Treatment of Overweight/Obesity in Children and Youth: A Systematic Review with Meta-analyses

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Abstract

Background: This report will be used by the Canadian Task Force on Preventive Health Care (CTFPHC) to update the previous (1994) guidelines on the treatment of overweight/obesity in children and youth.

Purpose: To synthesize evidence on behavioural and pharmacological interventions for treating overweight/obesity in children and youth.

Data Sources: We searched EMBASE, Medline, Cochrane Central Registry of Controlled Trials, and PsychINFO from June 10, 2008 to August 28, 2013 to update the search conducted for the United States Preventive Services Task Force (USPSTF) 2010 review on this same topic. We also searched for evidence to answer the contextual questions, checked reference lists of included studies and relevant systematic reviews, and conducted a targeted grey literature search.

Study Selection: The titles and abstracts of papers considered for the key question and sub-questions were reviewed in duplicate; any article marked for inclusion by either team member went on to full text screening. Full text review was done independently by two people with consensus required for inclusion or exclusion. For treatment benefits we included randomized controlled trials of behavioural and/or pharmacological (orlistat) interventions for overweight and obese children/youth that reported data for at least one weight outcome of interest at a minimum of six months post baseline assessment. All studies reporting adverse effects of treatments were included, regardless of design, timeframe or outcomes.

Data Abstraction: Review team members extracted data about the population, study design, intervention, analysis and results for outcomes of interest. One team member completed full abstraction, followed by a second team member who verified all extracted data and ratings. We assessed study quality using Cochrane's Risk of Bias tool and the GRADE framework. For the contextual questions, inclusion screening and abstraction were done by one person.

Results: A total of 32 studies were included in this systematic review (29 behavioural interventions studies; two studies using pharmacological plus behavioural interventions; and one study, included only to answer the harms question involved a surgical procedure and a lifestyle intervention). Using the GRADE system the bodies of evidence used to answer the key question and sub-questions were mostly rated as moderate and low quality. Downgrading occurred as a result of methodological limitations increasing the risk of bias, and sometimes due to imprecision or reporting bias. No studies on the merits of screening for overweight/obesity were identified.

Overall, behavioural treatment interventions showed a benefit with a medium effect in terms of a lowered BMI/BMIz assessed using standardized mean difference. At post-intervention, compared to the control group, intervention participants showed a statistically significant reduced BMI/BMIz [SMD (95% CI) -0.54 (-0.73, -0.36); I^2=85%]. Combined pharmacological (orlistat) and behavioural interventions also showed a benefit, but with a small effect in terms of a lowered BMI/BMIz. At post-intervention, compared to the control group, intervention participants showed a statistically significant reduced BMI/BMIz [SMD (95% CI) -0.43 (-0.60, -0.25); I^2=0%].

Sensitivity analyses found significant differences between intervention and control groups, in favour of treatment, for subgroups based on: behavioural interventions and pharmacological (orlistat) plus behavioural interventions; diet, exercise, diet plus exercise, and lifestyle strategies; interventions lasting one year or less; children aged 2 to 12 and youth aged 13 to 18; interventions targeted at individuals and at families; and low and unclear risk of bias studies. Only the target of intervention (individual, families) explained some of the variation across this evidence. The high statistical heterogeneity and variation across studies in most sub-group analyses is most likely due to small versus large treatment effects observed across studies.

While the four studies available to examine how well improvements in BMI/BMIz scores are maintained after treatment interventions are completed showed a medium effect in terms of lowered BMI/BMIz by the end of the interventions, there was no statistically significant difference between groups on this outcome from the point of intervention completion to up to 12 months later [SMD (95% CI) 0.08 (-0.07, 0.23); I^2=0%].

Three studies reported on the outcome of change in overweight/obesity prevalence; the data could not be pooled. One study reported a 5-6% reduction in the prevalence of obesity in the group of children who participated in the diet plus exercise intervention. The second study found no significant difference between the lifestyle intervention and control groups in terms of the likelihood of showing a change in the prevalence of overweight in the participating adolescents [RR (95% CI) 0.90 (0.54, 1.46)]. The third study reported no significant difference between the diet plus exercise intervention and control groups in terms of the likelihood of showing a change in the prevalence of overweight/obesity in the participating children [RR (95% CI) 0.93 (0.82, 1.06)].

Across the nine secondary health outcomes of interest to this review [i.e., change in total cholesterol, triglycerides, HDL-C, LDL-C, two-hour fasting glucose, SBP, DBP, overall quality of life, and physical fitness], the pooled effect estimates for SBP, DBP, and overall quality of life were the only analyses to show significant benefits in favour of the intervention group compared to control group.

Few behavioural intervention studies provided harms data; those that did indicated no adverse events were reported or, if harms were reported, the symptoms, illnesses and injuries were usually not associated with study participation. Except for gastrointestinal symptoms, no significant differences were found between intervention and control groups in terms of experiencing adverse effects. In one study, compared to control group participants, youth who took a 120 mg dose of orlistat three times daily were more likely to report having experienced at least one gastrointestinal symptom during the course of the intervention [RR (95% CI) 3.77 (2.56, 5.55)].

Of the 30 studies included in the BMI/BMIz meta-analysis, 16 (53%) showed a significant effect in favour of the intervention participants; these interventions were designated as efficacious. Fifteen studies included behavioural interventions and one study combined pharmacological (orlistat) and behavioural strategies. Across behavioural studies, the focus of intervention included two diet, one exercise, four diet and exercise combined, and eight lifestyle programs. Ten interventions involved group sessions, six used individual sessions and 12 incorporated parent/family involvement. Duration of treatment ranged from three months to two years; 11 interventions

lasted six months or less. Most interventions involved at least weekly or bi-weekly contact with participants. The efficacious intervention that combined pharmacological and behavioural strategies used a 120 mg dose of orlistat three times daily for one year alongside diet and exercise components.

Limitations: Most of the evidence used to answer the key questions was taken from studies that could not reliably be assessed for risk of bias. Potential reporting bias was an occasional concern. Using GRADE, the evidence was assessed mostly as moderate and low quality, which reduces confidence in the pooled estimates of effect. Results for secondary health outcomes should be interpreted with caution as our review might have missed trials that reported these outcomes but not our primary weight outcomes. We searched only for papers in English or French.

Conclusion: There is moderate to low quality evidence that behavioural interventions for treating overweight/obesity in children and youth are associated with a medium treatment effect in terms of lowered BMI/BMIz as compared to a small treatment effect shown by combined pharmacological (orlistat) and behavioural interventions. Benefits of behavioural interventions are achieved with minimal or no adverse effects. Benefits of drug treatments should be considered in light of the adverse effects. There are few additional health benefits to be gained by participating in behavioural and/or pharmacological interventions; observed benefits are small or medium in magnitude and the maintenance of such health improvements is unknown.

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Table of Contents

Abstract 2

Table of Contents 5

List of Acronyms 7

Chapter 1: Introduction 8

Chapter 2: Methods 14
- Review Approach 14
- Analytic Framework and Key Questions 14
- Search Strategy 16
- Study Selection 16
- Inclusion and Exclusion Criteria 17
- Data Abstraction 18
- Assessing Risk of Bias 19
- Assessing Strength or Quality of the Evidence 20
- Data Analysis 20

Chapter 3: Results 23
- Summary of the Literature Search for Key Questions 23
- Summary of the Included Studies 23
- Results for Key Questions 24
- KQ1: Effect of Treatment Interventions on Primary Outcomes 24
  - Weight – Change in BMI/BMIz 24
  - Weight – Change in Prevalence of Overweight/Obesity 34
- KQ1a: Effect of Treatment Interventions on Secondary Outcomes 35
  - Change in Total Cholesterol 35
  - Change in Triglycerides 37
  - Change in High Density Lipoprotein Cholesterol 38
  - Change in Low Density Lipoprotein Cholesterol 40
  - Change in Two-Hour Fasting Glucose 41
  - Change in Systolic Blood Pressure 42
  - Change in Diastolic Blood Pressure 43
  - Change in Overall Quality of Life 44
  - Change in Physical Fitness 46
- KQ1b: Effect of Treatment Interventions – Subgroup Analyses 46
- KQ1c: Adverse Effects of Treatment Interventions 46
- KQ1d: Adverse Effects – Subgroup Analyses 51
- KQ1e: Common Elements of Efficacious Interventions 51
- KQ2: Weight Management Interventions 52
- Results for Contextual Questions 52

Results for Supplemental Questions 61

Chapter 4: Discussion, Limitations and Conclusion....62
Discussion 62
Limitations 64
Conclusion....65

References....66

Figures....76
Figure 1: Analytic Framework 77
Figure 2: Search and Selection Results 78

Tables 79
Table 1: Summary of Risk of Bias Assessment of Included RCTs 80
Table 2: Characteristics of Included Studies....81
Table 3: Broad Features of the Available Evidence....95
Table 4: Key Findings of Analyses for Continuous Outcomes....96
Table 5: Key Findings of Analyses for Dichotomous Outcomes....99
Table 6: Details of Adverse Events....100
Table 7: Summary of Common Elements of Efficacious Behavioural Treatment Interventions 102
Table 8: Details of Treatment Strategies of Efficacious Interventions 103
Table 9: Prevalence of Overweight and Obesity in Manitoba Children and Youth....105

Evidence Sets 106
Evidence Set 1: Weight – Change in BMI/BMIz....107
Evidence Set 2: Weight – Change in Prevalence of Overweight/Obesity 143
Evidence Set 3: Health/Physiological Outcomes – Change in Total Cholesterol....147
Evidence Set 4: Health/Physiological Outcomes – Change in Triglycerides 153
Evidence Set 5: Health/Physiological Outcomes – Change in HDL-C 159
Evidence Set 6: Health/Physiological Outcomes – Change LDL-C 165
Evidence Set 7: Health/Physiological Outcomes – Change in SBP....171
Evidence Set 8: Health/Physiological Outcomes – Change in DBP 177
Evidence Set 9: Health/Physiological Outcomes – Change in Quality of Life....183
Evidence Set 10: Adverse Effects – Any Adverse Events 189
Evidence Set 11: Adverse Effects – Serious Adverse Events 194
Evidence Set 12: Adverse Effects – Gastrointestinal Events....199
Evidence Set 13: Adverse Effects – Withdrawal from Studies due to Adverse Events....204

Appendices....209
Appendix 1: Search Strategies 210
Appendix 2: Acknowledgements 226

List of Acronyms

ARI	Absolute Risk Increase
BMI	Body Mass Index
BMIz	Body Mass Index Z-Score
CDC	Centers for Disease Control and Prevention
CHMS	Canadian Health Measures Survey
CI	Confidence Interval
CIHI	Canadian Institute for Health Information
CQ	Contextual Question(s)
CTFPHC	Canadian Task Force on Preventive Health Care
DBP	Diastolic Blood Pressure
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HDL-C	High Density Lipoprotein Cholesterol
IV	Inverse Variance
kg	Kilograms
KQ	Key Question(s)
LDL-C	Low Density Lipoprotein Cholesterol
MD	Mean Difference
m	Metre
mg/dL	Milligram per Decilitre
mmol/L	Millimole per Litre
NNH	Number Needed to Harm
OR	Odds Ratio
QOL	Quality of Life
RCT	Randomized Controlled Trial
RR	Relative Risk / Risk Ratio
SBP	Systolic Blood Pressure
SD	Standard Deviation
SE	Standard Error
SES	Socioeconomic Status
SMD	Standardized Mean Difference
T2D	Type 2 Diabetes
UK	United Kingdom
US	United States
USPSTF	United States Preventive Services Task Force
WHO	World Health Organization

Chapter 1: Introduction

Purpose and Background

This review will be used by the Canadian Task Force on Preventive Health Care (CTFPHC) to provide guidelines to update the previous (1994) guidelines on the treatment of overweight/obesity in children and youth.[1] Other Canadian and international groups have provided guidance on obesity screening, management, and prevention, including the Canadian Clinical Practice Guidelines for the Prevention and Treatment of Obesity in Adults and Children (2007),[2] the Scottish Intercollegiate Guidelines Network (2010)[3] and the United States Preventive Services Task Force (USPSTF, 2010).[4] The lack of updated Canadian guidelines on this topic, the availability of new evidence and the growing burden of obesity were key reasons why this topic was chosen by the CTFPHC.

Definition

Obesity is a condition characterized by the accumulation of excess body fat or adipose tissue, resulting in disturbances in health. Though an imperfect measure, excess adiposity is most often approximated by calculation of the body mass index (BMI), utilizing measured weight (kg) and height (m) (kg/m^2). As BMI changes with growth in childhood and adolescence, classification of obesity in this population relies on the use of standardized curves and age and sex specific cut-off points.[5] In the absence of standardized Canadian growth curves, Canadian clinicians previously utilized the US Centers for Disease Control and Prevention (CDC) curves published in 2000,[6] while epidemiological studies including the recent Canadian Health Measures Survey (CHMS)[7] utilized a set of cut-offs established by the International Obesity Task Force.[8] Recently, prompted by the availability of improved growth charts developed by the World Health Organization (WHO), the Canadian Paediatric Society, College of Family Physicians of Canada, Dieticians of Canada and Community Health Nurses of Canada have published a collaborative statement urging use of the new WHO charts.[9] From birth to five years, the WHO chart represents a growth standard based on the growth of healthy, breastfed infants living in conditions of good hygiene and included participants from diverse geographical regions. Thus, this new standard reflects normal human growth in an ethnically diverse sample appropriate for use in multiethnic communities such as Canada.[10,11] For children five to 19 years of age, the WHO Growth Reference 2007, constructed from historical, cross-sectional data, is recommended. The Canadian collaborative statement encourages growth monitoring in all children and recommends tracking BMI rather than weight alone after two years of age. While trajectory in BMI is most important, cut-off points for overweight and obesity were assigned to alert the practitioner to the need for "further assessment, referral or intervention." The recommended cut-offs for five to 19 years are greater than the 85^{th} centile for overweight and greater than the 97^{th} centile for obese. At 19 years of age, these points coincide with adult cut-offs of 25 and 30 kg/m^2 for overweight and obesity respectively. In the preschool years, a more

conservative approach is applied with recommended cut-offs for children aged two to five years of greater than the 97th centile for overweight and greater than the 99.9th centile for obese.

BMI continues to be most widely used because of its relatively easy application and ability to predict presence of adverse health outcomes in adulthood.[12] It is however an indirect measure of adiposity and has some limitations as it does not specifically measure the amount or location of body fat. Among adults, waist circumference is more closely related to obesity-related health consequences than BMI, prompting the recommendation for classification in adults based on waist circumference cut-offs. There are preliminary data suggesting increased waist circumference is associated with cardiovascular risk factors but some data also suggest that waist circumference percentiles or waist/height add little to BMIz score in the identification of cardiovascular risk factors in children.[13,14] While different risk cut-offs for BMI in adults are suggested in some ethnic groups, it is recommended that the same cut-offs be applied across the pediatric population.

Prevalence and Burden of Obesity

The problem of childhood obesity has increased rapidly in Canada over the last three decades. The 2007-2009 CHMS survey reported obesity prevalence among six to 17 year old Canadian children and youth, based on measured height and weight, at 8.6% with an additional 17% classified as overweight.[7] The more recent CHMS (2009-2011) reported an increase in obesity prevalence among five to 17 year olds (11.7%), and a similar increase in prevalence of overweight (19.8%).[15] The rise in obesity prevalence was particularly notable between 1978 and 2004 when obesity prevalence increased two and a half fold, with somewhat greater increases in the 12 to 17 year age group (an increase from 3.0% to 9.4%).[16] These studies used the International Obesity Task Force BMI cut-offs to assign classification as overweight or obese.[17]

Prevalence among Canadian Aboriginal children and youth living off reserve is likely higher as 32% of six to eight year olds and 13.1% of nine to 14 year olds were classified as obese, based on self-reported height and weight, collected in the 2006 Aboriginal Peoples Survey.[18] In First Nation children and youth living on reserve, obesity prevalence was estimated at 14.1% for youth 12 to 17 years old, 26.4% for children aged nine to 11 years, and 48.7% for those three to five years of age.[19]

Obesity in childhood usually persists into adulthood[20] and is associated with adverse metabolic and psychosocial outcomes by adolescence.[21-24] Recent longitudinal studies highlight the increased risk of atherosclerotic coronary artery disease associated with increased BMI during adolescence, particularly if left untreated.[23,24] Metabolic disturbances identified in children with obesity include dyslipidemia, hypertension, impaired glucose tolerance, type 2 diabetes (T2D), and hepatosteatosis. Multiple cardiovascular disease risk factors are identified in up to 50% of obese children and youth attending weight management programs,[25] and the number of cardiovascular risk factors is related to extent of atherosclerosis in autopsy studies by the second decade of life.[26] The presence of multiple cardiovascular risk factors in adolescence is associated with a 14-fold increased risk of a cardiac event by 50 years of age.[27]

Adverse health outcomes linked to obesity extend far beyond metabolic health and include disturbances in musculoskeletal, neurological, gastrointestinal, respiratory and psychosocial health. Perhaps most prevalent are the adverse psychosocial disturbances linked to childhood obesity including low self-esteem, increased risk of depression, and decreased health related quality of life.[28,29] Psychosocial disturbances and reduced quality of life are more prevalent in clinic-based studies than in population studies and are a common reason for referral.[30]

Etiology and Natural History of Obesity and Consequences if Left Untreated

Although obesity ultimately develops from a positive energy balance, the underlying causes include a complex web of interactions among genetic, biological, environmental, social and economic factors. Further, as these factors interact at the individual, family, community and national levels, solutions must also address obesity at multiple levels. Changes in the social and physical environments, together with behaviour changes have culminated in the markedly increased prevalence of obesity in childhood. Obesity prevalence in children is also linked to family history of obesity and is related to both genetic predisposition (heritability approximately 50%) and shared environment.[31] Parental obesity also predicts increased persistence of childhood obesity into adulthood.[20] Individual and family characteristics that increase the risk for obesity development include lifestyle behaviours of the parents and the child (nutrition, physical activity and sedentary time), lower socioeconomic status (SES) and early life determinants including maternal cigarette smoking in pregnancy, maternal diabetes and obesity, low birth weight, formula feeding and poor sleep habits in the preschool years.[32,33]

The natural history of obesity appears to vary with age of onset, but deciphering the natural history in light of rapidly rising prevalence is difficult. A tracking study which began prior to the current obesity epidemic showed that the likelihood that obese children will continue to be obese in adulthood increased with increasing age, increasing extent of obesity and with a parental history of obesity. Tracking refers to periodic monitoring of BMI percentiles, with particular attention paid to children whose BMI percentile increases over time even if it has not reached the threshold for classification of obesity.[9] Obese children from age three years to adolescence who had at least one obese parent had approximately an 80% chance of being obese as adults.[20] With no parental obesity, 33% of three to five year olds and 66% of 10 to 17 year olds with obesity were also obese as young adults.

Risk Factors

The most predominant risk factor for the development of childhood obesity is parental history of obesity. Age influences the probability of persistence of obesity into adulthood and also influences the development of obesity related health consequences. The prevalence of dysglycemia, dyslipidemia and hypertension increase in the second decade of life, and evidence from studies tracking lipid values and blood pressure from childhood into adulthood underscores calls for early detection.[34] Low SES is an additional determinant thought to increase risk of developing obesity.

Rationale for Screening and Screening Strategies

The increasing prevalence of obesity among children and youth and recognition of related health consequences has prompted multiple organizations to recommend growth monitoring or serial measurements of height and weight for early identification of disturbed growth.[5,35,36] In relation to overweight and obesity, the calculation and plotting of BMI is recommended from two years of age onwards. Should an individual's BMI trajectory increase over time, discussion of lifestyle behaviours and other prevention strategies are recommended. Should the BMI fall within the overweight or obese range, further evaluation of obesity related health measures is recommended and development and implementation of a treatment plan is encouraged.[2,37] Given that growth monitoring is accepted as a critical component of well child visits for many reasons, it is expected that the additional step of calculating and plotting BMI should be easily incorporated.[9]

Monitoring BMI in children and youth is recommended within primary care practices and is also practiced in community settings such as public health clinics. Linkage to well child visits, immunizations and, for children that do not attend well child visits, at presentation for acute illness is encouraged.

Prevention Interventions in Children and Youth

Primary prevention interventions for obesity would be applicable to all children and youth, and must be differentiated from secondary prevention interventions designed to detect obesity at an early stage so that the progress of obesity can be arrested and, if possible, reversed. Given the complexity of the underlying causes contributing to the development of obesity, population based interventions that focus on change at multiple levels are encouraged.[38] Multiple population based approaches have been recommended including the implementation of school based programs and changes to the built environment (structures and resources constructed by humans with the purpose of supporting human activity) to promote physical activity, alter the nutrition environment and reduce child focused food advertising. The role of prevention at the individual and family levels through interventions that can be conducted or referred to by primary care is recommended in some clinical practice guidelines; evidence on this practice is the focus of this review.

At the individual and family levels, monitoring BMI in primary care practices for the purpose of screening for development of overweight or obesity has been recommended.[9] Referral for treatment of childhood obesity to specialized treatment centres utilizing a family-based, comprehensive, behavioural modification approach has been supported based on recent reviews suggesting short-term efficacy of such programs. Programs defined as having moderate to high intensity (>30 hours of individual or group intervention)[4,39,40] are efficacious in achieving moderate reductions in BMI, at least over the short-term (up to 12 months). While encouraging, many questions remain about the impact of treatment programs on health measures beyond BMI (e.g., blood pressure, lipids, and quality of life) and the sustainability of any short-term benefits. Whitlock et al.[4] identified only seven papers that examined the influence of weight management programs on lipids, blood pressure, glucose and/or adiposity, and noted their lack of confidence

in the conclusions given small sample sizes and methodological concerns across the studies. In the largest study, improvements in insulin resistance, glycaemia, blood pressure, HDL-C and triglyceride levels were identified in children and youth participating in a weight management program over the short-term and after one year of follow-up, but only in the children who demonstrated persistent weight loss.[41] Pharmacotherapy and surgical interventions have been identified more recently as being efficacious[42] but these approaches are only recommended in restricted populations after other weight loss strategies have been attempted and they are not without consequences.[43]

Current Clinical Practice

While CDC growth curves were previously recommended for clinical use in Canadian children, it is now recommended that health professionals utilize the 2007 WHO Child Growth Reference and Growth Standard as described above. The BMI growth curves generated by this research are described in detail on the WHO website.[10]

While screening for BMI is recommended throughout the world, implementation at the clinical practice level has been moderate at best.[44-46] Barriers to monitoring BMI centiles in children have been identified and include lack of familiarity with recommendations, disagreement with recommendations[46] and physician attitudes and beliefs relating to outcome.[47] While willing to engage in discussions with their patients around lifestyle behaviours, primary care physicians have expressed concerns over available resources for treatment and knowledge gaps have been identified.[48]

The availability of specialized weight management programs for children in Canada has historically been quite limited. This has changed in the last five years with 18 programs identified in a recent environmental scan.[49] These programs incorporate a multi-disciplinary approach to family based interventions designed to change nutrition and activity behaviours utilizing group and individual counseling. Most interventions have developed over the last five years and few have been formally evaluated. Given the national geography, proximity to treatment centres continues to influence referral patterns.[50] The fact that 72% of the identified programs are affiliated with academic institutions highlights the paucity of available programs connected to primary care in Canada.

Previous Review and Recommendations

The 1994 Canadian Periodic Health Examination[51] included two recommendations regarding screening and treatment of childhood obesity:

1. Detection: Physicians should continue to plot the height and weight of infants and children during a periodic health examination, primarily to identify children who are failing to thrive. There is insufficient evidence to support screening children for obesity; however, there is no evidence that screening for obesity is harmful (C category recommendation).[51]

2. Intervention: There is insufficient evidence to include counseling about nutrition and exercise in or exclude it from the routine treatment of severely obese children (C category

recommendation). There is fair evidence to exclude very-low-kilojoule diets from the routine treatment of preadolescent obese children (D category recommendation). There is conflicting evidence concerning the inclusion or exclusion of exercise in the routine treatment of obese children (C category recommendation).[51]

Other Guidelines

Previously the Obesity Canada Clinical Guidelines Expert Panel (2006),[2] recommended screening for overweight and obesity in children and adolescents aged two years and older with BMI using the CDC growth charts (overweight ≥85th to <95th centile; obesity ≥95th centile). In managing overweight or obesity these guidelines recommended a multi-disciplinary team including a registered dietician and utilizing behaviour modification strategies to assist families change eating patterns, increase physical activity and reduce sedentary activities. However, as noted above, it is currently recommended that health professionals utilize the 2007 WHO Child Growth Reference and Growth Standard.[10] The National Institute for Health and Care Excellence (2006) group recommends (with caution) using BMI to measure overweight and obesity and recommends lifestyle changes including decreasing sedentary behaviours and making dietary changes.[52] In 2010 the USPSTF recommended screening children aged six years and older for obesity using BMI and referring overweight and obese children to behavioural or intensive counseling.[53]

Chapter 2: Methods

Review Approach

At the outset of the review process the CTFPHC Working Group conceptualized an "ideal approach," considering the analytic framework and key questions for both screening and prevention of obesity in children and youth that they believed were most important for clinicians. An evidence based analysis on screening and prevention of obesity was planned to address key questions about the effectiveness of screening and preventive efforts for normal weight, overweight or obese children/youth in primary care on mortality, morbidity, various anthropometric measures of weight reduction or stabilization, costs and harms. However, our preliminary search revealed recent reviews by the USPSTF[53] and the Scottish Intercollegiate Guidelines Network[3] that asked similar questions and identified no evidence on screening. To avoid duplication of effort, we removed the key question related to screening and instead added a series of supplemental questions on screening. These questions were examined through a condensed review process that searched for evidence on screening for obesity published since the USPSTF review. The USPSTF also examined the effectiveness of weight management programs on children.[54] In addition, a preliminary review of the literature indicated that the Cochrane Collaboration had conducted a review that examined obesity prevention interventions in children.[40]

Based on the acquired knowledge and newly available products, the CTFPHC Working Group adopted a pragmatic approach to select the review questions, focusing on areas which the scoping review indicated there would be sufficient evidence upon which to formulate recommendations. In addition, to avoid duplication of work already completed, the Working Group directed the McMaster Evidence Review and Synthesis Centre team to:

- use the 2011 Cochrane review by Waters et al.[40] as a foundation for examining the effectiveness of prevention interventions for children and youth who are currently of normal weight, and
- use the 2010 USPSTF review[54] as a foundation for examining treatment interventions for children and youth who are already overweight and obese.

The protocol was registered with PROSPERO (#CRD42012002754).

Analytic Framework and Key Questions

The analytic framework, presented in Figure 1, includes both prevention and treatment of child/youth overweight/obesity. This review focuses only on the aspects related to treatment; a separate review was conducted to examine prevention (available on the CTFPHC website http://canadiantaskforce.ca/).

The key questions (KQ) and sub-questions considered for this treatment focused review are:

KQ1. Do weight management interventions (behavioural, pharmacological and/or surgical) lead to BMI, weight, or adiposity stabilization or reduction in children and adolescents who are obese or overweight?

a. Do these weight management interventions lead to other positive outcomes (e.g. improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)?
b. Are there population (e.g., age, sex, race-ethnicity, low SES, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding) or environmental factors that influence the effectiveness of the weight management interventions?
c. What are the adverse effects of weight management interventions attempting to stabilize or reduce BMI (i.e., death, need for medical or psychiatric treatment, growth retardation, risk of injury, pharmacological side effects)?
d. Are there differences in adverse effects between subgroups (e.g., age, sex, race-ethnicity, low SES, severity of obesity, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding)?
e. What are common features of efficacious weight management interventions?

KQ2. Do weight management interventions (behavioural, pharmacological and/or surgical) help children and adolescents who are initially obese or overweight maintain BMI, weight, or adiposity improvements after the completion of an active intervention?

a. Do these weight management interventions lead to other positive outcomes (e.g. improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)?
b. Are there population [e.g. age, sex, race-ethnicity (e.g., Canadian Aboriginal youth), lower SES, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding] or environmental factors that influence the effectiveness of the weight management interventions?
c. What are the adverse effects of weight management interventions attempting to stabilize or maintain BMI?
d. Are there differences in adverse effects between subgroups (e.g., age, sex, race-ethnicity, low SES, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding)?
e. What are common features of efficacious weight management programs?

The contextual questions (CQ) considered for both the prevention and treatment reviews are:

CQ1. Is there evidence that the burden of disease, the risk/benefit ratio of prevention/treatment, the optimal prevention/treatment method, access, and implementation differ in any ethnic subgroups (e.g. Canadian Aboriginal youth) or by age (e.g., infant, child, adolescent), rural and remote populations, or lower SES populations?

CQ2. What are the resource implications and cost effectiveness of overweight and obesity prevention/treatment in Canada?

CQ3. What are parents' and children's values and preferences regarding overweight and obesity prevention/treatment?

CQ4. What are the most effective (accurate and reliable) risk assessment tools identified in the literature to identify those at higher risk of obesity or to assess future health risk as a result of obesity?

The supplemental questions (SQ) on obesity screening considered for both the prevention and the treatment reviews are:

SQ1. Does screening for overweight and obesity in children and youth in primary care practice reduce the risk of morbidity, and mortality and/or improve health outcomes (impaired glucose tolerance, T2D, hypertension, dyslipidemia, non-alcoholic fatty liver disease, sleep apnea, slipped capital femoral epiphysis and psychosocial disorders)?

a. Does screening for overweight/obesity in children and youth result in reduction or stabilization of adiposity?
b. What is the most effective method of screening for overweight and obesity in children in primary care?
c. What is the optimal interval/frequency for screening for overweight and obesity in children in primary care?
d. What is the most effective type of screening (opportunistic vs. organized/systematic) for overweight and obesity in children in primary care?
e. What are the harms associated with screening for overweight and obesity in children in primary care?
f. Do screening interventions decrease mortality and incidence of health outcomes in high risk groups such as but not limited to those with a family history of obesity, psychological issues or co-morbid conditions?

Search Strategy

For this review we updated the search conducted for the 2010 USPSTF review.[54] For the key and supplemental questions we searched EMBASE, Medline, Cochrane Central Registry of Controlled Trials, and PsychINFO from June 10, 2008 (the date of the last USPSTF search) to August 28, 2013, using terms such as *obesity, overweight, weight loss, weight maintenance, orlistat, behavior therapy, diet, exercise,* and *lifestyle*. Reference lists of the included studies of this review and the included studies of other on topic reviews were searched for any relevant studies that were not captured by our search. A separate search was conducted to look for evidence that would answer the contextual questions; this strategy included two databases (Medline and EMBASE) and covered the period between January 2007 and August 16, 2013. The full search strategies are provided in Appendix 1. In addition, a focused grey literature search of Canadian sources was undertaken for recent reports on obesity in Canada. All citations were uploaded to a web-based systematic review software program[55] for screening and data extraction.

Study Selection

Titles and abstracts of papers considered for the key questions and sub questions were reviewed in duplicate; articles marked for inclusion by either team member went on to full text screening. Full

text inclusion was done independently by two people. All disagreements were resolved through discussions rather than relying on a particular level of kappa score to indicate when discussions were no longer necessary. The inclusion results were reviewed by a third person. For papers located in the contextual questions search, title and abstract screening was done by one person.

Inclusion and Exclusion Criteria

Language

The published results of studies had to be available in either English or French.

Populations

Eligible studies included children and/or youth aged 2 to 18 years who were overweight or obese (BMI >85th percentile for age and sex-specific BMI or met previously accepted criteria for overweight based on ideal body weight). The search included unselected populations or populations selected for increased risk for specified conditions (i.e., cardiovascular disease, hypertension, dyslipidemia, T2D) or other risk factors such as parental obesity, ethnic background (e.g., Canadian Aboriginal youth), low SES, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding).

Studies were excluded if the sample was limited to: (1) children or youth with eating disorders; (2) pregnant or post-partum adolescents; (3) children or youth whose overweight/obesity was secondary to genetic or medical conditions including polycystic ovarian syndrome, hypothyroid, Cushings, GH deficiency, insulinoma, hypothalamic disorders (e.g., Froelich's syndrome), Laurence-Moon-Biedl syndrome, Prader-Willi syndrome, use of antipsychotic medications; or (4) other idiosyncratic weight loss issues.

Interventions

The type of intervention could be one or a combination of the following approaches: behavioural [diet, exercise and/or lifestyle (broad based strategies that focus on diet and/or exercise plus use other approaches such as counselling, education, support or environmental changes to address nutrition and physical activity as well as other health issues such as screen time, sleep, alcohol or tobacco use)], pharmacological (i.e., orlistat), surgical, complimentary/alternative (e.g., acupuncture, chiropractic, naturopathic), and health care system interventions. The interventions must be designed to promote weight control, loss or maintenance or an important component of the intervention must focus on weight loss (e.g., physical activity).

Interventions that focused on primary prevention of overweight/obesity, were faith-based programs, involved changes in the built environment, or treatment using any drugs other than orlistat (e.g., sibutramine, mazindol) were excluded.

Settings

Trials were conducted in settings generalizable to Canadian primary care, feasible for conducting in primary care or feasible for referral from primary care.

Studies were excluded if interventions were delivered as in-patient programs or were situated in schools or workplaces.

Comparator and Study Design

To answer the questions about the benefits of treatment interventions, only randomized controlled trials (RCTs) with minimal intervention (e.g., an information session or newsletter covering general health concepts), usual care or placebo control, and only placebo controlled RCTs for pharmacological interventions were considered for inclusion. In addition, trials had to have a minimum of 10 participants per arm. Case reports, case series and chart reviews were excluded.

Any study design (with or without comparison groups) with any number of participants was considered acceptable to answer the questions about adverse effects and the contextual questions.

Outcomes

To answer the questions about the benefits of treatment interventions, only studies that reported data for one or more of the specified weight outcomes were included (i.e., change in BMI, BMIz-score and prevalence of overweight/obesity). There was no weight outcome requirement if a study reported data for any of the adverse effects of interest (death, need for medical or psychiatric treatment, growth retardation, risk of injury, pharmacological side effects). Secondary outcomes of interest included change in total cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), two-hour fasting blood glucose, systolic blood pressure (SBP), diastolic blood pressure (DBP), overall quality of life (QOL) and physical fitness.

Timeframe

There was no intervention duration criterion. However, for the questions regarding intervention effectiveness, studies were only included if they provided outcome data for a minimum of six months post baseline assessment.

There was no minimum duration requirement or six month minimum expectation for outcome measurements in studies that reported adverse effects or for inclusion of studies to address the contextual questions.

Data Abstraction

For each study used to answer the KQs, review team members extracted data about the population, study design, intervention, analysis and results for outcomes of interest. For each study one member completed full abstraction (study characteristics, risk of bias assessment, outcome data) using electronic forms housed in a web-based systematic review software program.[55] A second member verified all extracted data and ratings; disagreements were resolved through discussion and/or third party consultation when consensus could not be reached. Prior to performing meta-analyses, tables were produced for each outcome and all data were checked in a third round of verification.

Unadjusted immediate post assessment data was extracted for most studies. However, for eight studies the immediate post intervention data was not reported in the available papers or the interventions lasted less than six months and our inclusion criteria required outcome assessment

at a minimum of six months post baseline. For these studies we extracted data at the point closest to the end of the intervention and at least six months post baseline assessment to use for the KQ1 analyses (e.g., one month after a five month intervention, three months after a three month intervention, four months after a four month intervention). Some papers reported relevant follow-up data that was extracted for the KQ2 analyses.

To answer the adverse effects KQ we selected the more inclusive option and looked for data for all reported adverse events of interest, regardless of whether they were attributed to study participation. In addition, for the meta-analyses we only included mutually exclusive adverse events data, that is, we selected results that reported the number of participants who experienced at least one event in the respective overall adverse effects category. The results from studies that reported the total number of adverse events experienced across all study group participants are captured only in the narrative results of this review.

Assessing Risk of Bias

Arriving at a Grading of Recommendations Assessment, Development and Evaluation or GRADE rating for a body of evidence (see next section) requires a preliminary assessment of the risk of bias or study limitations for the individual studies. All RCTs included to answer the KQs of this review were assessed using the Cochrane Risk of Bias tool.[56]

This rating tool covers six domains: sequence generation; allocation concealment; blinding of participants, personnel and outcome assessors; incomplete outcome reporting; selective outcome reporting; and other risk of bias. A few adjustments were made for the purpose of this review: we separated our assessment of blinding of participants and personnel from our assessment of blinding of outcome assessors; we considered objective (total cholesterol, triglycerides, HDL-C, LDL-C, fasting glucose), subjective (weight, blood pressure, QOL, physical fitness, adverse effects) and self-report (QOL, adverse effects) outcomes separately under the domains of blinding of outcome assessors and incomplete outcome reporting; we selected industry funding, insufficient study power and sample size less than 30 per arm as the main sources of other risk of bias; and we added an overall risk of bias rating specific to outcome group (objective, subjective, self-report).

Information to determine risk of bias was abstracted from the primary methodology paper for each study and any other relevant published papers. For each study, one team member completed the initial ratings which were then verified by a second person; disagreements were resolved through discussion and/or third party consultation when consensus could not be reached. To assign a high or low risk of bias rating for a particular domain we looked for explicit statements or other clear indications that the relevant methodological procedures were or were not followed. In the absence of such details we assigned unclear ratings to the applicable risk of bias domains. To determine the overall risk of bias rating for an outcome group we considered all domains, however greater emphasis was placed on the assessments of the first three areas of randomization, allocation, and blinding of outcome assessment.

Table 1 summarizes the risk of bias ratings applied to the RCTs included in this review.

Assessing Strength or Quality of the Evidence

The strength of the evidence was determined based on the GRADE system of rating the quality of evidence.[57,58] This system of assessing evidence is widely used and is endorsed by over 40 major organizations including WHO, CDC and the Agency for Healthcare Research and Quality.[59] The GRADE system rates the quality of a body of evidence as high, moderate, low or very low; each of the four levels reflects a different assessment of the likelihood that further research will impact the estimate of effect (i.e., high quality: further research is unlikely to change confidence in the estimate of effect; moderate quality: further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate; low quality: further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate; very low quality: the estimate of effect is very uncertain).[59]

A GRADE quality rating is based on an assessment of five conditions: (1) risk of bias (limitations in study designs), (2) inconsistency (heterogeneity) in the direction and/or size of the estimates of effect, (3) indirectness of the body of evidence to the populations, interventions, comparators and/or outcomes of interest, (4) imprecision of results (few participants/events/observations, wide confidence intervals), and (5) indications of reporting or publication bias. Grouped RCTs begin with a high quality rating which may be downgraded if there are serious or very serious concerns across the studies related to one or more of the five conditions. For this review, key data were entered into the GRADEPro software along with the quality assessment ratings to produce two analytic products for each outcome and the comparisons of interest: (1) a GRADE Evidence Profile Table and (2) a GRADE Summary of Findings Table (presented in Evidence Sets 1 to 13).

There was no assessment of the quality of the evidence used to answer the contextual questions.

Data Analysis

To perform meta-analyses, immediate post-treatment data (means, standard deviations) were utilized for continuous outcomes such as BMI, BMIz score (hereafter BMIz), total cholesterol, triglycerides, HDL-C, LDL-C, and systolic and diastolic blood pressure, while number of events data were utilized for binary outcomes (i.e., prevalence of overweight/obesity, adverse events). For the primary outcome of weight change, we took BMI as the primary outcome measure and if BMI was not reported we took BMIz. The DerSimonian and Laird random effects model with inverse variance (IV) method was utilized to generate the summary measures of effect in the form of standardized mean difference (SMD) for the primary weight outcome of BMI/BMIz and mean difference (MD) for other continuous outcomes.[60] The random effects model assumes the studies are a sample of all potential studies and incorporates an additional between-study component to the estimate of variability. The outcome of change in prevalence of overweight/obesity at post-intervention as compared to control group was meta-analyzed using the number of events data at post-intervention and the summary measures of effect were generated as a risk ratio (RR) utilizing the DerSimonian and Laird random effects model with

inverse variance method.[60] If the pooled effect estimate was significant we planned to calculate the absolute risk reduction and the number needed to treat.

SMD and MD were calculated using change from baseline data [i.e., mean difference between pre-treatment (baseline) and post-treatment (final/end-point) values along with the standard deviation (SD) for both intervention and control groups]. For studies that did not report SD, we calculated this value from the reported standard error (SE) of the mean, or from the 95% confidence intervals (CI) using equations provided in Chapter 9 of the *Cochrane Handbook for Systematic Reviews of Interventions.*[61] For studies that provided neither SD or SE for the follow-up data, we imputed the SD from either the baseline values or other included studies of similar sample size and for the same outcome. Based on Cohen's rule,[62] an SMD value of 0.2 or less indicates a very small effect, a value between 0.2 and 0.5 indicates a small effect, a value between 0.5 and 0.8 indicates a medium effect and a value of 0.8 or larger indicates a large effect. To help interpret SMD we converted values to BMI and BMIz units. Pooled SMD was multiplied by a typical among-person standard deviation for BMI and BMIz which yielded an estimate of the difference in mean outcome scores (intervention versus control). The SD for BMI and BMIz 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.[56]

The units of measurement for total cholesterol, triglycerides, HDL-C, and LDL-C, if reported in mg/dL, were converted to Canadian standard units (i.e., mmol/L).

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 to identify gender (e.g., Taveras 2011-M, Taveras 2011-F). For studies with more than one intervention arm, we were able to combine the 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. In the BMI/BMIz meta-analysis the -z extension indicates we used the BMIz data provided by this study.

Cochrane's Q (α=0.10) and I^2 statistic were used to quantify statistical heterogeneity between studies, where $P<0.05$ indicates high statistical heterogenity between studies. There are no strict rules for interpreting I^2 but an I^2 >50% may represent substantial heterogeneity.[61]

Sensitivity analyses were performed to evaluate statistical stability and effect on statistical heterogeneity. The sub-group analyses based on primary focus of intervention (behavioural, pharmacological plus behavioural), type of behavioural intervention (diet, exercise, diet plus exercise, lifestyle), intervention duration (≤12 months, >12 months), age groups (2 to 12 years, 13 to 18 years), intervention target (individual, families) and study risk of bias rating (low, unclear, high) were performed for BMI/BMIz because this was an outcome that most of the studies reported and, to be consistent, this was the outcome used for sensitivity analyses in our companion review on prevention interventions. Only primary focus of intervention (behavioural, pharmacological plus behavioural) was used to conduct sensitivity analyses across other outcomes.

For significant adverse effects outcomes we added absolute risk increase (ARI) and number needed to harm (NNH) to the GRADE tables. We calculated NNHs using the absolute numbers presented in the GRADE tables. GRADE estimates the absolute number per million using the control group event rate and risk ratio with the 95% confidence interval obtained from the meta-analysis.

Meta-analyses were performed using Review Manager version 5.1 software.[63] The Egger's test[64] for publication bias for each outcome was conducted using STATA version 12.[65]

For studies that provided data that could not be pooled, findings are reported narratively in the respective results sections.

Results presented throughout the body of this review are rounded and/or reported to the second decimal. However, at the request of the CTFPHC, we used four decimals in our calculations and in the presentation of results in the Evidence Sets.

To answer the sub-question about common elements of efficacious interventions (KQ1e) it was necessary to first to identify the efficacious interventions. For this review we identified efficacious interventions from studies included in the BMI/BMIz meta-analysis that showed a statistically significant effect size in favour of the intervention group. Some of the elements we examined in these interventions were adapted from the features list presented in the 2011 USPSTF review of interventions to treat adult obesity.[66] We also included intervention duration, estimated number of sessions/frequency of sessions, intervention target, focus and parental involvement as we believe primary care physicians might want to take such features into consideration when making program recommendations to their patients and their families.

Chapter 3: Results

Summary of the Literature Search for Key Questions

The search and selection process for relevant literature occurred in three stages. Initially we conducted a combined search that included children and adults; prevention and treatment. We believed that some efficiency would be gained in the screening stage if we started with a comprehensive search strategy.

The initial comprehensive search (including both adults and children) located 30,196 unique citations (see Figure 2). These citations were reviewed for title and abstract relevance and were filtered for population (adult or child) and intervention focus (prevention or treatment). A total of 10,914 were excluded at this first level of relevance screening. There were 8,099 citations streamed for children and 11,183 citations streamed for adult populations (further information regarding adult-related citations reported in the adult obesity treatment and adult obesity prevention reviews available on the CTFPHC website http://canadiantaskforce.ca/).

The second stage involved another round of title and abstract screening and streaming of the 8,099 citations related to children. At this level 7,424 citations were excluded and 675 citations remained for consideration as treatment interventions (these results are further delineated in the child obesity prevention review available on the CTFPHC website http://canadiantaskforce.ca/).

Finally, the literature search was updated in August 2013. This updated search added an additional 2,041 citations for possible inclusion. Another round of title and abstract screening was undertaken where an additional 2,396 citations were excluded leaving 320 eligible for full text screening (one of these papers could not be retrieved). To the remaining search yield we added 15 of the 23 studies included the 2010 USPSTF review[54] for consideration (we pre-emptively excluded the eight trials that examined sibutramine or metformin as the pharmacological intervention). Full text screening took place on 334 citations and 232 were excluded (see list of excluded studies available on the CTFPHC website http://canadiantaskforce.ca/).

Sixty-four systematic reviews were identified by our team. The reference lists of recent (published in 2012 and 2013) and on topic systematic reviews were searched to ensure that we had not missed any relevant studies. No additional studies were located in those reference lists.

At the end of the search and selection process, 32 studies with 38 papers met the inclusion criteria for this review. This total includes nine studies brought forward from the 2010 USPSTF review[54] that met our inclusion criteria[67-75] and 23 studies found in the more recent literature.[76-98]

Summary of the Included Studies

A total of 32 RCTs were included to answer the key question and sub-questions in this review.[67-98] Most (90%) of the studies were rated as having unclear or high risk of bias for the weight outcomes, primarily due to the lack of information about or lack of procedures to ensure random sequence generation, allocation concealment and blinding of participants, personnel and outcome

assessment (see Table 1). Nearly three-quarters of the studies (n=23) targeted children aged two to 12 years and just over one-quarter (n=9) were directed at youth aged 13 to 18 years. Most studies (n=31) included mixed gender samples; one targeted only girls.[77] At baseline about two-thirds of the studies (n=19) included samples of overweight and obese participants; one study included only overweight children, and the remaining 12 studies included only obese participants at baseline. The focus of behavioural interventions was diet in two studies, exercise in one study, diet plus exercise in six studies, and lifestyle in 20 studies. Two studies were included that used combined pharmacological (120 mg orlistat three times daily) and behavioural (diet plus exercise components) interventions, and one study that was included only to answer the adverse effects key question used a surgical intervention (gastric lap-band). In 14 studies the target of intervention was the individual child/youth and in the other 18 studies the target was families. The intervention duration was one year or less in most studies (n=28) with 18 of these interventions lasting six months or less; in the remaining four studies the duration was two years. Many studies (n=23) included a no intervention or usual care comparison group; just over one-quarter of the studies (n=9) provided control participants with a minimal component (e.g., information sessions or newsletters covering general health concepts). One of the orlistat studies was co-located in Canada and the US,[67] 12 studies were conducted in the US, about one-third (n=10) were conducted in European countries, four were located in Australia and one study was conducted in each of Iran, Israel, Malaysia and New Zealand. Two-thirds of the studies (n=22) were published in the last five years (2009-2013); the remaining 10 studies appeared in the literature between 2002 and 2008. The characteristics of the 32 included studies are reported individually in Table 2.

Results for Key Questions

High level summaries of the included studies and key findings across outcomes with pooled estimates of effect are provided in Tables 3 through 5. Detailed results for each outcome are presented below.

KQ1: Do weight management programs (behavioural, combined behavioural, pharmacological and/or surgical interventions) lead to BMI, weight, or adiposity stabilization or reduction in children and adolescents who are overweight or obese?

To answer this key question we examined the included studies for three primary weight outcomes: change in BMI, BMIz and prevalence of overweight/obesity.

Primary Outcome: Weight

Change in BMI/BMIz

Evidence Set 1 provides the GRADE Evidence Profile Tables (1.1, 1.2), the GRADE Summary of Findings Tables (1.1, 1.2), the forest plots (1.1 to 1.8), the funnel plots (1.1 to 1.6) and the Egger's test results (for publication bias) generated for the outcome of change in BMI/BMIz for the comparison between intervention participation and usual care, placebo or no intervention at two

time points: (1) immediate post intervention and (2) longest available follow-up. For the immediate post intervention assessment, an overall analysis was performed including 30 studies that reported change in BMI/BMIz data that could be pooled. Six sub-analyses were conducted to look more closely at this comparison: (1) by primary focus of intervention (behavioural, pharmacological plus behavioural), (2) by type of behavioural intervention (diet, exercise, diet plus exercise, lifestyle), (3) by duration of behavioural intervention (≤12 months, >12 months), (4) by age group of behavioural intervention participants (2 to 12 years, 13 to 18 years), (5) by behavioural intervention target (individual, family), and (6) by behavioural intervention study risk of bias rating (low, unclear, high). To examine the maintenance of treatment benefits, an overall analysis was performed including four studies that showed a statistically significant lowered BMI/BMIz in favour of the intervention group at the immediate post intervention point and provided additional outcome data for a follow-up assessment. One sub-analysis was performed to examine the available evidence according to participant age group (2 to 12 years, 13 to 18 years). The effects for BMI/BMIz are presented as standard mean difference (SMD). Using Cohen's guideline for interpreting the SMD statistic,[62] a value less than 0.2 indicates a very small effect, a value between 0.2 and 0.5 indicates a small effect, a value between 0.5 and 0.8 indicates a medium effect, and a value greater than 0.8 indicates a large effect. To help interpret SMD, values were converted and are also presented as BMI and BMIz units. In addition, results of a meta-analysis including only those studies reporting BMI as an outcome are reported.

1.1 Immediate Post Assessment: Overall and by Primary Focus of Intervention

Overall

Thirty RCTs (n=3,908) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.1).[67-96] Across the 30 studies, most included mixed gender samples (n=29); one included only girls. About three-quarters (n=22) of the studies included children aged 2 to 12 and the remaining quarter (n=8) included youth aged 13 to 18. In terms of weight status at baseline, 18 studies included overweight and obese participants, one study included only overweight children, and 11 studies included only obese participants. In terms of type of intervention, two were diet, one was exercise, six were diet plus exercise, 19 were lifestyle, and two were pharmacological plus behavioural (120 mg of orlistat three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in most studies (n=22) and a minimal component in the remaining six studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 13 studies was the individual child/youth; in 17 studies the target for intervention was families. Intervention duration was 12 months or less in 27 (90%) studies (in about two-thirds of these studies the duration was six months or less) and duration was two years in three studies. One study was jointly located in Canada and the US, 11 studies were conducted in the US, 10 in European countries, five in Australia or New Zealand,

and one in each of Iran, Israel, and Malaysia. Two-thirds of the studies (n=20) were published in the last five years (2009-2013); the remaining 10 studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a medium magnitude of effect [SMD -0.53 (95% CI -0.69, -0.36), I^2=83%; converted into BMI units -0.97 kg/m^2 (95% CI -1.28, -0.66); converted into BMIz units -0.26 (95% CI -0.34, -0.18)]. There was no evidence that the effect of treatment differed based on primary focus of intervention (behavioural, pharmacological plus behavioural) [Chi^2=0.79, df=1 (P=0.37), I^2=0%].

One additional RCT met the inclusion criteria of this review but could not be incorporated in the BMI/BMIz meta-analyses because the baseline values were missing with no change reported at follow-up; only a p-value was provided without individual treatment group data.[98] This recent US study of a six month lifestyle intervention directed at children aged 5 to 8 years (n=20 intervention, n=20 control) found no significant (P<0.1) treatment effect for BMIz.

Meta-analysis (forest plot 1.1.1) considering only the 21 studies (n=3,100) reporting BMI as an outcome, showed a statistically significant lowered BMI in the intervention group compared to the control group [MD (95% CI) -1.12 kg/m^2 (-1.52, -0.72); I^2=92%].[67,68,70-73,75,78,81-89,92-95] The test for subgroup differences based on primary focus of the intervention (behavioural, pharmacological plus behavioural) was not significant [Chi^2=1.12, df=1 (P=0.29), I^2=10.4%)]. BMI was lowered in intervention participants more than in control for both behavioural interventions (19 studies) [MD (95% CI) -1.15 kg/m^2 (-1.59, -0.72); I^2=93%] and pharmacological plus behavioural interventions (2 studies) [MD (95% CI) -0.86 kg/m^2 (-1.19, -0.52); I^2=0%].

Behavioural

Twenty-eight RCTs (n=1,946) of low GRADE quality (downgraded for risk of bias and reporting bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.1).[68-74,76-96] Across the 28 studies, most included mixed gender samples (n=27); one included only girls. About three-quarters (n=22) of the studies included children aged 2 to 12 and the remaining six studies included youth aged 13 to 18. In terms of weight status at baseline, 17 studies included overweight and obese participants, one study included only overweight children, and 10 studies included only obese participants. In terms of type of intervention, two were diet, one was exercise, six were diet plus exercise, and 19 were lifestyle. Control participants received usual care or no intervention in most studies (n=22) and a minimal component in the remaining six studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 12 studies was the individual child/youth; in 16 studies the target for intervention was families. Intervention duration was 12 months or less in 25 (89%) studies (in about two-thirds of these studies the duration was six months or less) and duration was two years in three studies. Ten studies were conducted in the US, 10 in European countries, five in Australia or New Zealand, and one in each of Iran, Israel, and Malaysia. More than two-thirds of the studies (n=20) were published in the last five years (2009-2013); the remaining eight studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to

the control group with a medium magnitude of effect [SMD -0.54 (95% CI -0.73, -0.36), I^2=85%; SMD converted into BMI units 1.01 kg/m^2 (95% CI -1.35, -0.66); converted into BMIz units SMD -0.27 (95% CI -0.36, -0.18)].

Pharmacological plus Behavioural

Two pharmacological plus behavioural RCTs (n=562) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz.[67,75] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and one study included only obese participants. In terms of type of intervention both were pharmacological plus behavioural (120 mg of orlistat taken three times daily plus diet and exercise components). Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months in one study and six months in the other study. One study was jointly located in Canada and the US and the other was conducted in the US. The studies were published in 2005 and 2006. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a small magnitude of effect [SMD -0.43 (95% CI -0.60, -0.25), I^2=0%; converted into BMI units -0.86 kg/m^2 (95% CI -1.19, -0.52)].

1.2 Immediate Post Assessment: Type of Behavioural Intervention

There was no evidence that the effect of treatment differed based on type of behavioural intervention (diet, exercise, diet plus exercise, lifestyle) [Chi^2=3.22, df=3 (P=0.36), I^2=6.8%].

Diet

Two diet focused RCTs (n=270) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.2).[85,93] Both diet intervention studies included mixed gender samples, one with children aged 2 to 12 and one with youth aged 13 to 18. In terms of weight status at baseline both studies included overweight and obese participants. Control participants in one study received no intervention; in the second study they were given a placebo (3g of sunflower oil added per serving of milk). The intervention target in both studies was the individual child/youth. Intervention duration was 12 months in one study and six months in the other study. Both studies were conducted in the US. The studies were published in the last five years (2010, 2012). Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.36 (-0.65, -0.06); I^2=19%].

Exercise

One exercise focused RCT (n=322) of high GRADE quality provided data on BMI/BMIz (forest plot 1.2).[82] This six month exercise intervention study included a mixed gender sample of overweight and obese children aged 2 to 12. Control participants received no intervention. The intervention target was the individual child. The study was conducted in New Zealand and was published in the last five years (2011). Intervention participants had a statistically significant

lowered BMI/BMIz as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.43 (-0.65, -0.21)].

Diet plus Exercise

Six diet plus exercise focused RCTs (n=684) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.2).[72,83,86,87,92,94] All diet plus exercise intervention studies included mixed gender samples. Five studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, three studies included overweight and obese participants and three studies included only obese participants. Control participants received usual care or no intervention in all studies. The intervention target in three studies was the individual child/youth; in three studies the target for intervention was families. Intervention duration was 12 months or less in five studies (in three of these studies the duration was six months or less) and duration was two years in one study. Three studies were conducted in European countries and one in each of Australia, Iran and Israel. Four of the studies were published in the last five years (2009-2013); the remaining two studies were published in 2005 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a large magnitude of effect [SMD (95% CI) -1.09 (-1.84, -0.34); I^2=94%].

