Eating Disorders & Obesity Treatments

A systematic review of the physical, psychological and eating disorders outcomes from obesity treatments

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Executive Summary

Both eating disorders and obesity are complex, chronic conditions with substantial individual and societal consequences and significant shared risk factors.

In Australia, over 60% of the population is currently estimated to be overweight or obese and over 10% are estimated to be suffering from an eating disorder. While often regarded as separate problems, obesity and eating disorders both revolve around unhealthy beliefs and behaviours around weight and eating, and one in five individuals with obesity also presents with comorbid disordered eating. In light of the considerable overlap between conditions at either end of the weight spectrum, there is an urgent need to facilitate evidence-informed dialogue between obesity and eating disorders sectors.

A sizeable literature indicates that prevention initiatives targeting overweight and obesity may inadvertently increase eating disorders risk factors. Public health campaigns that emphasise the desirability of an ideal body weight and shape are associated with increased stigma and body dissatisfaction in individuals of all weights. Whether a similar relationship exists between obesity treatments and eating disorders outcomes has received significantly less attention, but is equally important in ensuring that the benefits of an intervention outweigh the harms.

This report systematically reviews the literature on obesity treatments, including dietary, exercise, behavioural/psychological, pharmacological and surgical interventions for weight loss. Scientific databases were systematically searched for all treatment studies published within the past five years that included an assessment of treatment impacts on physical, psychological or eating disorders outcomes. The National Health and Medical Research Council guidelines and level of evidence scheme were used as a framework to address key study questions.

In total, 3628 citations were assessed for potential relevance to the study questions and 134 studies (33 systematic reviews and 101 randomised controlled trials) met all criteria and were evaluated in this review.

Obesity Treatment Interventions and Outcomes

Numerous treatment strategies have been trialled to assist people to lose weight. As with prior reports, lifestyle interventions incorporating dietary, exercise and behavioural or psychological components were the most commonly recommended first-line approach, with escalation to pharmacotherapy and bariatric surgery in more severe or complicated cases. Bariatric surgery and registered medicines consistently reduced weight but were also associated with adverse effects that ranged from mild to severe, while exercise, dietary and behavioural/psychological interventions produced mixed weight loss outcomes but had few adverse effects.

The most common measure of psychological outcomes was quality of life, which improved in all cases where it was assessed, across all intervention types. Symptoms of depression also improved in a subset of interventions (behavioural, psychological, pharmacotherapy and surgical interventions). A smaller body of evidence supported improvements in anxiety,
fatigue and confusion (following pharmacotherapy) and psychosocial functioning (following bariatric surgery).

Studies of behavioural and psychological interventions and lifestyle interventions for weight loss reported consistent improvements in cognitive restraint, control over eating and binge eating. In contrast, bariatric surgery resulted in improvements in eating behaviour and body image that were not sustained over the long-term, while pharmacotherapies did not produce clinically significant outcomes in any instance. However, relatively few studies directly assessed the impact of weight loss interventions on psychological and eating disorders outcomes, making it difficult to ascertain whether improvements were a result of the supportive treatment context or weight loss per se.

Concerns have been raised that dieting may precipitate eating disorders in overweight and obese individuals; however, the studies evaluated in this review do not support this suggestion. Rather, we find that professionally administered weight-loss programmes often lead to improvements in quality of life alongside weight loss. At the same time, it is imperative that clinicians are aware of the large and consistent body of evidence reporting harms from unhealthy dieting behaviours, and monitor patients to ensure that healthy diets do not transition into unhealthy diets over time.

There were a number of limitations in the evidence base addressing our key questions that constrain our interpretation of outcomes. Key among these was the scarcity of studies assessing the impacts of weight loss interventions on psychological and eating disorders outcomes, the lack of a well-validated measure to assess eating disorders specifically within the weight loss population, and the overreliance on BMI as a measure of treatment success. Additionally, most studies included only short-term (≤1 year) follow-ups which failed to account for longer-term changes in outcome or relapse.

The Way Forward

Overweight and obesity interventions, taken as a whole, are often effective at reducing weight, and for many individuals, weight reduction is associated with significant improvements in health outcomes and quality of life. Since obesity itself is a risk factor for binge eating disorder, weight reduction is also likely to have positive outcomes for eating disorders. Indeed, consistent improvements in eating disorder psychopathology were reported in weight loss interventions that incorporated behavioural and psychological components. These findings underscore the potential gains from multidisciplinary interventions that target psychological well-being alongside measures of physical health.

In consideration of the strengths and limitations of the current evidence base, this review highlights the need for improved clinical tools and practices, greater dialogue and collaboration between sectors, and increased research into the area of overlap between obesity and eating disorders. In particular, the following key areas in research and practice require further attention:

Recommendations for Practice

- Better training of health professionals is required to increase awareness about the physical and psychological features of obesity and eating disorders as well as their shared, modifiable risk factors.
- Incorporate evidence based treatment strategies into obesity care. Given the benefits of behavioural and psychological interventions on eating disorders outcomes and weight
loss, future weight loss interventions should incorporate these components into a more holistic program of care.

- Longer-term monitoring and maintenance sessions with a combined emphasis on stabilising weight, well-being, and healthy activity and eating patterns.
- Improve postsurgical follow-up care. Bariatric surgery patients present unique challenges that must be carefully monitored, such as the development of disordered eating behaviours with and without concomitant eating disorders psychopathology.

**Recommendations for Research**

- Develop a well-validated psychometric measure of disordered eating for patients seeking weight loss. Current measures targeting traditional eating disorders populations should be adapted to populations seeking weight loss to encompass eating attitudes, cognitions and behaviours that may be unique to this population.
- Develop a more comprehensive metric of success that incorporates quality of life, psychological and eating disorders outcomes into existing measures of BMI and weight loss.
- Increase research into the psychological and eating disorders outcomes of weight loss interventions.

Taken together, the evidence evaluated in this review provides empirical support for an integrative approach to obesity and eating disorders conceptualisation and care. The overlap between these disorders represents a significant yet underrepresented public health challenge. Urgent dialogue and collaboration between sectors is required to maximise treatment outcomes, minimise harms, and lay the groundwork for an integrated model of care.
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Glossary and Abbreviations

AN anorexia nervosa
BED binge eating disorder
BN bulimia nervosa
BMI body mass index
BPD-DS biliopancreatic diversion-duodenal switch
BWL behavioural weight loss
CBT cognitive behavioural therapy
DSM diagnostic and statistical manual
GBP gastric bypass
GP general practitioner
kKcal kilocalories
kg/m² kilogram per square metre, unit of BMI
kJ kilojoule
LAGB laparoscopic adjustable gastric band
LGB laparoscopic gastric bypass
LSG laparoscopic sleeve gastrectomy
N number
p probability, usually p value
SR systematic review
SSRI selective serotonin reuptake inhibitor
RCT randomised controlled trial
RYGB roux-en-y gastric bypass
TGA therapeutic goods administration
Acknowledgements

Collaboration, defined as the act of ‘voluntarily and cooperatively working together to achieve a common goal’ is the core operating principle of the National Eating Disorders Collaboration (NEDC). The work of the NEDC has been based on identifying, analysing and then building on the available evidence. Every voice in the collaboration has been an important one in contributing to the current knowledge base.

The NEDC also acknowledges the considerable work that has already been undertaken by a number of state governments, academic institutions and consumer advocacy groups on identification of gaps and opportunities for improved service for people with eating disorders.

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Objectives of the NEDC

The National Eating Disorders Collaboration (NEDC) is the second phase of a project initiated and funded by the Commonwealth Government Department of Health in 2009. The primary purpose of the NEDC is to bring together eating disorder stakeholders and experts in mental health, public health, health promotion, education, research, and the media to develop a nationally consistent approach to the prevention and management of eating disorders in Australia.

The project’s objectives are:

- To provide or facilitate access to helpful, evidence-based information for young people and their families on the prevention and management of eating disorders and healthy eating;
- To promote a consistent evidence-based national approach to eating disorders;
- To develop and assist in implementing a comprehensive national strategy to communicate appropriate evidence-based messages to schools, the media and health service providers.

In working towards these objectives, the NEDC is actively pursuing the following outcomes that were identified in the first phase of the project:

- Eating disorders are a priority mainstream health issue in Australia;
- A healthy, diverse and inclusive Australian society acts to prevent eating disorders;
- Every Australian at risk has access to an effective continuum of eating disorders prevention, care and ongoing recovery support.
1. Background

Obesity and eating disorders are significant public health concerns that are associated with a broad range of adverse physical and psychological conditions. In Australia, more than 60% of adults and 25% of children and adolescents are overweight or obese\(^ {111,282}\), with an additional 16% presenting with disordered eating behaviours or eating disorders\(^ {117}\). The rate of both eating disorders\(^ {116}\) and obesity\(^ {282}\) is increasing in the Australian population, and recent evidence indicates that the rate of comorbid obesity and eating disorder behaviours has increased more rapidly than either disorder alone\(^ {66}\).

Healthy body weight is associated with normal growth and development in young people and reduced risk of short- and long-term morbidity and mortality among people of all ages\(^ {35}\). While the health risks of being overweight are widely acknowledged, it is imperative to also attend to the risks associated with being underweight, including decreased immunity, osteoporosis, decreased muscle strength, hypothermia and psychological distress\(^ {193}\).

A growing body of evidence highlights the significant shared space between disorders at both ends of the weight spectrum. Overweight individuals are at increased risk of disordered eating and eating disorders compared with the general population\(^ {14}\), while individuals who use unhealthy weight-control practices (e.g. fasting, purging and diet pills) are at increased risk of overweight and obesity\(^ {63,186,200}\). Moreover, individuals with eating disorders are more than twice as likely to contact health professionals or weight loss centres for weight reduction assistance\(^ {116}\) than they are to seek treatment specifically for their disorder\(^ {116}\). This raises the concern that active participation in weight loss may contribute to the development of disordered eating or eating disorders\(^ {121}\).

1.1. Overweight and obesity

The World Health Organisation defines obesity as a condition of abnormal or excessive body fat that impairs health\(^ {994}\). Since measuring body fat directly is not always practical, body mass index (BMI, a ratio of weight by height) is used as a proxy. Body mass index is a standardised and relatively straightforward method for describing large populations but is an imperfect measure of overall health at the individual level\(^ {153,201}\) and may require updating as research progresses\(^ {148}\).

Current definitions ascribe overweight status to individuals with BMI \( \geq 25 \text{ kg/m}^2 \) and obesity to individuals with BMI \( >30 \text{ kg/m}^2 \), but a straightforward relationship may not apply for all groups (such as children, athletes, those at the extremes of the height distribution and certain ethnic populations\(^ {140,258}\)).

Obesity is a complex, chronic condition that is accompanied by substantial physical and mental health consequences. The prevalence of overweight and obesity in Australia is among the highest in the developed world, affecting over 60% of adults and 25% of children and adolescents\(^ {111,282}\). In Australia, the combined direct, indirect and social costs of overweight and obesity in 2008 were estimated to be in excess of $58 billion\(^ {172}\), and if current trends continue an estimated 80% of adults will be overweight or obese by 2025\(^ {111,282}\).

The major determinants of obesity are complex, multifaceted and extend beyond simplistic explanations of overconsumption of calories and insufficient exercise. The early influence of genetics, intrauterine environment, early infant feeding and environmental factors interact to set the stage for weight trajectory throughout life\(^ {170}\). Overweight and obesity are associated with overall increased mortality\(^ {87}\), as well as risk factors for cardiovascular disease, type 2 diabetes, sleep apnoea osteoarthritis, hypertension, musculoskeletal conditions and certain cancers\(^ {97}\). Further, overweight and obesity have consistently been linked with a lower quality of life, including increased risk of psychological distress\(^ {157,158}\), mood and anxiety disorders\(^ {369}\), suicidal ideation and attempts\(^ {53,73}\) and binge eating disorder\(^ {1}\).

1.2. Dieting, disordered eating and eating disorders

The term ‘dieting’, as defined here, refers to the intentional and sustained restriction of calories
for the purpose of reducing body weight or changing body shape. In Western countries, approximately 55% of women and 29% of men report having dieted to lose weight at some point in their lives. Disordered eating describes unhealthy eating behaviours that are not sufficient to meet the current criteria for a clinical disorder but nonetheless constitute a serious health problem. Disordered eating differs from dieting in that it describes unhealthy, extreme and dangerous dietary and weight control practices, such as, skipping meals, self-induced vomiting, misuse of laxatives and diet pills, and binge eating. Over 10% of Australian women and around 8% of Australian men regularly engage in at least one form of disordered eating.

Eating disorders are highly complex and serious mental and physical illnesses that are characterised by abnormal eating behaviours and psychological disturbances surrounding shape and weight. Like obesity, eating disorders can affect every major organ in the body and cause significant physiological harms, including gastrointestinal illnesses, osteoporosis, kidney failure, heart failure, dental and gum diseases, type 2 diabetes, infertility issues and anaemia.

There are several types of eating disorders currently recognised (DSM-5), including anorexia nervosa (AN), bulimia nervosa (BN) and binge eating disorder (BED). These three disorders each have specific, formal diagnostic criteria and cause marked distress. In reference to weight status, individuals with AN are often underweight, individuals with BN are typically of average weight, and individuals with BED are often overweight. Binge eating disorder is characterised by recurring episodes of binging and feelings of lack of control, without subsequent compensatory behaviours. In comparison, bulimia nervosa (BN) is characterised by frequent episodes of binge eating followed by compensatory behaviours, such as self-induced vomiting or laxatives, to avoid weight gain.

1.3. The interface between obesity and eating disorders

The incidence of obesity and eating disorders are interrelated. Obesity is both a risk factor for eating disorders and a serious and common outcome for individuals with BN and BED. Individuals with BED are at increased risk of weight gain and related complications, and experience a higher rate of medical problems than obese individuals without BED. Further, obesity and eating disorders share a number of risk factors that apply to a broad range of eating- and weight-related problems. These include (i) individual factors such as dieting, unhealthy weight-control behaviours, weight and shape concerns, and self-esteem issues; (ii) social factors, such as parental and peer weight and shape related behaviours; and (iii) societal factors, such as sociocultural norms, media exposure and weight discrimination. Collectively, these factors place enormous pressure on individuals to conform to an ideal weight and shape, and contribute to body dissatisfaction that is a predictor of both eating disorders and excessive weight gain.

Adolescents are a particularly vulnerable demographic for weight-related concerns. The peak period of eating disorders onset is between the ages of 12 and 25 years, with a median age of 18 years. In the past three decades, obesity in adolescents has increased by nearly 75% and nearly 25% of Australian children and adolescents are currently overweight or obese. Amongst young people, dieting is one of the most common precursors of eating disorders. Nearly 38% of girls and 12% of boys diet moderately, and nearly 7% of girls and 1% of boys diet at an extreme level. Dieting that is not clinically supervised is associated with other health concerns including depression, anxiety, metabolic problems, disordered weight control behaviours and eventual eating disorders.

Given the relationship between dieting and obesity in young people, there is reason to be concerned that obesity interventions targeting youth could contribute to the development of eating disorders in later years. Similar concerns have been raised that obesity treatment initiatives may contribute to the onset of disordered eating behaviours in individuals of any age, by increasing anxiety about body shape and weight and the development of unhealthy weight loss behaviours.

1.4. Purpose and scope

The physiological benefits of weight loss in overweight and obese adults has been clearly demonstrated. Many weight loss interventions focus on strategies to lose weight, and by extension, the most common metric for measuring the success of weight loss interventions is the amount of weight lost. However, overweight and obesity may be
precipitated by psychological factors as well as increase the risk of psychological consequences\textsuperscript{161}, which may play an important role in modulating treatment outcomes\textsuperscript{156}. Both obesity and eating disorders are associated with low self and body-esteems, depressive symptoms and poor quality of life, among other psychological comorbidities\textsuperscript{26,65}. However the majority of studies exploring the efficacy of weight loss interventions lack assessment of psychological or eating disorders outcomes associated with weight loss\textsuperscript{156}.

Thus, the overall aim of this report was to systematically evaluate the outcomes from weight loss interventions along these three interrelated domains and provide a framework for integrated care going forward. More specifically, the questions guiding this evidence review were:

1. What are the physical health outcomes associated with weight loss interventions?
2. What are the mental health outcomes associated with weight loss interventions?
3. What are the impacts of weight loss interventions on the incidence and symptoms of eating disorders?
2. Methodology

This study was conducted in the form of a systematic review (SR) of the current literature on overweight and obesity treatment interventions. Searches of the electronic databases Medline, Psycinfo and Cochrane Library were conducted in February 2016 using both medical subject headings (MeSH) and equivalent free text searches for terms pertaining to obesity (overweight, overnutrition, hyperphagia), obesity interventions (exercise, diet, psychological, pharmacological, behavioural and surgical), and eating disorders (anorexia nervosa, bulimia nervosa, binge eating disorder, other specified feeding and eating disorders).

2.1. Criteria for considering studies for this review

Studies were included or excluded from this review using the following criteria:

**Article Criteria**

We considered peer-reviewed SRs or randomised controlled trials (RCT) published in 2011 or more recent, or in the case of SRs or meta-analyses, an original or updated search date of 2011 or more recent. These criteria were chosen because of the volume of available literature, because non-recent RCTs will be evaluated within recent SRs, and because recent SRs eclipse non-recent SRs. Where SRs or RCTs were unavailable, other levels of evidence were sought. We excluded non-English studies, studies reporting primarily qualitative or methodological data, studies focused on preventative interventions and studies in which the outcomes of an overweight or obesity intervention were not the study focus.

**Demographic**

The target sample included overweight or obese males and females ranging in age from 12-65 years. Adolescents (12-18 years) were assessed separately from adults (18-65 years). Because of prominent differences in treatment strategies, paediatric and elderly patients were excluded from consideration. As our aim was to evaluate treatment interventions on a general population, our target sample was otherwise healthy, and with the exception of BED, had no physical or psychological comorbidities.

**Interventions and Outcome Measures**

The primary interventions evaluated in this review were dietary, exercise/physical activity, psychological/behavioural, pharmacological and surgical interventions, while the primary outcome measures were standardised anthropometric measures (e.g., BMI and body weight), standardised body composition measures (e.g., body fat mass), psychological and quality of life measures, and reports of adverse treatment effects.

2.2. Study selection and data extraction

The search strategy yielded a total of 3628 citations after removal of duplicates. Following exclusion of studies that did not meet inclusion criteria, 134 studies remained, of which 33 were SRs and 101 were RCTs. The most common reasons for exclusion were study foci other than treatment outcomes (N=1478); not being about overweight or obesity, or not having overweight or obesity as the primary focus of the study (N=1194); reporting primary outcomes measures not considered in this study (N=241); and including participants with physical or psychological comorbidities (N=48).

2.3. Quality assessment of studies

All included studies were assessed first individually and second collectively according to treatment intervention. Quality assessment included appraisal of each of the following: level of evidence, study quality, clinical impact, generalisability, applicability and consistency (for SRs only; adapted from NHMRC guidelines13). Each assessment item was scored by one of two reviewers, and a subset of studies (10%) was scored by both reviewers to assess accuracy. Disagreements were resolved by consensus.

**Level of Evidence**

A level of evidence scheme (outlined in Appendix A and developed by the National Health and Medical Research Council13) was used to organise the study retrieval and selection process, such that Level I (SRs of level II studies) and II (RCT) studies were targeted first for retrieval for each key question.
Study Quality

A quality score of high, moderate or low quality was assigned to each study included in this review. Systematic reviews were assessed using the Overview Quality Assessment Questionnaire\textsuperscript{207} (OQAQ, Appendix 1B). The OQAQ contains 9 questions that evaluate whether review authors conducted a comprehensive search, minimised bias in study selection and appropriately assessed and pooled data for analyses. Randomised controlled trials were assessed using the Jadad scale\textsuperscript{132}. The Jadad scale, considered the most reliable amongst scales of its kind\textsuperscript{202}, contains 7 questions that evaluates whether the study was appropriately randomised and blinded, and whether withdrawals and dropouts were appropriately accounted for (Appendix 1C).

Clinical Impact

Clinical impact, in the context of this evidence review, refers to the potential benefit that a study’s outcomes may have for the general population. Each study received a clinical impact rating of high, moderate or low based on the statistical precision of the effect, the size of the effect, and the relevance of the outcome to patients compared with other treatments or no treatment. We present a qualitative summary of key outcomes reported by the original study authors, specifically, whether statistically significant differences occurred pre- to post-intervention or between intervention and control conditions. Statistical significance is partly a function of sample size, such that large samples may produce a statistically significant difference that is not clinically meaningful, while small samples may fail to find a statistically significant difference despite the occurrence of clinically meaningful outcomes. As such, we additionally report on measures reflecting the clinical relevance of outcomes, when this data is available.

Consistency

Systematic reviews were given a consistency rating of high, moderate or low based on how consistent the findings of included studies were. For SRs that also included meta-analyses of RCTs, a high to moderate rating required that statistical heterogeneity between studies was small and/or well accounted for.

Summary of Evidence

Following the assessment of each individual SR and RCT, the evidence for each intervention was evaluated along the following features: evidence base, consistency and clinical impact. The evidence base here refers to the number and quality of all studies included for an intervention. Each of the other factors was assessed as described above, and assigned a rating of poor, satisfactory, good or excellent based on the degree to which relevant criteria were fulfilled. These methods were adapted from the NHMRC Body of Evidence Matrix\textsuperscript{191} (Appendix D).

2.4. Methodological limitations

Reporting of evidence is limited to qualitative summary of outcomes reported by the original study authors. An important extension of the SR process is to conduct quantitative meta-analyses of all available evidence from multiple trials, in order to draw more reliable conclusions about a given topic. However, this was outside the scope of the present review.

Overweight and obese patients receiving treatment for weight loss are a demographically complex group, often presenting with comorbid conditions that may be the cause or consequence of their condition. Treatment outcomes are tied with the patient’s physical and psychological condition, and patients with multiple comorbidities may have a poorer prognosis than those presenting in better health at the onset of treatment. In order to synthesise data that are generalisable to the broader population, we limited our review to studies assessing primarily healthy participants free of comorbid diagnoses. Since individuals with eating disorders often present with comorbidities that may precede or follow development of the condition, this review may overlook data on those individuals at greatest risk.
3. Obesity treatment interventions and outcomes

Lifestyle interventions that combine diet, exercise and behavioural changes are currently recommended as the first-line approach for the treatment of overweight and obesity\textsuperscript{135,192}. Lifestyle modifications involve dietary and behavioural changes that can be sustained in the long-term to promote health, and are distinct from dieting, which centres on a specific pattern of food intake over a discrete period of time. In this section, we first evaluate the treatment outcomes for each lifestyle component (diet, exercise and behavioural change) individually, followed by an assessment of strategies that combine these.

We subsequently evaluate the treatment outcomes for pharmacotherapies, which are recommended for patients who have attempted but not succeeded at attaining weight loss through lifestyle interventions\textsuperscript{100} (or delivered as an adjunct to a lifestyle intervention\textsuperscript{107}), and surgery, which is generally reserved for individuals in the higher BMI range (>40 kg/m\textsuperscript{2}). Adolescents are assessed separately from adults and are reported in section 3.8. Each section begins with a brief background on the intervention, followed by a qualitative assessment of the treatment outcomes as they pertain to our three research questions. Finally, an evidence table summarises the body of evidence in each intervention type in respect to the quantity and quality of available studies (evidence base), the degree to which study outcomes are consistent with each other (consistency) and the statistical and clinical significance of these findings (clinical impact). The evidence summary table concluding each intervention section reflects the breadth of the available literature on each intervention. Due to the comparatively small body of literature reporting on mental health and eating disorders outcomes, these two areas are summarised only briefly in each evidence table, but explored in greater detail (and drawing upon a broader literature base) in section 4. Likewise, outcomes from treatment targeting adolescents are summarised in a single overview table (Tables 3.8) rather than per intervention type.

3.1. Dietary interventions

3.1.1. Overview of dietary interventions for weight loss

Dietary interventions for overweight and obesity are designed to create a negative energy balance (e.g., energy expended is greater than energy consumed) by a sustained reduction in energy intake below an individual’s unique energy requirements\textsuperscript{80}. A variety of dietary approaches exist to accomplish this, including energy restricted diets, modified macronutrient diets, pre-set food portions and meal replacements, or some combination of these components. The dietary approaches evaluated in this review are briefly discussed below.

Energy restricted diets include low-energy diets and very low-energy diets that restrict kilojoules to be below the metabolic expenditure of each individual. The general recommendations for low-energy diets is consumption of 4200-5000 kJ for women and 5000-6700 kJ for men, with careful self-monitoring of food intake\textsuperscript{80}. Low-energy diets may include structured meal plans or meal replacements, both of which increase adherence to energy restriction\textsuperscript{80}. The general recommendations for very low-energy diets is consumption of 1600-3350 kJ, with large amounts of protein to preserve lean body mass. Very low-energy diets are normally reserved for patients with a BMI > 30 kg/m\textsuperscript{2} (or BMI > 27 kg/m\textsuperscript{2}) who have failed to lose weight on a low-energy diet\textsuperscript{778}. These diets were popular during the 1980s but are prescribed today on a much more limited basis. During the intensive early phase of very low-energy diets, all meals are replaced with a specific high protein/low carbohydrate meal replacement formula. The lower levels of carbohydrates cause a drop in blood glucose, which promotes the breakdown of fat as an energy source and induces satiety through the metabolic process of ketosis\textsuperscript{107}.

Modified macronutrient diets alter the levels of fat, carbohydrates and proteins relative to each other. For example, low fat diets require ≤ 10% total energy comes from fat; low/high carbohydrate diets require ≤ 40% ≥ 65% of total energy comes from carbohydrates; and high
protein diets require ≥ 35% of total energy comes from protein\textsuperscript{192}.

One practical means of regulating energy intake is through pre-portioned meals. Food portion sizes strongly influence energy intake, such that larger portions lead to increased consumption compared with smaller portions\textsuperscript{231}. This portion size effect has been demonstrated across a range of food items, and is particularly relevant in the current food environment given the pervasiveness of larger portion sizes\textsuperscript{286}.

3.1.2. Treatment outcomes of dietary interventions for weight loss

Two SRs and 6 RCTs evaluating exclusively dietary interventions for weight loss were included in this review. These studies ranged from low to moderate quality and reported mixed positive and negative outcomes with few adverse effects.

What are the physical health outcomes associated with dietary interventions for weight loss?

One SR (assessing 7 RCTs)\textsuperscript{141} evaluated the effects of increased fruit and vegetable consumption on weight loss. This study demonstrated that the current dietary advice to increase fruit and vegetable consumption, without concomitant energy restriction, is unfounded. Increased fruit and vegetable intake produced no discernible effect on body weight.

One SR (assessing 19 RCTs)\textsuperscript{184} and 5 RCTs\textsuperscript{101,146,168,176,224} evaluated low-energy diets for weight loss with mixed outcomes. Low carbohydrate diets produced similar reductions in weight and BMI as balanced diets\textsuperscript{184}, while low-calorie-ketogenic diets produced greater weight loss than standard low-calorie diets but were accompanied by a number of short-term side effects\textsuperscript{176}. High protein diets produced greater weight and fat loss than high carbohydrate diets at 6-month but not 12-month follow-up\textsuperscript{101}. Three forms of portion control were trialled as a means of restricting energy intake. One study\textsuperscript{168} replaced evening snacks with a ready-to-eat cereal and found no effect on weight loss, while another study\textsuperscript{146} with the meal replacement Optifast reported reductions in body fat and waist circumference that exceeded outcomes from a conventional reduced-fat diet. Finally, a portion-control study\textsuperscript{224} reported a significant reduction in BMI at 3-month, but not 12-month, follow-up.

What are the mental health outcomes associated with dietary interventions for weight loss?

Only a single RCT\textsuperscript{146} assessed mental health outcomes associated with dietary interventions for weight loss. This study compared the meal replacement Optifast to a conventional reduced-fat diet, and reported significant quality of life improvements in both groups.

What are the impacts of dietary interventions for weight loss on eating disorders symptomatology?

There were no SRs or RCTs reporting eating disorders outcomes from dietary interventions for weight loss.

3.1.3. Summary of outcomes

Weight loss was reported in studies in which participants received very-low-calorie ketogenic diets, high-protein diets or portion-controlled diets, although in most cases this effect was not sustained over longer (12-month) follow-up periods. Increased fruit and vegetable consumption, low carbohydrate diets and a ready-to-eat cereal snack replacement were ineffective as weight loss interventions. Physical adverse effects were reported in only a single study in which participants received very-low-calorie ketogenic diets, and these effects ceased when a normal diet was resumed. Only a single study assessed mental health outcomes associated with weight loss interventions, and in this case, an improvement of quality of life was demonstrated. There were no SRs or RCTs reporting eating disorders outcomes from dietary interventions for weight loss.
Table 3.1. Summary of dietary interventions for weight loss

<table>
<thead>
<tr>
<th>Intervention/Outcome</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased fruit &amp; vegetables</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td>Low energy diets (overall)</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Low calorie</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>High protein/low carbohydrate</td>
<td>Poor</td>
<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td>Portion controlled meals</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.

3.2. Exercise and physical activity

3.2.1. Overview of exercise and physical activity interventions for weight loss

Exercise and physical activity may be prescribed alone, or in combination with behavioural and dietary interventions within a lifestyle intervention. Physical activity refers to any physical movement that utilises one or more large muscles and increases heart rate, while exercise, a type of physical activity, refers to movement within a more structured program that maintains or enhances overall health, fitness and well-being. The intensity, frequency and duration of the program are important parts of the exercise prescription. The exercise and physical activity approaches evaluated in this review are briefly discussed below.

All forms of exercise are typically divided into two broad groups: aerobic exercise or resistance exercise. Aerobic exercise, which includes a greater variety of forms and is more commonly studied, recruits several large muscle groups and relies on oxygen for fuel. Aerobic exercise is a broad category for mild to moderate intensity activity over a relatively long period of time. Aerobic activities evaluated in this review include Pilates, rhythmic movement and active video games. Resistance training, on the other hand, usually involves short bursts of activity that activate single muscle groups to work against a resistive load, and use blood sugars rather than oxygen for fuel (is anaerobic). Resistance exercise activities evaluated in this review include strength and endurance training and high-intensity interval training.

3.2.2. Treatment outcomes of exercise and physical activity interventions for weight loss

Eight RCTs evaluating exclusively exercise or physical activity interventions for weight loss were included in this review. These studies ranged from low to moderate quality and reported predominantly positive outcomes with few adverse effects.

What are the physical health outcomes associated with exercise and physical activity interventions for weight loss?

One study compared the effects of aerobic in males with females when prescribed a low (400kcal) or high (600kcal) calorie target. Body weight and fat reductions occurred in all exercise groups compared with no-exercise controls, but no differences were observed between low and high kcal targets or between males and females.

Two studies assessed the effects of aerobic or aerobic plus resistance exercise on body weight and composition. In both studies, participants in both the aerobic and aerobic plus resistance groups experienced improvements in body weight or composition. In one study, there was no significant difference between groups, while in the other study, the aerobic plus resistance intervention resulted in greater overall fat free mass than the aerobic only intervention.

Two studies assessed the effects of aerobic high intensity interval training (HIIT) on body weight and composition. One study reported weight loss in both HIIT and a moderate exercise control group, with a greater reduction in HIIT participants, while the second study found that...
neither HIIT nor continuous aerobic exercise led to weight reductions.

Two studies\(^\text{229,234}\) assessed the effects of varying intensities of exercise on weight loss. In both studies, weight was reduced across exercise intensity groups with no significant differences between groups. Lastly, one study\(^\text{231}\) demonstrated that 8 weeks of Pilates exercise was effective at reducing weight in obese women, although the effect size of this finding was small.

