. (overweight or over weight or overeat* or over eat*).mp.
7. weight change*.mp.
8. ((bmi or body mass index) adj2 (gain or loss or change)).mp.
9. weight maintenance.mp.
10. or/1-9
11. limit 10 to (100 childhood or 120 neonatal or 140 infancy or 160 preschool age or 180 school age or 200 adolescence)
12. (child* or adolescen*).mp.
13. (teenage* or young people or young person or young adult*).mp.
14. (schoolchildren or school children).mp.
15. (pediatr* or paediatr*).ti,ab.
16. (boys or girls or youth or youths).mp.
17. or/11-16
18. exp behavior therapy/
19. behavior modification/
20. support groups/ or social support/
21. family therapy/
22. exp group psychotherapy/
23. ((psychological or behavio?r) adj (therapy or modif* or strateg* or intervention*)).mp.
24. (group therapy or cognitive therapy or family therapy).mp.
25. ((lifestyle or life style) adj (chang* or intervention* or modification*)).mp.
26. counsel?ing.mp.
27. (peer adj2 support).mp.
28. ((child adj3 parent) and therapy).mp.

29. social support.mp.
30. or/18-29
31. exp appetite depressing drugs/
32. lipase inhibitor*.mp.
33. (orlistat or xenical or tetrahydrolipstatin).mp.
34. (appetite adj (suppressant* or depressant*)).mp.
35. sibutramine.mp. or meridia.ti,ab.
36. (dexfenfluramine or fenfluramine or phentermine).mp.
37. bulking agent$.mp.
38. (methylcellulose or celevac).mp.
39. ((antiobesity or anti obesity) adj (drug$ or agent$)).mp.
40. guar gum.mp.
41. (metformin or glucophage).mp.
42. (fluoxetine or prozac).mp.
43. (Sertraline or zoloft).mp.
44. Diethylpropion.mp.
45. zonisamide.mp.
46. topiramate.mp.
47. (Octreotide or somatostatin or sandostatin).mp.
48. (Amantadine or symmetrel).mp.
49. (Glucagon-Like Peptide 1 or glp-1).mp.
50. (rimonabant or acomplia).mp.
51. (SLV 319 or SLV319).mp.
52. exenatide.mp.
53. liraglutide.mp.
54. vildagliptin.mp.
55. sitagliptin.mp.
56. (qnexa or contrave or excalia).mp.
57. diets/ or dietary restraint/
58. diet therapy.mp.
59. Food Deprivation/
60. (diet or diets or dieting).mp.
61. (diet* adj (modif* or therapy or intervention* or strateg*)).ti,ab.
62. (low calorie or calorie control* or healthy eating).mp.
63. (fasting or modified fast*).mp.
64. dietary fats.mp.
65. (fruit or vegetable*).mp.
66. (high fat* or low fat* or fatty food*).mp.
67. formula diet*.mp.
68. or/57-67
69. bariatric surgery/
70. surgical stapl*.mp.
71. lipectomy.mp.
72. gastric bypass.mp.
73. gastroplasty.mp.
74. (dental splinting or jaw wiring).mp.