Lifestyle

Nineteen lifestyle focused RCTs (n=2,070) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.2).[68-71,73,74,76-81,84,88-91,95,96] Most of the lifestyle intervention studies (n=18) included mixed gender samples; one study included only girls. Fifteen studies included children aged 2 to 12 and the remaining four studies included youth aged 13 to 18. In terms of weight status at baseline, 11 studies included overweight and obese participants, one study included only overweight children, and seven studies included only obese participants. Control participants received usual care or no intervention in most studies (n=14) and a minimal component in the remaining five studies (e.g., newsletters or handouts covering general health concepts). The intervention target in five studies was the individual child/youth; in 14 studies the target for intervention was families. Intervention duration was 12 months or less in 17 studies (in 11 of these studies the duration was six months or less) and duration was two years in two studies. Eight studies were conducted in the US, seven were conducted in European countries, three in Australia, and one in Malaysia. Thirteen of the studies were published in the last five years (2009-2013); the remaining six studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.42 (-0.61, -0.23); I^2=76%].

1.3 Immediate Post Assessment: Behavioural Intervention Duration

There was no evidence that the effect of treatment differed based on duration of behavioural intervention (≤12 months, >12 months) [Chi^2=0.00, df=1 (P=0.97), I^2=0%].

Intervention Duration ≤12 Months

Twenty-five RCTs (n=3,056) of low GRADE quality (downgraded for risk of bias and reporting bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.3).[68-73,76-87,89-93,95,96] Most studies included mixed gender samples (n=24); one included only girls. Most studies (n=20) included children aged 2 to 12 and the remaining five studies included youth aged 13 to 18. In terms of weight status at baseline, 15 studies included overweight and obese participants, one study included only overweight children, and nine studies included only obese participants. In terms of type of intervention, two were diet, one was exercise, five were diet plus exercise, and 17 were lifestyle. Control participants received usual care or no intervention in most studies (n=20) and a minimal component in the remaining five studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 10 studies was the individual child/youth; in 15 studies the target for intervention was families. Intervention duration was six months or less in two-thirds of the studies (n=16). Nine studies were conducted in the US, nine in European countries, five in Australia or New Zealand, and one in each of Israel and Malaysia. Almost three-quarters of the studies (n=18) were published in the last five years (2009-2013); the remaining seven studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.54 (-0.73, -0.35); I^2=84%].

Intervention Duration >12 Months

Three RCTs (n=290) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.3).[74,88,94] All three studies included mixed gender samples. Two studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, two studies included overweight and obese participants and one study included only obese participants. In terms of type of intervention, one was diet plus exercise and two were lifestyle. Control participants received usual care or no intervention in two studies and a minimal component in the remaining study (e.g., newsletters or handouts covering general health concepts). The intervention target in one study was the individual child/youth; in two studies the target for intervention was families. Intervention duration was two years in all three studies. One study was conducted in the US, one in Sweden, and one in Iran. Two studies were published in the last five years (2011); the remaining study was published in 2008. There was no difference in change in BMI/BMIz between the intervention and control groups [SMD (95% CI) -0.53 (-1.31, 0.26); I^2=90%].

1.4 Immediate Post Assessment: Behavioural Intervention Age Group

There was no evidence that the effect of treatment differed based on age group (aged 2-12 years, aged 13-18 years) [Chi^2=0.05, df=1 (P=0.81), I^2=0%].

Aged 2 to 12 Years

Twenty-two RCTs (n=2,612) of low GRADE quality (downgraded for risk of bias and reporting bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.4).[68-

[70,72,74,76,78-90,92,95,96] All 22 studies for children aged 2 to 12 years included mixed gender samples. In terms of weight status at baseline, 13 studies included overweight and obese participants, one study included only overweight children, and eight studies included only obese participants. In terms of type of intervention, one was diet, one was exercise, five were diet plus exercise, and 15 were lifestyle. Control participants received usual care or no intervention in most studies (n=18) and a minimal component in the remaining four studies (e.g., newsletters or handouts covering general health concepts). The intervention target in six studies was the individual child; in 16 studies the target for intervention was families. Intervention duration was 12 months or less in 20 (91%) studies (in almost two-thirds of these studies the duration was six months or less) and duration was two years in two studies. Six studies were conducted in the US, nine in European countries, five in Australia or New Zealand, and one in each of Israel and Malaysia. Almost three-quarters of the studies (n=16) were published in the last five years (2009-2013); the remaining six studies were published between 2005 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.54 (-0.76, -0.32); I^2=86%].

Aged 13 to 18 Years

Six RCTs (n=734) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.4).[71,73,77,91,93,94] Five of the six studies for youth aged 13 to 18 years included mixed gender samples; one study included only girls. In terms of weight status at baseline, four studies included overweight and obese participants and two studies included only obese participants. In terms of type of intervention, one was diet, one was diet plus exercise, and four were lifestyle. Control participants received usual care or no intervention in four studies and a minimal component in the remaining two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in five studies was the individual youth; in one study the target for intervention was families. Intervention duration was 12 months or less in five studies (in four of these studies the duration was six months or less) and duration was two years in one study. Four studies were conducted in the US, and one in each of the Netherlands and Iran. Four of the studies were published in the last five years (2009-2013); the remaining two studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.59 (-0.92, -0.25); I^2=78%].

<u>1.5 Immediate Post Assessment: Behavioural Intervention Target</u>

The test for subgroup differences was significant [Chi^2=7.22, df=1 (P=0.007), I^2=86.2%] suggesting that change in BMI/BMIz depended on the target of the intervention strategy (individual child/youth, family). Interventions targeting the child or youth had a larger impact on BMI/BMIz than those targeting families.

Individual

Eleven RCTs (n=1,347) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.5).[71,73,77,78,82,84,85,87,92-94] Across

the individual child/youth targeted studies, most included mixed gender samples (n=10); one included only girls. About half (n=6) of the studies included children aged 2 to 12 and the other half (n=5) included youth aged 13 to 18. In terms of weight status at baseline, seven studies included overweight and obese participants, one study included only overweight children, and three studies included only obese participants. In terms of type of intervention, two were diet, one was exercise, three were diet plus exercise, and five were lifestyle. Control participants received usual care or no intervention in most studies (n=8) and a minimal component in the remaining three studies (e.g., newsletters or handouts covering general health concepts). Intervention duration was 12 months or less in 10 (91%) studies (in eight of these studies the duration was six months or less) and duration was two years in one study. Five studies were conducted in the US, four in European countries, one in New Zealand and one in Iran. Almost three-quarters of the studies (n=8) were published in the last five years (2009-2013); the remaining three studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a large magnitude of effect [SMD -0.90 (95% CI -1.27, -0.53), I^2=89%; converted into BMI units -1.66 kg/m^2 (95% CI -2.34, -0.98); converted into BMIz units -0.44 (95% CI -0.62, -0.26)].

Family

Seventeen RCTs (n=1,999) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.5).[68-70,72,74,76,79-81,83,86,88-91,95,96] All of the family targeted studies included mixed gender samples. Most (n=16) of the studies included children aged 2 to 12 and one study included youth aged 13 to 18. In terms of weight status at baseline, 10 studies included overweight and obese participants and seven studies included only obese participants. In terms of type of intervention, three were diet plus exercise, and 14 were lifestyle. Control participants received usual care or no intervention in most studies (n=14) and a minimal component in the remaining three studies (e.g., newsletters or handouts covering general health concepts). Intervention duration was 12 months or less in 15 (79%) studies (in about half of these studies the duration was six months or less) and duration was two years in two studies. Five studies were conducted in the US, six in European countries, four in Australia, and one in each of Malaysia and Israel. Most of the studies (n=12) were published in the last five years (2009-2013); the remaining five studies were published between 2005 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.34 (-0.52, -0.16), I^2=73%; converted into BMI units -0.62 kg/m^2 (95% CI -0.96, -0.29); converted into BMIz units -0.17 (95% CI -0.25, -0.08)].

1.6 Immediate Post Assessment: Behavioural Intervention Study Risk of Bias Rating

There was no evidence that the effect of treatment differed based on study risk of bias rating (low, unclear, high) [Chi^2=1.34, df=2 (P=0.51), I^2=0%].

Low Risk of Bias

Three RCTs (n=479) of high GRADE quality were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.6).[69,73,82] All three low risk of bias studies included mixed gender samples. Two studies included children aged 2 to 12 and the other study included youth aged 13 to 18. In terms of weight status at baseline, all three studies included overweight and obese participants. In terms of type of intervention, one was exercise and two were lifestyle. Control participants received usual care or no intervention in one study and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in one study the target for intervention was families. Intervention duration was 12 months or less in all three studies (in two studies the duration was six months or less). One study was conducted in the US, one in Australia, and one in New Zealand. One study was published in the last five years (2009-2013); the other two studies were published between 2007 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.41 (-0.59, -0.22); I^2=0%].

Unclear Risk of Bias

Twenty-two RCTs (n=1,387) of low GRADE quality (downgraded for risk of bias and reporting bias) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.6).[68,70-72,74,77-81,83-86,88-91,93-96] Across the unclear risk of bias studies, most (n=21) included mixed gender samples; one study included only girls. Most studies (n=17) included children aged 2 to 12 and the other five studies included youth aged 13 to 18. In terms of weight status at baseline, 13 studies included overweight and obese participants, one study included only overweight children, and eight included only obese participants. In terms of type of intervention, two were diet, four were diet plus exercise and 16 were lifestyle. Control participants received usual care or no intervention in 18 studies and a minimal component in the other four studies (e.g., newsletters or handouts covering general health concepts). The intervention target in seven studies was the individual child/youth; in 15 studies the target for intervention was families. Intervention duration was 12 months or less in 19 studies (in 13 of these studies the duration was six months or less); in three studies the intervention duration was two years. Nine studies were conducted in the US, seven in European countries, three in Australia, and one each in Iran, Israel and Malaysia. Seventeen studies were published in the last five years (2009-2013); the other five studies were published between 2002 and 2008. Intervention participants had a statistically significant lowered BMI/BMIz as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.49 (-0.68, -0.30); I^2=81%].

High Risk of Bias

Three RCTs (n=229) of very low GRADE quality (downgraded for very serious risk of bias and imprecision) were included in the meta-analysis assessing change in BMI/BMIz (forest plot 1.6).[76,87,92] All high risk of bias studies included mixed gender samples of children aged 2 to 12. In terms of weight status at baseline, one study included overweight and obese participants and

the other two studies included only obese children. In terms of type of intervention, two were diet plus exercise and one was lifestyle. Control participants received usual care or no intervention in all three studies. The intervention target in two studies was the individual child; in one study the target for intervention was families. Intervention duration was 12 months or less in all three studies (in one study the duration was six months or less). All three studies were conducted in European countries. Two studies were published in the last five years (2009-2013); the other study was published in 2008. There was no difference in change in BMI/BMIz between the intervention and control groups [SMD (95% CI) -1.24 (-2.79, 0.32); I^2=96%].

1.7 Follow-up Assessment: Maintenance of Treatment Benefits

Of the 16 studies that showed a benefit in terms of a lowered BMI/BMIz at the post intervention assessment (see forest plot 1.1), four studies also reported follow-up data for this outcome.[68,77,93,96] The duration of follow-up varied across the studies: six months,[96] seven months,[77] and 12 months.[68,93] An overall analysis was performed including all four studies and a sub-group analysis was conducted to look at the two age categories (2 to 12 years, 13 to 18 years). The body of evidence did not present any other meaningful options for sensitivity analyses.

Overall

Four RCTs (n=686) of low GRADE quality (downgraded for risk of bias and imprecision) provided follow-up data on BMI or BMIz that could be pooled. Three of the studies included mixed gender samples and one included only girls. Two studies included children aged 2 to 12 and two studies included youth aged 13 to 18. In terms of weight status at baseline, three studies included overweight and obese participants and one study included only obese participants. In terms of type of intervention, one was diet and three were lifestyle. Control participants received usual care or no intervention in two studies and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all four studies (in two of these studies the duration was six months or less). All four studies were conducted in the US. Three of the studies (n=20) were published in the last five years (2009-2013); the remaining study was published in 2007. Intervention participants had a significantly lowered BMI/BMIz as compared to control participants by the end of the intervention with a medium magnitude of effect [SMD (95% CI) -0.51 (-0.86, -0.16); I^2=81%] (forest plot 17). However, there was no difference in change in BMI/BMIz between the intervention and control groups from the point of intervention completion to up to one year later [SMD (95% CI) 0.08 (-0.07, 0.23); I^2=0%] (forest plot 1.8). There was no evidence that the effect of treatment differed based on age groups (aged 2-12, aged 13-18) [Chi^2=0.63, df=1 (P=0.43), I^2=0%].

Aged 2 to 12 Years

Two RCTs (n=304) of low GRADE quality (downgraded for risk of bias and imprecision) provided follow-up data on BMI or BMIz that could be pooled. Both of the studies for children aged 2 to 12 years were focused on lifestyle interventions that included mixed gender samples. In terms of

weight status at baseline, one study included overweight and obese participants and one study included only obese participants. Control participants received usual care or no intervention in one study and a minimal component in the other study (e.g., newsletters or handouts covering general health concepts). The intervention target in both studies was families. Intervention duration was six months in one study and 12 months in the other. Both studies were conducted in the US. One study was published in the last five years (2009-2013) the other study was published in 2007. At post assessment the pooled point estimate showed a medium effect in terms of a benefit for BMI/BMIz [SMD (95% CI) -0.72 (-1.38, -0.07); I^2=87%] (forest plot 1.7). However, there was no difference in change in BMI/BMIz between the intervention and control groups from the point of intervention completion to up to 12 months later [SMD (95% CI) 0.15 (-0.12, 0.43); I^2=33%] (see forest plot 1.8).

Aged 13 to 18 Years

Two RCTs (n=382) of low GRADE quality (downgraded for risk of bias and imprecision) provided follow-up data on BMI or BMIz that could be pooled. One of the studies for youth included a mixed gender sample and the other included only girls. In terms of weight status at baseline, both studies included overweight and obese participants. In terms of type of intervention, one was diet and one was lifestyle. Control participants received usual care or no intervention in one study and a minimal component in the other study (e.g., newsletters or handouts covering general health concepts). The intervention target in both studies was the individual youth. Intervention duration was five months in one study and 12 months in the other. Both studies were conducted in the US and both were published in the last five years (2009-2013). Intervention participants showed significantly lowered BMI/BMIz scores than control participants by the end of the intervention [(SMD (95% CI) -0.31 (-0.50, -0.11); I^2=0%] (forest plot 1.7), however, there was no difference in change in BMI/BMIz between the intervention and control groups from the point of intervention completion to up to 12 months later [SMD (95% CI) 0.02 (-0.19, 0.22); I^2=0%] (forest plot 1.8).

<u>Change in Prevalence of Overweight/Obesity</u>

Evidence Set 2 provides the GRADE Evidence Profile Table (2.1) generated for the outcome of change in prevalence of overweight/obesity for the comparison between intervention participation and usual care, placebo or no intervention. Three RCTs that met the inclusion criteria of this review provided results for prevalence but the data could not be pooled because the studies used different weight categories (overweight, overweight/obesity, obesity) and because one study did not provide any events data.[71,72,86] In all studies the interventions were three or four months in duration. In order to meet the minimum post baseline assessment criterion we extracted available prevalence data for the point closest to the end of the treatment and at least six months after baseline.

A US based study reported on prevalence of overweight (BMI 85th < 95th percentile) at three months following the completion of a four month lifestyle intervention with a small mixed gender sample (n=38) of overweight and obese youth aged 13 to 18.[71] At baseline, 62% of the

intervention group and 66% of the control group were overweight; by the follow-up point prevalence of overweight in the intervention group had dropped to 60% and increased to 67% in the control group. These results demonstrate no statistically significant difference between the intervention and control groups in terms of the likelihood of showing a reduction in the prevalence of overweight [RR (95% CI) 0.90 (0.54, 1.46)].

An Australian study reported on prevalence of overweight/obesity (BMI >85th percentile) at nine months following the completion of a three month diet and exercise intervention with over 250 overweight and obese boys and girls aged 5 to 10 years.[86] At 12 months post baseline 77% of the intervention group children and 83% of the control group were still overweight/obese. This study found no statistically significant difference between the intervention group and control group in terms of the likelihood of showing a reduction in the prevalence of overweight/obesity [RR (95% CI) 0.93 (0.82, 1.06)].

Finally, a study that took place in Israel reported on prevalence of obesity (BMI ≥ 95% percentile) at nine months following completion of a three month diet and exercise intervention that was delivered to a small mixed gender sample (n=40) of obese children aged 2 to 12.[72] Limited data were provided in the paper for this outcome; the authors reported that a 5 to 6% reduction in obesity prevalence was observed in the intervention group (n=20).

KQ1a. Do these weight management programs lead to other positive outcomes (e.g. improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)?

To answer this sub-question we examined the included studies for nine secondary outcomes: change in total cholesterol, triglycerides, HDL-C, LDL-C, two-hour fasting glucose, systolic blood pressure, diastolic blood pressure, overall quality of life, and physical fitness. A total of 12 studies provided data for these secondary outcomes.[67,68,70,75,77,78,84-87,89,91]

Secondary Outcomes: Lipids

Change in Total Cholesterol

Evidence Set 3 provides the GRADE Evidence Profile Table (3.1), the GRADE Summary of Findings Table (3.1), the forest plot (3.1), the funnel plot (3.1) and the Egger's test results (for publication bias) generated for the outcome of change in total cholesterol for the comparison between intervention participation and usual care, placebo or no intervention. An overall analysis was performed including five studies that reported on the outcome of total cholesterol. A subgroup analysis was conducted for the primary focus of intervention (behavioural, pharmacological plus behavioural). The test for subgroup differences was not significant [Chi^2=1.55, df=1 (P=0.21), I^2=35.3%] therefore, the primary focus of intervention does not explain the variation across this body of evidence.

Overall

Five RCTs (n=904) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in total cholesterol.[67,68,75,77,85] Most studies included mixed gender samples (n=4); one included only girls. Two of the studies included children aged 2 to 12 and the remaining three studies included youth aged 13 to 18. In terms of weight status at baseline, three studies included overweight and obese participants and two studies included only obese participants. In terms of type of intervention, one was diet, two were lifestyle, and two were pharmacological plus behavioural (120 mg of orlistat three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in one study and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in four studies was the individual child/youth; in one study the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). One study was jointly located in Canada and the US, and the other four were conducted in the US. Two of the studies were published in the last five years (2009-2013); the remaining three studies were published between 2005 and 2007. There was no difference in change in total cholesterol between the intervention and control groups [MD (95% CI) -0.06 mmol/L (-0.19, 0.07); I^2=63%].

Only one of the studies that showed an immediate post treatment benefit for BMI/BMIz that also reported benefits for secondary outcomes provided results for a follow-up assessment. At six months post intervention, results of a 12 month US based study that examined the effectiveness of a lifestyle intervention for obese children aged 8 to 16 years showed a mean change of -0.24 mmol/L (95 % CI -0.38, 0.09) in the weight management group and a mean change of 0.10 mmol/L (95% CI -0.10, 0.29) in the control group.[68]

Behavioural

Three RCTs (n=342) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in total cholesterol.[68,77,85] Two studies included mixed gender samples and one included only girls. Two of the studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, two studies included overweight and obese participants and one included only obese participants. In terms of type of intervention, one was diet and two were lifestyle. Control participants received usual care or no intervention in one study and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in one study the target for intervention was families. Intervention duration was 12 months or less in all studies (in two of these studies the duration was six months or less). All three studies were conducted in the US. Two of the studies were published in the last five years (2009-2013); the remaining study was published in 2007.

There was no difference in change in total cholesterol between the intervention and control groups [MD (95% CI) -0.12 mmol/L (-0.34, 0.09); I^2=62%].

Pharmacological plus Behavioural

Two RCTs (n=562) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in total cholesterol.[67,75] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and one study included only obese participants. Both interventions included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months or less in both studies; one of these studies lasted six months. One study was jointly located in Canada and the US and the other was conducted in the US. Neither study was published in the last five years (2009-2013); one was published in 2005 and the other in 2006. There was no difference in change in total cholesterol between the intervention and control groups [MD (95% CI) 0.02 mmol/L (-0.07, 0.11); I^2=0%].

Change in Triglycerides

Evidence Set 4 provides the GRADE Evidence Profile Table (4.1), the GRADE Summary of Findings Table (4.1), the forest plot (4.1), the funnel plot (4.1) and the Egger's test results (for publication bias) generated for the outcome of change in triglycerides for the comparison between intervention participation and usual care, placebo or no intervention. An overall analysis was performed including five studies that reported on the outcome of triglycerides. A subgroup analysis was conducted for the primary focus of intervention (behavioural, pharmacological plus behavioural). The test for subgroup differences was not significant [Chi^2=1.97, df=1 (P=0.16), I^2=49.3%] therefore, the primary focus of intervention does not explain the variation across this body of evidence.

Overall

Five RCTs (n=937) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in triglycerides.[67,68,77,85,91] Across the five studies, most studies included mixed gender samples (n=4); one included only girls. Two of the studies included children aged 2 to 12 and the remaining three studies included youth aged 13 to 18. In terms of weight status at baseline, two studies included overweight and obese participants and three studies included only obese participants. In terms of type of intervention, one was diet, three were lifestyle, and one was pharmacological plus behavioural (orlistat, 120 mg three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in two studies and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). Control participants in the orlistat study were given a placebo instead of the active medication and they

received the same diet and exercise conditions as intervention participants. The intervention target in three studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). One study was jointly located in Canada and the US, three were conducted in the US, and one in the Netherlands. Three of the studies were published in the last five years (2009-2013); the remaining two studies were published between 2005 and 2007. There was no difference in change in triglycerides between the intervention and control groups [MD (95% CI) -0.02 mmol/L (-0.12, 0.09); I^2=35%].

Behavioural

Four RCTs (n=409) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in triglycerides.[68,77,85,91] Across the behavioural studies, three included mixed gender samples and one included only girls. Two of the studies included children aged 2 to 12 and the other two included youth aged 13 to 18. In terms of weight status at baseline, two studies included overweight and obese participants and two included only obese participants. In terms of type of intervention, one was diet and three were lifestyle. Control participants received usual care or no intervention in two studies and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). Three studies were conducted in the US, one in the Netherlands. Three of the studies were published in the last five years (2009-2013); the remaining study was published in 2007. There was no difference in change in triglycerides between the intervention and control groups [MD (95% CI) -0.06 mmol/L (-0.17, 0.06); I^2=18%].

Pharmacological plus Behavioural

One RCT (n=528) of low GRADE quality (downgraded for risk of bias and imprecision) provided data for triglycerides.[67] This pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. There was no difference in change in triglycerides between the intervention and control groups [MD (95% CI) 0.07 mmol/L (-0.07, 0.21)].

Change in High Density Lipoprotein Cholesterol (HDL-C)

Evidence Set 5 provides the GRADE Evidence Profile Table (5.1), the GRADE Summary of Findings Table (5.1), the forest plot (5.1), the funnel plot (5.1) and the Egger's test results (for publication bias) generated for the outcome of HDL-C for the comparison between intervention participation and usual practice or no intervention. An overall analysis was performed including

six studies that reported on the outcome of HDL-C. A subgroup analysis was conducted for the primary focus of intervention (behavioural, pharmacological plus behavioural). The test for subgroup differences was not significant [Chi^2=0.15, df=1 (P=0.70), I^2=0%] therefore, the primary focus of intervention does not explain the variation across this body of evidence.

Overall

Six RCTs (n=971) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in HDL-C.[67,68,75,77,85,91] Most studies included mixed gender samples (n=5); one included only girls. Two of the studies included children aged 2 to 12 and the remaining four studies included youth aged 13 to 18. In terms of weight status at baseline, three studies included overweight and obese participants and three studies included only obese participants. In terms of type of intervention, one was diet, three were lifestyle, and two were pharmacological plus behavioural (orlistat, 120 mg three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in two studies and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). Control participants in the orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in four studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in four of these studies the duration was six months or less). One study was jointly located in Canada and the US, four were conducted in the US, and one in the Netherlands. Three of the studies were published in the last five years (2009-2013); the other three studies were published between 2005 and 2007. There was no difference in change in HDL-C between the intervention and control groups [MD (95% CI) -0.02 mmol/L (-0.05, 0.01); I^2=37%].

Behavioural

Four RCTs (n=409) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in HDL-C.[68,77,85,91] Across the behavioural studies, three included mixed gender samples and one included only girls. Two of the studies included children aged 2 to 12 and the other two included youth aged 13 to 18. In terms of weight status at baseline, two studies included overweight and obese participants and two included only obese participants. In terms of type of intervention, one was diet and three were lifestyle. Control participants received usual care or no intervention in two studies and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). Three studies were conducted in the US, one in the Netherlands. Three of the studies were published in the last five years (2009-2013); the remaining study was published in 2007. There was no difference in change in HDL-C between the intervention and control groups [MD (95% CI) -0.03 mmol/L (-0.09, 0.04); I^2=44%].

Pharmacological plus Behavioural

Two RCTs (n=562) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in HDL-C.[67,75] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and one study included only obese participants. Both interventions included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months or less in both studies; one of these studies lasted six months. One study was jointly located in Canada and the US and the other was conducted in the US. Neither study was published in the last five years (2009-2013); one was published in 2005 and the other in 2006. There was no difference in change in HDL-C between the intervention and control groups [MD (95% CI) -0.01 mmol/L (-0.05, 0.02); I^2=58%].

Change in Low Density Lipoprotein Cholesterol (LDL-C)

Evidence Set 6 provides the GRADE Evidence Profile Table (6.1), the GRADE Summary of Findings Table (6.1), the forest plot (6.1), the funnel plot (6.1) and the Egger's test results (for publication bias) generated for the outcome of change in LDL-C for the comparison between intervention participation and usual care, placebo or no intervention. An overall analysis was performed including five studies that reported on the outcome of LDL-C. A subgroup analysis was conducted for the primary focus of intervention (behavioural, pharmacological plus behavioural). The test for subgroup differences was not significant [Chi^2=0.54, df=1 (P=0.46), I^2=0%] therefore, the primary focus of intervention does not explain the variation across this body of evidence.

Overall

Five RCTs (n=904) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in LDL-C.[67,68,75,77,85] Most studies included mixed gender samples (n=4); one included only girls. Two of the studies included children aged 2 to 12 and the remaining three studies included youth aged 13 to 18. In terms of weight status at baseline, three studies included overweight and obese participants and two studies included only obese participants. In terms of type of intervention, one was diet, two were lifestyle, and two were pharmacological plus behavioural (120 mg of orlistat three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in one study and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in four studies was the individual child/youth; in one study the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or

less). One study was jointly located in Canada and the US, and the other four were conducted in the US. Two of the studies were published in the last five years (2009-2013); the remaining three studies were published between 2005 and 2007. There was no difference in change in LDL-C between the intervention and control groups [MD (95% CI) 0.01 mmol/L (-0.11, 0.13); I^2=70%].

Behavioural

Three RCTs (n=342) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in LDL-C.[68,77,85] Two studies included mixed gender samples and one included only girls. Two of the studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, two studies included overweight and obese participants and one included only obese participants. In terms of type of intervention, one was diet and two were lifestyle. Control participants received usual care or no intervention in one study and a minimal component in the other two studies (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in one study the target for intervention was families. Intervention duration was 12 months or less in all studies (in two of these studies the duration was six months or less). All three studies were conducted in the US. Two of the studies were published in the last five years (2009-2013); the remaining study was published in 2007. There was no difference in change in LDL-C between the intervention and control groups [MD (95% CI) -0.04 mmol/L (-0.19, 0.11); I^2=46%].

Pharmacological plus Behavioural

Two RCTs (n=562) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in LDL-C.[67,75] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and one study included only obese participants. Both interventions included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months or less in both studies; one of these studies lasted six months. One study was jointly located in Canada and the US and the other was conducted in the US. Neither study was published in the last five years (2009-2013); one was published in 2005 and the other in 2006. There was no difference in change in LDL-C between the intervention and control groups [MD (95% CI) 0.05 mmol/L (-0.13, 0.24); I^2=83%].

Secondary Outcomes: Glucose

Change in Two-Hour Fasting Glucose

Only one RCT examining the effectiveness of a combined pharmacological and behavioural intervention for treating obesity provided results for the outcome of change in two-hour fasting glucose.[67] The study, which was jointly located in Canada and the US, included a mixed gender

sample of 528 obese youth aged 13 to 18. The 12 month intervention provided a 120 mg dose of orlistat taken three times daily in addition to diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. Results showed no statistically significant difference between study groups in terms of change in Oral Glucose Tolerance Test levels at the post intervention assessment point [MD (95% CI) 0.06 mmol/L (-0.29, 0.17)].

Secondary Outcomes: Hypertension

Change in Systolic Blood Pressure (SBP)

Evidence Set 7 provides the GRADE Evidence Profile Table (7.1), the GRADE Summary of Findings Table (7.1), the forest plot (7.1), the funnel plot (7.1) and the Egger's test results (for publication bias) generated for the outcome of change in SBP for the comparison between intervention participation and usual care, placebo or no intervention. An overall analysis was performed including five studies that reported on the outcome of SBP. A subgroup analysis was conducted for the primary focus of intervention (behavioural, pharmacological plus behavioural). The test for subgroup differences was significant [Chi^2=5.96, df=1 (P=0.01), I^2=83.2%] therefore, the primary focus of intervention explains some of the variation across this body of evidence.

Overall

Five RCTs (n=808) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in SBP.[67,84,87,89,91] All five studies included mixed gender samples. Three of the studies included children aged 2 to 12 and the remaining two studies included youth aged 13 to 18. In terms of weight status at baseline, one study included only overweight participants and four studies included only obese participants. In terms of type of intervention, one was diet plus exercise, three were lifestyle, and one was pharmacological plus behavioural (orlistat, 120 mg three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in all studies. Control participants in the orlistat study were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in three studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). One study was jointly located in Canada and the US, the other four were conducted in European countries. Three of the studies were published in the last five years (2009-2013); the remaining two studies were published between 2005 and 2008. Intervention participants had a significantly greater change in SBP as compared to the control group [MD (95% CI) -3.42 mmHg (-6.56, -0.29); I^2=75%].

Behavioural

Four RCTs (n=280) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in SBP.[84,87,89,91] All four behavioural studies included mixed gender samples. Three of the studies included children aged 2 to 12 and one included youth aged

13 to 18. In terms of weight status at baseline, one study included only overweight participants and two included only obese participants. In terms of type of intervention, one was diet plus exercise and three were lifestyle. Control participants received usual care or no intervention in all four studies. The intervention target in two studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). All four studies were conducted in European countries. Three of the studies were published in the last five years (2009-2013); the remaining study was published in 2008. Intervention participants had a significantly greater change in SBP as compared to the control group [MD (95% CI) -4.64 mmHg (-7.46, -1.82); I^2=48%].

Pharmacological plus Behavioural

One RCT (n=528) of low GRADE quality (downgraded for risk of bias and imprecision) provided data for change in SBP.[67] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. There was no difference in change in SBP between the intervention and control groups [MD (95% CI) -0.22 mmHg (-2.38, 1.94)].

Change in Diastolic Blood Pressure (DBP)

Evidence Set 8 provides the GRADE Evidence Profile Table (8.1), the GRADE Summary of Findings Table (8.1), the forest plot (8.1), the funnel plot (8.1) and the Egger's test results (for publication bias) generated for the outcome of change in DBP for the comparison between intervention participation and usual care, placebo or no intervention. An overall analysis was performed including five studies that reported on the outcome of DBP. A subgroup analysis was conducted for the primary focus of intervention (behavioural, pharmacological plus behavioural). The test for subgroup differences was not significant [Chi^2=2.74, df=1 (P=0.10), I^2=63.5%] therefore, the primary focus of intervention does not explain the variation across this body of evidence.

Overall

Five RCTs (n=808) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in DBP.[67,84,87,89,91] All five studies included mixed gender samples. Three of the studies included children aged 2 to 12 and the remaining two studies included youth aged 13 to 18. In terms of weight status at baseline, one study included only overweight participants and four studies included only obese participants. In terms of type of intervention, one was diet plus exercise, three were lifestyle, and one was pharmacological plus behavioural (orlistat, 120 mg three times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in all studies. Control participants in the orlistat study were given a placebo instead of the active

medication and they received the same diet and exercise conditions as intervention participants. The intervention target in three studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). One study was jointly located in Canada and the US, the other four were conducted in European countries. Three of the studies were published in the last five years (2009-2013); the remaining two studies were published between 2005 and 2008. Intervention participants had a significantly greater change in DBP as compared to the control group [MD (95% CI) -3.39 mmHg (-5.17, -1.60); I^2=47%].

Behavioural

Four RCTs (n=280) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in DBP.[84,87,89,91] All four behavioural studies included mixed gender samples. Three of the studies included children aged 2 to 12 and one included youth aged 13 to 18. In terms of weight status at baseline, one study included only overweight participants and two included only obese participants. In terms of type of intervention, one was diet plus exercise and three were lifestyle. Control participants received usual care or no intervention in all four studies. The intervention target in two studies was the individual child/youth; in two studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in three of these studies the duration was six months or less). All four studies were conducted in European countries. Three of the studies were published in the last five years (2009-2013); the remaining study was published in 2008. Intervention participants had a significantly greater change in DBP as compared to the control group [MD (95% CI) -4.08 mmHg (-6.07, -2.09); I^2=31%].

Pharmacological plus Behavioural

One RCT (n=528) of moderate GRADE quality (downgraded for risk of bias) provided data for change in DBP.[67] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. Intervention participants had a significantly greater change in DBP as compared to the control group [MD (95% CI) -1.81 mmHg (-3.61, -0.01)].

Secondary Outcomes: Quality of Life

Change in Overall Quality of Life (QOL)

Evidence Set 9 provides the GRADE Evidence Profile Table (9.1), the GRADE Summary of Findings Table (9.1), the forest plot (9.1), the funnel plot (9.1) and the Egger's test results (for publication bias) generated for the outcome of change in overall QOL for the comparison between intervention participation and usual care, placebo or no intervention. An overall analysis was performed including six behavioural intervention studies that reported on the outcome of

overall QOL using either the Pediatric Quality of Life Inventory (PedsQL) or the DISAKIDS questionnaire. A subgroup analysis was conducted for the source of the data (parent, child/youth). The test for subgroup differences was not significant [Chi^2=0.01, df=1 (P=0.92), I^2=0%] therefore, the source of data does not explain the variation across this body of evidence.

Overall

Six RCTs (n=777) of moderate GRADE quality (downgraded for risk of bias) were included in the meta-analysis assessing change in overall QOL.[70,77,78,80,86,91] Most (n=5) of the studies included mixed gender samples; one included only girls. Four of the studies included children aged 2 to 12 and the remaining two studies included youth aged 13 to 18. In terms of weight status at baseline, three studies included overweight and obese participants and three studies included only obese participants. In terms of type of intervention, one was diet plus exercise and five were lifestyle. Control participants received usual care or no intervention in five studies and a minimal component in one study (e.g., newsletters or handouts covering general health concepts). The intervention target in two studies was the individual child/youth; in four studies the target for intervention was families. Intervention duration was six months or less in all studies. One study was located in the US, two in European countries, two in Australia and one in Malaysia. Five of the studies were published in the last five years (2009-2013); the remaining study was in 2007. Intervention participants had a significantly greater improvement in overall QOL score as compared to the control group [MD (95% CI) 2.10 (0.60, 3.60); I^2=8%].

One additional RCT met the inclusion criteria of this review but could not be incorporated into the quality of life meta-analysis because baseline values were missing and no change at follow-up data were reported by group; only an effect size was provided.[95] This recent Australian study that investigated a 12 month lifestyle intervention directed at 118 obese children aged 3 to 10 years found no significant difference between the intervention and control group for the outcome of parent-reported overall QOL using the Paediatric Quality of Life Inventory (scale range 1 to 100) [MD (95% CI) 1.7 (-3.8, 7.2)].

Parent Reported

Four RCTs (n=504) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in overall QOL as reported by parents.[70,78,80,86] All of the studies included mixed gender samples of children aged 2 to 12 years. In terms of weight status at baseline, two studies included overweight and obese participants and two included only obese participants. In terms of type of intervention, one was diet plus exercise and three were lifestyle. Control participants received usual care or no intervention in all four studies. The intervention target in one study was the individual child; in three studies the target for intervention was families. Intervention duration was six months or less in all studies. One study was located in the UK, two in Australia and one in Malaysia. Three of the studies were published in the last five years (2009-2013); the remaining study was published in 2007. There was no difference in change in overall QOL score between the intervention and control groups [MD (95% CI) 2.05 (-0.31, 4.40); I^2=35%].

Child/Youth Reported

Two RCTs (n=273) of low GRADE quality (downgraded for risk of bias and imprecision) were included in the meta-analysis assessing change in overall QOL as reported by the child/youth.[77,91] One of the studies included a mixed gender sample of youth aged 13 to 18, the other included only girls in this age category. In terms of weight status at baseline, one study included overweight and obese participants and one included only obese participants. In terms of type of intervention, both were lifestyle. Control participants received usual care or no intervention in one study and a minimal component in the other (e.g., newsletters or handouts covering general health concepts). The intervention target in one study was the individual child/youth; in the other study the target for intervention was families. Intervention duration was six months or less in both studies. One study was located in the US the other in the Netherlands. Both studies were published in the last five years (2009-2013). There was no difference in change in overall QOL score between the intervention and control groups [MD (95% CI) 2.22 (-0.22, 4.67); I^2=0%].

Secondary Outcomes: Physical Fitness

There was no evidence that met the inclusion criteria for this review that reported on the outcome of change in physical fitness as a result of a weight loss intervention as measured by laps or stages of the multi-stage fitness test.[99]

KQ1b: Are there population (e.g., age, sex, race-ethnicity, low socio-economic status, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding, etc.) or environmental factors that influence the effectiveness of the weight management programs?

Subgroup analyses were conducted for the change in BMI/BMIz outcome for age groups (2 to 12 years, 13 to 18 years) at the immediate post assessment point and at the longest available follow-up point. Results of these sub-analyses are presented above and in Evidence Set 1 (see forest plots 1.4, 1.7, 1.8). The included studies did not provide separate results for race-ethnicity, baseline cardiovascular risk status, low socio-economic status, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding or environmental factors, therefore no differentiated analyses could be performed for these subgroups.

KQ1c: What are the adverse effects of weight management programs (behavioural, combined behavioural and pharmacological) attempting to stabilize or reduce BMI?

Ten studies were found that met the inclusion criteria and provided data for adverse effects of treatment interventions.[67,75,78,82,85,86,93-95,97] In this review adverse effects are divided into four categories: (1) any adverse events (the number of participants who experienced one or more adverse events of any sort while taking part in the study), (2) serious adverse events (the number of participants who experienced one or more hospitalizations or who required urgent medical care one or more times while taking part in the study), (3) gastrointestinal events (the number of participants who reported experiencing one or more gastrointestinal symptoms during the course

of the study), and (4) the number of participants who withdrew from the studies because they experienced adverse effects. Table 6 provides more details and examples regarding the nature of the adverse events experienced by participants in the included studies.

Any Adverse Events

Evidence Set 10 provides the GRADE Evidence Profile Table (10.1), the GRADE Summary of Findings Table (10.1), the forest plot (10.1), the funnel plot (10.1) and the Egger's test results (for publication bias) generated for the outcome of any adverse events for the comparison between intervention participation and usual care, placebo or no intervention. Analyses were conducted to look separately at adverse events reported in three behavioural interventions and adverse events occurring in one pharmacological plus behavioural study. Results from three studies that could not be pooled with the other evidence are reported narratively below

Behavioural

Three RCTs (n=482) of moderate GRADE quality (downgraded for risk of bias) mentioned that no one in the intervention or control groups experienced any adverse effects during study participation.[78,86,94] All three of the studies included mixed gender samples. Two of the studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and two studies included only obese participants. In terms of type of intervention, two were diet plus exercise and one was lifestyle. Control participants received usual care or no intervention in all three studies. The intervention target in two studies was the individual child/youth; in one study the target for intervention was families. Intervention duration was six months or less in two studies and two years in the third study. One study was located in the UK, one in Australia and one in Iran. All of the studies were published in the last five years (2009-2013). Since the studies all reported zero events data, meta-analysis was not possible.

Pharmacological plus Behavioural

One RCT (n=533) of low GRADE quality (downgraded for risk of bias and imprecision) provided data on any adverse events.[67] This pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. Almost all participants (97% of the orlistat group, 94% of the placebo group) reported experiencing at least one adverse event (mostly gastrointestinal disturbances) during the study. There was no difference between the intervention and control groups in terms of the likelihood of experiencing any adverse event [RR (95% CI) 1.03 (0.99, 1.08)].

Three additional RCTs met the inclusion criteria of this review but could not be incorporated into the meta-analysis because either there was no appropriate control group (i.e., it was a head-to-

head trial with no usual care or no intervention group) or data for adverse events in the control group were not reported.[93,95,97] One Australian based study focused on laparoscopic adjustable banding as the active intervention for 25 adolescents, with a lifestyle modification program as the control arm for another 25 adolescents. The study reported that a total of 13 adverse events were experienced by 48% (n=12) of the youth in the gastric banding group (e.g., proximal gastric enlargements, needle stick injury to tubing, cholecystectomy, hospital admission for depression) while 18 adverse events were reported by 44% (n=11) of the youth in the lifestyle group (e.g., hospital admissions for depression and intracranial hypertension, cholecystectomy).[97] A recent US study that examined a 12 month diet intervention delivered to 224 overweight and obese adolescents found seven adverse events were reported by parents of treatment group participants, none of which appear to be harms caused by the intervention (i.e., a diagnosis of Graves' disease, diagnosis of polycystic ovarian syndrome, infected finger, asthma attack, mild head injury due to a car accident, development of a blood clot after knee surgery, temporary hearing loss due to the buildup of fluid and wax in the ears.[93] This study did not report data for adverse events experienced by participants in the control arm. Finally, a recent Australian study examined adverse effects associated with a 12 month lifestyle intervention study involving just over 100 obese children aged 3 to 10 years.[95] Fewer than 15% of treatment and control parents thought their children's feelings were adversely affected because they were told they were obese and less than 10% of intervention parents thought their children experienced negative effects relating to visits with the specialists and general practitioners.

Serious Adverse Events

Evidence Set 11 provides the GRADE Evidence Profile Table (11.1), the GRADE Summary of Findings Table (11.1), the forest plot (11.1), the funnel plot (11.1) and the Egger's test results (for publication bias) generated for the outcome of serious adverse events for the comparison between intervention participation and usual care, placebo or no intervention. Analyses were conducted to look separately at adverse events reported in one behavioural intervention and adverse events occurring in two pharmacological plus behavioural studies.

Behavioural

One behavioural RCT (n=322) of moderate GRADE quality (downgraded for risk of bias) provided data for serious adverse events.[82] This exercise intervention study included a mixed gender sample of overweight and obese children aged 2 to 12. Control participants received usual care or no intervention. The intervention target was the individual child. Intervention duration was six months or less. The study was conducted in New Zealand and was published in 2011. This body of evidence was not downgraded for indirectness. Eight serious adverse events (i.e., hospitalizations due to seasonal influenza, hip surgery related to a chronic condition, a blood clot, observation after a fall, diagnosis of type 2 diabetes, ankle injury) were experienced by 6 participants (2 intervention, 4 control); none were attributed to study participation. There was no difference between the intervention and control groups in terms of the likelihood of experiencing serious adverse events [RR (95% CI) 0.51 (0.09, 2.73)].

Pharmacological plus Behavioural

Two combined pharmacological and behavioural intervention RCTs (n=573) of low GRADE quality (downgraded for risk of bias and imprecision) provided data on serious adverse events.[67,75] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and one study included only obese participants. In terms of type of intervention both were pharmacological plus behavioural (orlistat, 120 mg three times daily plus diet and exercise components). Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months in one study and six months in the other study. One study was jointly located in Canada and the US and the other was conducted in the US. The studies were published in 2005 and 2006. In the larger study (n=533),[67] the placebo group reported five serious adverse events (i.e., acute demyelinating encephalomyelitis, facial palsy, pneumonia, worsening of asthma, pain in right side) and intervention participants experienced 11 serious adverse events (e.g., pilonidal abscess, depression, asthma attack, seizure, appendicitis, cholelithiasis); only the case of symptomatic cholelithiasis resulting in cholecystectomy was considered potentially related to study medication. In the smaller study (n=40),[75] one participant, already under care of a psychiatrist for depression, committed suicide. There was no difference between the intervention and control groups in terms of the likelihood of experiencing serious adverse events [RR (95% CI) 1.25 (0.46, 3.35); I^2=0%].

Gastrointestinal Events

Evidence Set 12 provides the GRADE Evidence Profile Table (12.1), the GRADE Summary of Findings Table (12.1), the forest plot (12.1), the funnel plot (12.1) and the Egger's test results (for publication bias) generated for the outcome of gastrointestinal events for the comparison between intervention participation and usual care, placebo or no intervention. The forest plot (12.1) includes a single study that examined the effects of a combined pharmacological (orlistat) and behavioural intervention. Results from two additional studies that could not be pooled are reported narratively below.

Pharmacological plus Behavioural

One RCT (n=533) of moderate GRADE quality (downgraded for risk of bias) provided data on participant reported gastrointestinal symptoms.[67] This pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken three times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. Intervention participants were significantly more likely to report experiencing gastrointestinal symptoms (e.g., bloating

and diarrhea) as compared to the control group [RR (95% CI) 3.77 (2.56, 5.55)]. The absolute risk increase is 36.74% and the number needed to harm is 3 (95% CI 2, 5).

Two additional RCTs met the inclusion criteria of this review but could not be incorporated into a meta-analysis either because only a P-value was provided without individual study arm data or because the number of gastrointestinal events experienced was reported rather than number of individuals experiencing gastrointestinal symptoms.[75,85] One US study examined a six month orlistat (120 mg three times per day) plus diet and exercise counseling intervention for 40 adolescents between 14 and 18 years of age. Compared to placebo group participants, youth in the orlistat group reported significantly more soft stools (P=0.002), oily spotting (P<0.001), fatty or oily stools (P<0.001), oily evacuation (P<0.001), liquid stools (P=0.02), cramping (P=0.02), flatus with discharge (P<0.001), and fecal incontinence (P<0.001).[75] Another US based study that examined a six month diet intervention (conjugated linoleic acid versus sunflower oil placebo) for 62 obese children aged 6 to 10 years reported an increase in gastrointestinal symptoms (no examples provided) in both treatment and control groups; in the intervention group there were 22 reports of gastrointestinal events at the initial assessment and 29 at follow-up, and in the placebo group there were 14 reported events at baseline and 17 at follow-up.[85]

Withdrawal from Studies due to Adverse Events

Evidence Set 13 provides the GRADE Evidence Profile Table (13.1), the GRADE Summary of Findings Table (13.1), the forest plot (13.1), the funnel plot (13.1) and the Egger's test results (for publication bias) generated for the outcome of withdrawal from studies due to adverse events for the comparison between intervention participation and usual care, placebo or no intervention. The meta-analysis is limited to two studies that examined the effects of combined pharmacological and behavioural interventions.

Pharmacological plus Behavioural

Two RCTs (n=573) of low GRADE quality (downgraded for risk of bias and imprecision) reported data for withdrawals from the studies due to adverse effects.[67,75] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, one study included overweight and obese participants and one study included only obese participants. In terms of type of intervention both were pharmacological plus behavioural (orlistat, 120 mg three times daily plus diet and exercise components). Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months in one study and six months in the other study. One study was jointly located in Canada and the US and the other was conducted in the US. The studies were published in 2005 and 2006. In the smaller study (n=40),[75] no control participants withdrew due to adverse effects but three intervention participants did, two due to side effects and one as a result of suicide. In the larger study (n=533),[67] three of the individuals taking the placebo and 12 of those taking orlistat withdrew because of adverse effects (more specific reasons not given). There was

no difference between intervention and control groups in terms of the likelihood of withdrawing from the study due to adverse effects [RR (95% CI) 2.49 (0.79, 7.87); I^2=0%].

One additional RCT met the inclusion criteria of this review but could not be incorporated into the meta-analysis because the paper did not specify if the data applied to the treatment group or the control group. This US based study examined a six month diet intervention for 62 obese children aged 6 to 10 years.[85] One of the seven participants who withdrew from the study reported leaving as a result of experiencing gastrointestinal problems (no specific symptoms reported).

KQ1d: Are there differences in adverse effects between subgroups (e.g., age, sex, race-ethnicity, low socio-economic status, severity of obesity, parental history of obesity, maternal cigarette smoking in pregnancy, maternal diabetes, low birth weight, formula feeding, etc.)?

For the adverse effects outcomes, there were insufficient studies to on which to run subgroup analyses based on age, gender or any other participant characteristic. Therefore we are unable to provide an answer to the sub-question posed in this review regarding adverse effects of treatment interventions for particular patient subgroups.

KQ1e. What are common elements of efficacious weight management programs?

Efficacious treatment interventions were identified from studies included in the BMI/BMIz meta-analysis that showed a statistically significant effect size in favour of the intervention group (see Evidence Set 1, forest plot 1.1). A total of 16 studies included interventions that resulted in statistically significant effects at the immediate post intervention assessment point, 15 behavioural[68,71,72,77,82,84,85,87,89-94,96] and one that combined pharmacological (orlistat) and behavioural strategies.[67] Some of the components we examined in these efficacious interventions were adapted from the features list presented in the 2011 USPSTF review of interventions to treat adult obesity.[66] We also included intervention duration, estimated number of sessions/frequency of sessions, intervention target, focus and parental involvement as we believe primary care physicians might want to take such features into consideration when making program recommendations to their patients and their families. Table 7 offers a summary of the common elements of the 15 efficacious behavioural interventions identified in this review. Table 8 provides details regarding the specific features of each treatment strategy.

The focus of the behavioural interventions varied and included diet,[85,93] exercise,[82] diet and exercise combined,[72,87,92,94] and lifestyle.[68,71,77,84,89-91,96] Eleven interventions involved group sessions,[68,72,77,84,87,89-91,93,94,96] five used individual sessions,[68,71,72,85,92] and almost all efficacious interventions (n=12) incorporated parent/family involvement.[68,71,72,77,84,85,87,89-91,94,96] Three interventions used technology based strategies either to facilitate interaction between participants and study personnel or as a means of delivering information or encouraging physical activity.[71,82,93] The duration of the efficacious interventions ranged from three months to two years. All but one intervention lasted one year or less and most of these interventions (n=11) were in place for six months or less.[71,72,77,82,84,85,89-92,96] The number and frequency of sessions

varied across interventions; however most strategies involved weekly or at least bi-weekly contact with participants; a few interventions were more intense, interacting with participants two or more times a week. It is of interest to note that most of the interventions were offered to mixed gender groups (n=14) and two-thirds (n=10) targeted pre-school and elementary school age children (five studies were directed at adolescents). About half (n=7) of the interventions were conducted in the US and a third (n=5) took place in European countries.

There was also one efficacious intervention that combined pharmacological and behavioural strategies. The drug treatment was a 120 mg dose of orlistat taken three times daily. The diet component involved caloric distribution of 30% fat, 50% carbohydrate and 20% protein, and participants were encouraged to engage in regular physical activity. Following a two week lead-in period the intervention ran for one year. The intervention, which was delivered in Canadian and US locations, was targeted at obese male and female adolescents.

KQ2. Do weight management programs help children and adolescents who are initially overweight or obese maintain BMI, weight, or adiposity improvements after the completion of an active intervention?

No studies were found that met the inclusion criteria of this review that examined the effectiveness or harms of interventions that help children or adolescents who have lost weight through participation in weight management programs to maintain weight-related improvements. Therefore this review is unable to answer KQ2 and all sub-questions posed for this question.

Results for Contextual Questions

We searched Medline and EMBASE from January 2007 to August 2013 for any papers, with any study design, that might answer the Contextual Questions (CQ).

CQ1. Is there evidence that the burden of disease, the risk/benefit ratio of prevention, the optimal prevention method, access, and implementation differ in any ethnic subgroups (e.g. Canadian Aboriginal youth) or by age (e.g., infant, child, adolescent), rural and remote populations, or lower SES populations?

Summary of Findings

A total of 69 articles were screened for evidence relating to this question and 24[2,40,100-121] were selected for inclusion. Sixteen studies[101-105,108-112,114-116,118,120,121] addressed burden of disease; eight[102,105,109,111,114,116,118,121] provided information on ethnic subgroups, two[102,103] on age groups, three[101,110,115] on rural and remote populations and five[102,104,108,112,120] on SES in a Canadian context. Four studies[100,106,117,119] examined optimal prevention in ethnic subgroups, four studies[2,40,107,113] looked at optimal prevention by age and one[40] in relation to SES. Only one of the studies that looked at optimal prevention was Canadian.[100] Studies of optimal prevention in rural and remote regions were not identified. Studies regarding the risk-benefit ratio of prevention were also not identified.

Burden of Disease

Ethnic Subgroups

Maximova et al.[105] studied differences in the rate of increase of BMI between first generation immigrant children, second generation immigrant children, and native-born children. Using data from a five-year heart health promotion program that targeted elementary school children (aged nine to 12 years) from 24 multi-ethnic disadvantaged neighbourhoods in Montréal, the authors studied changes in BMI individual growth models stratified by immigrant status, and found that average BMI increased by 0.59, 0.73, and 0.82 kg/m^2 per year among first generation, second-generation, and native-born children, respectively. These differences were observed through four origin groupings (European, Asian, Central/South American, and other). The authors concluded that the protective effect of immigrant status on BMI dissipated with the second generation, making this group's BMI similar to that of native-born Canadians.

Galloway et al.[111] reported the growth status of 388 preschool-age (three to five years) Canadian Inuit children, obtained from the *International Polar Year Inuit Health Survey*. Using data on BMI, the authors reported the overall prevalence of overweight in these children to be 50.8%, with a higher prevalence in boys (57.1%) than girls (45.2%).

Using a cross-sectional study design, Downs et al.[114] assessed associations among food environment, diet quality, and weight status in 201 Cree children (grades four to six) in Québec. Based on BMI estimates, the authors found that 29.9% of children were overweight and 34.3% were obese (total 64.2%). The authors found diets in this community commonly contained high-energy-density foods of low nutritional value.

Pigford et al.[116] studied abdominal adiposity, BMI, and physical activity in 105 Cree First Nations children (aged five to 12 years) living on-reserve in Alberta. The authors reported high rates of abdominal obesity (49.5%), overweight and obesity (56.2%), and physical inactivity (64.0%). Using multiple linear regression analysis that controlled for age, sex, and physical activity (steps/day), the authors found that age and daily step counts combined explained 42.6% of the variance in waist circumference.

Zorzi et al.[118] reported on a prospective study of the prevalence of impaired glucose tolerance and the components of metabolic syndrome in 192 Canadian Tsimshian Nation youth (aged six to 18 years). The authors found 19% were overweight, 26% were obese, and 36% had central obesity (waist circumference $\geq 90^{th}$ percentile for age and sex).

A Public Health Agency of Canada short report on *Obesity in Canada*[121] reported data from the 2002-03 *First Nations Regional Longitudinal Health Survey*, and stated that the prevalence of obesity is particularly high among on-reserve First Nations people, affecting 14.0% of youth and 36.2% of children.

Anderson et al.[109] compared total and central adiposity in a prospective study of 212 Aboriginal children and 204 Caucasian children (aged eight to 17 years). Children were matched on age,

gender, and three levels of maturity. Measurements of waist circumference, height, weight, and relative total body and trunk fatness as measured by dual energy x-ray absorptiometry were obtained. Aboriginal children were found to have consistently higher weight, BMI scores, waist circumference, as well as central and trunk adiposity, and a larger proportion were classified as being overweight and obese, in both genders, regardless of the level of maturity.

The weight status of Manitoba children and youth was described by Yu et al.[102] using data from the 2004 *Canadian Community Health Survey*. Over 41% of Aboriginal children were either overweight or obese compared to just over 29% of non-Aboriginal children.

Age

The study by Yu et al.[102] also estimated overweight and obesity by age groups (2 to 5 years, 6 to 11 years, 12 to 17 years) and showed that prevalence of overweight and obesity generally increased with increasing age (see Table 9).