**What are the mental health outcomes associated with exercise and physical activity interventions for weight loss?**

Only a single RCT\(^\text{229}\) assessed mental health outcomes associated with exercise interventions for weight loss. In this study, quality of life scores improved in moderate- and high-intensity exercise groups compared with no-exercise controls.

**What are the impacts of exercise and physical activity interventions for weight loss on eating disorders symptomatology?**

There were no SRs or RCTs reporting eating disorders outcomes from exercise and physical activity interventions for weight loss.

**3.2.3. Summary of outcomes**

Weight loss was reported in all but one study assessing aerobic and resistance exercise. A number of these studies also reported favourable changes in body composition, such as reductions in body fat, and no adverse effects were reported. Only a single study assessed mental health outcomes associated with weight loss interventions, and in this case, an improvement in quality of life was demonstrated. There were no studies reporting eating disorders outcomes from exercise and physical activity interventions for weight loss.

**Table 3.2. Summary of exercise & physical activity interventions for weight loss**

<table>
<thead>
<tr>
<th>Exercise &amp; Physical Activity</th>
<th>Evidence Base</th>
<th>Consistency</th>
<th>Clinical Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerobic + resistance</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>High intensity interval training</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Pilates</td>
<td>Poor</td>
<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td>Poor</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.

**3.3. Behavioural and psychological interventions**

**3.3.1. Overview of behavioural and psychological interventions for weight loss**

Behavioural and psychological skill building is a cornerstone of obesity treatment. These interventions are usually delivered in group settings, and in combination with other weight loss strategies. While traditionally delivered in person, a number of recent treatment programmes have integrated technology as either the basis or as an adjunct to in-person treatment. The behavioural and psychological interventions evaluated in this review are briefly discussed below.

**Behavioural therapy**, as applied to weight control, refers to a set of principles and techniques to help individuals adopt and maintain new eating and activity habits\(^\text{36}\). These include self-monitoring (recording weight, diet and/or activity to increase awareness), stimulus control (altering the environment to contain positive cues), problem solving (identifying and generating solutions to problems) and cognitive restructuring (countering negative thoughts with positive thoughts)\(^\text{36}\). Behavioural therapies evaluated in this review were labelled as behavioural weight loss, behavioural weight management or behavioural counselling, but shared the target of either improving diet, activity or both.

Other more psychologically focused strategies evaluated in this review include cognitive
behavioural therapy, motivational interviewing and mindfulness-based interventions.

**Cognitive behavioural therapies (CBT)** are the most commonly used psychological therapies for weight reduction, and focus on helping individuals make long-term behavioural changes in dietary restraint, food intake and physical activity\(^{192,248}\). The goal of CBT is to provide the individual with coping skills to manage responses to food-related cues and lapses from diet and physical activity when they occur.

**Mindfulness**, which originated in the Buddhist concept of mindful meditation, is a mainstay of depression and anxiety interventions but is a relatively new addition to weight loss programmes\(^{201}\). Mindfulness emphasises bringing attention to the experiences in the current moment, without reaction or judgement. In the context of weight management, mindfulness trains individuals to become aware of and alter responses that are inconsistent with their needs and goals, such as awareness of bodily signals of hunger and satiety to prevent overeating in response to social cues.

Mindful awareness is an important component of **acceptance based behavioural therapies**, which aims to foster the willingness to experience negative internal experiences rather than reduce the frequency of those experiences\(^{90}\). Acceptance based therapies promote a better 'meta-cognitive' understanding of one's decision-making processes\(^{215}\) that supports behaviours that are consistent with an individual's desired goals and values\(^{88}\).

**Motivational interviewing** is a person-centred, time-limited counselling approach that focuses on strengthening an individual's motivation and commitment to behavioural change\(^{173}\). Clinicians use open-ended questions to help patients discuss change, focusing on optimism and intent to change, combined with clinician empathy and avoidance of confrontation.

Motivation to change and maintain positive behaviours is an important factor in weight loss outcomes\(^{296}\). A number of techniques to enhance motivation have been trialled to improve weight loss, with self-monitoring at the core of most programmes. Self-monitoring increases awareness of how behaviours are impacting weight, and creates personal accountability that fuels positive behavioural change. The self-monitoring methods of diary-keeping, daily self-weighting, and pedometer-assisted weight loss are evaluated in this review.

### 3.3.2. Treatment outcomes of behavioural and psychological interventions for weight loss

Seven SRs and 14 RCTs evaluating exclusively behavioural or psychological interventions for weight loss were included in this review. These studies ranged from low to high quality and reported mixed positive and negative outcomes with no adverse effects.

**What are the physical health outcomes associated with behavioural and psychological interventions for weight loss?**

Five SRs (assessing between 8 and 16 RCTs each) and 6 RCTs assessed the effects of behavioural weight management interventions on weight loss and quality of life measures. Outcomes varied depending on the particular intervention, outcome variable and duration of follow-up. One SR\(^{300}\) reported no effect of behavioural weight management on weight loss when delivered by primary care physicians; another\(^{90}\) found a very small, but clinically insignificant, positive effect; and the remaining 3\(^{129,136,275}\) reported reductions in weight associated with treatment. Reductions in weight were also observed in 2 RCTs\(^{137,222}\) assessing the commercially available behavioural weight loss program Weight Watchers; 1 RCT\(^{180}\) assessing the behavioural Camden Weight loss program; 1 RCT\(^{173}\) assessing a stepped-care behavioural weight-loss approach; 1 RCT\(^{196}\) assessing a 3 year lifestyle counselling intervention; and 1 RCT\(^{125}\) assessing a gender-sensitised weight loss programme.

Three studies\(^{73,203}\) evaluated psychological therapies targeting weight loss and behavioural change. One SR\(^{209}\) (assessing 8 RCTs) assessed mindfulness-based programmes and reported a reduction in weight in most included studies (6 of 8 RCTs). One SR\(^{190}\) (assessing 24 RCTs) assessed motivational interviewing and reported a significant reduction in weight in only 9 of 24 included RCTs. One RCT\(^{305}\) assessed an acceptance-based behavioural treatment for weight loss and reported significant reductions in weight.

Four RCTs incorporated technology into behavioural or psychological weight loss treatments. Two of these\(^{45,263}\) provided participants with personal digital assistants to self-monitor diet and physical activity, and
reported enhanced weight loss compared with participants receiving standard-care alone. A third study\textsuperscript{117} provided participants with a technology-based system (electronic arm-band, monitor, and tracking website) with or without standard behavioural weight loss and reported a significant reduction in weight, but there were no differences between technology-present and technology-absent groups. Finally, 1 RCT\textsuperscript{56} delivered enhanced-CBT to obese patients with BED using virtual-reality technology. Weight reduction was observed in the enhanced-CBT group but not standard-CBT or inpatient multimodal groups.

Four RCTs assessed weight loss in obese patients with BED. Two studies\textsuperscript{56,104} evaluating cognitive behavioural interventions and one study\textsuperscript{24} evaluating a motivational interviewing intervention reported positive weight loss outcomes, while one study\textsuperscript{105} assessing self-help delivered in a primary care setting found no effect of treatment on weight.

**What are the mental health outcomes associated with behavioural and psychological interventions for weight loss?**

Three RCTs evaluated mental health outcomes from behavioural or psychological interventions for weight loss. One RCT\textsuperscript{90} reported quality of life improvements in participants in standard and acceptance-based behavioural interventions, with no significant difference between groups. Two RCTs assessed changes in depression symptoms with weight loss treatments targeting obese patients with binge eating disorder. One study\textsuperscript{24} reported an improvement in depression symptoms with a motivational-interviewing weight loss intervention that was statistically greater than controls, while the second\textsuperscript{105} reported a similar improvement with a self-help CBT intervention, however an improvement was observed in the control group as well.

**What are the impacts of exercise and physical activity interventions for weight loss on eating disorders symptomatology?**

Six RCTs evaluated eating disorders outcomes from behavioural and psychological interventions for weight loss, and all reported positive outcomes. One study\textsuperscript{196} reported improved cognitive restraint and control over eating after participation in a 3-year lifestyle intervention which included healthy diet and exercise counselling. Five studies reported reductions in binge eating episodes following standard CBT\textsuperscript{104}, self-help CBT\textsuperscript{125}, virtual-reality enhanced CBT\textsuperscript{56}, motivational interviewing\textsuperscript{24} and behavioural weight loss\textsuperscript{36}. Behavioural weight loss and standard CBT also led to significantly greater remission from binge eating compared with participants receiving a control intervention.

### 3.3.3. Summary of outcomes

Weight loss was reported, in varying degrees, in most studies assessing behavioural and psychological interventions. Interventions producing positive effects on weight loss include lifestyle counselling, self-help CBT, and a number of technology-based behavioural interventions, while mixed outcomes occurred following behavioural weight loss or weight management programmes (including commercially available programmes), mindfulness based interventions and motivational interviewing interventions. A subset of studies targeted obese patients with binge eating disorder. Of these, motivational interviewing yielded reductions in weight, while CBT had mixed outcomes depending on the subtype: standard and virtual-reality enhanced CBT, but not self-help CBT, produced weight loss. No adverse effects were reported. Three studies assessed mental health outcomes associated with weight loss interventions, and of these, one reported no improvement in quality of life while two reported improvements in depression symptoms. Five studies assessed, and reported improvements in, eating disorders outcomes from behavioural and psychological interventions for weight loss, including improved cognitive restraint, control over eating and binge eating episodes. A single study reported remission from binge eating following a CBT or behavioural weight loss program.
groups displayed a small reduction in weight, with no significant difference between groups.

The combination of diet and behavioural/psychological components were assessed in 5 RCTs, with mixed outcomes. One study\textsuperscript{167} compared weight loss in obese patients with binge eating disorder following 6 months of CBT plus a low-energy density diet to CBT plus general nutrition counselling not related to weight loss. Nearly a third of participants lost 5% of body weight, but weight reduction did not differ between treatment groups. A second study\textsuperscript{91} reported greater weight reduction, at 6- but not 18-months, in overweight and obese adults receiving a hypocaloric almond-enriched diet plus behavioural weight management compared to those receiving a nut-free version of the same intervention. A third study\textsuperscript{9} compared physical activity plus fruit and vegetable meal replacements to usual-care counselling with a dietician. Participants receiving the full intervention had greater weight loss than usual-care controls at 8, 16 and 24 week follow-ups. A fourth study\textsuperscript{99} compared a behavioural weight management program plus calorie and fat restricted diet with or without modifications to the home environment. Participants receiving the additional home modification component had significantly greater weight loss than those in the standard program at 6 but not 18 month follow-up. Finally, a fifth study\textsuperscript{179} compared weight loss in obese women receiving a behavioural intervention plus 1000 calorie diet or 1500 calorie diet. While a significant reduction in weight was observed in both groups, participants receiving the 1000 calorie diet lost significantly more weight than participants on the 1500 calorie diet.

Table 3.3. Summary of behavioural & psychological interventions for weight loss

<table>
<thead>
<tr>
<th>Behavioural &amp; Psychological</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioural weight loss</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Cognitive behavioural therapy</td>
<td>Good</td>
<td>Poor</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Mindfulness based interventions</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Acceptance based therapy</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Motivational interviewing</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Self-monitoring programmes</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.

3.4. Lifestyle interventions

3.4.1. Overview of lifestyle interventions for weight loss

In this section we evaluate the evidence for combinations of diet, exercise or behavioural and psychological modification.

3.4.2. Treatment outcomes of lifestyle interventions for weight loss

Five SRs and 8 RCTs evaluating lifestyle interventions for weight loss were included in this review. These studies ranged from low to high quality and reported predominantly positive outcomes with no adverse effects.

What are the physical health outcomes associated with lifestyle interventions for weight loss?

The combination of diet and exercise were evaluated in 1 SR (assessing 8 RCTs)\textsuperscript{21} and 3 RCTs, and all reported a reduction in weight. The SR compared diet plus exercise to exercise alone, and reported greater reductions in weight in participants receiving the multicomponent intervention. One RCT\textsuperscript{81} compared encouragement to exercise plus meal replacement to supervised exercise plus structured meal plan, and reported greater reductions in participants receiving the structured combination approach. Another RCT study\textsuperscript{27} compared a hypocaloric diet plus one of three exercise regimes to a control group receiving a hypocaloric diet plus recommendation to exercise, and reported weight reduction in all combination groups compared with controls. Finally, a third RCT\textsuperscript{26} compared a diet and physical activity program delivered in full-form via the internet or in condensed-form via emails. Both

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The combination of exercise and behavioural/psychological interventions were assessed in 2 RCTs, with mixed outcomes. One study\(^5\) reported greater weight reduction in overweight and obese women receiving an exercise plus behavioural weight management intervention compared to an education-intervention control. A second study\(^6\) provided standard inpatient medical obesity rehabilitation to all participants, with add-on intensive phone after-care for one group. Significant weight reduction was observed in both groups, with no significant difference between groups.

The combination of diet, exercise and behavioural/psychological interventions were assessed in two SRs (assessing 39\(^7\) and 7\(^2\) RCTs) and 1 RCT with positive outcomes. One SR\(^8\) compared commercial weight loss programs with education or behavioural counselling. The three programs that consistently produced greater weight loss outcomes than education or counselling controls were Weight Watchers, Jenny Craig and Nutrisystem. Similarly, the second SR\(^9\) reported reductions in fat mass and waist circumference in individuals receiving lifestyle interventions compared with education or counselling controls. One RCT\(^10\) compared a lifestyle program that included calorie restriction, CBT and strengthening exercises to an education-only control. Participants receiving the lifestyle intervention had significantly greater reduction in weight, body fat and waist circumference than controls.

What are the mental health outcomes associated with lifestyle interventions for weight loss?

Only a single SR\(^11\) assessed mental health outcomes from lifestyle interventions for weight loss. Two of seven RCTs included in this SR assessed quality of life, and both reported an overall improvement of quality of life after lifestyle weight loss interventions.

What are the impacts of lifestyle interventions for weight loss on eating disorders symptomatology?

Only a single RCT\(^12\) evaluated eating disorders outcomes from a lifestyle intervention for weight loss. In this study, CBT was prescribed to obese patients with BED in combination with a low-energy-density diet or general nutrition counselling. Both groups had significant reductions in binge eating, and at 12-month follow-up, had significant improvements in behavioural and attitudinal features of BED.

3.4.3. Summary of outcomes

Lifestyle interventions that include combinations of diet, exercise and behavioural/psychological components were largely effective at improving body weight and related measures in overweight and obese individuals. Specifically, interventions that included diet plus exercise or diet plus exercise plus behavioural/psychological components had consistently positive outcomes. Mental health was assessed in a single SR, which reported quality of life improvements following a lifestyle intervention. Eating disorders outcomes were assessed in a single RCT, which reported improvements in binge-eating and behavioural and attitudinal features of BED. No adverse effects were reported.

<table>
<thead>
<tr>
<th>Combined interventions</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet + Exercise</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Diet + Behavioural</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Behavioural + Exercise</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
<tr>
<td>Behavioural + Exercise + Diet</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.
3.5. Pharmacological interventions

3.5.1. Overview of pharmacological interventions for weight loss

In Australia, the Therapeutic Goods Administration (TGA) classifies most prescription and over-the-counter medicines as registered medicines, which carry higher risk and are subject to thorough evaluation prior to reaching market. The TGA classifies low-risk complimentary medicines, such as herbal medicines, vitamins, minerals and other supplements, as listed medicines, which contain only pre-approved low-risk ingredients. A variety of registered and listed medicines have been trialled for the treatment of overweight and obesity, and most of these target weight reduction by decreasing the consumption or absorption of food, and/or by increasing energy expenditure. Registered medicines evaluated in this review include weight loss agents (often referred to as anorectics or antiobesity medications), antidiabetics, anticonvulsants and antidepressants; listed medicines include vitamins, minerals, enzymes, lipids and dietary fibres. Pharmacological agents may be delivered as monotherapies, in multiple-agent compounds, or as an adjunct to lifestyle interventions. The medicines evaluated in this review are briefly discussed below.

In the past decade, several prominent antiobesity medications were withdrawn from market due to side effects and clinical trials were discontinued. For example, a massive (>10,000 enrolled patients) 2010 trial of the withdrawn anorectic sibutramine demonstrated significant reductions in weight and waist circumference, but also significant cardiovascular risk concerns which contraindicated 90% of recruited patients. Sibutramine functions by increasing satiety and thermogenesis through the inhibition of serotonin, noradrenaline and dopamine in the hypothalamus. A second anorectic showing initial promise for the treatment of obesity but withdrawn from market due to adverse effects is the cannabinoid CB1 receptor antagonist rimonabant. Rimonabant, developed in the mid-1990s, was licensed in Europe as an anti-obesity agent in 2006, but subsequently withdrawn in 2008 over reports of serious psychiatric problems. The endocannabinoid system plays an important modulatory role in controlling metabolism and energy balance, and is thought to be over-active in individuals with obesity. Despite the withdrawal of rimonabant and the cancellation of several CB1-receptor antagonist development programmes, the CB1 receptor is still considered a viable therapeutic target for the treatment of obesity and is currently the subject of a number of research programs.

Among registered medicines, Orlistat is the only weight-loss agent currently approved for long-term clinical use. Orlistat, which was approved in 1999, is an oral inhibitor of pancreatic lipases that acts by reducing the absorption of dietary fat in the gut. Two new medications, phentermine-topiramate and lorcaserin, have recently been approved by the United States Food and Drug Administration (FDA), but have not yet been approved for use by the Therapeutic Goods Administration (TGA) in Australia (although phentermine is approved for delivery as a short-term monotherapy for obesity). Phentermine, one of the earliest pharmacological agents used for weight loss, is currently the most commonly prescribed antiobesity agent in the United States. It is a centrally-acting amphetamine that triggers the hypothalamic release of noradrenaline and dopamine, leading to appetite suppression. Topiramate, which is currently approved for the treatment of migraines and seizures, was demonstrated in early studies to have an unexpected (and as of yet unaccounted for) weight-loss benefit. It is frequently prescribed alongside phentermine in a compound that has improved efficacy and reduced side effects compared to either agent alone. Lorcaserin is a novel selective agonist of the serotonin 2C receptor in the hypothalamus that reduces weight by suppressing appetite. It was initially rejected in 2010 due to safety concerns raised in preclinical trials, but was later reassessed and approved by the FDA. Zonisamide is an antiepileptic drug that acts on weight through its dose-dependent actions on dopaminergic and serotonergic activity.

Other less commonly prescribed anorectics evaluated in this review are the central nervous stimulants diethylpropion, fenproporex and mazindol. Diethylpropion and fenproporex suppress appetite through their action on hypothalamic noradrenaline, while mazindol is a sympathomimetic amine that inhibits hunger by blocking reuptake of norepinephrine. Similarly, ephedrine in combination with caffeine stimulates the central nervous system and leads to weight loss, and has been trialled.
independently and in a compound with the ‘satiety hormone’ leptin. Antidepressants may also have a role to play in weight loss. Fluoxetine is a selective serotonin reuptake inhibitor (SSRI) that is indicated for the treatment of depression and bulimia nervosa. Although it has no formal indication for the treatment of overweight and obesity, it is occasionally prescribed off-label to promote weight loss through its appetite suppressing properties. Bupropion is a dopamine and noradrenaline reuptake inhibitor that is indicated for depression and smoking cessation. Similar to fluoxetine, it has been prescribed as a weight loss agent due to its appetite suppressing properties, most commonly alongside the opioid antagonist naltrexone. Bupropion may also hold promise as a psychopharmacological agent for treating overweight people with binge eating disorders who experience food cravings and negative mood.

Four medications typically prescribed for diabetes were evaluated in this review. Metformin is an oral antihyperglycemic agent that is currently the most widely used drug for the treatment of type 2 diabetes. Its primary mode of action is through the reduction of blood glucose in the liver and the sensitisation to insulin peripherally. It has also been demonstrated to function as a weight-loss agent, and is a particularly popular choice in the treatment of children and adolescents due to its safety profile and multiple metabolic and cardiovascular targets. Similarly, canagliflozin is an oral antihyperglycemic that reduces blood glucose by decreasing the absorption of glucose in the liver. Metformin and canagliflozin are prescribed both in combination and as monotherapies. The two other antidiabetic agents target the gut hormone glucagon-like peptide-1 (GLP-1) that enhances insulin secretion. The GLP-1 analogues exenatide and liraglutide both improve glycaemic control and reduce weight, although this has primarily been tested in individuals with type 2 diabetes. While the more commonly used anti-obesity drugs are centrally acting agents that target nonspecific neurotransmitter pathways, leading to multiple adverse effects, the GLP-1 analogues work by targeting gut hormones directly and are considered a novel, but promising direction for obesity drug therapies.

A wide range of listed medicines have been trialled for weight loss with varied modes of action. In comparison to the other interventions evaluated in this review, the evidence base supporting listed medicines is small, and each of the agents discussed below is evaluated in only one or two publications.

Dietary fats play a controversial role in obesity. A diet high in saturated fat and trans-fatty acids favours weight gain, while the digestion of fat into free fatty acids in the small intestine slows gastric emptying and suppresses appetite. Dietary fats vary substantially in structure and function, and certain types, such as the long-chain omega-3 fatty acids, may facilitate weight loss by mediating fat oxidation, adipose reduction and appetite suppression. The phospholipid N-oleoyl-ethanolamine (NOPE) may reduce appetite by inhibiting the cannabinoid CB1 receptor agonist anandamide. Bioavailability and absorption of NOPE can be maximised by delivering it in combination with the green tea extract epigallocatechin gallate.

Dietary protein is thought to be more satiating than an isoenergetic portion of fat or carbohydrate. However, most human studies investigating the impact of protein on weight reduction prescribe energy restriction alongside increased protein, which can make it difficult to separate the effects of diet from those of the catabolic state induced by an energy deficit. In the single study evaluating protein for weight reduction included in this review, supplemental whey or soy protein were added to the diet of overweight and obese adults without concomitant energy restriction.

Vitamin D and calcium are thought to play an important role in body weight and composition. As a fat soluble vitamin, Vitamin D levels are often lower than normal in overweight and obese individuals due to sequestration in the expanded adipose tissue mass, with adverse effects on calcium absorption. Calcium is believed to regulate body weight through the stimulation of whole body fat oxidation. Supplementation of vitamin D has been suggested as a means of countering calcium deficiency and improving weight status in overweight and obese individuals. Calcium has also been trialled as a weight loss agent delivered in combination with the polysaccharide sodium alginate. Extracted from brown algae, sodium alginate is commonly added to food because of its gelling properties, which may hold potential for weight loss due to satiety induced by gelling in the stomach.
The intestinal microbiota is composed of trillions of bacteria that play an important role in metabolism and energy storage. Differences in microbiota composition have been implicated in obesity, with unique species of Lactobacillus identified in normal-weight and obese individuals. Probiotics containing specific strains of Lactobacillus may alter the microbiota balance and play a role in weight loss or weight maintenance.

Less common forms of weight loss include the use of dietary supplements, minerals and extracts. Glucomannan is a water-soluble, fermentable, fibre supplement extracted from the root of the elephant yam. It passes relatively unimpeaded into the colon where it can absorb up to 50 times its weight in water. It is thought to mediate body weight by displacing nutrients and producing satiety as it takes on water and expands in the gastrointestinal tract.

Chromium is an essential trace element that occurs naturally in a wide variety of foods, including cereals, nuts, vegetables and eggs. Chromium is necessary for fat and carbohydrate metabolism, and may reduce body weight by increasing insulin sensitivity, reducing food cravings, and increasing metabolic rate.

Yeast hydrolysate is derived, through hydrolysis, from the single-celled fungus Saccharomyces cerevisiae (commonly known as brewers yeast). The process of hydrolysis breaks down the complex proteins in yeast to free amino acids which are easy to digest and have been suggested to play a role in fat reduction in obese individuals.

Gynostemma pentaphyllum is another natural weight loss product traditionally consumed in Asian countries as a tea. G. pentaphyllum is thought to mediate weight loss through the activation of the enzyme AMPK, which is involved in regulating metabolism and energy balance.

Finally, green tea is a natural product made from the leaves of the plant Camellia sinensis. Green tea is most commonly consumed as a social beverage and to increase alertness, but in more recent years has been trialled, with limited evidence, as a treatment for a variety of conditions. The plant from which green tea is derived contains a complex mix of compounds known as catechins, which are believed to account for most of green tea’s pharmacological activity. Catechins are theorised to reduce weight by increasing levels of norepinephrine, which in turn increases energy expenditure and fat oxidation. Green tea for weight loss is normally consumed as a capsule containing a concentrated extract of catechins and/or caffeine, with highly variable chemical content and pharmacological outcomes.

3.5.2. Treatment outcomes of pharmacological interventions for weight loss

Seven SRs and 19 RCTs evaluating exclusively pharmacological interventions and 13 RCTs evaluating the combination of pharmacological and behavioural/psychological, dietary or exercise interventions for weight loss were included in this review. These studies ranged from low to high quality and reported mixed positive and negative outcomes with a number of adverse effects.

What are the physical health outcomes associated with pharmacological interventions for weight loss?

Two SRs (assessing 4 and 20 RCTs) and four RCTs assessed the effects of anorectic medications on weight loss. Eight different anorectic medications were trialled across these studies (lorcaserin, phentermine+topiramate, Orlistat, mazindol, sibutramine, fenproporex, diethylpropion and rimonabant) and all were reported to be effective at reducing weight and in most cases, this weight loss was considered clinically significant. However, all studies reported physical adverse effects that ranged from mild to severe, and including gastrointestinal adverse effects, headache, dizziness, fatigue, dry mouth, anxiety, irritability, insomnia and elevated heart rate.

Three RCTs assessed the effects of antidepressant medications on weight loss with mixed outcomes. One RCT prescribed bupropion to overweight women with binge eating disorder and reported short-term weight loss; one RCT prescribed a compound of bupropion and naltrexone to obese patients and reported clinically meaningful weight loss; while a third RCT prescribed fluoxetine to obese patients and reported no effect on weight loss. Two of these RCTs reported adverse effects including nausea, headache, dry mouth, insomnia, dizziness and constipation.

One RCT assessed the efficacy of the anticonvulsant medication zonisamide as a weight loss agent. Zonisamide led to greater weight loss than placebo after 12-months of treatment, but...
also led to greater weight regain than placebo after discontinuation. Zonisamide also produced a number of side effects, including altered taste, constipation, diarrhoea, dry mouth, headache, fatigue and nausea.

Five SRs (assessing 9 to 18 RCTs) and 11 RCTs assessed the effects of listed “complimentary” medicines on weight loss with highly variable outcomes. Two studies (1 SR\(^{205}\) evaluating 9 RCTs and one RCT\(^{144}\)) assessed the efficacy of glucomannan fibre supplementation on weight loss in overweight and obese adults, and both reported no weight loss benefit and adverse short-term effects (including nausea, headache and vomiting). Two studies (1 SR\(^{211}\) assessing 18 RCTs and one RCT\(^{237}\)) assessed the efficacy of Vitamin D on body weight and fat, and while the RCT reported fat reduction, the SR reported no benefits of Vitamin D treatment.

The remaining 14 compounds were assessed in only a single study each. Positive weight loss outcomes were reported for chromium supplementation (in an SR\(^{204}\) assessing 18 RCTs), whey protein\(^{18}\), yeast hydrolysate\(^{138}\), leptin and leptin+caffeine/ephedrine\(^{150}\), Gymnemima pentaphyllum extract\(^{208}\) and canagliflozin\(^{25}\), while green tea (in an SR\(^{219}\) assessing 14 RCTs), plant extracts (in an SR\(^{214}\) assessing 14 RCTs), DHA-rich fatty acid supplementation\(^{215}\), lipid dietary supplementation\(^{205}\), probiotic supplementation\(^{219}\), calcium\(^{32}\) and soy protein\(^{19}\) produced no significant changes in weight. Of these, physical adverse effects were reported for green tea (e.g., mild to moderate nausea, constipation and increased blood pressure), chromium supplementation (e.g., digestive disturbances, dizziness and headaches), plant extracts (e.g., headache, dizziness, nausea, fatigue), glucomannan (bloating, belching, stomach fullness), lipid dietary supplement (e.g., blurry vision, headache, shakiness) and canagliflozin (e.g., dizziness, hypoglycaemia, polyuria, infections).

Fifteen RCTs evaluated interventions that combined pharmacotherapy with diet, exercise and psychological components with mixed outcomes. Two RCTs\(^{256,277}\) assessed the combination of pharmacotherapy and diet. One study\(^{206}\) reported significantly greater weight loss in individuals receiving alginate supplement plus a calorie restricted diet compared with control participants receiving placebo plus a calorie restricted diet. However, alginate treatment was also associated with gastrointestinal adverse effects. The second study\(^{277}\) supplemented a low-energy diet with omega-3 fatty acids and reported no additional weight loss when compared to a low-energy diet alone.

Thirteen RCTs assessed the combination of pharmacological and behavioural/ psychological, dietary and exercise interventions for weight loss. One study\(^{274}\) compared conventional obesity therapy (including nutritional education and medical treatment) with an intensive lifestyle intervention that included the addition of anorectic or antidepressant medications (as required by each patient). Participants receiving the intensive lifestyle intervention had greater weight loss at 1 year follow-up than controls. One study\(^{294}\) evaluated weight loss after the addition of the anticonvulsant zonisamide (200 or 400mg) to lifestyle counselling. Participants receiving zonisamide 400mg had significantly greater weight loss than zonisamide 200mg and placebo pill controls. Two studies assessed weight loss after antidepressant medication and behavioural/ psychological therapy. In one study\(^{277}\), bupropion and naltrexone were prescribed as an adjunct to behaviour modification, which resulted in significantly greater weight loss than placebo. In the other\(^{237}\), overweight and obese adults with BED were prescribed fluoxetine plus CBT, fluoxetine alone, or CBT plus placebo. None of the treatments produced significant weight loss.

Four studies combined anorectic medications with behavioural/ psychological therapies. One study\(^{206}\) assessed the combination of Orlistat plus behavioural weight loss therapy (compared with Orlistat + placebo and therapy + placebo) for obese patients with or without BED. The combination therapy resulted in a significant weight reduction in obese patients without BED only. A second study\(^{33}\) assessed the combination of Orlistat plus CBT for obese patients with BED, and reported significantly greater weight reduction compared with CBT plus placebo controls. Both studies reported adverse gastrointestinal effects. A third study\(^{279}\) compared lifestyle counselling plus Orlistat or sibutramine to lifestyle counselling or usual care. At 24 month follow-up, participants receiving combination therapy (either medication) had greater weight loss than controls. Adverse events included one case of syncope and two patients requiring gallbladder removal, as well as dropouts due to elevated blood pressure (5 patients receiving sibutramine) and gastrointestinal symptoms (5 patients receiving orlistat). Finally, one study\(^{203}\) compared combination self-help CBT plus
sibutramine to CBT plus placebo or sibutramine only in obese patients with BED. Sibutramine was associated with greater weight loss at 4 but not 6 or 12 month follow-up.

One study²²³ combined the antidiabetic medication liraglutide with lifestyle modification counselling and reported significantly greater weight loss and body composition at 56 weeks than individuals receiving placebo plus lifestyle modification counselling. However, a range of adverse effects were reported, including nausea, constipation and nasopharyngitis. In contrast, a second study reported no additional weight loss benefit from the addition of an antidiabetic (metformin) to a lifestyle intervention. Finally, three studies combined listed medicines with lifestyle interventions. One study²²⁵ reported a weight loss benefit from the addition of natural fiber to lifestyle counselling, while the remaining two studies reported no additional gains from the addition of an omega-3 supplement²⁴⁹ or weight loss supplement to lifestyle interventions²²⁶.

