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Effective Psychological and Behavioural Interventions in Obesity Management

Michael Vallis PhD R. Psych[i], David Macklin MD[ii],
Shelly Russell-Mayhew PhD R. Psych[iii]

i) Department of Family Medicine, Faculty of Medicine, Dalhousie University
ii) Department of Family and Community Medicine, University of Toronto; Medcan Clinic
iii) Education Psychology, Werklund School of Education, University of Calgary

KEY MESSAGES FOR HEALTHCARE PROVIDERS

- All obesity management interventions involve behaviour on the part of the individual living with obesity (e.g., eating, activity, medication adherence), so behavioural change supports should be incorporated into all obesity management plans. This requires a shift in the patient-provider relationship from the provider as the expert (teach and tell) to that of the collaborator, sensitive to the psychology of the person.

- Obesity management interventions should be evaluated based on how sustainable the behavioural components of the intervention are for the individual. Obesity management plans that are sustainable for the individual should be prioritized over clinician- or program-led management plans.

- Individuals living with obesity should be encouraged to build self-esteem and self-efficacy (confidence to overcome barriers to the desired behaviour), based on results that are achievable from behavioural efforts and not on idealized ideas of body weight and shape.

- Nutrition, medical adherence and physical activities are outcomes of psychological and behavioural interventions and not interventions in themselves. Behaviour change strategies underlying dietary, medical and activity programs should be identified (i.e., what are the change strategies by which sustainable changes to eating, medical adherance and activity are achieved?)

KEY MESSAGES FOR HEALTHCARE PROVIDERS WORKING IN A SOLO PRACTICE

- Adopt a collaborative relationship with the patient, using the principles of motivational interviewing, to encourage the patient to choose and commit to evidence-based, sustainable behaviours associated with obesity management.

- Consider the use of a minimal intervention tool, such as Obesity Canada's 5As of Obesity Management™ (*Ask, Assess, Advise, Agree, Assist*).

- Healthcare providers should ask permission to educate the patient about obesity management success being related more to improved health, function and quality of life resulting from achievable behavioural and psychological goals, and not just on the amount of weight loss.

- Education should be focused around biology, bias and behaviour. Ask permission to discuss evidence regarding biological and environmental factors, including genetics (family history, the instinctual drive for food), neuroendocrine functions that promote weight regain following weight loss, and physical and social environments (i.e. built environment, food availability/security, sociocultural factors).

- Consider using the concept of "best weight" (i.e., the weight that a person can achieve and maintain while living their healthiest and happiest life). This education should be offered as a means of reducing self-bias and supporting appropriate outcome goals that acknowledge that weight is not a behaviour. This encourages body acceptance.

- Educate the patient that success is related to setting achievable, sustainable goals to which they can adhere, while developing confidence to overcome barriers and fostering an intrinsic motivation to maintain the plan. Goals should positively impact health, function and quality of life.

- Encourage the patient to:

  - Set, and sequence goals that are realistic and achievable.

  - Self-monitor behaviour.

  - Analyze setbacks using problem solving and cognitive reframing, including clarifying and reflecting on values-based behaviours. See Figure 1 for an illustration of how to support the patient in their obesity management journey.

  - For providers who function within teams (including obesity specialty programs), at least one member of the team should develop competency in behavioural interventions, including self-monitoring, goal setting and action planning, reinforcement management, social comparison, cognitive restructuring, motivational interviewing and values-based counselling. Psychological and behavioural interventions should focus on the impact of the intervention on adherence, self-efficacy and autonomous motivation.

Recommendations

1. Multicomponent psychological interventions (combining behaviour modification [goal setting, self-monitoring, problem solving], cognitive therapy [reframing] and values-based strategies to alter nutrition and activity) should be incorporated into care plans for weight loss and improved health status and quality of life (Level 1a, Grade A)[1–8] in a manner that promotes adherence, confidence and intrinsic motivation (Level 1b, Grade A).[9–13]

2. Healthcare providers should provide longitudinal care with consistent messaging to people living with obesity to support the development of confidence in overcoming barriers (self-efficacy) and intrinsic motivation (personal, meaningful reasons to change), to encourage the patient to set and sequence health goals that are realistic and achievable (Level 1a, Grade A,),[9–15] to self-monitor behaviour (Level 1a, Grade A)[9,10,14,15] and to analyze setbacks using problem-solving and adaptive thinking (cognitive reframing), including clarifying and reflecting on values-based behaviours (Level 1a, Grade A).[9,10,14,15]

3. Healthcare providers should ask patients' permission to educate them that success in obesity management is related to improved health, function and quality of life resulting from achievable behavioural goals, and not on the amount of weight loss. (Level 1a, Grade A).[16,17]

4. Healthcare providers should provide follow-up sessions consistent with repetition and relevance to support the development of self-efficacy and intrinsic motivation.[9–15] Once an agreement to pursue a behavioural path has been established (health behaviour and/or medication and/or surgical pathways) follow-up sessions should repeat the above messages in a fashion consistent with repetition (the provider role) and relevance (the patient role) to support the development of self-efficacy and intrinsic motivation (Level 1a, Grade A).

Key messages for people living with obesity

- The main goal of psychological and behavioural interventions is to help people living with obesity make changes that are sustainable, that promote positive self-esteem and confidence, and that improve health, function and quality of life.

- There is not one pathway to success. Goals should be individualized and be important to the individual and not just the clinician or program.

- There are many psychological and behavioural strategies that can be helpful. Individuals living with obesity should seek out a clinician with expertise in behaviour change to help identify relevant strategies.

- Given that healthier weights involve overcoming many challenges (cravings, habits, availability, social pressures) sustained behaviour change is more successful if the behaviours chosen by the individual are consistent with his/her core values.