Janssen et al.[103] used data from several national surveys conducted between 1981 and 2009 to explore prevalence and secular changes in abdominal obesity in Canadian adolescents and adults. The authors reported that based on data from the 2007-09 *Canadian Health Measurement Survey* (CHMS) and waist circumference risk levels defined by the WHO, Health Canada, and Obesity Canada, approximately 9.5% of 12 to 19 year olds had waist circumference values in the increased risk zone, and 12.8% had values in the high risk zone.

Rural and Remote Regions

Ismailov and Leatherdale[110] published data from a 2005-06 cross-sectional study (SHAPES-Ontario) of 24,416 adolescent students, and looked at differences in the prevalence of overweight and obesity in urban, suburban and rural areas. The authors reported that the prevalence of overweight in urban, suburban and rural areas was 14.6%, 13.8%, and 15.11%, respectively, and for obesity, these estimates were 6.3%, 6.0%, and 6.7%, respectively. Using multivariate logistic regression, the authors found the following factors to be associated with obesity among rural residents: watching one to three hours of television per day in males [odds ratio (OR) 2.35, 95% CI 1.02, 5.38]; watching four or more hours of television per day in females (OR 3.12, 95% CI 1.15, 8.44); younger age among male adolescents (compared with grade 12: OR 1.86, 95% CI 1.01, 3.41 for grade 9; OR 1.92, 95% CI 1.06, 3.48 for grade 10; and OR 2.17, 95% CI 1.18, 4.02 for grade 11); and perception of being overweight (OR 61.75, 95% CI 40.88, 93.26 for males; and OR 58.58, 95% CI 25.42, 135.03 for females).

Bruner et al.[115] studied differences in obesity among 4,851 adolescents (grades six to 10) who lived in rural and urban regions using the 2001-02 *Health Behaviour in School-aged Children Survey*. After adjusting for age, sex, SES, and region of Canada with logistic regression, the authors found a significant trend for increasing overweight (P=0.001) and obesity (P=0.03) as living areas became more rural.

Bilinski et al.[101] published descriptive data on the weight status and health characteristics of rural Saskatchewan children. Data on 99 children (grades one to seven) were obtained using the 1997-98 *Health Behaviour in School Aged Children Survey*. Based on BMI estimates, the authors reported that 34% of children were categorized as either overweight (23.7%) or obese (10.3%).

Socioeconomic Status

The study by Yu et al.[102] also estimated overweight and obesity rates in Manitoba children (aged two to17 years), stratified by parental education and family income adequacy. Overweight and obesity rates tended to be higher in lower levels of education, with 45.4% of children of parents with less than a high school education being overweight or obese, and 25.2% of children of university graduates being overweight or obese. Similar trends were seen with respect to income; 40.7% of children from households in the lowest income category were overweight or obese, compared with 25.2% of children in the highest income category.

Using data from the *Québec Longitudinal Study of Child Development* (2008), Dubois et al.[104] used logistic regression on cross-sectional data to assess the relationship between food insecurity and overweight. They reported that the adjusted (for consumption of pastry and vegetables, and for physical activity) odds ratio for being overweight was 3.03 (95% CI 1.8, 5.0) among children in food insecure households, compared with children in food secure households.

Kuhle et al.[112] published an analysis of perinatal and childhood risk factors for overweight in grade five students from Nova Scotia. The authors linked data from a provincial perinatal registry to the 2003 *Children's Lifestyle and School Performance Study*. Family and socioeconomic risk factors were considered, including household income, parental education attainment, and neighbourhood dwelling value. Using logistic regression analysis, univariate models (and an adjusted model for household income only) showed decreasing odds of overweight with higher levels of income, parental education, and neighborhood dwelling value.

Tamayo et al.[108] conducted two systematic reviews to explore the impact of early psychosocial factors on future risk of T2D, metabolic disturbances, and obesity. Eleven studies from eight countries with a total sample size of 70,420 were included in their review of obesity. The authors found an independent association between low childhood SES and risk of overweight and obesity later in life in four of the 11 studies. One of these studies was a Canadian birth cohort study that reported a 2.5-fold increased odds (95% CI 1.3, 4.8) of overweight and obesity, an average of 4.5 years after birth, compared with households with incomes of $60,000 or more.

Findings of an evidence synthesis on urban health and healthy weights published by the Canadian Institute for Health Information (CIHI),[120] suggest that lower individual SES is associated with obesity among children. Among the evidence cited was a Canadian study[122] that showed that among children (aged six to 10 years) from differing SES neighbourhoods in Hamilton Ontario, there were twice as many overweight and obese children in the two lowest SES schools, compared with the two highest SES schools. Interestingly, the authors of the CIHI report noted that no studies have assessed the impact of an intervention to improve SES on obesity.

Optimal Prevention Method/Access and Implementation

Ethnic Subgroups

Willows et al.[100] published a socioecological framework to understand weight-related issues in Aboriginal children in Canada, and described two interventions in Aboriginal communities that used a socioecological approach to address childhood obesity. The first was the Kahnawake Schools Diabetes Prevention Program which combined social learning theory, the precede-proceed model, the Ottawa Charter for Health Promotion, traditional learning styles, as well as collaborations from community organizations. Evaluations of the Kahawake Schools Diabetes Prevention Program showed no impact on reducing obesity prevalence in children. The researchers suggested that this may have been due to the concurrent introduction of satellite television, increased disposable income, and increased availability of fast food in the region. The Sandy Lake Health and Diabetes Project was a community-based primary prevention program that incorporated the principles of participatory research. It included radio programming to highlight healthy lifestyle activities, healthy food labelling at the local grocery store, home visits to promote healthy food preparation, health promotion activities during community events, walking clubs, walking trails, and increased opportunities for physical activity. While a first-year evaluation of the Sandy Lake Health and Diabetes Project found decreases in total fat intake, increased fibre intake, increased knowledge of low-fat foods among children, improved overall health knowledge, and dietary self-efficacy, there was no reduction in obesity in the children and in fact, mean BMI and body fat percentage increased. The authors of the evaluation suggested that longer follow-up was needed in order to observe program impacts.

A systematic review of childhood obesity prevention interventions targeting Hispanic children[106] identified nine studies (five RCTs and four quasi-experimental or pilot studies), and only four of these studies reported significant findings. The interventions were more likely to be successful among higher risk participants, if parental participation was part of the intervention, if the intervention had a theoretical basis, if children were older, if the intervention was longer in duration, and if the intervention was delivered by a dedicated staff.

Stevens et al.[117] conducted a literature review on obesity prevention interventions for ethnic minority middle school-age children. The authors identified eight studies, five of which were conducted in the United States. Ethnic minorities included African Americans, Hispanics, Asians, American Indians, Pacific Islanders, and others. While all the studies showed modest results for improving healthy eating and activity behaviours, the authors found a better response to interventions among girls compared with boys, particularly with diet-based interventions. Some improvement in physical-activity-based interventions was seen in boys. Based on their review, the authors suggested that influencing factors to be addressed in this age group include self-esteem and motivation, sedentary behaviours, neighbourhood safety, and parental inclusion in intervention programs.

Butte[119] reported an analysis of the impact of feeding practices on childhood obesity, using data on 1,030 Hispanic children from the *Viva La Familia Study* in the United States. Among the risk

factors examined in this analysis were exclusive breastfeeding, partial breastfeeding, breastfeeding duration, and age at introduction of solid food. The authors found no significant associations between early infant feeding practices and later obesity.

Age

Waters et al.[40] published a Cochrane systematic review of interventions for preventing obesity in children. The review included 55 controlled trials (randomized and non-randomized), 26 of which were conducted in the United States, two in Canada, six in the United Kingdom, four in Australia and New Zealand, and the remaining 17 trials were conducted in 10 other countries. The authors conducted a meta-analysis of 37 studies to estimate reductions in adiposity as measured by BMI, by three age subgroups (0 to 5 years, 6 to 12 years, and 13 to 18 years). Some unexplained heterogeneity was found in the analyses. The standardized mean difference (SMD) in BMI attributed to interventions in the seven studies included for the 0 to 5 year age group was -0.26 (95% CI -0.53, 0.00), and -0.15 (95% CI -0.23, -0.08) in 24 studies included for the 6 to 12 year age group. A smaller and non-significant decrease in BMI was estimated using data from six studies for the 13 to 18 year age group [SMD (95% CI) -0.09 (-0.20, 0.03)]. The overall SMD in BMI attributed to preventive interventions for all age groups combined was -0.15 (95% CI -0.21, -0.09). In terms of the specific interventions studied in each of the age groups, the authors reported only modest behavioural (dietary, physical activity) impacts in the zero to five year age group. One study reported a significant decrease in television viewing following a 12-week pre-school-based intervention. Follow-up of these interventions showed a lack of further impact on adiposity and behaviour. Among the 39 studies in children aged 6 to 12 years, six targeted dietary factors, 12 targeted factors related to physical activity, and 21 targeted both. The authors described the overall impacts of the interventions in this age group as modest as well. Only four of the studies in this age group reported on the sustainability of the interventions' effects, and all four reported a sustained impact up to 12 months post-intervention. The objectives of these interventions were to either decrease screen time, to improve diet, or to encourage physical activity. Finally, the eight studies on dietary and physical-activity-related interventions in adolescents also showed only modest impacts, with some sustained body fat reduction seen at 12 months post-intervention in one of the studies (only two studies reported post-intervention follow-up).

Bond et al.[107] published a systematic review of the effectiveness of weight management schemes for children under five years of age in 2009. Only controlled trials were considered and the authors identified four relevant studies (two from the United States, one from the United Kingdom, and one from Thailand). The four studies offered some combination of physical activity intervention and/or education, nutrition activities or education, and parental involvement. Only one study (Hip Hop Jr.), which combined all of the mentioned elements, showed a statistically significant impact on BMI in African American children. Two years post intervention initiation, the reported mean BMI (SD) was 17.1 (2.5) kg/m^2 for the intervention group, and 17.9 (3.3) kg/m^2 for the control group, with an increase in means of 0.48 (0.14) kg/m^2 in the intervention group and 1.14 (0.14) kg/m^2 in the control group (P=0.008).

A second systematic review of the effectiveness of weight management schemes for children under age five years was published by Bond et al.[113] in 2009, and this review considered systematic reviews as well as controlled trials. A total of 22 reports (16 systematic reviews or meta-analyses and six RCTs) were identified and included. Only the Hip Hop Jr. trial (previously described) showed a significant improvement in the intervention group among African Americans. Similar effectiveness results were not observed among Latino trial centres. The authors suggested that, based on close examination of the included studies, future interventions should include effective training of staff, cultural sensitivity, sustained physical activity and nutritional advice components, and active engagement of parents and caregivers.

As part of the 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children,[123] Berall and Desantadina[124] conducted a review of the effectiveness of prevention of childhood obesity through nutrition. In their review, they stated the conclusion of a meta-analysis of 28 studies that looked at the protective effects of breast-feeding on obesity in later life. This meta-analysis by Owen et al.[125] reported a statistically significant reduction in BMI with breastfeeding compared with formula feeding (OR 0.87, 95% CI 0.85, 0.89).

Socioeconomic Status

The systematic review by Waters et al.[40] examined the association between the intervention outcomes and measures of equity, and found generally positive impacts among groups of lower SES. One study reported that the association between weight-related outcomes and SES was less strong and not statistically significant in the intervention group, compared with the control group where the association was stronger and statistically significant in 19 of 20 analyses.[126]

CQ2. What are the resource implications and cost effectiveness of overweight and obesity prevention in Canada?

Summary of Findings

A total of five articles were screened for relevant information regarding this question, and three[40,113,127] were included.

Resource Implications

Using data from the *Canadian Health Measures Survey* (2007-09) Kuhle et al.[127] compared medication use in 2,087 normal weight and overweight children between the ages of six and 19 years. Weight status was based on BMI. The authors found no difference between normal weight and overweight children aged six to 11 years with respect to prescription, over-the-counter and natural health product use. A significantly higher frequency of prescription drug use was reported in overweight and obese 12 to 19 year-olds (adjusted incidence rate ratio 1.59, 95% CI 1.19, 2.14), and this group was less likely to use natural health products (adjusted incidence rate ratio 0.52, 95% CI 0.32, 0.82).

Cost-effectiveness

The systematic review of 55 international studies by Waters et al.[40] aimed to assess the cost-effectiveness of preventive interventions as a secondary outcome. Only a few of the studies reviewed provided some limited program costs, and none of the studies conducted a cost-effectiveness analysis of their interventions.

The systematic review on the effectiveness of weight management schemes for children under age five years by Bond et al.[113] also searched for relevant cost-effectiveness studies, however the authors were unable to find any studies that met their inclusion criteria.

CQ3. What are parents' and children's values and preferences regarding overweight and obesity prevention?

Our search located two papers that help to answer this question. The first paper, a systematic review of qualitative studies, explored barriers to physical activity in overweight and obese adolescents.[128] The 15 included studies identified 35 barriers. The review authors grouped the barriers thematically under the headings: environment, interpersonal and personal. In schools, children/youth thought that school rules such as having to change clothes in front of other students, the way activities were organized especially sports that had enrollment limits, and teaching practices such as punishing the entire class when overweight/obese students slowed the pace of activity were barriers to participation in physical activity. Barriers identified outside the education system included lack of resources, lack of neighbourhood safety, weather conditions and a perception that physical activity was not culturally valued. Participants identified bullying (both verbal and physical), stereotyping, and social exclusion as interpersonal barriers they experienced when trying to participate in physical activity. Personal barriers to physical activity that children and youth reported were that their households were chaotic with a lack of predictability, they lacked family and peer support, and they lacked personal motivation which they attributed to physical discomfort, being too out of shape and general fatigue. The review authors suggest that knowing the reasons children and youth give for not participating in physical activities can help shape practitioners approaches when trying to engage them in activities.

The second paper was based on a qualitative study designed to identify treatment preferences of overweight and obese youth and their parents.[129] This study was conducted in Edmonton Alberta with a group of 20 families seeking treatment for obesity in a pediatric weight management clinic. Findings from this study suggest that parents attempted to influence their children's lifestyle choices using inconsistent strategies that often represented extremes of control and leniency. The authors suggest that teaching parents to have authoritative and autonomy-supportive styles with regard to healthy eating and physical activity for their children may improve child adherence. Parents and children also expressed a hesitancy to reduce screen time, with some parents suggesting that screen time was important for their children's social life. Participants thought there was sometimes a disconnect between what they needed and what was offered by healthcare professionals. While the authors did not ascribe blame for interpersonal

conflicts between patients and professionals, they did suggest that healthcare professionals should take responsibility for initiating and developing a supportive and empathetic relationship with the children and their parents. Finally, the study identified a need for policy-level changes at all levels of government to create and maintain healthy environments.

CQ4. What are the most effective (accurate and reliable) risk assessment tools identified in the literature to identify those at higher risk of obesity or to assess future health risk as a result of obesity?

No relevant articles were identified to respond to this question.

General Summary of Evidence for Contextual Questions

Data Gaps

- There is a general lack of literature on overweight and obesity prevention in children and adolescents, particularly in a Canadian context;
- No information on optimal prevention in rural and remote regions was found;
- Long-term follow-up of preventive interventions is needed to assess the sustainability of effects;
- Comprehensive estimates of the economic burden of childhood obesity were not found;
- Cost-effectiveness assessments of preventive interventions for childhood obesity were not found.

Findings

- The protective effect of immigrant status reported in many Canadian studies may dissipate with second-generation immigrant children;
- Overweight and obesity rates among Aboriginal children are high, and are higher than children in the general Canadian population;
- A Manitoba study found that the prevalence of overweight and obesity in children increases with age, while an Ontario study found younger age to be associated with overweight and obesity among adolescent males;
- In general, the tendency for overweight and obesity in Canadian children increases as living areas become more rural;
- In general, an inverse relationship between SES level and overweight and obesity has been seen in Canadian children, where SES is assessed by family income, parental education, or neighbourhood dwelling value. A positive relationship has been seen between BMI and food insecurity;
- Limited information on Canadian community-based interventions has shown these strategies are not effective in reducing obesity; however other factors (increased incentives for sedentary behaviour and access to fast food, as well as inadequate follow-up) may explain this lack of impact;
- Authors suggest several potential influencing factors improve success with preventive interventions, including parental participation, a theoretical basis for the intervention(s), cultural sensitivity, longer intervention duration, delivery of interventions by dedicated staff,

addressing self-esteem and motivation, sedentary behaviours, nutritional advice, and neighbourhood safety;

- A Cochrane systematic review of obesity prevention interventions (targeting diet and physical activity) found the strongest impact among children aged six to 12 years;
- A higher rate of prescription drug use has been reported in Canadian overweight and obese 12 to19 year-olds (compared with normal weight);
- Overweight/obese children and youth experience environmental, interpersonal and personal barriers to participation in physical activities;
- Parents and health care professionals can play important roles in supporting, managing and implementing strategies for treating obesity in children and youth.

Results for Supplemental Questions

SQ1: Does screening for overweight and obesity in children and youth in primary care practice reduce the risk of morbidity, and mortality and/or improve health outcomes (impaired glucose tolerance, type 2 diabetes, hypertension, dyslipidemia, non-alcoholic fatty liver disease, sleep apnea, slipped capital femoral epiphysis and psychosocial disorders)?

For the supplemental questions, we did not find any studies that examined primary care screening programs for childhood overweight or obesity that met the inclusion criteria for this review.

Chapter 4: Discussion, Limitations and Conclusion

Discussion

To address the questions of interest, this review used a systematic review process and the quality of the evidence provided by the included studies was evaluated using the GRADE system.[58] A sizable body of high level (RCT) evidence was found to answer most of the key questions.

Childhood and adolescence are characterized by substantial physical growth and development. Weight gain is expected and desirable as children get taller and older. However, problems arise when excess weight is gained. Children and teens who are overweight or obese face social, emotional and physical challenges, and if excess weight is retained into adulthood, these individuals will have greater risk for developing obesity related health problems.[130-134] The most recent data from Statistics Canada shows a downward trend in the prevalence of overweight/obesity in children and adolescents aged 6 to 17 years.[135] In 2004, the prevalence rate was 34.7%, the rate dropped to 32% between 2007 and 2009, and fell again, to 31.1% during the period 2009 to 2011. These reductions are a good sign, however, at a rate of 31%, which is 6 percentage points higher than the 2011 national estimate for prevalence in adults,[6] this means that almost one-third of Canadian elementary and secondary school aged children and youth are overweight or obese.

Overall, the behavioural treatment interventions included in this review showed a benefit with a medium effect in terms of a lowered BMI/BMIz assessed using standardized mean difference. At the post-intervention point, compared to the control group, intervention participants showed a statistically significant reduced BMI/BMIz [SMD (95% CI) -0.54 (-0.73, -0.36); I^2=85%]. The combined pharmacological (orlistat) and behavioural interventions also showed a benefit, but with a small effect in terms of a lowered BMI/BMIz. At the post-intervention point, compared to the control group, intervention participants showed a statistically significant reduced BMI/BMIz [SMD (95% CI) -0.43 (-0.60, -0.25); I^2=0%].

Sensitivity analyses performed on studies providing BMI/BMIz data found significant differences between intervention and control groups, in favour of treatment, for subgroups based on: behavioural interventions and pharmacological (orlistat) plus behavioural interventions; diet, exercise, diet plus exercise, and lifestyle strategies; interventions lasting one year or less; children aged 2 to 12 and youth aged 13 to 18; interventions targeted at individuals and at families; and low and unclear risk of bias studies. No significant differences between intervention and control groups were found for two subgroups: interventions lasting more than 12 months and interventions in high risk of bias studies. Only one specified categorization (i.e., target of intervention: individual, families) explained some of the variation across this evidence. The high statistical heterogeneity and variation across studies in most sub-group analyses is most likely due to small versus large treatment effects observed across studies.

Four studies were available to examine how well improvements in BMI/BMIz scores are maintained after treatment interventions are completed. This body of evidence showed a statistically significant effect in terms of lowered BMI/BMIz by the end of the interventions

[SMD (95% CI) -0.51 (-0.86, -0.16); I^2=81%]; however, overall there was no statistically significant difference in BMI/BMIz in the intervention group participants as compared to the control group from the point of intervention completion to up to 12 months later [SMD (95% CI) 0.08 (-0.07, 0.23); I^2=0%]. A sub-group analysis performed using two age categories (2 to 12 years, 13 to 18 years) found no significant effects for maintenance of lowered BMI/BMIz.

This review also considered the outcome of prevalence of overweight/obesity. Data from the three studies that included this outcome could not be pooled. One study reported a 5 to 6% reduction in the prevalence of obesity in the group of children who participated in the diet plus exercise intervention.[72] The second study found no significant difference between the lifestyle intervention and control groups in terms of the likelihood of showing a reduction in the prevalence of overweight in the participating adolescents [RR (95% CI) 0.90 (0.54, 1.46)].[71] Likewise, the third study reported no significant difference between the diet plus exercise intervention and control groups in terms of the likelihood of showing a reduction in the prevalence of overweight/obesity in the participating children [RR (95% CI) 0.93 (0.82, 1.06)].[86]

In addition to the primary weight outcomes we examined the available evidence for nine secondary health outcomes: change in total cholesterol, triglycerides, HDL-C, LDL-C, two-hour fasting glucose, SBP, DBP, overall quality of life, and physical fitness. Pooled effect estimates for three outcomes assessed at the immediate post treatment point were significant in favour of the intervention groups. Across four studies there was a significantly greater reduction in SBP in the behavioural intervention group as compared to the control group [MD (95% CI) -4.64 mmHg (-7.46, -1.82); I^2=48%]. Across five studies there was a significantly greater reduction in DBP in the behavioural and the pharmacological and behavioural intervention groups as compared to the control group [MD (95% CI) -3.39 mmHg (-5.17, -1.60); I^2=47%]. Finally, across six studies, statistically significant improvements were found in overall QOL score in the behavioural and the pharmacological and behavioural intervention groups as compared to the control group [MD (95% CI) 2.10 (0.60, 3.60); I^2=8%]. Based on the evidence available for this review, we are unable to comment on the long-term sustainability of any of these secondary health benefits.

The benefits of treatment must be considered in light of any harm induced by or associated with the interventions. For this review we looked at the available evidence for harms data in four categories: any adverse effects, serious adverse effects (requiring hospitalization or urgent medical care), gastrointestinal effects, and withdrawal from studies due to adverse effects. Few behavioural intervention studies (about 25%) provided harms data; those that did either indicated no adverse events were reported or, if harms were reported, the symptoms, illnesses and injuries were usually not associated with study participation. Except for gastrointestinal symptoms, no significant differences were found between intervention and control groups in terms of experiencing adverse effects. In one study, compared to control group participants, youth who took a 120 mg dose of orlistat three times daily were more likely to report having experienced at least one gastrointestinal symptom (e.g., fatty/oily stool, oily spotting, oily evacuation, abdominal pain, fecal urgency, flatus

with discharge, soft stool, nausea, increased defecation, flatulence, fecal incontinence) during the course of the intervention [RR (95% CI) 3.77 (2.56, 5.55)].

To answer the key question about common elements of efficacious interventions we identified all studies included in the BMI/BMIz meta-analysis that showed a statistically significant effect at post assessment. Sixteen of the 30 studies in this meta-analysis met this criterion; fifteen studies included behavioural interventions and one study combined pharmacological (orlistat) and behavioural strategies. Across the behavioural studies, the focus of intervention varied and included two diet, one exercise, four diet and exercise combined, and eight lifestyle programs. Ten interventions involved group sessions, six used individual sessions and 12 incorporated parent/family involvement. The duration of treatment ranged from three months to two years however about three-quarters of the interventions (n=11) were in place for six months or less and most involved at least weekly or bi-weekly contact with participants. The one efficacious intervention that combined pharmacological and behavioural strategies used a 120 mg dose of orlistat three times daily for one year alongside diet and exercise components.

For the contextual questions this review found a general lack of literature on the prevention and treatment of overweight and obesity in children and adolescents, particularly in a Canadian context. No evidence was found that provided information on optimal prevention/treatment in rural and remote regions, comprehensive estimates of the economic burden of childhood obesity, cost-effectiveness assessments of preventive/treatment interventions for child obesity, or effective tools for assessing future health risks associated with obesity. In general, for Canadian children/youth, the literature suggests that overweight and obesity is more of a problem for Aboriginal children/youth, older children/youth, children/youth living in rural areas, and children/youth who are members of low SES families. Overweight and obese children and youth encounter a variety of environmental, interpersonal and personal barriers to taking part in physical activities. Limited information on Canadian community-based primary prevention interventions indicates these strategies are not effective in reducing obesity. The contextual literature identified intervention features that may contribute to more successful outcomes, including family involvement, a theoretical basis, cultural sensitivity, longer duration, dedicated staff for delivery, and addressing self-esteem, motivation, sedentary behaviours, nutritional advice and neighbourhood safety.

Limitations

The findings of this review are impacted by the biases and limitations of the literature.

Most of the evidence used to answer the key questions was taken from studies that were assessed as having unclear risk of bias, primarily due to the lack of information about or lack of procedures to ensure random sequence generation, allocation concealment and blinding of participants, personnel and outcome assessment as well as other sources of bias (i.e., industry funding, study was underpowered and/or sample size <30 per arm). Potential reporting bias was also identified across a number of outcome/comparison-based study groupings. These concerns

reduced the strength of the evidence, resulting in mostly moderate to low quality GRADE ratings which weaken confidence in the estimates.

Results presented for the secondary health outcomes (total cholesterol, triglycerides, HDL-C, LDL-C, two-hour fasting glucose, SBP, DBP, overall quality of life and physical fitness) should be considered with caution as we did not conduct a full systematic review for these components. To be included in this review studies had to report data for the primary outcome of weight; therefore any investigations of relevant interventions that examined the secondary outcomes and/or adverse effects of interest that did not provide weight data were excluded.

We did not find any studies that examined the effectiveness of weight maintenance interventions for children or youth; thus the second key question of this review could not be answered.

We did not find any studies that examined primary care screening programs for child/youth overweight or obesity that met the inclusion criteria for this review; thus none of the supplemental questions could be answered.

Finally, we restricted our search to papers in English or French, thus we may have missed the opportunity to analyze data from papers written in other languages.

Conclusion

The evidence presented in this systematic review supports the conclusion that behavioural interventions for treating overweight/obesity in children and youth are associated with a medium treatment effect in terms of lowered BMI/BMIz as compared to a small treatment effect shown by combined pharmacological (orlistat) and behavioural interventions. The benefits of behavioural interventions are achieved with minimal or no adverse effects; however, the benefits of drug treatments should be considered in light of the adverse effects that are also experienced by those who take these medications. The available evidence suggests there are few additional health benefits to be gained by participating in behavioural and/or pharmacological interventions; the observed benefits are small or medium in magnitude and the maintenance of such health improvements is unknown.

References

1. Feldman W and Beagen BL. Screening for childhood obesity. Ottawa, ON: Health Canada; 1994. Available at: http://www.nafwa.org/the-library/obesity/screening-for-childhood-obesity.html.
2. Lau DC, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E, et al. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children [summary]. CMAJ. 2007;176(8):S1-13. PM:17420481.
3. Scottish Intercollegiate Guidelines Network. Management of obesity: A national clinical guideline. Edinburgh, Scotland: Scottish Intercollegiate Guidelines Network (SIGN); 2010. 115. Available at: http://www.sign.ac.uk/pdf/sign115.pdf.
4. Whitlock EP, O'Connor EA, Williams SB, Beil TL, and Lutz KW. Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF. Pediatrics. 2010;125(2):e396-418. PM:20083531.
5. Katzmarzyk PT, Janssen I, Morrison KM, and Tremblay MS. Classification of overweight and obesity in children and adolescents. CMAJ. 2007;176(Suppl 8):S27-32. http://www.cmaj.ca/content/suppl/2007/09/04/176.8.S1.DC1/obesity-lau-onlineNEW.pdf.
6. Gotay CC, Katzmarzyk PT, Janssen I, Dawson MY, Aminoltejari K, and Bartley NL. Updating the Canadian obesity maps: an epidemic in progress. Can J Public Health. 2013;104(1):e64-8. PM:23618109.
7. Statistics Canada. Canadian Health Measures Survey (CHMS). Ottawa Ont.: (Statistics Canada, 2010) Cat No. 82-623-X.; 2010. C*ycle 1 Data Table 34 2007 to 2009*.
8. Cole TJ, Bellizzi MC, Flegal KM, and Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000;320(7244):1240-3. PM:10797032.
9. Dietitians of Canada, Canadian Paediatric Society, The College of Family Physicians of Canada, and Community Health Nurses of Canada. Promoting optimal monitoring of child growth in Canada: using the new World Health Organization growth charts. 2010. Available at: http://www.cps.ca/en/documents/position/child-growth-charts.
10. World Health Organization. The WHO child growth standards.; 2013. Available at: http://www.who.int/childgrowth/en/.
11. Dietitians of Canada. WHO Growth Charts adated for Canada.; 2013. Available at: http://www.dietitians.ca/Secondary-Pages/Public/Who-Growth-Charts.aspx.
12. Skinner AC, Mayer ML, Flower K, Perrin EM, and Weinberger M. Using BMI to determine cardiovascular risk in childhood: how do the BMI cutoffs fare? Pediatrics. 2009;124(5):e905-12. PM:19858150.
13. Freedman DS, Katzmarzyk PT, Dietz WH, Srinivasan SR, and Berenson GS. The relation of BMI and skinfold thicknesses to risk factors among young and middle-aged adults: the Bogalusa Heart Study. Ann Hum Biol. 2010;37(6):726-37. PM:20450389.

14. Janssen I, Katzmarzyk PT, Srinivasan SR, Chen W, Malina RM, Bouchard C, et al. Combined influence of body mass index and waist circumference on coronary artery disease risk factors among children and adolescents. Pediatrics. 2005;115(6):1623-30. PM:15930225.

15. 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.

16. Shields M and Tremblay MS. Canadian childhood obesity estimates based on WHO, IOTF and CDC cut-points. Int J Pediatr Obes. 2010;5(3):265-73. PM:20210678.

17. World Health Organization. Obesity: preventing and managing the global epidemic. 2000. No 894. Available at: http://apps.who.int/bookorders/WHP/detart1.jsp?sesslan=1&codlan=1&codcol=10&codcch=894.

18. Milligan S. 2006 Aboriginal population profile for Vancouver. Ottawa, ON: Statistics Canada; 2010. 89-638-X. Available at: http://www.statcan.gc.ca/pub/89-638-x/2010004/article/11085-eng.pdf.

19. Public Health Agency of Canada and Canadian Institute for Health Informatioin. Obesity in Canada. A joint report from the Public Health Agency of Canada and the Canadian Institute for Health Information. Public Health Agency of Canada; 2011. Cat.: HP5-107/2011E-PDF. Available at: https://secure.cihi.ca/free_products/Obesity_in_canada_2011_en.pdf.

20. 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. PM:9302300.

21. Mustillo S, Worthman C, Erkanli A, Keeler G, Angold A, and Costello EJ. Obesity and psychiatric disorder: developmental trajectories. Pediatrics. 2003;111(4 Pt 1):851-9. PM:12671123.

22. Strauss RS. Childhood obesity and self-esteem. Pediatrics. 2000;105(1):e15. PM:10617752.

23. Tirosh A, Shai I, Afek A, Dubnov-Raz G, Ayalon N, Gordon B, et al. Adolescent BMI trajectory and risk of diabetes versus coronary disease. N Engl J Med. 2011;364(14):1315-25. PM:21470009.

24. Juonala M, Juhola J, Magnussen CG, Würtz P, Viikari JS, Thomson R, et al. Childhood environmental and genetic predictors of adulthood obesity: the cardiovascular risk in young Finns study. J Clin Endocrinol Metab. 2011;96(9):e1542-9. PM:21778217.

25. Weiss R and Kaufman FR. Metabolic complications of childhood obesity: identifying and mitigating the risk. Diabetes Care. 2008;31(Supple 2):S310-6. PM:18227502.

26. Berenson GS, Srinivasan SR, Bao W, Newman WP3, Tracy RE, and Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. N Engl J Med. 1998;338(23):1650-6. PM:9614255.

27. 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. PM:17671060.

28. Schwimmer JB, Burwinkle TM, and Varni JW. Health-related quality of life of severely obese children and adolescents. JAMA. 2003;289(14):1813-9. PM:12684360.

29. 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. PM:15632338.

30. Wardle J and Cooke L. The impact of obesity on psychological well-being. Best Pract Res Clin Endocrinol Metab. 2005;19(3):421-40. PM:16150384.

31. O'Rahilly S and Farooqi IS. Human obesity: a heritable neurobehavioral disorder that is highly sensitive to environmental conditions. Diabetes. 2008;57(11):2905-10. PM:18971438.

32. Morrison KM, Atkinson SA, Yusuf S, Bourgeois J, McDonald S, McQueen MJ, et al. The Family Atherosclerosis Monitoring In earLY life (FAMILY) study: rationale, design, and baseline data of a study examining the early determinants of atherosclerosis. Am Heart J. 2009;158(4):533-9. PM:19781411.

33. Monasta L, Batty GD, Cattaneo A, Lutje V, Ronfani L, Van Lenthe FJ, et al. Early-life determinants of overweight and obesity: a review of systematic reviews. Obes Rev. 2010;11(10):695-708. PM:20331509.

34. Falkner B. Hypertension in children and adolescents: epidemiology and natural history. Pediatr Nephrol. 2010;25(7):1219-24. PM:19421783.

35. Davis MM, Gance-Cleveland B, Hassink S, Johnson R, Paradis G, and Resnicow K. Recommendations for prevention of childhood obesity. Pediatrics. 2007;120(Suppl 4):S229-53. PM:18055653.

36. Promoting optimal monitoring of child growth in Canada: Using the new World Health Organization growth charts - Executive Summary. Paediatr Child Health. 2010;15(2):77-83. PM:21286295.

37. Spear BA, Barlow SE, Ervin C, Ludwig DS, Saelens BE, Schetzina KE, et al. Recommendations for treatment of child and adolescent overweight and obesity. Pediatrics. 2007;120(Suppl 4):S254-88. PM:18055654.

38. Daniels SR, Jacobson MS, McCrindle BW, Eckel RH, and Sanner BM. American Heart Association Childhood Obesity Research Summit Report. [Erratum in Circulation. 2009 Jul 14;120(2):e14-5]. Circulation. 2009;119(15):e489-e517. PM:19332458.

39. Oude LH, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP, et al. Interventions for treating obesity in children. Cochrane Database Syst Rev. 2009;(1):CD001872. PM:19160202.

40. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y, et al. Interventions for preventing obesity in children. Cochrane Database Syst Rev. 2011;(12):CD001871. PM:22161367.

41. Reinehr T, de Sousa G, Toschke AM, and Andler W. Long-term follow-up of cardiovascular disease risk factors in children after an obesity intervention. Am J Clin Nutr. 2006;84(3):490-6. PM:16960161.

42. Sharma, A. M. Shifting to second gear in obesity prevention.; 2011. Available at: http://www.huffingtonpost.ca/arya-m-sharma-md/canada-obesity-prevention_b_865914.html?view=screen .

43. Aikenhead A, Lobstein T, and Knai C. Review of current guidelines on adolescent bariatric surgery. Clin Obes. 2011;1(1):3-11. http://dx.doi.org/10.1111/j.1758-8111.2010.00002.x.

44. O'Brien SH, Holubkov R, and Reis EC. Identification, evaluation, and management of obesity in an academic primary care center. Pediatrics. 2004;114(2):e154-9. PM:15286251.

45. Perrin EM, Flower KB, and Ammerman AS. Body mass index charts: useful yet underused. J Pediatr. 2004;144(4):455-60. PM:15069392.

46. Flower KB, Perrin EM, Viadro CI, and Ammerman AS. Using body mass index to identify overweight children: barriers and facilitators in primary care. Ambul Pediatr. 2007;7(1):38-44. PM:17261481.

47. Khanna R, Kavookjian J, Scott VG, Kamal KM, Miller LA, and Neal WA. Using the theory of reasoned action to determine physicians' intention to measure body mass index in children and adolescents. Res Social Adm Pharm. 2009;5(2):170-81. PM:19524864.

48. Spivack JG, Swietlik M, Alessandrini E, and Faith MS. Primary care providers' knowledge, practices, and perceived barriers to the treatment and prevention of childhood obesity. Obesity (Silver Spring). 2010;18(7):1341-7. PM:19910934.

49. Ball GD, Ambler KA, and Chanoine JP. Pediatric weight management programs in Canada: where, what and how? Int J Pediatr Obes. 2011;6(2-2):e58-61. PM:20799914.

50. Ambler KA, Hagedorn DW, and Ball GD. Referrals for pediatric weight management: the importance of proximity. BMC Health Serv Res. 2010;10:302. PM:21040585.

51. Periodic health examination, 1994 update: 1. Obesity in childhood. Canadian Task Force on the Periodic Health Examination. CMAJ. 1994;150(6):871-9. PM:8131120.

52. National Institute for Health and Clinical Excellence. Obesity: guidance on prevention, identification, assessment and mangement of overweight and obesity in adults and children. London, UK: National Institute for Health and Clinical Excellence; 2006. Nice clinical guideline 43. Available at: http://www.nice.org.uk/nicemedia/pdf/CG43NICEGuideline.pdf.

53. US Preventive Services Task Force and Barton M. Screening for obesity in children and adolescents: US Preventive Services Task Force Recommendation Statement. Pediatrics. 2010;125(2):361-7. PM:20083515.

54. 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.

55. Distiller (DistillerSR systematic review software) [computer program]. Ottawa, ON: Evidence Partners; 2008. Available at: http://systematic-review.net/.

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

57. GRADEpro for Windows [computer program]. Version 3.2 2008.

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

59. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336(7650):924-6. PM:18436948.

60. DerSimonian R and Laird N. Meta-analysis in clinical trials. Control Clin Trials. 1986;7(3):177-88. PM:3802833.

61. Deeks JJ, Higgins JP, Altman DG, and the Cochrane Methods Group. Analysing data and undertaking meta-analyses. Cochrane Handbook for Systematic Reviews of Interventions 5.0.2 (Updated September 2009). Version 5.0.2 ed. Chichester, UK: John Wiley & Sons, Ltd.; 2009. Chapter 9.

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

63. Review Manager (RevMan) [computer program]. Version 5.1. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration; 2011.

64. Shields M. Measured obesity: overweight Canadian children and adolescents. Statistics Canada; 2005. Available at: http://s3.amazonaws.com/zanran_storage/www.calgaryhealthregion.ca/ContentPages/18451313.pdf.

65. Stata statistical software: release 12 [computer program]. Station, TX: StataCorp LP; 2011.

66. LeBlanc ES, O'Connor E, Whitlock EP, Patnode CD, and Kapka T. Effectiveness of primary care-Relevant treatments for obesity in adults. 2011. Available at: http://www.uspreventiveservicestaskforce.org/uspstf11/obeseadult/obeseart.htm.

67. 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. PM:15956632.

68. Savoye M, Shaw M, Dziura J, Tamborlane WV, Rose P, Guandalini C, et al. 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. PM:17595270.

69. 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. PM:17332205.

70. McCallum Z, Wake M, Gerner B, Baur LA, Gibbons K, Gold L, et al. 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. PM:17160087.

71. 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. PM:11786598.

72. 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. PM:15805347.

73. 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. PM:18639791.

74. Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, et al. 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. PM:18316661.

75. Maahs D, de Serna DG, Kolotkin RL, Ralston S, Sandate J, Qualls C, et al. Randomized, double-blind, placebo-controlled trial of orlistat for weight loss in adolescents. Endocr Pract. 2006;12(1):18-28. PM:16524859.

76. 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. PM:22024104.

77. DeBar LL, Stevens VJ, Perrin N, Wu P, Pearson J, Yarborough BJ, et al. A primary care-based, multicomponent lifestyle intervention for overweight adolescent females. Pediatrics. 2012;129(3):e611-20. PM:22331335.

78. Croker H, Viner RM, Nicholls D, Haroun D, Chadwick P, Edwards C, et al. 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. PM:21931327.

79. 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. PM:21487425.

80. Wafa SW, Talib RA, Hamzaid NH, McColl JH, Rajikan R, Ng LO, et al. 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. PM:21604965.

81. Taveras EM, Gortmaker SL, Hohman KH, Horan CM, Kleinman KP, Mitchell K, et al. 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. PM:21464376.

82. Maddison R, Foley L, Ni MC, Jiang Y, Jull A, Prapavessis H, et al. Effects of active video games on body composition: a randomized controlled trial. Am J Clin Nutr. 2011;94(1):156-63. PM:21562081.

83. 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. PM:20739446.

84. 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. PM:20106567.

85. Racine NM, Watras AC, Carrel AL, Allen DB, McVean JJ, Clark RR, et al. Effect of conjugated linoleic acid on body fat accretion in overweight or obese children. Am J Clin Nutr. 2010;91(5):1157-64. PM:20200257.

86. Wake M, Baur LA, Gerner B, Gibbons K, Gold L, Gunn J, et al. 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. PM:19729418.

87. 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. PM:18984493.

88. 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://informahealthcare.com/doi/pdf/10.3109/14038196.2011.562540.

89. Sacher PM, Kolotourou M, Chadwick PM, Cole TJ, Lawson MS, Lucas A, et al. Randomized controlled trial of the MEND program: A family-based community intervention for childhood obesty. Obesity (Silver Spring). 2010;18(Suppl 1):S62-8. PM:20107463.

90. 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. PM:19566621.

91. 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. PM:22161746.

92. Lisón JF, Real-Montes JM, Torró I, Arguisuelas MD, Alvarez-Pitti J, Martínez-Gramage J, et al. Exercise intervention in childhood obesity: a randomized controlled trial comparing hospital-versus home-based groups. Acad Pediatr. 2012;12(4):319-25. PM:22634075.

93. Ebbeling CB, Feldman HA, Chomitz VR, Antonelli TA, Gortmaker SL, Osganian SK, et al. A randomized trial of sugar-sweetened beverages and adolescent body weight. N Engl J Med. 2012;367(15):1407-16. PM:22998339.

94. 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. PM:22423669.

95. Wake M, Lycett K, Clifford SA, Sabin MA, Gunn J, Gibbons K, et al. Shared care obesity management in 3-10 year old children: 12 month outcomes of HopSCOTCH randomised trial. BMJ. 2013;346:f3092. PM:23751902.

96. Lochrie AS, Wysocki T, Hossain J, Milkes A, Antal H, Buckloh L, et al. 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.

97. O'Brien PE, Sawyer SM, Laurie C, Brown WA, Skinner S, Veit F, et al. Laparoscopic adjustable gastric banding in severely obese adolescents: a randomized trial.[Erratum appears in JAMA. 2010 Jun 16;303(23):2357]. JAMA. 2010;303(6):519-26. PM:20145228.

98. 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.

99. 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. PM:3184250.

100. Willows ND, Hanley AJ, and Delormier T. A socioecological framework to understand weight-related issues in Aboriginal children in Canada. Appl Physiol Nutr Metab. 2012;37(1):1-13. PM:22269027.

101. Bilinski H, Rennie D, and Duggleby W. Weight status and health characteristics of rural Saskatchewan children. RURAL REMOTE HEALTH. 2011;11(4):1699. PM:22070419.

102. Yu BN, Protudjer JL, Anderson K, and Fieldhouse P. Weight status and determinants of health in Manitoba children and youth. Can J Diet Pract Res. 2010;71(3):115-21. PM:20825691.

103. Janssen I, Shields M, Craig CL, and Tremblay MS. Prevalence and secular changes in abdominal obesity in Canadian adolescents and adults, 1981 to 2007-2009. Obes Rev. 2011;12(6):397-405. PM:20977603.

104. Dubois L, Francis D, Burnier D, Tatone-Tokuda F, Girard M, Gordon-Strachan G, et al. Household food insecurity and childhood overweight in Jamaica and Quebec: a gender-based analysis. BMC Public Health. 2011;11:199. PM:21453491.

105. Maximova K, O'Loughlin J, and Gray-Donald K. Healthy weight advantage lost in one generation among immigrant elementary schoolchildren in multi-ethnic, disadvantaged, inner-city neighborhoods in Montreal, Canada. Ann Epidemiol. 2011;21(4):238-44. PM:21376270.

106. Branscum P and Sharma M. A systematic analysis of childhood obesity prevention interventions targeting Hispanic children: lessons learned from the previous decade. Obes Rev. 2011;12(5):e151-e158. PM:20977600.

107. Bond M, Wyatt K, Lloyd J, and Taylor R. Systematic review of the effectiveness of weight management schemes for the under fives. Obes Rev. 2011;12(4):242-53. PM:20149120.

108. Tamayo T, Christian H, and Rathmann W. Impact of early psychosocial factors (childhood socioeconomic factors and adversities) on future risk of type 2 diabetes, metabolic disturbances and obesity: a systematic review. BMC Public Health. 2010;10:525. PM:20809937.

109. Anderson KD, Baxter-Jones ADG, Faulkner RA, Muhajarine N, Henry CJ, and Chad KE. Assessment of total and central adiposity in Canadian Aboriginal children and their Caucasian peers. Int J Pediatr Obes. 2010;5(4):342-50. PM:20233147.

110. Ismailov RM and Leatherdale ST. Rural-urban differences in overweight and obesity among a large sample of adolescents in Ontario. Int J Pediatr Obes. 2010;5(4):351-60. PM:20053147.

111. Galloway T, Young TK, and Egeland GM. Emerging obesity among preschool-aged Canadian Inuit children: results from the Nunavut Inuit Child Health Survey. Int J Circumpolar Health. 2010;69(2):151-7. PM:20356466.

112. Kuhle S, Allen AC, and Veugelers PJ. Perinatal and childhood risk factors for overweight in a provincial sample of Canadian Grade 5 students. Int J Pediatr Obes. 2010;5(1):88-96. PM:19565401.

113. Bond M, Wyatt K, Lloyd J, Welch K, and Taylor R. Systematic review of the effectiveness and cost-effectiveness of weight management schemes for the under fives: a short report. Health Technol Assess. 2009;13(61):1-100. PM:20015425.

114. Downs SM, Arnold A, Marshall D, McCargar LJ, Raine KD, and Willows ND. Associations among the food environment, diet quality and weight status in Cree children in Quebec. Public Health Nutr. 2009;12(9):1504-11. PM:19144239.

115. Bruner MW, Lawson J, Pickett W, Boyce W, and Janssen I. Rural Canadian adolescents are more likely to be obese compared with urban adolescents. Int J Pediatr Obes. 2008;3(4):205-11. PM:18608637.

116. Pigford A-A, Sanou D, Ball GDC, Fehderau DD, and Willows ND. Abdominal adiposity and physical activity in Cree First Nations Children living on-reserve in an Alberta community. Can J Diabetes. 2011;35(4):328-33.

117. Stevens CJ. Obesity prevention interventions for middle school-age children of ethnic minority: A review of the literature. J Spec Pediatr Nurs. 2010;15(3):233-43. PM:20618638.

118. Zorzi A, Wahi G, MacNab AJ, and Panagiotopoulos C. Prevalence of impaired glucose tolerance and the components of metabolic syndrome in Canadian Tsimshian Nation youth. Can J Rural Med. 2009;14(2):61-7. PM:19379629.

119. Butte NF. Impact of infant feeding practices on childhood obesity. J Nutr. 2009;139(Suppl 2):S412-6. PM:19106326.

120. Canadian Institute for Health Information. State of the Evidence Review on Urband Health and Healthy Weights. 2006.

121. Public Health Agency of Canada. Obesity in Canada - Snapshot. 2009.

122. Moffat T, Galloway T, and Latham J. Stature and adiposity among children in contrasting neighborhoods in the city of Hamilton, Ontario, Canada. Am J Hum Biol. 2005;17(3):355-67. PM:15849705.

123. Lau DC, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E, et al. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. CMAJ. 2007;176(8):1-117. http://www.cmaj.ca/content/suppl/2007/09/04/176.8.S1.DC1/obesity-lau-onlineNEW.pdf.

124. Berall G and Desantadina V. Prevention of childhood obesity through nutrition: review of effectiveness. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. CMAJ. 2007;176(8):102-5. http://www.cmaj.ca/content/suppl/2007/09/04/176.8.S1.DC1/obesity-lau-onlineNEW.pdf.

125. Owen CG, Martin RM, Whincup PH, Smith GD, and Cook DG. Does breastfeeding influence risk of type 2 diabetes in later life? A quantitative analysis of published evidence. Am J Clin Nutr. 2006;84(5):1043-54. PM:17093156.

126. Sanigorski AM, Bell AC, Kremer PJ, Cuttler R, and Swinburn BA. Reducing unhealthy weight gain in children through community capacity-building: results of a quasi-experimental intervention program, Be Active Eat Well. Int J Obes (Lond). 2008;32(7):1060-7. PM:18542082.

127. Kuhle S, Fung C, and Veugelers PJ. Medication use in normal weight and overweight children in a nationally representative sample of Canadian children. Arch Dis Child. 2012;97(9):842-7. PM:22833408.

128. Stankov I, Olds T, and Cargo M. Overweight and obese adolescents: what turns them off physical activity? Int J Behav Nutr Phys Act. 2012;9:53. PM:22554016.

129. Holt NL, Moylan BA, Spence JC, Lenk JM, Sehn ZL, and Ball GD. Treatment preferences of overweight youth and their parents in Western Canada. Qual Health Res. 2008;18(9):1206-19. PM:18689534.

130. Eckersley RM. Losing the battle of the bulge: Causes and consequences of increasing obesity. Med J Aust. 2001;174(11):590-2. PM:11453334.

131. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. JAMA. 2003;289(1):76-9. PM:12503980.

132. Flegal KM, Graubard BI, Williamson DF, and Gail MH. Excess deaths associated with underweight, overweight, and obesity. JAMA. 2005;293(15):1861-7. PM:15840860.

133. Allison DB, Fontaine KR, Manson JE, Stevens J, and VanItallie TB. Annual deaths attributable to obesity in the United States. JAMA. 1999;282(16):1530-8. PM:10546692.

134. Wilson PW, D'Agostino RB, Sullivan L, Parise H, and Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. Arch Intern Med. 2002;162(16):1867-72. PM:12196085.

135. Roberts KC, Shields M, de Groh M, Aziz A, and Gilbert J-A. Overweight and obesity in children and adolescents: Results from the 2009 to 2011 Canadian Health Measures Survey. Health Rep. 2012;23(3).

136. Chanoine JP and Richard M. Early weight loss and outcome at one year in obese adolescents treated with orlistat or placebo. Int J Pediatr Obes. 2011;6(2):95-101. PM:20858149.

137. Janicke DM, Sallinen BJ, Perri MG, Lutes LD, Huerta M, Silverstein JH, et al. Comparison of parent-only vs family-based interventions for overweight children in underserved rural settings: outcomes from project STORY. Arch Pediatr Adolesc Med. 2008;162(12):1119-25. PM:19047538.

138. Maddison R, Mhurchu CN, Jull A, Prapavessis H, Foley LS, and Jiang Y. Active video games: the mediating effect of aerobic fitness on body composition. Int J Behav Nutr Phys Act. 2012;9:54. PM:22554052.

139. Schaefer A, Winkel K, Finne E, Kolip P, and Reinehr T. An effective lifestyle intervention in overweight children: one-year follow-up after the randomized controlled trial on "Obeldicks light". Clin Nutr. 2011;30(5):629-33. PM:21514017.

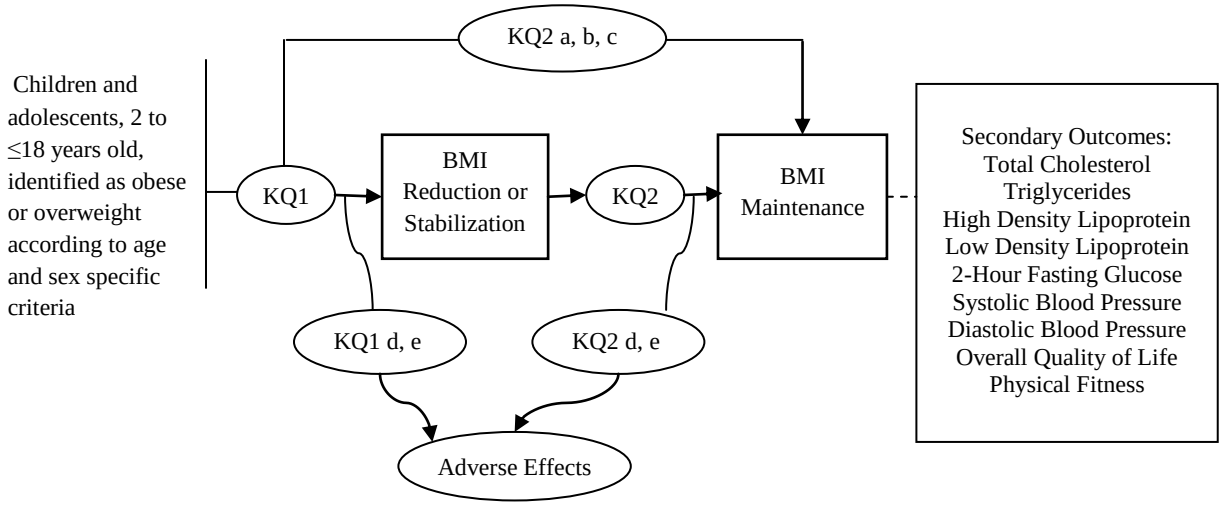
140. Savoye M, Nowicka P, Shaw M, Yu S, Dziura J, Chavent G, et al. Long-term results of an obesity program in an ethnically diverse pediatric population. Pediatrics. 2011;127(3):402-10. PM:21300674.

141. Vos RC, Wit JM, Pijl H, and Houdijk ECAM. Long-term effect of lifestyle intervention on adiposity, metabolic parameters, inflammation and physical fitness in obese children: a randomized controlled trial. Nutr Diabetes. 2011;1:e9. PM:23455021.

Figures

- Figure 1: Analytic Framework
- Figure 2: Search and Selection Results

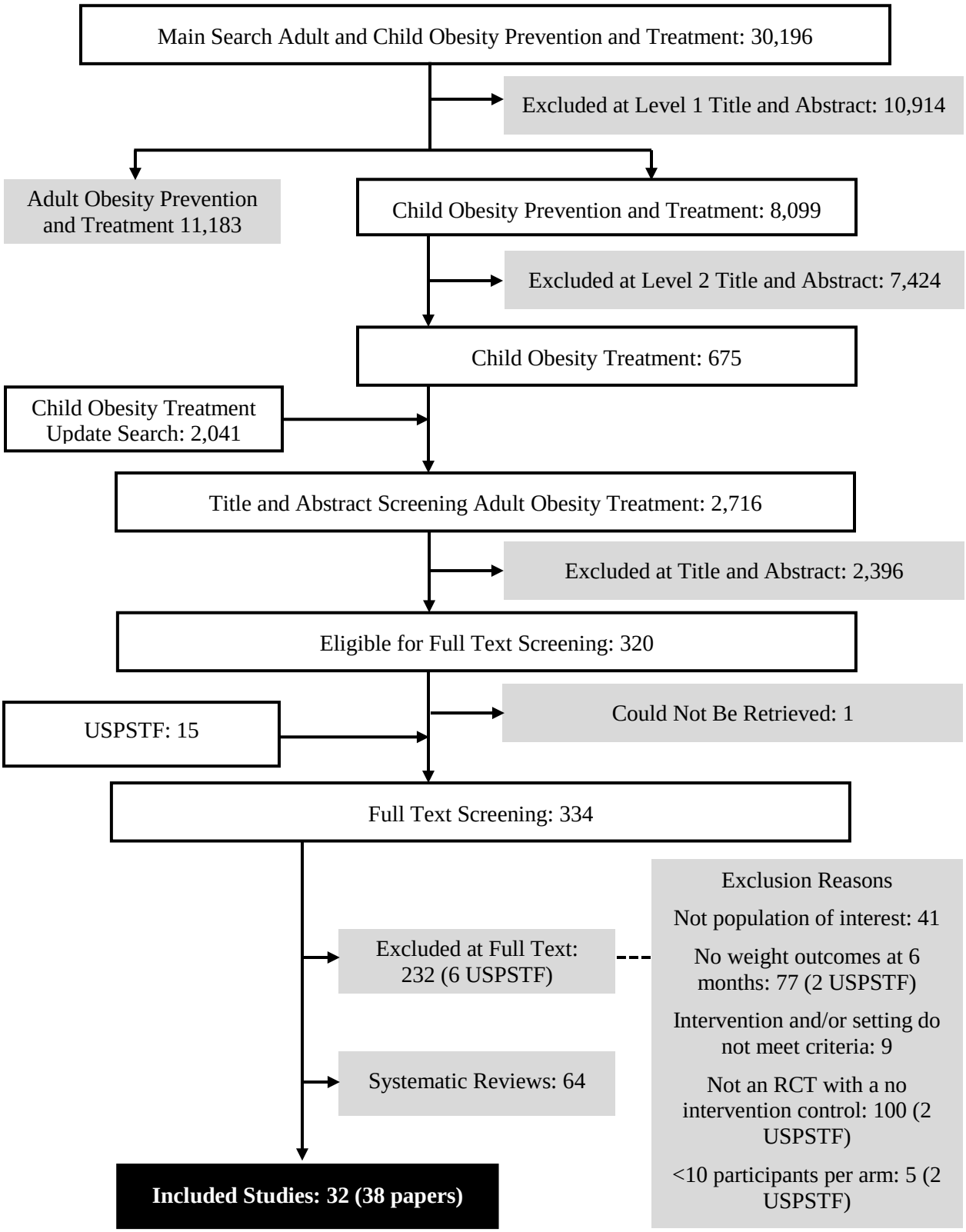
Figure 1: Analytic Framework



KQ1 refers to overweight/obesity treatment interventions

KQ2 refers to interventions for those who have achieved an initial BMI reduction or stabilization to support them in weight maintenance over time. Note: the inclusion criteria stipulate a minimum of six months for the initial and subsequent step.