What are the mental health outcomes associated with pharmacological interventions for weight loss?

Three RCTs assessed mental health outcomes associated with exclusively pharmacological interventions for weight loss. One RCT²⁸⁸ reported improvements in quality of life, depression and anxiety from treatment with the medications diethylpropion, fenproporex, mazindol, fluoxetine and sibutramine. Likewise, the second RCT¹⁶⁵ reported a significant improvement in mood, fatigue and confusion from treatment with a lipid dietary supplement. In contrast, the third RCT²⁴⁹ reported mild neuropsychiatric adverse events with zonisamide treatment, including anxiety-related and depression-related adverse events, along with impaired attention, concentration and memory with zonisamide treatment. However, these resolved quickly after the drug was reduced or discontinued.

Three RCTs assessed mental health outcomes associated with combined pharmacological plus behavioural/psychological, exercise or dietary interventions. One study²⁷⁷ reported quality of life improvements from treatment with bupropion/naltrexone plus behavioural modification. A second study²⁹⁵ reported improvements in depression symptoms in patients receiving self-help CBT, sibutramine, self-help CBT plus sibutramine or CBT plus placebo, with no significant difference between groups. In contrast, a third study¹⁰⁶ reported no improvement in psychological outcomes when Orlistat was added to behavioural weight loss.

What are the impacts of pharmacological interventions for weight loss on eating disorders symptomatology?

Two RCTs assessed eating disorders outcomes from exclusively pharmacological interventions. The first study²⁸⁹ prescribed the antidepressant medication bupropion to obese women with BED and reported that medication did not improve binge eating, food cravings or associated eating disorders features relative to placebo. The second study²¹⁰ was the first to prescribe the endocannabinoid medication rimonabant to obese patient with BED. The treatment group had a significantly greater reduction in scores on the binge eating scale compared with placebo controls; however, this change was not clinically significant.

3.5.3. Summary of outcomes

Registered medicines, including anorectics, antidepressants, anticonvulsants and antidiabetics, are highly effective at reducing weight in overweight and obese individuals. All studies of registered medicines reported weight loss; however, all but one of these studies also reported adverse effects that ranged from mild to severe.

In contrast, listed “complimentary” medicines were less effective (less than half of all studies reported positive weight loss outcomes) and also reported fewer adverse effects (less than half of all studies reported adverse effects). Three studies assessed mental health outcomes associated with weight loss. Two studies (assessing anorectics, an antidepressant and a lipid dietary supplement) reported improvements in quality of life, depression, anxiety, mood, fatigue or confusion, while the third study (assessing an anticonvulsant) reported worsening attention, concentration and memory. Eating disorders outcomes from pharmacological interventions for weight loss were assessed in 2 RCTs with mixed outcomes: one study reported a reduction in binge eating in patients prescribed the endocannabinoid rimonabant, while the second study reported no improvement in binge eating or food cravings in patients prescribed the antidepressant bupropion.

Similar to pharmacotherapy alone, studies that included pharmacotherapy as an adjunct to a
lifestyle intervention generally reported a resulting improvement in weight loss, with the exception of listed medicines, which again produced ambiguous outcomes. Three studies assessed mental health outcomes and 2 studies assessed eating disorders outcomes with mixed results. Of these, positive outcomes were reported in patients prescribed bupropion/naltrexone plus behavioural modification (improved quality of life) and in patients prescribed the now banned endocannabinoid medication rimonabant (reduced binge eating).

Table 3.5. Summary of pharmacological interventions for weight loss

<table>
<thead>
<tr>
<th>Pharmacotherapy</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single interventions (overall)</td>
<td>Excellent</td>
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<td>Good</td>
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<tr>
<td>Registered medicines (overall)</td>
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<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Anorectics</td>
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<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Antidiabetics</td>
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<td>Good</td>
</tr>
<tr>
<td>Antidepressants</td>
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<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Anticonvulsants</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Listed medicines (overall)</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Vitamin D &amp; calcium</td>
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<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Sodium alginate</td>
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<td>Poor</td>
</tr>
<tr>
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<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Dietary protein</td>
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<td>Poor</td>
</tr>
<tr>
<td>Probiotics</td>
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<td>Satisfactory</td>
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<tr>
<td>Glucomannan supplement</td>
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</tr>
<tr>
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<td>Good</td>
</tr>
<tr>
<td>Yeast hydrolysate</td>
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<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Gynostemma pentaphyllum extract</td>
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<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td>Green tea extract</td>
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<td>Poor</td>
</tr>
<tr>
<td>Combined interventions (overall)</td>
<td>Good</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Pharmacotherapy + Diet</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Pharmacotherapy + Exercise</td>
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<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td>Pharmacotherapy + Behavioural</td>
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<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Pharmacotherapy + Diet + Exercise + Behavioural</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single interventions</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Combined interventions</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single interventions</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Combined interventions</td>
<td>Poor</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.

3.6. Bariatric surgery

3.6.1. Overview of bariatric surgery procedures for weight loss

Gastrointestinal surgery for obesity, also called bariatric surgery, alters normal digestive processes to promote weight loss. Bariatric surgery procedures include two classes of surgery: malabsorptive procedures, that limit the absorption of calories, proteins and nutrients, and restrictive procedures, that restrict gastric volume, and consequently, the amount of food that can be consumed. In Australia, the three most commonly performed bariatric procedures are Roux-en-Y gastric bypass, laparoscopic sleeve gastrectomy (LSG) and laparoscopic adjustable gastric banding (LAGB). These and the other procedures evaluated in this review are most commonly performed laparoscopically, via a
minimally invasive keyhole incision. Bariatric surgery reduces weight by reducing hunger, increasing satiety, restricting food intake or causing a malabsorption of food via surgical alterations to the gastrointestinal tract. The most commonly used criteria for considering bariatric surgery is BMI > 40 kg/m², or BMI >35 kg/m² with obesity related comorbidities, although recent positive outcomes in the mildly to moderate obesity range have provided support for lowering the BMI cut-off to <30 kg/m². The bariatric procedures evaluated in this review are briefly discussed below.

The Roux-en-Y gastric bypass (RYGB) is a combination procedure that restricts food intake via the creation of a small gastric pouch, and prevents full nutrient absorption via a bypass of the lower stomach, duodenum and first portion of the jejunum. Collectively, these two surgical components markedly reduce the functional volume of the stomach. RYG is currently the most commonly performed surgical procedure for treating morbid obesity, representing 70-75% of all bariatric procedures.

Two procedures evaluated in this review that are primarily restrictive in nature are adjustable gastric banding and sleeve gastrectomy. Adjustable gastric banding (LAGB), considered the least invasive purely restrictive procedure, limits food intake by placing an adjustable gastric band around the top portion of the stomach. The band can be tightened or loosened over time without the need for additional surgery, allowing the patient to alter the level of restriction as required. Gastric banding is reversible through a second minimally invasive keyhole operation. For patients that are considered high risk for bariatric surgery, laparoscopic sleeve gastrectomy (LSG) is often considered as the safest option. This procedure permanently removes a large, vertical section of the stomach, leaving behind a tube-shaped stomach that is about 25% of its original size. For some patients, the stomach may expand over time requiring additional (gastric bypass) surgery for optimal results.

In contrast to the previously discussed procedures, the bilipancreatic diversion with duodenal switch (BPD-DS) is primarily malabsorptive in nature. A portion of the stomach is removed (via a sleeve gastrectomy) to limit food intake, and a section of the small intestine is bypassed to reduce surface area for nutrient absorption. This partially reversible procedure is considerably more complex and has higher complication rates than the alternatives, and as such, is generally reserved for “super obese” patients (BMI >50kg/m²) or for those for whom other bariatric procedures have failed.

3.6.2. Treatment outcomes of bariatric surgery interventions for weight loss

Nine SRs and 6 RCTs evaluating exclusively surgical interventions for weight loss were included in this review. These studies ranged from low to high quality and reported predominantly positive weight loss outcomes. Adverse effects were common across all procedures.

What are the physical health outcomes associated with bariatric surgery for weight loss?

Most SRs (7 of 9) assessed outcomes from multiple surgical procedures, and a subset of these pooled outcomes across procedures. Surgical outcomes, summarised broadly in SRs, will be presented first, followed by outcomes per intervention where this data was available.

Compared with non-surgical interventions, bariatric surgery produced significant reductions in body weight, fat mass and BMI across all studies, regardless of procedure type. Using these measures, a large Cochrane SR (assessing 22 RCTs) found that BDDS outperformed RYG; RYG outperformed LAGB (over 5 years of assessment); and RYG, open-RYG and LSG all produced similar outcomes. Similarly, gastric bypass procedures (most notably RYG) outperformed gastric banding procedures in all 3 other SRs assessing these procedures, and RYG produced similar outcomes to LSG in two SRs. Complications were reported in all studies, and ranged from short-term and minor to long-term and severe (requiring reoperation or causing death). Complications and complication rates varied with study, population and procedure. Across bariatric surgery procedures, roughly 18% of patients developed complications, 7% required readmission and reoperation and 0.3% died postoperatively. Gastric bypass procedures (such as the RYG) were associated with amongst the highest complication rates and postoperative mortality (21% and 4%, respectively), but amongst the lowest reoperation rates (3%). Compared with gastric bypass procedures, LAGB and LSG had lower complication (~13%) and mortality (0.2 and 0.3% respectively) rates, but higher reoperation rates (12 and 9%).

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Laparoscopic sleeve gastrectomy was the primary focus of 1 SR\textsuperscript{279} (assessing 15 RCTs) and 2 RCTs\textsuperscript{143,302}. These studies all reported significant reductions in weight, body fat and/or BMI. Overall, these studies reported a complication rate of 3.2\textsuperscript{279} to 9.2\%\textsuperscript{279} with no mortalities. Both RCTs compared LSG with RYGB but reported different outcomes: in one RCT\textsuperscript{279}, RYGB outperformed LSG in terms of weight loss, while the second RCT\textsuperscript{143} reported similar outcomes.

Finally the remaining studies focused on RYGB, LGB, DS, or some combination of these procedures. One SR\textsuperscript{13} (assessing 3 RCTs) and 1 RCT\textsuperscript{201} compared banded to non-banded RYGB with mixed outcomes. While the SR reported a greater weight reduction in patients undergoing banded RYGB in the intermediate term, the RCT reported no significant difference in weight reduction outcomes between procedures. Three RCTs\textsuperscript{120,261,262} compared RYGB to BPD-DS and reported greater weight loss in patients who had undergone BPD-DS. However, patients who had undergone BPD-DS also experienced significantly more complications, particularly adverse gastrointestinal effects.

What are the mental health outcomes associated with bariatric surgery loss?

Three SRs\textsuperscript{67,152,162} focused predominantly on mental health and quality of life in obese patients before and after bariatric surgery. One SR\textsuperscript{67} (assessing 3 RCTs) reported that bariatric surgery was associated with lower rates and fewer symptoms of mental health conditions. In particular, depression was reduced following bariatric surgery in 11 of 12 studies (2 of which were RCTs), while rates of alcohol abuse increased relative to similar populations treated non-operatively. A second SR\textsuperscript{152} (assessing 19 RCTs) reported a similar decrease in postoperative depressive symptoms along with improvements in anxiety. However, long-term outcomes were mixed, with some studies reporting an improvement in depressive symptoms lasting upwards of 4 years, while other studies reported an initial postoperative benefit followed by a gradual decline. A third SR and meta-analysis\textsuperscript{162} (assessing 21 RCTs) compared mental health outcomes of bariatric surgery using a specific assessment tool (the Short-Form 36). This study reported a significant, consistent and large-magnitude improvement in mental health quality of life following bariatric surgery at 1-year follow-up.

One SR\textsuperscript{67} (assessing 3 RCTs) and 3 RCTs\textsuperscript{261,262,302} focusing on weight loss outcomes also reported mental health outcomes following bariatric surgery. These studies reported improvements in quality of life across treatment groups (LSG and RYGB\textsuperscript{201}), RYGB banded and unbanded\textsuperscript{45} as well as in specific treatment groups (duodenal switch outperforming gastric bypass)\textsuperscript{45}. One study\textsuperscript{262} also reported improvements in psychosocial functioning following gastric bypass and duodenal switch.

What are the impacts of surgical interventions for weight loss on eating disorders symptomatology?

Two SRs assessed eating disorders outcomes from bariatric surgery. The first SR\textsuperscript{152} (assessing 19 RCTs) evaluated the impact of bariatric surgery on psychological functioning in morbidly obese individuals. This review reported overall improvements in eating behaviour and body image following bariatric surgery for weight loss, but noted that not all bariatric surgery patients experienced improvements in mental health (discussed in greater detail in Section 4). The second SR\textsuperscript{152} (assessing 3 RCTs) reported a reduction in binge eating episodes up to 2 years post-surgery, followed by an increase at further time points.

3.6.3. Summary of outcomes

Bariatric surgery is highly effective at reducing weight in overweight and obese adults. Compared with non-surgical interventions, bariatric surgery produced greater reductions in body weight, fat mass and BMI across all studies, regardless of procedure type. All studies reported adverse effects that ranged from mild to severe, with rates of complications, reoperation and mortality varying with procedure type. Gastric bypass procedures were generally associated with the greatest improvements in weight-related outcomes, but also had the highest complication and mortality rates. Mental health and quality of life were the primary focus of 3 SRs, and the secondary focus of 1 SR and 3 RCTs. Overall, bariatric surgery led to improvements in quality of life and depressive symptoms, with some evidence for improvements in anxiety and psychosocial functioning. Two SRs reported overall improvements in eating behaviour, binge eating episodes and body image following bariatric surgery for weight loss.
nervous system and has been hypothesised to be activated in waters above 42°C, activates the sympathetic nervous system around the ear and stimulates peripheral nerves at specific ‘acupoints’. These peripheral nerves then relay the signal to the spine and onwards to the brain where they stimulate the release of neurotransmitters, and subsequently, physiological changes. Auricular acupuncture and acupressure stimulate five acupoints in and around the ear that are thought to modulate appetite and satiety and induce calmness.

The sympathetic nervous system, which governs the fight or flight response and contributes to regulation of homeostasis, has recently been proposed to play a role in the onset and development of obesity through its mediation of energy balance and food intake. Hot bathing, in waters above 42°C, activates the sympathetic nervous system and has been hypothesised to be a valuable adjunct to exercise and dietary interventions for weight loss.

3.7. Other approaches

3.7.1. Overview of other approaches to weight loss

While lifestyle interventions, pharmacotherapy and surgery remain the primary approaches for treating overweight and obesity, recent studies have also trialled traditional Chinese medicine (TCM), bright light therapy, and self-motivation for change through the use of pedometers or self-weighing. In comparison to other interventions evaluated in this review, the evidence base supporting these alternative interventions is small, and evaluated in only one or two studies.

Acupuncture and acupressure are the TCM approaches most commonly explored as treatments for obesity. From the perspective of Western medicine, acupuncture and acupressure are conceptualised to alter neurotransmitter levels in the central nervous system by stimulating peripheral nerves at specific ‘acupoints’. These peripheral nerves then relay the signal to the spine and onwards to the brain where they stimulate the release of neurotransmitters, and subsequently, physiological changes. Auricular acupuncture and acupressure stimulate five acupoints in and around the ear that are thought to modulate appetite and satiety and induce calmness.

In addition to acupressure, other treatments for obesity include traditional Chinese medicine (TCM) approaches such as acupuncture, bright light therapy, and self-motivation for change through the use of pedometers or self-weighing. In comparison to other interventions evaluated in this review, the evidence base supporting these alternative approaches to weight loss is small, and evaluated in only one or two studies. Acupuncture and acupressure are the TCM approaches most commonly explored as treatments for obesity. From the perspective of Western medicine, acupuncture and acupressure are conceptualised to alter neurotransmitter levels in the central nervous system by stimulating peripheral nerves at specific ‘acupoints’. These peripheral nerves then relay the signal to the spine and onwards to the brain where they stimulate the release of neurotransmitters, and subsequently, physiological changes. Auricular acupuncture and acupressure stimulate five acupoints in and around the ear that are thought to modulate appetite and satiety and induce calmness.

Table 3.6. Summary of surgical interventions for weight loss

<table>
<thead>
<tr>
<th>Surgical interventions</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roux-en-Y gastric bypass</td>
<td>Good</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
<tr>
<td>Laparoscopic sleeve gastrectomy</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Laparoscopic gastric banding</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
<tr>
<td>Duodenal switch</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>Excellent</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good = substantial; Satisfactory = moderate; Poor = slight or restricted.

3.7.2. Treatment outcomes of other interventions for weight loss

Five RCTs evaluating non-traditional interventions for weight loss were included in this review. These studies ranged from low to moderate quality and reported predominantly positive outcomes with no adverse effects.

What are the physical health outcomes associated with other interventions for weight loss?

Two RCTs assessing auricular acupressure reported positive weight outcomes, including reductions in weight and waist circumference. Similarly, 1 RCT assessed auricular acupuncture and reported reductions in waist circumference and BMI with both five-point and hunger-point acupuncture, with no significant difference between groups. One RCT assessed the effects of bright light therapy on body weight and composition, and reported a small reduction in percentage of body fat but not body weight. Finally, one RCT assessed the effects of hot
bathing on body weight and composition, and found that the addition of hot bathing to a diet and exercise regimen significantly improved outcomes.

**What are the mental health outcomes associated with other approaches to weight loss?**

Only a single RCT assessed mental health outcomes from other interventions for weight loss. This study reported improvements in self-efficacy (a belief in our own ability to succeed) following auricular acupuncture for obesity compared with no-acupressure controls.

**What are the impacts of other interventions for weight loss on eating disorders symptomatology?**

There were no SRs or RCTs reporting eating disorders outcomes from other interventions for weight loss.

### Summary of outcomes

Non-traditional weight loss interventions evaluated in this review were acupressure, acupuncture, bright light therapy and hot bathing, which each included only 1-2 low or moderate quality RCTs. Reductions in weight-related outcomes were reported in each intervention. The single RCT assessing a mental health outcome reported improvements in self-efficacy in participants receiving auricular acupressure. None of the included studies reported on eating disorders outcomes or adverse effects.

### Table 3.7. Summary of other interventions for weight loss

<table>
<thead>
<tr>
<th>Other interventions</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acupressure</td>
<td>Poor</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Good</td>
</tr>
<tr>
<td>Bright light therapy</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td>Hot bathing (+ Diet + Exercise)</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td>Poor</td>
<td>N/A</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good = substantial; Satisfactory = moderate; Poor = slight or restricted.

### 3.8. Treatment for adolescents

#### 3.8.1. Overview of weight loss interventions for adolescents

Reduced energy consumption and increased physical activity are the basis for obesity interventions for adolescents, as they are for adults. Pharmacological and surgical interventions are considered in more severe or treatment-resistant cases. Since intervention types parallel those available for adults and have been described in the preceding sections, this section will focus only on treatment outcomes.

#### 3.8.2. Treatment outcomes of interventions for weight loss in adolescents

Four SRs and 13 RCTs evaluating weight loss interventions for adolescents were included in this review. These studies ranged from low to high quality and reported predominantly positive outcomes with few adverse effects.

**What are the physical health outcomes associated with weight loss interventions for adolescents?**

Two RCTs assessed dietary interventions for weight loss in obese adolescents. One study prescribed a high-protein breakfast to obese Chinese adolescents and reported significant weight loss compared with individuals consuming a standard breakfast. The second study prescribed meal replacements (SlimFast shake consumed 3x daily) and reported significant weight loss at 4 but not 12 months compared with conventional-diet controls.

Three RCTs evaluated exercise interventions for weight loss in overweight and obese adolescents. One study assessed aerobic and resistance training and reported significantly greater weight
loss in exercise groups compared with no-exercise controls. The second study reported no statistical difference in weight loss or body composition between overweight or obese adolescents cycling to music or cycling as part of a video game. The third study reported no significant weight reduction in obese adolescents participating in a dance-based exergaming (video game exercise) program compared with wait list controls.

One SR and 1 RCT assessed pharmacotherapy for weight loss in overweight and obese adolescents. The SR reported small but significant weight loss in non-diabetic obese adolescents prescribed the antidiabetic medication metformin. No adverse effects were reported. The RCT assessed the glucagon-like peptide 1 receptor agonist exenatide in severely obese adolescents, and reported significantly greater weight and BMI reductions compared with placebo pill controls. A number of adverse effects were reported, including short term nausea, abdominal pain, diarrhoea, headache, and vomiting.

Two SRs assessed bariatric surgery for weight loss in obese adolescents. One SR reported significant short-term weight loss in adolescents following bariatric surgery. The second SR reported significant reductions in BMI following LAGB. However, both studies included only a single RCT each which limits interpretation of results. Both studies reported adverse effects, including nutrient deficiencies, hernias, wound infections, small bowel obstructions and ulcers.

The remaining studies included combinations of dietary, exercise, behavioural/ psychological and pharmacological interventions. One RCT evaluated the combination of exercise and behavioural/ psychological therapies. This study reported a long-term reduction in BMI compared with usual-care controls. Another RCT evaluated the combination of diet and behavioural/ psychological therapies. This study reported reductions in weight, BMI and waist circumference in participants receiving dietary counselling and a low glycaemic index diet compared with standard-diet controls.

Three RCTs evaluated the combination of diet, exercise and behavioural/ psychological therapies. The first study reported significant weight loss in overweight and obese adolescents participating in CBT interventions that included motivational interviewing, diet and exercise advice, compared with no-treatment controls.

The second study reported small but significant reductions in BMI in obese adolescent females participating in multi-component (diet + exercise + counselling) lifestyle interventions compared with usual-care controls. The third study reported significant reductions in body weight, waist and hip circumference in obese adolescents participating in a school-based behaviour intervention program consisting of nutritional and exercise education and dietary modification, compared with education-booklet controls.

Finally, 1 SR and 1 RCT evaluated the combination of pharmacological and behavioural/ psychological therapy interventions. The RCT reported a significant reduction in BMI in overweight or obese adolescents prescribed the antidiabetic metformin as part of a lifestyle intervention. Similarly, the RCT reported a significant reduction in BMI in overweight or obese adolescents prescribed the anorectic sibutramine plus behavioural counselling, compared with behavioural-counselling plus placebo controls. Weight loss was comparable between individuals with and without binge eating during the 12 months of treatment.

What are the mental health outcomes associated with weight loss interventions for adolescents?

One SR and 5 RCTs evaluated mental health outcomes associated with weight loss interventions for adolescents. Improvements in quality of life were reported following LAGB and combined CBT and exercise, while improvements in psychosocial functioning (improved perception of self and social competence) were reported following exercise interventions (cycling exercise and dance based exergaming). Combined diet, exercise and psychological interventions led to improvements in depressive symptoms, improved body satisfaction and decreased internalisation of female norms.

What are the eating disorders outcomes associated with weight loss interventions in adolescents?

Three RCTs evaluated eating disorders outcomes from weight loss interventions for adolescents. One study prescribed twice weekly aerobic fitness (stationary or interactive video game cycling) to obese adolescents and observed a positive association between changes in fitness and psychosocial functioning, including improvements in body image and social competence. The second study assigned
overweight and obese girls to a primary-care based, multi-component lifestyle intervention specifically targeting overweight adolescent females, and reported significant improvements in body image compared with usual-care controls. The third study assigned behavioural weight loss plus an anorectic (sibutramine) to ethnically diverse obese adolescents with and without binge eating behaviours, and reported an improvement in cognitive restraint and disinhibition (loss of control over eating) in individuals with and without initial binge eating behaviours.

3.8.3. Summary of outcomes

Weight loss interventions targeting overweight and obese adolescents were largely effective at improving body weight and related measures. The only trialled intervention that did not reduce weight or a related measure was dance-based exergaming. A number of studies reported significant short-term results that dissipated at longer-term follow-ups. Adverse effects, ranging from mild to severe, were reported in 2 SRs on bariatric surgery and 1 RCT prescribing the glucagon-like peptide 1 receptor agonist exanetide to severely obese patients. Mental health was assessed in a 1 SR and 4 RCTs, which reported improvements in quality of life, psychosocial functioning, depressive symptoms, body satisfaction and internalisation of female norms. Improvements in eating disorders outcomes were reported in 3 RCTs, including improvements in body image, social competence, cognitive restraint and disinhibition.

Table 3.8. Summary of weight loss interventions for adolescents

<table>
<thead>
<tr>
<th>Summary Assessment</th>
<th>Evidence base</th>
<th>Consistency</th>
<th>Clinical impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight loss outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Exercise (aerobic)</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Behavioural (CBT)</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Pharmacological (antidiabetics)</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Surgical</td>
<td>Good</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Lifestyle (diet, exercise and/or behavioural)</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Lifestyle + Pharmacological</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Mental health outcomes</strong></td>
<td>Satisfactory</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
<td><strong>Eating disorders outcomes</strong></td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

Summary of outcomes from weight loss treatments for adolescents. Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good = substantial; Satisfactory = moderate; Poor = slight or restricted.

3.9. Strengths and limitations

To our awareness, this is the first review to systematically examine physical, psychological and eating disorders outcomes from weight loss interventions. This study evaluated a large number of high quality SRs and RCTs using structured methods for article retrieval and evaluation. However, there were limitations in the studies evaluated in this review that must be taken into account when interpreting outcomes (e.g., see Tables 3.1-3.11 for a summary of the breadth, quality, consistency and clinical impact of the evidence base for each intervention type). First, the heterogeneity of the evidence base for each intervention type.

Adverse effects, ranging from mild to severe, were reported in 2 SRs on bariatric surgery and 1 RCT prescribing the glucagon-like peptide 1 receptor agonist exanetide to severely obese patients. Mental health was assessed in a 1 SR and 4 RCTs, which reported improvements in quality of life, psychosocial functioning, depressive symptoms, body satisfaction and internalisation of female norms. Improvements in eating disorders outcomes were reported in 3 RCTs, including improvements in body image, social competence, cognitive restraint and disinhibition.
4. Summary and discussion

4.1. Overview of research findings

Physical health outcomes from weight loss interventions

The most common measure of obesity intervention success is the amount of weight lost. In this review, and consistent with the large literature on the topic, the amount of weight lost varied considerably with intervention type. Surgical interventions consistently resulted in significant weight loss across all procedures and demographics (adolescents and adults), but also consistently resulted in adverse effects which ranged from relatively minor (e.g., nausea) to more severe (requiring reoperation or causing mortality).

Dietary interventions produced mixed weight-loss outcomes. The most positive results were reported in studies in which participants received very-low-calorie ketogenic diets, high-protein diets or portion-controlled diets, although in most cases this effect was not sustained, and in the case of ketogenic diets, also produced temporary adverse effects. Exercise interventions produced more positive outcomes (weight loss in all but one trial) and no adverse effects were reported. Likewise, behavioural and psychological interventions produced weight reductions in the majority of studies assessing behavioural weight loss (commercial and non-commercial programmes), mindfulness-based programmes, and acceptance-based behavioural programmes. Mixed outcomes were observed for motivational interviewing and technology-based interventions.

Pharmacological interventions were broadly divided into registered medicines and listed (or ‘complimentary’) medicines, and assessed individually as well as in combination with the above mentioned interventions. Registered medicines, including anorectics, antidepressants, anticonvulsants and antidiabetics, were highly and consistently effective at reducing weight, however, in all but one study also produced adverse effects that ranged from mild to severe. One study prescribed an anorectic plus behavioural weight loss to obese individuals with and without BED, and reported improvements in individuals without BED only. In contrast, listed “complimentary” medicines produced fewer adverse effects but were considerably less effective, with less than half of all studies resulting in weight reduction. Similarly, the addition of pharmacotherapy to lifestyle interventions typically improved weight loss outcomes for registered medicines and had ambiguous outcomes for listed medicines.

<table>
<thead>
<tr>
<th>Summary Assessment</th>
<th>Evidence Base</th>
<th>Consistency</th>
<th>Clinical Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Exercise</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Good</td>
<td>Good</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Surgical</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
</tr>
<tr>
<td>Lifestyle (diet, exercise and/or)</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
<tr>
<td>Lifestyle + Pharmacotherapy</td>
<td>Good</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.
Mental health outcomes from weight loss interventions

The majority of research exploring the efficacy of weight loss interventions lacked assessment of psychological changes associated with weight loss. In studies that did include a measure of mental health, the outcomes were predominantly positive. The most common outcome observed in all intervention types was an improvement in quality of life, followed by improvements in depression symptoms (in behavioural and psychological interventions, pharmacotherapy and surgery only). A smaller body of evidence supported improvements in anxiety, fatigue and confusion (following pharmacotherapy) and psychosocial functioning (following bariatric surgery).

While the psychological outcomes were largely positive across intervention types, very few studies directly assessed the relationship between actual weight loss and degree of improvement in psychological outcomes. Mood improvements in clinical trials may be due to a number of factors, such as the supportive treatment context or behavioural and psychological changes brought on by the treatment rather than weight loss per se.

### Table 4.2. Summary of all weight loss interventions

<table>
<thead>
<tr>
<th>Summary Assessment</th>
<th>Evidence Base</th>
<th>Consistency</th>
<th>Clinical Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>Poor</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Exercise</td>
<td>Poor</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Surgical</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Lifestyle (diet, exercise and/or)</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Lifestyle + Pharmacotherapy</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Other interventions</td>
<td>Poor</td>
<td>N/A</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.

Impacts of obesity treatment on eating disorders

The impact of weight loss interventions on eating disorders outcomes was rarely assessed. Studies of behavioural and psychological interventions and lifestyle interventions for weight loss reported consistent improvements (across 5 RCTs) in cognitive restraint, control over eating or binge eating. In contrast, bariatric surgery resulted in improvements in eating behaviour and body image that were not sustained over the long-term, while pharmacotherapies did not produce clinically significant outcomes in any instance. No studies of dietary and exercise interventions reported on eating disorders outcomes.

Due to the shortage of high quality SRs and RCTs assessing eating disorders outcomes from weight loss interventions, we draw upon a broader literature base to further explore this key question in section 4.2.

### Table 4.3. Summary of all weight loss interventions

<table>
<thead>
<tr>
<th>Summary Assessment</th>
<th>Evidence Base</th>
<th>Consistency</th>
<th>Clinical Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Exercise</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Satisfactory</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>Satisfactory</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Surgical</td>
<td>Excellent</td>
<td>Satisfactory</td>
<td>Good</td>
</tr>
<tr>
<td>Lifestyle (diet, exercise and/or)</td>
<td>Satisfactory</td>
<td>N/A</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Lifestyle + Pharmacotherapy</td>
<td>Poor</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Other interventions</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: Evidence base: Excellent = >1 SRs or >2 RCTs with low risk of bias; Good = 1-2 RCTs or 1 SR with low risk of bias; Satisfactory = SRs or RCTs with moderate risk of bias; Poor = SRs or RCTs with high risk of bias. Consistency: Excellent = all studies consistent; Good = mostly consistent; Satisfactory = some inconsistency; Poor = inconsistent; N/A = only 1 RCT. Impact: Excellent = very large; Good= substantial; Satisfactory = moderate; Poor = slight or restricted.
4.2. Discussion

Numerous treatment strategies exist to assist people in losing weight. As with prior reports,87,157,229 lifestyle interventions incorporating dietary, exercise and behavioural or psychological components were the most commonly recommended first-line approach, with escalation to pharmacotherapy and bariatric surgery in more severe or treatment-resistant cases. Bariatric surgery and registered medicines consistently reduced weight but were also associated with adverse effects that ranged from mild to severe, while exercise, dietary interventions and behavioural/psychological interventions produced mixed weight loss outcomes but had few adverse effects. Improvements in quality of life, and in some cases depression, where reported in a subset of studies of all intervention types, while improvements in eating disorders symptoms were reported consistently only in interventions incorporating behavioural or psychological treatments. Given the reciprocal relationship between obesity and mental health and the benefits of both psychological and psychological interventions on eating disorders outcomes, overweight and obesity interventions that incorporate these components would provide a more balanced approach than the traditional focus on weight loss alone.