Figure 1: Solo MD Model

Assessment and Diagnosis of Obesity (leads to the understanding of the cause and severity of obesity)

Develop a treatment plan that you would recommend to the person with obesity (PwO)

Ask permission to work with the PwO to create a weight management plan

PwO Agrees: Ask permission to educate:
Describe the theoretical framework of obesity as a method of addressing bias and supporting behaviour change

PwO Does not Agree: Ask permission to discuss again at a follow up visit
Explore reasons for No

Encourage self-monitoring of behaviour, Encourage parallel nutrition and activity program. Set, and sequence, goals that are realistic and achievable

Invite patient to enter behavioural treatment. Using Motivational Communication conduct the behavioral intervention by progressing through and repeating the comprehensive topics below

Address Internalized Bias
- Introduce Weight Bias and internalized Weight Bias
- Present the evidence that describes obesity as a chronic, progressive real medical condition.
- The genetics of Obesity.
- The neurohormonal response to weight loss, specifically changes in appetite and metabolic rate that favour weight re-gain.
- Describe evidence detailing effective treatments,
- Describe potential adverse outcomes of internalized bias (low self-esteem, learned helplessness, depression)

Manage Expectations
- Ask if patient may consider their weight management journey as a process of discovering their Best weight.
- Remind that Obesity is a chronic condition requiring lifelong management.
- Describe how behaviours adopted to lose weight need to be continued to maintain weight loss
- Describe best weight as the weight one discovers when living the healthiest lifestyle one can truly enjoy and realistically maintain long-term.
- Describe the neurohormonal events that determine the shape and depth of the weight loss curve and how these events are outside of a patient's control.Encourage a satisfaction with discovering one's Best Weight.
- Encourage consideration of the benefits of 5–10–15% weight loss.

Diet, Exercise and Calorie Deficit
- Describe how well conducted clinical trials and meta analyses of multiple trials suggests that there is no best diet for weight loss.
- Describe how in weight loss trials sustained weight loss and improved health outcomes are consistently associated, not with a particular diet, but instead with the level of long-term adherence to a calorie deficit relative to pre-weight loss calorie intake.
- Describe how physical activity is considered a best behaviour in generating disease risk reduction, improving health outcomes improving mood, sleep and even increased executive function.
- However, it should be described that systematic review and meta-analysis of randomized controlled trial data suggests that isolated exercise is not an effective weight loss therapy. Introduce principles of metabolic rate and energetics. Consider calculating patient Resting Metabolic Rate and suggesting this number a potential calorie target. Ask patient if they may consider self monitoring calorie intake and activity levels.

Encourage values clarification and reflection
- Remind that Obesity is a chronic condition requiring lifelong management and therefore requiring lifelong effort.
- Discover what are the things in a patient's life that are meaningful enough that the patient would be willing to maintain a lifelong effort.
- Describe how values are a direction and not a destination.
- Encourage reflection on behaviours and their direction relative to values to allow for reinforcement.

Explain, Map and Create Awareness of Wanting
- Describe wanting as the central human motivational drive to behaviours especially eating.
- Explain how associations between specific circumstances and tasty and /or abundant food lead to reward learning.
- Map with the patient their own personal places, times and circumstances that now in a conditioned/Pavlovian fashion generate wanting.
- Encourage an understanding and acceptance of wanting as normal, adaptive and built for a calorie depleted environment.
- Because wanting is non-conscious, encourage identification, awareness, and tolerance of wanting to bring wanting more into consciousness to ultimately best manage.

Encourage Cognitive Restraint development
- Describe cognitive restraint as a key skill that can be developed to best manage eating in a moments of wanting.
- Describe cognitive restraint as the central change in thinking associated with those who lose weight and keep it off.
- Remind patient that eating decisions in the face of wanting are mediated by either 1) Fast, automatic, effortless permission thinking without foresight or 2) Slow, deliberate, consequence considering thoughts.
- Conduct CBT by capturing the current "permission thinking" patterns and helping develop the values based, forward looking, gratification delaying thoughts.
- Educate the patient about permission thinking and executive restraint thinking.
- Support the patient, by referencing values, to identify and learn to counter permission thinking with restraint thinking.

Modulators of Appetite
- Describe how poor sleep and fatigue, stress, depressed mood, anxiety, sedentariness and alcohol use can effect the appetite system by strengthening wanting and lowering restraint capacity.
- Assess, diagnose and manage if necessary stress, fatigue, depression, anxiety, sedentariness and alcohol use.

Encourage Cognitive Resilience development
- Describe Resilience as a key cognitive skill that can be strengthened to maintain motivation in moments of setback.
- Describe that setbacks are an expected component of behaviour change.
- Ask patients to consider and recognize the common setbacks including 1) off track eating and drinking events/days 2) days the scale shows changes not in their favour and 3) Events when exposed to their image as in a mirror, photo or reflections in building.
- Explain how each of these setbacks may automatically generate patterns of thinking that demotivate.
- Conduct CBT by scapturing the current "self critical thinking" patterns that occur in the event of setbacks and help develop alternative fact based thoughts, minimizing demotivation and enabling learning and skill development.
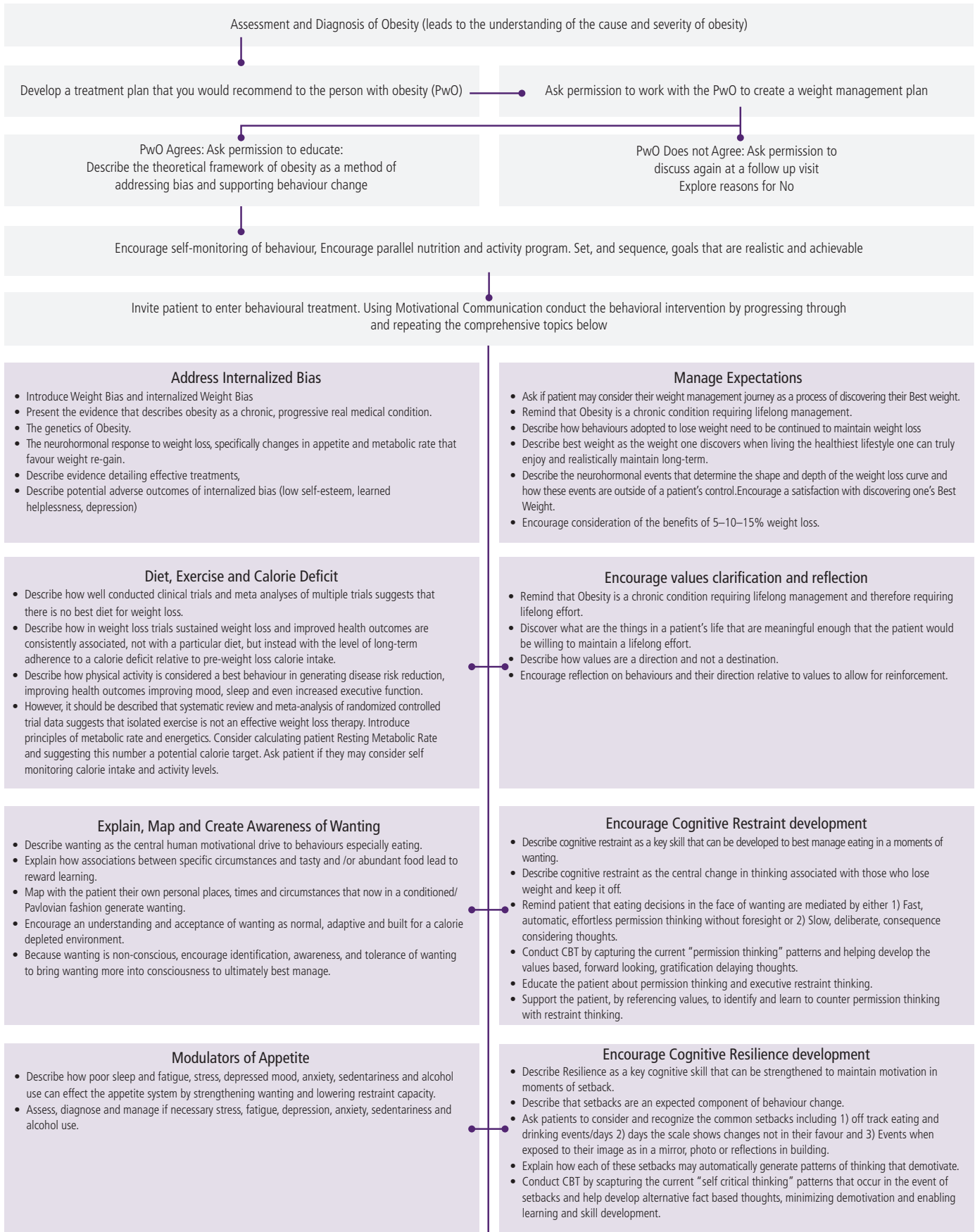
Table 1: Evidence review