Figure 2: Search and Selection Results



Tables

- Table 1: Summary of Risk of Bias Assessment of Included RCTs
- Table 2: Characteristics of Included Studies
- Table 3: Broad Features of the Available Evidence
- Table 4: Key Findings of Overall and Sub-group Analyses for Continuous Outcomes
- Table 5: Key Findings of Overall Analysis for Dichotomous Outcomes
- Table 6: Details of Adverse Effects
- Table 7: Summary of Common Elements of Efficacious Behavioural Treatment Interventions
- Table 8: Details of Treatment Strategies of Efficacious Interventions
- Table 9: Prevalence of Overweight and Obesity in Manitoba Children and Youth

Table 1: Summary of Risk of Bias Assessment of Included RCTs

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 [88]	U	U	H		U			L		L	L
Bryant 2011 [76]	L	U	H		U			H		H	H
Chanoine 2005 [67]	U	L	U	L	U	U	H	H	H	L	H
Coppins 2011 [79]	U	U	H		U			L		L	L
Croker 2012 [78]	L	U	H		L	H		H	H	L	L
DeBar 2012 [77]	L	U	H	L	L	H	L	L	L	L	L
Doyle 2008 [73]	L	L	H		L			L		L	L
Ebbeling 2012 [93]	U	U	H		L	H		L	L	L	L
Epstein 2008 [74]	L	U	H		U			L		L	L
Golley 2007 [69]	L	L	H		L			L		L	L
Janicke 2009 [90]	U	U	H		U			L		L	H
Lisón 2012 [92]	H	H	H		U			L		L	H
Lochrie 2013 [96]	U	U	H		U			H		L	H
Maahs 2006 [75]	U	U	L	L	L	L	L	L	L	L	H
Maddison 2011 [82]	L	L	H		U	U		L	L	L	L
McCallum 2007 [70]	L	U	H		U			L		L	L
Nemet 2005 [72]	L	U	H		U			L		L	L
O'Brien 2010 [97]	L	U	H			H			H	L	H
O'Connor 2013 [98]	L	U	H		U			L		L	H
Racine 2010 [85]	U	U	H	L	U	U	L	L	U	L	H
Reinehr 2010 [84]	L	U	H		H			L		L	H
Sacher 2010 [89]	L	U	H	L	H		H	H		L	L
Saelens 2002 [71]	L	L	H		U			L		L	H
Savoye 2007 [68]	L	L	H	L	U		H	H		L	L
Taveras 2011 [81]	L	U	H		U			L		L	L
Toulabi 2012 [94]	U	U	H		U			U		L	L
Vos 2011 [91]	L	U	H	L	U	H	L	L	L	L	H
Wafa 2011 [80]	L	L	H		L	H		H	H	L	L
Wake 2009 [86]	L	L	H		L	H		L	L	L	U
Wake 2013 [95]	L	U	H		L	H		L	L	L	H
Waling 2010 [83]	U	U	L		U			H		L	L
Weigel 2008 [87]	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

Table 2: Characteristics of Included Studies

Study/Location	**Bäcklund 2011 [88] Sweden**
Objective	To examine the effect of a 2-year family-based lifestyle intervention on physical activity among overweight and obese Swedish children
Methods	Design: RCT Selection: all families with children born 1995-1998 that lived in study area informed by postal letter; those interested were interviewed by telephone to ascertain eligibility Inclusion criteria: age- and gender- adjusted BMI >25, born 1995-1998, living in or nearby the city of Umeå in the northern part of Sweden
Participants	Sample: 105 Intervention n=58; Control n=47 Age mean (SD) (years): Intervention: 10.5 (1.13); Control: 10.6 (1.02) Gender [Female n (%)]: Intervention: 15 (42%); Control: 19 (54%) Loss to follow-up: Intervention n=22; Control n=12
Intervention	Description of intervention: 2-year family-based lifestyle intervention focused on promoting a healthy lifestyle among overweight and obese children, based on principles of behaviour; 14 group sessions with a duration of 90-120 minutes each Description of control: no intervention Duration of intervention: 24 months Length of follow-up: immediate post
Study/Location	**Bryant 2011 [76] UK**
Objective	To conduct a feasibility trial of the evaluation of WATCH IT, a community obesity intervention for children and adolescents
Methods	Design: RCT Selection: referral and self-referral and contacted by research team Inclusion criteria: aged 8-16 years; BMI >98th percentile value; parent/carer with fluent spoken English Exclusion criteria: medical cause for obesity; severe learning difficulties; significant medical or psychiatric problems; siblings already enrolled
Participants	Sample: 70 Intervention n=35; Control n=35 Age mean (SD) (years): Intervention: 11.5 (1.8); Control: 11.3 (2.2) Gender [Female n (%)]: Intervention 22 (63%); Control 23 (66%) Race/Ethnicity [White n (%)]: Intervention n=32 (91%); Control n=29 (83%) SES [Household income <£15,000 n (%)]: Intervention n=17 (49%); Control n=18 (51%) Loss to follow-up: Intervention n=8; Control n=9
Intervention	Description of intervention: child and parent/carer receive weekly individual

	appointments structured on the Healthy Eating Lifestyle Programme and group physical activity sessions; weekly appointments address emotional or social issues affecting the young person's ability to achieve healthy behaviours Description of control: wait list Duration of intervention: 12 months Length of follow-up: immediate post
Study/Location	**Chanoine 2005 [67] Canada; Companion paper: Chanoine [136]**
Comments	See USPSTF review[54] for details
Study/Location	**Coppins 2011 [79] UK**
Objective	To determine if a multi-component family focused education package is more effective than a waiting list control group in treating overweight and obese children
Methods	Design: RCT Selection: referrals from healthcare professionals or self-referral as a result of media advertising via local newspaper and television channel Inclusion criteria: children 6-14 years; BMI >91st percentile; those with intellectual disability included if able to participate in intervention activities; general practitioners asked to notify dietitian of medical conditions which might impede physical activity
Participants	Sample: 65 Intervention n=35; Control n=30 Age, mean (months): Intervention: 133.4; Control: 116.9 Gender (Female %): Intervention: 62.9%; Control: 70.0% Loss to follow-up: Intervention n=10; Control n=5
Intervention	Description of intervention: 2 workshops (8 h total) held 1-2 weeks apart and 2 physical activity sessions 1 h/week; siblings 6-14 years and parents encouraged to participate; focused on healthy eating, physical activity, reducing sedentary behaviour, behaviour change and psychological well-being; designed/delivered by dietitian, physical activity health promotion officer, educational or clinical psychologist and 2-3 physical activity instructors; junior gym sessions (bikes and various weights), circuits, trampolining, rock climbing, table tennis, basketball, tennis, badminton, football Description of control: no intervention Duration of intervention: 12 months Length of follow-up: immediate post
Study/Location	**Croker 2012 [78] UK**
Objective	To examine the acceptability and effectiveness of family-based behavioural treatment for childhood obesity in ethnically and socially diverse families
Methods	Design: RCT Selection: recruited through local professional networks in primary and secondary

	care, from schools and through information in local media Inclusion criteria: aged 8-12 years; overweight or obese according to International Obesity Task Force definition; at least one parent/guardian willing to participate in treatment; parent and child had sufficient command of English language to participate Exclusion criteria: identified medical cause for obesity (e.g., hypothyroidism, Prader Willi syndrome, single-gene defects); T2D; taking anti-obesity medication; undergoing obesity treatment; significant learning difficulties; significant mental health problems in child or parent; receiving psychological or psychiatric treatment
Participants	Sample: 72 Intervention n=37; Control n=35 Age, mean (SD) years: Intervention: 10.8 (1.6); Control: 9.8 (1.4) Gender [Female n (%)]: Intervention: 26 (70.3%); Control: 24 (68.6%) Race/Ethnicity [White]: 56.9% SES [parents with compulsory education or below]: 45.8% Loss to follow-up: Intervention n=4; Control n=5
Intervention	Description of intervention: advice for whole family change, behavioural weight control programme for children Description of control: wait-list Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**DeBar 2012 [77] US**
Objective	To evaluate a primary care–based, multicomponent lifestyle intervention specifically tailored for overweight adolescent females
Methods	Design: RCT Selection: recruited from a large health maintenance organization in Pacific Northwest Inclusion criteria: female ;health plan members; aged 12-17 years; age- and gender-adjusted BMI >90th percentile Exclusion criteria: significant cognitive impairment or psychosis; severe obesity (BMI >45); use of medications known to affect body weight; pregnant
Participants	Sample: 208 Intervention: n=105; Control n=103 Age, mean (SD) years: Intervention: 14.12 (1.48); Control: 14.03 (1.50) Gender (Female %): 100% SES [Family income >$75K n (%)]: Intervention n=40 (40.0%); Control n=35 (36.5%) Loss to follow-up: Intervention n=15; Control n=20
Intervention	Description of intervention: multicomponent developmentally tailored behavioural intervention delivered as 90-minute group meetings conducted over 5 months; focused on change in dietary intake and eating patterns, increasing physical activity, addressing

	issues associated with obesity in adolescent girls and training participants' primary care providers to support behavioural weight management goals Description of control: materials on weight management approaches including parents' guide; identified local resources, books and on-line materials for weight management and healthy lifestyle; met primary care providers at onset to encourage healthy changes (no tailored patient assessment summaries provided for use in this visit) Duration of intervention: 6 months Length of follow-up: 6 months
Study/Location	**Doyle 2008 [73] US**
Comments	See USPSTF review[54] for details
Study/Location	**Ebbeling 2012 [93] US**
Objective	To assess the effect on weight gain of an intervention that provided non-caloric beverages at home to overweight and obese adolescents
Methods	Design: RCT Selection: not reported Inclusion criteria: consume ≥1 serving (12 oz) per day of sugar-sweetened beverages or fruit juice; enrollment in grade 9 or 10; BMI ≥ 85th percentile for sex and age
Participants	Sample: 224 Intervention n=110; Control n=114 Age, mean (SD) years: Intervention: 15.3 (0.7); Control: 15.2 (0.7) Gender [Female n (%)]: Intervention n=52 (47%); Control n=48 (42%) Loss to follow-up: Intervention n=5; Control n=5
Intervention	Description of intervention: home delivery of non-caloric beverages (e.g., bottled water and "diet" beverages) every 2 weeks; monthly motivational telephone calls with parents (30 minutes/call); 3 check-in visits with participants (20 minutes/visit) Description of control: mailed $50 supermarket gift cards at 4 and 8 months as retention strategy but no instructions on what to purchase with cards Duration of intervention: 12 months Length of follow-up: 12 months
Study/Location	**Epstein 2008 [74] US**
Comments	See USPSTF review[54] for details
Study/Location	**Golley 2007 [69] Australia**
Comments	See USPSTF review[54] for details
Study/Location	**Janicke 2009 [90] US; Companion paper: Janicke [137]**
Objective	To assess the effectiveness of parent-only vs. family-based interventions for pediatric weight management in underserved rural settings

Methods	Design: RCT Selection: families recruited through direct mailings, distribution of brochures through local schools, and community presentations Inclusion criteria: children aged 8-14 years; BMI >85th percentile for age and sex; physician approval to participate Exclusion criteria: medical condition that contraindicates mild energy restriction or moderate physical activity; use of prescription weight loss drugs; enrollment in another weight loss program
Participants	Sample: 93 Intervention 1 (Family-based) n=33; Intervention 2 (Parent-only) n=34; Control n=26 Age, mean, years: Intervention 1: 11; Intervention 2: 11; Control: 11 Gender (Female n): Intervention 1: 15, Intervention 2: 12; Control: 16 Race/Ethnicity (Caucasian): Intervention 1: 66.7%; Intervention 2: 80.8%; Control: 80.9% SES [Family income <60K]: Intervention 1: 62.4%; Intervention 2: 65.3%; Control: 81% Loss to follow-up: Intervention 1 n=9; Intervention 2 n=8; Control n=5
Intervention	For both intervention conditions, weekly 90 minute group sessions held for first 8 weeks, then biweekly for next 8 weeks; participants in both treatment conditions were asked to monitor everything they ate but were not required to record caloric intake Description of family based intervention: parent and child dyads participated in simultaneous groups; at the end of session children and parents brought together to develop goals for the week and specific plans to achieve these (dietary) goals Description of parent only intervention: only participating parent(s) attended meetings with 3 segments; emphasis placed on teaching parents goal setting with their children Description of control: wait list Duration of intervention: 16 weeks Length of follow-up: 6 months
Study/Location	**Lisón 2013 [92] Spain**
Objective	To compare the effect of a hospital clinic group versus home-based combined exercise-diet program for treating child obesity
Methods	Design: RCT Selection: recruited at university hospital based obesity and cardiovascular risk unit Exclusion criteria: patients with secondary obesity syndromes or acute illnesses
Participants	Sample: 110 Intervention 1 (Clinic group) n=45; Intervention 2 (Home-based) n=41; Control n=24 Age, mean (SD) years: Intervention 1:11.9 (2.2); Intervention 2: 12.3 (1.9); Control: 11.2 (2.1) Gender (Female n) Intervention 1: 20; Intervention 2: 23; Control: 11 Loss to follow-up: Intervention 1 n=13; Intervention 2 n=9; Control n=4

Intervention	Description of intervention 1: 5 supervised clinic based exercise sessions/week for 6 months (120 sessions); advised to attend ≥3 sessions/week (minimum attendance rate) Description of intervention 2: instructed to complete all exercises in home environment; 5 sessions/week for 6 months (120 sessions) Description of control: instructed about diet and other lifestyle changes during regular clinic visits, but no exercise or nutrition education sessions Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**Lochrie 2013 [96] US**
Objective	To examine effects of a lifestyle intervention involving diet, education, physical exercise, behaviour change, and psychosocial methods for overweight or obese children
Methods	Design: RCT Selection: flyers posted in pediatricians' offices, area elementary schools, and an outpatient medical specialty clinic; families also referred by pediatricians Inclusion criteria: aged 8-11 years; age- and sex adjusted BMI ≥85th percentile; no impaired glucose tolerance, T2D, MS, hypertension, or significant learning problems
Participants	Sample: 130 Intervention n=65; Control n=65 Age, mean (SD) years: Overall 9.9 (1.1) Gender [Female n (%)]: 82 (63%) Loss to follow-up: Intervention n=20; Control n=22
Intervention	Description of intervention: family-based lifestyle intervention with 8 weekly sessions, followed by 4 bimonthly sessions, and then 2 monthly sessions (14 sessions over 6 months); each group session lasted 60 to 90 min. Description of control: typical educational/consultative intervention that might be (and was currently being) offered at specialty clinic; 1 group session by registered dietitian Duration of intervention: 8 months (mean) Length of follow-up: 6 months
Study/Location	**Maahs 2006 [75] US**
Comments	See USPSTF review[54] for details
Study/Location	**Maddison 2011 [82] New Zealand; Companion paper: Maddison [138]**
Objective	To evaluate the effect of active video games on weight, body composition, physical activity, and physical fitness
Methods	Design: RCT Selection: recruited through schools and various community locations Inclusion criteria: aged 10–14 years; overweight or obese (according to International Obesity Task Force definition); owned a PlayStation 2 or 3 gaming console but no

	active video games; played >2h of video games/week Exclusion criteria: contra-indications to performing physical activity (e.g., medical condition); another child in household already taking part in the study
Participants	Sample: 322 Intervention n=160; Control n=162 Age mean (SD) years: Intervention: 11.6 (1.1); Control: 11.6 (1.1) Gender [Female n (%)]: Intervention: 44 (27.5%); Control 43 (26.5%) Race/Ethnicity (New Zealand and European): Intervention n=92 (57.5%), Control n=91 (56.2%) Loss to follow-up: Intervention n=36; Control n=27
Intervention	Description of intervention: upgrade (hardware and games) of existing gaming technology to enable active video game play at home; encouraged to use gaming system to be moderately to vigorously active for 60 minutes on most days of the week Description of control: normal video game play; no information about increasing physical activity, healthy eating or weight loss Duration of intervention: 24 weeks Length of follow-up: immediate post
Study/Location	**McCallum 2007 [70] Australia**
Objective	See USPSTF review[54] for details
Study/Location	**Nemet 2005 [72] Israel**
Objective	See USPSTF review[54] for details
Study/Location	**O`Brien 2010 [97] Australia**
Objective	To compare outcomes of gastric banding with a lifestyle program on adolescent obesity
Methods	Design: RCT (head to head treatments) Selection: telephone contact, information session and clinical assessment Inclusion criteria: adolescents 14-18 years with a BMI >35
Participants	Sample: 50 Intervention 1 (Gastric banding) n=25; Intervention 2 (Lifestyle intervention) n=25 Age, mean (SD) years: Intervention 1: 16.5 (1.4); Intervention 2: 16.6 (1.2) Gender [Female n (%)]: Intervention 1: 16 (64%); Intervention 2: 8 (72%) Loss to follow-up: Intervention 1 n=1; Intervention 2 n=7
Intervention	Description of intervention 1: gastric banding Description of intervention 2: lifestyle intervention with reduced calorie diet, increased physical activity Duration of intervention: 24 months Length of follow-up: immediate post

Study/Location	O'Connor 2013 [98] US
Objective	To test the feasibility of Helping HAND (Healthy Activity and Nutrition Directions), an obesity intervention for 5-8 year old children in primary care clinics
Methods	Design: RCT Selection: recruited from 4 pediatric clinics; families referred by paediatricians, clinic staff and self-referred via posters and fliers posted in the clinics Exclusion criteria: experiencing medical consequences of obesity (e.g., hypertension or T2D) requiring more intensive treatment; on medications that could affect weight status; medical problems that could impede participation in a behaviour change program; already participated in other weight treatment program; parent unable to read or write in English or Spanish; parent participated in formative studies to develop Helping HAND; another child in household already taking part in study
Participants	Sample: 40 Intervention n=20; Control n=20 Age, mean (SD) years: Intervention: 7.0 (1.0); Control: 6.6 (1.1) Gender [Female n (%)]: Intervention: 18 (90%); Control: 14 (70%) Race/Ethnicity [Hispanic/Latino/Mexican American n (%)]: Intervention: 16 (80%); Control: 17 (85%) SES [Income <$30, 000 n (%)]: Intervention: 10 (50%); Control: 16 (80%) Loss to follow-up: Intervention n=2; Control n=4
Intervention	Description of intervention: monthly sessions, self-selected child behaviours and parenting practices to change Description of control: regular paediatric care, wait-listed Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**Racine 2010 [85] US**
Objective	To determine conjugated linoleic acid's efficacy with regard to change in fat and BMI in children
Methods	Design: RCT Selection: recruited from metropolitan area using flyers Exclusion criteria: Tanner scale ≥stage 2; history of metabolic disease; excessive fear of blood draw; claustrophobia; extreme dislike of taste of treatment delivery beverage; fasting blood chemistry at screening exceeded the following: glucose >110mg/dl, insulin >45 uIu/ml, LDL-C >160 mg/dl, total cholesterol >240 mg/dl, triglycerides >200 mg/dL, aspartate aminotransferase (AST) >40 U/L and >50 U/L (males age 10 y) alanine aminotransferase (ALT) >65/U/l and y-glutamyl transferase (GGT) >30 U/L
Participants	Sample: 62 Intervention n=unclear; Control n=unclear

	Age, mean (SD) years: Intervention: Females 8.6 (0.8), Males 8.8 (1.3); Control: Females: 8.1 (0.6), Males: 9.3 (0.8) Gender [Female n (%)]: Intervention n=12 (43%); Control n=10 (40%) Loss to follow-up: 9
Intervention	Description of intervention: 250g chocolate milk beverage with 1.4% fat and 183 kcal per serving; conjugated linoleic acid treatment milk had 3g Clarinol added per serving Description of control: placebo milk had 3g of sunflower oil added per serving Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**Reinehr 2010 [84] Germany; Companion paper: Schaefer [139]**
Objective	To examine the effect of a lifestyle intervention on weight in overweight children and youth
Methods	Design: RCT Selection: media (newspapers and radio) Inclusion criteria: aged 6-16 years; overweight; apparently healthy; not on any medication; attending a regular school Exclusion criteria: obese children
Participants	Sample: 71 Intervention n=39; Control n=32 Age, mean (SD) years: Intervention: 11.6 (1.6); Control: 11.4 (1.7) Gender (Female %): Intervention: 62%; Control: 59% Loss to follow-up: Intervention n=6; Control n=5
Intervention	Description of intervention: outpatient lifestyle intervention based on physical activity training, nutrition education, and behavioural counselling for child and family Description of control: wait list Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**Sacher 2010 [89] UK**
Objective	To evaluate the effectiveness of the Mind, Exercise, Nutrition, Do it (MEND) Program, a multicomponent community-based childhood obesity intervention
Methods	Design: RCT Selection: recruited from five sites by referrals from local health professionals (dieticians, school nurses, and general practitioners) or self-referral Inclusion criteria: aged 8-12 years; obese (BMI $\geq 98^{th}$ percentile, UK 1990 reference data); no apparent clinical problems, comorbidities, physical disabilities, or learning difficulties which would impede participation; at least one parent/carer able to attend each of the program sessions

Participants	Sample: 116 Intervention n=60; Control n=56 Age, mean (SD) years: Intervention: 10.3 (1.3); Control: 10.2 (1.3) Gender [Female n (%)]: Intervention: 38 (63%); Control: 25 (45%) Race/Ethnicity [White n (%)]: Intervention: 30 (50%); Control: 28 (50%) Loss to follow-up: Intervention n=23; Control n=11
Intervention	Description of intervention: integrated, multicomponent healthy lifestyle program consisting of 18 2-hour group sessions over 9 weeks delivered by two MEND leaders Description of control: usual care, wait list Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**Saelens 2002 [71] US**
Comments	See USPSTF review[54] for details
Study/Location	**Savoye 2007 [68] US; Companion paper: Savoye [140]**
Comments	See USPSTF review[54] for details
Study/Location	**Taveras 2011 [81] US**
Objective	To examine the effectiveness of a primary care-based obesity intervention over the first year of a 2-year study
Methods	Design: RCT Selection: children in 10 primary care pediatric offices Inclusion criteria: aged 2-6.9 years; BMI ≥95th percentile or 85th to 95th percentile if at least 1 parent overweight (BMI ≥25) Exclusion criteria: children whose parent/guardian could not respond to interviews in English or Spanish; children whose families were planning to leave the primary care practice; families for whom the primary care clinician thought the intervention was not appropriate; children with chronic medical conditions
Participants	Sample: 475 Intervention n=271; Control n=204 Age, mean (SD) years: Total: 4.9 (1.2) Gender [Female n (%)]: 230 (52%) Loss to follow-up: Intervention n=18; Control n=12
Intervention	Description of intervention: family-based lifestyle intervention including four 25-minute in-person chronic disease managements visits and three 15 minute telephone calls in 1st year of the intervention delivered by trained pediatric nurse practitioners Description of control: current standard care offered by pediatric practice Duration of intervention: 12 months Length of follow-up: immediate post

Study/Location	Toulabi 2012 [94] Iran
Objective	To determine the influence of a behaviour modification program on BMI in obese public high school students
Methods	Design: RCT Selection: students identified in a previous study Inclusion criteria: not morbidly obesity; no hormone disorders e.g. hypothyroidism or Cushing's syndrome; absence of weight-reducing diets or drugs affecting body weight; participation of one parent (with a minimum 9th grade education); tendency of the students and parents to lose weight; BMI ≥28 in the 1st grade students (15 years old), and BMI ≥29 in the 2nd grade and 3rd grade students (16 and 17 years old)
Participants	Sample: 152 Intervention n=76; Control n=76 Age, mean (SD) (years): Overall 15.87 (1) Gender: not reported Loss to follow-up: not reported
Intervention	Description of intervention: behaviour modification included: (1) 24-hour diet record for students and parents; (2) face to-face nutritional instructions for parents supported by an educational booklet (during four 1-hour weekly sessions); (3) face-to-face nutritional instructions for students regarding dietary modification and techniques for increasing physical activity supported by an educational booklet (during eight 45-minute sessions, twice a week); (4) exercises demonstrated by physical education expert at school in a group, 1 hour per day, 3 days per week, for 6 weeks Description of control: not reported Duration of intervention: 24 months Length of follow-up: immediate post
Study/Location	**Vos 2011 [91] Netherlands; Companion paper: Vos [141]**
Objective	To evaluate the effect of multidisciplinary treatment on obesity and health-related quality of life
Methods	Design: RCT Selection: participants living in or close to the Hague were invited to participate. Inclusion criteria: added 81-17 years; newly presented with obesity according to Cole's reference values; not using corticosteroids, thyroid supplementation, anti-depressive medication, anticonvulsive medication, orlistat, sibutramine, or metformin Exclusion criteria: insufficient knowledge of Dutch language to participate; medical co-morbidities that could affect participation (e.g., hypothyroidism, high dose of glucocorticoids, diabetes mellitus); previous enrollment in another cognitive behavioural treatment program with the focus on reducing obesity
Participants	Sample: 81 Intervention 1 n=41; Control n=40

	Age mean (SD) years: Intervention: 13.3 (2.0); Control: 13.1 (1.9) Gender (Female): Intervention n=22; Control n=20 Loss to follow-up: Intervention n=4; Control n=1
Intervention	Description of intervention: multidisciplinary cognitive behavioural intervention including medical, nutritional, physical and psychological counseling Description of control: initial advice on physical activity and nutrition; wait listed Duration of intervention: 3 months Length of follow-up: 9 months
Study/Location	**Wafa 2011 [80] Malaysia**
Objective	To test whether a practice intervention for the treatment of childhood obesity would have a greater impact on weight status and other outcomes than a control condition
Methods	Design: RCT Selection: recruited from primary schools Inclusion criteria: aged 7-11 years; obese (BMI >95th percentile relative to US reference data); at least one parent who perceived child's weight status as a problem and were willing to attend the intervention Exclusion criteria: children with serious co-morbidity requiring treatment
Participants	Sample: 107 Intervention n=52; Control n=55 Age, mean (SD) years: Intervention: 9.7 (1.4); Control: 9.9 (1.6) Gender (Female n): Intervention n=24; Control n=29 Loss to follow-up: Intervention n=18; Control n=9
Intervention	Description of intervention: low intensity program (8 1-hour group sessions), delivered over 26-weeks largely by a dietician; clinical psychologist supported work of dietician outside treatment sessions, and provided support to parents directly during one session Description of control: no treatment Duration of intervention: 6 months Length of follow-up: immediate post
Study/Location	**Wake 2009 [86] Australia**
Objective	To determine whether identification of obesity by surveillance followed by structured intervention in primary care improved outcomes in overweight or mildly obese children
Methods	Design: RCT Selection: non-representative sample of 66 general practitioners in 45 family medical practices; recruited by personalised letters sent to GPs via paediatric special interest group spanning 11 Melbourne divisions of general practice, the Health Insurance Commission, GPs from the LEAP1 trial, and contacts made through these networks Inclusion criteria: all children age 5-10 attending the practice for any reason

	Exclusion criteria: BMI Z-score ≥3.0
Participants	Sample: 258 Intervention n=139; Control n=119 Age, mean (SD) years: Intervention: 7.4 (1.4); Control: 7.6 (1.4) Gender [Female n (%)]: Intervention: 83 (60%); Control: 73 (61%) SES [mother did not finish high school n (%)]: Intervention 42 (31%); Control 39 (33%) Loss to follow-up: Intervention n=12; Control n=4
Intervention	Description of intervention: GPs used brief, solution focused approach to set and record appropriate, healthy lifestyle goals; "family folder" with printed materials to support behaviour change Description of control: not described Duration of intervention: 3 months Length of follow-up: 3 months, 6 months
Study/Location	**Wake 2013 [95] Australia**
Objective	To determine whether general practice surveillance for childhood obesity, followed by obesity management across primary and tertiary care settings using a shared care model, improves BMI and related outcomes
Methods	Design: RCT Selection: GPs recruited through professional networks and/or personal invitation; 9 had participated in previous LEAP trial; children attending each practice invited to be weighed and measured to determine eligibility Inclusion criteria: aged 3-10 years; obese but not in a weight management program Exclusion criteria: known endocrine or chromosomal cause for obesity; major health or developmental conditions; insufficient English to participate
Participants	Sample: 118 Intervention 1 n=62; Control n=56 Age mean (SD) years: Intervention: 7.2 (2.3); Control: 7.4 (2.2) Gender [Female n (%)]: Overall 54 (45%) Loss to follow-up: n=11
Intervention	Description of intervention: one tertiary appointment followed by up to 11 GP consultations over one year; discussion and goal setting focused on relevant dietary, physical activity and family/child lifestyle changes; supported by shared care, web based software that enabled a structured intervention at each consultation Description of control: free to seek assistance from GP or any other service Duration of intervention: 12 months Length of follow-up: immediate post
Study/Location	**Waling 2010 [83] Sweden**

Objective	To evaluate the impact of a 1 year food and physical activity intervention on energy and macronutrient intake in overweight and obese children
Methods	Design: RCT Selection: invitation letters sent to families living in study area Exclusion criteria: born 1995-1998; age- and gender-adjusted BMI ≥25; access to Internet; no chronic diseases affecting metabolic variables; no ADD diagnosis
Participants	Sample: 105 Intervention n=unclear; Control n=unclear Age, mean (SD) years: Intervention: 10.4 (1.09); Control: 10.5 (1.06) Gender [Female n (%)]: Intervention: 25 (58%); Control:18 (45%) Loss to follow-up: 39
Intervention	Description of intervention: 14 group sessions (once or twice a month) aimed at improving food and physical activity habits Description of control: attended 1 meeting at study outset to receive information about informed measurements; no further contact with research team Duration of intervention: 12 months Length of follow-up: immediate post
Study/Location	**Weigel 2008 [87] Germany**
Objective	To examine impacts of health-oriented lifestyle intervention on weight status of obese children
Methods	Design: RCT Selection: recruited by pediatricians and local newspaper reports Inclusion criteria: not reported
Participants	Sample: 73 Intervention n=37; Control n=36 Age, mean (SD) years: Overall 10.9 (1.4) Gender [Female n (%)]: Intervention 22 (59%); Control 18 (50%) Loss to follow-up: Intervention n=1; Control n=6
Intervention	Description of intervention: modules for physical activity, nutritional education, and coping strategies; 2 sessions/week; monthly parental meetings; medical supervision Description of control: written therapeutic advice from physician during outpatient visits at 0 and 6 months; medical supervision and laboratory tests at 0, 6, 12 months Duration of intervention: 12 months Length of follow-up: immediate post

Table 3: Broad Features of the Available Evidence

Designs	• 32 RCTs • 23 studies (72%) with a no intervention control condition; 9 studies (28%) provided control participants with a minimal component (e.g., information session or newsletter on general health concepts)
Populations	• 19 studies (59%) included overweight and obese children/youth; 1 study (3%) included only overweight children; 12 studies (38%) included only obese participants • 23 interventions (72%) targeted children aged 2 to 12; 9 (28%) targeted youth aged 13 to 18 • 31 studies included boys and girls; 1 included only girls
Interventions	• 2 diet interventions, 1 exercise intervention, 6 diet plus exercise interventions, 20 lifestyle interventions; 2 pharmacological (orlistat 120 mg 3x daily) plus behavioural (diet plus exercise components); 1 gastric lap band vs lifestyle intervention trial (adverse effects only) • 14 intervention strategies (44%) targeted individuals (child/youth), 18 (56%) targeted families • 28 interventions (88%) were 12 months or less in duration (18 of which were 6 months or less), 4 interventions (12%) lasted two years
Quality Assessment	• 28 RCTs (90%) were rated as having unclear or high risk of bias for the weight outcomes • Most outcomes received moderate (downgraded for risk of bias) or low GRADE ratings (downgraded for risk of bias and inconsistency or reporting bias)
Study Locations	• 1 study was conducted in Canada and the US, 12 (38%) in the US, 10 (31%) in European countries, 4 in Australia, 1 in each of Iran, Israel, Malaysia and New Zealand
Publication Dates	• 22 studies (69%) were published in the last 5 years; 10 (31%) were published between 2002 and 2008

Table 4: Key Findings of Analyses for Continuous Outcomes (BMI/BMIz, BMI, Total Cholesterol, Triglycerides, HDL-C, LDL-C, Fasting Glucose, SBP, DBP, Overall Quality of Life)

Group or Sub-group	Meta-analysis, (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	GRADE Rating
Outcome: Change in Body Mass Index/Body Mass Index Z-Score; Standard Mean Difference (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, 90%		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)					

Group or Sub-group	Meta-analysis, (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	GRADE Rating
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; Standard Mean Difference (Up to 1 Year Post Intervention)						
Baseline to Immediate Post	-0.51 (-0.86, -0.16)	0.001, 81%	na	716	4	Moderate
Immediate Post to 6-12 Months Follow-up	0.08 (-0.07, 0.23)	0.44, 0%		686	4	Low
Outcome: Change in Body Mass Index (kg/m^2); Mean Difference (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 Total Cholesterol (mmol/L); Mean Difference (Baseline to Immediate Post)						
Overall	-0.06 (-0.19, 0.07)	0.03, 63%	na	904	5	Low
Behavioural	-0.12 (-0.34, 0.09)	0.07, 62%	0.21, 35.3%	342	3	Low
Pharmacological + Behavioural	0.02 (-0.07, 0.11)	0.41, 0%		564	2	Low
Outcome: Change in Triglycerides (mmol/L); Mean Difference (Baseline to Immediate Post)						
Overall	-0.02 (-0.12, 0.09)	0.19, 35%	na	937	5	Low
Behavioural	-0.06 (-0.17, 0.06)	0.30, 18%	0.16, 49.3%	409	4	Low
Pharmacological + Behavioural	0.07 (-0.07, 0.21)	na		528	1	Low
Outcome: Change in HDL-C (mmol/L); Mean Difference (Baseline to Immediate Post)						
Overall	-0.02 (-0.05, 0.01)	0.16, 37%	na	971	6	Low
Behavioural	-0.03 (-0.09, 0.04)	0.15, 44%	0.70, 0%	409	4	Low
Pharmacological + Behavioural	-0.01 (-0.05, 0.02)	0.12, 58%		562	2	Low
Outcome: Change in LDL-C (mmol/L); Mean Difference (Baseline to Immediate Post)						
Overall	0.01 (-0.11, 0.13)	0.009, 70%	na	904	5	Low
Behavioural	-0.04 (-0.19, 0.11)	0.16, 46%	0.46, 0%	342	3	Low
Pharmacological + Behavioural	0.05 (-0.13, 0.24)	0.02, 83%		562	2	Low

Group or Sub-group	Meta-analysis, (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	GRADE Rating
Outcome: Change in Fasting Glucose (mmol/L); Mean Difference (Baseline to Immediate Post)						
Pharmacological + Behavioural	0.06 (-0.29, 0.17)	na	na	528	1	Low
Outcome: Change in SBP (mmHg); Mean Difference (Baseline to Immediate Post)						
Overall	-3.42 (-6.56, -0.29)	0.003, 75%	na	808	5	Moderate
Behavioural	-4.64 (-7.46, -1.82)	0.12, 48%	0.01, 83.2%	280	4	Moderate
Pharmacological + Behavioural	-0.22 (-2.38, 1.94)	na		528	1	Low
Outcome: Change in DBP (mmHg) (Baseline to Immediate Post)						
Overall	-3.39 (-5.17, -1.60)	0.11, 47%	na	808	5	Moderate
Behavioural	-4.08 (-6.07, -2.09)	0.22, 31%	0.10, 63.5%	280	4	Moderate
Pharmacological + Behavioural	-1.81 (-3.61, -0.01)	na		528	1	Moderate
Outcome: Change in Overall Quality of Life (Scores on Pediatric Quality of Life Inventory or DISAKIDS Questionnaire); Mean Difference (Baseline to Immediate Post)						
Overall	2.10 (0.60, 3.60)	0.37, 8%	na	777	6	Moderate
Behavioural	2.05 (-0.31, 4.40)	0.20, 35%	0.92, 0%	504	4	Low
Pharmacological + Behavioural	2.22 (-0.22, 4.67)	0.37, 0%		273	2	Low

Table 5: Key Findings of Analyses for Dichotomous Outcomes (Prevalence of Overweight/Obesity, 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	GRADE Rating
	RR (95% CI)	Absolute Risk Increase	Number-Needed-to-Harm (95% CI)					
Outcome: Prevalence of Overweight (BMI 85th <95th Percentile)								
Overall	0.90 (0.54, 1.46)	-	-	-	-	38	1	Low
Outcome: Prevalence of Overweight/Obesity (BMI >85th Percentile)								
Overall	0.93 (0.82, 1.06)	-	-	-	-	242	1	Low
Outcome: Prevalence of Obesity (>95th Percentile)								
Overall	5 to 6% reduction in intervention group prevalence			-	-	40	1	Low
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

Table 6: Details of Adverse Effects

BEHAVIOURAL INTERVENTIONS			
Any Adverse Events	**Serious Adverse Events**	**Gastrointestinal Events**	**Withdrawal from Study due to Adverse Events**
Includes any and all adverse events reported by study participants	Includes adverse events that require hospitalization or urgent medical care	Includes variety of gastrointestinal symptoms from mild to severe	Includes participants who indicate experiencing adverse event(s) was reason for withdrawing from study
Croker [78] 0 events; authors state that they were not aware of any specific adverse events for the participating children although one child in the control group reduced %BMI by 28.8 and BMI by 4.2	Maddison [82] 2 participants in intervention group and 4 in control group experienced a serious adverse event (hospitalization due to influenza, hip surgery related to a chronic condition, blood clot, observation after a fall, diagnosis of type 1 diabetes, and an ankle injury); the authors report none of these events were determined to be related to the intervention	Racine [85] 22 reports of gastrointestinal symptoms at baseline and 29 at follow-up in the intervention group; in the control group there were 14 reports at baseline and 17 reports at follow-up	Racine [85] 1 withdrawal due to adverse events in the intervention group related to gastrointestinal issues; 0 withdrawals in the control group
Toulabi [94] 0 events			
Wake [86] 0 events; authors report there was no evidence the intervention was harmful			
Ebbeling [93] 7 events reported by intervention group parents (diagnosis of Graves' disease, diagnosis of polycystic ovary syndrome, infected finger, asthma attack, mild head injury due to car accident, blood clot after knee surgery, temporary hearing loss due to buildup of fluid/wax in ears)			
Wake [95] 13% of intervention and 14% of control parents reported that being informed that they were obese negatively impacted child's feelings, <10% of intervention parents reported negative effects from practitioner visits			

PHARMACOLOGICAL (ORLISTAT, 120mg 3X DAILY) PLUS BEHAVIOURAL (DIET, EXERCISE) INTERVENTIONS			
Any	**Serious**	**Gastrointestinal**	**Withdrawal**
Chanoine [67] 341 events reported in the intervention group, 170 events reported in the control group; events included: fatty/oily stool, oily spotting, oily evacuation, abdominal pain, fecal urgency, flatus with discharge, soft stool, nausea, increased defecation, flatulence, fecal incontinence	Chanoine [67] 11 serious events in intervention group (pilonidal abscess, depression, asthma attack, seizure, repair of deviated septum, appendicitis, cholelithiasis, gallbladder disorder, cholecystectomy, adenoidal hypertrophy, aseptic meningitis); 5 serious adverse events in placebo group (facial palsy, pneumonia, worsening of asthma, pain in right side, acute demyelinating encephalomyelitis); only the symptomatic cholelithiasis that led to cholecystectomy in a girl treated with orlistat was possibly a result of the drug	Chanoine [67] 176 events in the orlistat group; 24 events in the control group; events included: fatty/oily stool, oily spotting, oily evacuation, abdominal pain, fecal urgency, flatus with discharge, soft stool, nausea, increased defecation, flatulence, fecal incontinence	Chanoine [67] 12 withdrawals due to adverse events in the orlistat group; 3 withdrawals due to adverse events in the control group; authors did not provide details regarding the adverse events resulting in withdrawal
	Maahs [75] 1 serious event in the orlistat group (1 participant committed suicide)	Maahs [75] orlistat group had significantly more soft stools (P=0.002), oily spotting (p<0.001), fatty/oily stools (p<0.001), oily evacuation (p<0.001), liquid stools (P=0.02), cramping (P=0.02), flatus with discharge (P<0.001), and fecal incontinence (P<0.001)	Maahs [75] 3 withdrawals due to adverse events in the orlistat group (1 suicide and 2 side effects); 0 withdrawals due to adverse events in the control group;
SURGICAL (GASTRIC BANDING) INTERVENTION			
Any	**Serious**	**Gastrointestinal**	**Withdrawal**
O'Brien [97] 12 participants experienced a total of 13 adverse events in the gastric banding group (proximal gastric enlargements, needle stick injury to tubing, cholecystectomy, hospital admission for depression); 18 adverse events occurred in 11 participants in lifestyle group (hospital admission for depression, cholecystectomy)			

Table 7: Summary of Common Elements of Efficacious Behavioural Treatment Interventions

Study	Gender	Age Group (Years)	Intervention Duration (Months)	Estimated # of Sessions	Intervention Focus	Intervention Target	Group Sessions	Individual Sessions	Parent Involvement	Technology Based
DeBar 2012 [77]	female	13 to 18	6	28 total; 16 group meetings for teens, 12 parent sessions	lifestyle	Individual	Yes	-	Yes	-
Ebbeling 2012 [93]	mixed	13 to 18	12	3 check-in visits, 12 phone calls	diet	individual	Yes	-	-	Yes
Janicke 2009 [90]	mixed	2 to 12	4	12 group sessions	lifestyle	family	Yes	-	Yes	-
Lison 2012 [92]	mixed	2 to 12	6	120 exercise sessions	diet + exercise	individual	-	Yes	-	-
Lochrie 2013 [96]	mixed	2 to 12	6	14 (8 weekly, 4 bimonthly, 2 monthly)	lifestyle	family	Yes	-	Yes	-
Maddison 2011 [82]	mixed	2 to 12	6	not specified - children encouraged to meet recommendations (60 min moderate to vigorous physical activity on most days)	exercise	Individual	-	-	-	Yes
Nemet 2005 [72]	mixed	2 to 12	3	34 total; 24 training sessions, 6 individual meetings with dietician, 4 evening lectures	diet + exercise	family	Yes	Yes	Yes	-
Racine 2010 [85]	mixed	2 to 12	6	1 session with a dietician	diet	individual	-	Yes	Yes	-
Reinehr 2010 [84]	mixed	2 to 12	6	48 total; 37 sessions for children, 6 for parents, 5 for families	lifestyle	Individual	Yes	-	Yes	-
Sacher 2010 [89]	mixed	2 to 12	6	18 sessions over 9 weeks (2-hr group sessions held twice weekly)	lifestyle	family	Yes	-	Yes	-
Saelens 2002 [71]	mixed	13 to 18	4	1 meeting with pediatrician; 1 week later meeting with author, 11 calls from phone counselor (10-20 mins weekly first 8x, biweekly last 3x)	lifestyle	Individual	-	Yes	Yes	Yes
Savoye 2007 [68]	mixed	2 to 12	12	2 sessions per week for first 6 months; bi-weekly next 6 months	lifestyle	family	Yes	Yes	Yes	-
Toulabi 2012 [94]	mixed	13 to 18	24	4 1-hr weekly parents sessions on nutrition; 8 45-min student sessions 2x week on nutrition and physical activity; exercises 1 hour per day, 3x per week for 6 weeks	diet + exercise	Individual	Yes	-	Yes	-
Vos 2011 [91]	mixed	13 to 18	3	7 group meetings for children, 5 for parents; 1 for families (2hr 40 min biweekly)	lifestyle	family	Yes	Yes	Yes	-
Weigel 2008 [87]	mixed	2 to 12	12	2 sessions per week; monthly parent meetings	diet + exercise	individual	Yes	-	Yes	-

Table 8: Details of Treatment Strategies of Efficacious Interventions

Diet	Ebbeling:[93] intervention designed to reduce consumption of sugar-sweetened beverages; 1-year trial consisted of bi-weekly home delivery of noncaloric beverages (bottled water and artificially sweetened "diet" drinks), monthly motivational phone calls with parents (30 minutes/call), and three 20-mintue check-in visits with adolescent participants
	Racine:[85] 3-month supply of milk distributed to participants with instructions for child to drink one full serving each day under parental supervision; 250g chocolate milk beverage containing 1.4% fat and 183 kcal/serving; treatment milk had 3g of Clarinol added per serving
Exercise	Maddison:[82] participants received upgrade (hardware and games) of existing gaming technology that enabled them to play active video games at home; children encouraged to meet physical activity recommendations (60min moderate to vigorous physical activity on most days) by (1) supplementing periods of inactivity with active video game play and (2) substituting periods of traditional non-active videogame play with the active version
Diet plus Exercise	Lison:[92] two 1-hr educational sessions led by 2 pediatricians at the hospital; nutritional instruction; participants encouraged to reduce sedentary behaviour; hospital based group had 5 supervised exercise session per week for 6 months; home based group instructed to complete all 5 weekly exercises sessions in their home environments
	Nemet:[72] participants met with dietitian 6 times during 3-month program; each family instructed to come to first meeting with a 24-hr dietary recall; first 45-60 minute appointment focused on getting acquainted, reasons for childhood obesity, food choices, dietary and cooking habits, understanding motivation for losing weight; shorter (30-45 min) subsequent appointments focused on nutritional education; received a balanced hypocaloric diet, consisting of 5,021 to 8,368 kJ depending on child's age and weight, reduction of 30% of reported caloric intake or 15% less than estimated daily required intake; intervention participants took part in 1-hr training sessions twice-weekly; instructed to perform 30-45 minutes of extra walking or other weight-bearing sport activities at least once per week
	Toulabi:[94]: implemented by nursing and physical education experts; 24-hr diet record; face-to-face (1-hr weekly sessions) instructions for parents plus educational booklet; eight 45-minute face-to face nutritional sessions (held twice weekly) for students regarding dietary modification and techniques for increasing physical activity plus an education booklet; exercises demonstrated by physical education expert at school in a group, 1 hour per day, 3 days per week, for 6 weeks
	Weigel:[87] 1 year program at local sports center and health association; divided into 3 age groups; modules for physical activity, nutritional education, and coping strategies; offered in 2 sessions of 45 to 60 minutes each; 2-hr monthly parent support and feedback meetings; based on dietary approach in Consensus Statement of the Obesity Consensus Working groups; dieticians and psychologists took turns with 4-week teaching blocks; all sessions performed by trained personnel
Lifestyle	DeBar:[77] Participants given a package including outlines of evidence-based approaches to weight management for youth and adults, a guide for parents to help teens make healthy lifestyle changes, local resources for weight management and healthy activities, and recommended books and online resources on healthy lifestyle change
	Janicke:[90] weekly 90-minute group sessions held for first 8 weeks, then bi-weekly for next 8 weeks; children and parents monitored food intake and physical activity; families taught to categorize foods as red, yellow, and green based on Stoplight approach; increased physical activity promoted through pedometer-based step program; group leaders helped families set daily dietary and physical activity goals
	Lochrie:[96] children in outpatient family-based lifestyle group offered 8 weekly sessions, followed by 4 bi-monthly sessions, and then 2

	monthly sessions (14 sessions over 6 months); 60-90 min sessions covered topics in nutrition, behaviour modification, psychosocial interventions, physical activity, and medical issues related to obesity
	Reinehr:[84] outpatient lifestyle intervention based on physical activity training, nutrition education, and behavioural counselling for child and family; 1.5-hr physical activity training session each week over 6-month intervention period (ball games, jogging, trampoline jumping, dancing, wrestling); instructions on how to make physical activity part of every-day life and how to reduce sedentary screen-time behaviours; 3-month (six 1.5-hr sessions) intensive nutrition and eating behaviour courses for children; individual nutrition counselling; six 1.5-hr parent sessions offered
	Sacher:[89] integrated, multicomponent healthy lifestyle program based on principles of nutritional and sports science, learning and social cognitive theories and the study of therapeutic processes; families engage in weight management through education, skills training and motivational enhancement; 18 sessions delivered over 9 weeks (2-hr group sessions twice weekly) by two leaders and one assistant to groups of 8-15 children and their families in community settings such as recreation centers and schools; introduction meeting, 8 sessions on behaviour change; 8 sessions on nutrition education, 16 physical activity sessions, closing session; free-family access to local community swimming pool available for further 12 weeks
	Saelens:[71] computer program at baseline visit; 1 meeting with pediatrician; 1 meeting to discuss phone/mail contact; telephone contact 10-20 minutes weekly for first 8 calls and biweekly for the last 3 calls; counselors use detailed scripts to address weight changes; self-monitoring booklets for each week to be completed and mailed back to counselors
	Savoye:[68] 50 minutes twice weekly for 6 months (exercise and nutrition/behaviour modification once – 40 minutes each – per week) and then every other week for an additional 6 months; children and parents attended classes, including nutrition-related topics, together, but behaviour modification classes were held separately; behaviour mod component facilitated by a registered dietician or social worker; exercise component facilitated by exercise physiologists (warm-up, high-intensity aerobic exercise and a cool-down)
	Vos:[91] 7 group meetings for children; 5 parent meetings, 1 family meeting; 2.5-hr bi-weekly focused on nutritional information (energy balance and healthy eating)and learning about self-control, coping strategies, and self-image
Orlistat plus Diet/Exercise	Chanoine:[67] 2 week single-blind, placebo lead-in period; 52-weeks of 120 mg of orlistat taken 3 times daily; general guidelines for diet, exercise and behavioural modification were supplied but each centre was free to use its own strategy; nutritionally balanced, hypocaloric diet with 30% fat, 50% carbohydrate and 20% protein

Table 9: Prevalence of Overweight and Obesity in Manitoba Children/Youth by Age, 2004 [102]

Age Group (Years)	Overweight (%)	Obese (%)	Overweight/Obese (%)
2 to 5	15.0	8.2	23.2
6 to 11	21.8	8.1	29.9
12 to 17	25.9	10.0	35.9

EVIDENCE SETS

- **Evidence Set 1: Weight – Change in BMI/BMIz**
- **Evidence Set 2: Weight – Change in Prevalence Overweight/Obesity**
- **Evidence Set 3: Health/Physiological Outcomes – Change in Total Cholesterol**
- **Evidence Set 4: Health/Physiological Outcomes – Change in Triglycerides**
- **Evidence Set 5: Health/Physiological Outcomes – Change in HDL-C**
- **Evidence Set 6: Health/Physiological Outcomes – Change in LDL-C**
- **Evidence Set 7: Health/Physiological Outcomes – Change in SBP**
- **Evidence Set 8: Health/Physiological Outcomes – Change in DBP**
- **Evidence Set 9: Health/Physiological Outcomes – Change in Overall Quality of Life**
- **Evidence Set 10: Adverse Effects – Any Adverse Events**
- **Evidence Set 11: Adverse Effects – Serious Adverse Events**
- **Evidence Set 12: Adverse Effects – Gastrointestinal Events**
- **Evidence Set 13: Adverse Effects – Withdrawal from Studies due to Adverse Events**

Evidence Set 1: Do weight management programs (behavioural and combined pharmacological and behavioural interventions) lead to BMI stabilization or reduction in children and adolescents who are overweight or obese? – BMI/BMIz

- Summary of Change in BMI/BMIz Evidence
- GRADE Evidence Profile Table 1.1: Effect of Treatment Interventions on BMI/BMIz
- GRADE Summary of Findings Table 1.1: Effect of Treatment Interventions on BMI/BMIz
- Forest Plots 1.1 to 1.6: Effect of Treatment Interventions on BMI/BMIz
    - 1.1: Overall and by Primary Focus of Intervention [Behavioural, Pharmacological (Orlistat) plus Behavioural)]
    - 1.1.1 Effect of Treatment Interventions on BMI Only – Overall and by Primary Focus of Intervention [Behavioural, Pharmacological (Orlistat) plus Behavioural]
    - 1.2: Type of Intervention (Diet, Exercise, Diet plus Exercise, Lifestyle)
    - 1.3: Intervention Duration (≤12 Months, >12 Months)
    - 1.4: Age Group (2 to 12 Years, 13 to 18 Years)
    - 1.5: Intervention Target (Individual Child/Youth, Families)
    - 1.6: Study Risk of Bias Rating (Low, Unclear, High)
- Funnel Plots 1.1 to 1.6: Effect of Treatment Interventions on BMI/BMIz
    - Same as bulleted list above
- Egger's Test Results (Reporting Bias) for Effect of Treatment Interventions on BMI/BMIz
- GRADE Evidence Profile Table 1.2: Maintenance of Treatment Benefits – BMI/BMIz
- GRADE Summary of Findings Table 1.2: Maintenance of Treatment Benefits – BMI/BMIz
- Forest Plot 1.7: Maintenance of Treatment Benefits – Baseline to Immediate Post Assessment for BMI/BMIz (age group sub-analysis)
- Forest Plot 1.8: Maintenance of Treatment Benefits – Immediate Post to Follow-up Assessment for BMI/BMIz (age group sub-analysis)

Summary of Change in BMI/BMIz Evidence

1.1 Immediate Post: Overall and Primary Focus of Intervention

Overall

- 30 studies; 3,908 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.53 (-0.69, -0.36)]
- High statistical heterogeneity across studies [Chi^2=181.58, df=30 (P<0.00001), I^2=83%]
- Moderate GRADE rating

Test for subgroup differences is not significant [Chi^2=0.79, df=1 (P=0.37), I^2=0%]; primary focus of intervention does not explain variation across studies

1.1.1 Only Studies Reporting BMI

- Overall: 21 studies; 3,100 participants; statistically significant lower BMI in the intervention group compared to the control group [MD (95% CI) -1.12 kg/m^2 (-1.52, -0.72); I^2=92%]
- Behavioural: 19 studies; 2,538 participants; statistically significant lower BMI in intervention group compared to the control group [MD (95% CI) -1.15 kg/m^2 (-1.59, -0.72); I^2=93%]
- Pharmacological plus behavioural: 2 studies; 562 participants; statistically significant lower BMI in intervention group compared to control group [MD (95% CI) -0.86 kg/m^2 (-1.19, -0.52); I^2=0%]
- Test for subgroup differences is not significant [Chi^2=1.12, df=1 (p=0.29), I^2=10.4%)]; primary focus of intervention (behavioural, pharmacological plus behavioural) does not explain variation across studies

Behavioural

- 28 studies; 3,346 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.54 (-0.73, -0.36)]
- High statistical heterogeneity across studies [Chi^2=180.65, df=28 (P<0.00001), I^2=85%]
- Low GRADE rating

Pharmacological plus Behavioural

- 2 studies; 562 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.43 (-0.60, -0.25)]
- Low statistical heterogeneity across studies [Chi^2=0.93, df=1 (P=0.34), I^2=0%]
- Moderate GRADE rating

1.2 Immediate Post: Type of Intervention

Test for subgroup differences is not significant [Chi^2=3.22, df=3 (P=0.36), I^2=6.8%]; type of intervention does not explain variation across studies

Diet

- 2 studies; 270 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.36 (-0.65, -0.06)]
- Low statistical heterogeneity across studies [Chi^2=1.23, df=1 (P=0.27), I^2=19%]
- Moderate GRADE rating

