Refining Evidence Based Psychotherapy and Exercise Interventions for Clinical Depression in Adults with Overweight or Obesity

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This thesis is presented in partial fulfilment of the requirements for the Combined Master of Applied Psychology (Clinical) and Doctor of Philosophy, Murdoch University, 2018.
I declare that this thesis is my own account of my research and contains no material which has been accepted for the award of any other degree in any university.

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

Nick Buckley
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Dedication

For Timmy.
Statement of Contribution

The majority of work producing this dissertation was my own. This included being the lead investigator on the included research studies, recruiting participants, collecting psychometric and interview data, conducting data analysis and interpretation. I was the primary author on all chapters. Contributing authors are listed where applicable. My Supervisors, Dr. Helen Correia and Dr. Timothy Fairchild provided valuable input during the design of the four studies, reviewed each chapter and provided feedback throughout. Dr. Fairchild and Dr. Correia worked with me on the randomised controlled trial and Dr. Correia in developing qualitative themes for the mixed methods paper. Dr. Correia and Mr. Stefano Brini acted as second reviewers for the systematic and meta-analytic review and Mr. Brini assisted as a second reviewer on data extraction and charting of meta-analytic data.

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Abstract

Clinical depression and overweight or obesity (OW/OB) frequently co-occur. Either condition significantly increases risk of developing the other whilst being obese significantly reduces utilisation of psychotherapy. To date, the few interventions developed to treat clinical depression in adults with co-morbid OW/OB have combined standard interventions aimed at reducing depression or promoting weight loss from a conceptual framework based on depression and obesity as discrete conditions. The overall aim of the present research is to develop an integrated evidence-based program for clinical depression involving psychotherapy and regular exercise for adults with co-morbid OW/OB. We conducted a meta-analytic review investigating current treatments for symptoms of depression in adults with OW/OB. We compared three different exercise-based interventions among 36 adults with clinical depression and OW/OB in a randomised controlled clinical trial (RCT). To further understand the contributing factors influencing depression and treatment gains in this population, we conducted mixed methods research with a subgroup of participants who completed the RCT, including thematic analysis of 17 interviews. The findings from this research were then incorporated into a protocol paper for an RCT which will assess the impact of a tailored, evidence-based approach to treating clinical depression in overweight or obese adults. This novel approach combines elements of cognitive behaviour therapy, including schema, self-compassion and mindfulness-based approaches along with an evidence-based exercise program for depression.
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Chapter 1 – Introduction and Overview
1.1. Introduction

Clinical depression is a significant social, public health and economic issue in today’s society. Typically recurrent (Solomon et al., 2000), it is associated with substantially reduced functioning and quality of life, medical morbidity and mortality (Bromet et al., 2011; Ferrari et al., 2013; Spijker et al., 2004). An increasingly common comorbid condition is overweight or obesity (OW/OB) (de Wit et al., 2010; Faith et al., 2011; Luppino et al., 2010; Stunkard, Faith, & Allison, 2003) which itself represents a major public health and economic issue (Ruhm, 2012) and is associated with elevated mortality and higher rates of hypertension, diabetes, cancer and other diseases (Aballay, Eynard, Diaz Mdel, Navarro, & Munoz, 2013; Cameron, Shaw, & Zimmet, 2004; Kahn, Hull, & Utzschneider, 2006; Kannel, D'Agostino, & Cobb, 1996; Norberg & Danielsson, 2012). Despite substantial research presenting a clear bidirectional link between clinical depression and OW/OB, many individuals with clinical depression are routinely screened out of treatment trials involving individuals with OW/OB—even trials investigating psychological symptoms (e.g. Andersen et al., 1999; Annesi & Unruh, 2008; Rubin et al., 2005). As a result, there is a paucity of research on clinical interventions for this burgeoning population (Faulconbridge & Bechtel, 2014) who likely present with a unique set of psychological and physiological factors which perpetuate their clinical depression and OW/OB.

1.1.1. Clinical Depression: Definition and Prevalence

According to the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association 2013) an episode of clinical depression is primarily characterised by depressed or irritable mood and/or anhedonia or loss of interest in almost all activities. Changes may also occur in weight, appetite, activity levels, sleep patterns, increased fatigue or decreased energy level, feelings of excessive guilt or worthlessness, indecisiveness, difficulty concentrating and self-harm or suicidality. The average age of onset for a first episode of clinical depression is 25.7 years. The lifetime and 12-month prevalence
estimates for high income nations in Europe and the Americas are 14.6% and 5.5% respectively (Bromet et al., 2011). Twelve month prevalence rates in Australia (5.2%) are similar to other developed counties (Henderson, Andrews, & Hall, 2000). Approximately 85% individuals who have a first episode of depression will experience a subsequent episode in their lifetime and on average, individuals with clinical depression will have four episodes of depression of 20 weeks duration during their lifetime (Carr & McNulty, 2006). Given that symptoms of clinical depression include changes in activity and dietary behaviours, it is not surprising that the relationship between depression and OW/OB is receiving increasing interest in Western society.