Recommendations for primary care providers working in solo practices, teams and obesity management specialty services were based on a systematic review of the literature.

MAIN FINDING		EVIDENCE LEVEL
Multicomponent behavioural interventions implemented by trained individuals (regulated providers) focused on calorie restriction and energy expenditure are effective:	In producing modest weight loss in individuals with overweight and obesity.[1–7]	LEVEL 1A – GRADE A
	In producing improved health status and quality of life.[3,8]	LEVEL 1A – GRADE A
	Healthcare providers can be trained to effectively implement the wide range of behavioural interventions available.[14, 18–25]	LEVEL 1B – GRADE A
	The use of technology, such as interactive websites or mobile devices are effective as adjuncts to in person delivery of behavioural interventions (more research needed).[26,27]	LEVEL 1B – GRADE A
A number of specific behavioural interventions have been demonstrated to be effective, including self-monitoring, goal setting and action planning, reinforcement management, social comparison, cognitive restructuring and motivational interviewing.[9,10,14,15]		LEVEL 1A – GRADE A
	Behavioural interventions that impact adherence, self-efficacy and autonomous (intrinsic) motivation are associated with the best long-term outcome.[9–13]	LEVEL 1B – GRADE A
Providers should be informed about the powerful neurobiological underpinnings of the drive to eat (food cravings) as well as the power of food as a reinforcement (associative learning). This information should be used to establish a nonjudgmental understanding of the barriers to change in the individual living with obesity (reducing stigma) and aid in the identification of behavioural goals that are achievable in the context of the strength of this drive. [28–31]		LEVEL 1A – GRADE A
	Behavioural interventions that strengthen restraint (self-regulation) improve outcomes, particularly in those who report strong food cravings.[32–34]	LEVEL 2 – GRADE B
	Acceptance and commitment therapies are value-added adjuncts to multi-component behavioural interventions.[35,36]	LEVEL 2 – GRADE B
	Self-bias is common and may affect outcomes. Assessing for internalized weight bias is recommended to aid with reducing bias and encouraging achievable expectations.[37–39]	LEVEL 2 – GRADE B
	Coping strategies consistent with the principles of cognitive behaviour therapy and acceptance and commitment therapy can help mitigate against internalized weight bias.[37,40,41]	LEVEL 1B – GRADE A
	Excessive weight loss expectations do not appear to be a deterrent to behavioural interventions.[16,17]	LEVEL 1B – GRADE A
	Satisfaction with weight loss is associated with improved outcomes and can be encouraged as an alternative goal to achieving a specific weight.[42–43]	LEVEL 1B – GRADE A

Definitions

Behavioural interventions have been traditionally seen as nutrition and exercise programs (i.e. lifestyle interventions). In this guideline we have decided to replace the term "lifestyle interventions" with "behavioural interventions".

Behavioural change interventions are programs that help patients reach their health behaviour goals (nutrition, physical activity, sleep, stress reduction, etc.) or health goals (e.g. improved quality of life, obesity management, etc). In this guideline, we call them "behavioural change interventions" which include programs that offer obesity management and standard behaviour therapy such as goal setting, self-monitoring, stimulus control, problem solving, cognitive restructuring and relapse prevention.

Multicomponent psychological and/or behavioural therapy is one of the core evidence-based treatment modalities in obesity management, along with pharmacotherapy and surgery. Multicomponent psychological and behavioural therapy/interventions are theory-driven programs. In this guideline, psychological therapy includes interventions such as CBT, Acceptance Therapy, etc. Behavioural therapy includes strategies such as goal setting, self-monitoring, stimulus control, problem solving, cognitive restructuring and relapse prevention. So, as with pharmacotherapy and surgery, not all patients may need psychological or behavioural therapy.

Introduction

With obesity being understood as a chronic medical disease and With obesity being understood as a chronic medical disease and not simply a consequence of poor health behaviour choices, obesity management takes on many of the principles of chronic disease management.[44] There are several implications of this chronic disease perspective that are noteworthy with regard to psychological interventions for obesity management.

First, as with other chronic conditions, the outcomes that are desired from obesity management interventions are primarily determined not by what the clinician does inside the visit but by the behavioural choices the individual makes outside of the clinic and within the context of their lives.[45,46] As such, it needs to be recognized with psychological and behavioural interventions that outcomes are dependent on what the person living with obesity is able to do (behavioural adherence), not what the clinician does. Early literature on behavioural treatments did not make this distinction; rather, there was a focus on interventions as characterized by the nature of the changes desired by the clinician. Early studies described behavioural interventions as nutrition or exercise interventions, in which specific behaviours were recommended to the patient and the intervention was dominated by delivering these behavioural instructions to patients. The evidence supported that such interventions were effective, at least in the short term, while participants were engaged with clinicians around the recommended behaviours. Over time, the focus expanded to address behavioural strategies that were designed to overcome barriers to the recommended behaviours.