Exercise
- 1 study; 322 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.43 (-0.65, -0.21)]
- High GRADE rating

Diet plus Exercise
- 6 studies; 684 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a large magnitude of effect [SMD (95% CI) -1.09 (-1.84, -0.34)]
- High statistical heterogeneity across studies [Chi^2=88.89, df=5 (P<0.00001), I^2=94%]
- Moderate GRADE rating

Lifestyle
- 19 studies; 2,070 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.42 (-0.61, -0.23)]
- High statistical heterogeneity across studies [Chi^2=79.96, df=19 (P<0.00001), I^2=76%]
- Moderate GRADE rating

1.3 Immediate Post: Duration of Intervention

Test for subgroup differences is not significant [Chi^2=0.00, df=1 (P=0.97), I^2=0%]; duration of intervention does not explain variation across studies

≤12 Months
- 25 studies; 3,056 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.54 (-0.73, -0.35)]
- High statistical heterogeneity across studies [Chi^2=156.06, df=25 (P<0.00001), I^2=84%]
- Low GRADE rating

>12 Months
- 3 studies; 290 participants
- No statistically significant difference between the intervention group and control group in terms of change in BMI/BMIz [SMD (95% CI) -0.53 (-1.31, 0.26)]
- High statistical heterogeneity across studies [Chi^2=20.28, df=2 (P<0.0001), I^2=90%]
- Low GRADE rating

1.4 Immediate Post: Age Group

Test for subgroup differences is not significant [Chi^2=0.05, df=1 (P=0.81), I^2=0%]; age groups does not explain variation across studies

2 to 12 Years
- 22 studies; 2,612 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.54 (-0.76, -0.32)]
- High statistical heterogeneity across studies [Chi^2=155.74, df=22 (P<0.00001), I^2=86%]
- Low GRADE rating

13 to 18 Years

- 6 studies; 734 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.59 (-0.92, -0.25)]
- High statistical heterogeneity across studies [Chi^2=22.56, df=5 (P=0.0004), I^2=78%]
- Moderate GRADE rating

1.5 Immediate Post: Intervention Target

Test for subgroup differences is significant [Chi^2=7.22, df=1 (P=0.007), I^2=86.2%]; target of intervention explains some of the variation across studies

Individual Child/Youth

- 11 studies; 1,347 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a large magnitude of effect [SMD (95% CI) -0.90 (-1.27, -0.53)]
- High statistical heterogeneity across studies [Chi^2=94.07, df=10 (P<0.00001), I^2=89%]
- Moderate GRADE rating

Family

- 17 studies; 1,999 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.34 (-0.52, -0.16)]
- High statistical heterogeneity across studies [Chi^2=63.10, df=17 (P<0.00001), I^2=73%]
- Moderate GRADE rating

1.6 Immediate Post: Study Risk of Bias Rating

Test for subgroup differences is not significant [Chi^2=1.34, df=2 (P=0.51), I^2=0%]; study risk of bias rating does not explain variation across studies

Low Risk of Bias

- 3 studies; 479 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.41 (-0.59, -0.22)]
- Low statistical heterogeneity across studies [Chi^2=0.16, df=2 (P=0.92), I^2=0%]
- High GRADE quality

Unclear Risk of Bias

- 22 studies; 2,638 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.49 (-0.68, -0.30)]
- High statistical heterogeneity across studies [Chi^2=117.57, df=22 (P<0.00001), I^2=81%]
- Low GRADE rating

High Risk of Bias

- 3 studies; 229 participants
- No statistically significant difference between the intervention group and control group in terms of change in BMI/BMIz [SMD (95% CI) -1.24 (-2.79, 0.32)]
- High statistical heterogeneity across studies [Chi^2=46.14, df=2 (P<0.00001), I^2=96%]
- Very Low GRADE rating

Maintenance of Treatment Benefits

1.7 Benefits from Baseline to Immediate Post

Overall

- 4 studies; 716 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.51 (-0.86, -0.16)]
- High statistical heterogeneity across studies [Chi^2=15.74, df=3 (P=0.001), I^2=81%]
- Moderate GRADE rating

Test for subgroup differences is not significant [Chi^2=1.42, df=1 (P=0.23), I^2=30%]; age groups does not explain variation across studies

Aged 2 to 12 Years

- 2 studies; 304 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a medium magnitude of effect [SMD (95% CI) -0.72 (-1.38, -0.07)]
- High statistical heterogeneity across studies [Chi^2=7.73, df=1 (P=0.005), I^2=87%]
- Moderate GRADE rating

Aged 13 to 18 Years

- 2 studies; 412 participants
- Statistically significant lowered BMI/BMIz in the intervention group as compared to the control group with a small magnitude of effect [SMD (95% CI) -0.31 (-0.50, -0.11)]
- Low statistical heterogeneity across studies [Chi^2=0.13, df=1 (P=0.72), I^2=0%]
- Moderate GRADE rating

1.8 Benefits from Immediate Post to Follow-up

Overall

- 4 studies; 686 participants
- No statistically significant difference between the intervention group and control group in terms of change in BMI/BMIz [SMD (95% CI) 0.08 (-0.07, 0.23)]
- Low statistical heterogeneity across studies [Chi^2=2.72, df=3 (P=0.44), I^2=0%]
- Low GRADE rating

Test for subgroup differences is not significant [Chi^2=0.63, df=1 (P=0.43), I^2=0%]; age groups does not explain variation across studies

Aged 2 to 12 Years

- 2 studies; 304 participants
- No statistically significant difference between the intervention group and control group in terms of change in BMI/BMIz [SMD (95% CI) 0.15 (-0.12, 0.43)]
- Moderate statistical heterogeneity across studies [Chi^2=1.48, df=1 (P=0.22), I^2=33%]
- Low GRADE rating

Aged 13 to 18 Years

- 2 studies; 382 participants
- No statistically significant difference between the intervention group and control group in terms of change in BMI/BMIz [SMD (95% CI) 0.02 (-0.19, 0.22)]
- Low statistical heterogeneity across studies [Chi^2=0.36, df=1 (P=0.55), I^2=0%]
- Low GRADE rating

GRADE Evidence Profile Table 1.1: Effect of Treatment Interventions on BMI/BMIz *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Standard Mean Difference (95% CI)		
Change in BMI/BMIz: Overall (Better indicated by lower values)											
30	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	no serious imprecision[5]	none[6]	2,156	1,752	0.5263 lower (0.6949 to 0.3578 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Primary Focus of Intervention - Behavioural (Better indicated by lower values)											
28	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	no serious imprecision[11]	reporting bias[12]	1,792	1,554	0.5446 lower (0.7298 to 0.3594 lower)	⊕⊕OO LOW	CRITICAL
Change in BMI/BMIz: by Primary Focus of Intervention – Pharmacological (Orlistat 120 mg 3x/day) plus Behavioural (Better indicated by lower values)											
2	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	no serious imprecision[17]	none[18]	364	198	0.4287 lower (0.6044 to 0.2529 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Type of Behavioural Intervention - Diet (Better indicated by lower values)											
2	randomized trials[19]	serious risk[20]	no serious inconsistency[21]	no serious indirectness[22]	no serious imprecision[23]	none[24]	138	132	0.3586 lower (0.6530 to 0.0642 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Type of Behavioural Intervention - Exercise (Better indicated by lower values)											
1	randomized trial[25]	no serious risk[26]	no serious inconsistency[27]	no serious indirectness[28]	no serious imprecision[29]	none[30]	160	162	0.4323 lower (0.6533 to 0.2113 lower)	⊕⊕⊕⊕ HIGH	CRITICAL
Change in BMI/BMIz: by Type of Behavioural Intervention - Diet plus Exercise (Better indicated by lower values)											
6	randomized trials[31]	serious risk[32]	no serious inconsistency[33]	no serious indirectness[34]	no serious imprecision[35]	none[36]	385	299	1.0883 lower (1.8356 to 0.3409 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Type of Behavioural Intervention - Lifestyle (Better indicated by lower values)											
19	randomized trials[37]	serious risk[38]	no serious inconsistency[39]	no serious indirectness[40]	no serious imprecision[41]	none[42]	1,109	961	0.4193 lower (0.6074 to 0.2312 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Duration ≤12 Months (Better indicated by lower values)											
25	randomized trials[43]	serious risk[44]	no serious inconsistency[45]	no serious indirectness[46]	no serious imprecision[47]	reporting bias[48]	1,645	1,411	0.5435 lower (0.7348 to 0.3522 lower)	⊕⊕OO LOW	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Duration >12 Months (Better indicated by lower values)											
3	randomized trials[49]	serious risk[50]	no serious inconsistency[51]	no serious indirectness[52]	serious imprecision[53]	none[54]	147	143	0.5258 lower (1.3144 lower to 0.2629 higher)	⊕⊕OO LOW	CRITICAL

Change in BMI/BMIz: by Age Group in Behavioural Interventions - 2 to 12 Years (Better indicated by lower values)											
22	randomized trials[55]	serious risk[56]	no serious inconsistency[57]	no serious indirectness[58]	no serious imprecision[59]	reporting bias[60]	1,423	1,189	0.5371 lower (0.7575 to 0.3167 lower)	⊕⊕OO LOW	CRITICAL
Change in BMI/BMIz: by Age Group in Behavioural Interventions - 13 to 18 Years (Better indicated by lower values)											
6	randomized trials[61]	serious risk[62]	no serious inconsistency[63]	no serious indirectness[64]	no serious imprecision[65]	none[66]	369	365	0.5851 lower (0.9211 to 0.2491 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Target – Individual Child/Youth (Better indicated by lower values)											
11	randomized trials[67]	serious risk[68]	no serious inconsistency[69]	no serious indirectness[70]	no serious imprecision[71]	none[72]	714	633	0.8997 lower (1.2680 to 0.5315 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Target – Families (Better indicated by lower values)											
17	randomized trials[73]	serious risk[74]	no serious inconsistency[75]	no serious indirectness[76]	no serious imprecision[77]	none[78]	1,078	921	0.3377 lower (0.5177 to 0.1577 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Study Risk of Bias Rating - Low (Better indicated by lower values)											
3	randomized trials[79]	no serious risk[80]	no serious inconsistency[81]	no serious indirectness[82]	no serious imprecision[83]	none[84]	253	226	0.4072 lower (0.5899 to 0.2244 lower)	⊕⊕⊕⊕ HIGH	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Study Risk of Bias Rating – Unclear (Better indicated by lower values)											
22	randomized trials[85]	serious risk[86]	no serious inconsistency[87]	no serious indirectness[88]	no serious imprecision[89]	reporting bias[90]	1,390	1,248	0.4877 lower (0.6760 to 0.2995 lower)	⊕⊕OO LOW	CRITICAL
Change in BMI/BMIz: by Behavioural Intervention Study Risk of Bias Rating – High (Better indicated by lower values)											
3	randomized trials[91]	very serious risk[92]	no serious inconsistency[93]	no serious indirectness[94]	serious imprecision[95]	none[96]	149	80	1.2362 lower (2.7945 lower to 0.3221 higher)	⊕OOO VERY LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 1.1: Effect of Treatment Interventions on BMI/BMIz

Outcome: Change in BMI/BMIz	In terms of standard mean difference (95% CI), compared to the control group, the BMI/BMIz in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	**0.5263 lower** (0.6949 to 0.3578 lower)	3,908 (30 studies[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]
By Primary Focus of Intervention - Behavioural	**0.5446 lower** (0.7298 to 0.3594 lower)	3,346 (28 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
By Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural	**0.4287 lower** (0.6044 to 0.2529 lower)	562 (2 studies[13])	⊕⊕⊕⊖ **moderate**[14,15,16,17,18]
By Type of Behavioural Intervention - Diet	**0.3586 lower** (0.6530 to 0.0642 lower)	270 (2 studies[19])	⊕⊕⊕⊖ **moderate**[20,21,22,23,24]
By Type of Behavioural Intervention - Exercise	**0.4323 lower** (0.6533 to 0.2113 lower)	322 (1 study[25])	⊕⊕⊕⊕ **high**[26,27,28,29,30]
By Type of Behavioural Intervention - Diet plus Exercise	**1.0883 lower** (1.8356 to 0.3409 lower)	684 (6 studies[31])	⊕⊕⊕⊖ **moderate**[32,33,34,35,36]
By Type of Behavioural Intervention - Lifestyle	**0.4193 lower** (0.6074 to 0.2312 lower)	2,070 (19 studies[37])	⊕⊕⊕⊖ **moderate**[38,39,40,41,42]
By Behavioural Intervention Duration ≤12 Months	**0.5435 lower** (0.7348 to 0.3522 lower)	3,056 (25 studies[43])	⊕⊕⊖⊖ **low**[44,45,46,47,48]
By Behavioural Intervention Duration >12 Months	**0.5258 lower** (1.3144 lower to 0.2629 higher)	290 (3 studies[49])	⊕⊕⊖⊖ **low**[50,51,52,53,54]
By Age Group in Behavioural Interventions - 2 to 12 Years	**0.5371 lower** (0.7575 to 0.3167 lower)	2,612 (22 studies[55])	⊕⊕⊖⊖ **low**[56,57,58,59,60]
By Age Group in Behavioural Interventions - 13 to 18 Years	**0.5851 lower** (0.9211 to 0.2491 lower)	734 (6 studies[61])	⊕⊕⊕⊖ **moderate**[62,63,64,65,66]
By Behavioural Intervention Target – Individual Child/Youth	**0.8997 lower** (1.2680 to 0.5315 lower)	1,347 (11 studies[67])	⊕⊕⊕⊖ **moderate**[68,69,70,71,72]
By Behavioural Intervention Target – Family	**0.3377 lower** (0.5177 to 0.1577 lower)	1,999 (17 studies[73])	⊕⊕⊕⊖ **moderate**[74,75,76,77,78]
By Study Risk Of Bias Rating – Low	**0.4072 lower** (0.5899 to 0.2244 lower)	479 (3 studies[79])	⊕⊕⊕⊕ **high**[80,81,82,83,84]
By Study Risk of Bias Rating - Unclear	**0.4877 lower** (0.6760 to 0.2995 lower)	2,638 (22 studies[85])	⊕⊕⊖⊖ **low**[86,87,88,89,90]
By Study Risk of Bias Rating - High	**1.2362 lower** (2.7945 lower to 0.3221 higher)	229 (3 studies[91])	⊕⊖⊖⊖ **very low**[92,93,94,95,96]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 1.1 for Effect of Treatment Interventions on BMI/BMIz

[1] The 30 studies are:[67-96] Immediate post assessment for all but 8 studies. For these studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Nemet[72] and Vos[91] provide data for outcomes at 9 months after completion of 3 month interventions).

[2] Using Cochrane's Risk of Bias tool, for this outcome 3 studies (10%) were rated as high risk, 24 studies (80%) were rated as unclear risk and 3 studies (10%) were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (40%), allocation concealment (73%), blinding of participants and/or personnel (93%), blinding of outcome assessors (70%), and other sources of bias (40%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is high [Chi^2=181.58, df=30 (P<0.00001); I^2=83%], but the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Across the 30 studies, most included mixed gender samples (n=29); 1 included only girls. About three-quarters (n=22) of the studies included children aged 2 to 12 and the remaining quarter (n=8) included youth aged 13 to 18. In terms of weight status at baseline, 18 studies included overweight and obese participants, 1 study included only overweight children, and 11 studies included only obese participants. In terms of type of intervention, 2 were diet, 1 was exercise, 6 were diet plus exercise, 19 were lifestyle, and 2 were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in most studies (n=22) and a minimal component in the remaining 6 studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 13 studies was the individual child/youth; in 17 studies the target for intervention was families. Intervention duration was 12 months or less in 27 (90%) studies (in about two-thirds of these studies the duration was 6 months or less) and duration was 2 years in 3 studies. One study was jointly located in Canada and the US, 11 studies were conducted in the US, 10 in European countries, 5 in Australia or New Zealand, and 1 in each of Iran, Israel, and Malaysia. Two-thirds of the studies (n=20) were published in the last 5 years (2009-2013); the remaining 10 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (2,156 intervention; 1,752 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.5263 (-0.6949, -0.3578)]. This body of evidence was not downgraded for imprecision.

[6] The funnel plot for these studies and this outcome is roughly symmetrical. The Egger's test was conducted to detect publication bias; results were not significant (P=0.067). This body of evidence was not downgraded for reporting bias.

[7] The 28 studies are:[68-74,76-96] Immediate post assessment for all but 8 studies. For these studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Wake[86] presents outcomes

at 3 months following completion of a 3 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Nemet[72] and Vos[91] provide data for outcomes at 9 months after completion of 3 month interventions).

[8] Using Cochrane's Risk of Bias tool, for this outcome 3 studies (11%) were rated as high risk, 22 studies (78%) were rated as unclear risk and 3 studies (11%) were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (36%), allocation concealment (75%), blinding of participants and/or personnel (96%), blinding of outcome assessors (71%), and other sources of bias (36%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is high [Chi^2=180.65, df=28 (P<0.00001); I^2=85%], but the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Across the 28 studies, most included mixed gender samples (n=27); 1 included only girls. About three-quarters (n=22) of the studies included children aged 2 to 12 and the remaining 6 studies included youth aged 13 to 18. In terms of weight status at baseline, 17 studies included overweight and obese participants, 1 study included only overweight children, and 10 studies included only obese participants. In terms of type of intervention, 2 were diet, 1 was exercise, 6 were diet plus exercise, and 19 were lifestyle. Control participants received usual care or no intervention in most studies (n=22) and a minimal component in the remaining 6 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 12 studies was the individual child/youth; in 16 studies the target for intervention was families. Intervention duration was 12 months or less in 25 (89%) studies (in about two-thirds of these studies the duration was 6 months or less) and duration was 2 years in 3 studies. Ten studies were conducted in the US, 10 in European countries, 5 in Australia or New Zealand, and 1 in each of Iran, Israel, and Malaysia. More than two-thirds of the studies (n=20) were published in the last 5 years (2009-2013); the remaining 8 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[11] The sample size is adequate (1,792 intervention; 1,554 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.5446 (-0.7298, -0.3594)]. This body of evidence was not downgraded for imprecision.

[12] The funnel plot for these studies and this outcome is asymmetrical. The Egger's test was conducted to detect publication bias; results were significant (P=0.023). This body of evidence was downgraded for suspected reporting bias.

[13] The 2 studies are:[67,75] Immediate post assessment for both studies.

[14] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (50%), blinding of participants and/or personnel (50%), blinding of outcome assessors (50%), and other sources of bias (100%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[15] The statistical heterogeneity is low [Chi^2=0.93, df=1 (P=0.34); I^2=0%], the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[16] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. In terms of type of intervention both were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months in 1 study and 6 months in the other study. One study was jointly located in Canada and the US and the other was conducted in the US. The studies were published in 2005 and 2006. This body of evidence was not downgraded for indirectness.

[17] The sample size is adequate in the intervention arm (n=364) but of some concern in the control arm (n=198); however the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.4287 (-0.6044, -0.2529)]. This body of evidence was not downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

[19] The 2 studies are:[85,93] Immediate post assessment for both studies.

[20] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (100%), blinding of participants and/or personnel (100%), blinding of outcome assessors (50%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[21] The statistical heterogeneity is low [Chi^2=1.23, df=1 (P=0.27); I^2=19%], the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[22] Both diet intervention studies included mixed gender samples, one with children aged 2 to 12 and one with youth aged 13 to 18. In terms of weight status at baseline both studies included overweight and obese participants. Control participants in one study received no intervention; in the second study they were given a placebo (3g of sunflower oil added per serving of milk). The intervention target in both studies was the individual child/youth. Intervention duration was 12 months in 1 study and 6 months in the other study. Both studies were conducted in the US. The studies were published in the last 5 years (2010, 2012). This body of evidence was not downgraded for indirectness.

[23] The sample size is of concern in both arms (138 intervention; 132 control) but the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.3586 (-0.6530, -0.0642)]. This body of evidence was not downgraded for imprecision.

[24] Too few studies (n<10) to assess reporting bias.

[25] The 1 study is:[82] Immediate post assessment.

[26] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as low risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with blinding of participants and/or personnel and blinding of outcome assessors but all other domains were rated as low risk of bias. This body of evidence was not downgraded for study limitations.

[27] Cannot assess inconsistency with a single study.

[28] This 6 month exercise intervention study included a mixed gender sample of overweight and obese children aged 2 to 12. Control participants received no intervention. The intervention target was the individual child. The study was conducted in New Zealand and was published in the last 5 years (2011). This body of evidence was not downgraded for indirectness.

[29] The sample size is of concern in both arms (160 intervention; 162 control) but the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.4323 (-0.6533, -0.2113)]. This body of evidence was not downgraded for imprecision.

[30] Too few studies (n<10) to assess reporting bias.

[31] The 6 studies are:[72,83,86,87,92,94] Immediate post assessment for all but 2 studies. For these 2 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; Nemet[72] provides data for outcomes at 9 months after completion of a 3 month intervention).

[32] Using Cochrane's Risk of Bias tool, for this outcome 2 studies (33%) were rated as high risk and 4 studies (66%) were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (67%), allocation concealment (83%), blinding of participants and/or personnel (83%), blinding of outcome assessors (83%), and other sources of bias (33%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[33] The statistical heterogeneity is high [Chi^2=88.89, df=5 (P<0.00001); I^2=94%] but the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[34] All 6 diet plus exercise intervention studies included mixed gender samples. Five studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, 3 studies included overweight and obese participants and 3 studies included only obese participants. Control participants received usual care or no intervention in all studies. The intervention target in 3 studies was the individual child/youth; in 3 studies the target for intervention was families. Intervention duration was 12 months or less in 5 studies (in 3 of these studies the duration was 6 months or less) and duration was 2 years in 1 study. Three studies were conducted in European countries and 1 in each of Australia, Iran and Israel. Four of the studies were published in the last 5 years (2009-2013); the remaining 2 studies were published in 2005 and 2008. This body of evidence was not downgraded for indirectness.

[35] The sample size is adequate (385 intervention; 299 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -1.0883 (-1.8356, -0.3409)]. This body of evidence was not downgraded for imprecision.

[36] Too few studies (n<10) to assess reporting bias.

[37] The 19 studies are:[68-71,73,74,76-81,84,88-91,95,96] Immediate post assessment for all but 6 studies. For these 6 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[38] Using Cochrane's Risk of Bias tool, for this outcome 1 study (5%) was rated as high risk, 16 studies (85%) were rated as unclear risk, and 2 studies (10%) were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (21%), allocation concealment (74%), blinding of participants and/or personnel (100%), blinding of outcome assessors (68%), and other sources of bias (37%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[39] The statistical heterogeneity is high [Chi^2=79.96, df=19 (P<0.00001); I^2=76%] but the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[40] Most of the lifestyle intervention studies (n=18) included mixed gender samples; 1 study included only girls. Fifteen studies included children aged 2 to 12 and the remaining 4 studies included youth aged 13 to 18. In terms of weight status at baseline, 11 studies included overweight and obese participants, 1 study included only overweight children, and 7 studies included only obese participants. Control participants received usual care or no intervention in most studies (n=14) and a minimal component in the remaining 5 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 5 studies was the individual child/youth; in 14 studies the target for intervention was families. Intervention duration was 12 months or less in 17 studies (in 11 of these studies the duration was 6 months or less) and duration was 2 years in 2 studies. Eight studies were conducted in the US, 7 studies were conducted in European countries, 3 in Australia, and 1 in Malaysia. Thirteen of the studies were published in the last 5 years (2009-2013); the remaining 6 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[41] The sample size is adequate (1,109 intervention; 961 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.4193 (-0.6074, -0.2312)]. This body of evidence was not downgraded for imprecision.

[42] The funnel plot for these studies and this outcome is roughly symmetrical. The Egger's test was conducted to detect publication bias; results were not significant (P=0.221). This body of evidence was not downgraded for reporting bias.

[43] The 25 studies are:[68-73,76-87,89-93,95,96] Immediate post assessment for all but 8 studies. For these studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Nemet[72] and Vos[91] provide data for outcomes at 9 months after completion of 3 month interventions).

[44] Using Cochrane's Risk of Bias tool, for this outcome 3 studies (12%) were rated as high risk, 19 studies (76%) were rated as unclear risk and 3 studies (12%) were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (32%), allocation concealment (72%), blinding of participants and/or personnel (96%), blinding of outcome assessors (68%), and other sources of bias (40%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[45] The statistical heterogeneity is high [Chi^2=156.06, df=25 (P<0.00001); I^2=84%] but the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[46] Across the 25 studies, most included mixed gender samples (n=24); 1 included only girls. Most studies (n=20) included children aged 2 to 12 and the remaining 5 studies included youth aged 13 to 18. In terms of weight status at baseline, 15 studies included overweight and obese participants, 1 study included only overweight children, and 9 studies included only obese participants. In terms of type of intervention, 2 were diet, 1 was exercise, 5 were diet plus exercise, and 17 were lifestyle. Control participants received usual care or no intervention in most studies (n=20) and a minimal component in the remaining 5 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 10 studies was the individual child/youth; in 15 studies the target for intervention was families. Intervention duration was 6 months or less in two-thirds of the studies (n=16). Nine studies were conducted in the US, 9 in European countries, 5 in Australia or New Zealand, and 1 in each of Israel and Malaysia. Almost three-quarters of the studies (n=18) were published in the last 5 years (2009-2013); the remaining 7 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[47] The sample size is adequate (1,645 intervention; 1,411 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.5435 (-0.7348, -0.3522)]. This body of evidence was not downgraded for imprecision.

[48] The funnel plot for these studies and this outcome is asymmetrical. The Egger's test was conducted to detect publication bias; results were significant (P=0.010). This body of evidence was downgraded for suspected reporting bias.

[49] The 3 studies are:[74,88,94] Immediate post assessment for all studies.

[50] Using Cochrane's Risk of Bias tool, for this outcome all 3 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (100%), blinding of participants and/or personnel (100%), and blinding of outcome assessors (67%). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[51] The statistical heterogeneity is high [Chi^2=20.28, df=2 (P<0.0001); I^2=90%] but the direction of the effect is consistent across studies and the confidence intervals overlap across most studies. This body of evidence was not downgraded for inconsistency.

[52] All 3 studies included mixed gender samples. Two studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, 2 studies included overweight and obese participants and 1 study included only obese participants. In terms of type of intervention, 1 was diet plus exercise and 2 were lifestyle. Control participants received usual care or no intervention in 2 studies and a minimal component in the remaining study (e.g., newsletters or handouts covering general health concepts). The intervention target in 1 study was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 2 years in all 3 studies. One study was conducted in the US, 1 in Sweden, and 1 in Iran. Two studies were published in the last 5 years (2011); the remaining study was published in 2008. This body of evidence was not downgraded for indirectness.

[53] The sample size is of concern in both arms (147 intervention; 143 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [SMD (95% CI) -0.5258 (-1.3144, 0.2629)]. This body of evidence was downgraded for imprecision.

[54] Too few studies (n<10) to assess reporting bias.

[55] The 22 studies are:[68-70,72,74,76,78-90,92,95,96] Immediate post assessment for all but 4 studies. For these 4 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Nemet[72] provides data for outcomes at 9 months after completion of a 3 month intervention).

[56] Using Cochrane's Risk of Bias tool, for this outcome 3 studies (14%) were rated as high risk, 17 studies (77%) were rated as unclear risk and 2 studies (9%) were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (36%), allocation concealment (77%), blinding of participants and/or personnel (95%), blinding of outcome assessors (77%), and other sources of bias (36%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[57] The statistical heterogeneity is high [Chi^2=155.74, df=22 (P<0.00001); I^2=86%] but the direction of the effect is consistent across studies and the confidence intervals overlap across most studies. This body of evidence was not downgraded for inconsistency.

[58] All 22 studies for children aged 2 to 12 years included mixed gender samples. In terms of weight status at baseline, 13 studies included overweight and obese participants, 1 study included only overweight children, and 8 studies included only obese participants. In terms of type of intervention, 1 was diet, 1 was exercise, 5 were diet plus exercise, and 15 were lifestyle. Control participants received usual care or no intervention in most studies (n=18) and a minimal component in the remaining 4 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 6 studies was the individual child/youth; in 16 studies the target for intervention was families. Intervention duration was 12 months or less in 20 (91%) studies (in almost two-thirds of these studies the duration was 6 months or less) and duration was 2 years in 2 studies. Six studies were conducted in the US, 9 in European countries, 5 in Australia or New Zealand, and 1 in each of Israel and Malaysia. Almost three-quarters of the studies (n=16) were published in the last 5 years (2009-2013); the remaining 6 studies were published between 2005 and 2008. This body of evidence was not downgraded for indirectness.

[59] The sample size is adequate (1,423 intervention; 1,189 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.5371 (-0.7575, -0.3167)]. This body of evidence was not downgraded for imprecision.

[60] The funnel plot for these studies and this outcome is asymmetrical. The Egger's test was conducted to detect publication bias; results were significant (P=0.029). This body of evidence was downgraded for suspected reporting bias.

[61] The 6 studies are:[71,73,77,91,93,94] Immediate post assessment for 2 studies and for 4 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention; Vos[91] provides data for outcomes at 9 months after completion of 3 month intervention).

[62] Using Cochrane's Risk of Bias tool, for this outcome 5 studies (83%) were rated as unclear risk and 1 study (17%) was rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (33%), allocation concealment (67%), blinding of participants and/or personnel (100%), blinding of outcome assessors (50%), and other sources of bias (33%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[63] The statistical heterogeneity is high [Chi^2=22.56, df=5 (P=0.0004); I^2=78%] but the direction of the effect is consistent across studies and the confidence intervals overlap across most studies. This body of evidence was not downgraded for inconsistency.

[64] Five of the 6 studies for youth aged 13 to 18 years included mixed gender samples; 1 study included only girls. In terms of weight status at baseline, 4 studies included overweight and obese participants and 2 studies included only obese participants. In terms of type of intervention, 1 was diet, 1 was diet plus exercise,

and 4 were lifestyle. Control participants received usual care or no intervention in 4 studies and a minimal component in the remaining 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 5 studies was the individual youth; in 1 study the target for intervention was families. Intervention duration was 12 months or less in 5 studies (in 4 of these studies the duration was 6 months or less) and duration was 2 years in 1 study. Four studies were conducted in the US, and 1 in each of the Netherlands and Iran. Four of the studies were published in the last 5 years (2009-2013); the remaining 2 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[65] The sample size is adequate (369 intervention; 365 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.5851 (-0.9211, -0.2491)]. This body of evidence was not downgraded for imprecision.

[66] Too few studies (n<10) to assess reporting bias.

[67] The 11 studies are:[71,73,77,78,82,84,85,87,92-94] Immediate post assessment for all but 3 studies. For these 3 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention).

[68] Using Cochrane's Risk of Bias tool, for this outcome 2 studies (18%) were rated as high risk, 7 studies (64%) were rated as unclear risk and 2 studies (18%) were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (45%), allocation concealment (73%), blinding of participants and/or personnel (100%), blinding of outcome assessors (64%), and other sources of bias (36%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[69] The statistical heterogeneity is high [Chi^2=94.07, df=10 (P<0.00001); I^2=89%] but the direction of the effect is consistent across studies and the confidence intervals overlap across most studies. This body of evidence was not downgraded for inconsistency.

[70] Across the 11 child/youth targeted studies, most included mixed gender samples (n=10); 1 included only girls. About half (n=6) of the studies included children aged 2 to 12 and the other half (n=5) included youth aged 13 to 18. In terms of weight status at baseline, 7 studies included overweight and obese participants, 1 study included only overweight children, and 3 studies included only obese participants. In terms of type of intervention, 2 were diet, 1 was exercise, 3 were diet plus exercise, and 5 were lifestyle. Control participants received usual care or no intervention in most studies (n=8) and a minimal component in the remaining 3 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 12 studies was the individual child/youth; in 16 studies the target for intervention was families. Intervention duration was 12 months or less in 10 (91%) studies (in 8 of these studies the duration was 6 months or less) and duration was 2 years in 1 study. Five studies were conducted in the US, 4 in European countries, 1 in New Zealand and 1 in Iran. Almost three-quarters of the studies (n=8) were published in the last 5 years (2009-2013); the remaining 3 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[71] The sample size is adequate (714 intervention; 633 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.8997 (-1.2680, -0.5315)]. This body of evidence was not downgraded for imprecision.

[72] The funnel plot for these studies and this outcome is roughly symmetrical. The Egger's test was conducted to detect publication bias; results were not significant (P=0.053). This body of evidence was not downgraded for reporting bias.

[73] The 17 studies are:[68-70,72,74,76,79-81,83,86,88-91,95,96] Immediate post assessment for all but 5 studies. For these 5 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Nemet[72] and Vos[91] provide data for outcomes at 9 months after completion of 3 month interventions).

[74] Using Cochrane's Risk of Bias tool, for this outcome 1 study (6%) was rated as high risk, 15 studies (88%) were rated as unclear risk and 1 study (6%) was rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (29%), allocation concealment (76%), blinding of participants and/or personnel (94%), blinding of outcome assessors (71%), and other sources of bias (35%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that most of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[75] The statistical heterogeneity is high [Chi^2=63.10, df=17 (P<0.00001); I^2=73%] but the direction of the effect is consistent across studies and the confidence intervals overlap across most studies. This body of evidence was not downgraded for inconsistency.

[76] All 17 of the family targeted studies included mixed gender samples. Most (n=16) of the studies included children aged 2 to 12 and 1 study included youth aged 13 to 18. In terms of weight status at baseline, 10 studies included overweight and obese participants and 7 studies included only obese participants. In terms of type of intervention, 3 were diet plus exercise, and 14 were lifestyle. Control participants received usual care or no intervention in most studies (n=14) and a minimal component in the remaining 3 studies (e.g., newsletters or handouts covering general health concepts). Intervention duration was 12 months or less in 15 (79%) studies (in about half of these studies the duration was 6 months or less) and duration was 2 years in 2 studies. Five studies were conducted in the US, 6 in European countries, 4 in Australia, and 1 in each of Malaysia and Israel. Most of the studies (n=12) were published in the last 5 years (2009-2013); the remaining 5 studies were published between 2005 and 2008. This body of evidence was not downgraded for indirectness.

[77] The sample size is adequate (1,078 intervention; 921 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.3377 (-0.5177, -0.1577)]. This body of evidence was not downgraded for imprecision.

[78] The funnel plot for these studies and this outcome is roughly symmetrical. The Egger's test was conducted to detect publication bias; results were not significant (P=0.209). This body of evidence was not downgraded for reporting bias.

[79] The 3 studies are:[69,73,82] Immediate post assessment for 2 studies and for 1 study the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Doyle[73] presents outcomes at 4 months after completion of a 4 month intervention).

[80] Using Cochrane's Risk of Bias tool, for this outcome all 3 studies were rated as low risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with blinding of participants and/or personnel and in 1 study blinding of outcome assessors was unclear. Given that all of the information is from studies at low risk of bias, this body of evidence was not downgraded for study limitations.

[81] The statistical heterogeneity is low [Chi^2=0.16, df=2 (P=0.92); I^2=0%], the direction of the effect is consistent across studies and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[82] All 3 low risk of bias studies included mixed gender samples. Two studies included children aged 2 to 12 and the other study included youth aged 13 to 18. In terms of weight status at baseline, all 3 studies included overweight and obese participants. In terms of type of intervention, 1 was exercise and 2 were lifestyle.

Control participants received usual care or no intervention in 1 study and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 1 study the target for intervention was families. Intervention duration was 12 months or less in all 3 studies (in 2 studies the duration was 6 months or less). One study was conducted in the US, 1 in Australia, and 1 in New Zealand. One study was published in the last 5 years (2009-2013); the other 2 studies were published between 2007 and 2008. This body of evidence was not downgraded for indirectness.

[83] The sample size is of some concern in both groups (253 intervention; 226 control) but the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.4072 (-0.5899, -0.2244)]. This body of evidence was not downgraded for imprecision.

[84] Too few studies (n<10) to assess reporting bias.

[85] The 22 studies are:[68,70-72,74,77-81,83-86,88-91,93-96] Immediate post assessment for all but 7 studies. For these 7 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; Saelens[71] presents outcomes at 3 months following a 4 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Janicke[90] presents outcomes at 6 months post completion of an intervention that lasted 4 months; Nemet[72] and Vos[91] provide data for outcomes at 9 months after completion of 3 month interventions).

[86] Using Cochrane's Risk of Bias tool, for this outcome all 22 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (36%), allocation concealment (82%), blinding of participants and/or personnel (95%), blinding of outcome assessors (73%), and other sources of bias (36%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[87] The statistical heterogeneity is high [Chi^2=117.57, df=22 (P<0.00001); I^2=81%] but the direction of the effect is consistent across studies and most of the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[88] Across the 22 unclear risk of bias studies, most (n=21) included mixed gender samples; 1 study included only girls. Most studies (n=17) included children aged 2 to 12 and the other 5 studies included youth aged 13 to 18. In terms of weight status at baseline, 13 studies included overweight and obese participants, 1 study included only overweight children, and 8 included only obese participants. In terms of type of intervention, 2 were diet, 4 were diet plus exercise and 16 were lifestyle. Control participants received usual care or no intervention in 18 studies and a minimal component in the other 4 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 7 studies was the individual child/youth; in 15 studies the target for intervention was families. Intervention duration was 12 months or less in 19 studies (in 13 of these studies the duration was 6 months or less); in 3 studies the intervention duration was 2 years. Nine studies were conducted in the US, 7 in European countries, 3 in Australia, and 1each of Iran, Israel and Malaysia. Seventeen studies were published in the last 5 years (2009-2013); the other 5 studies were published between 2002 and 2008. This body of evidence was not downgraded for indirectness.

[89] The sample size is adequate (1,390 intervention; 1,248 control) and the pooled effect estimate is precise with a narrow confidence interval [SMD (95% CI) -0.4877 (-0.6760, -0.2995)]. This body of evidence was not downgraded for imprecision.

[90] The funnel plot for these studies and this outcome is asymmetrical. The Egger's test was conducted to detect publication bias; results were significant (P=0.046). This body of evidence was downgraded for suspected reporting bias.

[91] The 3 studies are:[76,87,92] Immediate post assessment for all studies.

[92] Using Cochrane's Risk of Bias tool, for this outcome all 3 studies were rated as high risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (67%), allocation concealment (100%), blinding of participants and/or personnel (100%), blinding of outcome assessors (100%), and other sources of bias (67%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at high risk of bias, this body of evidence was downgraded for very serious study limitations.

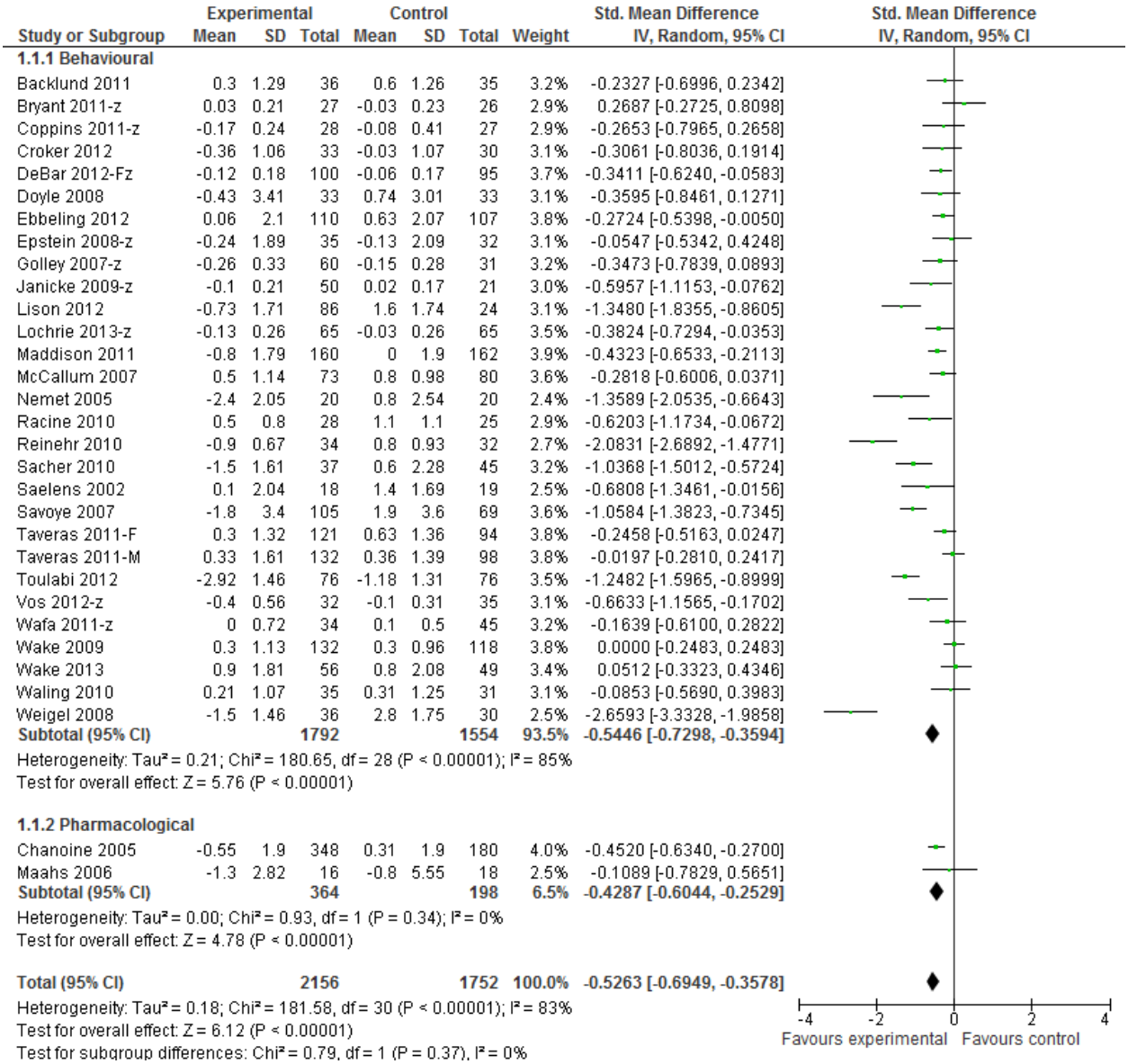
[93] The statistical heterogeneity is high [Chi^2=46.14, df=2 (P<0.00001); I^2=96%] but the meta-analysis shows either benefits toward the interventions or no effect. This body of evidence was not downgraded for inconsistency.

[94] All 3 high risk of bias studies included mixed gender samples of children aged 2 to 12. In terms of weight status at baseline, 1 study included overweight and obese participants and the other 2 studies included only obese children. In terms of type of intervention, 2 were diet plus exercise and 1 was lifestyle. Control participants received usual care or no intervention in all 3 studies. The intervention target in 2 studies was the individual child; in 1 study the target for intervention was families. Intervention duration was 12 months or less in all 3 studies (in 1 study the duration was 6 months or less). All 3 studies were conducted in European countries. Two studies were published in the last 5 years (2009-2013); the other study was published in 2008. This body of evidence was not downgraded for indirectness.

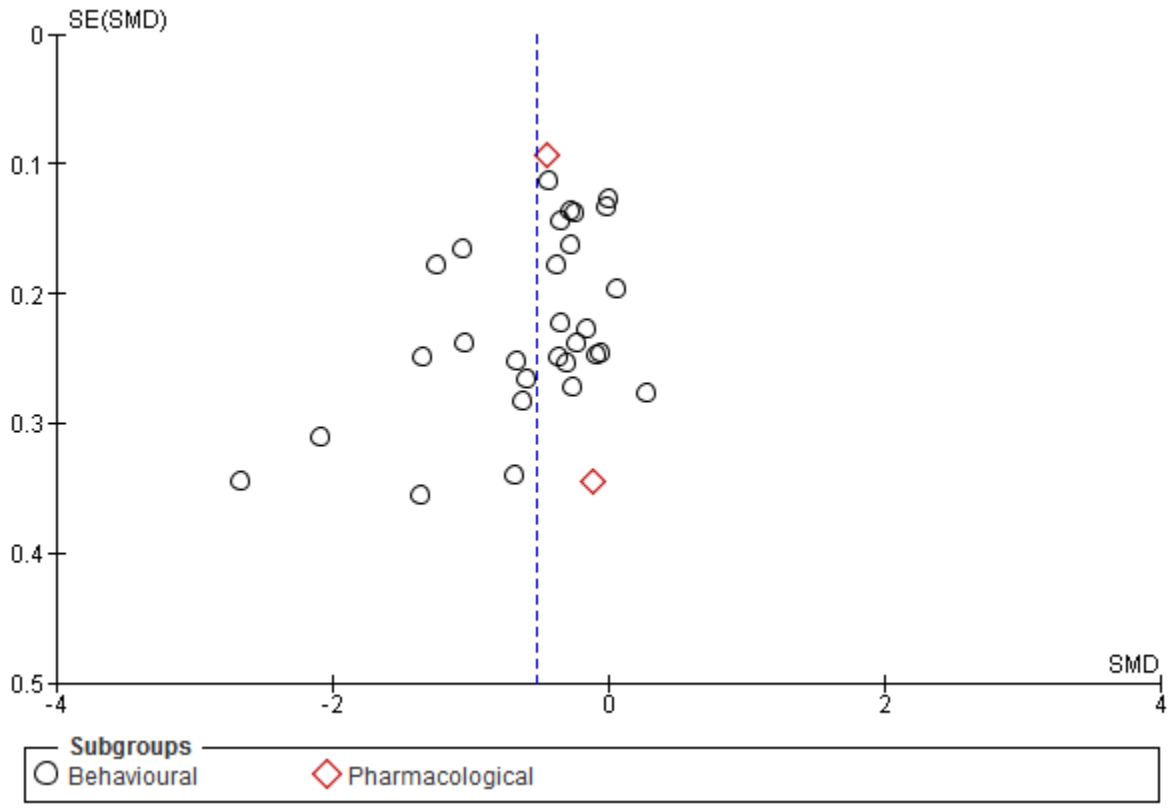
[95] There are concerns about the sample size in both groups (149 intervention; 80 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [SMD (95% CI) -1.2362 (-2.7945, 0.3221)]. This body of evidence was downgraded for imprecision.

[96] Too few studies (n<10) to assess reporting bias.

Forest Plot 1.1: Effect of Treatment Interventions on BMI/BMIz – Overall and by Primary Focus of Intervention [Behavioural, Pharmacological (Orlistat) plus Behavioural]



Funnel Plot 1.1: Effect of Treatment Interventions on BMI/BMIz – Overall and by Primary Focus of Intervention [Behavioural, Pharmacological (Orlistat) plus Behavioural]



Egger's Test to Detect Publication Bias: Change in BMI/BMIz – Overall and by Primary Focus of Intervention [Behavioural, Pharmacological (Orlistat) plus Behavioural]

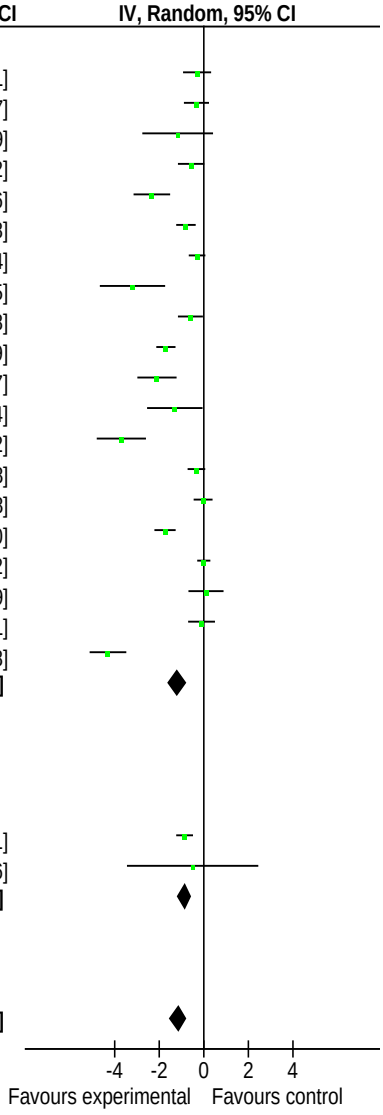
Included Studies	P-value
Overall	0.067
Behavioural Only	0.023*
Pharmacological (Orlistat) plus Behavioural	**

* Significant $p \leq 0.05$

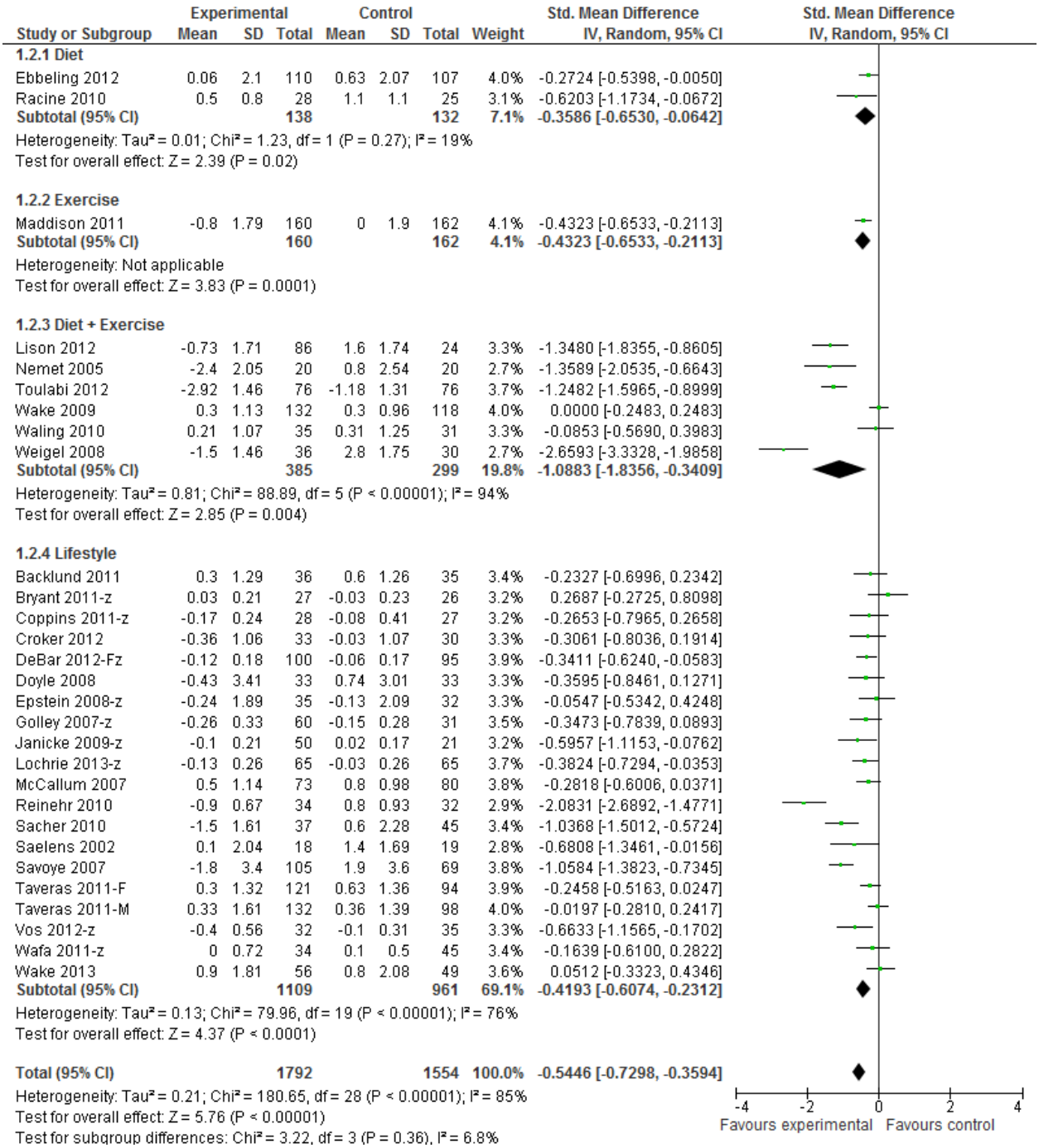
** Too few studies ($n < 10$) to assess

Forest Plot 1.1.1: Effect of Treatment Interventions on BMI Only – Overall and by Primary Focus of Intervention [Behavioural, Pharmacological (Orlistat) plus Behavioural]

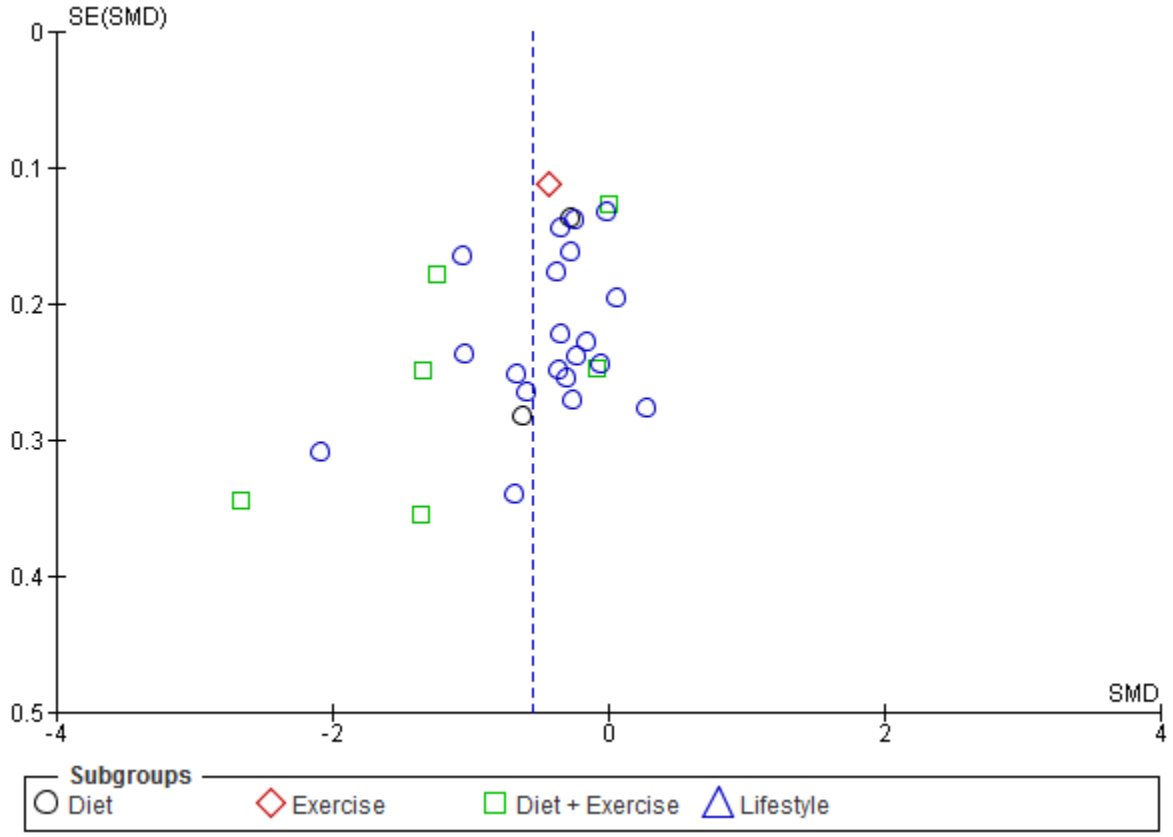
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
1.1.1 Behavioural								
Backlund 2011	0.3	1.29	36	0.6	1.26	35	4.9%	-0.3000 [-0.8931, 0.2931]
Croker 2012	-0.36	1.06	33	-0.03	1.07	30	5.0%	-0.3300 [-0.8567, 0.1967]
Doyle 2008	-0.43	3.41	33	0.74	3.01	33	3.0%	-1.1700 [-2.7219, 0.3819]
Ebbeling 2012	0.06	2.1	110	0.63	2.07	107	5.0%	-0.5700 [-1.1248, -0.0152]
Lison 2012	-0.73	1.71	86	1.6	1.74	24	4.5%	-2.3300 [-3.1144, -1.5456]
Maddison 2011	-0.8	1.79	160	0	1.9	162	5.2%	-0.8000 [-1.2032, -0.3968]
McCallum 2007	0.5	1.14	73	0.8	0.98	80	5.3%	-0.3000 [-0.6384, 0.0384]
Nemet 2005	-2.4	2.05	20	0.8	2.54	20	3.2%	-3.2000 [-4.6305, -1.7695]
Racine 2010	0.5	0.8	28	1.1	1.1	25	5.0%	-0.6000 [-1.1232, -0.0768]
Reinehr 2010	-0.9	0.67	34	0.8	0.93	32	5.2%	-1.7000 [-2.0931, -1.3069]
Sacher 2010	-1.5	1.61	37	0.6	2.28	45	4.4%	-2.1000 [-2.9443, -1.2557]
Saelens 2002	0.1	2.04	18	1.4	1.69	19	3.6%	-1.3000 [-2.5106, -0.0894]
Savoye 2007	-1.8	3.4	105	1.9	3.6	69	3.9%	-3.7000 [-4.7698, -2.6302]
Taveras 2011-F	0.3	1.32	121	0.63	1.36	94	5.3%	-0.3300 [-0.6918, 0.0318]
Taveras 2011-M	0.33	1.61	132	0.36	1.39	98	5.2%	-0.0300 [-0.4188, 0.3588]
Toulabi 2012	-2.92	1.46	76	-1.18	1.31	76	5.1%	-1.7400 [-2.1810, -1.2990]
Wake 2009	0.3	1.13	132	0.3	0.96	118	5.4%	0.0000 [-0.2592, 0.2592]
Wake 2013	0.9	1.81	56	0.8	2.08	49	4.6%	0.1000 [-0.6509, 0.8509]
Waling 2010	0.21	1.07	35	0.31	1.25	31	4.9%	-0.1000 [-0.6651, 0.4651]
Weigel 2008	-1.5	1.46	36	2.8	1.75	30	4.5%	-4.3000 [-5.0872, -3.5128]
Subtotal (95% CI)			**1361**			**1177**	**93.3%**	**-1.1520 [-1.5856, -0.7184]**
Heterogeneity: Tau² = 0.84; Chi² = 258.69, df = 19 (P < 0.00001); I² = 93%								
Test for overall effect: Z = 5.21 (P < 0.00001)								
1.1.2 Pharmacological								
Chanoine 2005	-0.55	1.9	348	0.31	1.9	180	5.3%	-0.8600 [-1.2019, -0.5181]
Maahs 2006	-1.3	2.82	16	-0.8	5.55	18	1.4%	-0.5000 [-3.4126, 2.4126]
Subtotal (95% CI)			**364**			**198**	**6.7%**	**-0.8551 [-1.1947, -0.5155]**
Heterogeneity: Tau² = 0.00; Chi² = 0.06, df = 1 (P = 0.81); I² = 0%								
Test for overall effect: Z = 4.94 (P < 0.00001)								
Total (95% CI)			**1725**			**1375**	**100.0%**	**-1.1199 [-1.5184, -0.7215]**
Heterogeneity: Tau² = 0.75; Chi² = 259.52, df = 21 (P < 0.00001); I² = 92%								
Test for overall effect: Z = 5.51 (P < 0.00001)								
Test for subgroup differences: Chi² = 1.12, df = 1 (P = 0.29), I² = 10.4%								