75. gastric band.mp.
76. (intragastric balloon* or vertical band*).mp.
77. (stomach adj (stapl* or band* or bypass*)).mp.
78. biliopancreatic diversion*.mp.
79. liposuction.mp.
80. or/69-79
81. exp alternative medicine/ or holistic health/ or exp hypnotherapy/
82. (alternative medicine or complementary therap* or complementary medicine).mp.
83. (hypnotism or hypnosis or hypnotherapy).mp.
84. (acupuncture or homeopathy).mp.
85. (chinese medicine or indian medicine or herbal medicine or ayurvedic).mp.
86. or/81-85
87. ((diet or dieting or slim*) adj (club* or organization or program*)).mp.
88. (weightwatcher* or weight watcher* or TOPS or commerical weightloss or commerical weight loss).tw.
89. (fat camp* or diet camp*).mp.
90. 87 or 89
91. (family intervention* or parent* intervention*).mp.
92. (parent* adj2 (behavio?r or involve* or control* or attitude* or educat*)).mp.
93. 91 or 92
94. (systematic* review* or systematic* overview*).mp.
95. (quantitative* review* or quantitative* overview*).mp.
96. evidence based practice/
97. evidence based review*.mp.
98. clinical trials/
99. exp experimental design/
100. ((singl* or doubl* or treb* or tripl*) adj5 (blind* or mask*)).mp.
101. (CONTROLLED-CLINICAL-TRIAL or RANDOMIZED CONTROLLED TRIAL or META-ANALYSIS).pt.
102. (CONTROLLED-CLINICAL-TRIAL or RANDOMI?ED CONTROLLED TRIAL or META-ANALYSIS).mp.
103. (control* and (trial* or stud* or evaluation* or experiment*)).mp.
104. (comparison group* or control group*).mp.
105. random*.ti,ab.
106. matched pairs.mp.
107. (outcome study or outcome studies).mp.
108. (quasiexperimental or quasi experimental or pseudo experimental).mp.
109. (nonrandomi?ed or non ramdomi?ed or pseudo randomi?ed).mp.
110. cohort analysis/
111. (cohort adj (study or studies)).ti,ab.
112. cohort analys*.ti,ab.
113. case series.ti,ab.
114. exp longitudinal studies/
115. longitudinal*.ti,ab.
116. followup studies/
117. ((follow-up or followup) adj (study or studies)).ti,ab.

118. prospective$.ti,ab.
119. or/94-118
120. 10 and 17
121. or/31-56
122. 119 and 120 and 121
123. physical activity/ or exp exercise/ or active living/ or activity level/ or exp health behavior/ or exp locomotion/ or physical fitness/
124. exercise*.mp.
125. (aerobics or physical therapy or physical activity or physical inactivity).mp.
126. (fitness adj (class* or regime* or program*)).mp.
127. (physical training or physical education).mp.
128. dance therapy.mp.
129. sedentary behavio?r.mp.
130. or/123-129
131. 30 or 33 or 35 or 68 or 80 or 86 or 90 or 93 or 130
132. 119 and 120 and 131
133. 130 or 132
134. limit 133 to human
135. limit 134 to english language
136. 122 or 132
137. limit 136 to human
138. limit 137 to english language
139. limit 138 to up=20080610-20130828

Cochrane Central-OVID
Search Last Run August 28, 2013
1. exp obesity/
2. weight-gain/
3. weight-loss/
4. (obesity or obese).mp.
5. (weight gain or weight loss).mp.
6. (overweight or over weight or overeat* or over eat*).mp.
7. weight change*.mp.
8. ((bmi or body mass index) adj2 (gain or loss or change)).mp.
9. weight maintenance.mp.
10. or/1-9
11. limit 10 to "child (6 to 12 years)"
12. limit 10 to "adolescent (13 to 18 years)"
13. limit 10 to "preschool child (2 to 5 years)"
14. (child* or adolescen*).mp.
15. (teenage* or young people or young person or young adult*).mp.
16. (schoolchildren or school children).mp.
17. (pediatr* or paediatr*).ti,ab.
18. (boys or girls or youth or youths).mp.
19. or/11-18
20. exp behavior-therapy/
21. social support/