Special consideration should be given to evaluations of adolescent obesity treatment. Overweight and obese young people are more vulnerable to a range of physical and psychological co-morbidities than their normal-weight peers98 and obesity during childhood increases the probability of obesity during adulthood99. Young people who engage in weight loss behaviours are at increased risk of developing eating pathologies in later life142, including a higher risk of binge eating and associated weight gain. Consequently, weight loss interventions for young people play an important role in improving health in the present as well as reducing the burden of disease associated with obesity in adulthood98.

In Australia, the use of surgical procedures to treat obesity has risen dramatically in recent years.88 Consistent with recent obesity guidelines (NHMRC, 2013195) our review found bariatric surgery to be the most effective intervention for sustained weight loss, and the majority of studies that included an assessment of psychological outcomes reported improvements, primarily in quality of life and depression symptoms. However, this benefit is not universal, and approximately 20% of patients undergoing bariatric surgery fail to achieve clinically significant weight loss or experience a worsening in psychological outcomes.122,254,255 For certain individuals who lose large amounts of weight, loose, sagging and excess skin may contribute to worsening body image. For example, one study found that over two thirds of post-bariatric surgery patients viewed the development of excess skin to be a negative outcome of treatment, and for some, a motivator to seek plastic surgery.242 Further, a growing literature demonstrates that bariatric surgery patients have significantly higher suicide rates than the general population121,219,271.

A recent Australian study of bariatric surgery candidates reported that 13.5% of individuals met the DSM-IV criteria for BED178, while other studies reported subthreshold disordered eating behaviours (such as Night Eating Syndrome, grazing and uncontrolled eating) in the pre-surgical population that were likely to exceed these rates.60,243 Since binge eating disorder and disordered eating pre-surgery are associated with increased disordered eating post-surgery144, poor weight loss outcomes, surgical complications and psychological distress60,71,160,194, it is vital that clinicians are informed about the overlap between these populations.

The prevalence of disordered eating symptoms such as specialised diets, episodic vomiting and nutrient deficits is often seen in post-bariatric surgery patients103, and certain postoperative symptoms may lead patients to engage in restrictive or compensatory behaviours to mitigate the discomfort from consuming foods that are difficult to tolerate post-surgery103. For example, post-operative patients may adopt vomiting behaviour after meals as a means to reduce discomfort from consuming newly indigestible foods, or as a means of accelerating weight loss103. Together, these factors make it challenging to distinguish between normal post-surgery eating behaviours and eating pathology, since many such changes in eating behaviour are necessitated by the surgery and even encouraged by clinicians152,166. Further, it is possible that disordered eating that has developed as a response to gastrointestinal symptoms may eventually trigger the onset of an eating disorder.110 In light of these behaviours and the increased vulnerability of the post-surgical
population, clinicians should ensure that long-term follow-ups include an assessment of the motivations for abnormal eating behaviours, separating behaviours motivated by physical discomfort from behaviours motivated by weight and shape concerns.

Concerns have previously been raised that dieting may precipitate eating disorders in overweight and obese individuals, however, the studies evaluated in this review do not support this suggestion. Our findings are in line with previous reviews which conclude that professionally administered weight-loss programmes do not increase the risk or symptoms of eating disorders. However, a large body of evidence reports harms from unhealthy dieting behaviours, which confer a 5- to 18-fold risk for the development of eating disorders. It is important that clinicians are aware of the increased risk for harm in individuals engaging in unhealthy dietary practices, and monitor individuals to ensure that healthy diets do not transition into unhealthy diets.
5. The way forward: An integrated approach

Numerous factors contribute to the development and maintenance of overweight and obesity, including genetic, metabolic, biochemical, physiological, psychological and environmental factors. The presence of disordered eating and eating disorders in a significant portion of the obese population complicates the situation further. These complex causal features make it unlikely that researchers or clinicians will identify a weight-loss panacea that will be successful for all obese patients. Rather, the way forward requires a multidisciplinary approach that takes into account the various factors underlying obesity and eating disorders, as well as the factors confounding treatment outcomes.

Recent studies indicate that comorbid eating disorders and obesity are on the rise. A recent population survey in South Australia reported that comorbid obesity and eating disorders behaviours have increased 4.5 times between 1995 to 2005, with one in five individuals with obesity also presenting with comorbid disordered eating. Further, cross-sectional and longitudinal studies indicate that individuals may progress from one weight-related problem to another over time. Both obesity and eating disorders carry a significant personal and public health burden, in terms of decreased health and quality of life and increased use of health services, which is compounded for individuals with comorbid obesity and eating disorders. These individuals face the added difficulty of receiving care for both the medical complications associated with obesity and the psychosocial functioning difficulties associated with eating disorders.

The reasons for such a large increase in comorbid obesity and eating disorders in a relatively short period of time are unclear, but media and weight-reduction campaigns have been suggested as precipitating factors. The media plays an important role in propagating sociocultural pressures to attain an ideal body image, and numerous studies have demonstrated a causal link between levels and types of media exposure and body dissatisfaction. Likewise, weight-reduction campaigns in the form of community-based interventions and social marketing often emphasise the desirability of an ideal body weight or shape through dieting and physical exercise. In doing so, these campaigns may inadvertently stigmatisate the individuals they intend to help, and may be a risk factor in the development of eating disorders.

Both obesity and eating disorders would benefit from a reduction in the stigma and negativity that obesity attracts. Stigma increases levels of body dissatisfaction, which in turn increases depressive symptomatology and can play a determining role in both quality of life and treatment outcomes. A collaborative approach to overweight and obesity reduction that addresses weight stigma and promotes healthy eating practices without encouraging dieting or weight preoccupation would be a valuable first step to improving the health of individuals of all weights. Conscientious prevention interventions that integrate media literacy, body-satisfaction and self-esteem with messaging on general healthy eating and physical activity for enjoyment may improve outcomes while reducing weight stigma and other unintentional harms. On a practical level, integrated campaigns aimed at preventing the spectrum of eating- and weight-related problems would be time- and cost-effective, would improve coherence in messaging (and reduce harms from conflicting messaging), and would create a valuable avenue for discourse between sectors.

5.1. Recommendations for Practice

There is an increased need for prevention and treatment interventions that target the broad spectrum of weight-related disorders. This necessarily requires dialogue and collaboration between professionals in obesity and eating disorders sectors, as well as the involvement of stakeholders at all levels of community and government. Existing and new treatments should be grounded in evidence and should include long-term follow ups which incorporate routine assessments of psychological well-being alongside weight-related measures.

Better training of health professionals

Awareness by all health professionals of shared risk factors would help mitigate harms. For example, the identification of an effective pharmacological weight loss agent would be a
positive development for the obesity sector but may be a cause for concern for eating disorders professionals, as such an agent carries the potential for abuse by individuals with eating disorders. Health professionals interacting with eating disorders or overweight populations should be informed about the physical and psychological features of both conditions, as well as the significant shared space between them. Cross-training between specialists in both sectors, such as through shared conferences or workshops, would ensure that those in the obesity field learn about eating disorders and vice versa.

Certain individuals, such as young women, will be at greater eating disorders risk, and health professionals should be able to identify vulnerable overweight or obese individuals and adapt treatment appropriately. Further, some signs and symptoms of eating disorders may initially present as treatment benefits. For example, increased physical activity and control and discipline over biological urges may be viewed as positive outcomes from weight reduction interventions, but are also a sign of increasing disease severity for individuals with anorexia nervosa.

**Incorporate evidence based treatment strategies into obesity care**

Treatment strategies for obesity should be evidence based and comprehensive, taking into account a broader range of health outcomes than weight or BMI alone. Given the benefits of behavioural and psychological interventions on eating disorders outcomes and weight loss, weight loss interventions should incorporate these components into a more holistic program of care. Treatments should follow a chronic disease model of care that progresses from the use of micro-environmental and lifestyle interventions through to more intensive interventions alongside the severity of obesity. Importantly, psychological and physical comorbidities should be managed concurrently with weight to maximise outcomes in both physical health and quality of life, and when disordered eating is detected, stabilisation of eating disorders symptoms should precede and run alongside the weight loss program.

Although psychological outcomes often improve following weight loss, there are reports that risk of suicide is increased following bariatric surgery, and binge eating, one of the most common forms of disordered eating following bariatric surgery, may resurface two years after the procedure. These findings highlight the need for long-term monitoring and maintenance sessions, which are initiated earlier following completion of a treatment program, to ensure that individuals maintain healthy behaviours.

**Improve postsurgical follow-up care**

The development of eating disorders following bariatric surgery is an uncommon but serious postoperative issue that requires special attention by practitioners recommending or performing these procedures. A small body of literature supports the use of behavioural and cognitive approaches for patients who develop symptoms of anorexia nervosa or bulimia nervosa, but clinicians should be aware of the difficulties they may encounter when treating post-bariatric eating pathologies. These include the challenges of navigating healthy eating behaviours in patients facing postsurgical food intolerance and discomfort, fear of gaining weight, and intense management of weight and body image concerns. Additionally, since repeated vomiting, laxative abuse and fasting can all have severe medical repercussions, clinicians should be knowledgeable of the signs of symptoms of disordered eating and ensure that post bariatric patients are informed and have access to help should they require it.

**5.2. Recommendations for Research**

There is significant overlap between weight-related disorders that warrants increased research. Future studies should endeavour to improve study quality and consistency (particularly between outcome measures), and adopt a multidisciplinary approach that integrates perspectives from specialists across sectors.

**Develop a well-validated psychometric measure of disordered eating for patients seeking weight loss**

There is considerable variability in the range of diagnostic criteria and eating disorders measures currently employed. The validation of a psychometric tool is dependent on the population of interest and the purpose of assessment, and a measure validated in one context may not be valid in another. Current measures targeting traditional eating disorders populations should be adapted to populations seeking weight loss to encompass eating attitudes, cognitions and behaviours that may be unique to this population. Since outcomes can vary with measure type, care...
must be taken to select the appropriate measures. These measures should be openly disseminated, and importantly, should be integrated into a routine screening procedure during patient follow-ups.

**Develop a more comprehensive metric for treatment success**

Overweight and obesity are normally measured by weighing individuals and recording BMI. However, BMI is an imperfect measure\(^1\) and there is currently a lack of consensus about what an 'ideal' BMI is, particularly for individuals losing large amounts of weight\(^2\). The emphasis that is currently placed on external measures of health such as BMI may also detract from other important measures of health, such as physical activity and well-being\(^3\). Additionally, the suitability of a measure in one context does not imply suitability in all contexts. For instance, psychological outcomes may be of greater importance than physiological outcomes when determining the success of behavioural weight loss programs\(^4\). The development of a more comprehensive metric of success following obesity interventions should include measures of overall mental health alongside measures of weight reduction and changes in body composition\(^5\).

**Increase research into the psychological and eating disorders outcomes of weight loss interventions**

The evidence evaluated in this review highlights the need for more research into the psychological outcomes of weight loss interventions and the significant overlap between obesity and eating disorders. In particular, research focusing on the development of standardised tools for eating disorders assessment in the weight loss context and the identification of shared modifiable risk factors for both conditions would contribute to a more holistic model of care. Future studies should target a wider population base (studies were predominantly female and Caucasian) and include longer-term follow-ups since both weight and mental health are susceptible to relapse once removed from the supportive treatment context.
### Appendices

#### Appendix A: Level of evidence

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>A systematic review of randomised controlled trials</td>
</tr>
<tr>
<td>Level II</td>
<td>At least one well-designed randomised controlled trial</td>
</tr>
<tr>
<td>Level III-1</td>
<td>A well-designed pseudo-randomised controlled trial</td>
</tr>
</tbody>
</table>
| Level III-2 | A comparative study with concurrent controls:  
  - Non-randomised experimental trial  
  - Cohort study  
  - Case-control study  
  - Interrupted time series with a control group |
| Level III-3 | A comparative study without concurrent controls:  
  - Historical control study  
  - Two or more single arm study  
  - Interrupted time series without a parallel control group |
| Level IV | Case series with either post-test or pre-test and post-test outcomes |

The level of evidence scheme adopted a priori for this review was developed by the National Health and Medical Research Council. This review contains only Level 1 and Level II items.
Appendix B: Systematic Review Assessment Procedure

Overview quality assessment questionnaire (OQAQ) Items
1. Were the search methods reported?
2. Was the search for evidence reasonably comprehensive?
3. Were the study inclusion criteria reported?
4. Was selection bias avoided?
5. Were the criteria for assessing study validity reported?
6. Was assessment of study validity appropriate?
7. Were methods to combine studies reported?
8. Were the findings of studies combined appropriately?
9. Were the conclusions supported by the data/analysis?

Scoring: We adapted the scoring of the OQAQ\textsuperscript{207} to produce a quality rating of high (all criteria were met), moderate (>5 criteria were met items), or low (<5 criteria were met).
Appendix C: RCT assessment procedure

Jadad Scale
1. Was the study described as randomised (this includes words such as randomly, random, and randomisation)? (+1)
2. Was the method used to generate the sequence of randomisation described and appropriate (table of random numbers, computer-generated, etc)? (+1)
3. Was the study described as double blind? (+1)
4. Was the method of double blinding described and appropriate (identical placebo, active placebo, dummy, etc)? (+1)
5. Was there a description of withdrawals and dropouts? (+1)
6. Deduct one point if the method used to generate the sequence of randomisation was described and it was inappropriate (e.g. patients were allocated alternately, or according to date of birth, hospital number, etc). (+1)
7. Described but inappropriate (-1)
8. Deduct one point if the study was described as double blind but the method of blinding was inappropriate (e.g. comparison of tablet vs. injection with no double dummy). (+1)
9. Described but inappropriate (-1)

Scoring: We adapted the scoring of the Jadad scale to produce a quality rating of high (score of 5), moderate (score of 3-4) or low (score of 0-2).
Appendix D: Evidence summary procedure

NHMRC Body of Evidence Matrix

<table>
<thead>
<tr>
<th>Evidence base</th>
<th>Excellent</th>
<th>Good</th>
<th>Satisfactory</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Several high quality SRs/RCTs with low risk of bias</td>
<td>1-2 high quality SRs/RCTs studies with low risk of bias</td>
<td>SRs/RCTs with moderate quality and/or moderate risk of bias</td>
<td>SRs/RCTs with low quality and/or high risk of bias</td>
</tr>
<tr>
<td>Consistency</td>
<td>All studies consistent</td>
<td>Most studies consistent and inconsistency accounted for</td>
<td>Some inconsistency, reflecting genuine uncertainty around question</td>
<td>Inconsistent evidence</td>
</tr>
<tr>
<td>Clinical impact</td>
<td>Very large</td>
<td>Moderate</td>
<td>Slight</td>
<td>Restricted</td>
</tr>
</tbody>
</table>

The evidence summary procedure was adapted from the NHMRC *Levels of evidence and grades for recommendations for developers and guidelines*. SR= Systematic review; RCT= randomised controlled trial. When only a single RCT was available for an intervention, consistency was scored as N/A. When a single SR was available, consistency was scored based on the consistency between RCTs evaluated in the SR.
References


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### Appendix A: Systematic reviews

#### Systematic reviews meeting inclusion criteria for the evidence review

<table>
<thead>
<tr>
<th>Study Features</th>
<th>Objective &amp; Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
</table>
| **First author:** Astell  
**Publication/Search year:** 2013/2012  
**N studies:** 14 (all RCTs)  
**Demographic:** Obese adults  
**Inclusion criteria:** Double-blind RCTs with n>20; 2+ week interventions; measurable outcomes on appetite or food intake and anthropometry  
**Exclusion criteria:** Studies that only included baseline data; studies that did not include post treatment data; studies set in specialty care rather than primary care; studies that included paediatric or adolescent samples | Study questions/objective:  
- To determine the impact of natural supplements on appetite and subsequent weight loss  
**Interventions included**  
- Appetite suppressant plant extracts | The evidence reviewed for the efficacy of plant extracts in weight loss was inconclusive  
- The only exceptions were Caralluma fimbriata extract and a combination supplement containing Garcinia cambogia and Gymnema sylvestre, which had promising short-term results | Adverse events included disturbance of skin sensation, headache, dizziness, nausea, flushing, vomiting, fatigue, flatulence, bloating, injury/poisoning and respiratory infection |
| **Notes and/or limitations:** No assessment of study validity; few studies reported treatment fidelity; high variability in outcomes. |

| **First author:** Baillot  
**Publication/Search year:** 2014/2012  
**N studies:** 40 (8 RCTs)  
**Demographic:** Obese adults  
**Inclusion criteria:** Obese adults waiting to undergo bariatric surgery; studies with a physical activity intervention; reporting of anthropometric parameters, body composition, cardiometabolic risk factors, QOL or psychological parameters  
**Exclusion criteria:** Studies with weight-loss as the only outcome | Study questions/objective:  
- To determine the impact of physical activity on body composition and quality of life outcomes  
- To identify the research gaps and priorities regarding the impact of regular physical activity  
**Interventions included**  
- Any physical activity/exercise intervention | Combined diet + exercise is more effective than diet alone at reducing weight, waist circumference and body fat  
- Regular physical activity is positively associated with health outcomes  
- Due to the limited quantity and quality of studies in this review, no strong conclusions can be drawn from this study | None reported |
| **Notes and/or limitations:** Data could not be pooled for meta-analyses due to high heterogeneity and small sample sizes. |

| **First author:** Baillot  
**Publication/Search year:** 2015/2012  
**N studies:** 56 (7 RCTs)  
**Demographic:** Adults with class II and III obesity  
**Inclusion criteria:** Reported on either a physical or psychological outcomes.  
**Exclusion criteria:** None reported | Study questions/objective:  
- To determine the impact of lifestyle interventions (exercise, counselling and education) on physical and psychological outcomes  
**Interventions included**  
- Physical activity and exercise  
- Counselling and education | Lifestyle interventions led to significant improvements in fat mass and waist circumference  
- Improvements were greater for long-term interventions than intermediate- or short-term interventions  
- Lifestyle interventions did not have a significant impact on quality of life | None reported |
| **Notes and/or limitations:** The study methods and outcomes were highly heterogeneous. |

| **First author:** Barnes  
**Publication/Search year:** 2015/2014  
**N studies:** 24 RCTs  
**Demographic:** Overweight or obese adults  
**Inclusion criteria:** RCTs of motivational interviewing in a primary care setting where weight was an outcome variable  
**Exclusion criteria:** Studies that only included baseline data; studies that did not include post treatment data; studies set in specialty care rather than primary care; studies that included paediatric or adolescent samples | Study questions/objective:  
- To determine the impact of motivational interviewing on weight loss  
**Interventions included**  
- Motivational interviewing | The evidence reviewed for the efficacy of motivational interviewing for weight loss was inconsistent  
- Half of the included studies reported no weight loss in participants receiving motivational interviewing (compared with controls), while the remainder showed some or significant weight loss | None reported |
<p>| <strong>Notes and/or limitations:</strong> No assessment of study validity; few studies reported treatment fidelity; high variability in outcomes. |</p>
<table>
<thead>
<tr>
<th>Study Features</th>
<th>Objective &amp; Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>First author: Black</td>
<td>Study questions/objective: To determine the impact of bariatric surgery on children</td>
<td>Bariatric surgery led to significant short-term weight loss in children and adolescents overall</td>
<td>Adverse effects were specific to the type of bariatric surgery performed. These included nutrient deficiencies, hernias, wound infections, small bowel obstructions and ulcers</td>
</tr>
<tr>
<td>Publication/Search year: 2013</td>
<td>Interventions included: Bariatric surgery</td>
<td>In the single RCT included here\textsuperscript{20}, weight loss was significantly higher in participants randomised to surgery than control (lifestyle program)</td>
<td></td>
</tr>
<tr>
<td>N/studies/subjects: 23 (1 RCT)/637 (50 in RCT)</td>
<td>Notes and/or limitations: Only one RCT of adolescent bariatric surgery with small sample size (N=50) was included in this SR. This RCT had a high attrition in the non-surgical arm (28% withdraw post-randomisation, possibly introducing bias).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic: Children and adolescents (6-18 years)</td>
<td>Exclusion criteria: Assessed weight within 6 months of receiving bariatric surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inclusion criteria:</td>
<td>Exclusion criteria: Non-sequential case series and studies with less than 10 individuals</td>
<td></td>
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</tr>
</tbody>
</table>

| First author: Booth | Study questions/objective: To determine the impact of behavioural interventions delivered in a primary care setting on body weight | Behavioural interventions led to very small reductions in body weight which were unlikely to be clinically significant | None reported |
| Publication/Search year: 2014 | Interventions included: Behavioural interventions targeting diet and exercise | | |
| N/studies/subjects: 15 RCTs/4539 | Notes and/or limitations: The positive findings of this study reflect short-term outcomes. Further research is required to clarify long-term effects of metformin treatment. | | |
| Demographic: Overweight or obese adults | Exclusion criteria: RCTs conducted in a primary care setting; studies in which weight loss was measured as an outcome | | |
| Inclusion criteria: RCTs that compared metformin to a lifestyle intervention or placebo; studies that measured BMI, weight, or adverse side effects as outcomes | Exclusion criteria: Studies using drug treatment | | |
| First author: Bouza | Study questions/objective: To determine the impact and safety of metformin on BMI and adverse effects | Metformin, when combined with lifestyle interventions, is effective for reducing BMI in obese adolescents | There was no evidence for adverse effects |
| Publication/Search year: 2012/2011 | Interventions included: Metformin | | |
| N/studies/subjects: 9 RCTs/498 | Notes and/or limitations: The positive findings of this study reflect short-term outcomes. Further research is required to clarify long-term effects of metformin treatment. | | |
| Demographic: Overweight or obese adolescents | Exclusion criteria: Participants presenting with comorbidities | | |
| Inclusion criteria: RCTs that compared metformin to a lifestyle intervention or placebo; studies that measured BMI, weight, or adverse side effects as outcomes | Exclusion criteria: Studies using drug treatment | | |

| First author: Brufrani | Study questions/objective: To determine the effectiveness of metformin on weight loss in non-diabetic children compared with lifestyle interventions | Metformin resulted in small but significant weight loss in obese children in the short-term, but this outcome was considered to be clinically small | None reported |
| Publication/Search year: 2014/2013 | Interventions included: Metformin | | |
| N/studies: 11 (7 RCTs) | Notes and/or limitations: Authors do not assess bias or validity of included studies. The quality of this S.R. was somewhat limited. | | |
| Demographic: Obese non-diabetic children and adolescents | Exclusion criteria: Studies that were short in duration (<6 months) | | |
| Inclusion criteria: RCTs that compared metformin to a lifestyle intervention or placebo; studies that measured BMI, weight, or adverse side effects as outcomes | Exclusion criteria: Studies using drug treatment | | |

<p>| First author: Buchwald | Study questions/objective: To determine the outcomes of banded Roux-en-Y gastric bypass (B-RYGB) | B-RYGB resulted in significant intermediate-term weight loss that surpassed the intermediate-term weight loss outcomes of NB-RYGB | NB-RYGB (but not B-RYGB) produced adverse outcomes such as dumping syndrome and postoperative leak |
| Publication/Search year: 2014/2013 | Interventions included: B-RYGB | | |
| N/studies/subjects: 15 (3 RCTs)/8707 | Notes and/or limitations: The current review was limited by a shortage of experimental studies, lower-quality observational studies, no standardised B-RYGB procedure, and no specific bariatric surgery data-reporting requirements | | |
| Demographic: Obese adults | Exclusion criteria: Full length research articles published after January 1, 1990 about RYGB; reporting of weight and complications | | |
| Inclusion criteria: Full length research articles published after January 1, 1990 about RYGB; reporting of weight and complications | Exclusion criteria: Studies with a follow-up period &gt; 3 yrs; case studies | |</p>
<table>
<thead>
<tr>
<th>Study Features</th>
<th>Objective &amp; Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
</table>
| **First author:** Chang  
Publication/Search year: 2014  
N studies/subjects: 164 (37 RCTs)/161756  
**Demographic:** Obese adults  
**Inclusion criteria:** RCTs and observational studies of bariatric surgery; inclusion of at least one outcome criteria: weight change, surgery mortality, complications and impact on diseases  
**Exclusion criteria:** Studies that did not look at surgical interventions; studies of children/adolescents  
**Notes and/or limitations:** Only a subset of included studies were RCTs; outcome reporting was highly heterogeneous across studies.  
**Study questions/objective:**  
- To determine the risks and benefits associated with bariatric surgery  
**Interventions included**  
- Gastric bypass  
- Adjustable gastric banding  
- Vertical banded gastroplasty  
- Control (non-surgical interventions)  
**Summary of outcomes:**  
- Bariatric surgery resulted in significant long-term weight loss that was clinically relevant  
- Bariatric surgery was associated with low rates of post-surgery mortality  
**Adverse effects:**  
- Reoperation rates were ~7%.  
- Complication rates were ~10% - 17% and included bleeding, vomiting, reflux, gastrointestinal symptoms, and nutritional and electrolyte abnormalities. |

| **Notes and/or limitations:** Heterogeneity among studies was very high and results were based on a small number of studies and individuals with only short-term (<2 years) follow-up. |

| **First author:** Colquitt  
Publication/Search year: 2014/2013  
N studies: 22 (7 RCTs)/1798  
**Demographic:** Overweight or obese adults  
**Inclusion criteria:** RCTs comparing surgical interventions to other (non-surgical or surgical interventions) for the management of overweight and/or obesity; assessed relevant clinical outcomes; minimum duration of 12 months  
**Exclusion criteria:** Open versus laparoscopic procedures; procedures no longer in current use  
**Notes and/or limitations:** Heterogeneity among studies was very high and results were based on a small number of studies and individuals with only short-term (<2 years) follow-up.  
**Study questions/objective:**  
- To assess the effects of bariatric surgery for overweight and obesity  
**Interventions included**  
- Surgical procedures in current use  
- Non-surgical treatment (usual care, no treatment or medical management)  
**Summary of outcomes:**  
- Surgical interventions resulted in significantly greater reductions in body mass compared with non-surgical interventions  
- Individuals with higher BMIs (~40) lost significantly more weight than those with lower BMIs  
- Surgery led to greater improvements in quality of life than non-surgical interventions, although this outcome was derived from only a few studies  
**Adverse effects:**  
- The most commonly cited adverse events after bariatric surgery were iron deficiency anaemia and reoperations, although many other less common adverse events were reported. |

| **Notes and/or limitations:** Included studies had variation in their scales, thresholds and definitions of outcomes. Most included studies reported data from a single institution, which may reduce the generalisability of this report. |

| **First author:** Dawes  
Publication/Search year: 2016  
N studies: 68  
**Demographic:** Overweight or obese adults  
**Inclusion criteria:** Studies that addressed 1 specific study aim; report data for adults with BMI ≥35kg/m²; report data from primary research  
**Exclusion criteria:** Studies that asked patients to recall their preoperative health status  
**Notes and/or limitations:** Included studies had variation in their scales, thresholds and definitions of outcomes. Most included studies reported data from a single institution, which may reduce the generalisability of this report.  
**Study questions/objective:**  
- To estimate the prevalence of mental health conditions in patients seeking and undergoing bariatric surgery  
- To evaluate the association between preoperative mental health conditions and weight loss surgery  
- To evaluate the association between surgery and clinical course of mental conditions  
**Interventions included**  
- Bariatric surgery  
**Summary of outcomes:**  
- The most common mental health conditions among patients seeking bariatric surgery were depression and BED  
- Depression and BED were not consistently associated with differences in weight outcomes  
- Bariatric surgery was consistently associated with a decrease in postoperative depression  
- None reported  
**Notes and/or limitations:** Included studies had variation in their scales, thresholds and definitions of outcomes. Most included studies reported data from a single institution, which may reduce the generalisability of this report. |

| **First author:** Gloy  
Publication/Search year: 2013  
N studies/subjects: 11 RCTs/796  
**Demographic:** Obese individuals with BMI ≥30  
**Inclusion criteria:** RCTs of bariatric surgeries with a non-surgical treatment comparison  
**Notes and/or limitations:** Heterogeneity among studies was very high and results were based on a small number of studies and individuals with only short-term (<2 years) follow-up.  
**Study questions/objective:**  
- To compare surgical (bariatric) and non-surgical interventions for obesity  
**Interventions included**  
- Bariatric surgery  
- Non-surgical comparator (diet, weight reducing drugs, behavioural therapy, or any combination thereof)  
**Summary of outcomes:**  
- Bariatric surgery produced significantly greater improvements in body mass and QOL than non-surgical interventions  
- Individuals with higher BMIs (~40) lost significantly more weight than those with lower BMIs  
**Adverse effects:**  
- The most commonly cited adverse events after bariatric surgery were iron deficiency anaemia and reoperations, although many other less common adverse events were reported. |
### Study Features

<table>
<thead>
<tr>
<th>First author; Guzdune</th>
<th>Objective &amp; Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study questions/objective:</strong></td>
<td>To examine the benefits, adherence, and harms of commercial or proprietary weight-loss programs compared with control/education or behavioural counselling</td>
<td>The 3 programs that dominate the weight-loss service industry (Weight Watchers, Jenny Craig and Nutrisystem) consistently produced greater weight loss than control interventions</td>
<td>Very-low-calorie diets may increase the risk for gallstones</td>
</tr>
<tr>
<td><strong>Interventions included:</strong></td>
<td>Commercial or proprietary weight loss programs (11 included)</td>
<td>The 3 programs that promote weight loss through very-low-calorie meal replacements (HMR, Medifast and Optifast) produced short-term weight loss compared with controls</td>
<td></td>
</tr>
<tr>
<td><strong>Notes and/or limitations:</strong></td>
<td>Education or behavioural counselling</td>
<td>5 self-directed programs offered support through the internet. The Atkins program had the greatest short-term weight loss compared with controls</td>
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</tr>
<tr>
<td><strong>Demographic:</strong></td>
<td>Overweight and obese adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inclusion criteria:</strong></td>
<td>RCTs of ≥12 week duration that compared a commercial or proprietary weight-loss program to an education or behavioural counselling control</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exclusion criteria:</strong></td>
<td>Programs that focused on components other than weight loss, promoted medications or supplements, were not available in the US or were residential programs</td>
<td></td>
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</tr>
</tbody>
</table>

### Study Features

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Study questions/objective:</strong></td>
<td>To evaluate the effectiveness of eHealth interventions for the prevention and treatment of overweight and obesity</td>
<td>eHealth weight loss interventions resulted in modest weight loss compared to no or minimal treatment</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Interventions included:</strong></td>
<td>Electronic interventions using the Internet, email, text messages, monitoring devices, mobile applications, computer programs, podcasts and personal digital assistants</td>
<td>Interventions with evidence-based features (self-monitoring, personalised feedback) resulted in significantly greater weight loss</td>
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<tr>
<td><strong>Demographic:</strong></td>
<td>Overweight and obese adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inclusion criteria:</strong></td>
<td>RCTs assessing eHealth weight loss interventions compared to control, standard care, another delivery mode or another eHealth intervention; weight-related primary outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exclusion criteria:</strong></td>
<td></td>
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### Study Features

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<tbody>
<tr>
<td><strong>Study questions/objective:</strong></td>
<td>To evaluate behavioural weight management interventions targeting young women</td>
<td>Most (5/8) included studies reported significant improvements in weight status of participants receiving intervention as compared with minimal/no-intervention controls</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Interventions included:</strong></td>
<td>Behavioural weight gain prevention interventions</td>
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<tr>
<td><strong>Demographic:</strong></td>
<td>Young women 18-35 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inclusion criteria:</strong></td>
<td>RCTs about weight management (weight loss, maintenance and prevention) with at least one intervention study arm; reported weight-related outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exclusion criteria:</strong></td>
<td>Surgical interventions and drug trials; pregnant or postpartum women; participants with a recent history of major health conditions</td>
<td></td>
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</tr>
</tbody>
</table>

### Notes and/or limitations:

**First study:** Many studies assessed outcomes only over the short-term, the clearest exceptions being Weight Watchers and Jenny Craig, which provide consistent evidence for longer-term benefits. Studies often did not provide data on adherence or adverse outcomes and frequently lacked adequate blinding procedures.