Forest Plot 1.2: Effect of Treatment Interventions on BMI/BMIz – by Type of Behavioural Intervention (Diet, Exercise, Diet plus Exercise, Lifestyle)



Funnel Plot 1.2: Effect of Treatment Interventions on BMI/BMIz – by Type of Intervention (Diet, Exercise, Diet plus Exercise, Lifestyle)

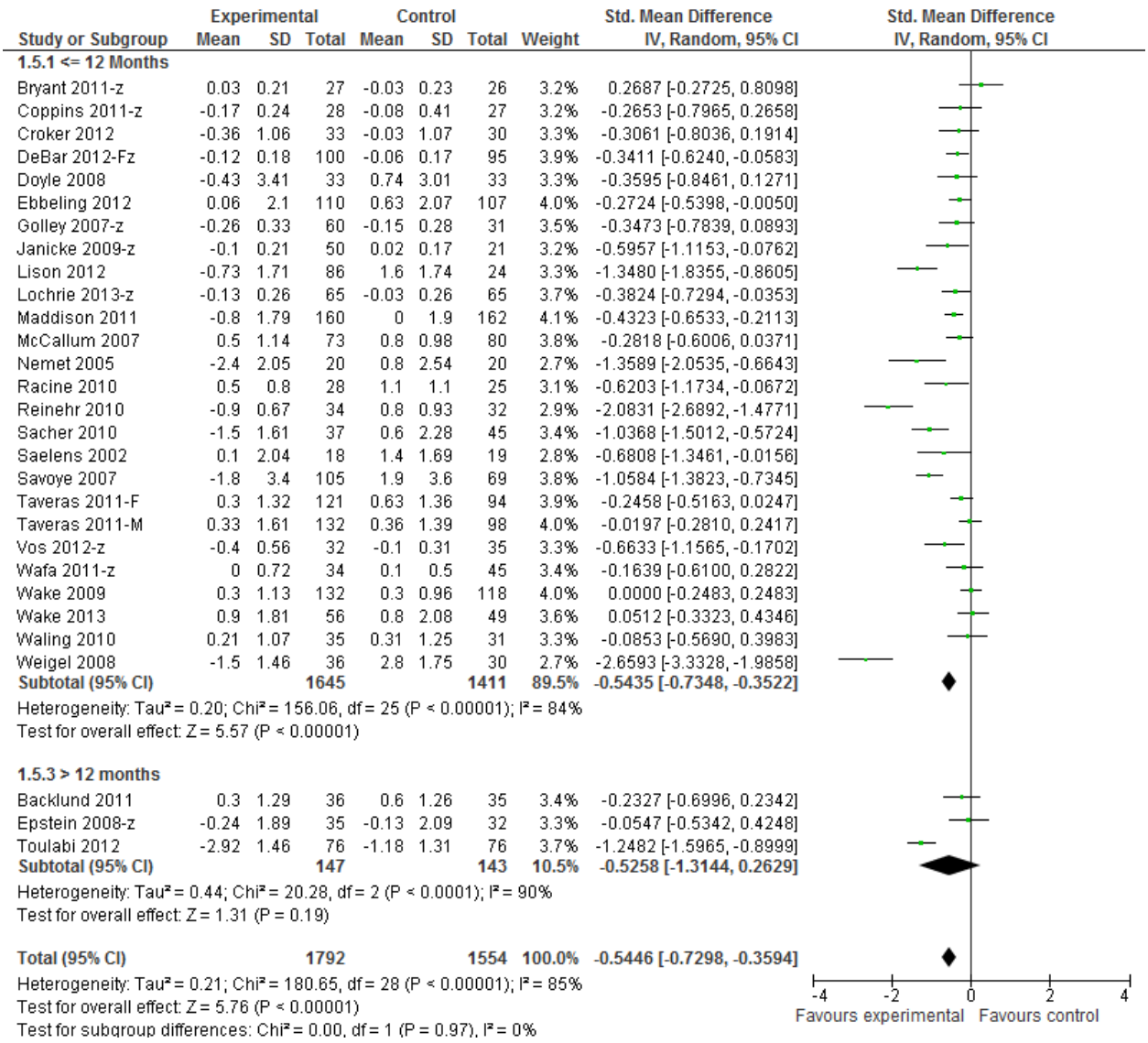


Egger's Test to Detect Publication Bias: Change in BMI/BMIz – by Type of Behavioural Intervention (Diet, Exercise, Diet plus Exercise, Lifestyle)

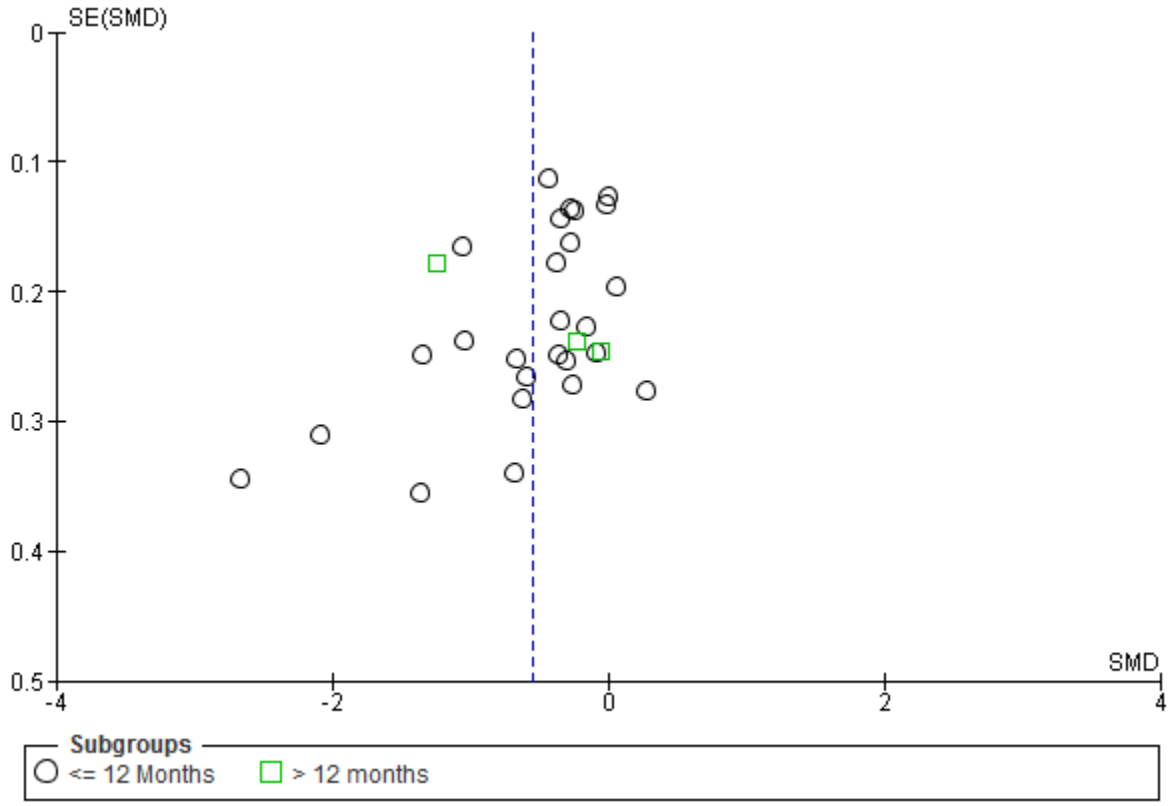
Included Studies	P-value
Diet	**
Exercise	**
Diet plus Exercise	**
Lifestyle	0.221

** Too few studies (n<10) to assess

Forest Plot 1.3: Effect of Treatment Interventions on BMI/BMIz – by Behavioural Intervention Duration (≤12 Months, >12 Months)



Funnel Plot 1.3: Effect of Treatment Interventions on BMI/BMIz – by Behavioural Intervention Duration (≤12 Months, >12 Months)



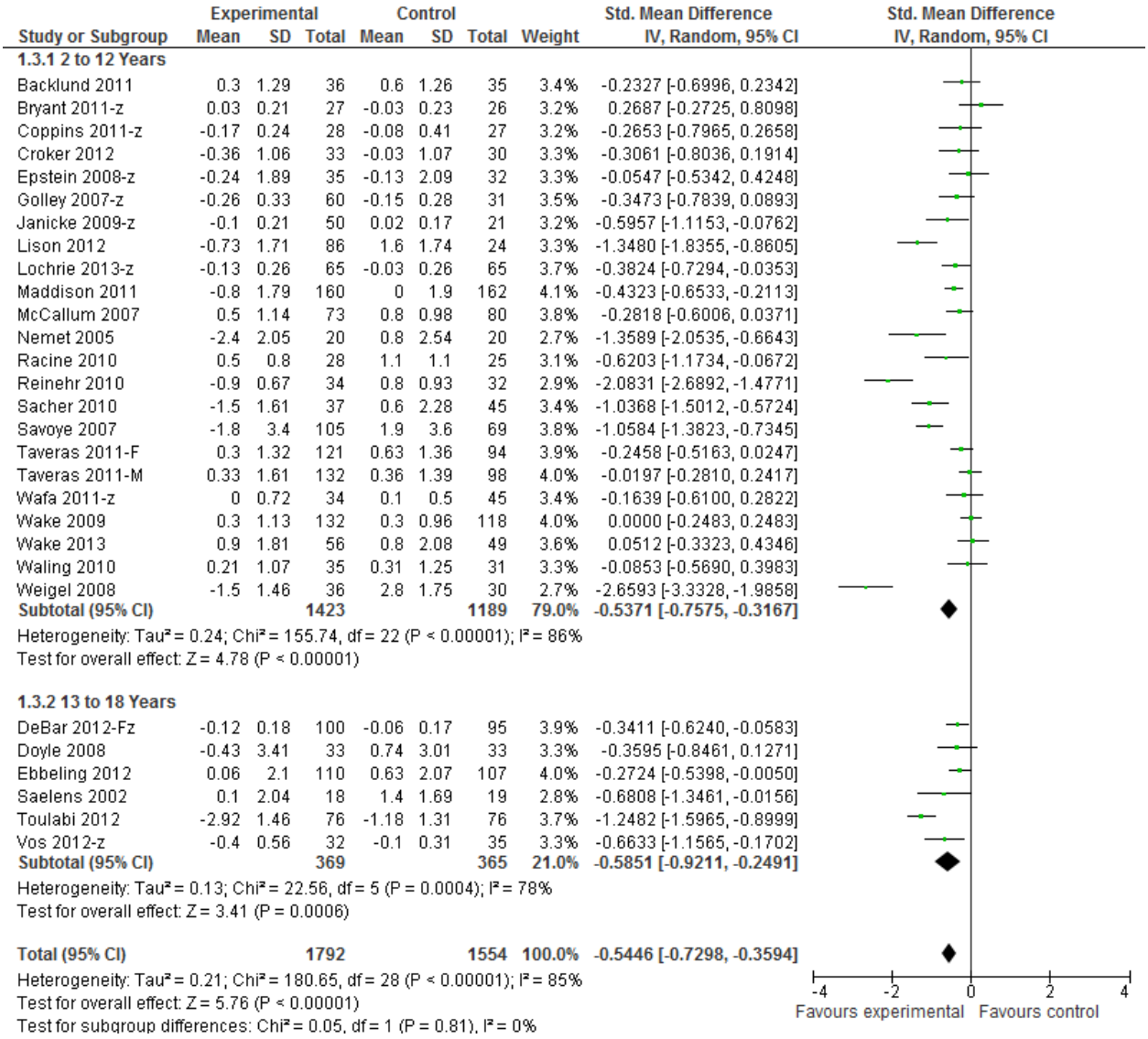
Egger's Test to Detect Publication Bias: Change in BMI/BMIz – by Behavioural Intervention Duration (≤12 Months, >12 Months)

Included Studies	P-value
≤12 Months	0.010*
>12 Months	**

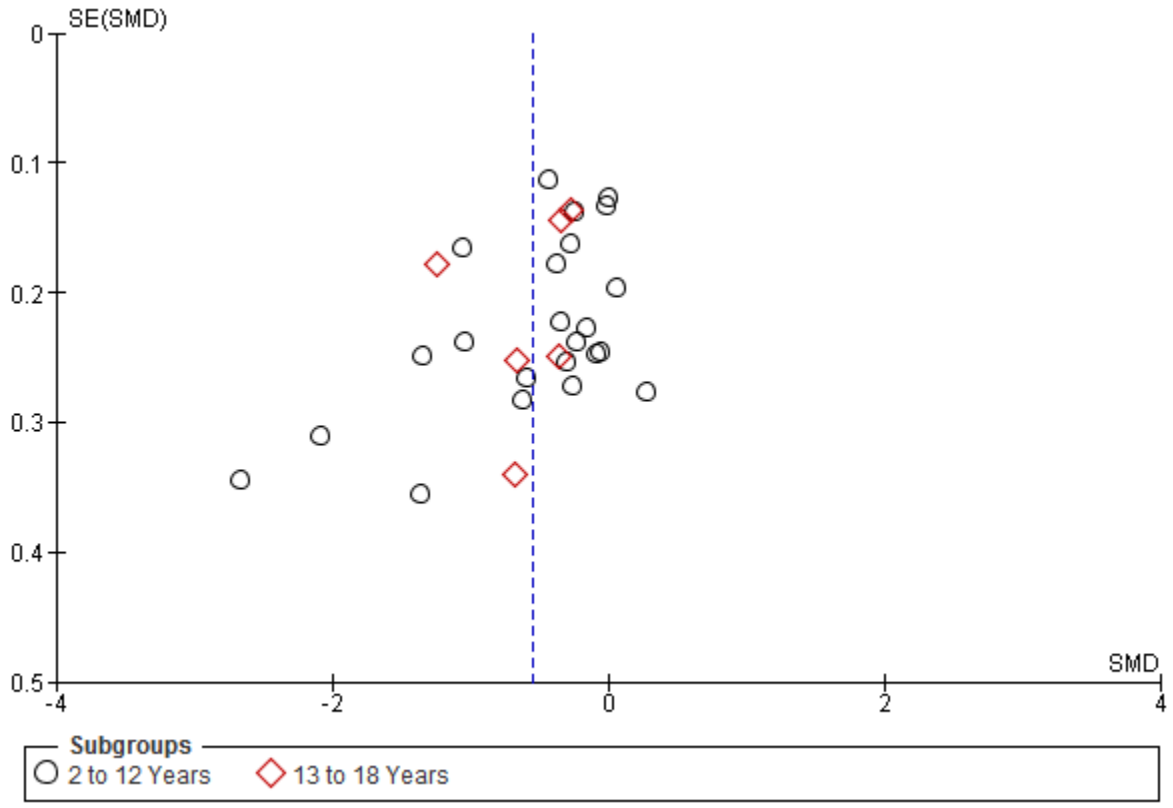
* Significant p≤0.05

** Too few studies (n<10) to assess

Forest Plot 1.4: Effect of Treatment Interventions on BMI/BMIz – by Participant Age Group (2 to 12 Years, 13 to 18 Years)



Funnel Plot 1.4: Effect of Treatment Interventions on BMI/BMIz – by Participant Age Group (2 to 12 Years, 13 to 18 Years)



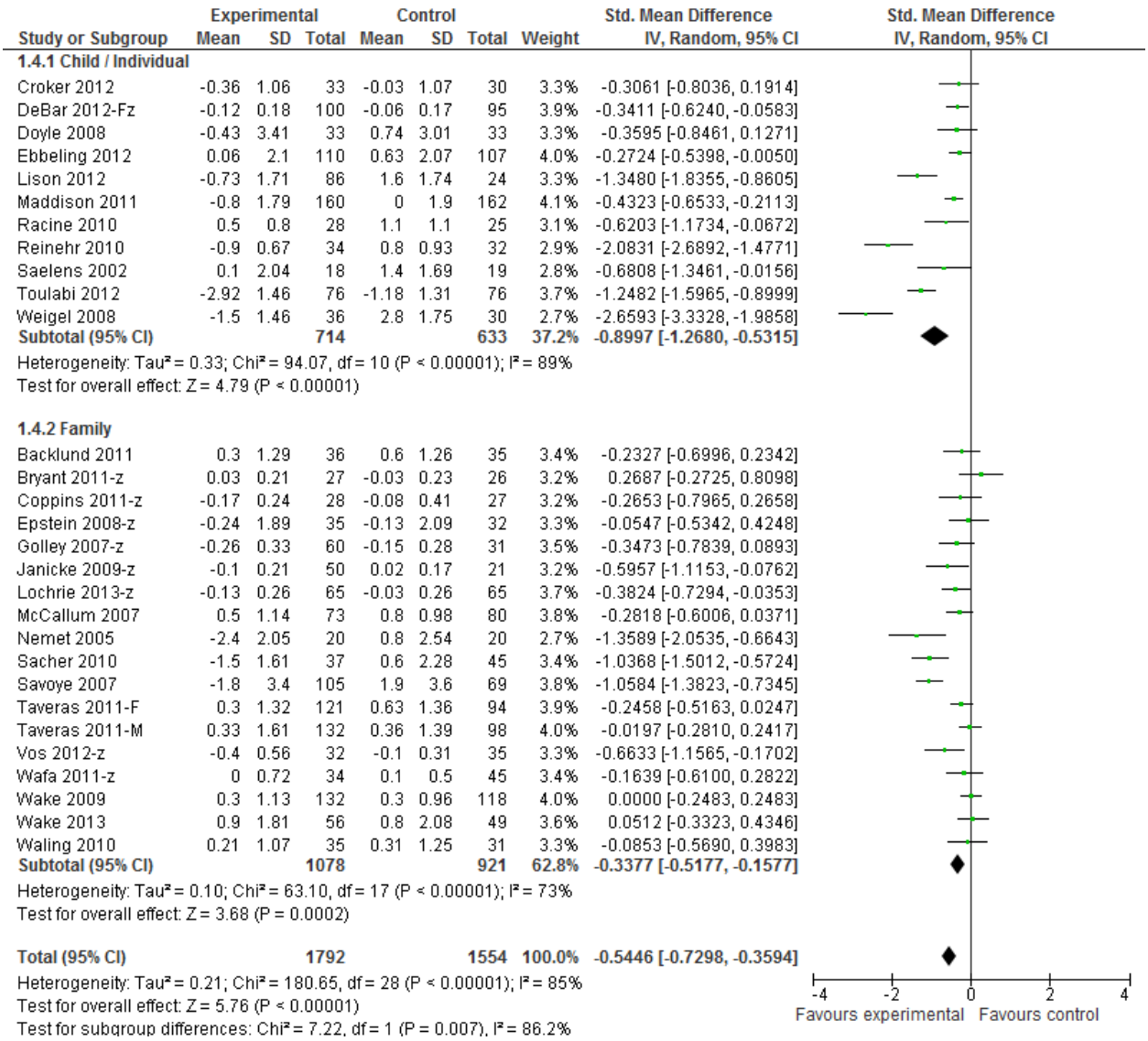
Egger's Test to Detect Publication Bias: Change in BMI/BMIz – by Participant Age Group (2 to 12 Years, 13 to 18 Years)

Included Studies	P-value
2 to 12 Years	0.029*
13 to 18 Years	**

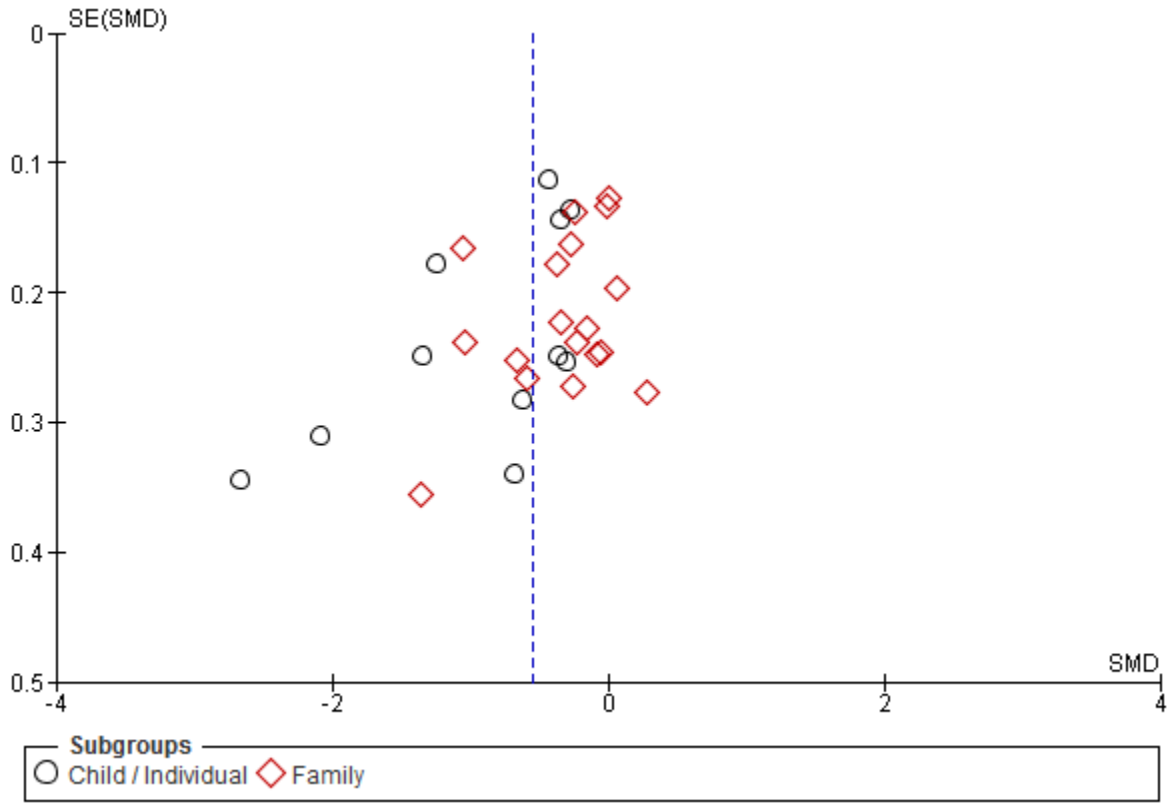
* Significant p≤0.05

** Too few studies (n<10) to assess

Forest Plot 1.5: Effect of Treatment Interventions on BMI/BMIz – by Intervention Target (Individual Child/Youth, Family)



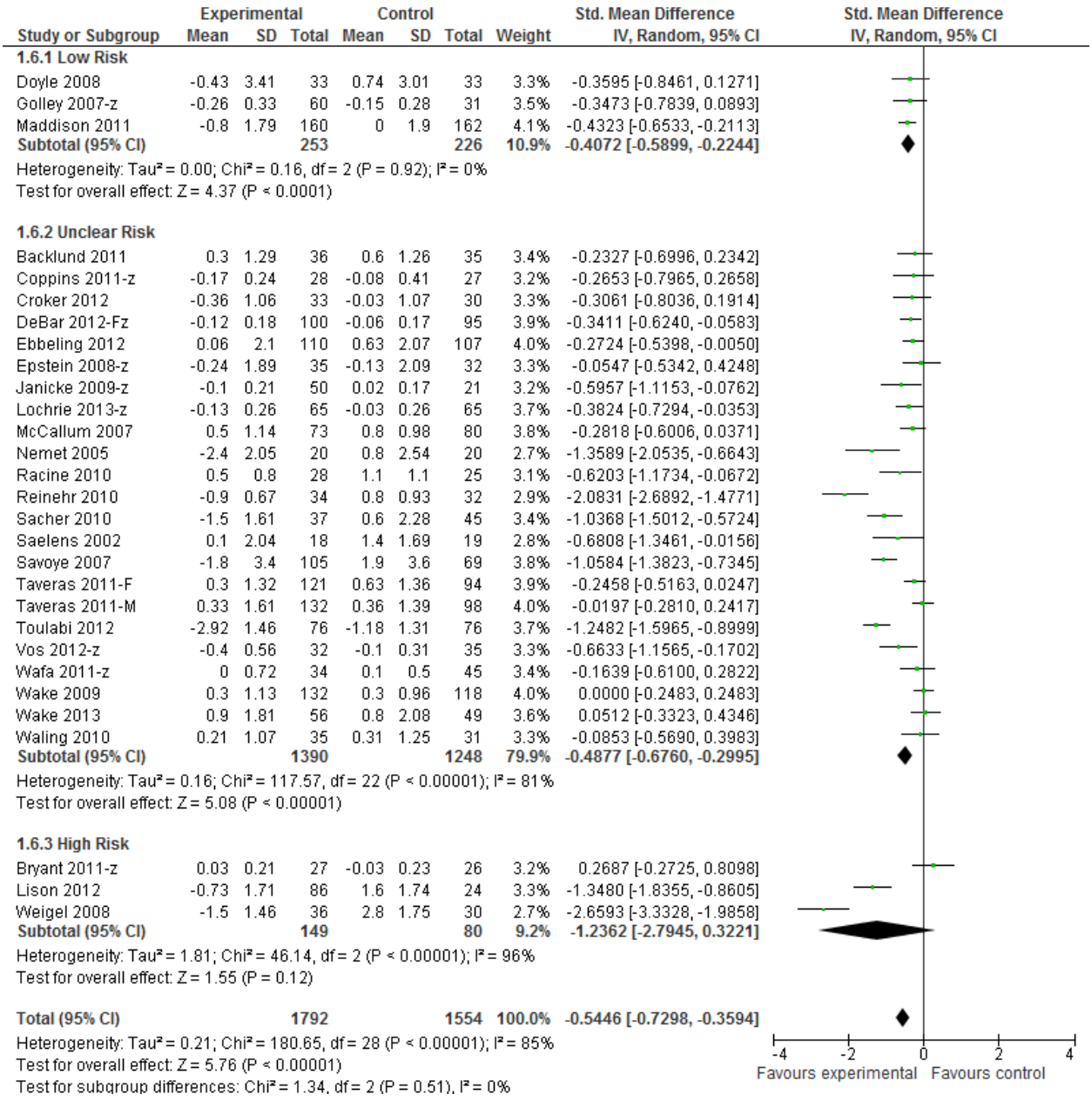
Funnel Plot 1.5: Effect of Treatment Interventions on BMI/BMIz – by Intervention Target (Individual Child/Youth, Family)



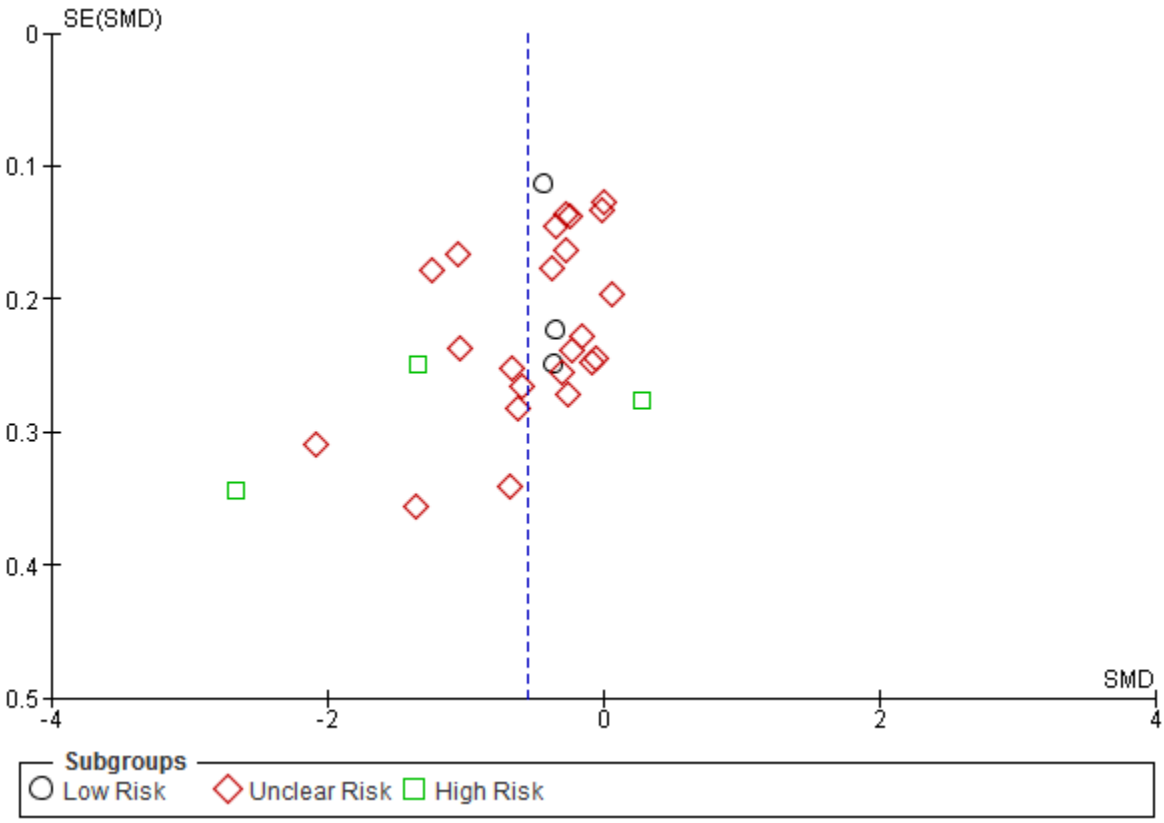
Egger's Test to Detect Publication Bias: Change in BMI/BMIz – by Intervention Target (Individual Child/Youth, Family)

Included Studies	P-value
Child/Individual	0.053
Family	0.209

Forest Plot 1.6: Effect of Treatment Interventions on BMI/BMIz – by Study Risk of Bias Rating (Low, Unclear, High)



Funnel Plot 1.6: Effect of Treatment Interventions on BMI/BMIz – by Study Risk of Bias Rating (Low, Unclear, High)



Egger's Test to Detect Publication Bias: Change in BMI/BMIz – by Study Risk of Bias Rating (Low, Unclear, High)

Included Studies	P-value
Low Risk	**
Unclear Risk	0.046*
High Risk	**

* Significant p≤0.05

** Too few studies (n<10) to assess

GRADE Evidence Profile Table 1.2: Maintenance of Treatment Benefits - BMI/BMIz *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Standard Mean Difference (95% CI)		
Change in BMI/BMIz Overall – Immediate Post to Follow-up (6 to 12 months) (Better indicated by lower values)											
4	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	365	321	0.0781 higher (0.0726 lower to 0.2288 higher)	⊕⊕OO LOW	CRITICAL
Change in BMI/BMIz for Aged 2 to 12 Years – Immediate Post to Follow-up (6 to 12 months) (Better indicated by lower values)											
2	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	170	134	0.1542 higher (0.1248 lower to 0.4332 higher)	⊕⊕OO LOW	CRITICAL
Change in BMI/BMIz for Aged 13 to 18 Years – Immediate Post to Follow-up (7 to 12 months) (Better indicated by lower values)											
2	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision[17]	none[18]	195	187	0.0150 lower (0.1857 lower to 0.2157 higher)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 1.2: Maintenance of Treatment Benefits – BMI/BMIz

Outcome: Change in BMI/BMIz	Compared to the control group, the standard mean difference (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall – Immediate Post to Follow-up (6 to 12 months)	**0.0781 higher** (0.0726 lower to 0.2288 higher)	686 (4 studies[1])	⊕⊕⊖⊖ **low**[2,3,4,5,6]
Aged 2 to 12 Years – Immediate Post to Follow-up (6 to 12 months)	**0.1542 higher** (0.1248 lower to 0.4332 higher)	304 (2 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
Aged 13 to 18 Years – Immediate Post to Follow-up (7 to 12 months)	**0.1542 higher** (0.1248 lower to 0.4332 higher)	382 (2 studies[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 1.2 for Maintenance of Treatment Benefits

[1] The 4 studies are:[68,77,93,96] Follow-up points varied from 6 months to 7 months to 12 months post intervention completion.

[2] Using Cochrane's Risk of Bias tool, for this outcome all 4 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (50%), allocation concealment (75%), blinding of participants and/or personnel (100%), blinding of outcome assessors (50%), incomplete reporting (50%), and other sources of bias (25%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is low [Chi^2=2.72, df=3 (P=0.44) I^2=0%], the meta-analysis shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Across the 4 studies, 3 included mixed gender samples and 1 included only girls. Two studies included children aged 2 to 12 and 2 studies included youth aged 13 to 18. In terms of weight status at baseline, 3 studies included overweight and obese participants and 1 study included only obese participants. In terms of type of intervention, 1 was diet and 3 were lifestyle. Control participants received usual care or no intervention in 2 studies and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all 4 studies (in 2 of these studies the duration was 6 months or less). All 4 studies were conducted in the US. Three of the studies (n=20) were published in the last 5 years (2009-2013); the remaining study was published in 2007. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (365 intervention arm, 321 control arm) but the pooled effect estimate is not precise with a confidence interval that includes the no effect value [SMD 0.0781 (-0.0726, 0.2288)]. This body of evidence was downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 2 studies are:[68,96] Follow-up assessment occurred at 6 months in one study[96] and at 12 months in the other.[68]

[8] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (50%), allocation concealment (50%), blinding of participants and/or personnel (100%), blinding of outcome assessors (100%), incomplete reporting (100%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is moderate [Chi^2=1.48, df=1 (P=0.22) I^2=33%], the meta-analysis shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Both of the studies for children aged 2 to 12 years were focused on lifestyle interventions that included mixed gender samples. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. Control participants received usual care or no intervention in 1 study and a minimal component in the other study (e.g., newsletters or handouts covering general health concepts). The intervention target in both studies was families. Intervention duration was 6 months in 1 study and 12 months in the other. Both studies were conducted in the US. One study was published in the last 5 years (2009-2013) the other study was published in 2007. This body of evidence was not downgraded for indirectness.

[11] There are concerns about the sample size in both arms (170 intervention, 134 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [SMD 0.1542 (-0.1248, 0.4332)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 2 studies are:[77,93] Follow-up assessment occurred at 7 months in one study[77] and at 12 months in the other.[93]

[14] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (50%), allocation concealment (100%), and blinding of participants and/or personnel (100%). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

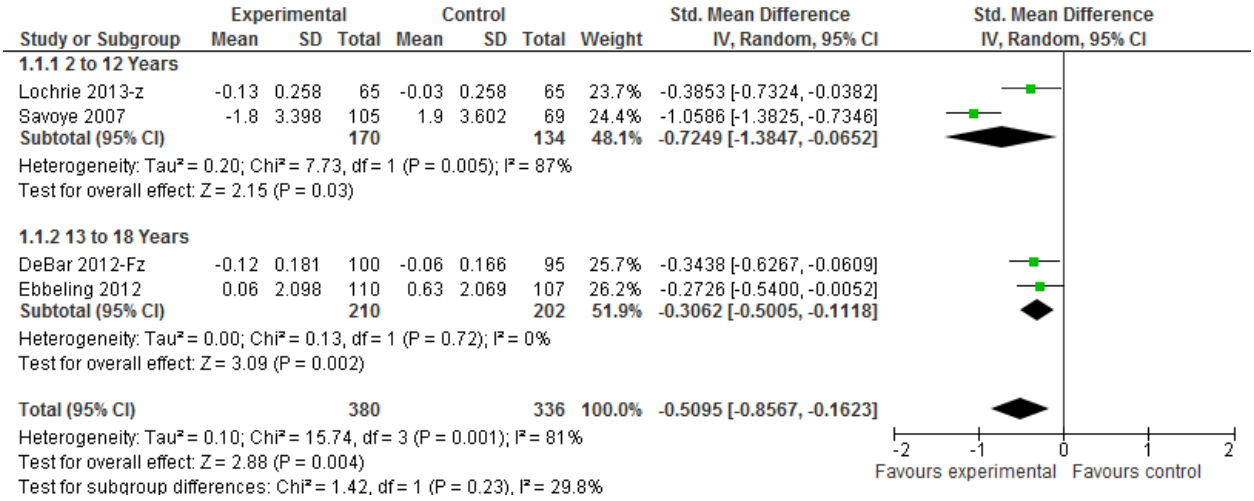
[15] The statistical heterogeneity is low [Chi^2=0.36, df=1 (P=0.55) I^2=0%], the meta-analysis shows no effect across studies, and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[16] One of the studies for youth included a mixed gender sample and the other included only girls. In terms of weight status at baseline, both studies included overweight and obese participants. In terms of type of intervention, 1 was diet and 1 was lifestyle. Control participants received usual care or no intervention in 1 study and a minimal component in the other study (e.g., newsletters or handouts covering general health concepts). The intervention target in both studies was the individual youth. Intervention duration was 5 months in one study and 12 months in the other. Both studies were conducted in the US and both were published in the last 5 years (2009-2013). This body of evidence was not downgraded for indirectness.

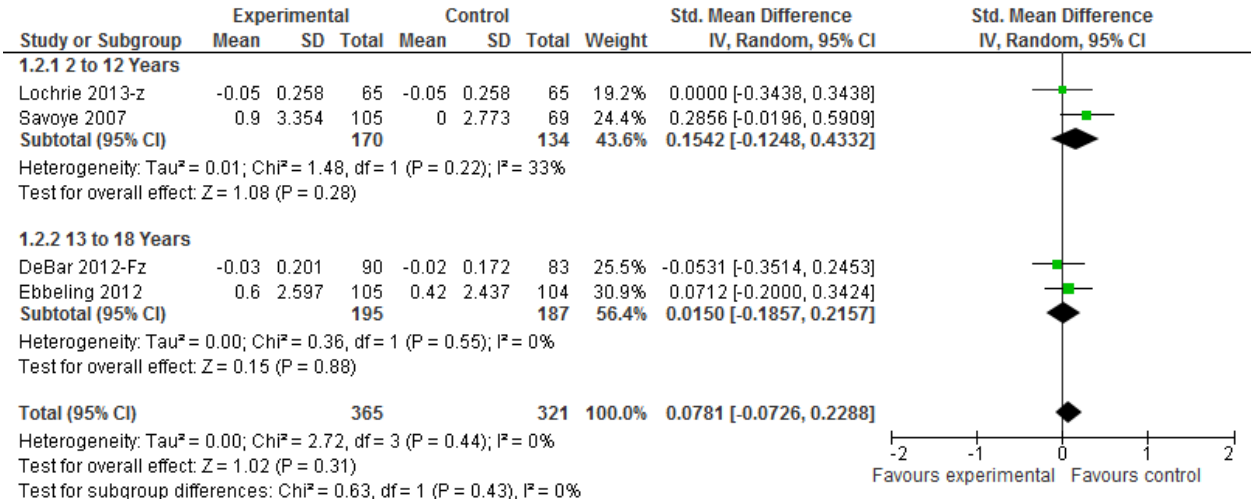
[17] There are concerns about the sample size in both arms (195 intervention, 187 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [SMD 0.0150 (-0.1857, 0.2157]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 1.7: Maintenance of Treatment Benefits – Baseline to Immediate Post Assessment for BMI/BMIz – by Participant Age Group (2 to 12 Years, 13 to 18 Years)



Forest Plot 1.8: Maintenance of Treatment Benefits – Immediate Post to Follow-up Assessment for BMI/BMIz – by Participant Age Group (2 to 12 Years, 13 to 18 Years)



Evidence Set 2: Do weight management programs (behavioural and combined pharmacological and behavioural interventions) lead to BMI stabilization or reduction in children and adolescents who are overweight or obese? – Prevalence of Overweight/Obesity

- Summary of Change in Prevalence of Overweight/Obesity Evidence
- GRADE Evidence Profile Table 2.1: Effect of Treatment Interventions on Prevalence of Overweight/Obesity

Summary of Change in Prevalence of Overweight/Obesity Evidence

Prevalence of Overweight (BMI 85th <95th Percentile)

- 1 study; 38 participants
- No statistically significant difference between the intervention group and control group in terms of the likelihood of showing a reduction in the prevalence of overweight [RR (95% CI) 0.90 (0.54, 1.46)]
- Low GRADE rating

Prevalence of Overweight/Obesity (BMI >85th Percentile)

- 1 study; 242 participants
- No statistically significant difference between the intervention group and control group in terms of the likelihood of showing a reduction in the prevalence of overweight/obesity [RR (95% CI) 0.93 (0.82, 1.06)]
- Low GRADE rating

Prevalence of Obesity (BMI >95th Percentile)

- 1 study; 40 participants
- 5 to 6% reduction in intervention group prevalence of obesity
- Low GRADE rating

GRADE Evidence Profile Table 2.1: Effect of Treatment Interventions on Prevalence of Overweight/Obesity

Quality Assessment							No. of Participants		Effect		Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other	Intervention	Control	RR (95% CI)	Absolute per Million (Range)		
Change in Prevalence Overweight BMI 85<95th Percentile (assessed 3 months after completion of a 4 month intervention)												
1	randomized trial[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	12/20 60.0000%	12/18 66.6667 %	0.9000 (0.5444, 1.4611)	66,667 fewer (297,067 fewer to 307,400 more)	⊕⊕OO LOW	CRITICAL
Change in Prevalence Overweight/Obesity >85 Percentile (assessed 9 months after completion of a 3 month intervention)												
1	randomized trial[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	98/127 77.1654%	95/115 82.6087 %	0.9341 (0.8232, 1.0600)	57,743 fewer (146,052 fewer to 49,565 more)	⊕⊕OO LOW	CRITICAL
Change in Prevalence Obesity ≥95 Percentile (assessed 9 months after completion of a 3 month intervention)												
1	randomized trial[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision [17]	none[18]	not reported / 20	not reported / 20	5 to 6% reduction in intervention group	-	⊕⊕OO LOW	CRITICAL

[1] The 1 study is:[71] The data point closest to the immediate post and a minimum of 6 months post baseline was selected (Saelens[71] presents outcomes at 3 months following a 4 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome the study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with blinding of participants and/or personnel, blinding of outcome assessors, and other sources of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

[3] Cannot assess inconsistency with only one study.

[4] This lifestyle intervention study included a mixed gender sample of overweight and obese youth aged 13 to 18. Control participants received usual care. The intervention target was the individual youth and intervention duration was 4 months. The study was conducted in the US and was published in 2002. This body of evidence was not downgraded for indirectness.

[5] The sample size is very small (20 intervention, 18 control), the number of events is small (12 intervention, 12 control), and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [RR (95% CI) 0.90 (0.54, 1.46)]. This body of evidence was downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 1 study is:[86] The data point closest to the immediate post and a minimum of 6 months post baseline was selected (Wake[86] presents prevalence outcomes at 9 months following completion of a 3 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome the study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with blinding of participants and/or personnel, blinding of outcome assessors, and other sources of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

[9] Cannot assess inconsistency with only one study.

[10] This diet plus exercise intervention study included a mixed gender sample of overweight and obese children aged 2 to 12. Control participants received usual care. The intervention target was the family and intervention duration was 3 months. The study was conducted in Australia and was published in 2009. This body of evidence was not downgraded for indirectness.

[11] The sample size is small (127 intervention, 115 control), the number of events is fairly small (98 intervention, 95 control), and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [RR (95% CI) 0.93 (0.82, 1.06)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 1 study is:[72] The data point closest to the immediate post and a minimum of 6 months post baseline was selected (Nemet[72] provides data for outcomes at 9 months after completion of a 3 month intervention).

[14] Using Cochrane's Risk of Bias tool, for this outcome the study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with allocation concealment and blinding of participants and/or personnel. This body of evidence was downgraded for serious study limitations.

[15] Cannot assess inconsistency with only one study.

[16] This diet plus exercise intervention study included a mixed gender sample of obese children aged 2 to 12. Control participants received usual care. The intervention target was the family and intervention duration was 3 months. The study was conducted in Israel and was published in 2005. This body of evidence was not downgraded for indirectness.

[17] The sample size is very small (20 intervention, 20 control), the number of events information is not available and the pooled effect estimate could not be calculated. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Evidence Set 3: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – Total Cholesterol

- Summary of Change in Total Cholesterol Evidence
- GRADE Evidence Profile Table 3.1: Effect of Treatment Interventions on Total Cholesterol
- GRADE Summary of Findings Table 3.1: Effect of Treatment Interventions on Total Cholesterol
- Forest Plot 3.1: Effect of Treatment Interventions on Total Cholesterol
- Funnel Plot 3.1: Effect of Treatment Interventions on Total Cholesterol
- Egger's Test Results (for Publication Bias)

Summary of Change in Total Cholesterol Evidence

Overall

- 5 studies; 904 participants
- No statistically significant difference between the intervention group and control group in terms of change in total cholesterol [MD (95% CI) -0.06 mmol/L (-0.19, 0.07)]
- Moderate statistical heterogeneity across studies [Chi^2=10.88, df=4 (P=0.03); I^2=63%]
- Low GRADE rating

Test for subgroup differences is not significant [Chi^2=1.55, df=1 (P=0.21), I^2=35.3%]; primary focus of intervention (behavioural, pharmacological plus behavioural) does not explain variation across studies

Behavioural Interventions

- 3 studies; 342 participants
- No statistically significant difference between the intervention group and control group in terms of change in total cholesterol [MD (95% CI) -0.12 mmol/L (-0.34, 0.09)]
- Moderate statistical heterogeneity across studies [Chi^2=5.32, df=2 (P=0.07); I^2=62%]
- Low GRADE rating

Pharmacological (Orlistat) plus Behavioural Interventions

- 2 studies; 562 participants
- No statistically significant difference between the intervention group and control group in terms of change in total cholesterol [MD (95% CI) 0.02 mmol/L (-0.07, 0.11)]
- Low statistical heterogeneity across studies [Chi^2=0.69, df=1 (P=0.41); I^2=0%]
- Low GRADE rating

GRADE Evidence Profile Table 3.1: Effect of Treatment Interventions on Total Cholesterol *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in Total Cholesterol (mmol/L): Overall (Better indicated by lower values)											
5	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	570	334	0.0588 lower (0.1894 lower to 0.0717 higher)	⊕⊕OO LOW	CRITICAL
Change in Total Cholesterol (mmol/L): Behavioural Studies (Better indicated by lower values)											
3	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	206	136	0.1239 lower (0.3358 lower to 0.0879 higher)	⊕⊕OO LOW	CRITICAL
Change in Total Cholesterol (mmol/L): Pharmacological plus Behavioural Studies (Better indicated by lower values)											
2	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision[17]	none[18]	364	198	0.0221 higher (0.0678 lower to 0.1119 higher)	⊕⊕OO LOW	CRITICAL

***** Footnotes appear after Summary of Findings Table

GRADE Summary of Findings Table 3.1: Effect of Treatment Interventions on Total Cholesterol

Outcome: Change in Total Cholesterol (mmol/L)	Compared to the control group, the mean change in total cholesterol (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	**0.0588 lower** (0.1894 lower to 0.0717 higher)	904 (5 studies[1])	⊕⊕⊖⊖ **low**[2,3,4,5,6]
Behavioural Studies	**0.1239 lower** (0.3358 lower to 0.0879 higher)	342 (3 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
Pharmacological plus Behavioural Studies	**0.0221 higher** (0.0678 lower to 0.1119 higher)	562 (2 studies[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 3.1 for Effect of Treatment Interventions on Total Cholesterol

[1] The 5 studies are:[67,68,75,77,85] Immediate post assessment for all but 1 study. For the one exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome all 5 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (60%), allocation concealment (60%), blinding of participants and/or personnel (83%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is moderate [Chi^2=10.88, df=4 (P=0.03); I^2=63%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Across the 5 studies, most studies included mixed gender samples (n=4); 1 included only girls. Two of the studies included children aged 2 to 12 and the remaining 3 studies included youth aged 13 to 18. In terms of weight status at baseline, 3 studies included overweight and obese participants and 2 studies included only obese participants. In terms of type of intervention, 1 was diet, 2 were lifestyle, and 2 were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in 1 study and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 4 studies was the individual child/youth; in 1 study the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). One study was jointly located in Canada and the US, and the other 4 were conducted in the US. Two of the studies were published in the last 5 years (2009-2013); the remaining 3 studies were published between 2005 and 2007. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (570 intervention; 334 control) but the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0588 mmol/L (-0.1894, 0.0717)]. This body of evidence was downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 3 studies are:[68,77,85] Immediate post assessment except for 1 study. For the one exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome all 3 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (33%), allocation concealment (67%), blinding of participants and/or personnel (100%), and other sources of bias (33%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is moderate [Chi^2=5.32, df=2 (P=0.07); I^2=62%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Across the behavioural studies, two included mixed gender samples and 1 included only girls. Two of the studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, 2 studies included overweight and obese participants and 1 included only obese participants. In terms of type of intervention, 1 was diet and 2 were lifestyle. Control participants received usual care or no intervention in 1 study and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 1 study the target for intervention was families. Intervention duration was 12 months or less in all studies (in 2 of these studies the duration was 6 months or less). All 3 studies were conducted in the US. Two of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2007. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (206 intervention; 136 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.1239 mmol/L (-0.3358, 0.0879)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 2 studies are:[67,75] Immediate post assessment for both studies.

[14] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (50%), blinding of participants and/or personnel (50%), and other sources of bias (100%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

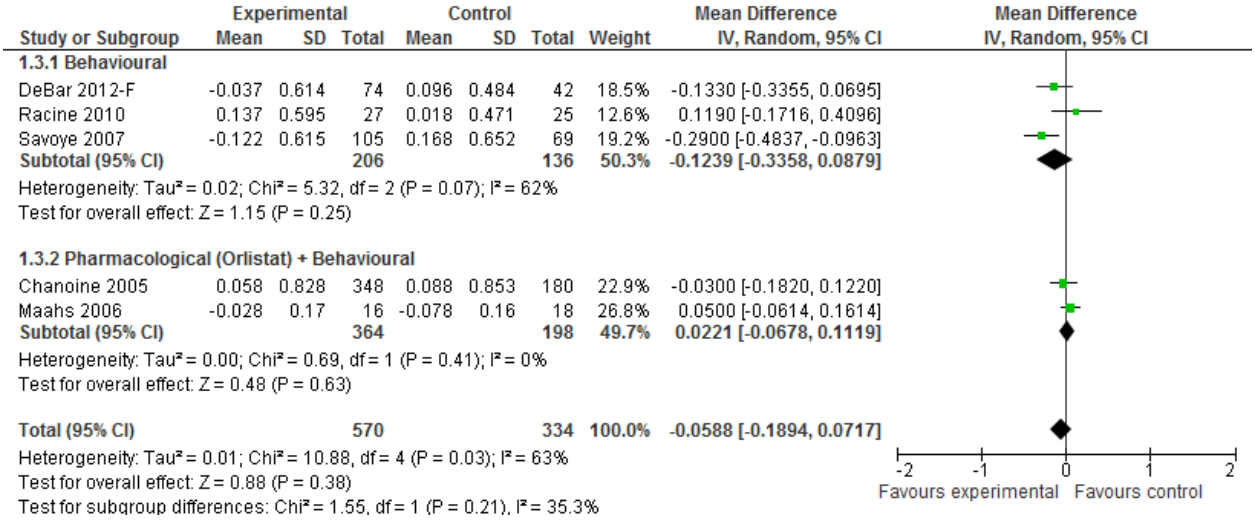
[15] The statistical heterogeneity is low [Chi^2=0.69, df=1 (P=0.41); I^2=0%] but the meta-analysis shows no effects and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[16] Both pharmacological plus behavioural interventions studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. Both interventions included 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months or less in both studies; 1 of these studies lasted 6 months. One study was jointly located in Canada and the US and the other was conducted in the US. Neither study was published in the last 5 years (2009-2013); 1 was published in 2005 and the other in 2006. This body of evidence was not downgraded for indirectness.