Such studies would describe their intervention as nutrition interventions and/or exercise combined with behavioural strategies such as goal setting, self-monitoring, problem solving, cognitive restructuring, etc. These interventions are described as multicomponent behavioural interventions.[47,48]

More recent literature has linked interventions to behavioural and psychological theory and have also begun to examine the mediators of change; that is, what are the behavioural strategies most likely to be associated with success? So, as behavioural interventions have matured, nutrition interventions and exercise are not seen as the independent variable (the treatment), but as the dependent variable (the outcome). The independent variables are the theory-driven behavioural methods designed to change eating and activity behaviours.

Second, when obesity management is framed in the context of chronicity and patient centricity, it becomes important to view sustained behaviour and psychological change as the ultimate goal. This again supports a shift from what the clinician is doing to what the patient is able to sustain in the long run. Behavioural and psychological theories that address constructs such as self-efficacy (confidence to perform a behaviour in the face of barriers), intrinsic motivation and readiness to change support this shift from short-term (following the instructions of the clinician) to long-term change (identifying and committing to a behavioural pathway that can be incorporated into one's lifestyle). As well, the behavioural aspects of managing obesity as a chronic condition support a broad perspective on behaviour. That is, obesity management behaviours go beyond nutrition interventions and exercise to include adherence to medication and/or surgery protocols when they are relevant. One way of conceptualizing this is to see behavioural interventions as impacting behaviour – or the "doing" component of obesity management.[49,50]

What is the evidence that psychological and behavioural interventions positively impact what individuals living with obesity actually do, and does this impact health, function, quality of life and weight positively? We will examine the literature from two perspectives. First, evaluating the existing literature to determine the evidence that multicomponent behavioural interventions positively impact weight and associated health outcomes. Because this literature is extensive, it is also possible to examine the changes, both behavioural (e.g., regular self-weighing) and psychological (e.g., intrinsic motivation), associated with success. Second, we will examine the moderators that impact the "doing" component. There are several important contextual factors that impact sustained health behaviour change. Reflective processing of experience raises issues such as self-bias, expectations and satisfaction with outcomes and how these moderate the success of behavioural interventions. Such processing illustrates how important psychological change is to successful behavioural management. Associative learning involves awareness of the wanting (cravings, reward dynamics of food) and thinking (permission thoughts) components of eating and reflects neurobiological (both bottom up and top down) and social factors that should be addressed in interventions to promote sustained behaviour change. Psychological values-based behaviour links behaviour change interventions to self-bias/self-esteem and intrinsic motivation.

It bears emphasizing that the outcomes of behavioural interventions go beyond weight loss. As obesity is accepted as a chronic disease, the complexity of obesity must also be recognized. Psychological and behavioural interventions are designed to change behaviour and adaptation. The impact of behaviour change on weight is complex. Success in obesity management is broader than weight loss and should be expanded to include health behaviour change, psychosocial functioning and quality of life. While this perspective is consistent with current views of obesity, until recently most of the research in the area has been selectively focused on weight and associated biomedical outcomes as the primary outcome measures. For this chapter, interventions that change behaviour and impact quality of life and function, independent of weight outcomes, will be considered successful.

To understand the evidence around psychological and behavioural interventions for obesity it is critical to incorporate two of the most basic and scientifically validated models of understanding and modifying behaviours: the classical conditioning and the operant conditioning paradigms. Classical conditioning is based on associationism and dominates behaviour.[48,51–53] Habits are based on this model. Classical conditioning is critical to understanding obesity because food is one of the most powerful reinforcers, and there is evidence to support that this is hard-wired in the brain. Second, operant (Skinnerian) conditioning also dominates our understanding of behaviour. Operant conditioning reflects reinforcement paradigms. That is, if a behaviour is associated with perceived positive consequences (either by the addition of a positive event or the removal of a negative event, which is called reinforcement) the signal strength of that behaviour increases and the behaviour is likely to continue. Conversely, if a behaviour is associated with perceived negative consequences (either by the addition of a negative event or the removal of a positive event, which is called punishment) the signal strength of that behaviour decreases and the behaviour is less likely to continue. Consider, for example, the experience of the weight plateau. When a person has been putting significant effort into weight loss and then weight reaches a plateau, will they continue with the behaviours associated with the heretofore positive outcomes, or stop the behaviours? If they perceive the plateau as failure, they are likely to stop (because the reinforcement stopped i.e., punishment). If they were to grasp the concept of "best weight" and view the plateau as success (reinforcement) they would likely continue. Many of the cognitive interventions in obesity management are designed to help the patient reframe experiences from a negative (punishment) to a more positive (reinforcement) interpretive context. It can be seen here that behaviour and psychology are heavily intertwined.

Psychological and behavioural interventions for obesity management have evolved to become multicomponent interventions, with the three main components being dietary goals, exercise/activity goals, and psychological and behaviour change strategies to support these goals. As noted above, the specifics of the nutrition and exercise goals differ from trial to trial (e.g., low carb approach, intermittent fasting, the Mediterranean diet, etc.) but share the behavioural goal of a change in eating and activity. Standard behavioural therapy strategies include goal setting, self-monitoring, stimulus control, problem solving, cognitive restructuring and relapse prevention.

The field had been lacking an organized approach to behaviour change techniques for some time. Susan Michie and her colleagues in the United Kingdom have developed taxonomies to categorize the variety of behaviour change techniques. This has been adapted for use in obesity. The original taxonomy, created by Abraham and Michie,[54] has been revised[55] and renamed the the **C**oventry, **A**berdeen and **L**ondon – **R**efined (CALO – RE) taxonomy. Table 2 shows the 40 operationalized strategies for behavioural interventions in obesity.

A final comment about terminology is necessary. People use terms such as lifestyle interventions, behavioural change programs, behavioural interventions, psychological therapy, etc. interchangeably. This issue has been addressed in a previous publication[45] in which i) behaviour change refers to new patient behaviours consistent with healthcare professional (HCP) recommendations (e.g., stopping smoking); ii) behaviour change theories are models of how behaviour arises and can be altered (e.g., stages of change); iii) behaviour change interventions (methods) are coordinated activities to change behaviour (e.g., the 5As of smoking cessation); and iv) behaviour change counselling is the intervention, knowledge and skills of HCPs that foster behaviour change via the patient-provider relationship. Behaviour change counselling defines how HCPs guide individuals from not doing to doing the recommended behaviour. Behaviour change counselling relies on theories and interventions to facilitate behaviour change and does so by identifying sequential steps that guide the provider to empower the individual to engage in and sustain health behaviours in the face of barriers. It is sustained health behaviours that define lifestyle. So, the process of behaviour change is a psychological process with a focus on the behaviours of the individual. In this chapter we will use the terms psychological and behavioural interventions.