**Second study:** Although the meta-analyses conducted in this review were large, robust, and resulted in statistically significant weight loss, it is worth noting that the clinical significance of the average weight loss (1.4-2.7kg) is lower than traditional behavioural weight loss interventions (i.e., weekly group-based lifestyle counselling resulted in an average weight loss of 10.7kg).}

**Third study:** The overall effectiveness of weight management interventions described here is difficult to ascertain due to the following study features: the intervention types, components and durations where highly heterogeneous; the sample sizes were small; the risk of bias was high and the included studies were rated as poor to moderate in quality.
### Study Features

<table>
<thead>
<tr>
<th>First author: Johns</th>
<th>Publication/Search year: 2014/2012</th>
<th>N studies/subjects: 8 RCTs/1022</th>
<th>Demographic: Overweight or obese (BMI≥25) adults (≥18 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion criteria: Clearly defined behavioural weight management program (BWMP) that included diet and physical activity compared to a diet and/or physical activity-only program; a measure of weight change at ≥12 months</td>
<td>Exclusion criteria: Pregnant women, people with eating disorders; weight loss targeted to medical disorders; weight loss by surgery or medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes and/or limitations: High heterogeneity in some analyses; unclear allocation concealment in most studies. However, all but one study indicated high compliance.</td>
<td></td>
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</tbody>
</table>

### Objective & Interventions

<table>
<thead>
<tr>
<th>Study questions/objective:</th>
<th>In the short-term, combined BWMPs result in similar weight loss as diet-only interventions</th>
<th>Adverse effects: None reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>To evaluate whether BWMPs involving both diet and physical activity lead to greater weight loss in the long-term (&gt;12 months) than programs involving diet or physical activity alone</td>
<td>In the long-term, weight-loss is greatest for combined BWMPs</td>
<td></td>
</tr>
<tr>
<td>Interventions included:</td>
<td>Interventions based on physical activity alone are less effective than combined BWMPs in both the short and long term</td>
<td></td>
</tr>
<tr>
<td>Combined BWMP (diet + physical activity)</td>
<td>Diet only</td>
<td></td>
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<tr>
<td>Physical activity only</td>
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</tbody>
</table>

### Summary of outcomes

- Green tea preparations induce a clinically small, non-significant reduction in weight in overweight and obese adults
- Increased fruit and vegetable intake had a small, clinically insignificant effect on weight loss
- The current recommendations to increase fruit and vegetable intake, without concomitant energy restriction, is unsupported
- There were overall improvements in psychopathology, depressive symptoms, eating behavior, body image, and HRQoL following bariatric weight loss surgery
- A subset of patients did not improve at all

### Adverse effects

- Of the 8 studies that reported on adverse events, half reported mild to moderate adverse events including nausea, constipation, abdominal discomfort and increased blood pressure

### Notes and/or limitations

- The number of studies included in analyses was small (2 in primary analyses and 7 in secondary analyses).
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<tr>
<td><strong>First author:</strong> Magallares</td>
<td><strong>Study questions/objective:</strong> • To evaluate mental and physical health-related quality of life in obese patients following bariatric surgery</td>
<td>• Physical and mental health (as measured by the SF-36 QOL questionnaire) were considerably higher in the post-surgery group compared to the pre-surgery group</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Publication year:</strong> 2015</td>
<td><strong>Interventions included</strong> • Any bariatric procedure</td>
<td>• These effects were very large in magnitude*</td>
<td></td>
</tr>
<tr>
<td><strong>N studies:</strong> 21</td>
<td><strong>Exclusion criteria:</strong> Other questionnaires or measurement tools; non-empirical studies</td>
<td>• Improvements in HRQoL were observed up to one year following bariatric surgery</td>
<td></td>
</tr>
<tr>
<td><strong>Demographic:</strong> Not reported</td>
<td><strong>Notes and/or limitations:</strong> Short follow-up periods (max one-year) that may not be long enough to capture long-term maintenance of HRQoL. Approximately 15% of participants did not complete the post-surgery assessment, which may have biased outcomes. *High heterogeneity should temper our interpretation of pooled data.</td>
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<tbody>
<tr>
<td><strong>First author:</strong> Nigro</td>
<td><strong>Study questions/objective:</strong> • To evaluate the clinical data on lorcaserin for obesity management</td>
<td>• There were no significant differences in weight loss between low carbohydrate and balanced diets</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Publication/Search year:</strong> 2013</td>
<td><strong>Interventions included</strong> • The anti-obesity agent lorcaserin (a novel serotonin 2C agonist)</td>
<td>• Reductions in weight or BMI, when noted, occurred in both low and balanced diet groups</td>
<td></td>
</tr>
<tr>
<td><strong>N studies:</strong> 4 RCTs</td>
<td><strong>Exclusion criteria:</strong> None reported</td>
<td>• Weight loss was therefore the result of a reduction in dietary energy intake rather than manipulations of macronutrient components</td>
<td></td>
</tr>
<tr>
<td><strong>Demographic:</strong> Overweight or obese adults</td>
<td><strong>Notes and/or limitations:</strong> Many of the included trials were deemed to have high risk of bias with inter-trial variation in the type and quantity of fat consumed; adherence to dietary goals was low; and trials were small with short duration.</td>
<td></td>
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<tr>
<td><strong>Inclusion criteria:</strong> In-vitro or in-vivo evaluations of lorcaserin</td>
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<tr>
<td><strong>Exclusion criteria:</strong> None reported</td>
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<tr>
<td><strong>First author:</strong> Olson</td>
<td><strong>Study questions/objective:</strong> • To evaluate the current evidence for MBIs for weight loss</td>
<td>• A significantly higher proportion of patients receiving lorcaserin lost &gt;5% body weight compared with those receiving placebo</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Publication/Search year:</strong> 2015</td>
<td><strong>Interventions included</strong> • MBIs</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>N studies/subjects:</strong> 19 (8 RCTs)</td>
<td>• Acceptance-based weight-loss interventions</td>
<td>• Patients receiving lorcaserin also had greater weight loss compared those receiving placebo (6 and 3kg, respectively)</td>
<td></td>
</tr>
<tr>
<td><strong>Demographic:</strong> Overweight or obese adults</td>
<td><strong>Notes and/or limitations:</strong> Although lorcaserin resulted in significantly greater weight loss than placebo in all 3 Stage 2 trials, this reduction met FDA standards (≥5% reduction compared with placebo) on only two trials, and by a small margin (5.8% in both cases). Trial participants received behavioural counselling and daily exercise instruction that may explain all or some of the reported treatment outcomes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inclusion criteria:</strong> Evaluation of a mindfulness-based intervention (MBI) for weight management; weight measured as an outcome at baseline and completion</td>
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<tr>
<td><strong>Exclusion criteria:</strong> Studies including children or adolescents; studies of post-bariatric surgery patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exclusion criteria:</strong> None reported</td>
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</tbody>
</table>

Notes and/or limitations: The measurement and assessment of mindfulness itself is important in determining the validity and efficacy of mindfulness as an intervention for weight loss, however, most studies do not include any specific measure of mindfulness. Since nearly all reviewed programs are multi-component (including education, diet, physical activity and self-monitoring components), it remains unclear whether mindfulness actively influences weight loss.
<table>
<thead>
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<tbody>
<tr>
<td>Onakpoya</td>
<td>To evaluate the efficacy of chromium supplements on body weight and related parameters in overweight and obese patients</td>
<td>Chromium supplementation led to significant reductions in body weight and percent body fat, but not BMI, waist circumference or waist to hip ratio</td>
<td>Adverse events were reported with daily doses exceeding 1000 µg, including watery stools, vertigo, weakness, nausea, vomiting, dizziness and head-aches. These events stopped when chromium was withdrawn and reappeared when chromium was reintroduced</td>
</tr>
<tr>
<td>Pathak</td>
<td>To evaluate whether calcium restriction reduced body weight and fat in the absence of caloric restriction</td>
<td>Glucosamine intake did not significantly influence body weight or BMI when compared with placebo</td>
<td>Most RCTs reported adverse events. The most commonly reported were related to the gastrointestinal system and included diarrhea, constipation, abdominal discomfort, and mild meteorism</td>
</tr>
<tr>
<td>Puzziferi</td>
<td>To assess the effectiveness of bariatric surgeries for weight loss 2 years post-procedure</td>
<td>RYGB resulted in greater weight loss than LAGB in both the short (&lt;2 years) and long-term (2-5 years)</td>
<td>None reported</td>
</tr>
</tbody>
</table>

Notes and/or limitations: The included studies were variable along a number of quality parameters (i.e., randomisation, allocation concealment, blinding, etc), and the data included in meta-analyses were highly heterogeneous. Although reductions in weight and fat were significant, the magnitude of the effect in each case was small.
### Studies of Lorcaserin

**Objective & Interventions**

- To evaluate the clinical data on lorcaserin for obesity management
- The anti-obesity agent lorcaserin (a novel serotonin 2C agonist)

**Summary of outcomes**

- Significantly more patients receiving lorcaserin lost >5% body weight compared with those receiving placebo
- Patients receiving lorcaserin also had greater weight loss compared to those receiving placebo (6 and 3kg, respectively)

**Adverse effects**

- None reported

---

### Studies of Mindfulness

**Objective & Interventions**

- To evaluate mental and physical health-related quality of life in obese patients following bariatric surgery
- Any bariatric procedure

**Summary of outcomes**

- Physical and mental health (as measured by the SF-36 QOL questionnaire) were considerably higher in the post-surgery group compared to the pre-surgery group. These effects were very large in magnitude*.
- Improvements in hRQOL were observed up to one year following bariatric surgery

**Adverse effects**

- None reported

---

### Studies of Bariatric Surgery

**Objective & Interventions**

- To evaluate the beneficial and harmful effects of low carbohydrate diets on weight in comparison to balanced diets
- Low carbohydrate diets
- Balanced diets

**Summary of outcomes**

- There were no significant differences in weight loss between low carbohydrate and balanced diets
- Reductions in weight or BMI, when noted, occurred in both low and balanced diet groups
- Weight loss was therefore the result of a reduction in dietary energy intake rather than manipulations of macronutrient components

**Adverse effects**

- None reported

---

### Notes and/or limitations

- Included only one-year follow-up, which may not be long enough to capture long-term maintenance of hRQOL.
- *High heterogeneity should temper our interpretation of pooled data. Approximately 15% of participants did not complete the post-surgery assessment, which may have biased outcomes.

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## Table

<table>
<thead>
<tr>
<th>Study Features</th>
<th>Objective &amp; Interventions</th>
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</tr>
</thead>
</table>
| First author: Magalares | **Study questions/objective:**
- To evaluate mental and physical health-related quality of life in obese patients following bariatric surgery  
- Any bariatric procedure | **Physical and mental health (as measured by the SF-36 QOL questionnaire)** were considerably higher in the post-surgery group compared to the pre-surgery group. These effects were very large in magnitude*
- Improvements in hRQOL were observed up to one year following bariatric surgery | None reported |
| Publication year: 2015 | **Exclusion criteria:**
- Other questionnaires or measurement tools; non-empirical studies | **Notes and/or limitations:**
- Included only one-year follow-up, which may not be long enough to capture long-term maintenance of hRQOL. *High heterogeneity should temper our interpretation of pooled data. Approximately 15% of participants did not complete the post-surgery assessment, which may have biased outcomes. | |
| N: 36 health trials | **Inclusion criteria:**
- Obese patients; bariatric surgery; application of the SF-36 health-related quality of life questionnaire; longitudinal studies with follow-up measures up to one year | | |
| Demographic: Not reported | | | |
| N: 19 RCTs/3209 | **Study questions/objective:**
- To evaluate the beneficial and harmful effects of low carbohydrate diets on weight in comparison to balanced diets  
- Low carbohydrate diets  
- Balanced diets | **Adverse effects**
- None reported | |
| First author: Naude | **Exclusion criteria:**
- Pregnant or lactating women; < 18 years; <10 participants per group; diets combined with other interventions | | |
| Publication/Search year: 2014 | **Inclusion criteria:**
- RCTs providing macronutrient dietary goals; low carb weight loss diets compared to balanced weight loss diet plans with similar energy content | | |
| N: 4 RCTs (1 Stage 2; 3 Stage 3 trials) | **Study questions/objective:**
- To evaluate the clinical data on lorcaserin for obesity management  
- The anti-obesity agent lorcaserin (a novel serotonin 2C agonist) | **Notes and/or limitations:**
- Many of the included trials had high risk of bias with high variation in the type and quantity of fat consumed; adherence to dietary goals was low; and trials were small with short duration. | |
| Demographic: Overweight or obese adults | **Interventions included** | **Summary of outcomes** | |
| Inclusion criteria: RCTs providing macronutrient dietary goals; low carb weight loss diets compared to balanced weight loss diet plans with similar energy content | **Adverse events associated with lorcaserin included nausea, dizziness, headache, upper respiratory tract infections and nasopharyngitis** | *** | |
| Exclusion criteria: Pregnant or lactating women; < 18 years; <10 participants per group; diets combined with other interventions | **Notes and/or limitations:**
- Reductions in weight met FDA standards (≥5% reduction compared with placebo) on only two trials, and by a small magnitude | **Summary of outcomes** | |
| First author: Nigro | **Study questions/objective:**
- To evaluate the clinical data on lorcaserin for obesity management  
- The anti-obesity agent lorcaserin (a novel serotonin 2C agonist) | **Significantly more patients receiving lorcaserin lost >5% body weight compared with those receiving placebo**  
**Patients receiving lorcaserin also had greater weight loss compared to those receiving placebo (6 and 3kg, respectively)** | |
| Publication/Search year: 2013 | **Exclusion criteria:**
- None reported | | |
| N: 4 RCTs (1 Stage 2; 3 Stage 3 trials) | **Inclusion criteria:**
- In-vitro or in-vivo evaluations of lorcaserin | | |
| Demographic: None reported | **Study questions/objective:**
- To evaluate the beneficial and harmful effects of low carbohydrate diets on weight in comparison to balanced diets | | |
| Inclusion criteria: In-vitro or in-vivo evaluations of lorcaserin | **Interventions included** | | |
| Exclusion criteria: None reported | **Adverse effects**
- None reported | | |
| First author: Olson | **Study questions/objective:**
- To evaluate the current evidence for MBIs for weight loss  
- MBIs  
- Acceptance-based weight-loss interventions | **Significant weight loss was reported in 3 of 8 RCTs comparing MBIs to control interventions**  
**Effect sizes (and the clinical significance of the treatment effect) among these studies ranged from weak to strong**  
**Only a single study applied an empirical assessment of the relationship between mindfulness and weight change. This study found no association between increased mindfulness and weight loss at program completion** | None reported |
| Publication/Search year: 2015 | **Exclusion criteria:**
- Studies including children or adolescents; studies of post-bariatric surgery patients | | |
| N: 19 (8 peer reviewed RCTs) | **Inclusion criteria:**
- Overweight or obese adults | | |
| Demographic: Overweight or obese adults | **Objective & Interventions**
- To evaluate the clinical data on lorcaserin for obesity management  
- The anti-obesity agent lorcaserin (a novel serotonin 2C agonist) | | |
<table>
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<th>Adverse effects</th>
</tr>
</thead>
</table>
| **First author:** Trastulli  
**Publication/Search year:** 2013/2012  
**No. studies/subjects:** 15 RCTs/1191  
**Demographic:** Obese adults (BMI ≥40 kg/m²; aged ≥18 years)  
**Inclusion criteria:** RCTs reporting ≥1+ outcome of interest; ≥1+ comparison arms including adult obese patients undergoing laparoscopic sleeve gastrectomy (LSG)  
**Exclusion criteria:** Studies reporting on LSG data pooled with other data; data on single-incision LSG | **Study questions/objective:** To evaluate the effectiveness and safety of LSG for weight loss  
**Interventions included**  
- LSG | **LSG led to a reduction in % excessive weight loss and % excess BMI, without any significant differences compared to alternative surgical procedures (such as LGB or LAGB)**  
**Notes and/or limitations:** RCT data included in this study reflect short-term (≤3 year) outcomes only. These data reflect the extent of the current literature on this procedure: recent observational and non-randomised study data evaluating long-term effects exists, but RCT data evaluating ≥3 years post-operative is lacking. Since corrective procedures for weight loss failure or weight regain (such as resleeve, gastric bypass and duodenal switch) are normally performed ≥3 years postoperatively, the positive surgical outcomes reported here must be interpreted with caution. | LSG was deemed to have high feasibility and acceptable safety, with a mortality rate of 0% and a mean complication rate of 9.2% (lower than rates for LGB) |

| **First author:** Wadden  
**Publication/Search year:** 2014  
**No. studies/subjects:** 12 RCTs/3893  
**Demographic:** Overweight and obese patients (BMI ≥25 kg/m²)  
**Inclusion criteria:** RCTs that recruited participants from primary care settings; included behavioural weight loss counselling or lifestyle interventions; ≥3 months intervention and ≥6 months follow-up; delivered by primary care practitioners; weight as outcome; sample of ≥15+ participants per group  
**Exclusion criteria:** Weight gain prevention interventions or pharmacological agents | **Study questions/objective:** To evaluate behaviourally counselling delivered by primary care practitioners for weight loss  
**Interventions included**  
- Behavioural weight loss counselling  
- Lifestyle interventions (including diet, physical activity and behavioural components) | **There were no RCTs in which primary care practitioners delivered intensive behaviour counselling following CMS guidelines (14 sessions over 6 months)**  
**Notes and/or limitations:** No meta-analyses conducted to pool result; no studies located addressing original study queries | None reported |

| **First author:** Willcox  
**Publication/Search year:** 2014/2013  
**No. studies/subjects:** 11 (1 RCT)/453  
**Demographic:** Adolescents  
**Inclusion criteria:** Adolescents (<18yrs); pre- and post-op outcome data presented  
**Exclusion criteria:** Obesity resultant from an underlying medical condition, not reported in English, studies had less than 10 participants | **Study questions/objective:** To determine the impact of LAGB on weight loss and psychosocial outcomes  
**Interventions included**  
- LAGB | **LAGB reduced BMI in all studies**  
**Notes and/or limitations:** Data could not be pooled for meta-analysis; only 1 RCT included. | Post-operative complication rates ranged from 4-25% (reported in 5 studies) Most complications occurred post-discharge |

| **First author:** Yanovski  
**Publication/Search year:** 2014/2013  
**No. studies:** 21 (20 RCTs)  
**Demographic:** Obese adults  
**Inclusion criteria:** Primary or secondary outcome of body weight change; ≥50+ participants per group; ≥50%+ retention; reported intention-to-treat results  
**Exclusion criteria:** None reported gastric plication | **Study questions/objective:** To evaluate currently approved obesity medications  
**Interventions included**  
- Orlistat  
- Lorcaserin  
- Phentermine + topiramate | **Orlistat, lorcaserin, and phentermine+ topiramate, used alongside lifestyle interventions, all increase the probability that patient will achieve clinically meaningful (≥5%) 1-year weight loss (ranging from 35-70% of patients)**  
**Notes and/or limitations:** Many included studies had high attrition rates. Approved medications refer to approval by the FDA (USA). | Orlistat: mainly gastrointestinal adverse effects  
Lorcaserin: headache, dizziness, fatigue, nausea, dry mouth, cough, constipation  
Phentermine: dizziness, taste alterations, insomnia, constipation, dry mouth, elevation in heart rate, memory or cognitive changes |

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<tbody>
<tr>
<td><strong>First author:</strong> Yoong</td>
<td><strong>Study questions/objective:</strong> • To evaluate the effectiveness of behavioural weight-loss interventions delivered by primary-care physicians</td>
<td>• High-intensity weight-loss counselling did not result in clinically significant weight loss when delivered by primary care physicians</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Publication/Search year:</strong> 2013/2011</td>
<td><strong>Interventions included</strong> • Behavioural interventions delivered by primary care physicians</td>
<td>• High-intensity weight-loss counselling resulted in clinically significant weight loss when delivered by non-physicians, incorporated meal replacements alongside dietician counselling and participation in commercial weight-loss programmes with regular monitoring</td>
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<tr>
<td><strong>N studies:</strong> 16 RCTs</td>
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<tr>
<td><strong>Demographic:</strong> Overweight or obese adults in primary care (BMI ≥25 kg/m²)</td>
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<tr>
<td><strong>Inclusion criteria:</strong> Adult overweight or obese primary-care patients; behavioural weight-loss interventions delivered in primary-care; weight loss or BMI reductions as outcomes</td>
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<tr>
<td><strong>Exclusion criteria:</strong> Surgical and pharmacological interventions</td>
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</tbody>
</table>

**Notes and/or limitations:** The methodological qualities of some included studies were poor, and the number of studies addressing the SR questions was limited.

Outcomes reflect all studies included in a review, however note that in some cases these may include study types other than RCTs. While many types of outcome variables may be reported in the above studies, only data on outcome variables of interest are included here. The number of subjects listed reflects the total number of subjects across all study types, unless otherwise indicated.
### Appendix B: Randomised controlled trials

#### Randomised controlled trials meeting inclusion criteria for the evidence review

<table>
<thead>
<tr>
<th>Study Features</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First author, year:</strong> Allison, 2013</td>
<td><strong>Inclusion criteria:</strong> See population</td>
<td><strong>Adverse effects</strong> were most commonly experienced by Tx B, including paresthesia, dry mouth, constipation, dysgeusia, and insomnia. Most adverse effects were mild in severity</td>
<td></td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td><strong>Exclusion criteria:</strong> Not reported</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Population:</strong> Obese adults (mean age: 43, 83% female)</td>
<td><strong>Tx A:</strong> Placebo pill (N=514)</td>
<td><strong>Tx A had statistically and clinically greater weight loss than Tx B</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Participants:</strong> N=1267</td>
<td><strong>Tx B:</strong> Placebo pill (N=512)</td>
<td><strong>Both Tx groups had statistically and clinically greater reductions in weight and waist circumference than controls</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Setting:</strong> Not reported</td>
<td><strong>Control:</strong> Placebo pill (N=514)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Follow-up duration:</strong> 56 weeks</td>
<td><strong>Intervention:</strong> Pharmacological</td>
<td></td>
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</tr>
<tr>
<td><strong>Inclusion criteria:</strong> See population</td>
<td><strong>Study questions/objective:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exclusion criteria:</strong> Not reported</td>
<td><strong>Study questions/objective:</strong></td>
<td></td>
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</tbody>
</table>

| **First author:** Almeida, 2015      | **Inclusion criteria:** Employment at a participating worksite; have access to the internet | **Participants both Tx and control groups displayed a small reduction in weight (1kg and 0.6kg, respectively) and BMI (0.4 and 0.2 kg/m², respectively), however, there were no significant differences between groups** | None reported |
| **Country:** USA                     | **Exclusion criteria:** Medical conditions (including pregnancy), participating in a weight loss program |                                                                                  |                                                                                  |
| **Population:** Overweight adults (mean age: 46, 80% female) | **Tx:** Internet-based INCENT program: Weight loss support via diet and physical activity program delivered via email. Included monetary incentive (N=789) |                                                                                  |                                                                                  |
| **Total Participants:** N=1001       | **Control:** Email-based Livin' My Weigh minimal intervention control program: Provided a condensed version of the Incent program without tailoring (emails) or monetary incentive (N=495) |                                                                                  |                                                                                  |
| **Setting:** Outpatient              |                                                                                     |                                                                                  |                                                                                  |
| **Follow-up duration:** 6 months     |                                                                                     |                                                                                  |                                                                                  |
| **Inclusion criteria:** Not reported |                                                                                     |                                                                                  |                                                                                  |

| **First author:** Anderson, 2011     | **Inclusion criteria:** Pregnant or planning pregnancy; current or recent participants of another trial; use of medications that can effect weight or use of anticoagulants or oxcarbazepine; diagnosis of diabetes mellitus | **Participants receiving Tx had significantly greater weight loss than controls at 8, 16 and 24 week follow-ups** | None reported |
| **Country:** USA                     | **Exclusion criteria:** BMI of 30-39.9kg/m²; in good health                  | **The frequency and severity of adverse events were similar in both groups**         |                                                                                  |
| **Population:** Overweight adults (mean age: 51, 77% female) | **Tx:** Naltrexone/bupropion: 32 mg/day naltrexone + 360 mg/day bupropion, twice daily (N=506) |                                                                                  |                                                                                  |
| **Total Participants:** N=22         | **Control:** Usual-care counselling with registered dietician (N=16)          |                                                                                  |                                                                                  |
| **Setting:** Outpatient              | **Intervention:** Standardised behavioural intervention using meal replacements, fruits and vegetables + increased physical activity (N=8) |                                                                                  |                                                                                  |
| **Follow-up duration:** 24 weeks     | **Study questions/objective:**                                               |                                                                                  |                                                                                  |
| **Inclusion criteria:** Not reported | **Control:** Placebo pill (N=495)                                            |                                                                                  |                                                                                  |
| **Exclusion criteria:** Not reported | **Intervention:** Pharmacological                                             |                                                                                  |                                                                                  |

| **First author:** Apovian, 2013      | **Inclusion criteria:** Diabetes; vascular, hepatic or renal disease; weight change of >4kg 3 months prior to study; history of seizures or serious psychiatric illness | **Individuals receiving Tx had significantly greater weight loss at week 28 (-6.5% vs. -1.9%) and 56 (-6.4% vs. -1.2%) than controls** | Participants receiving treatment reported greater incidence of adverse events compared with placebo, including mild to moderate nausea, headache and constipation. |
| **Country:** USA                     | **Exclusion criteria:** Benzodiazepines, antipsychotics, antidepressants, antihypertensives, hormone replacement therapy, glucocorticoids, hormonal contraception, hormone replacement therapy, hormone therapy, antiretroviral therapy (including pregnancy), participating in a weight loss program |                                                                                  |                                                                                  |
| **Population:** Overweight and obese adults (mean age: 44, 85% female) | **Tx:** Naltrexone/bupropion: 32 mg/day naltrexone + 360 mg/day bupropion, twice daily (N=506) |                                                                                  |                                                                                  |
| **Total Participants:** N=1001       | **Control:** Placebo pill (N=495)                                            |                                                                                  |                                                                                  |
| **Setting:** Outpatient              | **Intervention:** Pharmacological                                             |                                                                                  |                                                                                  |
| **Follow-up duration:** 28 and 56 weeks | **Study questions/objective:**                                               |                                                                                  |                                                                                  |
| **Inclusion criteria:** See population | **Control:** Placebo pill (N=495)                                            |                                                                                  |                                                                                  |
| **Exclusion criteria:** Not reported | **Intervention:** Pharmacological                                             |                                                                                  |                                                                                  |