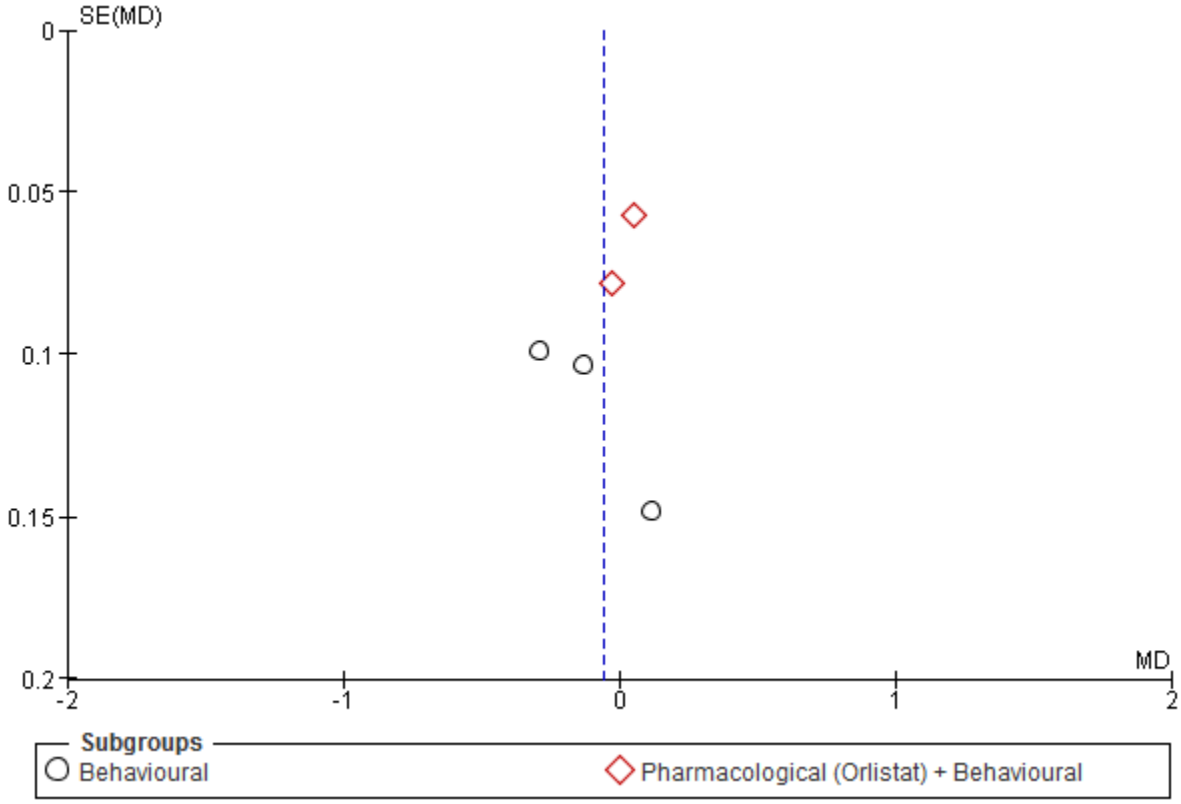
[17] The sample size is of some concern in the control arm (364 intervention; 198 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) 0.0221 mmol/L (-0.0678, 0.1119)]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 3.1: Effect of Treatment Interventions on Total Cholesterol



Funnel Plot 3.1: Effect of Treatment Interventions on Total Cholesterol



Egger's Test to Detect Publication Bias: Change in Total Cholesterol

Included Studies	P-value
All Studies Reporting Total Cholesterol	**

** Too few studies (n<10) to assess

Evidence Set 4: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – Triglycerides

- Summary of Change in Triglycerides Evidence
- GRADE Evidence Profile Table 4.1: Effect of Treatment Interventions on Triglycerides
- GRADE Summary of Findings Table 4.1: Effect of Treatment Interventions on Triglycerides
- Forest Plot 4.1: Effect of Treatment Interventions on Triglycerides
- Funnel Plot 4.1: Effect of Treatment Interventions on Triglycerides
- Egger's Test Results (for Publication Bias)

Summary of Change in Triglycerides Evidence

Overall

- 5 studies; 937 participants
- No statistically significant difference between the intervention group and control group in terms of change in triglycerides [MD (95% CI) -0.02 mmol/L (-0.12, 0.09)]
- Moderate statistical heterogeneity across studies [Chi^2=6.12, df=4 (P=0.19); I^2=35%]
- Low GRADE rating

Test for subgroup differences is not significant [Chi^2=1.97, df=1 (P=0.16), I^2=49.3%]; primary focus of intervention (behavioural, pharmacological plus behavioural) does not explain variation across studies

Behavioural Interventions

- 4 studies; 409 participants
- No statistically significant difference between the intervention group and control group in terms of change in triglycerides [MD (95% CI) -0.06 mmol/L (-0.17, 0.06)]
- Low statistical heterogeneity across studies [Chi^2=3.67, df=3 (P=0.30); I^2=18%]
- Low GRADE rating

Pharmacological (Orlistat) plus Behavioural Interventions

- 1 study; 528 participants
- No statistically significant difference between the intervention group and control group in terms of change in triglycerides [MD (95% CI) 0.07 mmol/L (-0.07, 0.21)]
- Low GRADE rating

GRADE Evidence Profile Table 4.1: Effect of Treatment Interventions on Triglycerides *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in Triglycerides (mmol/L): Overall (Better indicated by lower values)											
5	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	586	351	0.0165 lower (0.1208 lower to 0.0878 higher)	⊕⊕OO LOW	CRITICAL
Change in Triglycerides (mmol/L): Behavioural Studies (Better indicated by lower values)											
4	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	238	171	0.0565 lower (0.1696 lower to 0.0566 higher)	⊕⊕OO LOW	CRITICAL
Change in Triglycerides (mmol/L): Pharmacological plus Behavioural (Better indicated by lower values)											
1	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision[17]	none[18]	348	180	0.0700 higher (0.0655 lower to 0.2055 higher)	⊕⊕OO LOW	CRITICAL

***** Footnotes appear after Summary of Findings Table

GRADE Summary of Findings Table 4.1: Effect of Treatment Interventions on Triglycerides

Outcome: Change in Triglycerides (mmol/L)	Compared to the control group, the mean change in triglycerides (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	**0.0165 lower** (0.1208 lower to 0.0878 higher)	937 (5 studies[1])	⊕⊕⊖⊖ **low**[2,3,4,5,6]
Behavioural Studies	**0.0565 lower** (0.1696 lower to 0.0566 higher)	409 (4 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
Pharmacological plus Behavioural	**0.0700 higher** (0.0655 lower to 0.2055 higher)	528 (1 study[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 4.1 for Effect of Treatment Interventions on Triglycerides

[1] The 5 studies are:[67,68,77,85,91] Immediate post assessment for all but 2 studies. For the 2 exceptions the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome all 5 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (40%), allocation concealment (60%), blinding of participants and/or personnel (100%), incomplete reporting (40%), and other sources of bias (60%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is moderate [Chi^2=6.12, df=4 (P=0.19); I^2=35%] but the meta-analysis shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Across the 5 studies, most studies included mixed gender samples (n=4); 1 included only girls. Two of the studies included children aged 2 to 12 and the remaining 3 studies included youth aged 13 to 18. In terms of weight status at baseline, 2 studies included overweight and obese participants and 3 studies included only obese participants. In terms of type of intervention, 1 was diet, 3 were lifestyle, and 1 was pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in 2 studies and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). Control participants in the orlistat study were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 3 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). One study was jointly located in Canada and the US, 4 were conducted in the US, and 1 in the Netherlands. Three of the studies were published in the last 5 years (2009-2013); the remaining 2 studies were published between 2005 and 2007. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (586 intervention; 351 control) but the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0165 mmol/L (-0.1208, 0.0878)]. This body of evidence was downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 4 studies are:[68,77,85,91] Immediate post assessment for all but 2 studies. For the 2 exceptions the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome all 4 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (25%), allocation concealment (75%), blinding of participants and/or personnel (100%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is low [Chi^2=3.67, df=3 (P=0.30); I^2=18%], the meta-analysis consistently shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Across the 4 behavioural studies, three included mixed gender samples and 1 included only girls. Two of the studies included children aged 2 to 12 and the other 2 included youth aged 13 to 18. In terms of weight status at baseline, 2 studies included overweight and obese participants and 2 included only obese participants. In terms of type of intervention, 1 was diet and 3 were lifestyle. Control participants received usual care or no intervention in 2 studies and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). Three studies were conducted in the US, 1 in the Netherlands. Three of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2007. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (238 intervention; 171 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0565 mmol/L (-0.1696, 0.0566)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 1 study is:[67] Immediate post assessment.

[14] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation, blinding of participants and/or personnel, incomplete reporting, and other sources of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

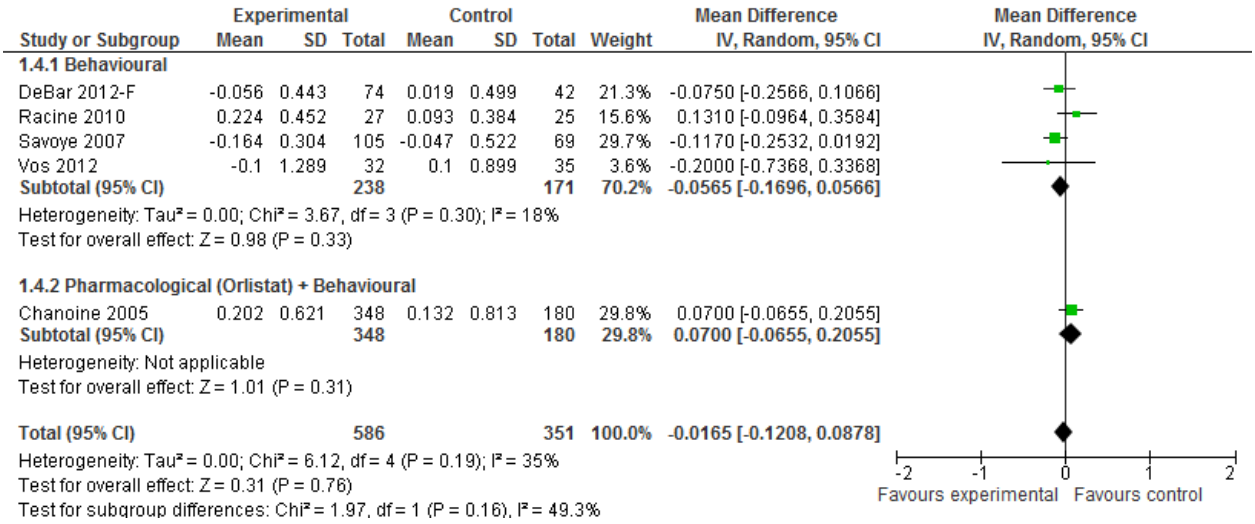
[15] Cannot assess inconsistency with only one study.

[16] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. This body of evidence was not downgraded for indirectness.

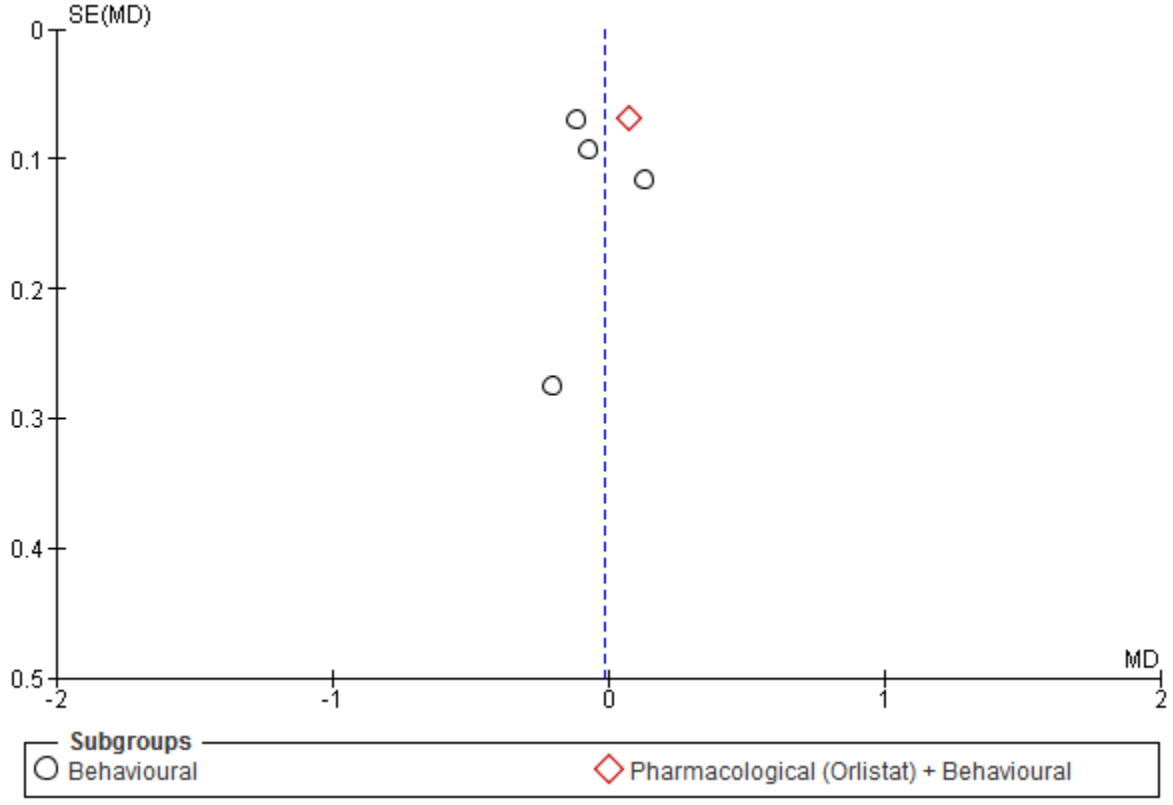
[17] The sample size is of some concern in the control arm (348 intervention; 180 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) 0.0700 mmol/L (-0.0655, 0.2055)]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 4.1: Effect of Treatment Interventions on Triglycerides



Funnel Plot 4.1: Effect of Treatment Interventions on Triglycerides



Egger's Test to Detect Publication Bias: Change in Triglycerides

Included Studies	P-value
All Studies Reporting Triglycerides	**

** Too few studies (n<10) to assess

Evidence Set 5: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – High Density Lipoprotein Cholesterol (HDL-C)

- Summary of Change in HDL-C Evidence
- GRADE Evidence Profile Table 5.1: Effect of Treatment Interventions on HDL-C
- GRADE Summary of Findings Table 5.1: Effect of Treatment Interventions on HDL-C
- Forest Plot 5.1: Effect of Treatment Interventions on HDL-C
- Funnel Plot 5.1: Effect of Treatment Interventions on HDL-C
- Egger's Test Results (for Publication Bias)

Summary of Change in HDL-C Evidence

Overall

- 6 studies; 971 participants
- No statistically significant difference between the intervention group and control group in terms of change in HDL-C [MD (95% CI) -0.02 mmol/L (-0.05, 0.01)]
- Moderate statistical heterogeneity across studies [Chi^2=7.89, df=5 (P=0.16); I^2=37%]
- Low GRADE rating

Test for subgroup differences is not significant [Chi^2=0.15, df=1 (P=0.70), I^2=0%]; primary focus of intervention (behavioural, pharmacological plus behavioural) does not explain variation across studies

Behavioural Interventions

- 4 studies; 409 participants
- No statistically significant difference between the intervention group and control group in terms of change in HDL-C [MD (95% CI) -0.03 mmol/L (-0.09, 0.04)]
- Moderate statistical heterogeneity across studies [Chi^2=5.35, df=3 (P=0.15); I^2=44%]
- Low GRADE rating

Pharmacological (Orlistat) plus Behavioural Interventions

- 2 studies; 562 participants
- No statistically significant difference between the intervention group and control group in terms of change in HDL-C [MD (95% CI) -0.01 mmol/L (-0.05, 0.02)]
- Moderate statistical heterogeneity across studies [Chi^2=2.40, df=1 (P=0.12); I^2=58%]
- Low GRADE rating

GRADE Evidence Profile Table 5.1: Effect of Treatment Interventions on HDL-C *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in HDL-C (mmol/L): Overall (Better indicated by higher values)											
6	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	602	369	0.0174 lower (0.0474 lower to 0.0126 higher)	⊕⊕OO LOW	CRITICAL
Change in HDL-C (mmol/L): Behavioural Studies (Better indicated by higher values)											
4	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	238	171	0.0270 lower (0.0913 lower to 0.0374 higher)	⊕⊕OO LOW	CRITICAL
Change in HDL-C (mmol/L): Pharmacological plus Behavioural Studies (Better indicated by higher values)											
2	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision[17]	none[18]	364	198	0.0124 lower (0.0491 lower to 0.0242 higher)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 5.1: Effect of Treatment Interventions on HDL-C

Outcome: Change in HDL-C (mmol/L)	Compared to the control group, the mean change in HDL-C (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	0.0174 lower (0.0474 lower to 0.0126 higher)	971 (6 studies[1])	⊕⊕⊖⊖ **low**[2,3,4,5,6]
Behavioural Studies	0.0270 lower (0.0913 lower to 0.0374 higher)	409 (4 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
Pharmacological plus Behavioural Studies	0.0124 lower (0.0491 lower to 0.0242 higher)	562 (2 studies[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 5.1 for Effect of Treatment Interventions on HDL-C

[1] The 6 studies are:[67,68,75,77,85,91] Immediate post assessment for all but 2 studies. For the 2 exceptions the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome all 6 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (50%), allocation concealment (67%), blinding of participants and/or personnel (83%), and other sources of bias (67%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is moderate [Chi^2=7.89, df=5 (P=0.16); I^2=37%] most studies in the meta-analysis show no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Across the 6 studies, most studies included mixed gender samples (n=5); 1 included only girls. Two of the studies included children aged 2 to 12 and the remaining 4 studies included youth aged 13 to 18. In terms of weight status at baseline, 3 studies included overweight and obese participants and 3 studies included only obese participants. In terms of type of intervention, 1 was diet, 3 were lifestyle, and 2 were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in 2 studies and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 4 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 4 of these studies the duration was 6 months or less). One study was jointly located in Canada and the US, 4 were conducted in the US, and 1 in the Netherlands. Three of the studies were published in the last 5 years (2009-2013); the remaining 3 studies were published between 2005 and 2007. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (602 intervention; 369 control) but the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0174 mmol/L (-0.0474, 0.0126)]. This body of evidence was downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 4 studies are:[67,68,75,77,85,91] Immediate post assessment for all but 2 studies. For the 2 exceptions the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome all 4 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (25%), allocation concealment (75%), blinding of participants and/or personnel (100%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is moderate [Chi^2=5.35, df=3 (P=0.15); I^2=44%] but most of the studies in the meta-analysis show no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Across the 4 behavioural studies, three included mixed gender samples and 1 included only girls. Two of the studies included children aged 2 to 12 and the other 2 included youth aged 13 to 18. In terms of weight status at baseline, 2 studies included overweight and obese participants and 2 included only obese participants. In terms of type of intervention, 1 was diet and 3 were lifestyle. Control participants received usual care or no intervention in 2 studies and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). Three studies were conducted in the US, 1 in the Netherlands. Three of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2007. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (238 intervention; 171 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0270 mmol/L (-0.0913, 0.0374)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 2 studies are:[67,75] Immediate post assessment for both studies.

[14] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (50%), blinding of participants and/or personnel (50%), and other sources of bias (100%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

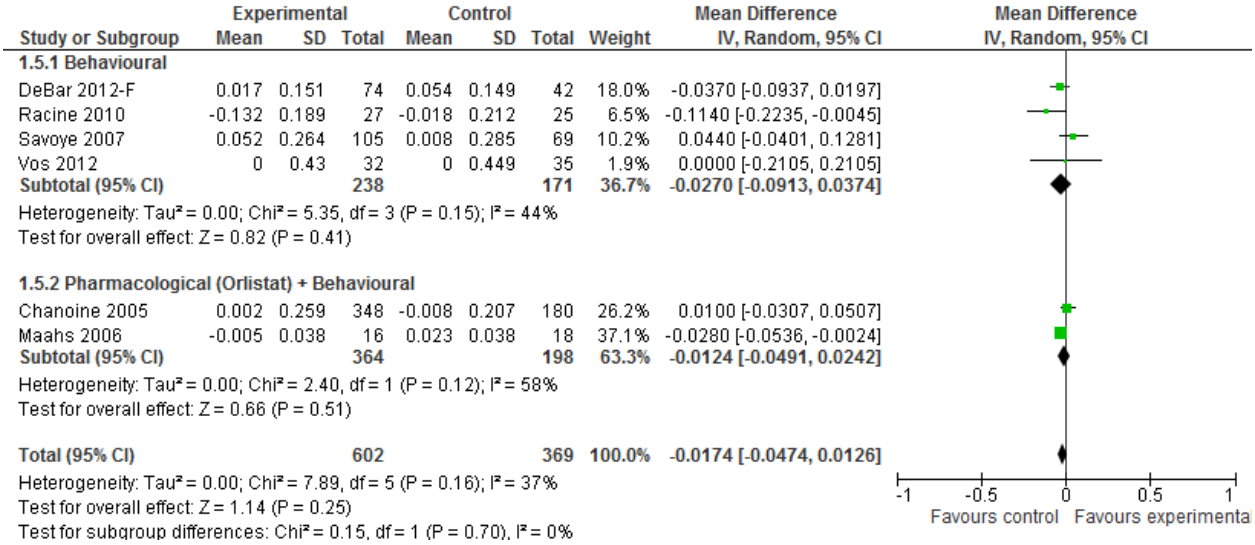
[15] The statistical heterogeneity is moderate [Chi^2=2.40, df=1 (P=0.12); I^2=58%] but most of the studies in the meta-analysis show no effects and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[16] Both pharmacological plus behavioural interventions studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. Both interventions included 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months or less in both studies; 1 of these studies lasted 6 months. One study was jointly located in Canada and the US and the other was conducted in the US. Neither study was published in the last 5 years (2009-2013); 1 was published in 2005 and the other in 2006. This body of evidence was not downgraded for indirectness.

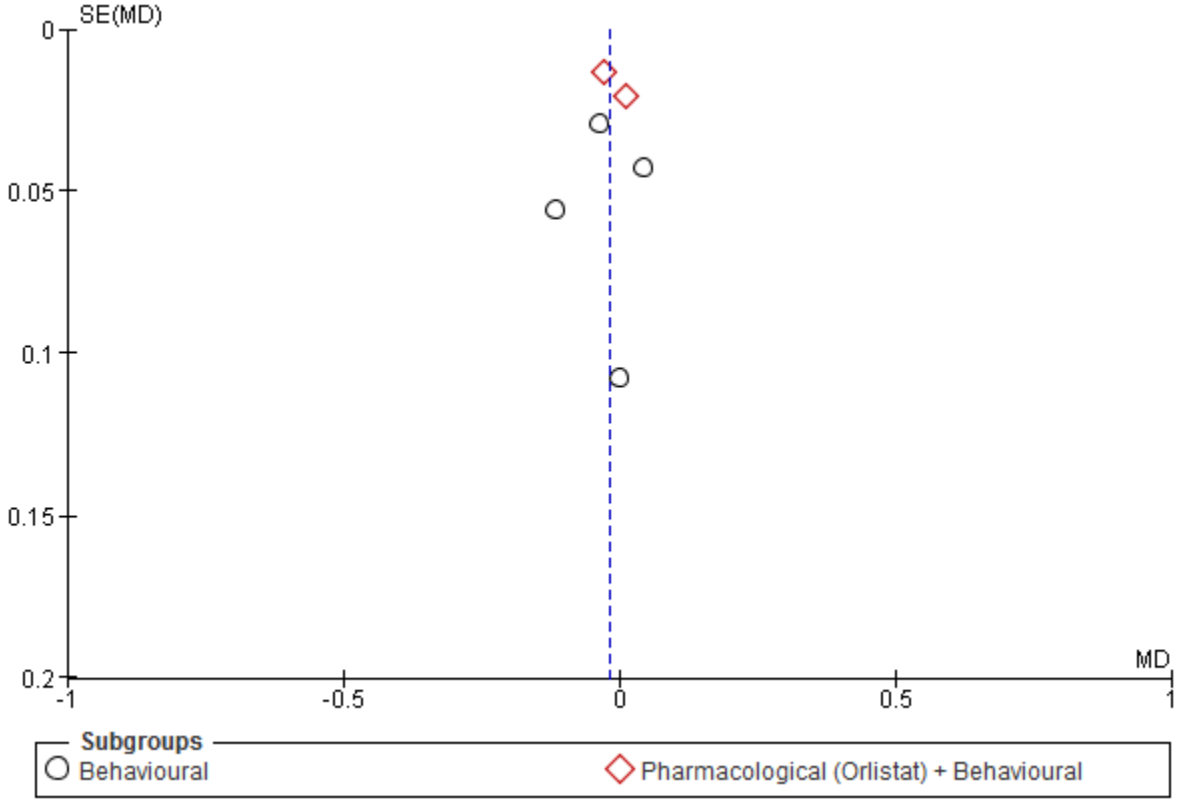
[17] The sample size is of some concern in the control arm (364 intervention; 198 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0124 mmol/L (-0.0491, 0.0242)]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 5.1: Effect of Treatment Interventions on HDL-C



Funnel Plot 5.1: Effect of Treatment Interventions on HDL-C



Egger's Test to Detect Publication Bias: Change in HDL-C

Included Studies	P-value
All Studies Reporting HDL-C	**

** Too few studies (n<10) to assess

Evidence Set 6: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – Low Density Lipoprotein Cholesterol (LDL-C)

- Summary of Change in LDL-C Evidence
- GRADE Evidence Profile Table 6.1: Effect of Treatment Interventions on LDL-C
- GRADE Summary of Findings Table 6.1: Effect of Treatment Interventions on LDL-C
- Forest Plot 6.1: Effect of Treatment Interventions on LDL-C
- Funnel Plot 6.1: Effect of Treatment Interventions on LDL-C
- Egger's Test Results (for Publication Bias)

Summary of Change in LDL-C Evidence

Overall

- 5 studies; 904 participants
- No statistically significant difference between the intervention group and control group in terms of change in LDL-C [MD (95% CI) 0.01 mmol/L (-0.11, 0.13)]
- High statistical heterogeneity across studies [Chi^2=13.52, df=4 (P=0.009); I^2=70%]
- Low GRADE rating

Test for subgroup differences is not significant [Chi^2=0.54, df=1 (P=0.46), I^2=0%]; primary focus of intervention (behavioural, pharmacological plus behavioural) does not explain variation across studies

Behavioural Interventions

- 3 studies; 342 participants
- No statistically significant difference between the intervention group and control group in terms of change in LDL-C [MD (95% CI) -0.04 mmol/L (-0.19, 0.11)]
- Moderate statistical heterogeneity across studies [Chi^2=3.68, df=2 (P=0.16); I^2=46%]
- Low GRADE rating

Pharmacological (Orlistat) plus Behavioural Interventions

- 2 studies; 562 participants
- No statistically significant difference between the intervention group and control group in terms of change in LDL-C [MD (95% CI) 0.05 mmol/L (-0.13, 0.24)]
- High statistical heterogeneity across studies [Chi^2=5.78, df=1 (P=0.02); I^2=83%]
- Low GRADE rating

GRADE Evidence Profile Table 6.1: Effect of Treatment Interventions on LDL-C *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in LDL-C (mmol/L): Overall (Better indicated by lower values)											
5	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	serious indirectness[4]	serious imprecision[5]	none[6]	570	334	0.0079 higher (0.1145 lower to 0.1303 higher)	⊕⊕OO LOW	CRITICAL
Change in LDL-C (mmol/L): Behavioural Studies (Better indicated by lower values)											
3	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	serious indirectness[10]	serious imprecision[11]	none[12]	206	136	0.0389 lower (0.1924 lower to 0.1147 higher)	⊕⊕OO LOW	CRITICAL
Change in LDL-C (mmol/L): Pharmacological plus Behavioural Studies (Better indicated by lower values)											
2	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	serious indirectness[16]	serious imprecision[17]	none[18]	364	198	0.0512 higher (0.1327 lower to 0.2350 higher)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 6.1: Effect of Treatment Interventions on LDL-C

Outcome: LDL-C (mmol/L)	Compared to the control group, the mean change in LDL-C (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	0.0079 higher (0.1145 lower to 0.1303 higher)	904 (5 studies[1])	⊕⊕⊖⊖ **low**[2,3,4,5,6]
Behavioural Studies	0.0389 lower (0.1924 lower to 0.1147 higher)	342 (3 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
Pharmacological plus Behavioural Studies	0.0512 higher (0.1327 lower to 0.2350 higher)	562 (2 studies[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 6.1 for Effect of Treatment Interventions on LDL-C

[1] The 5 studies are:[67,68,75,77,85] Immediate post assessment for all but 1 study. For the one exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome all 5 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (60%), allocation concealment (60%), blinding of participants and/or personnel (83%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is high [Chi^2=13.52, df=4 (P=0.009); I^2=70%] but most of the studies in the meta-analysis show no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Across the 5 studies, most studies included mixed gender samples (n=4); 1 included only girls. Two of the studies included children aged 2 to 12 and the remaining 3 studies included youth aged 13 to 18. In terms of weight status at baseline, 3 studies included overweight and obese participants and 2 studies included only obese participants. In terms of type of intervention, 1 was diet, 2 were lifestyle, and 2 were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in 1 study and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). Control participants in the two orlistat studies were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 4 studies was the individual child/youth; in 1 study the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). One study was jointly located in Canada and the US, and the other 4 were conducted in the US. Two of the studies were published in the last 5 years (2009-2013); the remaining 3 studies were published between 2005 and 2007. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (570 intervention; 334 control) but the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) 0.0079 mmol/L (-0.1145, 0.1303)]. This body of evidence was downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 3 studies are:[68,77,85] Immediate post assessment except for 1 study. For the one exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome all 3 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (33%), allocation concealment (67%), blinding of participants and/or personnel (100%), and other sources of bias (33%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is moderate [Chi^2=3.68, df=2 (P=0.16); I^2=46%] but the meta-analysis shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Across the behavioural studies, two included mixed gender samples and 1 included only girls. Two of the studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, 2 studies included overweight and obese participants and 1 included only obese participants. In terms of type of intervention, 1 was diet and 2 were lifestyle. Control participants received usual care or no intervention in 1 study and a minimal component in the other 2 studies (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 1 study the target for intervention was families. Intervention duration was 12 months or less in all studies (in 2 of these studies the duration was 6 months or less). All 3 studies were conducted in the US. Two of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2007. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (206 intervention; 136 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.0389 mmol/L (-0.1924, 0.1147)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 2 studies are:[67,75] Immediate post assessment for both studies.

[14] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (50%), blinding of participants and/or personnel (50%), and other sources of bias (100%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

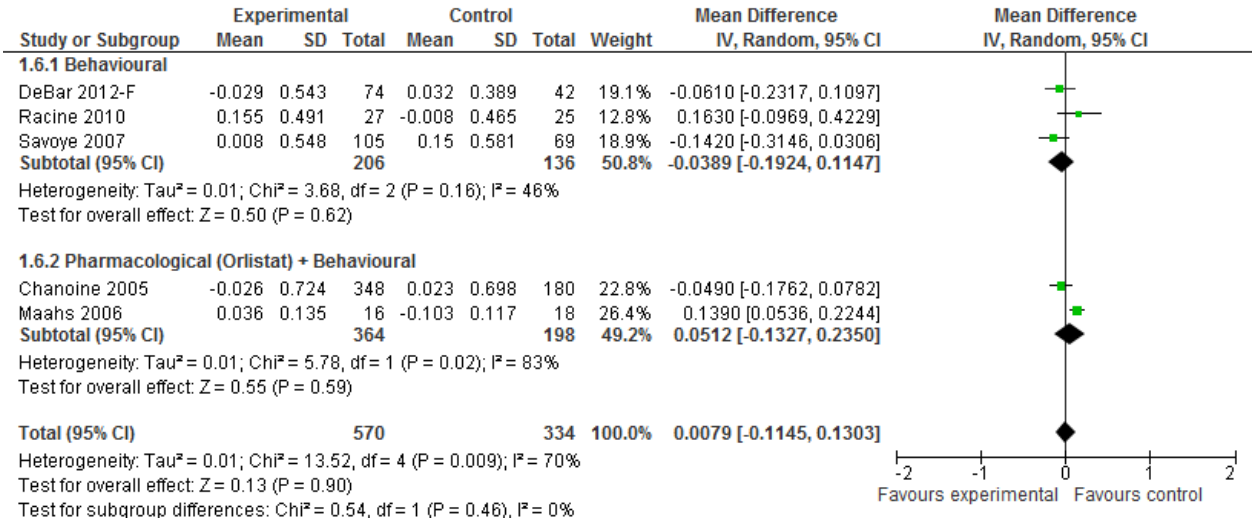
[15] The statistical heterogeneity is high [Chi^2=5.78, df=1 (P=0.02); I^2=83%] one study shows no effects, one shows a benefit for the control group and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[16] Both pharmacological plus behavioural interventions studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. Both interventions included 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months or less in both studies; 1 of these studies lasted 6 months. One study was jointly located in Canada and the US and the other was conducted in the US. Neither study was published in the last 5 years (2009-2013); 1 was published in 2005 and the other in 2006. This body of evidence was not downgraded for indirectness.

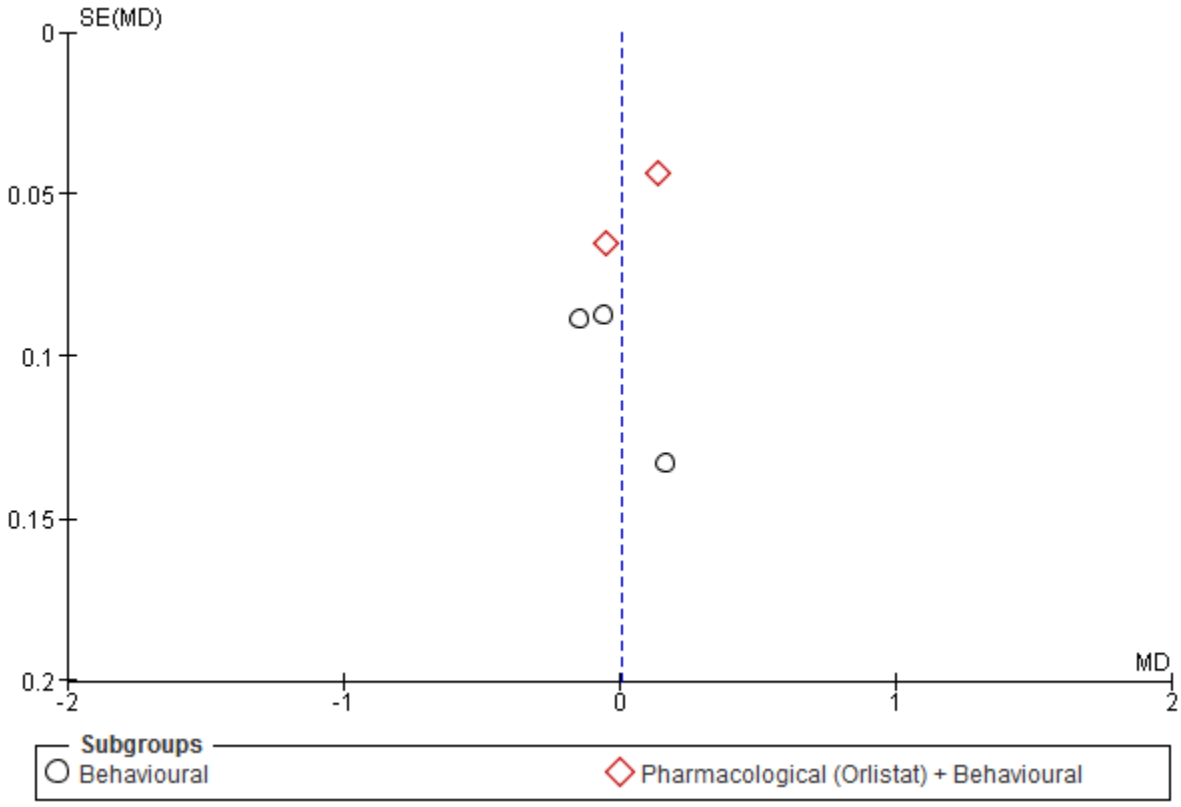
[17] The sample size is of some concern in the control arm (364 intervention; 198 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) 0.0512 mmol/L (-0.1327, 0.2350)]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 6.1: Effect of Treatment Interventions on LDL-C



Funnel Plot 6.1: Effect of Treatment Interventions on LDL-C



Egger's Test to Detect Publication Bias: Change in LDL-C

Included Studies	P-value
All Studies Reporting LDL-C	**

** Too few studies (n<10) to assess

Evidence Set 7: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – Systolic Blood Pressure (SBP)

- Summary of Change in SBP Evidence
- GRADE Evidence Profile Table 7.1: Effect of Treatment Interventions on SBP
- GRADE Summary of Findings Table 7.1: Effect of Treatment Interventions on SBP
- Forest Plot 7.1: Effect of Treatment Interventions on SBP
- Funnel Plot 7.1: Effect of Treatment Interventions on SBP
- Egger's Test Results (for Publication Bias)

Summary of Change in SBP Evidence

Overall

- 5 studies; 808 participants
- Statistically significant change in SBP in the intervention group as compared to the control group [MD (95% CI) -3.42 mmHg (-6.56, -0.29)]
- High statistical heterogeneity across studies [Chi^2=15.73, df=4 (P=0.003); I^2=75%]
- Moderate GRADE rating

Test for subgroup differences is significant [Chi^2=5.96, df=1 (P=0.01), I^2=83%]; primary focus of intervention (behavioural, pharmacological plus behavioural) explains some of the variation across studies

Behavioural Interventions

- 4 studies; 280 participants
- Statistically significant change in SBP in the intervention group as compared to the control group [MD (95% CI) -4.64 mmHg (-7.46, -1.82)]
- Moderate statistical heterogeneity across studies [Chi^2=5.79, df=3 (P=0.12); I^2=48%]
- Moderate GRADE rating

Pharmacological (Orlistat) plus Behavioural Interventions

- 1 study; 528 participants
- No statistically significant difference between the intervention group and control group in terms of change in SBP [MD (95% CI) -0.22 mmHg (-2.38, 1.94)]
- Low GRADE rating

GRADE Evidence Profile Table 7.1: Effect of Treatment Interventions on SBP *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in SBP (mmHg): Overall (Better indicated by lower values)											
5	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	no serious imprecision[5]	none[6]	486	322	3.4225 lower (6.5566 to 0.2885 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in SBP (mmHg): Behavioural Studies (Better indicated by lower values)											
4	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	no serious imprecision[11]	none[12]	138	142	4.6420 lower (7.4591 to 1.8248 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in SBP (mmHg): Pharmacological plus Behavioural Studies (Better indicated by lower values)											
1	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision[17]	none[18]	348	180	0.2200 lower (2.3793 lower to 1.9393 higher)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 7.1: Effect of Treatment Interventions on SBP

Outcome: Change in SBP (mmHg)	Compared to the control group, the mean change in SBP (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	**3.4225 lower** (6.5566 to 0.2885 lower)	808 (5 studies[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]
Behavioural Studies	**4.6420 lower** (7.4591 to 1.8248 lower)	280 (4 studies[7])	⊕⊕⊕⊖ **moderate**[8,9,10,11,12]
Pharmacological plus Behavioural Studies	**0.2200 lower** (2.3793 lower to 1.9393 higher)	528 (1 study[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 7.1 for Effect of Treatment Interventions on SBP

[1] The 5 studies are:[67,84,87,89,91] Immediate post assessment for all but 1 study. For the 1 exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome 1 study was rated as high risk and 4 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (40%), allocation concealment (80%), blinding of participants and/or personnel (100%), blinding of outcome assessment (100%), incomplete reporting, and other sources of bias (60%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate or high risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is high [Chi^2=15.73, df=4 (P=0.003); I^2=75%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] All 5 studies included mixed gender samples. Three of the studies included children aged 2 to 12 and the remaining 2 studies included youth aged 13 to 18. In terms of weight status at baseline, 1 study included only overweight participants and 4 studies included only obese participants. In terms of type of intervention, 1 was diet plus exercise, 3 were lifestyle, and 1 was pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in all studies. Control participants in the orlistat study were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 3 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). One study was jointly located in Canada and the US, the other 4 were conducted in European countries. Three of the studies were published in the last 5 years (2009-2013); the remaining 2 studies were published between 2005 and 2008. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (486 intervention; 322 control) and the pooled effect estimate is precise with a narrow confidence interval [MD (95% CI) -3.4225 mmHg (-6.5566, -0.2885)]. This body of evidence was not downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 4 studies are:[84,87,89,91] Immediate post assessment for all but 1 study. For the 1 exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome 1 study was rated high risk and 3 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (20%), allocation concealment (100%), blinding of participants and/or personnel (100%), blinding of outcome assessment (100%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate or high risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is moderate [Chi^2=5.79, df=3 (P=0.12); I^2=48%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] All 4 behavioural studies included mixed gender samples. Three of the studies included children aged 2 to 12 and 1 included youth aged 13 to 18. In terms of weight status at baseline, 1 study included only overweight participants and 2 included only obese participants. In terms of type of intervention, 1 was diet plus exercise and 3 were lifestyle. Control participants received usual care or no intervention in all 4 studies. The intervention target in 2 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). All 4 studies were conducted in European countries. Three of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2008. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (138 intervention; 142 control) but the pooled effect estimate is precise with a narrow confidence interval [MD (95% CI) -4.6420 mmHg (-7.4591, -1.8248)]. This body of evidence was not downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 1 study is:[67] Immediate post assessment.

[14] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation, blinding of participants and/or personnel, incomplete reporting, and other sources of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

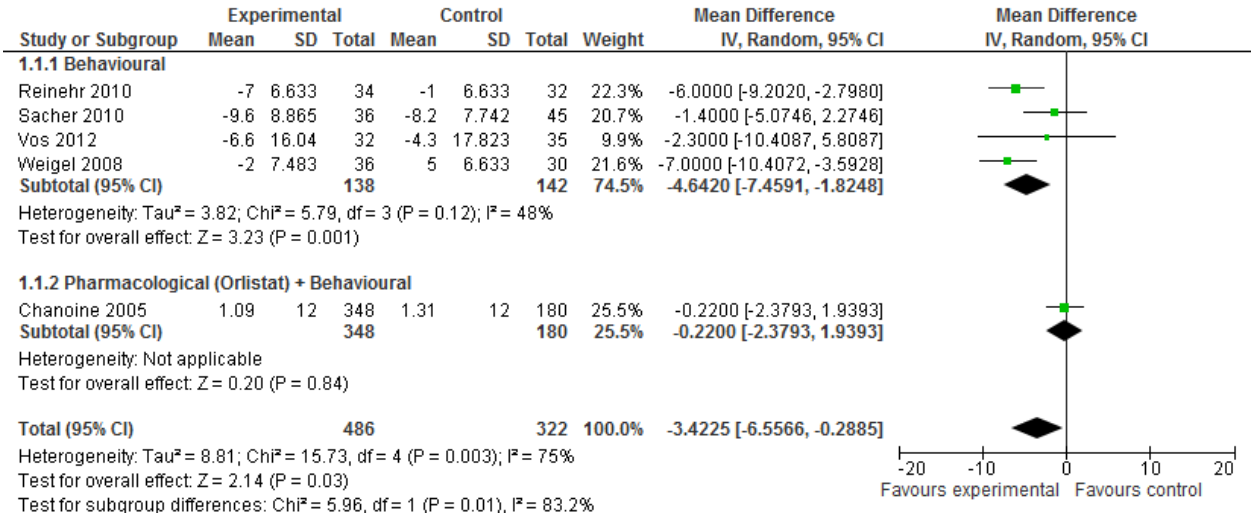
[15] Cannot assess inconsistency with only one study.

[16] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. This body of evidence was not downgraded for indirectness.

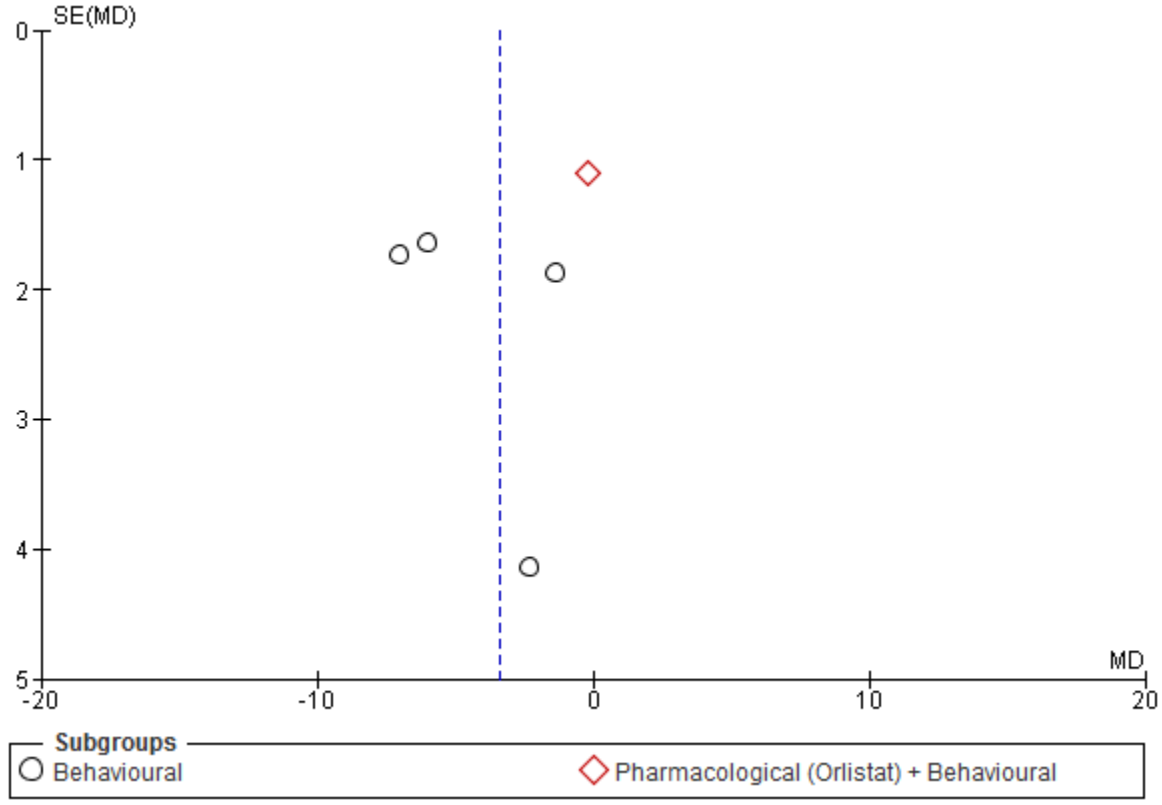
[17] The sample size is of some concern in the control arm (348 intervention; 180 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) -0.2200 mmHg (-2.3793, 1.9393)]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 7.1: Effect of Treatment Interventions on SBP



Funnel Plot 7.1: Effect of Treatment Interventions on SBP



Egger's Test to Detect Publication Bias: Change in SBP

Included Studies	P-value
All Studies Reporting SBP	**

** Too few studies (n<10) to assess

Evidence Set 8: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – Diastolic Blood Pressure (DBP)

- Summary of Change in DBP Evidence
- GRADE Evidence Profile Table 8.1: Effect of Treatment Interventions on DBP
- GRADE Summary of Findings Table 8.1: Effect of Treatment Interventions on DBP
- Forest Plot 8.1: Effect of Treatment Interventions on DBP
- Funnel Plot 8.1: Effect of Treatment Interventions on DBP
- Egger's Test Results (for Publication Bias)

Summary of Change in DBP Evidence

Overall

- 5 studies; 808 participants
- Statistically significant change in DBP in the intervention group as compared to the control group [MD (95% CI) -3.39 mmHg (-5.17, -1.60)]
- Moderate statistical heterogeneity across studies [Chi^2=7.61, df=4 (P=0.11); I^2=47%]
- Moderate GRADE rating

Test for subgroup differences is not significant [Chi^2=2.74, df=1 (P=0.10), I^2=63.5%]; primary focus of intervention (behavioural, pharmacological plus behavioural) does not explain the variation across studies

Behavioural Interventions

- 4 studies; 280 participants
- Statistically significant change in DBP in the intervention group as compared to the control group [MD (95% CI) -4.08 mmHg (-6.07, -2.09)]
- Moderate statistical heterogeneity across studies [Chi^2=4.37, df=3 (P=0.22); I^2=31%]
- Moderate GRADE rating

Pharmacological (Orlistat) plus Behavioural Interventions

- 1 study; 528 participants
- Statistically significant change in DBP in the intervention group as compared to the control group [MD (95% CI) -1.81 mmHg (-3.61, -0.01)]
- Moderate GRADE rating

GRADE Evidence Profile Table 8.1: Effect of Treatment Interventions on DBP *

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in DBP (mmHg): Overall (Better indicated by lower values)											
5	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	no serious imprecision[5]	none[6]	486	322	3.3887 lower (5.1738 to 1.6036 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in DBP (mmHg): Behavioural Studies (Better indicated by lower values)											
4	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	no serious imprecision[11]	none[12]	138	142	4.0798 lower (6.0747 to 2.0850 lower)	⊕⊕⊕O MODERATE	CRITICAL
Change in DBP (mmHg): Pharmacological plus Behavioural Studies (Better indicated by lower values)											
1	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	no serious imprecision[17]	none[18]	348	180	1.8100 lower (3.6094 to 0.0106 lower)	⊕⊕⊕O MODERATE	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 8.1: Effect of Treatment Interventions on DBP

Outcome: Change in DBP (mmHg)	Compared to the control group, the mean change in DBP (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall	**3.3887 lower** (5.1738 to 1.6036 lower)	808 (5 studies[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]
Behavioural Studies	**4.0798 lower** (6.0747 to 2.0850 lower)	280 (4 studies[7])	⊕⊕⊕⊖ **moderate**[8,9,10,11,12]
Pharmacological plus Behavioural Studies	**1.8100 lower** (3.6094 to 0.0106 lower)	528 (1 study[13])	⊕⊕⊕⊖ **moderate**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 8.1 for Effect of Treatment Interventions on DBP

[1] The 5 studies are:[67,84,87,89,91] Immediate post assessment for all but 1 study. For the 1 exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome 1 study was rated as high risk and 4 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (40%), allocation concealment (80%), blinding of participants and/or personnel (100%), blinding of outcome assessment (100%), incomplete reporting, and other sources of bias (60%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate or high risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is moderate [Chi^2=7.61, df=4 (P=0.11); I^2=47%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] All 5 studies included mixed gender samples. Three of the studies included children aged 2 to 12 and the remaining 2 studies included youth aged 13 to 18. In terms of weight status at baseline, 1 study included only overweight participants and 4 studies included only obese participants. In terms of type of intervention, 1 was diet plus exercise, 3 were lifestyle, and 1 was pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants in the behavioural intervention studies received usual care or no intervention in all studies. Control participants in the orlistat study were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in 3 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). One study was jointly located in Canada and the US, the other 4 were conducted in European countries. Three of the studies were published in the last 5 years (2009-2013); the remaining 2 studies were published between 2005 and 2008. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (486 intervention; 322 control) and the pooled effect estimate is precise with a narrow confidence interval [MD (95% CI) -3.3887 mmHg (-5.1738, -1.6036)]. This body of evidence was not downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 4 studies are:[84,87,89,91] Immediate post assessment for all but 1 study. For the 1 exception the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome 1 study was rated high risk and 3 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (20%), allocation concealment (100%), blinding of participants and/or personnel (100%), blinding of outcome assessment (100%), and other sources of bias (50%; i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate or high risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is moderate [Chi^2=4.37, df=3 (P=0.22); I^2=31%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] All 4 behavioural studies included mixed gender samples. Three of the studies included children aged 2 to 12 and 1 included youth aged 13 to 18. In terms of weight status at baseline, 1 study included only overweight participants and 2 included only obese participants. In terms of type of intervention, 1 was diet plus exercise and 3 were lifestyle. Control participants received usual care or no intervention in all 4 studies. The intervention target in 2 studies was the individual child/youth; in 2 studies the target for intervention was families. Intervention duration was 12 months or less in all studies (in 3 of these studies the duration was 6 months or less). All 4 studies were conducted in European countries. Three of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2008. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (138 intervention; 142 control) but the pooled effect estimate is precise with a narrow confidence interval [MD (95% CI) -4.0798 mmHg (-6.0747, -2.0850)]. This body of evidence was not downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 1 study is:[67] Immediate post assessment.

[14] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation, blinding of participants and/or personnel, incomplete reporting, and other sources of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

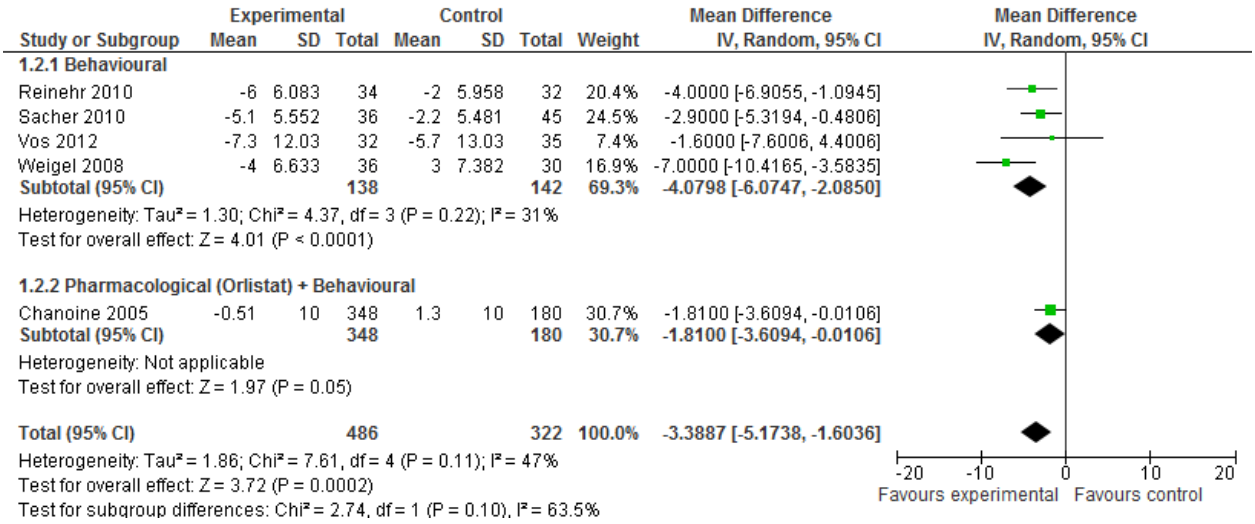
[15] Cannot assess inconsistency with only one study.

[16] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. This body of evidence was not downgraded for indirectness.