Are psychological and behavioural interventions effective as treatment for obesity in adults?

Many studies have examined the impact of multicomponent behavioural interventions for obesity management. Several meta-analyses confirm that such multicomponent interventions, with a focus on calorie-reduced diet and increased physical activity as the main behavioural outcome goals, achieved through behavioural interventions, are effective in producing positive weight change and improving health and quality of life.

What is the evidence for positive weight change?

Soderlund et al.[56] conducted a systematic review of interventions built around increased physical activity as the main behavioural goal. This review concluded that the most successful interventions were those that combined physical activity with a focus on nutrition interventions and using behaviour therapy interventions.

Ramage et al.[1] performed a systematic review of diet interventions, that also included physical activity using behaviour therapy interventions. They concluded that the strongest evidence, both for obesity management and weight loss maintenance, was the combined diet, physical activity and behaviour therapy approach. In a systematic review, Johns et al.[2] examined single versus multicomponent interventions and concluded that, while short-term impact can be similar between single and multicomponent interventions (especially for diet), long-term outcome was better with multicomponent interventions. Lv et al.[3] conducted a systematic review of behavioural interventions in those living with moderate and severe obesity. Of the behavioural interventions reviewed, they reported 32%–97% of interventions achieved 5% weight loss while 3%–70% achieved 10% weight loss and concluded that behavioural interventions were effective in achieving modest weight loss.

Hassan et al.[4] examined the impact of behavioural interventions with severe obesity (BMI > 40) in a systematic review and concluded that multicomponent interventions were effective. These findings were confirmed by Dombrowski et al.[5] in another systematic review of behavioural interventions for obesity management. Seo and Sa[6] performed a meta-analysis of obesity management interventions in minority samples and concluded that moderate weight loss resulted from multicomponent behavioural interventions. Witham and Avenill[7] found evidence for moderate weight loss in seniors with overweight and obesity.

Several systematic reviews of multicomponent psychological and behavioural interventions implemented in real world primary care contexts have also been conducted. Hartmann-Boyce et al.[9] found evidence for multicomponent psychological and behavioural interventions implemented in commercial programs but not within primary care settings. Booth et al.[57] conducted a systematic review of behavioural interventions in primary care and found a slightly more positive outcome (small amount of weight loss) but noted a lack of theory-based psychological and behavioural interventions. Barnes and Ivezaj[58] conducted a systematic review of motivational interviewing-based interventions and reported little attention to treatment fidelity and variable results across studies. About half of the studies showed superiority of motivational interviewing and half failed to find differences from controls. It appears that more work needs to be done in primary care applications of psychological and behavioural interventions, likely work that focuses on fidelity to, and competency in, the delivery of the interventions.

Due to the past near-selective focus on weight loss as the primary outcome measure there is less literature examining the non-weight outcomes of obesity management: health, function and quality of life. Soderlund et al.'s[56] systematic review of activity-based interventions suggested that improved fitness resulted from interventions. Ramage's[1] and Hassan's[4] systematic reviews indicated improved health indicators associated with the intervention (e.g., cholesterol, HDL/LDL, BP). Quality of life was seen to improve according to the Hassan systematic review.

Meta-analyses and systematic reviews provide the highest level of evidence to support the efficacy of psychological and behavioural interventions for obesity management. However, the results of the Look AHEAD (Action for Health in Diabetes) trial, a large scale, multi-centred, randomized clinical trial that operationalized intensive behaviour therapy, are worth presenting separately.[8] In this eight-year study, 5,145 adults with overweight and obesity and type 2 diabetes were randomized to intensive lifestyle intervention or usual diabetes support and education. The lifestyle intervention in this trial can be considered state-of-the-art implementation of a multicomponent psychological and behavioural intervention. Experienced interventionists (monitored over time for the maintenance of competency) implemented group and individual sessions. In the first six months there were three group and one individual session(s) each month. Monthly individual sessions continued to month 12, but group sessions were reduced to two per month. Calorie restriction using meal plans and meal replacements along with unsupervised exercise were the target behaviours to support a goal of 7% weight loss at one year. In years two to eight, the focus of intervention was on weight and activity maintenance as well as overcoming barriers. Individual face-to-face and remote sessions and a group session occurred monthly. Psychological and behavioural interventions were based on cognitive behaviour therapy, problem solving and motivational interviewing, and were supported by a toolbox of intensive behavioural interventions (Table 2). After eight years, the lifestyle group continued to be superior to the control condition. Further, 37.9% of this group maintain a weight loss of greater than 10%. Of those that lost 10% or more by year one, 39.3% maintained this loss by year eight (average weight loss 16%). Maintenance of weight loss was associated with increased physical activity, reduced calories, use of meal replacements, regular weight monitoring and attendance at counselling visits.

Although not specific to obesity, the United States Preventive Services Task Force in 2017 updated its systematic review of behavioural counselling to promote healthy eating and physical activity for cardiovascular risk reduction in adults without known cardiovascular risks.[59] They concluded:

"The results of our updated systematic review are generally consistent in magnitude with our 2010 review on this topic. In general, nutrition interventions and physical activity behavioural interventions for generally unselected adults who were not targeted for counselling based on their cardiovascular disease risk resulted in consistent modest benefits across a variety of important intermediate health outcomes, including blood pressure, low-density lipoprotein, and total cholesterol levels as well as adiposity, with evidence of a dose response effect with higher intensity interventions resulting in greater improvements. Small-to-moderate improvements were also seen in dietary and physical activity behaviours. Very limited evidence exists on health outcomes or harmful effects of these interventions. The improvements we saw, however, in intermediate and behavioural health outcomes could translate into long-term reduction in cardiovascular disease-related events, with minimal to no harms, if such changes were maintained over time."

There has been recent interest in behavioural interventions for obesity being delivered using technology, including phone

counselling and online and app-based methods for delivering behavioural interventions. Although there is currently little literature on using technology in obesity management specifically, there are several systematic reviews looking at the use of innovative technology to deliver behavioural interventions. Okorodudu et al.[60] conducted a systematic review of web-based interventions, mobile health interventions (phone, tablet) and active video game interventions. They were able to review seven systematic reviews/meta-analyses of web-based interventions. Evidence suggests that web-based interventions can lead to positive outcomes, although not at the level of in-person interventions and are dependent on frequency of use. Literature on the use of mobile technologies is less extensive than web-based, but Okorodudu et al.60 conclude that there is value in such interventions, although more research is needed. Active video game-based interventions have been focused on children and adolescents and are outside of the scope of this chapter.