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### Study Features

<table>
<thead>
<tr>
<th>First author, year: Aronne, 2013</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
</table>
| **Country:** USA                  | **Intervention:** Behavioural + pharmacological  
  - **Tx A:** Phentermine 7.5mg (N=109)  
  - **Tx B:** Topiramate ER 46mg (N=106)  
  - **Tx C:** Phentermine/Topiramate ER 7.5mg/46mg (N=106)  
  - **Tx D:** Phentermine 15mg (N=108)  
  - **Tx E:** Topiramate ER 92mg (N=107)  
  - **Tx F:** Phentermine/Topiramate ER 15/92mg (N=108)  
  - **Control:** Placebo pill (N=109) | Combination of lifestyle counselling, Tx C and Tx F were the most effective treatments for weight loss, resulting in a statistically and clinically greater weight loss (-8.5% and -9.2% respectively) compared to all other treatment groups and placebo. | The only significant adverse effect was impairment in attention, which was found among all treatment groups vs. the control group. |
| **Country:** USA                  | **Intervention:** Pharmacological  
  - **Tx A:** Whey Protein supplement (N=30)  
  - **Tx B:** Soy Protein supplement (N=30)  
  - **Control:** Isoenergetic amount of carbohydrate (N=30) | Tx A produced significantly greater weight loss compared to control Tx, but the size of this effect was small (-1.8kg difference)  
  - There were no significant weight loss differences between Tx B and control or between Tx A and Tx B. | None reported |
| **Country:** USA                  | **Intervention:** Behavioural  
  - **Tx A:** Motivational interviewing, 5 sessions over 12 weeks (N=30)  
  - **Tx B:** Nutrition psycho-education, 5 sessions over 12 weeks (N=29)  
  - **Control:** Usual care (N=30) | Participants receiving Tx B had significantly greater weight loss than controls  
  - Participants receiving both Txs had significantly reduced symptoms of depression and BED compared with controls  
  - There was no significant difference in weight loss between Tx B and control or between participants with and without BED. | None reported |
| **Country:** USA and Puerto Rico  | **Intervention:** Pharmacological  
  - **Tx A:** Canagliflozin 50mg (N=98)  
  - **Tx B:** Canagliflozin 100mg (N=93)  
  - **Tx C:** Canagliflozin 300mg (N=96)  
  - **Control:** Placebo pill (N=89) | Weight was significantly reduced in all Tx groups compared with controls.  
  - The size of this effect was small and unlikely to be clinically significant. | Modest adverse effects including genital mycotic infections, osmotic diuresis, polyuria and reduced intravascular volume (e.g. dizziness), and hypoglycemia |
<table>
<thead>
<tr>
<th>Study Features</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
</table>
| **First author:** Benito, 2015  
**Country:** Madrid, Spain  
**Population:** Overweight and obese adults (50% female)  
**Total participants:** N=120  
**Setting:** Not specified  
**Follow-up duration:** 22 weeks  
**Inclusion criteria:** No history of important concomitant illness; non-smokers  
**Exclusion criteria:** Taking medication; physical and psychological diseases | **Intervention:** Exercise + Diet  
- **Tx A:** Strength training, 3x/week using a circuit (N=30)  
- **Tx B:** Endurance training, running, cycling or optional activities 3x/week (N=30)  
- **Tx C:** Strength + endurance training 3x/week (N=30)  
- **Control:** General physical activity recommendations (N=30)  
All groups were placed on a hypocaloric diet | - All forms of exercise resulted in statistically and clinically significant weight loss, but there were no significant differences between groups | None reported |
| **First author:** Berkowitz, 2011  
**Country:** USA  
**Population:** Overweight and obese adolescents (mean age: 15, 81% female)  
**Total Participants:** N=113  
**Setting:** Not specified  
**Follow-up duration:** 4 and 12 months  
**Inclusion criteria:** BMI 28–50kg/m²  
**Exclusion criteria:** Physical or medical disorders; pre-study weight loss; smokers | **Intervention:** Pharmacological  
- **Tx:** Meal replacement SlimFast shake consumed 3x/day (N=71)  
- **Control:** Conventional diet of 1,300–1,500kcal/day (N=42)  
- **Tx was effective for short- but not long-term weight loss**  
- **Tx produced statistically and clinically significant reductions in BMI after 4 but not 12 months compared to the control group** | None reported |
| **First author:** Bishop-Gilyard, 2011  
**Country:** USA  
**Population:** Overweight and obese adolescents (mean age: 14.1, 67% females)  
**Total Participants:** N=82  
**Setting:** Not specified  
**Follow-up duration:** 1, 6 and 12 months  
**Inclusion criteria:** See population  
**Exclusion criteria:** Psychiatric disorders; patients with high blood pressure; patients on anti depressant medication | **Intervention:** Behavioural + pharmacological  
- **Tx = Sibutramine 15mg/day + behavioural counselling (N=43)**  
- **Control:** Placebo pill + behavioural counselling (N=39)  
- **Participants receiving Tx had significantly greater reductions in BMI at 12 months compared to the control group**  
- **There was no significant difference in weight loss between participants identified with BED and participants identified without BED**  
- **Both groups had statistically and clinically significant reductions in binge eating symptoms but there were no differences between the treatment and control group** | None reported |
| **First author:** Blomquist, 2011  
**Country:** USA  
**Population:** Obese adults (mean age: 47, 88% female)  
**Setting:** Not specified  
**Total Participants:** N=82  
**Follow-up duration:** Post-treatment (12 weeks) and 3 months after treatment ended  
**Inclusion criteria:** BED diagnosis  
**Exclusion criteria:** Patients receiving treatment for eating or weight-related illnesses; patients with medical conditions that effect weight; pregnancy; severe psychiatric conditions | **Intervention:** Behavioural + pharmacological  
- **Tx:** Orlistat 120mg, 3 x day + 12 weeks of CBT (N=25)  
- **Control:** Placebo pill, 3 x a day + 12 weeks of CBT (N=25)  
- **Tx significantly reduced binge eating symptoms compared to the placebo at 12 weeks, but not at the 3 month follow up**  
- **The combination of CBT + orlistat was more effective for reducing weight compared to CBT alone (control group)** | Adverse effects included gastrointestinal symptoms were experienced by some participants in the treatment group |
<table>
<thead>
<tr>
<th>Study Features</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
</table>
| First author: Brennan, 2013 | **Intervention:** Behavioural  
- **Tx:** CBT Choose Health Program that includes motivational interviewing and diet and exercise advice (N=34)  
- **Control:** No treatment (N=29) | • The Tx group had significantly greater weight loss than the control group, but the size of this effect was small (partly the result of poor compliance rates in the treatment group) | None reported |
| Country: Australia  
Population: Overweight and obese adolescents (mean age: 14.3, 82% female)  
Total Participants: N= 63  
Setting: RMIT University, Melbourne and RMIT University, Bundoora campus  
Follow-up duration: 6 months  
Inclusion criteria: See population  
Exclusion criteria: Disability or illness that prevented participation | | | |
| First author: Burke, 2011 | **Intervention:** Behavioural + technology  
- **Tx A:** Personal Digital Assistant - no feedback (N=68)  
- **Tx B:** PDA with feedback (N=70)  
- **Control:** Paper record (N=72) | • Weight was significantly reduced in all groups at 6 months, but there were no significant differences between groups | None reported |
| Country: USA  
Population: Overweight and obese adults (mean age: 47, 85% female)  
Total Participants: N= 210  
Setting: Not specified  
Follow-up duration: 6 months  
Inclusion criteria: BMI 27-43kg/m²  
Exclusion criteria: Recent participation in weight loss program; medical conditions requiring diet + exercise treatment | | | |
| First author: Cakmakci, 2011 | **Intervention:** Exercise  
- **Tx:** Pilates sessions of 1 hour in duration 4x/week (N=34)  
- **Control:** No treatment (N=27) | • There were no significant differences between Tx and control groups | None reported |
| Country: Turkey  
Population: Obese women (mean age: 36)  
Total Participants: N= 63  
Setting: KOMEK (Vocational Training Course)  
Follow-up duration: 8 weeks  
Inclusion criteria: Not reported  
Exclusion criteria: Not reported | | | |
| First author: Carraca, 2012 | **Intervention:** Behavioural  
- **Tx:** Weight management intervention that included an exercise component (N=114)  
- **Control:** General health education (N=111) | • The weight management intervention, which included the promotion of regular exercise, resulted in statistically and clinically greater weight loss compared to the control group  
• Both groups reported statistically significant improvements in body image, but there was no significant differences between groups | None reported |
| Country: Portugal  
Population: Overweight and obese women (mean age: 38)  
Total Participants: N= 225  
Setting: Not specified  
Follow-up duration: 24 months  
Inclusion criteria: Female; BMI 25 – 40kg/m² ; premenopausal  
Exclusion criteria: Major illness; taking medication that effects weight | | | |
| First author: Cayir, 2015 | **Intervention** Technology  
- **Tx:** Pedometer + low calorie diet + exercise prescription (N=50)  
- **Control:** No pedometer + low calorie diet + exercise prescription (N=50) | • The Tx group lost a statistically and clinically greater amount of weight compared to controls | None reported |
| Country: Turkey  
Population: Obese women (mean age: 40)  
Total Participants: N=100  
Setting: Not reported  
Follow-up duration: 3 months  
Inclusion criteria: See population  
Exclusion criteria: Comorbidities; medication for weight loss | | | |
| **First author: Cesa, 2011** | **Country:** Italy  
**Population:** Adult women (mean age: 32)  
**Total Participants:** N=90  
**Setting:** Outpatient and inpatient  
**Follow-up duration:** 1 year  
**Inclusion criteria:** BED diagnosis for 6 months prior to study  
**Exclusion criteria:** Comorbidity of severe psychiatric disorders; other treatment for BED including medication; medical condition unrelated to disorder  
| **Intervention:** Behavioural  
- **TX A:** Enhanced CBT including virtual reality protocol (N=31)  
- **TX B:** Standard CBT (N=30)  
- **Control:** Inpatient treatment (N=29)  
| **Summary of outcomes:** Weight was reduced in all treatment groups, but there was no difference between groups  
| **Adverse effects:** None reported |

| **First author: Chambliss, 2011** | **Country:** USA  
**Population:** Overweight adults (mean age: 45, 83% female)  
**Total Participants:** N=120  
**Setting:** Not specified  
**Follow-up duration:** 12 weeks  
**Inclusion criteria:** Computer + email access; BMI 25-35kg/m²  
**Exclusion criteria:** Participation in another weight loss program; major health problems  
| **Intervention:** Behavioural + technology  
- **TX A:** Computerised self-monitoring with basic feedback. Participants recorded their daily food intake and exercise in a program and received generic feedback (N=45)  
- **TX B:** Computerised self-monitoring with enhanced behavioural feedback. Participants recorded their daily food intake and exercise in a program and received feedback that was individually tailored (N=45)  
- **Control:** No treatment waitlist (N=30)  
| **Summary of outcomes:** Both Tx groups had significantly greater weight loss after 12 weeks than controls  
| **Adverse effects:** None reported |

| **First author: Christen, 2011** | **Country:** Denmark  
**Population:** Female overweight health care workers (mean age: 46)  
**Total Participants:** N=98  
**Setting:** Health care workplace  
**Follow-up duration:** 3 months  
**Inclusion criteria:** Employees working minimum of 15hrs/week; BMI 25+  
**Exclusion criteria:** Not specified  
| **Intervention:** (FINALE) lifestyle program: diet + behavioural + exercise  
- **TX:** Calorie restricted diet plan + strengthening exercise + CBT (N=54)  
- **Control:** Monthly oral lecture (N=44)  
| **Summary of outcomes:** Participants in the Tx group had statistically and clinically significant reductions in weight, fat and waist circumference compared with controls  
| **Adverse effects:** None reported |

| **First author: Danilenka, 2013** | **Country:** Russia  
**Population:** Overweight adult women (mean age: 37)  
**Total Participants:** N=39  
**Setting:** Not specified  
**Follow-up duration:** 3 and 10 weeks  
**Inclusion criteria:** 20–54 yrs; BMI 25–30kg/m²; stable medication (if suffering from chronic disease)  
**Exclusion criteria:** Attempt to lose weight 3 months prior; acute illness 2 months prior; previous use of light therapy  
| **Intervention:** Other  
- **TX:** 3 weeks of daily bright light treatment using a device of light-emitting diodes (N=not specified)  
- **Control:** Identical placebo: imitation light-emitting device using a deactivated ion generator for 3 weeks (N=not specified)  
| **Summary of outcomes:** There was no significant difference in weight loss between participants in the Tx group and those in the control group  
<p>| <strong>Adverse effects:</strong> None reported |</p>
<table>
<thead>
<tr>
<th>Study Features</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First author:</strong> DeBar, 2012</td>
<td><strong>Intervention:</strong> Lifestyle: diet + behavioural + exercise</td>
<td>▪ Participants receiving Tx had significantly greater reductions in BMI than controls (small effect size)</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td>▪ <strong>Tx:</strong> Multi-component lifestyle intervention which includes dietary advice (restricted calories), the promotion of regular exercise and counselling (N=105)</td>
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<tr>
<td><strong>Population:</strong> Adolescent females (mean age: 14)</td>
<td>▪ <strong>Control:</strong> Usual primary care (N=103)</td>
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<tr>
<td><strong>Total Participants:</strong> N=208</td>
<td>▪ Psychological outcomes (improved body satisfaction and decreased internalisation of female norms) were significantly greater in the Tx than controls</td>
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<tr>
<td><strong>Setting:</strong> Primary care</td>
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<tr>
<td><strong>Follow-up duration:</strong> 6 and 12 months</td>
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<tr>
<td><strong>Inclusion criteria:</strong> BMI in 90th percentile or above</td>
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<tr>
<td><strong>Exclusion criteria:</strong> Significant cognitive impairment; severe obesity; medications that effect weight; pregnancy</td>
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<tr>
<td><strong>First author:</strong> DeFina, 2011</td>
<td><strong>Intervention:</strong> Pharmacological</td>
<td></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td>▪ <strong>Tx:</strong> Omega-3 supplements + calorie controlled diet + an exercise prescription (N=64)</td>
<td>▪ When combined with a calorie controlled diet and exercise prescription Omega-3 supplements were not found to be any more effective for reducing weight compared to the placebo group.</td>
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</tr>
<tr>
<td><strong>Population:</strong> Overweight and obese adults(68% female)</td>
<td>▪ <strong>Control:</strong> Placebo pill + calorie controlled diet + an exercise prescription (N=64)</td>
<td>▪ All participants lost more than 5% of their body weight however this effect was attributed to the calorie controlled and exercise promotion element of the study</td>
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<tr>
<td><strong>Total Participants:</strong> N= 128</td>
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<tr>
<td><strong>Setting:</strong> Not specified</td>
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<tr>
<td><strong>Follow-up duration:</strong> 6 months</td>
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<tr>
<td><strong>Inclusion criteria:</strong> BMI 26 – 40kg/m²; sedentary</td>
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<tr>
<td><strong>Exclusion criteria:</strong> Severe comorbidity; weight loss medication; oral contraceptive</td>
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<tr>
<td><strong>First author:</strong> Donnelly, 2013</td>
<td><strong>Intervention:</strong> Exercise</td>
<td></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td>▪ <strong>Tx A:</strong> Male aerobic exercise burning 400kcal/session, 5 days a week for 10 months (N=18)</td>
<td>▪ All forms of aerobic exercise resulted in statistically significant reductions in weight and body fat compared to the control groups, with no significant difference between groups</td>
<td></td>
</tr>
<tr>
<td><strong>Population:</strong> Overweight and obese adults (mean age: 23, 50% female)</td>
<td>▪ <strong>Tx B:</strong> Female aerobic exercise burning 400kcal/session, 5 days a week for 10 months (N=19)</td>
<td>▪ There was no significant difference between males and females</td>
<td></td>
</tr>
<tr>
<td><strong>Total Participants:</strong> N=141</td>
<td>▪ <strong>Tx C:</strong> Male aerobic exercise burning 600kcal/session, 5 days a week for 10 months (N=19)</td>
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<tr>
<td><strong>Setting:</strong> Not specified</td>
<td>▪ <strong>Tx D:</strong> Female aerobic exercise burning 600kcal/session (N= 18)</td>
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<tr>
<td><strong>Follow-up duration:</strong> 10 months</td>
<td>▪ <strong>Control A:</strong> Male no exercise, 5 days a week for 10 months (N=9)</td>
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<tr>
<td><strong>Inclusion criteria:</strong> Sedentary adults</td>
<td>▪ <strong>Control B:</strong> Female no exercise (N=9)</td>
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<tr>
<td><strong>Exclusion criteria:</strong> History of chronic disease; smoking; medication effecting exercise performance; planned physical activity</td>
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<tr>
<td><strong>First author:</strong> Forman, 2013</td>
<td><strong>Intervention:</strong> Behavioural</td>
<td></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td>▪ <strong>Tx:</strong> Acceptance-based behavioural Tx weekly for 40 weeks (N=48)</td>
<td>▪ Both groups had significant improvements in weight and quality of life post Tx and at 6 months, with no significant differences between groups</td>
<td></td>
</tr>
<tr>
<td><strong>Population:</strong> Overweight and obese adults (mean age: 46)</td>
<td>▪ <strong>Control:</strong> Standard behavioural Tx, weekly for 40 weeks (N=54)</td>
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<td></td>
</tr>
<tr>
<td><strong>Total Participants:</strong> N= 128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Setting:</strong> Not specified</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Follow-up duration:</strong> Post Tx (40 weeks) and 6 months</td>
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</tr>
<tr>
<td><strong>Inclusion criteria:</strong> BMI 27 – 40kg/m²</td>
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<td><strong>Exclusion criteria:</strong> Significant medical or psychiatric conditions; pregnancy or planned pregnancy; medication that effects weight</td>
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<td>Study Features</td>
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<td><strong>First author:</strong> Foster, 2012  &lt;br&gt; <strong>Country:</strong> USA  &lt;br&gt; <strong>Population:</strong> Overweight and obese adults (mean age: 47, 91% female)  &lt;br&gt; <strong>Total Participants:</strong> N=123  &lt;br&gt; <strong>Setting:</strong> Hospital outpatient  &lt;br&gt; <strong>Follow-up duration:</strong> 6 and 18 months</td>
<td><strong>Intervention:</strong> Diet + behavioural  &lt;br&gt; <strong>Tx:</strong> Hypocaloric almond-enriched diet + behavioural methods of weight control (N=61)  &lt;br&gt; <strong>Control:</strong> Hypocaloric nut free diet + behavioural methods of weight control (N=62)</td>
<td>When combined with behavioural methods of weight control, participants consuming the almond-enriched diet had significantly greater weight loss than to controls (small effect size), however, there was no effect at 18 months</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>First author:</strong> Gadde, 2011  &lt;br&gt; <strong>Country:</strong> USA  &lt;br&gt; <strong>Population:</strong> Obese adults (mean age: 43, 60% female)  &lt;br&gt; <strong>Total Participants:</strong> N=225  &lt;br&gt; <strong>Setting:</strong> Not specified  &lt;br&gt; <strong>Follow-up duration:</strong> 12 months</td>
<td><strong>Intervention:</strong> Behavioural + pharmacological  &lt;br&gt; <strong>Tx A:</strong> 200mg zonisamide/day + diet and lifestyle counselling (N=76)  &lt;br&gt; <strong>Tx B:</strong> 400mg zonisamide/day + diet and lifestyle counselling (N=75)  &lt;br&gt; <strong>Control:</strong> Placebo pill + diet and lifestyle counselling (N=74)</td>
<td>At 12 months participants receiving Tx B had statistically and clinically greater weight loss than those in Tx A or control groups  &lt;br&gt; There were no significant differences in the 12 month weight loss between Tx A and control</td>
<td>Gastrointestinal issues; nervous system problems; adverse psychiatric effects including memory impairment, heightened anxiety and depression associated with both treatment groups</td>
</tr>
<tr>
<td><strong>First author:</strong> Georg, 2012  &lt;br&gt; <strong>Country:</strong> Denmark  &lt;br&gt; <strong>Population:</strong> Obese adults  &lt;br&gt; <strong>Total Participants:</strong> N=96  &lt;br&gt; <strong>Setting:</strong> Not specified  &lt;br&gt; <strong>Follow-up duration:</strong> 12 weeks</td>
<td><strong>Intervention:</strong> Diet + pharmacological  &lt;br&gt; <strong>Tx:</strong> Alginate supplement + calorie restricted diet (N=48)  &lt;br&gt; <strong>Control:</strong> Placebo supplement + calorie restricted diet (N=48)</td>
<td>All forms of aerobic exercise resulted in statistically significant reductions in weight and body fat compared to the control groups, with no significant difference between groups or between males and females</td>
<td>Gastrointestinal symptoms</td>
</tr>
<tr>
<td><strong>First author:</strong> Goldfield, 2013  &lt;br&gt; <strong>Country:</strong> USA  &lt;br&gt; <strong>Population:</strong> Overweight or obese adolescents (54% female)  &lt;br&gt; <strong>Total Participants:</strong> N=30  &lt;br&gt; <strong>Setting:</strong> Laboratory  &lt;br&gt; <strong>Follow-up duration:</strong> 10 weeks</td>
<td><strong>Intervention:</strong> Exercise  &lt;br&gt; <strong>Tx:</strong> Cycling as part of a video game twice a week, 2x60 minute sessions per week for 10 weeks (N=15)  &lt;br&gt; <strong>Control:</strong> Cycling to music twice a week, 2x60 minute sessions per week for 10 weeks (N=15)</td>
<td>No statistical difference was found within or between the impact of cycling to music and cycling as part of a video game in terms of weight loss or body composition  &lt;br&gt; However, across both groups cycling was found to improve social competence, and body image</td>
<td>None reported</td>
</tr>
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<td><strong>First author:</strong> Gorin, 2013  &lt;br&gt; <strong>Country:</strong> USA  &lt;br&gt; <strong>Population:</strong> Overweight and obese adults (mean age: 49, 78% female)  &lt;br&gt; <strong>Total Participants:</strong> N=201  &lt;br&gt; <strong>Setting:</strong> Clinic and home  &lt;br&gt; <strong>Follow-up duration:</strong> 6 and 18 months</td>
<td><strong>Intervention:</strong> Diet + behavioural  &lt;br&gt; <strong>Tx:</strong> Standard behavioural weight loss + calorie and fat restricted diet + changes to home environment (N=102)  &lt;br&gt; <strong>Control:</strong> Standard behavioural weight loss + calorie and fat restricted diet (N=99)</td>
<td>When combined with a calorie and fast restricted diet, Tx resulted in a statistically greater weight loss at 6 month, but not 18 months, compared to the control group  &lt;br&gt; This effect was only observed in women; there was no treatment effect for men</td>
<td>Gastrointestinal symptoms</td>
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<td>Study Features</td>
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| First author: Griffin, 2013 | **Intervention:** Diet  
• Tx: High protein (N=36)  
• Control: High carbohydrate diet (N=35) | • Tx resulted in statistically and clinically significant weight loss and % of fat loss compared to controls at 6 months but not at 12 months | None reported |
| Country: Australia | Population: Overweight young women | Total Participants: N=71 | Setting: Not specified | Follow-up duration: 6 and 12 months |
| First author: Grilo, 2011 | **Intervention:** Behavioural  
• Tx A: CBT (N=45)  
• Tx B: Behavioural weight loss therapy (N=45)  
• Tx C: CBT + BWL (N=35)  
• All treatments were administered via 16 x 60 minute sessions over 24 weeks | • All behavioural treatments resulted in clinically significant BED remission but there were no statistical differences between the remission rates of the 3 types of treatments  
• Tx A resulted in statistically and clinically significant reductions in occurrences of binge eating compared to Tx B  
• Tx B and C resulted in statistically greater weight loss than CBT alone at 6 months but there was no statistical difference in weight loss among the 3 treatment groups at 12 months | None reported |
| Country: USA | Population: Obese adults with BED (mean age: 45) | Total Participants: N=125 | Setting: Not specified | Follow-up duration: 6 and 12 months |
| First author: Grilo, 2012 | **Intervention:** Behavioural + pharmacological  
• Tx A: Fluoxetine alone (N=27)  
• Tx B: Fluoxetine + CBT (N=26)  
• Control: CBT + placebo (N=28) | • At 6 months both groups receiving CBT (Tx B and control) had statistically and clinically higher rates of BED symptom remission compared to Tx A, but there was no significant difference between these groups  
• At 12 months BED symptom remission rates differed significantly for all groups; 4% of participants receiving Tx A were assessed as being in remission, compared to 27% for Tx B, and 36% of participants in the control group  
• None of the treatments were effective for inducing significant weight loss | None reported |
| Country: USA | Population: Overweight and obese adults with BED (mean age: 44, 75% female) | Total Participants: N=81 | Setting: Not specified | Follow-up duration: 6 and 12 months |
| First author: Grilo, 2013 | **Intervention:** Behavioural + pharmacological  
• Tx A: BED receiving Orlistat + behavioural weight loss (BWL) (N=20)  
• Tx B: Non BED receiving Orlistat + BWL (N=20)  
• Control A: BED receiving BWL + placebo (N=20)  
• Control B: Non BED receiving Orlistat + placebo (N=19) | • Overall, adding Orlistat to BWL did not impact on psychological outcomes compared with controls  
• However the addition of Orlistat to BWL resulted in significantly greater weight loss in obese patients without BED (but not with BED) | Minor gastrointestinal events including flatulence and fatty/oily stools |
| Country: USA | Population: Obese Spanish-speaking Latino adults with and without BED from economically disadvantaged backgrounds (82% female) | Total Participants: N=79 | Setting: Not specified | Follow-up duration: 6 months |
| First author: | **Intervention:** Behavioural + pharmacological  
• Tx A: BED receiving Orlistat + behavioural weight loss (BWL) (N=20)  
• Tx B: Non BED receiving Orlistat + BWL (N=20)  
• Control A: BED receiving BWL + placebo (N=20)  
• Control B: Non BED receiving Orlistat + placebo (N=19) | • Overall, adding Orlistat to BWL did not impact on psychological outcomes compared with controls  
• However the addition of Orlistat to BWL resulted in significantly greater weight loss in obese patients without BED (but not with BED) | Minor gastrointestinal events including flatulence and fatty/oily stools |
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<tr>
<th>Study author</th>
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<th>Population</th>
<th>Setting</th>
<th>Follow-up duration</th>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
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<tbody>
<tr>
<td>First author: Grilo, 2013</td>
<td>USA</td>
<td>Obese adults with BED (mean age: 44, 70% female)</td>
<td>Primary care</td>
<td>4 months</td>
<td>See population</td>
<td>BMI 50+; current use of medication or weight loss treatment; severe medical problems</td>
<td>Behavioural</td>
<td>Participants in both groups had significant reductions in episodes of binge eating, eating disorder psychopathology and depressive symptoms, although there were no differences between groups</td>
<td>None reported</td>
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<tr>
<td>First author: Grilo, 2014</td>
<td>USA</td>
<td>Obese adults with BED (mean age: 44, 70% female)</td>
<td>Primary care</td>
<td>Not reported</td>
<td>See population</td>
<td>BMI 40+; not able to eat fish; gastrointestinal disorders; food allergy/intolerance; weight instability 3 months prior; drug consumption; fish oil; medication affecting weight; severe medical or psychiatric problems</td>
<td>Behavioural + pharmacological</td>
<td>There were no significant group differences in BED remission rates at 6 or 12 months</td>
<td>None reported</td>
</tr>
<tr>
<td>First author: Grube, 2013</td>
<td>Germany</td>
<td>Overweight and obese adults (mean age: 45)</td>
<td>Not reported</td>
<td>12 weeks</td>
<td>History of an eating disorder; gastrointestinal issues; medication affecting gastrointestinal function; medical problems; pregnant/lactating</td>
<td>Diet + exercise + pharmacological</td>
<td>When combined with advice on a calorie restricted diet and exercise prescription, Litramine supplement was statistically and clinically effective for weight loss, BMI reduction, reduction in body fat and waist circumference compared to a placebo combined with advice on a calorie restricted diet and exercise prescription</td>
<td>None reported</td>
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<tr>
<td>First author: Harden, 2014</td>
<td>U.K.</td>
<td>Overweight and obese women (mean age: 45)</td>
<td>Not specified</td>
<td>12 weeks</td>
<td>See population</td>
<td>Pharmacological</td>
<td>Both treatments resulted in significant weight loss with no significant differences between groups</td>
<td>None reported</td>
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<td>First author: Hedberg, 2012</td>
<td>Sweden</td>
<td>Morbidly obese adults (mean age: 40, 53% male)</td>
<td>Hospital</td>
<td>4 years post-operation</td>
<td>Not reported</td>
<td>Surgery</td>
<td>Both surgeries resulted in statistically and clinically significant reduction in BMI at 4 years</td>
<td>Gastrointestinal issues (diarrhea and flatulence), reoperation (for 3 participants)</td>
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<tr>
<td>Study author</td>
<td>Interventions</td>
<td>Summary of outcomes</td>
<td>Adverse effects</td>
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</table>
| First author: Grilo, 2013 | **Intervention**: Behavioural  
• *Tx*: Self help CBT over 16 weeks (N=24)  
• *Control*: Usual care over 16 weeks (N=24) | • Participants in both groups had significant reductions in episodes of binge eating, eating disorder psychopathology and depressive symptoms, although there were no differences between groups  
• There was no significant reduction in BMI for either group | None reported |
| First author: Grilo, 2014 | **Intervention**: Behavioural + pharmacological  
• *Tx A*: Self help CBT for 4 months (N=27)  
• *Tx B*: Sibutramine 15mg/day for 4 months (N=26)  
• *Tx C*: CBT + sibutramine 15mg/day for 4 months (N=26)  
• *Control*: CBT + placebo for 4 months (N=25) | • There were no significant group differences in BED remission rates at 6 or 12 months  
• Individuals receiving *Tx B* had significantly greater weight loss than controls at 4 but not at 6 or 12 months  
• All groups displayed decreased symptoms of depression over the course of the study, but there were no significant differences between these groups | None reported |
| First author: Grube, 2013 | **Intervention**: Diet + exercise + pharmacological  
• *Tx A*: Docosahexaenoic acid (N=not reported)  
• *Tx B*: Oleic Acid (N=not reported) | • When combined with advice on a calorie restricted diet and exercise prescription, Litramine supplement was statistically and clinically effective for weight loss, BMI reduction, reduction in body fat and waist circumference compared to a placebo combined with advice on a calorie restricted diet and exercise prescription | None reported |
| First author: Harden, 2014 | **Intervention**: Pharmacological  
• *Tx A*: Duodenal switch (N=24)  
• *Control*: Roux-en-Y gastric bypass (N=23) | • Both surgeries resulted in statistically and clinically significant reduction in BMI at 4 years  
• The difference in weight loss between these groups was statistically significant | None reported |
| First author: Hedberg, 2012 | **Intervention**: Surgery  
• *Tx*: Duodenal switch (N=24)  
• *Control*: Roux-en-Y gastric bypass (N=23) | • Both surgeries resulted in statistically and clinically significant reduction in BMI at 4 years  
• The difference in weight loss between these groups was statistically significant | Gastrointestinal issues (diarrhoea and flatulence), reoperation (for 3 participants) |
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<tr>
<td>First author: Grilo, 2013</td>
<td>Intervention: Behavioural</td>
<td>• Participants in both groups had significant reductions in episodes of binge eating, eating disorder psychopathology and depressive symptoms, although there were no differences between groups</td>
<td>None reported</td>
</tr>
<tr>
<td>Country: USA</td>
<td>Tx: Self help CBT over 16 weeks (N=24)</td>
<td>• There were no significant group differences in BED remission rates at 6 or 12 months</td>
<td>None reported</td>
</tr>
<tr>
<td>Population: Obese adults with BED, mean age (46, 79% female)</td>
<td>Control: Usual care over 16 weeks (N=24)</td>
<td>• Individuals receiving Tx B had significantly greater weight loss than controls at 4 but not at 6 or 12 months</td>
<td>None reported</td>
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<td>Total Participants: N= 48</td>
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<td>• Depression symptoms decreased for all groups, but there were no significant differences between these groups</td>
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<td>Setting: Primary care</td>
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<td>Follow-up duration: 4 months</td>
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<td>Exclusion criteria: See population</td>
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<td>Inclusion criteria: See population</td>
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| First author: Grilo, 2014 | Intervention: Behavioural + pharmacological | | |
| Country: USA | Tx A: Self help CBT for 4 months (N=27) | | None reported |
| Population: Obese adults with BED, mean age: 44, 70% female | Tx B: Sibutramine 15mg/day for 4 months (N=26) | | |
| Total Participants: N=104 | Tx C: CBT + sibutramine 15mg/day for 4 months (N=26) | | |
| Setting: Primary care | Control: CBT + placebo for 4 months (N=25) | | |
| Follow-up duration: Post treatment (4 months), 6 and 12 months | | | |
| Exclusion criteria: See population | | | |
| Inclusion criteria: See population | | | |

| First author: Grube, 2013 | Intervention: Diet + exercise + pharmacological | | None reported |
| Country: Germany | Tx: Litramine supplement + advice on calorie restricted diet plan + exercise advice (N=62) | | |
| Population: Overweight and obese adults (mean age: 45) | Control: Placebo pill + advice on calorie restricted diet plan + exercise advice (N=63) | | |
| Total Participants: N=125 | | | |
| Setting: Not reported | | | |
| Follow-up duration: 12 weeks | | | |
| Exclusion criteria: History of an eating disorder; gastrointestinal issues; medication effecting GI function; medical problems; pregnant/lactating | | | |

| First author: Harden, 2014 | Intervention: Pharmacological | | None reported |
| Country: U.K. | Tx A: Docosahexaenoic supplement (N=not reported) | | |
| Population: Overweight and obese women (mean age: 45) | Tx B: Oleic Acid (N=not reported) | | |
| Total Participants: N=40 | | | |
| Setting: Not specified | | | |
| Follow-up duration: 12 weeks | | | |
| Exclusion criteria: See population | | | |
| Inclusion criteria: BMI 25 - 35kg/m² | | | |

| First author: Hedberg, 2012 | Intervention: Surgery | | |
| Country: Sweden | Tx: Duodenal switch (N=24) | | |
| Total Participants: N= 47 | | | |
| Setting: Hospital | | | |
| Follow-up duration: 4 years post-operation | | | |
| Inclusion criteria: BMI 48+ | | | |
| Exclusion criteria: Not reported | | | |