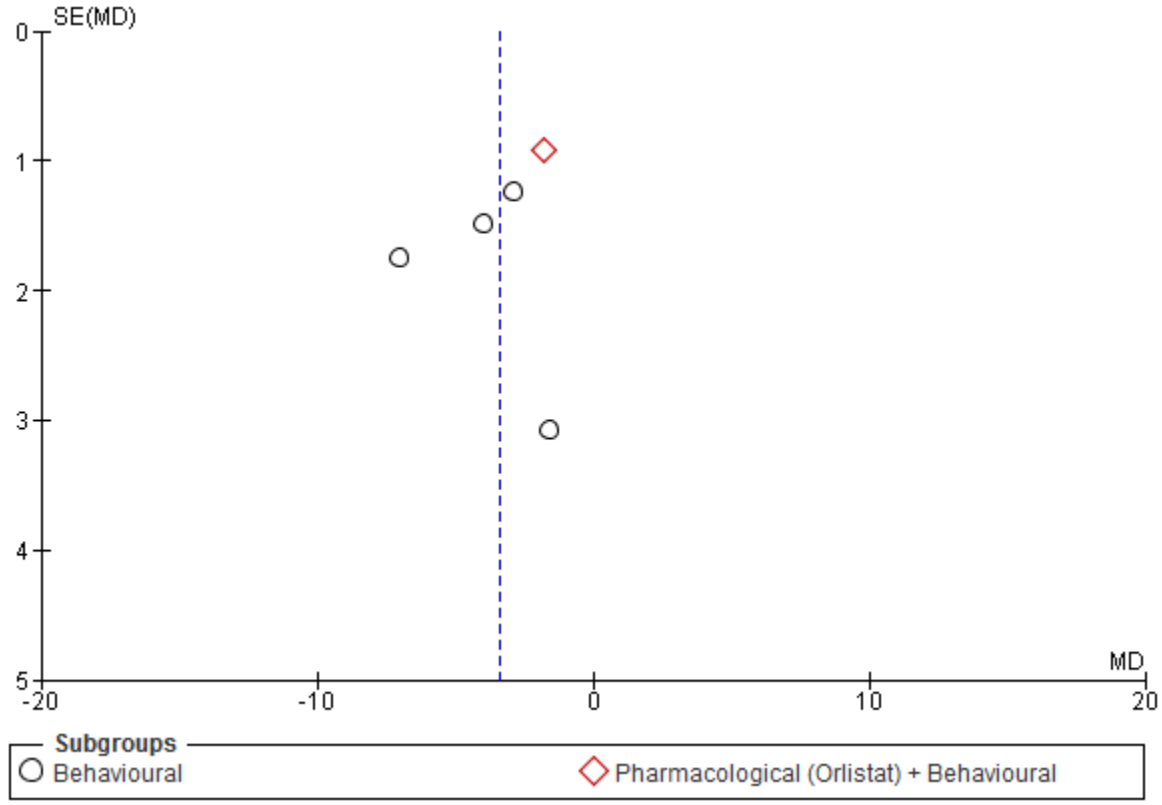
[17] The sample size is of some concern in the control arm (348 intervention; 180 control) but the pooled effect estimate is precise with a narrow confidence interval [MD (95% CI) -1.8100 mmHg (-3.6094, -0.0106)]. This body of evidence was not downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 8.1: Effect of Treatment Interventions on DBP



Funnel Plot 8.1: Effect of Treatment Interventions on DBP



Egger's Test to Detect Publication Bias: Change in DBP

Included Studies	P-value
All Studies Reporting DBP	**

** Too few studies (n<10) to assess

Evidence Set 9: Do these weight management programs lead to other positive outcomes (e.g., improved behavioural or physiological measures, decreased childhood morbidity, improved childhood functioning, or reduced adult morbidity and mortality)? – Overall Quality of Life (QOL)

- Summary of Change in Overall QOL Evidence
- GRADE Evidence Profile Table 9.1: Effect of Treatment Interventions on Overall QOL
- GRADE Summary of Findings Table 9.1: Effect of Treatment Interventions on Overall QOL
- Forest Plot 9.1: Effect of Treatment Interventions on Overall QOL
- Funnel Plot 9.1: Effect of Treatment Interventions on Overall QOL
- Egger's Test Results (for Publication Bias)

Summary of Change in Overall QOL Evidence

Overall

- 6 studies; 777 participants
- Statistically significant improvement in overall QOL score in the intervention group as compared to the control group [MD (95% CI) 2.10 (0.60, 3.60)]
- Low statistical heterogeneity across studies [Chi^2=5.41, df=5 (P=0.37); I^2=8%]
- Moderate GRADE rating

Test for subgroup differences is not significant [Chi^2=0.01, df=1 (P=0.92), I^2=0%]; source of data (parent, child/youth) does not explain variation across studies

Parent Reported Overall QOL

- 4 studies; 504 participants
- No statistically significant difference between the intervention group and control group in terms of change in overall QOL score [MD (95% CI) 2.05 (-0.31, 4.40)]
- Low statistical heterogeneity across studies [Chi^2=4.58, df=3 (P=0.20); I^2=35%]
- Low GRADE rating

Child/Youth Reported Overall QOL

- 2 studies; 273 participants
- No statistically significant difference between the intervention group and control group in terms of change in overall QOL score [MD (95% CI) 2.22 (-0.22, 4.67)]
- Low statistical heterogeneity across studies [Chi^2=0.81, df=1 (P=0.37); I^2=0%]
- Low GRADE rating

GRADE Evidence Profile Table 9.1: Effect of Treatment Interventions on Overall QOL

Quality Assessment							No. of Participants		Effect	Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Intervention	Control	Mean Difference (95% CI)		
Change in Overall QOL (measured with: PedsQL or DISAKIDS questionnaire, scale range 1 to 100; Better indicated by higher values)											
6	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	no serious imprecision[5]	none[6]	385	392	2.1009 higher (0.6028 to 3.5990 higher)	⊕⊕⊕O MODERATE	CRITICAL
Change in Overall QOL as Reported by Parents (measured with: PedsQL or DISAKIDS questionnaire, scale range 1 to 100; Better indicated by higher values)											
4	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	249	255	2.0456 higher (0.3067 lower to 4.3980 higher)	⊕⊕OO LOW	CRITICAL
Change in Overall QOL as Reported by Child/Youth (measured with: PedsQL and DISAKIDS questionnaire, scale range 1 to 100; Better indicated by higher values)											
2	randomized trials[13]	serious risk[14]	no serious inconsistency[15]	no serious indirectness[16]	serious imprecision[17]	none[18]	136	137	2.2231 higher (0.2217 lower to 4.6679 higher)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 9.1: Effect of Treatment Interventions on Overall QOL

Outcome: Change in Overall QOL (measured with PedsQL or DISAKIDS questionnaires, scale to 100)	Compared to the control group, the mean change in Overall QOL score (95% CI) in the intervention groups was	No. of Participants (Studies)	Quality of the Evidence (GRADE)
Overall QOL	**2.1009 higher** (0.6028 to 3.5990 higher)	777 (6 studies[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]
Studies in which Parents Reported Overall QOL	**2.0456 higher** (0.3067 lower to 4.3980 higher)	504 (4 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]
Studies in which Child/Youth Reported Overall QOL	**2.2231 higher** (0.2217 lower to 4.6679 higher)	273 (2 studies[13])	⊕⊕⊖⊖ **low**[14,15,16,17,18]

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 9.1 for Effect of Treatment Interventions on Overall Quality of Life

[1] The 6 studies are:[70,77,78,80,86,91] Immediate post assessment for 2 studies.[78,80] For the other 4 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[2] Using Cochrane's Risk of Bias tool, for this outcome all 6 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with allocation concealment (67%), blinding of participants and/or personnel (100%), and blinding of outcome assessment (100%). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] The statistical heterogeneity is low [Chi^2=5.41, df=5 (P=0.37); I^2=8%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Most (n=5) of the studies included mixed gender samples; 1 included only girls. Four of the studies included children aged 2 to 12 and the remaining 2 studies included youth aged 13 to 18. In terms of weight status at baseline, 3 studies included overweight and obese participants and 3 studies included only obese participants. In terms of type of intervention, 1 was diet plus exercise and 5 were lifestyle. Control participants received usual care or no intervention in 5 studies and a minimal component in 1 study (e.g., newsletters or handouts covering general health concepts). The intervention target in 2 studies was the individual child/youth; in 4 studies the target for intervention was families. Intervention duration was 6 months or less in all studies. One study was located in the US, 2 in European countries, 2 in Australia and 1 in Malaysia. Five of the studies were published in the last 5 years (2009-2013); the remaining study was in 2007. This body of evidence was not downgraded for indirectness.

[5] The sample size is adequate (385 intervention; 392 control) and the pooled effect estimate is precise with a narrow confidence interval [MD (95% CI) 2.1009 0.6028, 3.5990)]. This body of evidence was not downgraded for imprecision.

[6] Too few studies (n<10) to assess reporting bias.

[7] The 4 studies are:[70,78,80,86] Immediate post assessment for 2 studies.[78,80] For the other 2 studies the data point closest to the immediate post and a minimum of 6 months post baseline was selected (Wake[86] presents outcomes at 3 months following completion of a 3 month intervention; McCallum[70] provides outcome data for 6 months post completion of a 3 month intervention).

[8] Using Cochrane's Risk of Bias tool, for this outcome all 4 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or a high risk of bias associated with allocation concealment (50%), blinding of participants and/or personnel (100%), and blinding of outcome assessment (100%). Given that all of the information is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[9] The statistical heterogeneity is low [Chi^2=4.58, df=3 (P=0.20); I^2=35%] but the meta-analysis shows either benefits toward the interventions or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] All of the studies included mixed gender samples of children aged 2 to 12 years. In terms of weight status at baseline, 2 studies included overweight and obese participants and 2 included only obese participants. In terms of type of intervention, 1 was diet plus exercise and 3 were lifestyle. Control participants received usual care or no intervention in all 4 studies. The intervention target in 1 study was the individual child/youth; in 3 studies the target for intervention was

families. Intervention duration was 6 months or less in all studies. One study was located in the UK, 2 in Australia and 1 in Malaysia. Three of the studies were published in the last 5 years (2009-2013); the remaining study was published in 2007. This body of evidence was not downgraded for indirectness.

[11] The sample size is of some concern in both arms (249 intervention; 255 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) 2.0456 (-0.3067, 4.3980)]. This body of evidence was downgraded for imprecision.

[12] Too few studies (n<10) to assess reporting bias.

[13] The 2 studies are:[77,91] No immediate post intervention data available. The data point closest to the immediate post and a minimum of 6 months post baseline was selected (DeBar[77] provides data on outcomes assessed 1 month after completion of a 5 month intervention; Vos[91] provides data for outcomes at 9 months after completion of a 3 month intervention).

[14] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with allocation concealment (100%), blinding of participants and/or personnel (100%), blinding of outcome assessment (100%), and other sources of bias (50% i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information is from studies at moderate risk of bias this body of evidence was downgraded for serious study limitations.

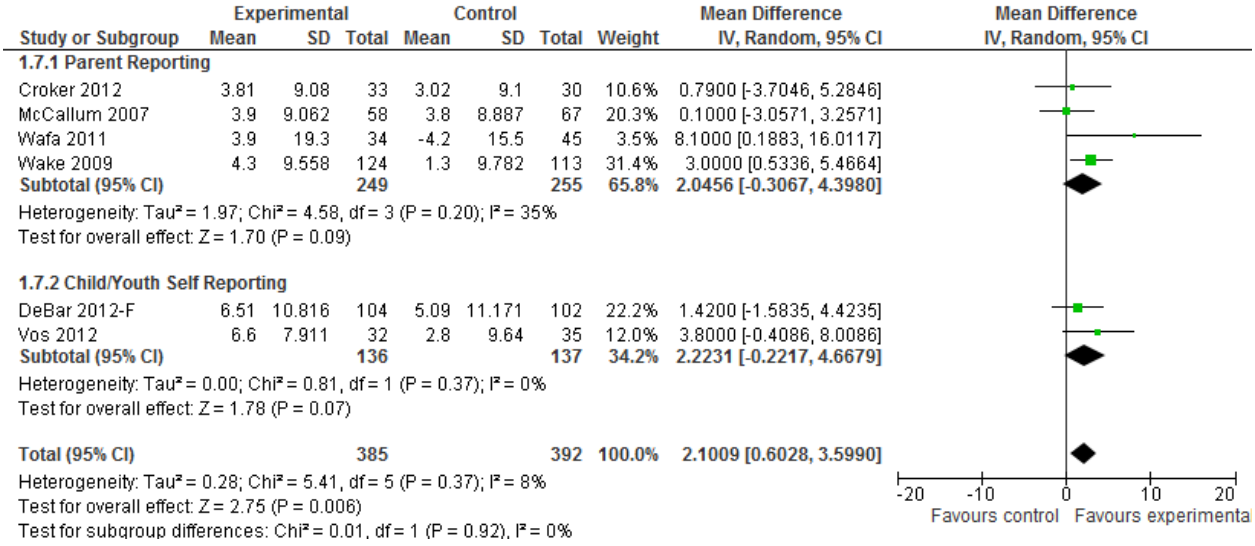
[15] The statistical heterogeneity is low [Chi^2=0.81, df=1 (P=0.37); I^2=0%] but the meta-analysis shows or no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[16] One of the studies included a mixed gender sample of youth aged 13 to 18, the other included only girls in this age category. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 included only obese participants. In terms of type of intervention, both were lifestyle. Control participants received usual care or no intervention in 1 study and a minimal component in the other (e.g., newsletters or handouts covering general health concepts). The intervention target in 1 study was the individual child/youth; in the other study the target for intervention was families. Intervention duration was 6 months or less in both studies. One study was located in the US the other in the Netherlands. Both studies were published in the last 5 years (2009-2013). This body of evidence was not downgraded for indirectness.

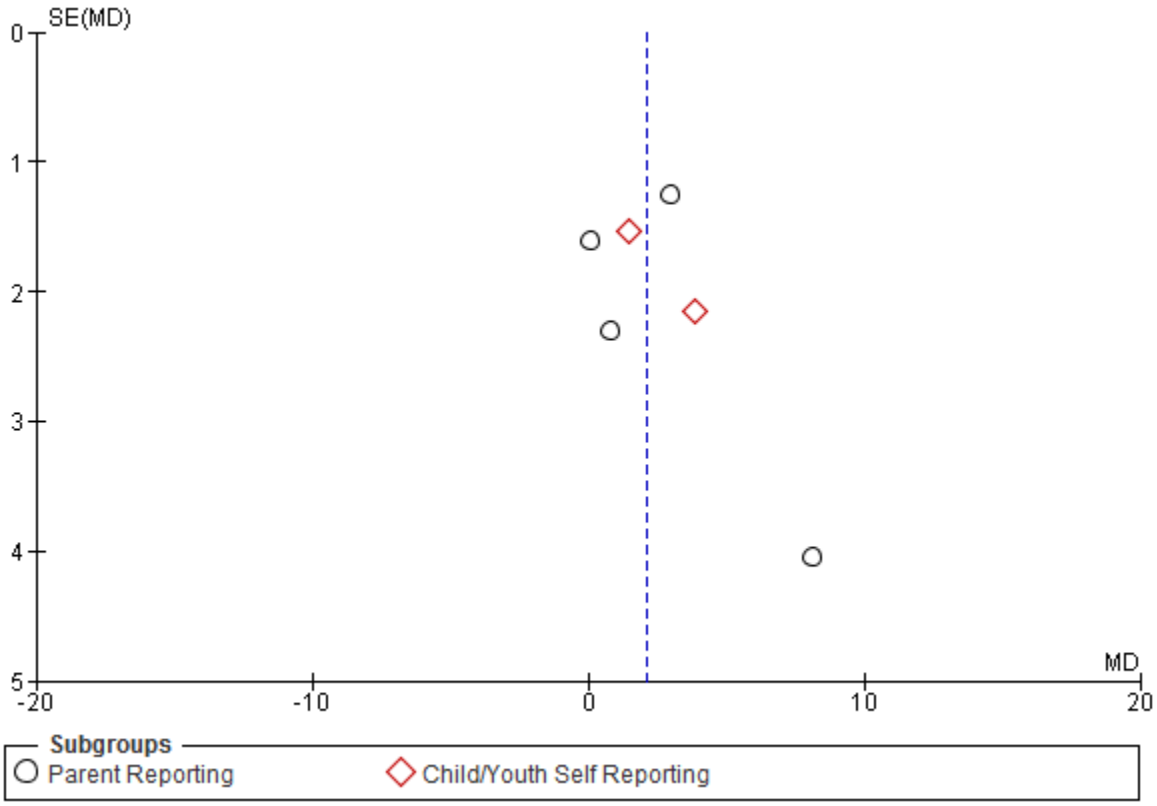
[17] The sample size is of some concern in both arms (136 intervention; 137 control) and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [MD (95% CI) 2.2231 (-0.2217, 4.6679)]. This body of evidence was downgraded for imprecision.

[18] Too few studies (n<10) to assess reporting bias.

Forest Plot 9.1: Effect of Treatment Interventions on Overall QOL



Funnel Plot 9.1: Effect of Treatment Interventions on Overall QOL



Egger's Test to Detect Publication Bias: Change in Overall QOL

Included Studies	P-value
All Studies Reporting Overall QOL	**

** Too few studies (n<10) to assess

Evidence Set 10: What are the adverse effects of weight management programs (behavioural, combined behavioural and pharmacological) attempting to stabilize or reduce BMI? – Any Adverse Events

- Summary of Any Adverse Events Evidence
- GRADE Evidence Profile Table 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events
- GRADE Summary of Findings Table 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events
- Forest Plot 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events
- Funnel Plot 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events
- Egger's Test Results (for Publication Bias)

Summary of Any Adverse Events Evidence

Behavioural

- 3 studies; 482 participants
- No adverse events reported by participants in either intervention or control groups
- Moderate GRADE rating

Pharmacological plus Behavioural

- 1 study; 533 participants
- No statistically significant difference between the intervention group and control group in terms of the likelihood of experiencing any adverse events [RR (95% CI) 1.03 (0.99, 1.08)]
- Low GRADE rating

GRADE Evidence Profile Table 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events

Quality Assessment							No. of Participants		Effect		Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other	Treatment	Control	Relative (95% CI)	Absolute per Million (Range)		
Any Adverse Events: by Primary Focus of Intervention – Behavioural												
3	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	no serious imprecision[5]	none[6]	0/252 (0%)	0/230 (0%)	-	-	⊕⊕⊕O MODERATE	CRITICAL
Any Adverse Events: by Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural												
1	randomized trial[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	341/352 (96.8750%)	170/181 (93.9227%)	RR 1.0314 (0.9895 to 1.0752)	29,492 more (from 9,862 fewer to 70,630 more)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events

Outcome: Any Adverse Events	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)
	Assumed Risk Number per Million Control	Corresponding Risk Number per Million Treatment			
By Primary Focus of Intervention – Behavioural	-	-	-	482 (3 studies[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]
By Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural	**939,227**	**968,718** (929,365 to 1,000,000)	**RR 1.0314** (0.9895 to 1.0752)	533 (1 study[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]

*The assumed risk is the mean control group risk across studies. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 10.1 for Adverse Effects of Treatment Interventions – Any Adverse Events

[1] The 3 studies are:[78,86,94] Immediate post assessment for 2 studies.[78,94] Unlike the primary and other secondary outcomes, no criteria were applied to length of follow-up for adverse events. In the third study,[86] adverse events were assessed/reported at the end of the 3 month intervention and at 3 months follow-up.

[2] Using Cochrane's Risk of Bias tool, for this outcome all 3 studies were rated as unclear risk. Across studies, there was a lack of certainty (unclear ratings) or high risk of bias associated with sequence generation (33%), allocation concealment (67%), blinding of participants and/or personnel (100%), blinding of outcome assessors (100%), and other sources of bias (33% i.e., industry funding, insufficiently powered and/or sample size <30 per arm). Given that all of the information for this outcome is from studies at moderate risk of bias, this body of evidence was downgraded for serious study limitations.

[3] RR could not be estimated as no events were reported across all studies. Therefore inconsistency could not be assessed.

[4] All 3 of the studies included mixed gender samples. Two of the studies included children aged 2 to 12 and the remaining study included youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 2 studies included only obese participants. In terms of type of intervention, 2 were diet plus exercise and 1 was lifestyle. Control participants received usual care or no intervention in all 3 studies. The intervention target in 2 studies was the individual child/youth; in 1 study the target for intervention was families. Intervention duration was 6 months or less in 2 studies and 2 years in the third study. One study was located in the UK, 1 in Australia and 1 in Iran. All of the studies were published in the last 5 years (2009-2013). This body of evidence was not downgraded for indirectness.

[5] There is some concern about sample size in both arms (252 intervention arm, 230 control arm). There were no reported events. This body of evidence was not downgraded for imprecision.

[6] There were too few studies to assess (n<10) reporting bias.

[7] The 1 study is:[67] Immediate post assessment.

[8] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation, blinding of participants and/or personnel, incomplete reporting, and other sources of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

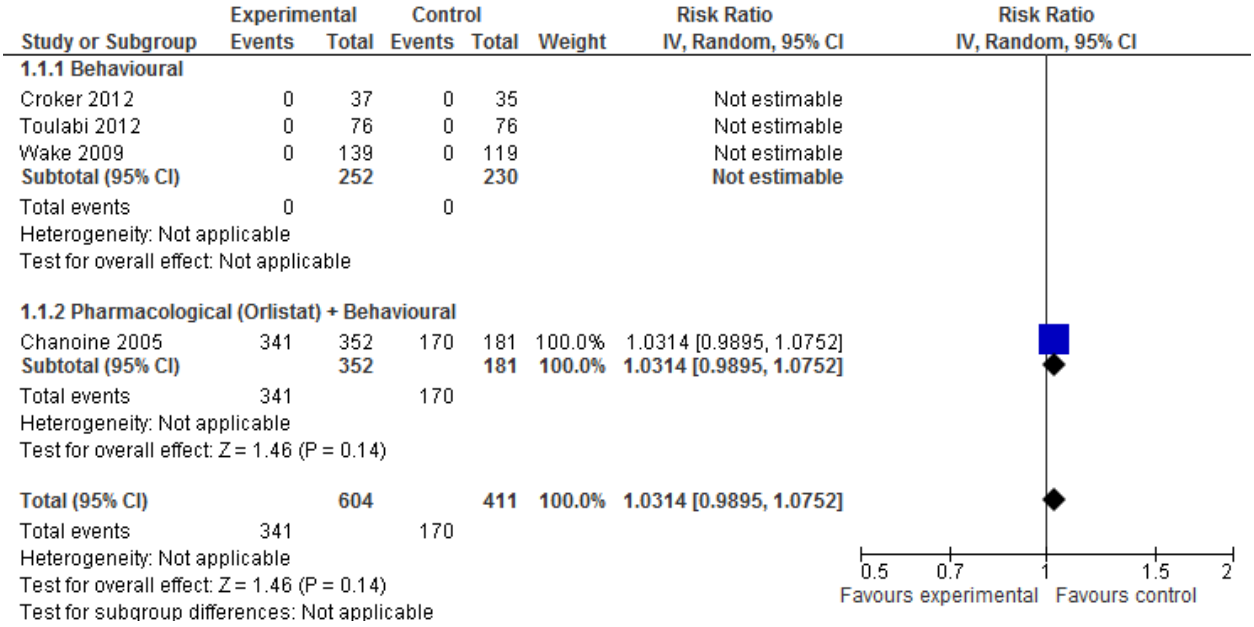
[9] Cannot assess inconsistency with only one study.

[10] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. This body of evidence was not downgraded for indirectness.

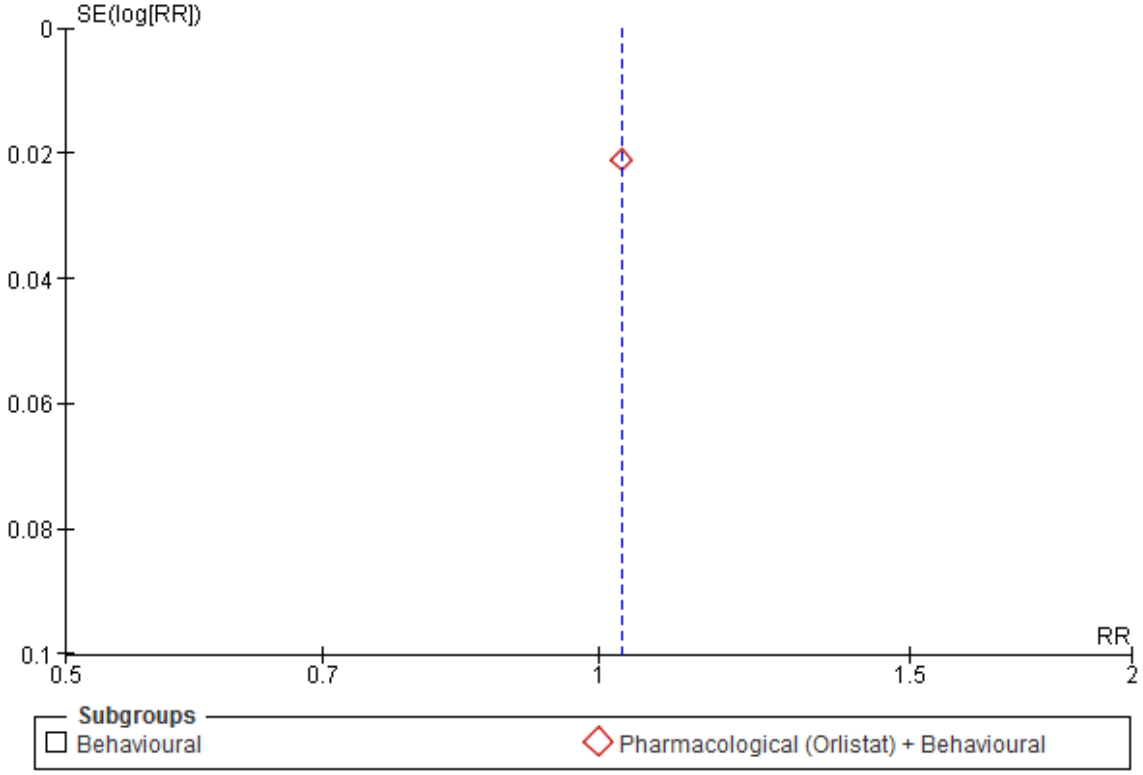
[11] The sample size is adequate in the intervention arm (n=352) but of some concern in the control arm (n=181), the number of events is adequate (341 intervention arm, 170 control arm), but the pooled effect estimate is not precise with a confidence interval that includes the no effect value [RR (95% CI) 1.0314 (0.9895, 1.0752)]. This body of evidence was downgraded for serious concerns regarding imprecision.

[12] There were too few studies (n<10) to assess publication bias.

Forest Plot 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events



Funnel Plot 10.1: Adverse Effects of Treatment Interventions – Any Adverse Events



Egger's Test to Detect Publication Bias: Any Adverse Events

Included Studies	P-value
All Studies Reporting Any Adverse Events	**

** Too few studies (n<10) to assess

Evidence Set 11: What are the adverse effects of weight management programs (behavioural, combined behavioural and pharmacological) attempting to stabilize or reduce BMI? – Serious Adverse Events

- Summary of Serious Adverse Events Evidence
- GRADE Evidence Profile Table 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events
- GRADE Summary of Findings Table 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events
- Forest Plot 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events
- Funnel Plot 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events
- Egger's Test Results (for Publication Bias)

Summary of Serious Adverse Events Evidence

Behavioural

- 1 study; 322 participants
- No statistically significant difference between the intervention group and control group in terms of the likelihood of experiencing serious adverse events [RR (95% CI) 0.51 (0.09, 2.73)]
- Moderate GRADE rating

Pharmacological plus Behavioural

- 2 studies; 573 participants
- No statistically significant difference between the intervention group and control group in terms of the likelihood of experiencing serious adverse events [RR (95% CI) 1.25 (0.46, 3.35)]
- Low statistical heterogeneity across studies [Chi^2=0.33, df=1 (P=0.56); I^2=0%]
- Low GRADE rating

GRADE Evidence Profile Table 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events

Quality Assessment							No. of Participants		Effect		Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other	Treatment	Control	Relative (95% CI)	Absolute per Million (Range)		
Serious Adverse Events: by Primary Focus of Intervention – Behavioural												
1	randomized trial[1]	no serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	2/160 (1.2500%)	4/162 (2.4691%)	RR 0.5062 (0.0940 to 2.7252)	12,193 fewer (from 22,370 fewer to 42,598 more)	⊕⊕⊕O MODERATE	CRITICAL
Serious Adverse Events: by Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural												
2	randomized trials[7]	serious risk[8]	no serious inconsistency[9]	no serious indirectness[10]	serious imprecision[11]	none[12]	12/372 (3.2258%)	5/201 (2.4876%)	RR 1.2459 (0.4635 to 3.3494)	6,117 more (from 13,346 fewer to 58,443 more)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events

Outcome: Serious Adverse Events	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)
	Assumed Risk Number per Million Control	Corresponding Risk Number per Million Treatment			
By Primary Focus of Intervention – Behavioural	**24,691**	**12,499** (2,321 to 67,289)	**RR 0.5062** (0.0940 to 2.7252)	322 (1 study[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]
By Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural	**24,876**	**30,993** (11,530 to 83,318)	**RR 1.2459** (0.4635 to 3.3494)	573 (2 studies[7])	⊕⊕⊖⊖ **low**[8,9,10,11,12]

*The assumed risk is the mean control group risk across studies. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 11.1 for Adverse Effects of Treatment Interventions – Serious Adverse Events

[1] The 1 study is:[82] Immediate post assessment.

[2] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as low risk. There was a high risk of bias associated with blinding of participants and/or personnel otherwise all dimensions were rated as low risk of bias. This body of evidence was not downgraded for study limitations.

[3] Cannot assess inconsistency with only one study.

[4] This exercise intervention study included a mixed gender sample of overweight and obese children aged 2 to 12. Control participants received usual care or no intervention. The intervention target was the individual child. Intervention duration was 6 months or less. The study was conducted in New Zealand and was published in 2011. This body of evidence was not downgraded for indirectness.

[5] There is some concern about sample size in both arms (160 intervention arm, 162 control arm). There were very few reported events (2 intervention, 4 control). The pooled effect estimate is not precise with a confidence interval that includes the no effect value [RR (95% CI) 0.5062 (0.0940, 2.7252)]. This body of evidence was downgraded for serious concerns regarding imprecision.

[6] There were too few studies to assess (n<10) reporting bias.

[7] The 2 studies are:[67,75] Immediate post assessment for both studies.

[8] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (50%), blinding of participants and/or personnel (50%), incomplete reporting (50%), and other sources of bias (100% i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

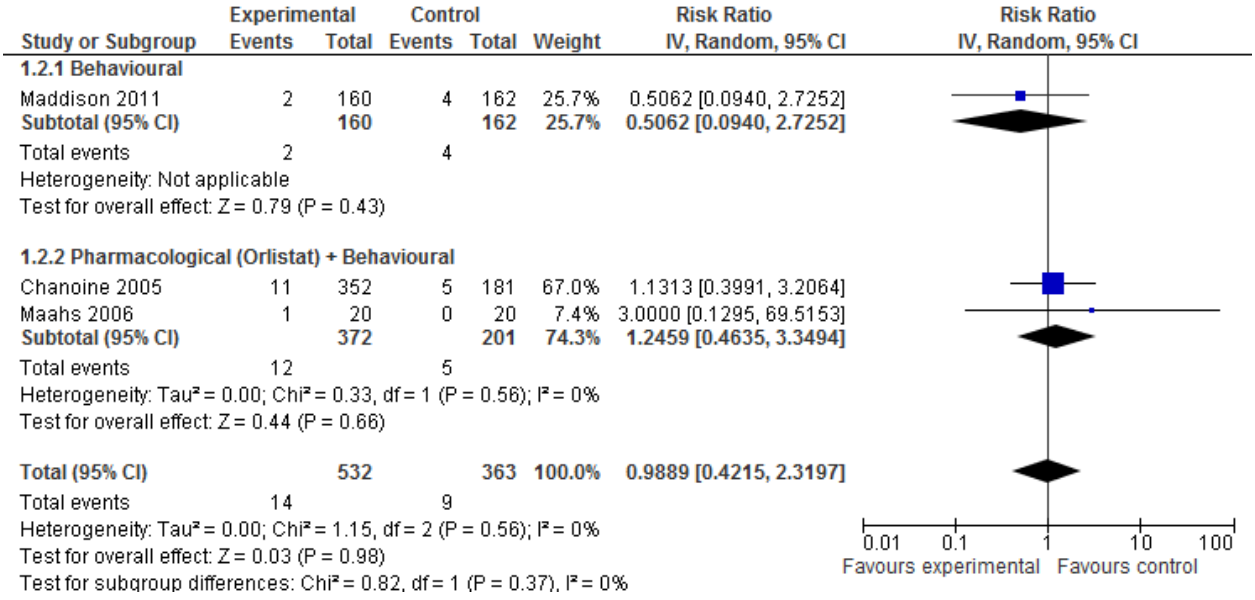
[9] The statistical heterogeneity is low [Chi^2=0.33, df=1 (P=0.56); I^2=0%], the meta-analysis shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[10] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. In terms of type of intervention both were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months in 1 study and 6 months in the other study. One study was jointly located in Canada and the US and the other was conducted in the US. The studies were published in 2005 and 2006. This body of evidence was not downgraded for indirectness.

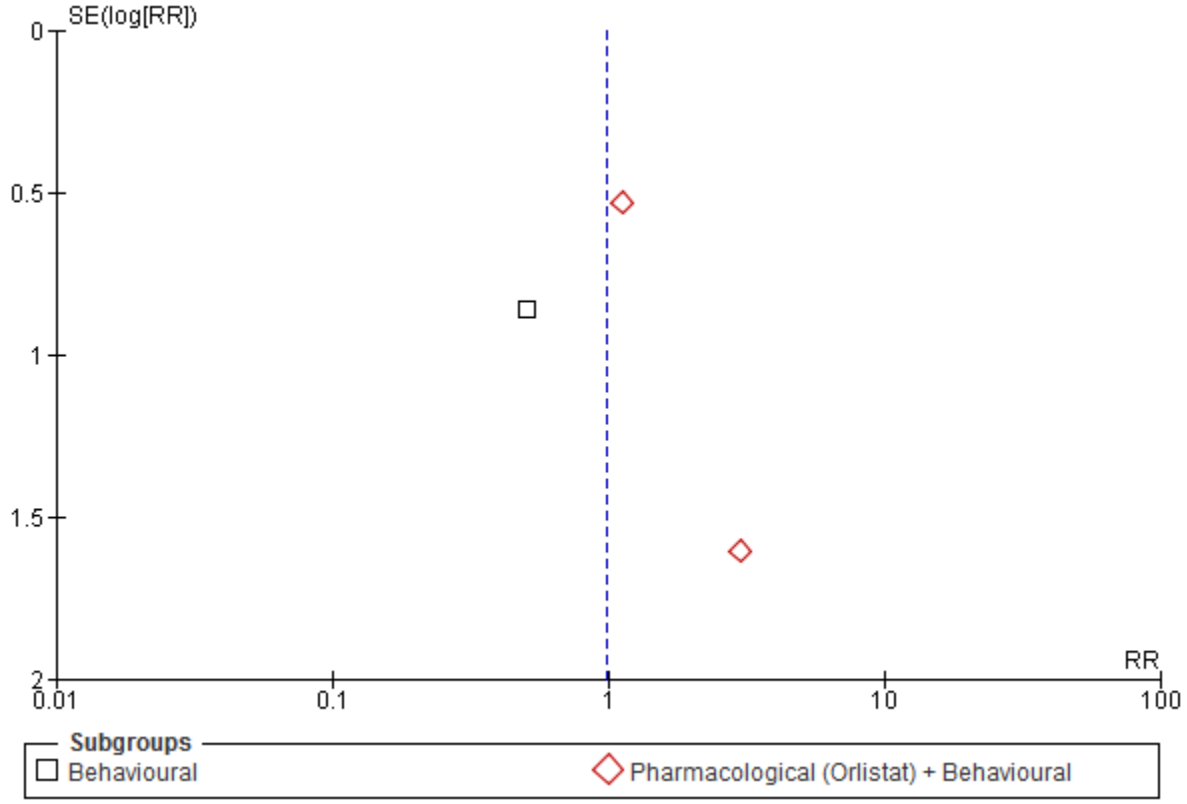
[11] The sample size is adequate in the intervention arm (n=372) but of some concern in the control arm (n=201), the number of events is very low (12 intervention arm, 5 control arm), and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [RR (95% CI) 1.2459 (0.4635, 3.3494)]. This body of evidence was downgraded for serious concerns regarding imprecision.

[12] There were too few studies (n<10) to assess publication bias.

Forest Plot 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events



Funnel Plot 11.1: Adverse Effects of Treatment Interventions – Serious Adverse Events



Egger's Test to Detect Publication Bias: Serious Adverse Events

Included Studies	P-value
All Studies Reporting Serious Adverse Events	**

** Too few studies (n<10) to assess

Evidence Set 12: What are the adverse effects of weight management programs (behavioural, combined behavioural and pharmacological) attempting to stabilize or reduce BMI? – Gastrointestinal Events

- Summary of Gastrointestinal Events Evidence
- GRADE Evidence Profile Table 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events
- GRADE Summary of Findings Table 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events
- Forest Plot 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events
- Funnel Plot 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events
- Egger's Test Results (for Publication Bias)

Summary of Gastrointestinal Events Evidence

Pharmacological plus Behavioural

- 1 study; 533 participants
- Intervention group participants were significantly more likely to experience gastrointestinal events as compared to the control group [RR (95% CI) 3.77 (2.56, 5.55)]
- ARI=36.74%
- NNH=3 (95% CI 2, 5)
- Moderate GRADE rating

GRADE Evidence Profile Table 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events

Quality Assessment							No. of Participants		Effect				Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other	Treatment	Control	Relative (95% CI)	Absolute per Million (Range)	ARI	NNH (95% CI)		
Gastrointestinal Events: by Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural														
1	randomized trial[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	no serious imprecision[5]	none[6]	176/352 (50.0000%)	24/181 (13.2597%)	RR 3.7708 (2.5608 to 5.5526)	367,399 more (from 206,957 more to 603,660 more)	36.74%	3 (2, 5)	⊕⊕⊕O MODERATE	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events

Outcome: Gastrointestinal Events	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)
	Assumed Risk Number per Million Control	Corresponding Risk Number per Million Treatment			
By Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural	**132,597**	**499,996** (339,554 to 736,256)	**RR 3.7708** (2.5608 to 5.5526)	533 (1 study[1])	⊕⊕⊕⊖ **moderate**[2,3,4,5,6]

*The assumed risk is the mean control group risk across studies. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 12.1 for Adverse Effects of Treatment Interventions – Gastrointestinal Events

[1] The 1 study is:[67] Immediate post assessment.

[2] Using Cochrane's Risk of Bias tool, for this outcome this study was rated as unclear risk. There was uncertainty (unclear risk) or high risk of bias associated with sequence generation, blinding of participants and/or personnel, blinding of outcome assessment, incomplete reporting and other risk of bias (i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious concerns regarding study limitations.

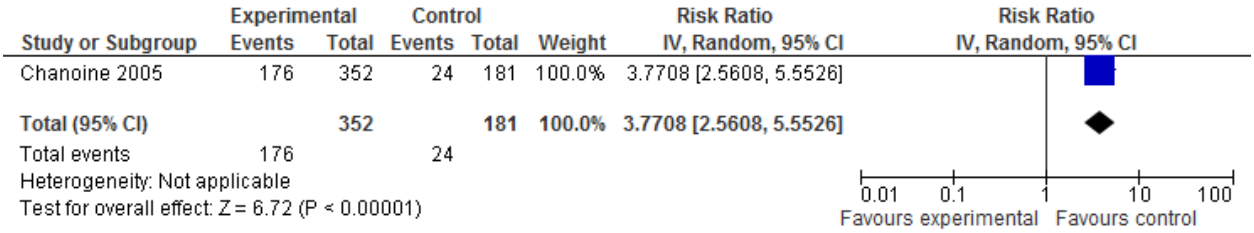
[3] Cannot assess inconsistency with only one study.

[4] The pharmacological plus behavioural intervention study included a mixed gender sample of obese youth aged 13 to 18. The intervention included a 120 mg dose of orlistat taken 3 times daily combined with diet and exercise components. Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target was the individual youth. Intervention duration was 12 months. This study was jointly located in Canada and the US and was published in 2005. This body of evidence was not downgraded for indirectness.

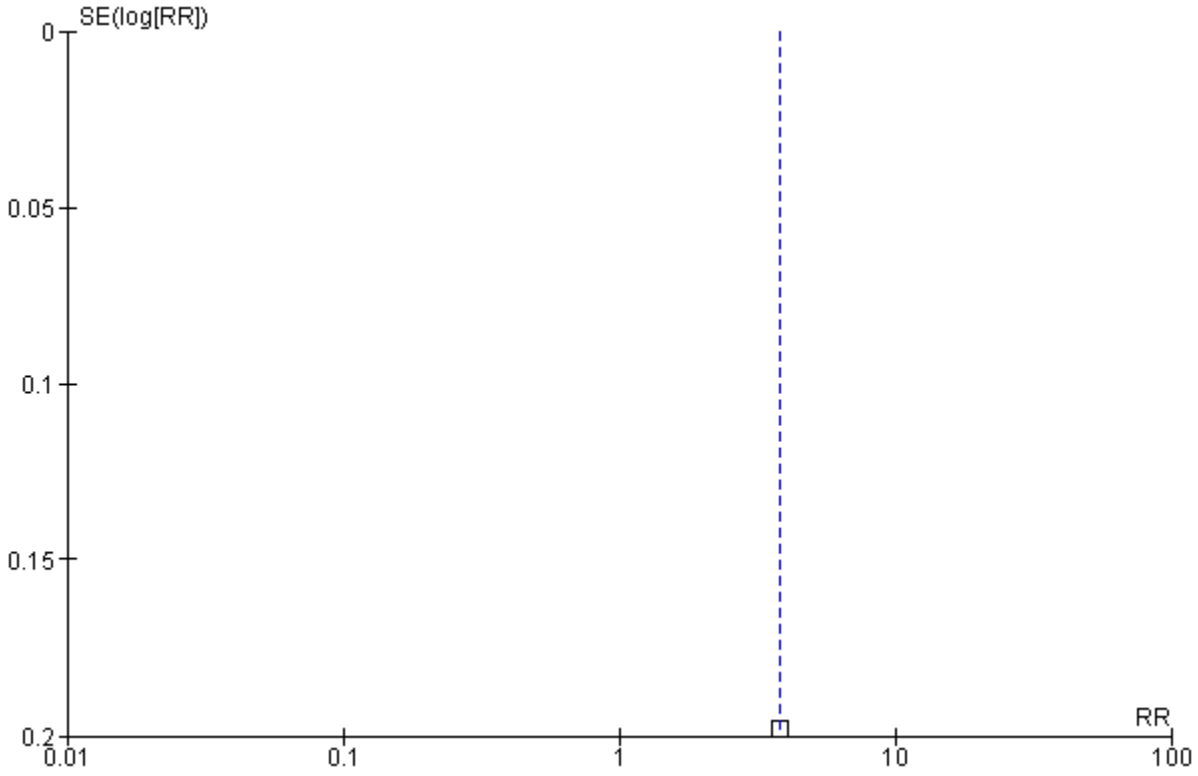
[5] The sample size in the intervention arm is adequate (n=352) but there is some concern about sample size in the control arm (n=181). There was an adequate number of events in the intervention arm (n=176) but few reported events in the control arm (n=24). The pooled effect estimate is precise with a narrow confidence interval [RR (95% CI) 3.7708 (2.5608, 5.5526)]. This body of evidence was not downgraded for imprecision.

[6] There were too few studies to assess (n<10) reporting bias.

Forest Plot 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events



Funnel Plot 12.1: Adverse Effects of Treatment Interventions – Gastrointestinal Events



Egger's Test to Detect Publication Bias: Gastrointestinal Events

Included Studies	P-value
All Studies Reporting Gastrointestinal Events	**

** Too few studies (n<10) to assess

Evidence Set 13: What are the adverse effects of weight management programs (behavioural, combined behavioural and pharmacological) attempting to stabilize or reduce BMI? – Withdrawals from Studies due to Adverse Events

- Summary of Withdrawals from Studies due to Adverse Events Evidence
- GRADE Evidence Profile Table 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events
- GRADE Summary of Findings Table 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events
- Forest Plot 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events
- Funnel Plot 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events
- Egger's Test Results (for Publication Bias)

Summary of Withdrawals from Studies due to Adverse Events Evidence

Pharmacological plus Behavioural

- 2 studies; 573 participants
- No statistically significant difference between the intervention group and control group in terms of likelihood of withdrawing from studies due to adverse events [RR (95% CI) 2.49 (0.79, 7.87)]
- Low statistical heterogeneity across studies [Chi^2=0.58, df=1 (P=0.45); I^2=0%]
- Low GRADE rating

GRADE Evidence Profile Table 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events

Quality Assessment							No. of Participants		Effect		Quality	Importance
No. of Studies	Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other	Treatment	Control	Relative (95% CI)	Absolute per Million (Range)		
Withdrawals from Studies due to Adverse Events: by Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural												
2	randomized trials[1]	serious risk[2]	no serious inconsistency[3]	no serious indirectness[4]	serious imprecision[5]	none[6]	15/372 (4.0323%)	3/201 (1.4925%)	RR 2.4932 (0.7896 to 7.8726)	22,287 more (from 3,140 fewer to 102,576 more)	⊕⊕OO LOW	CRITICAL

* Footnotes appear after the Summary of Findings Table

GRADE Summary of Findings Table 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events

Outcome: Withdrawals from Studies due to Adverse Events	Illustrative Comparative Risks* (95% CI)		Relative Effect (95% CI)	No. of Participants (Studies)	Quality of the Evidence (GRADE)
	Assumed Risk Number per Million Control	Corresponding Risk Number per Million Treatment			
By Primary Focus of Intervention – Pharmacological (Orlistat) plus Behavioural	**14,925**	**37,212** (11,785 to 117,501)	**RR 2.4932** (0.7896 to 7.8726)	573 (2 studies[1])	⊕⊕⊖⊖ **low**[2,3,4,5,6]

*The assumed risk is the mean control group risk across studies. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

Footnotes for GRADE Evidence Profile and Summary of Findings Tables 13.1 for Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events

[1] The 2 studies are:[67,75] Immediate post assessment.

[2] Using Cochrane's Risk of Bias tool, for this outcome both studies were rated as unclear risk. There was a lack of certainty (unclear ratings) or a high risk of bias associated with sequence generation (100%), allocation concealment (50%), blinding of participants and/or personnel (50%), incomplete reporting (50%), and other sources of bias (100% i.e., industry funding, insufficiently powered and/or sample size <30 per arm). This body of evidence was downgraded for serious study limitations.

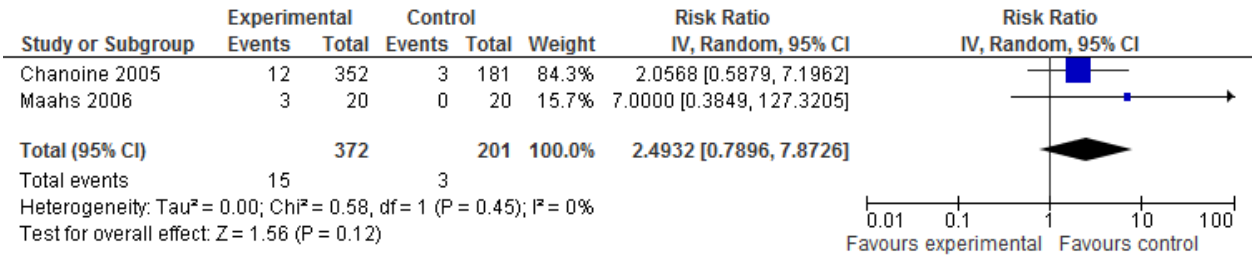
[3] The statistical heterogeneity is low [Chi^2=0.58, df=1 (P=0.45); I^2=0%], the meta-analysis shows no effect and the confidence intervals overlap. This body of evidence was not downgraded for inconsistency.

[4] Both studies included mixed gender samples of youth aged 13 to 18. In terms of weight status at baseline, 1 study included overweight and obese participants and 1 study included only obese participants. In terms of type of intervention both were pharmacological plus behavioural (orlistat, 120 mg 3 times daily plus diet and exercise components). Control participants were given a placebo instead of the active medication and they received the same diet and exercise conditions as intervention participants. The intervention target in both studies was the individual youth. Intervention duration was 12 months in 1 study and 6 months in the other study. One study was jointly located in Canada and the US and the other was conducted in the US. The studies were published in 2005 and 2006. This body of evidence was not downgraded for indirectness.

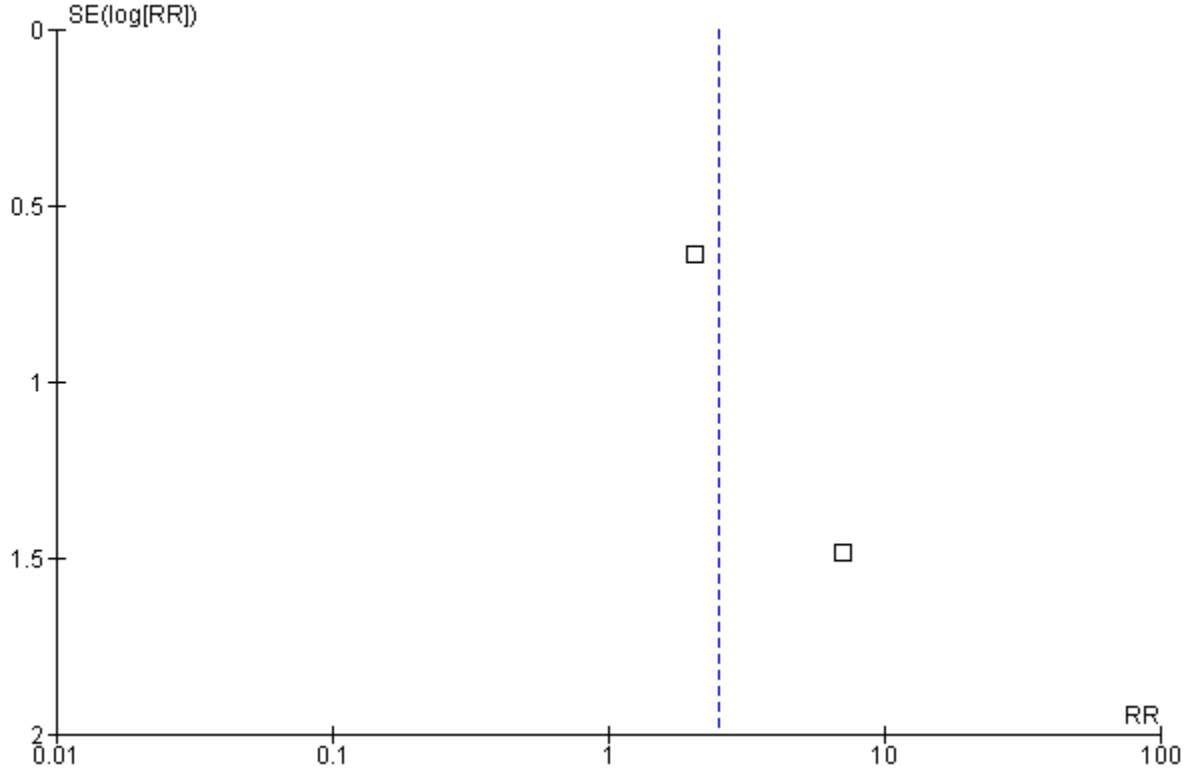
[5] The sample size is adequate in the intervention arm (n=372) but of some concern in the control arm (n=201), the number of events is very low (15 intervention arm, 3 control arm), and the pooled effect estimate is not precise with a confidence interval that includes the no effect value [RR (95% CI) 2.4932 (0.7896, 7.8726)]. This body of evidence was downgraded for serious concerns regarding imprecision.

[6] There were too few studies (n<10) to assess publication bias.

Forest Plot 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events



Funnel Plot 13.1: Adverse Effects of Treatment Interventions – Withdrawals from Studies due to Adverse Events



Egger's Test to Detect Publication Bias: Withdrawals from Studies due to Adverse Events

Included Studies	P-value
All Studies Reporting Withdrawals from Studies due to Adverse Events	**

** Too few studies (n<10) to assess

Appendices

- Appendix 1: Search Strategies
- Appendix 2: Acknowledgements

Appendix 1: Search Strategies for Key Questions (KQ) and Contextual Questions (CQ)

Medline-OVID (KQ)

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 (KQ)
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 (KQ)
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 (KQ)
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"

Medline - OVID (CQ)

August 16, 2013
1. exp continental population groups/
2. exp Ethnic Groups/
3. indians, north american/ or inuits/
4. first nations.tw.
5. (aboriginal? and canada).tw.
6. native canadians.tw.
7. (immigran* or new canadians).tw.
8. ((African or Asian or Indo or Columbian or Spanish or Chinese) adj2 Canadian?).mp.
9. Rural Population/
10. (rural adj (population? or area? or region?)).tw.
11. Rural Health/ or Rural Health Services/
12. Healthcare Disparities/
13. Social Class/
14. poverty/
15. socioeconomic.tw.
16. Socioeconomic Factors/
17. (poor or disadvantaged or poverty or social status).tw.
18. exp homeless persons/ or vulnerable populations/
19. exp "Costs and Cost Analysis"/
20. (cost or costs).tw.
21. *"patient acceptance of health care"/ or *patient compliance/ or *patient participation/ or patient satisfaction/ or patient preference/ or *treatment refusal/
22. (women? adj3 (acceptance or preference? or satisfaction or experience?)).tw.
23. (consumer? adj3 (acceptance or preference? or satisfaction or experience?)).tw.
24. (patient? adj3 (acceptance or perference? or satisfaction or experience?)).tw.
25. willingness to pay.tw.
26. ((conjoint or contingent) adj3 (valuation or analysis)).tw.
27. exp Canada/
28. (Canada or Canadian or Ontario or British Columbia or Alberta or Saskatchewan or Manitoba or Quebec or Nova Scotia or Prince Edward Island or Newfoundland or New Brunswick or Yukon or Northwest Territories or Nunavut).tw.
29. (meta anal* or metaanal*).ti,ab.
30. meta-analysis.pt,ti,ab,sh.
31. (meta anal$ or metaanal$).ti,ab,sh.
32. ((methodol$ or systematic$ or quantitativ$) adj3 (review$ or overview$ or survey$)).ti.
33. ((methodol$ or systematic$ or quantitativ$) adj3 (review$ or overview$ or survey$)).ab.
34. ((pool$ or combined or combining) adj (data or trials or studies or results)).ti,ab.
35. (medline or embase or cochrane or pubmed or pub med).ti,ab.
36. or/33-35

37. review.pt,sh.
38. 36 and 37
39. or/30-32
40. 38 or 39
41. "Process Assessment (Health Care)"/ or Quality Indicators, Health Care/ or Quality Assurance, Health Care/
42. Benchmarking/
43. (performance adj2 (indicators or measures)).tw.
44. or/41-43
45. or/1-28
46. 44 or 45
47. 40 and 46
48. Weight Reduction Programs/
49. exp obesity/pc
50. Overweight/pc
51. weight maintenance.tw.
52. weight management.tw.
53. exp *obesity/
54. *overweight/
55. *Weight Gain/
56. exp obesity/
57. overweight/
58. weight gain/
59. Weight Loss/
60. (weight or bmi or body mass index or waist circumference or obese or obesity).ti.
61. or/48-60
62. 47 and 61
63. limit 62 to yr="2007 -Current"
64. limit 63 to (english or french)
65. 29 or 30 or 31 or 32 or 33 or 34
66. 46 and 61 and 65
67. limit 66 to yr="2007 -Current"
68. limit 67 to (english or french)
69. (Canada or Canadian or Ontario or British Columbia or Alberta or Saskatchewan or Manitoba or Quebec or Nova Scotia or Prince Edward Island or Newfoundland or New Brunswick or Yukon or Northwest Territories or Nunavut).ti.
70. 53 or 54 or 55 or 60
71. 69 and 70
72. limit 71 to yr="2007 -Current"
73. limit 72 to (english or french)
74. weight gain/de
75. molecular weight.ti.
76. 74 or 75
77. (Meta-analysis or review).pt. or systematic review.ti.
78. 64 and 77
79. 73 or 78

80. 79 not 76
81. limit 80 to ed=20121017-20130816

EMBASE – OVID (CQ)
August 16, 2013
1. meta analysis/
2. systematic review/
3. (systematic* adj3 (review* or overview*)).tw.
4. exp "ethnic and racial groups"/
5. first nations.tw.
6. (aboriginal? and canada).tw.
7. native canadians.tw.
8. (immigran* or new canadians).tw.
9. ((African or Asian or Indo or Columbian or Spanish or Chinese) adj2 Canadian).mp.
10. rural health care/
11. rural population/
12. (rural adj (population? or area? or region?)).tw.
13. exp economic evaluation/
14. cost.tw.
15. or/13-14
16. exp patient attitude/
17. (women? adj3 (acceptance or preference? or satisfaction or experience?)).tw.
18. (consumer? adj3 (acceptance or preference? or satisfaction or experience?)).tw.
19. (patient? adj3 (acceptance or preference? or satisfaction or experience?)).tw.
20. willingness to pay.tw.
21. ((conjoint or contingent) adj3 (valuation or analysis)).tw.
22. or/16-21
23. ((process or performance or outcome) adj2 (measure? or indicator?)).tw.
24. performance measurement system/
25. or/23-24
26. exp socioeconomics/
27. exp social status/
28. (poor or disadvantaged or poverty or social status).tw.
29. health care disparity/
30. miscellaneous named groups/ or lowest income group/ or medically underserved/ or vulnerable population/
31. or/4-12
32. or/26-30
33. 15 or 22 or 25 or 31 or 32
34. exp Canada/
35. (Canada or Canadian or Ontario or British Columbia or Alberta or Saskatchewan or Manitoba or Quebec or Nova Scotia or Prince Edward Island or Newfoundland or New Brunswick or Yukon or Northwest Territories or Nunavut).tw.
36. or/34-35
37. *obesity/
38. *diabetic obesity/

39. *abdominal obesity/
40. *morbid obesity/
41. *weight reduction/
42. obes$.ti.
43. overweight.ti.
44. weight.ti.
45. or/37-44
46. (weight loss adj (intervention$ or program$ or trial$)).ti,ab.
47. (weight reduc$ adj (intervention$ or program$ or trial$)).ti,ab.
48. (weight management adj (intervention$ or program$ or trial$)).ti,ab.
49. (weight control adj (intervention$ or program$ or trial$)).ti,ab.
50. 37 or 38 or 39 or 40
51. 41 and 50
52. 33 and 45
53. 1 or 2 or 3
54. 15 or 22 or 25 or 31 or 32 or 36
55. 53 and 54
56. 45 or 51
57. 55 and 56
58. limit 57 to yr="2007 -Current"
59. limit 58 to (english or french)
60. (Canada or Canadian or Ontario or British Columbia or Alberta or Saskatchewan or Manitoba or Quebec or Nova Scotia or Prince Edward Island or Newfoundland or New Brunswick or Yukon or Northwest Territories or Nunavut).ti.
61. 56 and 60
62. limit 61 to yr="2007 -Current"
63. limit 62 to (english or french)
64. 59 or 63
65. limit 64 to em="201237-201332"

Appendix 2: Acknowledgements

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Sylvia Robinson	Joint Director, Public and Primary Care Collaboration, Ministry of Health Services, Victoria, British Columbia	Full Draft Reviewer
Mary Gauld	McMaster Evidence Review and Synthesis Centre	Research Assistance
Sharon Peck-Reid	McMaster Evidence Review and Synthesis Centre	Research Assistance

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