22. family-therapy/
23. exp psychotherapy-group/
24. ((psychological or behavio?r*) adj (therapy or modif* or strateg* or intervention*)).mp.
25. (group therapy or cognitive therapy or family therapy).mp.
26. ((lifestyle or life style) adj (chang* or intervention*)).mp.
27. counsel?ing.mp.
28. (peer adj2 support).mp.
29. ((child* adj3 parent*) and therapy).mp.
30. social support.mp.
31. or/20-30
32. exp obesity/dt
33. exp anti-obesity agents/
34. lipase inhibitor*.mp.
35. (orlistat or xenical or tetrahydrolipstatin).mp.
36. (appetite adj (suppressant* or depressant*)).mp.
37. sibutramine.mp. or meridia.ti,ab.
38. (dexfenfluramine or fenfluramine or phentermine).mp.
39. bulking agent$.mp.
40. (methylcellulose or celevac).mp.
41. ((antiobesity or anti obesity) adj (drug$ or agent$)).mp.
42. guar gum.mp.
43. (metformin or glucophage).mp.
44. (fluoxetine or prozac).mp.
45. (Sertraline or zoloft).mp.
46. Diethylpropion.mp.
47. zonisamide.mp.
48. topiramate.mp.
49. (Octreotide or somatostatin or sandostatin).mp.
50. (Amantadine or symmetrel).mp.
51. (Glucagon-Like Peptide 1 or glp-1).mp.
52. (rimonabant or acomplia).mp.
53. (SLV 319 or SLV319).mp.
54. exenatide.mp.
55. liraglutide.mp.
56. vildagliptin.mp.
57. sitagliptin.mp.
58. (qnexa or contrave or excalia).mp.
59. exp OBESITY/dh [Diet Therapy]
60. "Diet-Fat-Restricted"/
61. "Diet-Reducing"/
62. "Diet-Therapy"/
63. "Fasting"/
64. (diet or diets or dieting).mp.
65. (diet$ adj (modif$ or therapy or intervention$ or strateg$)).mp.
66. (low calorie or calorie control$ or healthy eating).mp.
67. (fasting or modified fast$).mp.

68. exp "Dietary-Fats"/
69. (fruit or vegetable$).mp.
70. (high fat$ or low fat$ or fatty food$).mp.
71. formula diet$.mp.
72. or/59-71
73. "Exercise"/
74. "Exercise-Therapy"/
75. exercis$.mp.
76. (aerobics or physical therapy or physical activity or physical inactivity).mp.
77. (fitness adj (class$ or regime$ or program$)).mp.
78. (physical training or physical education).mp.
79. dance therapy.mp.
80. sedentary behavio?r reduction.mp.
81. or/73-80
82. exp OBESITY/su [Surgery]
83. "Surgical-Staplers"/
84. "Surgical-Stapling"/
85. "Lipectomy"/
86. "Gastric-Bypass"/
87. "Gastroplasty"/
88. (dental splinting or jaw wiring).mp.
89. (gastroplasty or gastric band$ or gastric bypass).mp.
90. (intragastric balloon$ or vertical band$).mp.
91. (stomach adj (stapl$ or band$ or bypass)).mp.
92. biliopancreatic diversion$.mp.
93. liposuction.mp.
94. or/82-93
95. exp "Alternative-Medicine"/
96. (alternative medicine or complementary therap$ or complementary medicine).mp.
97. (hypnotism or hypnosis or hypnotherapy).mp.
98. (acupuncture or homeopathy).mp.
99. (chinese medicine or indian medicine or herbal medicine or ayurvedic).mp.
100. or/95-99
101. ((diet or dieting or slim$) adj (club$ or organi?ation$)).mp.
102. (weightwatcher$ or weight watcher$).mp.
103. (correspondence adj (course$ or program$)).mp.
104. (fat camp$ or diet$ camp$).mp.
105. or/101-104
106. (family intervention$ or parent$ intervention$).mp.
107. (parent$ adj2 (behavio?r or involve$ or control$ or attitude$ or educat$)).mp.
108. or/106-107
109. 10 and 19
110. or/32-58
111. 31 or 35 or 37 or 72 or 81 or 94 or 100 or 105 or 108
112. 10 and 19 and 111
113. limit 112 to yr="2008 - 2013"

e-Table 1: Summary of Risk of Bias Assessment of Included RCTs Using Cochrane's Risk of Bias Tool [1]