Tang et al.[26] reported a systematic review of reviews of interactive websites, smartphone applications and text messaging interventions. They concluded that the findings were mixed but promising. Self-directed interventions were able to independently promote weight loss and can augment personal contact interventions. Individualized feedback, email counselling and online social support appear to be particularly helpful. Semper et al.[27] report a systematic review of smartphone applications to promote dietary self-regulation for obesity management. Six relevant studies were identified for which goal setting was central to the intervention. The reviewers conclude that smartphone applications are effective at supporting obesity management, although future research is needed.
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What are the effective strategies associated with successful psychological and behavioural intervention for obesity management?

Given that multicomponent psychological and behavioural interventions are evidence-based, addressing the question of which behaviour change strategies are most effective is relevant. There is a substantial literature examining this issue, and we have the benefit of multiple systematic reviews.

Hartmann-Boyce et al.[9] investigated behavioural techniques and modes of delivery as they impact obesity interventions. They note that most behavioural interventions do not use the wide variety of behaviour change strategies available but focus on goal setting and action planning as well as self-monitoring and feedback (see the CALO-RE taxonomy, Table 2). Nonetheless, calorie counting, visiting a dietitian and social comparison activities were associated with greater weight loss in this systematic review. Samdal et al.[10] reported that the total number of behaviour change techniques, and the use of goal setting, behaviour shaping and stimulus control was associated with greater behaviour change in their systematic

review. This was especially true if person-centred psychological methods such as motivational interviewing and autonomy support were integrated into the intervention.

Olander et al.[61] conducted a systematic review to determine the behaviour change interventions associated with improved self-efficacy and physical activity in behavioural treatments for obesity. Changes in self-efficacy were associated with action planning, time management, self-monitoring and social support. There were numerous behaviour change techniques associated with increased physical activity, with the largest effects for prompting use of cues (stimulus control), prompting practice (action planning) and prompting rewards (reinforcement management). In their systematic review, Burgess et al.[13] reported session attendance and increased physical activity was associated with the use of motivational interviewing, goal setting, problem solving, stimulus control, relapse prevention, behavioural contracting, dissociation, cognitive restructuring and self-reinforcement.

Teixeira et al.[11] conducted a systematic review of what they called self-regulation mediators of the success of behavioural interventions in obesity. They reported that medium/long-term weight control was associated with self-efficacy, self-regulation (self-monitoring), flexible eating restraint and positive body image. Increased physical activity was mediated by autonomous motivation, self-efficacy and self-regulation. No clear mediators of diet changes were found in this study. Jacob et al.[15] conducted a systematic review of cognitive behavioural therapy interventions for weight control and concluded that there was evidence for the overall efficacy of cognitive behaviour therapy for weight, cognitive restraint and emotional eating. Zheng et al.'s[62] systematic review of self-weighing as a behavioural intervention supported regular self-weighing (greater weight loss without negative emotional effects such as anxiety or depression).

The majority of psychological and behavioural interventions in this area have focused on weight loss, as noted above. Clifford et al.[63] conducted a systematic review on the effect of non-diet approaches on attitudes, behaviour and health. Fourteen randomized control trials and two quasi-experimental studies were identified. While limited by inconsistent definitions of the intervention and disparate outcome measures, this review found that non-diet interventions led to improvements in disordered eating, self-esteem and depression. None of the interventions resulted in weight gain or worsening of blood pressure, glucose or cholesterol. Chao[64] completed a systematic review and meta-analysis of the impact of obesity management interventions on body image. Seven studies were available for review, four of these meta-analyses. Evidence on body shape concern, body size dissatisfaction and body satisfaction suggested that the intervention was effective relative to the control condition.

Burgess et al.[12] conducted a systematic review of factors that impair adherence to obesity management interventions. They conclude that the main barriers to behavioural intervention in adults with obesity are poor motivation, lack of time, environmental, societal and social pressures, health and physical limitations, negative

thoughts/moods, socioeconomic constraints, gaps in knowledge/ lack of awareness and lack of enjoyment of exercise. Further, the most prominent predictors of adherence in adults with obesity are early weight loss success, lower baseline BMI, better baseline mood, being male and older age.

Evidence for addressing reflective psychological processing in behavioural obesity management

Behavioural interventions represent a pathway to changes in behavioural choices on a moment-to-moment, day-to-day basis. However, behaviour needs to be put in context with other aspects of psychological functioning. In particular, humans engage in cognitive-affective processes at the same time that they engage in behaviour. A core construct in psychology is how behaviour, affect and cognition are co-occurring processes. This is relevant for obesity management in that there are several important cognitive/affective psychological processes that can impact on obesity management behaviours. In particular, the experience of self-bias and weight loss expectations/evaluations are specific reflective processing characteristics. These need to be understood in promoting a behavioural pathway that is patient-centred and empowering, two core aspects of the self-management of chronic conditions like obesity.

Self-bias in obesity

An important and understudied construct in obesity-related behaviour change is weight bias, which is defined broadly as the negative attitudes and social stereotypes held about people with obesity. Explicit weight bias is the conscious, clear, demonstrated bias against individuals with obesity, while implicit weight bias encompasses the automatic unconscious thoughts typically associated with social prejudices. Internalized weight bias is the extent to which individuals living with obesity endorse negative weight-biased beliefs about themselves. Few studies have explored the relationship between obesity management and weight bias, and even fewer have considered the influence of internalized weight bias. Yet, intrinsic motivation and self-efficacy appear to be central mediators of sustained behaviour change. Further, improved quality of life is a critical outcome for obesity management interventions. As such, it stands to reason that effective behavioural interventions should contribute to reduced internalized obesity bias for these outcomes to be achieved.