<p>| Study Features | Adverse effects | | |
|----------------|---------------|----------------|
| None reported | | | |
| None reported | | | |
| None reported | | | |
| Gastrointestinal issues (diarrhoea and flatulence), reoperation (for 3 participants) | | | |</p>
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<td><strong>First author: Hofsteeng, 2013</strong>&lt;br&gt;<strong>Country:</strong> Amsterdam, Netherlands&lt;br&gt;<strong>Population:</strong> Obese adolescents (mean age: 15, 62% female)&lt;br&gt;<strong>Total Participants:</strong> N= 122&lt;br&gt;<strong>Setting:</strong> Outpatient university clinic&lt;br&gt;<strong>Follow-up duration:</strong> 6 months&lt;br&gt;<strong>Inclusion criteria:</strong> See population&lt;br&gt;<strong>Exclusion criteria:</strong> Non-Dutch speaking; diabetes; physical or mental disability</td>
<td><strong>Intervention:</strong> Behavioural&lt;br&gt;• <strong>Tx:</strong> Go4it lifestyle intervention that includes dietary and exercise advice (N=71)&lt;br&gt;• <strong>Control:</strong> Usual care (N= 51)</td>
<td>• There were small but statistically significant benefits from Tx compared to control, including improvements in physical health and QOL</td>
<td>None reported</td>
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<td><strong>First author: Hofsteeng, 2014</strong>&lt;br&gt;<strong>Country:</strong> Amsterdam, Sweden&lt;br&gt;<strong>Population:</strong> Obese adolescents (mean age: 15, 62% female)&lt;br&gt;<strong>Total Participants:</strong> N = 122&lt;br&gt;<strong>Setting:</strong> Outpatient&lt;br&gt;<strong>Follow-up duration:</strong> 18 months&lt;br&gt;<strong>Inclusion criteria:</strong> See population&lt;br&gt;<strong>Exclusion criteria:</strong> Non-Dutch speaking; diabetes; physical or mental disability</td>
<td><strong>Intervention:</strong> Behavioural&lt;br&gt;• <strong>Tx:</strong> Go4it lifestyle intervention that includes dietary and exercise advice (N=71)&lt;br&gt;• <strong>Control:</strong> Usual care (N= 51)</td>
<td>• Tx led to a modest reduction in BMI compared with controls&lt;br&gt;• These reductions were greater for non-Western participants</td>
<td>None reported</td>
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<td><strong>First author: Hsieh, 2011</strong>&lt;br&gt;<strong>Country:</strong> North Taiwan&lt;br&gt;<strong>Population:</strong> Overweight Asian young adults (91% female)&lt;br&gt;<strong>Total Participants:</strong> N= 55&lt;br&gt;<strong>Setting:</strong> Not reported&lt;br&gt;<strong>Follow-up duration:</strong> 8 weeks&lt;br&gt;<strong>Inclusion criteria:</strong> Waist circumference &gt; 80cm (for females); &gt;90cm (for males)&lt;br&gt;<strong>Exclusion criteria:</strong> Not specified</td>
<td><strong>Intervention:</strong> Other&lt;br&gt;• <strong>Tx:</strong> Acupressure with Japanese Magnetic Pearl (N=27)&lt;br&gt;• <strong>Control:</strong> Placebo (N=28)</td>
<td>•Tx resulted in statistically and clinically significant reduction in weight and waist circumference compared the control group</td>
<td>None reported</td>
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<td><strong>First author: Huerta, 2015</strong>&lt;br&gt;<strong>Country:</strong> Spain&lt;br&gt;<strong>Population:</strong> Overweight and obese women&lt;br&gt;<strong>Setting:</strong> Not reported&lt;br&gt;<strong>Total Participants:</strong> N= 97&lt;br&gt;<strong>Follow-up duration:</strong> 10 weeks&lt;br&gt;<strong>Inclusion criteria:</strong> Regular menstrual cycle; unchanged weight for previous 3 months&lt;br&gt;<strong>Exclusion criteria:</strong> Significant or chronic physical or mental health problems</td>
<td><strong>Intervention:</strong> Pharmacological + diet&lt;br&gt;• <strong>Tx A:</strong> Eicosapentaenoic acid + energy restricted diet (N=20)&lt;br&gt;• <strong>Tx B:</strong> Alpha-lipoic acid + energy restricted diet (N=26)&lt;br&gt;• <strong>Tx C:</strong> Eicosapentaenoic acid + Alpha-lipoic acid + energy restricted diet (N=26)&lt;br&gt;• <strong>Control:</strong> Placebo + energy restricted diet (N=31)</td>
<td>• All groups had a significant reduction in weight, waist and hip circumference, and waist to hip ratio&lt;br&gt;• Tx B and Tx C produced in statistically and clinically significant reductions in weight and waist and hip circumference compared to Tx and control</td>
<td>None reported</td>
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<td><strong>First author: Hunt, 2014</strong>&lt;br&gt;<strong>Country:</strong> U.K.&lt;br&gt;<strong>Population:</strong> Overweight or obese men (mean age: 47, 98% Caucasian)&lt;br&gt;<strong>Total Participants:</strong> N=747&lt;br&gt;<strong>Setting:</strong> Not specified&lt;br&gt;<strong>Follow-up duration:</strong> 12 months&lt;br&gt;<strong>Inclusion criteria:</strong> See population&lt;br&gt;<strong>Exclusion criteria:</strong> Had previously completed FFF-IT; high blood pressure</td>
<td><strong>Intervention:</strong> Lifestyle&lt;br&gt;• <strong>Tx:</strong> Weight loss program which included dietary and exercise advice (N=374)&lt;br&gt;• <strong>Control:</strong> Wait list (N=374)</td>
<td>• Tx resulted in statistically greater reduction in weight, waist circumference and percentage of body fat compared to the WL group&lt;br&gt;• The clinical significance of these changes are moderate</td>
<td>Gall bladder removal (1 participant); rupture of Achilles tendon (1 participant)</td>
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</table>
| First author: Jakicic, 2012  
Country: USA  
Population: Overweight and obese adults (mean age: 43, 83% female)  
Total Participants: N=363  
Setting: Not reported  
Follow-up duration: 18 months  
Inclusion criteria: See population  
Exclusion criteria: medical conditions effecting exercise and dietary change; cardiovascular disease; medication effecting weight; exercise of 20mins +/day | Intervention: Behavioural + diet  
· Tx: Stepped-care weight loss intervention that included a low calorie diet and weekly to monthly counselling sessions (N=198)  
· Control: Standard behavioural weight loss (N=165) | · Participants in both significant amounts of weight by 18-month follow-up | None reported |
| First author: Johnston, 2013  
Country: Australia  
Population: Overweight and obese adults (mean age: 47, 90% female)  
Total Participants: N=292  
Setting: Not reported  
Follow-up duration: 3 and 6 months  
Inclusion criteria: See population  
Exclusion criteria: Dieting or taking weight loss medication; severe medical illness or condition; thyroid problems; pregnancy | Intervention: Behavioural  
· Tx: Weight watchers programme which included a food and exercise plan, skills to change behaviour and access to group support (N=147)  
· Control: Self-help weight loss methods in which the participants received publicly available material explaining basic weight-loss concepts (N=145) | · Tx resulted in a statistically and clinically greater percentage of weight loss at 3 and 6 months compared controls  
· Participants in the Tx group who used all 3 components of the weight loss intervention (web access, WW app and who attended meetings) lost statistically and clinically greater amounts of weight compared to participants who accessed only one or two components of the program | None reported |
| First author: Jung, 2014  
Country: Korea  
Population: Overweight and obese adults  
Total Participants: N=54  
Setting: Not reported  
Follow-up duration: 10 weeks  
Inclusion criteria: See population  
Exclusion criteria: Significant medical illnesses or conditions; anti-obesity medication; weight loss program | Intervention: Pharmacological  
· Tx: Yeast hydrolysate supplement taken daily (N=27)  
· Control: Placebo pill (N=27) | · After 10 weeks the Tx group had statistically and clinically greater reductions in weight, body fat mass and abdominal fat mass than controls | None reported |
| First author: Keating, 2014  
Country: Australia  
Population: Overweight adults (mean age: 43; 82% female)  
Total Participants: N=38  
Setting: Not specified  
Follow-up duration: 12 weeks  
Inclusion criteria: BMI 25 – 29.9kg/m²  
Exclusion criteria: significant medical condition; lipid-lowering medication | Intervention: Exercise  
· Tx A: High intensity interval training for 20–24 minutes, 3x/week (N=13)  
· Tx B: Continuous aerobic exercise training for 36–48 minutes, 3x/week (N=13)  
· Control: Placebo exercise which included stretching, using a fit ball and self massage (N=12) | · There were no significant changes in body mass in any group  
· Tx B resulted in significant reductions in body fat | Fainting was reported by one participant in Tx B |
| First author: Kehagias, 2011  
Country: Greece  
Population: Morbidly obese adults (73% female)  
Total Participants: N=60  
Setting: Not reported  
Follow-up duration: 3 years  
Inclusion criteria: See population  
Exclusion criteria: Chronic medical or psychiatric illness; previous surgery | Intervention: Surgery  
· Tx A: Laparoscopic sleeve gastrectomy (N=30)  
· Tx B: Roux-en-Y Gastric bypass (N=30) | · Statistically and clinically significant weight loss was found as the result of both types of surgery  
· Tx A resulted in statistically greater weight loss after 2 years, but there was no difference between the surgeries at the 3 year follow up | Intestinal obstruction; ventral hernia; enterocutaneous fistula; acid regurgitation, heartburn, and vomiting; 1 reoperation; abdominal abscess |

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<tr>
<th>Study Features</th>
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<th>Adverse effects</th>
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</thead>
<tbody>
<tr>
<td><strong>First author:</strong> Keithley, 2013</td>
<td><strong>Intervention:</strong> Pharmacological</td>
<td>Neither treatment resulted in significant weight loss or improvements in body composition at 8 weeks</td>
<td>Belching, bloating and stomach fullness were more commonly present in the treatment group</td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td>• <strong>Tx:</strong> Glucomannan supplement (N=26)</td>
<td></td>
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</tr>
<tr>
<td><strong>Population:</strong> Overweight – moderately obese adults (mean age: 41, 83% female)</td>
<td>• <strong>Control:</strong> Placebo pill (N=27)</td>
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<tr>
<td><strong>Participants:</strong> N=53</td>
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<tr>
<td><strong>Setting:</strong> Not reported</td>
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<tr>
<td><strong>Follow-up duration:</strong> 8 weeks</td>
<td></td>
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<tr>
<td><strong>Inclusion criteria:</strong> BMI 25-35kg/m²</td>
<td></td>
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<tr>
<td><strong>Exclusion criteria:</strong> Currently using fibre supplements; unstable medical conditions that effect weight; gastrointestinal problems; medications that effect weight; psychiatric conditions</td>
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</tr>
<tr>
<td><strong>First author:</strong> Kelly, 2013</td>
<td><strong>Intervention:</strong> Pharmacological</td>
<td>Tx resulted in a statistically greater absolute weight loss and BMI reduction compared to the placebo pill, although the size of this effect was modest</td>
<td>Short term nausea, abdominal pain, diarrhoea, headache, and vomiting</td>
</tr>
<tr>
<td><strong>Country:</strong> USA</td>
<td>• <strong>Tx:</strong> Glucagon-like peptide-1 receptor agonist (N=13)</td>
<td></td>
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<tr>
<td><strong>Population:</strong> Severely obese adolescents (mean age: 15, 62% female)</td>
<td>• <strong>Control:</strong> Placebo pill (N=13)</td>
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<tr>
<td><strong>Total Participants:</strong> N=26</td>
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<tr>
<td><strong>Setting:</strong> Outpatient</td>
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<tr>
<td><strong>Follow-up duration:</strong> 3 months</td>
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<tr>
<td><strong>Inclusion criteria:</strong> BMI over 35</td>
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<tr>
<td><strong>Exclusion criteria:</strong> Diabetes; psychiatric disorders; bariatric surgery; significant medical conditions</td>
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<tr>
<td><strong>First author:</strong> Khoo, 2014</td>
<td><strong>Intervention:</strong> Pharmacological</td>
<td>Both groups experienced significant weight loss at 40 weeks but only the Tx group had significantly reduced waist circumference</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Country:</strong> Singapore</td>
<td>• <strong>Tx:</strong> Optifast Meal replacements, 2 sachets/ day (N=24)</td>
<td>The Tx group had significant reductions in percentage of body fat compared with controls</td>
<td></td>
</tr>
<tr>
<td><strong>Population:</strong> Obese Asian males (mean age 40)</td>
<td>• <strong>Control:</strong> Conventional reduced-fat diet (N=24)</td>
<td>Both groups experienced significant improvements in QOL</td>
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<tr>
<td><strong>Total Participants:</strong> N=48</td>
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<td></td>
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<tr>
<td><strong>Setting:</strong> Not specified</td>
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<tr>
<td><strong>Follow-up duration:</strong> 40 weeks</td>
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<tr>
<td><strong>Inclusion criteria:</strong> BMI 27.5+ and waist circumference &gt; 90</td>
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<tr>
<td><strong>Exclusion criteria:</strong> cardiovascular disease; treatment for sexual or urinary problems</td>
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<tr>
<td><strong>First author:</strong> Kim, 2014</td>
<td><strong>Intervention:</strong> Other</td>
<td>Tx resulted in a statistically and clinically significant reduction in body weight and BMI compared to placebo</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Country:</strong> South Korea</td>
<td>• <strong>Tx:</strong> Auricular acupressure using Sinapis alba seeds (N=29)</td>
<td>There was no difference between the treatment and control group regarding changes in percentage of body fat or waist-to-hip ratio</td>
<td></td>
</tr>
<tr>
<td><strong>Population:</strong> Overweight or obese female college students (mean age: 21)</td>
<td>• <strong>Control:</strong> Placebo (N=29)</td>
<td>Self-efficacy improved significantly for participants receiving Tx, whereas self-efficacy decreased for participants receiving the placebo treatment</td>
<td></td>
</tr>
<tr>
<td><strong>Total Participants:</strong> N=58</td>
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<tr>
<td><strong>Setting:</strong> Not specified</td>
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<tr>
<td><strong>Follow-up duration:</strong> 4 weeks</td>
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<tr>
<td><strong>Inclusion criteria:</strong> No ear injury or surgery in the previous 6 months; no significant medical conditions; no history of treatment for Obesity</td>
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<tr>
<td><strong>Exclusion criteria:</strong> Not specified</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Study Features</td>
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<td>Summary of outcomes</td>
<td>Adverse effects</td>
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</tbody>
</table>
| First author: Kong, 2014 | **Intervention:** Diet + behavioural  
- **Tx:** Low glycemic index diet + fortnightly dietary counselling (N=52)  
- **Control:** Conventional Chinese diet based on the standard food pyramid promoted by the Hong Kong Department of Health (N=52) | - When combined with dietary counselling, individuals receiving Tx had a statistically significant reduction in obesity indices including BMI, body weight and waist circumference compared with controls | None reported |
| Country: Hong Kong  
Population: Obese adolescents (mean age: 17, 57% female)  
Total Participants: N=104  
Setting: Not specified  
Follow-up duration: 6 months  
Inclusion criteria: See population  
Exclusion criteria: Major medical illness; long-term medication | | | |
| First author: Kreider, 2011 | **Intervention:** Exercise + Diet  
- **Tx A:** Meal replacement (Special K) + encouragement to increase exercise (N=45)  
- **Tx B:** Structured meal plan diet + supervised exercise regime (N=45) | - At 10 weeks participants in both groups had significant reductions in weight, but this reduction was greater for Tx B  
- Similar results were found at 34 weeks  
- Participants in Tx A also experienced improvements in QOL scores, although the statistical significance of this was not reported | None reported |
| Country: USA  
Population: Overweight and obese sedentary women (mean age: 41)  
Total Participants: N=90  
Setting: University clinic  
Follow-up duration: 10 and 34 weeks  
Inclusion criteria: See population  
Exclusion criteria: Recent participation in diet or exercise program; recent weight loss; significant medical illness or co-morbidity | | | |
| First author: Lim, 2011 | **Intervention:** Pharmacological  
- **Tx A:** Metformin + lifestyle intervention (N=65)  
- **Tx B:** Lifestyle intervention (N=99)  
- **Control:** Placebo + lifestyle intervention (N=79) | - Tx B resulted in significantly greater reductions in weight and waist circumference than Tx or control groups  
- Gastrointestinal discomfort, rash, dizziness, chest pain – experienced by a small number of participants (<10) | |
| Country: Australia  
Population: Overweight and obese young women (mean age: 28)  
Total Participants: N=203  
Setting: Not specified  
Follow-up duration: 12 weeks  
Inclusion criteria: Access to Internet  
Exclusion criteria: Significant medical illnesses or co-morbidities; pregnant or lactating; current weight loss | | | |
| First author: Liu, 2013 | **Intervention:** Pharmacological  
- **Tx A:** 200mg caffeine/20mg ephedrine, 3x/day (N=30)  
- **Tx B:** Leptin daily (N=30)  
- **Tx C:** Caffeine/ephedrine + leptin daily (N=30) | - Tx A and C, but not B, had significant reductions in weight at 24 week follow-up  
- The difference in weight loss between participants receiving Tx A and C, compared to participants receiving Tx B, was attributed by study authors to a statistically greater reduction in overall fat mass | None reported |
| Country: USA  
Population: Overweight and obese adults  
Total Participants: N=90  
Setting: Not reported  
Follow-up duration: 24 weeks  
Inclusion criteria: See population  
Exclusion criteria: Pregnancy/lactating; regular use of medication; recent weight loss; co-morbidity | | | |
| First author: Maddison, 2011 | **Intervention:** Lifestyle  
- **Tx:** Active video game, 60 minutes every day of the week (N=160)  
- **Control:** Sedentary video game, playing times left to the discretion of the participants (N=162) | - Tx resulted in a significantly greater reduction in both body weight and percentage of overall body fat compared with control, but this treatment effect was small | No adverse effects related to the intervention were reported |
| Country: New Zealand  
Population: Overweight and obese children (mean age: 12, 27% female)  
Participants: N=322  
Setting: Not specified  
Follow-up duration: 24 weeks  
Inclusion criteria: Owns a PlayStation2 or 3 console; no active video games  
Exclusion criteria: Medical conditions effecting physical activity | | | |
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<tr>
<th>Study Features</th>
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<th>Adverse effects</th>
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</table>
| **First author:** Malkina-Pykh, 2012  
**Country:** Russia  
**Population:** Overweight or obese adults (mean age: 38, 69% female)  
**Total Participants:** N=58  
**Setting:** Not specified  
**Follow-up duration:** 12 weeks  
**Inclusion criteria:** Self-referred participants or patients referred by their GP  
**Exclusion criteria:** Not specified | **Intervention:** Behavioural  
- **Tx A:** Rhythmic movement therapy (N=30)  
- **Tx B:** CBT (N=28)  
- **Control:** No treatment (N=18)  
| **Tx A resulted in statistically and clinically improved symptoms of obesity and eating disorders including; a reduction in BMI, a reduction in restrained and emotional eating, body dissatisfaction, and emotional dysfunction**  
**Participants in Tx B and control group had no significant differences between pre- and post-treatment symptoms** | None reported |
| **First author:** Mangine, 2012  
**Country:** USA  
**Population:** Overweight and obese adults (70% female)  
**Total Participants:** N=50  
**Setting:** Not specified  
**Follow-up duration:** 4 and 8 weeks  
**Inclusion criteria:** Daily energy intake at or above recommended guidelines  
**Exclusion criteria:** Not reported | **Intervention:** Pharmacological  
- **Tx:** 40mg N-oleyl phosphatidylethanolamine + 35mg epigallocatechin-3-gallate, 3x/day (N=25)  
- **Control:** Placebo pill, 3x/day (N=25)  
| **Both groups experienced a reduction in body weight from baseline, however no significant differences were found between groups re: changes in body mass, percentage of body fat or waist circumference**  
**At week 8 participants in the Tx group reported a statistically significant, but modest reduction in tension**  
| Blurry vision, headache, increased appetite, shakiness, and disrupted alertness |
| **First author:** Masheb, 2011  
**Country:** USA  
**Population:** Obese adults with BED (mean age: 46, 76% female)  
**Total Participants:** N= 50  
**Setting:** Not specified  
**Follow-up duration:** 6 and 12 months  
**Inclusion criteria:** See population  
**Exclusion criteria:** Psychiatric co-morbidities; receiving any treatment that effects weight; medical co-morbidities; pregnant/lactating | **Intervention:** Behavioural + Diet  
- **Tx:** CBT + low energy density diet (N=25)  
- **Comparator:** CBT + general nutrition counselling (N=25)  
| **26% of all participants achieved a weight loss of greater than 5% at 6 months but there was no significant differences between groups**  
**30% of participants achieved a similar weight loss at 12 months but, again, there was no significant difference between groups**  
**Both groups had a significant improvement in the behavioural and attitudinal features of BED** | None reported |
| **First author:** Mathews, 2012  
**Country:** U.K.  
**Population:** Overweight adults (mean age: 40, 75% female)  
**Total Participants:** N=70  
**Setting:** Not specified  
**Follow-up duration:** 2, 4 and 6 weeks  
**Inclusion criteria:** BMI 25-32kg/m²  
**Exclusion criteria:** Significant illness or medical condition; smoking; eating disorder traits; medication effecting weight; significant weight fluctuation in previous 6 months; night shift workers | **Intervention:** Diet  
- **Tx:** Ready to eat Kellogg’s breakfast cereal (N=36)  
- **Control:** Usual evening snack (N=34)  
| **No significant weight loss or body composition differences were found between groups**  
**There was, however, a statistically significant reduction in waist circumference for participants in the Tx group at 6 weeks although the size of this effect was minimal** | None reported |
### Study Features

<table>
<thead>
<tr>
<th>First author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morena</td>
<td>2014</td>
</tr>
<tr>
<td>Munro</td>
<td>2013</td>
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<tr>
<td>Nackers</td>
<td>2013</td>
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<tr>
<td>Nanchahal</td>
<td>2012</td>
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### Interventions

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<tr>
<td><strong>Country</strong></td>
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<tr>
<td>Spain</td>
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<tr>
<td>Australia</td>
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<tr>
<td>USA</td>
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<tr>
<td>U.K.</td>
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<thead>
<tr>
<th><strong>Population</strong></th>
<th>Obese adults (mean age: 45, 89% female)</th>
<th>Obese adults (69% female)</th>
<th>Obese women, aged 25–75 years, mean age: 52, 74% female</th>
<th>Overweight and obese adults (mean age: 49, 71% female)</th>
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<table>
<thead>
<tr>
<th><strong>Total Participants</strong></th>
<th>N=79</th>
<th>N=35</th>
<th>N=125</th>
<th>N= 381</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setting</strong></td>
<td>Not specified</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Primary care</td>
</tr>
<tr>
<td><strong>Follow-up duration</strong></td>
<td>monthly for a total of 12 months</td>
<td>12 weeks</td>
<td>6 and 12 months</td>
<td>12 months</td>
</tr>
<tr>
<td><strong>Inclusion criteria</strong></td>
<td>Stable body weight in previous 3 months; history of failed diet attempts</td>
<td>See population</td>
<td>Basic English reading skills</td>
<td>See population</td>
</tr>
<tr>
<td><strong>Exclusion criteria</strong></td>
<td>Significant illness or medical condition; psychiatric conditions</td>
<td>Significant medical condition or illness; current energy restriction; pregnant/lactating</td>
<td>Psychiatric conditions; significant weight loss in previous 6 months; previous participation in behavioural weight loss program</td>
<td>Pregnancy; significant medical illness; participation in another study</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Intervention:</strong> Diet</th>
<th><strong>Summary of outcomes:</strong> At all monthly evaluations there was a statistically and clinically significant difference in weight loss between Tx and control groups</th>
<th><strong>Adverse effects:</strong> The Tx diet induced a range of short-term side effects in many participants including constipation, headache, asthenia, hyperuricemia and fatigue</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tx: Very low-calorie-ketogenic diet as part of a commercial weight loss program - Pronokal Method. This was based on a high-biological-value protein preparations diet and natural foods (N=39)</td>
<td><strong>Control:</strong> Standard low calorie diet with a caloric value of 10% below the total metabolic expenditure of each individual (N=40)</td>
<td><strong>Intervention:</strong> Pharmacological + diet</td>
</tr>
<tr>
<td>• Control: Standard low calorie diet with a caloric value of 10% below the total metabolic expenditure of each individual (N=40)</td>
<td><strong>Supplementing a low energy diet with omega 3 fatty acids was not shown to induce extra weight loss</strong></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Intervention:</strong> Diet + behavioural</td>
<td><strong>Both treatment groups had a statistically and clinically significant reduction in weight at 6 and 12 months</strong></td>
<td>None reported</td>
</tr>
<tr>
<td>• Tx A: 1,000 calorie diet + behavioural treatment (N=65)</td>
<td>Between 7–12 months participants in Tx A had significant weight re-gain, and at the 12 month assessment were not statistically different than Tx B</td>
<td><strong>Intervention:</strong> Behavioural</td>
</tr>
<tr>
<td>• Tx B: 1,500 calorie diet + behavioural treatment (N= 60)</td>
<td><strong>A statistically and clinically higher proportion of participants in the Tx group lost more than 5% of their baseline body weight and experienced a reduction in waist circumference than the proportion of participants in the control group</strong></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Control:</strong> Usual care (N=190)</td>
<td><strong>None reported</strong></td>
<td>None reported</td>
</tr>
</tbody>
</table>

First author: Morena, 2014
Country: Spain
Population: Obese adults (mean age: 45, 89% female)
Total Participants: N=79
Setting: Not specified
Follow-up duration: monthly for a total of 12 months
Inclusion criteria: Stable body weight in previous 3 months; history of failed diet attempts
Exclusion criteria: Significant illness or medical condition; psychiatric conditions

First author: Munro, 2013
Country: Australia
Population: Obese adults (69% female)
Total Participants: N=35
Setting: Not specified
Follow-up duration: 12 weeks
Inclusion criteria: See population
Exclusion criteria: Significant medical condition or illness; current energy restriction; pregnant/lactating

First author: Nackers, 2013
Country: USA
Population: Obese women, aged 25–75 years, mean age: 52, 74% female
Total Participants: N=125
Setting: Not specified
Follow-up duration: 6 and 12 months
Inclusion criteria: Basic English reading skills
Exclusion criteria: Psychiatric conditions; significant weight loss in previous 6 months; previous participation in behavioural weight loss program

First author: Nanchahal, 2012
Country: U.K.
Population: Overweight and obese adults (mean age: 49, 71% female)
Total Participants: N= 381
Setting: Primary care
Follow-up duration: 12 months
Inclusion criteria: See population
Exclusion criteria: Pregnancy; significant medical illness; participation in another study