Study	Sequence Generation	Allocation Concealment	Blinding of personnel/ participants	Blinding of Outcome Assessors			Incomplete Reporting			Selective Reporting	Other Bias
				OBJ	SUB	S-R	OBJ	SUB	S-R		
Bäcklund 2011 [2]	U	U	H		U			L		L	L
Bryant 2011 [3]	L	U	H		U			H		H	H
Chanoine 2005 [4]	U	L	U	L	U	U	H	H	H	L	H
Coppins 2011 [5]	U	U	H		U			L		L	L
Croker 2012 [6]	L	U	H		L	H		H	H	L	L
DeBar 2012 [7]	L	U	H	L	L	H	L	L	L	L	L
Doyle 2008 [8]	L	L	H		L			L		L	L
Ebbeling 2012 [9]	U	U	H		L	H		L	L	L	L
Epstein 2008 [10]	L	U	H		U			L		L	L
Golley 2007 [11]	L	L	H		L			L		L	L
Janicke 2009 [12]	U	U	H		U			L		L	H
Lisón 2012 [13]	H	H	H		U			L		L	H
Lochrie 2013 [14]	U	U	H		U			H		L	H
Maahs 2006 [15]	U	U	L	L	L	L	L	L	L	L	H
Maddison 2011 [16]	L	L	H		U	U		L	L	L	L
McCallum 2007 [17]	L	U	H		U			L		L	L
Nemet 2005 [18]	L	U	H		U			L		L	L
O'Connor 2013 [19]	L	U	H		U			L		L	H
Racine 2010 [20]	U	U	H	L	U	U	L	L	U	L	H
Reinehr 2010 [21]	L	U	H		H			L		L	H
Sacher 2010 [22]	L	U	H	L	H		H	H		L	L
Saelens 2002 [23]	L	L	H		U			L		L	H
Savoye 2007 [24]	L	L	H	L	U		H	H		L	L
Taveras 2011 [25]	L	U	H		U			L		L	L
Toulabi 2012 [26]	U	U	H		U			U		L	L
Vos 2012 [27]	L	U	H	L	U	H	L	L	L	L	H
Wafa 2011 [28]	L	L	H		L	H		H	H	L	L
Wake 2009 [29]	L	L	H		L	H		L	L	L	U
Wake 2013 [30]	L	U	H		L	H		L	L	L	H
Waling 2010 [31]	U	U	L		U			H		L	L
Weigel 2008 [32]	H	H	H		U			L		L	L

L (green) = Low Risk; U (yellow) = Unclear Risk; H (red) = High Risk; OBJ = Objective Outcome; SUB = Subjective Outcome; S-R = Self-Reported Outcome

References

1. Review Manager (RevMan) [computer program]. Version 5.1. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration; 2011 Available at: http://tech.cochrane.org/revman/download.

2. Bäcklund C, Sundelin G, and Larsson C. Effects of a 2-year lifestyle intervention on physical activity in overweight and obese children. Adv Physiother. 2011; 13(3): 97-109. http://dx.doi.org/10.3109/14038196.2011.562540.

3. Bryant M, Farrin A, Christie D, Jebb SA, Cooper AR, and Rudolf M. Results of a feasibility randomised controlled trial (RCT) for WATCH IT: a programme for obese children and adolescents. Clin Trials. 2011; 8(6): 755-64. http://dx.doi.org/10.1177/1740774511424766.

4. Chanoine JP, Hampl S, Jensen C, Boldrin M, and Hauptman J. Effect of orlistat on weight and body composition in obese adolescents: a randomized controlled trial. JAMA. 2005; 293(23): 2873-83. http://dx.doi.org/293/23/2873 [pii];10.1001/jama.293.23.2873 [doi].

5. Coppins DF, Margetts BM, Fa JL, Brown M, Garrett F, and Huelin S. Effectiveness of a multi-disciplinary family-based programme for treating childhood obesity (the Family Project). Eur J Clin Nutr. 2011; 65(8): 903-9. http://dx.doi.org/10.1038/ejcn.2011.43.

6. Croker H, Viner RM, Nicholls D, Haroun D, Chadwick P, Edwards C, Wells JC, and Wardle J. Family-based behavioural treatment of childhood obesity in a UK National Health Service setting: randomized controlled trial. Int J Obes (Lond). 2012; 36(1): 16-26. http://dx.doi.org/10.1038/ijo.2011.182.

7. DeBar LL, Stevens VJ, Perrin N, Wu P, Pearson J, Yarborough BJ, Dickerson J, and Lynch F. A primary care-based, multicomponent lifestyle intervention for overweight adolescent females. Pediatrics. 2012; 129(3): e611-20. http://dx.doi.org/10.1542/peds.2011-0863.

8. Doyle AC, Goldschmidt A, Huang C, Winzelberg AJ, Taylor CB, and Wilfley DE. Reduction of overweight and eating disorder symptoms via the Internet in adolescents: a randomized controlled trial. J Adolesc Health. 2008; 43(2): 172-9. http://dx.doi.org/10.1016/j.jadohealth.2008.01.011.