Internalized weight bias has been shown to have negative impact on outcomes that have conventionally been associated with the management of obesity. Importantly, and contrary to popular belief, weight bias does not encourage positive behaviour change. We know that when a goal is activated while negative affect is present, motivation tends to wane. This makes sense from the perspective of escape behaviour. That is, when a person is in a negative emotional state, they are motivated to get rid of the negative emotion. Once the negative emotion is gone, the motivation for that behaviour is also gone. This is antithetical to sustained

behaviour, which often occurs in the face of barriers (self-efficacy). Because of the emerging evidence about the negative psychological and affective consequences of weight bias[38,39,65] (explicit and internalized), it is an important consideration in behaviour change strategies with people with obesity. For example, individuals with higher internalized weight bias report less weight loss, lower physical activity levels, higher caloric intake, greater disordered eating behaviours[66] and even greater cardiometabolic risk.[67]

Carels et al.[68] explored the impact of explicit and implicit weight bias on weight loss outcomes in 46 healthy adults (non-smokers, free from cardiovascular disease and diabetes) classified as living with overweight or obesity (BMI> 27). Participants reporting less explicit weight bias at baseline had lower drop out from the behaviour change program. Higher weight bias scores were associated with less weight loss. More recently, Latner et al.[69] examined internalized weight bias with 81 women with obesity with similar results. High internalized weight bias showed associations with poorer quality of life (physical and mental). More interesting: the association between higher BMI and poorer physical quality of life was found only in individuals with high levels of internalized weight bias. In fact, recent randomized control studiese.g.,[41] indicate that weight bias harms healthy eating behaviours. Mensinger et al.38 demonstrated that across two different programs (one conventional weight loss program and one weight neutral program) internalized weight bias moderated results. Women (n=80; BMI> 30) with high internalized weight bias showed less improvement in eating behaviours and disordered eating regardless of program type versus women with low internalized weight bias. Addressing internalized weight bias in a targeted and specific way may be a helpful addition to any behaviour change program.

Taken together, these studies suggest that it may be important to assess the internalized weight bias and the meaning of weight for people with obesity, particularly because of the moderating effects weight bias has demonstrated in the emergent literature. Targeting internalized weight bias as a variable of interest would address multiple forms of weight stigma (explicit and internalized) and potentially improve intended health outcomes (i.e., quality of life, psychological distress). At minimum, obesity management strategies may not be maximizing the potential benefits of a given behavioural intervention by ignoring internalized weight bias. Clinicians would be advised to address internalized weight bias as par for the course of any psychological or behavioural intervention (i.e., self-compassion as a resource;[70] inducing empathy and influencing controllability attributions;[40] and careful and considered use of language).[71] Addressing self-esteem as part of any obesity management intervention is likely to be of benefit to the individual.

Weight loss expectations/evaluations

It has generally been established that individuals living with obesity who pursue treatment have expectations of weight loss that exceed what obesity management interventions are capable of achieving. Foster et al.[72] reported in a behavioural trial that goal weight loss in their sample was 32% of initial weight. Wadden et al.[73] evaluated the weight loss expectations of a group of women

participating in a medication trial and reported that, at baseline, these women were expecting to lose approximately 25% of their weight. Despite these high expectations, when satisfaction with weight loss was assessed, those in the drug plus behavioural and combined groups reported high levels of satisfaction. Linne et al.[17] collected data on expectations from a clinical day unit in Sweden offering an intensive behavioural intervention over three years (real world sample). At entry into the clinic the weight loss expectation for women was 32% and for men 29% of initial weight. They did not find a relationship between degree of weight loss expectations and weight lost during the program. Fabricatore et al.[74] assessed weight loss goals (desired weight loss irrespective of treatment) from weight loss expectations (anticipated weight loss given a specific treatment). Generally, expectations were lower than goals (20.9% versus 30.6%) and both were higher for women and those with higher BMIs. As the trial progressed, unmet expectations were not associated with attrition, nor weight outcomes but were associated with satisfaction.

Gorin et al.[75] did not find that unmet expectations were related to maintenance of weight loss in a group who were successful at weight loss. They did report that, despite having lost 19% at entry into this maintenance trial, 86% of the group were not satisfied. Dutton et al.[16] replicated the unrealistic weight loss expectations in a more real-world sample, a managed care organization in the US, where 10.4% weight loss was seen as disappointing, 19.7% as acceptable, 25.2% as happy and 30.9% as dream weight loss. Greater contact with a primary care provider was associated with more realistic weight loss expectations. Dalle Grave et al.[76] reported data on dropouts from Italian obesity clinics and found that dropouts reported greater expected weight loss at one year and lower dream weight than completers. Collectively these data suggest that, while weight loss expectations are exceedingly high in individuals living with obesity, these excessive expectations do not interfere with the success of interventions.

In contrast to weight loss expectations, which can be acknowledged as an issue but not seen as a major barrier to success, satisfaction with weight loss may be a more relevant construct to assess. Baldwin et al.[77] conducted a longitudinal study examining the relationships between satisfaction with weight loss (and weight changes over time) and weight loss outcomes and experiences, between and within individuals. These data showed that satisfaction was related to weight loss over the trial as well as to variables such as self-control, perceived attractiveness, positive feedback and improvement in clothes fitting (outcome variables). Level of effort and thinking about weight loss successes were positively associated with satisfaction, whereas level of frustration was negatively associated with satisfaction. Ames et al.[78] similarly found that lower levels of satisfaction with weight loss at the end of a low-calorie meal replacement intervention were associated with attrition from a behavioural follow-up intervention. Finch et al.[42] suggested that weight loss expectations might facilitate initiation of behaviour change, whereas weight loss satisfaction might maintain the behaviours associated with obesity management. In a prospective study they were able to show a relationship between satisfaction with weight loss and subsequent weight, both

between as well as within subjects. Foster et al.[79] also reported in a small study that satisfaction with weight loss at week 40 predicted maintenance of weight loss at week 92. Calugi et al.[43] reported that satisfaction with weight loss predicted weight maintenance in those with severe obesity (BMI > 40 or >35 with comorbidities). Jeffrey et al.[80] tried unsuccessfully to increase satisfaction with weight outcomes in randomized clinical trial.

This review of the psychological constructs of expectations and satisfaction can be informed by the literature on eating disorders, where expectations have also been examined. Polivy[81] has coined the term "false hope syndrome" in this area. The false hope syndrome results from excessive expectations of self-change, setting the person up for failure and leading to additional attempts to change, with a consequent negative psychological impact on the person.

Evidence for addressing associative learning in behavioural obesity management

Obesity is a consequence of energy intake that surpasses physiological need. Calorie intake in excess of energy needs often occurs in the absence of true physiological hunger. Sensory properties of palatable food have been suggested to promote the desire to eat independent of actual energy needs.[28,30] Not surprisingly, the reinforcing value of food is associated with BMI[82,83] and predicts weight gain in children and adults.[84,85] Evidence suggests that the appetite system is highly responsive to signals of palatable food available in the environment, and palatable food cues can overwhelm the body's homeostatic satiety mechanisms.[29,86] These food cues become powerful conditioned stimuli that drive eating behaviour through associative learning (classical conditioning).