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</tr>
</thead>
</table>
| **First author:** Napolitano, 2013  
Country: USA  
Population: Overweight and obese students (mean age: 21, 87% female)  
Total Participants: N= 52  
Setting: Not specified  
Follow-up duration: 4 and 8 weeks  
Inclusion criteria: mobile phone plan including unlimited text messaging; active Facebook user  
Exclusion criteria: Significant medical illness or condition; medication effecting weight; unstable psychiatric disorder; eating disorder | **Intervention:** Behavioural + technology  
- **Tx A:** Facebook (FB): participants were part of a private FB group through which they could access content about weight loss interventions (N=17)  
- **Tx B:** FB + text messaging: participants were part of a private FB group through which they received access to the same content as participants in the FB group. Participants in FB+ also received additional theoretically-driven intervention targets: goal setting, self-monitoring, and social support communicated via text messaging (N=18)  
- **Control:** Waiting List (N=17) | - Overall FB + personalised text messaging was effective for encouraging short term weight loss  
- At 4 weeks participants in Tx B lost significantly more weight than Tx A or controls  
- The size of this effect was modest | None reported |
| **First author:** Park, 2014  
Country: Korea  
Population: Obese adults (mean age: 41)  
Total Participants: N= 80  
Setting: Not specified  
Follow-up duration: 12 weeks  
Inclusion criteria: See population  
Exclusion criteria: Significant medical illnesses or conditions; morbidly obese patients’ weight variation 3 months prior to study | **Intervention:** Pharmacological  
- **Tx:** Gynostemma pentaphyllum extract 450mg/day (N=40)  
- **Control:** Placebo pill, taken once daily (N=40) | - Tx was statistically and clinically more effective for reducing abdominal fat and body weight compared to the control group  
- The effect size for reduced body weight, BMI and overall percentage of body fat was small | None reported |
| **First author:** Pataky, 2013  
Country: Multiple  
Population: Obese adults with BED (mean age: 43)  
Total Participants: N=289  
Setting: Not specified  
Follow-up duration: 6 months  
Inclusion criteria: BMI 30–45kg/m²; diagnosed BED  
Exclusion criteria: Previous surgery for weight loss; cannabis use; substance abuse problems in the previous 6 months; medication the effects weight; co-morbidities | **Intervention:** Pharmacological  
- **Tx:** Rimonabant 20mg/day (N=143)  
- **Control:** Placebo pill, daily (N=146) | - Participants receiving Tx had a statistically and clinically significant reduction in weight, waist circumference and binge eating compared with controls  
- Nausea, nasopharyngitis, diarrhoea and insomnia were more significant in the Tx groups | None reported |
| **First author:** Pellegrini, 2012  
Country: USA  
Population: Overweight and obese adults (mean age: 44)  
Total Participants: N=51  
Setting: Not specified  
Follow-up duration: 6 months  
Inclusion criteria: Sedentary; access to phone and internet  
Exclusion criteria: Significant illnesses or medical conditions; medications that effect weight; limitations of exercise | **Intervention:** Behavioural  
- **Tx A:** Technology based weight loss system (N=17)  
- **Tx B:** Standard behavioural weight loss system + a technology based element (N=17)  
- **Control:** Standard behavioural weight loss system (N=17) | - All treatment interventions resulted in significant reductions in body weight, waist circumference, hip circumference and percentage of body fat, with no significant differences between groups | None reported |
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<tr>
<td>First author: Pinto, 2013</td>
<td><strong>Intervention:</strong> Behavioural</td>
<td>• Adding fundamental principles of BWL treatment to the weight watchers program (Tx B) did not enhance weight loss</td>
<td>None reported</td>
</tr>
<tr>
<td>Country: USA</td>
<td>• <strong>Tx A:</strong> Standard behavioural weight loss treatment (N=48)</td>
<td>• Participants in all treatment groups lost statistically and clinically significant amounts of weight at 12, 24 and 48 weeks, with no significant differences between groups</td>
<td></td>
</tr>
<tr>
<td>Population: Overweight and obese adults (mean age: 50, 90% female)</td>
<td>• <strong>Tx B:</strong> Fundamental principles of BWL + weight watchers program (N=47)</td>
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<tr>
<td>Total Participants: N=144</td>
<td>• Comparator: Weight watchers program (N=49)</td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 24 and 48 weeks</td>
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<tr>
<td>Inclusion criteria: See populations</td>
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<tr>
<td>Exclusion criteria: Weight loss medication or participation in a weight loss program within previous 12 months; participated in weight watchers program in previous 2 years; significant medical illness or co-morbidity</td>
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<tr>
<td>First author: Pi-Sunyer, 2015</td>
<td><strong>Intervention:</strong> Pharmacological</td>
<td>In conjunction with lifestyle modification counselling, Liraglutide Tx resulted in statistically and clinically greater weight loss and reduction in waist circumference at 56 weeks compared to the placebo group</td>
<td>A range of adverse effects were noted with the most common being nausea, diarrhoea, constipation and nasopharyngitis</td>
</tr>
<tr>
<td>Country: 27 countries</td>
<td>• <strong>Tx A:</strong> 3mg Liraglutide injection, once daily + lifestyle modification counselling (N=2487)</td>
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<tr>
<td>Population: Obese adults, aged 18+ years, mean age: 45, 79% women</td>
<td>• <strong>Control:</strong> Placebo injection + lifestyle modification counselling (N=1244)</td>
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<td></td>
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<tr>
<td>Total Participants: N=3731</td>
<td></td>
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<td></td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 56 weeks</td>
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<tr>
<td>Inclusion criteria: Stable body weight</td>
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<tr>
<td>Exclusion criteria: Type 1 or 2 diabetes; medications affecting weight' previous bariatric surgery; significant medical illness; psychiatric disorder</td>
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</tr>
<tr>
<td>First author: Poelman, 2015</td>
<td><strong>Intervention:</strong> Behavioural</td>
<td>Tx resulted in a significant reduction in BMI at 3 months compared to the control group, however there was no difference at 12 months</td>
<td>None reported</td>
</tr>
<tr>
<td>Country: Netherlands</td>
<td>• <strong>Tx:</strong> PortionControl@Home program that aims to modify dietary behaviours (N=142)</td>
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<tr>
<td>Population: Overweight and obese adults (mean age: 46, 85% female)</td>
<td>• <strong>Control:</strong> Wait List (N= 142)</td>
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<tr>
<td>Total Participants: N= 278</td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 3, 6 and 12 months</td>
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<tr>
<td>Inclusion criteria: Participant required to be the gatekeeper of the family (e.g. the person who had the most significant influence on food)</td>
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<tr>
<td>Exclusion criteria: Co-morbidities; clinical depression; significant medical illness</td>
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<tr>
<td>First author: Poole, 2011</td>
<td><strong>Intervention:</strong> Exercise + pharmacological</td>
<td>Adding Tx to an exercise regime does not enhance weight loss</td>
<td>None reported</td>
</tr>
<tr>
<td>Country: USA</td>
<td>• <strong>Tx:</strong> Weight loss supplement + exercise (N=12)</td>
<td>There were no significant differences in BMI or body composition in either group or between groups</td>
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</tr>
<tr>
<td>Population: Overweight college students (mean age: 22)</td>
<td>• <strong>Control:</strong> Placebo pill + exercise (N=12)</td>
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<tr>
<td>Total Participants: N=24</td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 8 weeks</td>
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<tr>
<td>Inclusion criteria: See population</td>
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<tr>
<td>Exclusion criteria: Co-morbidities; medication effecting weight</td>
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</table>
| **First author:** Reichkendi, 2014  
**Country:** Denmark  
**Population:** Overweight Caucasian men  
**Total Participants:** N=64  
**Setting:** Not specified  
**Follow-up duration:** 11 weeks  
**Inclusion criteria:** Sedentary; stable weight  
**Exclusion criteria:** Significant medical condition; regular medication | Intervention: Exercise  
- **Tx A:** Moderate exercise, 3x/week (N=21)  
- **Tx B:** High intensity of exercise, 3x/week (N=22)  
- **Control:** No exercise (N=18) | - Both Tx groups had statistically and clinically significant reductions in weight and waist circumference compared with controls  
- QOL scores also improved for Tx A and Tx B groups, and remained statistically greater in Tx B compared with controls | None reported |
| **First author:** Ross, 2015  
**Country:** Canada  
**Population:** Abdominally obese adults (mean age: 51)  
**Total Participants:** N=300  
**Setting:** Not specified  
**Follow-up duration:** 24 weeks  
**Inclusion criteria:** See population  
**Exclusion criteria:** Illness preventing exercise; 2+ exercise sessions per week; diabetes | Intervention: Exercise  
- **Tx A:** Low amount, low intensity of exercise – exercise was walking or jogging, 5x/week (N=73)  
- **Tx B:** High amount, low intensity of exercise - exercise was walking or jogging, 5x/week (N=76)  
- **Tx C:** High amount, high intensity - exercise was walking or jogging, 5x/week (N=76)  
- **Control:** No prescribed exercise (N=75) | - At 24 weeks all treatment groups experienced statistically significant reductions in body weight and waist circumference, compared to the control group but there were no significant differences between the types of exercise performed | None reported |
| **First author:** Sukarai, 2013  
**Country:** Japan  
**Population:** Overweight older adults (mean age: 62, 77% female)  
**Total Participants:** N=66  
**Setting:** Not specified  
**Follow-up duration:** 3 months  
**Inclusion criteria:** Seen population  
**Exclusion criteria:** Significant medical condition; mental disorder or cognitive impairment | Intervention: Diet + exercise + other  
- **Tx A:** Dietary modification consisting of a series of 4x 75-min nutrition guidance classes + 75 minutes of exercise 2x/week + hot bathing for 20 minutes after each period of exercise (N=17)  
- **Tx B:** 75 minutes of exercise 2x/week + dietary modification consisting 4 nutrition guidance classes (N=16)  
- **Tx C:** Hot bathing for 20 minutes 2x/week (N=16)  
- **Control:** No treatment (N=17) | - Participants who hot bathed, dieted and exercised regularly (Tx A) experienced significantly greater weight reduction, BMI and body fat percentage compared to all other treatment groups and the control group | None reported |
| **First author:** Sanal, 2013  
**Country:** Turkey  
**Population:** Overweight and obese adults (mean age: 39)  
**Total Participants:** N=92  
**Setting:** Not specified  
**Follow-up duration:** 12 weeks  
**Inclusion criteria:** See population  
**Exclusion criteria:** Significant medical condition; aerobic program 12 months prior to study; medication effecting the musculoskeletal system | Intervention: Exercise  
- **Tx A:** Aerobic exercise for 20–45 minutes a day, 3-5 days per week (N=46)  
- **Tx B:** Aerobic resistance exercise, same exercise prescription as Tx A + resistance training twice a week (N=46) | - Both groups had significant reductions in body weight, BMI and waist circumferences but there were no significant differences between groups  
- Significant differences were found in changes to body composition. Overall Tx B was significantly more effective at increasing the fat free mass of in all regions of the body, and the body overall compared to Tx A  
- There was a significant gendered difference in response to the different types of exercise; Tx B was more effective for increasing the fat free mass of the arms, trunk and the whole body for men, whereas Tx B was more effective for reducing fat mass in the trunk region in women | None reported |
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| **First author:** Salenpour, 2012  
**Country:** Iran  
**Population:** Overweight and obese women (mean age: 38)  
**Total Participants:** N= 85  
**Setting:** Not specified  
**Follow-up duration:** 12 weeks  
**Inclusion criteria:** See population  
**Exclusion criteria:** Significant medical illness; consuming medication or other vitamin supplements; recent fluctuations in body weight; smoking and alcohol consumption  
| **Intervention:** Pharmacological  
- **Tx:** Vitamin D supplement 25 μg/day (N=42)  
- **Control:** Placebo pill 25 μg/day (N=42)  
| - The Tx group experienced statistically and clinically greater reductions in overall body mass compared to those taking the placebo  
- There were no significant differences within or between groups in relation to body weight, waist circumference or hip circumference  
| None reported |
| **First author:** Sanchez, 2014  
**Country:** Canada  
**Population:** Obese adults, aged 18 – 55 years (mean age: 36, 62% female)  
**Total Participants:** N=125  
**Setting:** Not reported  
**Follow-up duration:** 12 and 24 weeks  
**Inclusion criteria:** Stable body weight 3 months prior  
**Exclusion criteria:** Pregnancy; menopause; co-morbidities and significant medical conditions; medication effecting body weight  
| **Intervention:** Pharmacological  
- **Tx:** Lactobacillus rhamnosus supplement, 2x/day + moderate energy restricted diet (N=62)  
- **Control:** Placebo pill, 2x/day + moderate energy restricted diet (N=63)  
| - Overall, there was no statistical difference between the weight loss of participants receiving the Tx compared to those receiving the placebo, but there was a significant difference between the weight loss of women taking the Tx and those taking the placebo pill at both 12 and 24 week follow-ups  
| None reported |
| **First author:** Shapiro, 2012  
**Country:** USA  
**Population:** Overweight and obese adults (mean age: 42, 65% female)  
**Total Participants:** N= 170  
**Setting:** Not specified  
**Follow-up duration:** 6 and 12 months  
**Inclusion criteria:** Access to Internet and owns and uses a cell phone  
**Exclusion criteria:** Eating disorder; non-English speaking persons  
| **Intervention:** Behavioural  
- **Tx:** Text4Diet a daily interactive weight loss programme consisting of personalised text messages + monthly e-newsletter (N=81)  
- **Control:** Monthly e-newsletter (N=89)  
| - Neither group experienced weight loss at either follow-up assessment  
| None reported |
| **First author:** Shin, 2014  
**Country:** USA  
**Population:** Obese adults (60% female)  
**Total Participants:** N=225  
**Setting:** Not specified  
**Follow-up duration:** 12, 18 and 24 months  
**Inclusion criteria:** See population  
**Exclusion criteria:** Diabetes; co-morbidities; significant illness; psychiatric diagnoses; psychotic medication  
| **Intervention:** Pharmacological  
- **Tx A:** Zonisamide 200mg/day + diet and lifestyle counselling (N=76)  
- **Tx B:** Zonisamide 400mg/day + diet and lifestyle counselling (N=75)  
- **Control:** Placebo pill + diet and lifestyle counselling (N=74)  
| - At 12 months Tx B resulted in statistically and clinically greater weight loss compared to Tx A and placebo. There were no significant differences between the weight loss of participants consuming Tx A and the placebo. These differences were maintained at the 18 months follow up  
- At 24 months (6 months after the study was discontinued) patients receiving Tx B treatment had regained the most weight  
- Altered taste, constipation, diarrhoea, dry mouth, headache, fatigue, nausea/vomiting, somnolence, language/speech problems, impaired attention/concentration, memory problems, and anxiety-related and depression-related adverse events  
<p>| None reported |</p>
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| **Country**: Canada  
**Population**: Obese adolescents (mean age: 6, 70% female)  
**Total Participants**: N=304  
**Setting**: Not specified  
**Follow-up duration**: 6 months  
**Inclusion criteria**: Post-pubertal; sedentary for 4 months prior to study  
**Exclusion criteria**: Regular exercise of more than 2 days a week; significant medical illness or condition | **Intervention**: Exercise  
- **Tx A**: Aerobic training 4x/week (N=75)  
- **Tx B**: Resistance training 4x/week (N=78)  
- **Tx C**: Combination of Tx A, B and C 4x/week (N=75)  
- **Control**: No exercise (N=76) | • All exercise groups experienced significant reductions in percentage of body fat compared to the control group, but there were no significant differences between the three exercise groups and the size of these reductions were modest.  
• All exercise groups had significant reductions in waist circumference, but not the control. There were no differences between groups regarding waist circumference measurements at 6 months. | None reported |
| **First author**: Sijie, 2012  
**Country**: China  
**Population**: Overweight young women (mean age: 20)  
**Total Participants**: N=60  
**Setting**: Not specified  
**Follow-up duration**: 12 weeks  
**Inclusion criteria**: Normal menstrual cycle  
**Exclusion criteria**: Significant medical conditions | **Intervention**: Exercise  
- **Tx A**: Moderate intensity continuous training, 5x/week (N=16)  
- **Tx B**: High intensity interval training, 5x/week (N=17)  
- **Control**: No training (N=19) | • Participants in both exercise groups experienced statistically and clinically significant reductions in body mass, BMI, body fat percentage and waist-to-hip ratio  
• The reduction in body fat was significantly greater for participants in Tx B, than the Tx A and control group | None reported |
| **First author**: Sovik, 2011  
**Country**: Norway and Sweden  
**Population**: Morbidly obese adults  
**Total Participants**: N=60  
**Setting**: Not reported  
**Follow-up duration**: 12 and 24 months  
**Inclusion criteria**: See population  
**Exclusion criteria**: BMI greater than 60; history of bariatric surgery; significant illness | **Intervention**: Surgery  
- **Tx A**: Duodenal switch (N=29)  
- **Tx B**: Gastric bypass (N=31) | • Both procedures led to statistically and clinically improved outcomes for participants, but participants receiving Tx A had significantly greater reductions in BMI, total weight loss, waist circumference and hip circumference compared to participants who underwent Tx B  
• Participants in both surgical groups reported significant improvements in health related QOL, with statistically greater improvements in QOL in individuals who underwent Tx B  
• Participants who received Tx A experienced significantly more adverse effects compared to those who underwent Tx B, including readmission, requiring new surgery, vomiting and other gastric problems | Participants who received Tx A experienced significantly more adverse effects compared to those who underwent Tx B, including readmission, requiring new surgery, vomiting and other gastric problems |
| **First author**: Sovik, 2013  
**Country**: Sweden and Norway  
**Population**: Morbidly obese adults  
**Total Participants**: N=60  
**Setting**: Not specified  
**Follow-up duration**: 24 months  
**Inclusion criteria**: See population  
**Exclusion criteria**: BMI greater than 60; history of bariatric surgery; significant illness | **Intervention**: Surgery  
- **Tx A**: Duodenal switch (N=29)  
- **Tx B**: Gastric bypass (N=31) | • 24 months after surgery participants who underwent Tx A had significantly more adverse gastrointestinal effects compared to participants who underwent Tx B, for example diarrhoea, anal leakage of stool and more day time defecation  
• Psychosocial functioning improved significantly after surgery for both groups — there was no significant difference in these scores between surgery groups | See Sovik, 2011 |
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<th>Summary of outcomes</th>
<th>Adverse effects</th>
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</table>
| First author, yr: Spring 2013 | **Intervention:** Behavioural + technology  
- **Tx:** Usual physician care + mobile phone technology which participants used as a decision support tool to self-regulate energy intake (N=35)  
- **Control:** Usual care (N=35) | Participants who received their usual physician care with the addition of mobile phone technology (Tx) experienced statistically greater weight loss compared to participants who received only physician care (control)  
The size of this effect was moderate | None reported |
| Country: USA  
Population: Overweight and obese adults (mean age: 58, 86% male)  
Total Participants: N=89 | Setting: Primary care  
Follow-up duration: 3, 6, 9 and 12 months  
Inclusion criteria: Weight less than 181.4kg  
Exclusion criteria: Psychiatric hospitalization; BED | | |
| First author: Steinberg, 2013 | **Intervention:** Other  
- **Tx:** Daily self-weighing program which included use of a “smart” scale for daily weighing; a web-based graph of weight trends over time; weekly tailored feedback via e-mail on self-weighing frequency and weight loss progress; and 22 weekly lessons on behavioural weight control via e-mail (N=46)  
- **Comparator:** Delayed weighing, where participants were given scales at baseline for evaluation purposes only and instructed to maintain their current self-weighing habits (N=44) | At both 3 and 6 months, Tx resulted in statistically and clinically greater weight loss compared to the group that delayed weigh-ins | None reported |
| Country: Germany  
Population: Overweight and obese adults (mean age: 44, 75% female)  
Total Participants: N=91 | Setting: Not specified  
Follow-up duration: 3 and 6 months  
Inclusion criteria: Access to internet  
Exclusion criteria: Significant medical condition; psychiatric disorder other than depression; eating disorder; participation in weight loss program in past 6 months | | |
| First author: Strobl, 2013 | **Intervention:** Behavioural  
- **Tx:** Standard inpatient medical obesity rehabilitation + intensive after-care consisting of a combined planning and telephone aftercare intervention (N=228)  
- **Control:** Standard inpatient medical obesity rehabilitation (N=239) | Weight reduction was observed in both groups  
The difference in weight loss between the two groups was not statistically significant | None reported |
| Country: Germany  
Population: Obese adults (mean age: 48, 55% male)  
Total Participants: N=467 | Setting: After-care  
Follow-up duration: 12 months  
Inclusion criteria: Had started inpatient treatment for obesity; could speak and understand German  
Exclusion criteria: Type 1 diabetes; medical condition that affects ability to participate in sport; bariatric surgery; psychiatric disorders | | |
| First author: Suplicy, 2014 | **Intervention:** Pharmacological  
- **Tx A:** Diethylpropion 75mg/day (N=28)  
- **Tx B:** Fenproporex 25mg/day (N=29)  
- **Tx C:** Mazindol 2mg/day (N=29)  
- **Tx D:** Fluoxetine 20mg/day (N=29)  
- **Tx E:** Sibutramine 15mg/day (N=30)  
- **Control:** Placebo pill (N=29) | Participants receiving all drug treatments, with the exception of those receiving Tx D, experienced significant weight loss compared to participants receiving placebo  
There were no significant differences found between the drugs that resulted in significant weight loss  
A statistically and clinically greater proportion of participants receiving Tx A, B, C and D lost 5 or more percent of their body weight and had reductions in waist circumference at 52 weeks, than participants receiving either Tx D or placebo  
All Tx groups had significant improvements in QOL scores, depression and anxiety | Medically treated groups experienced more adverse effects than the placebo group, including dry mouth, constipation, anxiety, and irritability. These side effects were reported as mild to moderate in severity. |
| Country: Brazil  
Population: Obese premenopausal women (mean age: 37)  
Total Participants: N=174 | Setting: Academic institution  
Follow-up duration: 52 weeks  
Inclusion criteria: Stable weight previous 3 months  
Exclusion criteria: Males; previous bariatric surgery; significant medical illness; psychiatric disorders including diagnosed eating disorder | | |
| Country: USA  
Population: Overweight and obese adults (mean age: Males; previous bariatric surgery; significant medical illness; psychiatric disorders including diagnosed eating disorder | Setting: Primary care  
Follow-up duration: 3, 6, 9 and 12 months  
Inclusion criteria: Weight less than 181.4kg  
Exclusion criteria: Psychiatric hospitalization; BED | | |

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<td><strong>First author: Toulabi, 2012</strong>&lt;br&gt;Country: Iran&lt;br&gt;Population: Obese adolescents (mean age: 16)&lt;br&gt;Total Participants: N=152&lt;br&gt;Setting: Public high school&lt;br&gt;Follow-up duration: 6 weeks&lt;br&gt;Inclusion criteria: Participation of at least one parent&lt;br&gt;Exclusion criteria: drugs effecting body weight; consuming special diets; comorbidities</td>
<td>Intervention: Behavioural&lt;br&gt;• Tx: School-based behavioural intervention program consisting of nutritional education, modifying dietary habits, teaching exercise programs, teaching nutritional facts to the parents, and performing exercises 3 days a week (N=76)&lt;br&gt;• Control: Education booklets containing information about healthy eating and exercise (N=76)</td>
<td>• There was a statistically and clinically significant reduction in body weight, BMI, waist and hip circumference of participants of the school-based behavioural program compared to the control&lt;br&gt;• Participants in both the school-based behavioural program and those in the control group reported improved levels of depressive symptoms, with no differences between the groups on this measure</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>First author: Tur, 2013</strong>&lt;br&gt;Country: Spain&lt;br&gt;Population: Morbidly obese adults (mean age: 47, 69% female)&lt;br&gt;Total Participants: N=106&lt;br&gt;Setting: Not specified&lt;br&gt;Follow-up duration: 1 year&lt;br&gt;Inclusion criteria: See population&lt;br&gt;Exclusion criteria: Enrolment in another obesity program; prior bariatric surgery; significant medical conditions; psychiatric disorders</td>
<td>Intervention: Behavioural&lt;br&gt;• Tx: Intensive lifestyle intervention including regular group meetings focused on dietary habits and food choices, exercise prescription and the option of receiving weight loss medication (N=60)&lt;br&gt;• Control: Conventional obesity therapy which included the standard nutritional education, medical treatment and follow-up available for patients with morbid obesity (N=46)</td>
<td>• At 1 year there was a significantly greater proportion of participants who received Tx who achieved a weight loss of more than 2, 10 and 20% of body weight compared to the proportion of participants receiving conventional obesity therapy (control)</td>
<td>None reported</td>
</tr>
<tr>
<td><strong>First author: Wadden, 2011a</strong>&lt;br&gt;Country: USA&lt;br&gt;Population: Overweight and obese adults&lt;br&gt;Total Participants: N=793&lt;br&gt;Setting: Not specified&lt;br&gt;Follow-up duration: 56 weeks&lt;br&gt;Inclusion criteria: See population&lt;br&gt;Exclusion criteria: Significant medical illness; treatment with bupropion or naltrexone within the previous 12 months; history of drugs or alcohol within previous 12 months; psychiatric disorder; smokers</td>
<td>Intervention: Behavioural + pharmacological&lt;br&gt;• Tx: Naltrexone SR 32 mg/day combined with bupropion SR 360 mg/day + behavioural modification (N=591)&lt;br&gt;• Control: Placebo pill + behavioural modification (N=202)</td>
<td>• Participants in the Tx group lost a statistically greater proportion of their body weight compared to those in the placebo group&lt;br&gt;• Nearly twice as many individuals receiving Tx lost ≥10% and nearly three times as many lost ≥15% of initial weight compared with controls&lt;br&gt;• Tx also resulted in statistically and clinically enhanced QOL compared placebo (including enhanced self-esteem and reduced levels of public distress)</td>
<td>Nausea, constipation, dizziness, abdominal pain and depression were statistically greater side effects in the Tx group compared with control</td>
</tr>
<tr>
<td><strong>First author: Wadden, 2011b</strong>&lt;br&gt;Country: USA&lt;br&gt;Population: Obese adults (mean age: 52, 80% female)&lt;br&gt;Total Participants: N=390&lt;br&gt;Setting: Primary care&lt;br&gt;Follow-up duration: 24 months&lt;br&gt;Inclusion criteria: See population&lt;br&gt;Exclusion criteria: Significant medical condition; recent weight loss; medications effecting weight; psychiatric disorders</td>
<td>Intervention: Lifestyle&lt;br&gt;• Tx A: Brief lifestyle counselling (N=131)&lt;br&gt;• Tx B: Enhanced brief lifestyle counselling + either a meal replacement or Orlistat or sibutramine (N=129)&lt;br&gt;• Control: Usual primary care (N=130)</td>
<td>• Tx B resulted in statistically greater weight loss at 24 months compared to Tx A and control. The maximum weight loss for all groups was recorded at 12 months&lt;br&gt;• Participants in Tx B could choose to enhance their lifestyle counselling with meal replacements, Orlistat or sibutramine. There were no significant between outcomes with these additions</td>
<td>Two cholecystectomies and one case of syncope were reported. Sibutramine was discontinued in 5 participants due to increased blood pressure and Orlistat was discontinued in five participants due to gastrointestinal symptoms.</td>
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| **First author:** Strobl, 2013  
Country: Germany  
Population: Obese adults (mean age: 48, 55% male)  
Total Participants: N=467  
Setting: After-care  
Follow-up duration: 12 months  
Inclusion criteria: Had started inpatient treatment for obesity; could speak and understand German  
Exclusion criteria: Type 1 diabetes; medical condition that effects ability to participate in sport; bariatric surgery; psychiatric disorders  
**Intervention:** Behavioural  
- Tx: Standard inpatient medical obesity rehabilitation + Intensive after-care consisting of a combined planning and telephone aftercare intervention (N=228)  
- Control: Standard inpatient medical obesity rehabilitation (N=239)  
**Summary of outcomes:**  
- Weight reduction was observed in both groups  
- The difference in weight loss between the two groups was not statistically significant  
**Adverse effects:** None reported |
| **First author:** Suplicy, 2014  
Country: Brazil  
Population: Obese premenopausal women (mean age: 37)  
Total Participants: N=174  
Setting: Academic institution  
Follow-up duration: 52 weeks  
Inclusion criteria: Stable weight previous 3 months  
Exclusion criteria: Males; previous bariatric surgery; significant medical illness; psychiatric disorders including diagnosed eating disorder  
**Intervention:** Pharmacological  
- Tx A: Diethylpropion 75mg/day (N=28)  
- Tx B: Fenproporex 25mg/day (N=29)  
- Tx C: Mazindol 2mg/day (N=29)  
- Tx D: Fluoxetine 20mg/day (N=29)  
- Tx E: Sibutramine 15mg/day (N=30)  
- Control: Placebo pill (N=29)  
**Summary of outcomes:**  
- Participants receiving all drug treatments, with the exception of those receiving Tx D, experienced significant weight loss compared to participants receiving placebo  
- There were no significant differences found between the drugs that resulted in significant weight loss  
- A statistically and clinically greater proportion of participants receiving Tx A, B, C and D lost 5 or more percent of their body weight and had reductions in waist circumference at 52 weeks, than participants receiving either Tx D or placebo  
- All Tx groups had significant improvements in QOL scores, depression and anxiety  
**Adverse effects:** Medically treated groups experienced more adverse effects than the placebo group, including dry mouth, constipation, anxiety, and irritability. These side effects were reported as mild to moderate in severity. |
| **First author:** Steinberg, 2013  
Country: USA  
Population: Overweight and obese adults (mean age: 44, 75% female)  
Total Participants: N=467  
Setting: Not specified  
Follow-up duration: 3 and 6 months  
Inclusion criteria: Access to internet  
Exclusion criteria: Significant medical condition; psychiatric disorder other than depression; eating disorder; participation in weight loss program in past 6 months  
**Intervention:** Other  
- Tx: Daily self-weighing program which included use of a “smart” scale for daily weighing; a web-based graph of weight trends over time; a weekly tailored feedback via email on self-weighing frequency and weight loss progress; and 22 weekly lessons on behavioural weight control via email (N=46)  
- Comparator: Delayed weighing, where participants were given scales at baseline for evaluation purposes only and instructed to maintain their current self-weighing habits (N=44)  
**Summary of outcomes:**  
- At both 3 and 6 months, Tx resulted in statistically and clinically greater weight loss compared to the group that delayed weigh-ins  
**Adverse effects:** None reported |
| **First author:** Suplicy, 2014  
Country: USA  
Population: Overweight and obese adults (mean age: 58, 86% male)  
Total Participants: N=69  
Setting: Primary care  
Follow-up duration: 3, 6, 9 and 12 months  
Inclusion criteria: Weight less than 181kg  
Exclusion criteria: Psychiatric hospitalization; BED  
**Intervention:** Behavioural + technology  
- Tx: Usual physician care + mobile phone technology which participants used as a decision support tool to self-regulate energy intake (N=35)  
- Control: Usual care (N=35)  
**Summary of outcomes:**  
- Participants who received their usual physician care with the addition of mobile phone technology (Tx) experienced statistically greater weight loss compared to participants who received only physician care (control)  
- The size of this effect was moderate  
**Adverse effects:** None reported |
<table>
<thead>
<tr>
<th>Study Features</th>
<th>Interventions</th>
<th>Summary of outcomes</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>First author: Wagener, 2012</td>
<td>Exercise</td>
<td>Exergaming was not statistically effective for weight loss or improving psychological outcomes, with the exception of a statistically greater improvement in participants’ perceptions of competence (which was higher from baseline at 10 weeks compared to the control group)</td>
<td>None reported</td>
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<tr>
<td>Country: USA</td>
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<tr>
<td>Population: Obese adolescents (mean age: 14, 67% female)</td>
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<td>Total Participants: N=41</td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 10 weeks</td>
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<tr>
<td>Inclusion criteria: See population</td>
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<tr>
<td>Exclusion criteria: Significant medical illness; smoking; participation in 30+ minutes of exercise per day</td>
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<tr>
<td>First author: Wang, 2015</td>
<td>Diet</td>
<td>Participants that followed a high protein diet for breakfast lost a statistically and clinically greater proportion of body weight compared to participants that consumes a standard diet for breakfast</td>
<td>None reported</td>
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<tr>
<td>Country: China</td>
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<tr>
<td>Population: Obese Chinese adolescents (mean age: 15, 51% male)</td>
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<tr>
<td>Total Participants: N=156</td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 3 months</td>
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<tr>
<td>Inclusion criteria: See population</td>
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<tr>
<td>Exclusion criteria: Chronic illness; participation in weight loss program</td>
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<tr>
<td>First author: White, 2013</td>
<td>Pharmacological</td>
<td>Bupropion Tx resulted in a statistically and clinically greater reduction of body weight after eight weeks compared to those taking the placebo pill There were no significant differences in psychological outcomes between groups</td>
<td>None reported</td>
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<tr>
<td>Country: USA</td>
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<tr>
<td>Population: Overweight and obese women with BED (mean age: 44)</td>
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<td>Total Participants: N=61</td>
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<tr>
<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 8 weeks</td>
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<tr>
<td>Inclusion criteria: BED</td>
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<tr>
<td>Exclusion criteria: Significant medical illness; psychoactive medications; serious psychiatric disorders; history of anorexia or bulimia</td>
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<tr>
<td>First author: Willis, 2012</td>
<td>Exercise</td>
<td>Participants in Tx B and C experienced statistically significant reductions in overall body weight, fat mass and waist circumference Lean body mass increased significantly for participants in Tx A and C</td>
<td>None reported</td>
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<tr>
<td>Country: USA</td>
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<tr>
<td>Population: Overweight and obese sedentary results (57% female)</td>
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<td>Total Participants: N=119</td>
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<td>Setting: Not specified</td>
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<tr>
<td>Follow-up duration: 10 weeks</td>
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<tr>
<td>Inclusion criteria: Sedentary lifestyle; mild to moderate dyslipidemia</td>
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<tr>
<td>Exclusion criteria: Smokers; significant medical illness or comorbidities</td>
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<tr>
<td>Study Features</td>
<td>Interventions</td>
<td>Summary of outcomes</td>
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</tbody>
</table>
| **First author, yr:** Yeo, 2014  
**Country:** Korea  
**Population:** Overweight and obese Korean adults (mean age: 39, 82% female)  
**Total Participants:** N= 91  
**Setting:** Not reported  
**Follow-up duration:** 8 weeks  
**Inclusion criteria:** Sedentary lifestyle; stable body weight  
**Exclusion criteria:** Pregnancy; significant medical illness; current treatment for weight loss  
**Intervention:** Other  
- **Tx A:** 5 point acupuncture, once a week for 8 weeks (N=31)  
- **Tx B:** Hunger point acupuncture, once a week for 8 weeks (N=30)  
- **Control:** Placebo acupuncture, once a week for 8 weeks (N=30)  
**Summary of outcomes:**  
Both acupuncture Txs resulted in statistically and clinically significant reductions in BMI at 8 weeks, with no significant difference between groups.  
Waist circumference reduced significantly in all 3 groups from baseline, and waist circumference reduction was statistically greater for participants receiving Tx A  
**Adverse effects:** None reported |
| **First author:** Zarate, 2013  
**Country:** Mexico  
**Population:** Morbidly obese adults (mean age: 37, 89% female)  
**Total Participants:** N=43  
**Setting:** Not reported  
**Follow-up duration:** 5 years  
**Inclusion criteria:** See population  
**Exclusion criteria:** Not specified  
**Intervention:** Surgery  
- **Tx A:** Banded Roux-en-Y gastric bypass (RYGB) (N=21)  
- **Tx B:** Unbanded RYGB (N= 22)  
**Summary of outcomes:**  
At 5 years post-surgery participants in both groups had lost a statistically and clinically significant proportion of body weight, with no significant differences between groups  
**Adverse effects:** Occasional dysphagia and nausea |
| **First author:** Zhang, 2014  
**Country:** China  
**Population:** Obese adolescents and adults (mean age: 29, 59% female)  
**Total Participants:** N= 64  
**Setting:** Not specified  
**Follow-up duration:** Every 12 months for 5 years  
**Inclusion criteria:** See population  
**Exclusion criteria:** chronic medical or psychiatric condition; previous gastrointestinal surgery  
**Intervention:** Surgery  
- **Tx A:** Laparoscopic sleeve gastrectomy (N=32)  
- **Tx B:** Roux-en-Y gastric bypass (N=32)  
**Summary of outcomes:**  
Maximum weight loss in both groups was achieved at 1 year post-surgery, with participants in both groups gradually regaining weight over the following 4 years.  
At 5 years post-surgery participants who underwent Tx B had a statistically and clinically lower BMI compared to those who underwent Tx A  
Overall, participants in both groups reported statistically and clinically significant improvements in QoL over the 5 years post-surgery, with no significant difference between groups  
Improvements in QOL were correlated with the percentage of weight loss  
**Adverse effects:** None reported |

**Abbreviations used:** BED: binge eating disorder; BMI: body mass index; ER: extended release; RCT: randomised controlled trial; QOL: quality of life. All other abbreviations used are described first within the text for that entry.

**General notes:** While many types of outcome variables may be reported in the above studies, only data on outcome variables of interest are included here. Clinical and statistical significance, where reported, reflect the analysis of the study authors.