9. Ebbeling CB, Feldman HA, Chomitz VR, Antonelli TA, Gortmaker SL, Osganian SK, and Ludwig DS. A randomized trial of sugar-sweetened beverages and adolescent body weight. N Engl J Med. 2012; 367(15): 1407-16. http://dx.doi.org/10.1056/NEJMoa1203388.

10. Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, and Robinson TN. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. Arch Pediatr Adolesc Med. 2008; 162(3): 239-45. http://dx.doi.org/10.1001/archpediatrics.2007.45.

11. Golley RK, Magarey AM, Baur LA, Steinbeck KS, and Daniels LA. Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal

children: a randomized, controlled trial. Pediatrics. 2007; 119(3): 517-25. http://dx.doi.org/10.1542/peds.2006-1746.

12. Janicke DM, Sallinen BJ, Perri MG, Lutes LD, Silverstein JH, and Brumback B. Comparison of program costs for parent-only and family-based interventions for pediatric obesity in medically underserved rural settings. J Rural Health. 2009; 25(3): 326-30. http://dx.doi.org/10.1111/j.1748-0361.2009.00238.x.

13. Lisón JF, Real-Montes JM, Torró I, Arguisuelas MD, Alvarez-Pitti J, Martínez-Gramage J, Aguilar F, and Lurbe E. Exercise intervention in childhood obesity: a randomized controlled trial comparing hospital-versus home-based groups. Acad Pediatr. 2012; 12(4): 319-25. http://dx.doi.org/10.1016/j.acap.2012.03.003.

14. Lochrie AS, Wysocki T, Hossain J, Milkes A, Antal H, Buckloh L, Canas JA, Bobo E, and Lang J. The effects of a family-based intervention (FBI) for overweight/obese children on health and psychological functioning. Clin Pract Pediatr Psychol. 2013; 1(2): 159-70. http://dx.doi.org/10.1037/cpp0000020.

15. Maahs D, de Serna DG, Kolotkin RL, Ralston S, Sandate J, Qualls C, and Schade DS. Randomized, double-blind, placebo-controlled trial of orlistat for weight loss in adolescents. Endocr Pract. 2006; 12(1): 18-28. http://dx.doi.org/5M7NXE5T16TJGE6E [pii];10.4158/EP.12.1.18 [doi].

16. Maddison R, Foley L, Ni MC, Jiang Y, Jull A, Prapavessis H, Hohepa M, and Rodgers A. Effects of active video games on body composition: a randomized controlled trial. Am J Clin Nutr. 2011; 94(1): 156-63. http://dx.doi.org/10.3945/ajcn.110.009142.

17. McCallum Z, Wake M, Gerner B, Baur LA, Gibbons K, Gold L, Gunn J, Harris C, Naughton G, Riess C, Sanci L, Sheehan J, Ukoumunne OC, and Waters E. Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity. Int J Obes (Lond). 2007; 31(4): 630-6. http://dx.doi.org/10.1038/sj.ijo.0803509.

18. Nemet D, Barkan S, Epstein Y, Friedland O, Kowen G, and Eliakim A. Short- and long-term beneficial effects of a combined dietary-behavioral-physical activity intervention for the treatment of childhood obesity. Pediatrics. 2005; 115(4): e443-9. http://dx.doi.org/10.1542/peds.2004-2172.

19. O'Connor TM, Hilmers A, Watson K, Baranowski T, and Giardino AP. Feasibility of an obesity intervention for paediatric primary care targeting parenting and children: Helping HAND. Child Care Health Dev. 2013; 39(1): 141-9. http://dx.doi.org/10.1111/j.1365-2214.2011.01344.x.

20. Racine NM, Watras AC, Carrel AL, Allen DB, McVean JJ, Clark RR, O'Brien AR, O'Shea M, Scott CE, and Schoeller DA. Effect of conjugated linoleic acid on body fat accretion in overweight or obese children. Am J Clin Nutr. 2010; 91(5): 1157-64. http://dx.doi.org/10.3945/ajcn.2009.28404.