Individual differences exist in reward sensitivity, a term which speaks to

(1) the sensory, primarily opioid based, pleasure associated with eating (the liking response);[87] and

(2) the degree to which food and food cues elicit the motivation to eat (the wanting) and (3) the degree to which associative learning takes place in any individual.[88]

Studies have linked food reward sensitivity to stronger food cravings, which strengthens the argument that due to associative learning eating behaviour may be unlike other behaviours in its intrinsic drive strength.[89,90] The strength of this food drive is associated with food intake in laboratory studies[31] as well as higher body weights in children and adults.[91,92] It has been shown specifically that energy intake mediates the relationship between reward sensitivity and BMI.[93]

The wanting/motivational component of reward sensitivity is primarily anatomically associated with the brain's mesolimbic dopamine

system. The brain's reward circuitry also mediates the drives that motivate behaviours of sex, gambling, alcohol, smoking, shopping and substance use.[88] This wanting (dopamine circuitry) is characterized by associative learning, or reward learning. Repeated exposure to food reinforcers, internal stimuli or, even more effectively, external environmental stimuli can gain the capacity to elicit dopamine release, creating conditioned cues that generate conditioned wanting.[94,95] Midbrain dopamine projection signalling associated with obesity is influenced by neurobiological and genetic factors.[96–102] In summary, there is clear evidence that reward sensitivity is a risk factor for weight gain and obesity, with the implication that behavioural initiatives to alter food intake should be informed by this powerful internal drive coupled with strong associative learning. This evidence supports the recommendation that individuals living with obesity should be informed about the powerful neurobiological underpinnings of the drive to eat (food cravings) and supported to develop behavioural coping skills to manage such drives.

The evidence for addressing self-regulation in behavioural obesity management

Evidence also supports the role of self-regulation or inhibitory processing as a moderator of obesity. Self-regulation or cognitive restraint are associated with resistance to weight gain and effectiveness of psychological and behavioural interventions.[33,34] Self-regulation as a trait is described as a key behavioural attribute of those who lose weight and keep it off.[32] Obesity management outcomes in behavioural interventions, including weight, health and quality of life improvements, are primarily a product of sustained adherence to any reduced energy diet[103,104] and not affected significantly by the type of diet.[105] Disruption in adherence, or lapses in self-regulation, are mostly a result of temptation to hyper palatable foods with high reinforcing value.[106,107]

Self-regulation/restraint skills represent a key human executive function, suggested to be governed primarily by the prefrontal cortex (PFC), that has the potential to be modifiable.[108,109] Self-regulation is considered a variable trait, with lower levels of self-regulation thought to increase vulnerability to slips in adherence when exposed to foods with high reinforcing value. Neuroimaging studies support this concept, showing that stronger prefrontal cortex activity following food intake is associated with lower BMI[110,111] decreased food craving[112] and successful weight loss.[32]

Taken together, interventions that focus on the skills of restraint and self-regulation in the face of wanting in reward sensitive individuals exposed to foods with high reinforcing qualities could support desired outcomes in the treatment of obesity.

Differences in reward sensitivity and self-regulation capacity have been demonstrated to be significant risk factors for weight gain and obesity. These frame a theoretical model where obesity risk is a product of interactions between a bottom up reward drive and a top down self-regulation system. Anatomical correlates are:

1) the brain's reward system mediated primarily by dopamine, launching from the midbrain; and

2) the top down regulation involving primarily the dorsolateral prefrontal cortex.

With this understanding, behavioural treatments that integrate this theoretical model could increase the effectiveness of obesity treatments.

Forman et al.[36] proposed a psychological treatment to "intensively focus on developing skills that teach individuals how to override drives and urges for pleasure." The suggestion of the Acceptance and Commitment Treatment (ACT) model is that adherence to a calorie deficit over the long-term is dependent on the ability to self-regulate in the face of biological predispositions and a pervasive cue-filled obesogenic environment. In this trial, Forman compared this acceptance-based methodology to the highly effective standard behavioural therapy exemplified by the Diabetes Prevention Program (DPP) and the Look AHEAD trials. Note the authors have described the Acceptance Based Treatment as built on top of and including key standard behavioural therapy treatment components – an addition rather than a rebuild. Participants assigned to Acceptance Based Treatment attained significantly greater 12 month mean weight loss (13.3%) compared with those assigned to standard behavioural therapy (9.8%). In addition to restraint over impulse skills, Butryn35 suggested that committing to specific behaviours which are clearly linked to a person's core values can be beneficial when confronted with difficult weight control situations. Butryn also suggested a significant benefit to metacognitive awareness of decision-making processes. Psychological interventions based on acceptance and commitment therapies should be considered as adjuncts to multicomponent behavioural interventions.

Table 2

CALO-RE Taxonomy of Behavioural Interventions for Obesity Management[28]

1 – Provide information on consequences in general	11 – Prompt review of outcome goals	21 – Provide instruction on how to perform the behaviour	31 – Prompt anticipated regret
2 – Provide information on consequences to the individual	12 – Prompt rewards contingent on progress	22 – Model the behaviour	32 – Fear arousal
3 – Provide information about others' approval	13 – Prompt rewards contingent on success	23 – Teach to use prompts / cues	33 – Prompt self-talk
4 – Provide information normative information about others	14 – Shaping	24 – Environmental restructuring	34 – Prompt use of imagery
5 – Set Behavioural goals	15 – Prompt generalization of a target behaviour	25 – Agree behavioural contract	35 – Relapse prevention / coping planning
6 – Set outcome goals	16 – Prompt self-monitoring of behaviour	26 – Prompt practice	36 – Stress management / emotion control training
7 – Action planning	17 – Prompt self-monitoring of outcome	27 – Use of follow-up prompts	37 – Motivational interviewing
8 – Barrier identification / Problem solving	18 – Prompt focus on past success	28 – Facilitate social comparison	38 – Time management
9 – Set graded tasks	19 – Prompt feedback on performance	29 – Plan social support / social change	39 – General communication skills training
10 – Prompt review of behavioural goals	20 – Provide information on where and when to perform behaviour	30 – Prompt identification as a role model	40 – Stimulate anticipation of future rewards

Correspondence:

guidelines@obesitynetwork.ca.

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