21. Reinehr T, Schaefer A, Winkel K, Finne E, Toschke AM, and Kolip P. An effective lifestyle intervention in overweight children: findings from a randomized controlled trial on "Obeldicks light". Clin Nutr. 2010; 29(3): 331-6. http://dx.doi.org/10.1016/j.clnu.2009.12.010.

22. Sacher PM, Kolotourou M, Chadwick PM, Cole TJ, Lawson MS, Lucas A, and Singhal A. Randomized controlled trial of the MEND program: A family-based community intervention for childhood obesty. Obesity (Silver Spring). 2010; 18(Suppl 1): S62-8. http://dx.doi.org/10.1038/oby.2009.433.

23. Saelens BE, Sallis JF, Wilfley DE, Patrick K, Cella JA, and Buchta R. Behavioral weight control for overweight adolescents initiated in primary care. Obes Res. 2002; 10(1): 22-32. http://dx.doi.org/10.1038/oby.2002.4.

24. Savoye M, Shaw M, Dziura J, Tamborlane WV, Rose P, Guandalini C, Goldberg-Gell R, Burgert TS, Cali AM, Weiss R, and Caprio S. Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial. JAMA. 2007; 297(24): 2697-704. http://dx.doi.org/10.1001/jama.297.24.2697.

25. Taveras EM, Gortmaker SL, Hohman KH, Horan CM, Kleinman KP, Mitchell K, Price S, Prosser LA, Rifas-Shiman SL, and Gillman MW. Randomized controlled trial to improve primary care to prevent and manage childhood obesity: the High Five for Kids study. Arch Pediatr Adolesc Med. 2011; 165(8): 714-22. http://dx.doi.org/10.1001/archpediatrics.2011.44.

26. Toulabi T, Khosh Niyat NM, Amini F, Nazari H, and Mardani M. The influence of a behavior modification interventional program on body mass index in obese adolescents. J Formos Med Assoc. 2012; 111(3): 153-9. http://dx.doi.org/10.1016/j.jfma.2011.05.007.

27. Vos RC, Huisman SD, Houdijk ECAM, Pijl H, and Wit JM. The effect of family-based multidisciplinary cognitive behavioral treatment on health-related quality of life in childhood obesity. Qual Life Res. 2012; 21(9): 1587-94. http://dx.doi.org/10.1007/s11136-011-0079-1.

28. Wafa SW, Talib RA, Hamzaid NH, McColl JH, Rajikan R, Ng LO, Ramli AH, and Reilly JJ. Randomized controlled trial of a good practice approach to treatment of childhood obesity in Malaysia: Malaysian Childhood Obesity Treatment Trial (MASCOT). Int J Pediatr Obes. 2011; 6(2-2): e62-9. http://dx.doi.org/10.3109/17477166.2011.566340.

29. Wake M, Baur LA, Gerner B, Gibbons K, Gold L, Gunn J, Levickis P, McCallum Z, Naughton G, Sanci L, and Ukoumunne OC. Outcomes and costs of primary care surveillance and intervention for overweight or obese children: the LEAP 2 randomised controlled trial. BMJ. 2009; 339(7730): b3308. http://dx.doi.org/10.1136/bmj.b3308.

30. Wake M, Lycett K, Clifford SA, Sabin MA, Gunn J, Gibbons K, Hutton C, McCallum Z, Arnup SJ, and Wittert G. Shared care obesity management in 3-10 year old children: 12 month outcomes of HopSCOTCH randomised trial. BMJ. 2013; 346: f3092. http://dx.doi.org/10.1136/bmj.f3092.

31. Waling M, Lind T, Hernell O, and Larsson C. A one-year intervention has modest effects on energy and macronutrient intakes of overweight and obese Swedish children. J Nutr. 2010; 140(10): 1793-8. http://dx.doi.org/10.3945/jn.110.125435.

32. Weigel C, Kokocinski K, Lederer P, Dotsch J, Rascher W, and Knerr I. Childhood obesity: concept, feasibility, and interim results of a local group-based, long-term treatment program. J Nutr Educ Behav. 2008; 40(6): 369-73. http://dx.doi.org/10.1016/j.jneb.2007.07.009.