1.1.2. **Overweight and Obesity: Definition and Prevalence**

Overweight (Body Mass Index, BMI\(^1 > 25\)) and Obesity (BMI > 30) are estimated to directly affect 36.9% of men and 29.8% of women in developed countries worldwide – almost one-third higher than in 1980 (Ng et al., 2014). Prevalence rates in Australasia (63 per cent) North America (65.4 per cent) and Western Europe (54.5 per cent) are much higher than the global average (Australian Bureau of Statistics, 2011; Ng et al., 2014). Approximately 35 per cent of Australians are overweight and 28 per cent obese. Although the prevalence of overweight in Australia has risen modestly since the 1980’s (from 28.6% to 35.0%) obesity has increased three-fold in the same period – from 9.4% to 28.0%.

Overweight and obesity increase risk for a variety of significant cardiovascular diseases, (Kannel et al., 1996; Norberg & Danielsson, 2012) cancers, (Aballay et al., 2013) Type 2 Diabetes, and metabolic syndrome (Aballay et al., 2013; Cameron et al., 2004; Kahn et al., 2006). Yet together, OW/OB are considered one of the most preventable health conditions in the Western world (National Heart Foundation of Australia, 2007).

1.2. **Comorbid Clinical Depression and Overweight or Obesity**

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\(^1\) BMI (Body Mass Index) is a commonly used index measure of weight and height (kg/m\(^2\)).
An important bi-directional relationship appears to exist between OW/OB and depression, with each condition increasing the risk for developing the other. In a meta-analytic review, Luppino et al., (2010) reported that individuals with depression at baseline were significantly more likely to be obese 11.6 years later than non-depressed peers (OR = 1.58, 95% CI 1.33 to 1.87). Similarly, a systematic review of prospective community-based and cohort studies conducted by Faith et al. (2011) identified that eight of 15 studies (53%) assessing progression along the depression-to-obesity pathway, reported depression as a significant predictor of obesity, with odds ratios generally between 2.0 and 3.0. This systematic review by Faith et al. (2011) also assessed progression along the obesity-to-depression pathway and found eight out of 10 studies reported significant associations. The corresponding adjusted odds ratios were generally between 1.0 and 2.0. Of particular note, the two studies with null findings were conducted in paediatric populations. Likewise, Luppino et al. (2010) found that individuals with baseline BMI > 25 were 1.55 times more likely to have depression at follow-up 12 years later compared to normal weight peers (95% CI 1.22 to 1.98). These results strongly suggest the possibility of an obesity-to-depression pathway.

Further evidence of these associations appears in clinical settings, where the prevalence of co-morbid depression and OW/OB is high. For example Stunkard et al. (2003) provided collaborative care management to adults diagnosed with either clinical depression or dysthymia, of whom over 72% were incidentally overweight or obese. Similarly, Simon et al. (2008) found that American women with moderate to severe symptoms of depression as measured on the Patient Health Questionnaire (PHQ) were almost 2.3 times more likely to be obese than women with no symptoms of depression in a community based survey. Strikingly, Simon et al. indicated that obese individuals in this cohort were almost four times more likely to be depressed than their non-obese peers. According to Carpenter, Hasin, Allison, and Faith (2000), such women may be at greater risk of suicidal ideation relative to normal weight.
peers (OR = 1.21, 95% CI 1.02 to 1.44). Whilst this research suggests it is highly likely a bi-
directional relationship exists between depression and obesity, there appear to be a myriad of
contributing factors, many of which are still being investigated and deserve further
exploration.

1.2.1. Risk Factors and Comorbidities of Depression in Overweight or Obese
Adults

A variety of risk and protective factors in the aetiology of depression have been
proposed. Genetics appear to play a role, with heritability estimates ranging from 40 to 70%
(Craddock & Forty, 2006). Carr and McNulty (2006) assert that a family history of mood or
anxiety disorders or trait neuroticism may increase risk for depression. Furthermore,
childhood adversity, poor parental care or negative parent-child relationships are additional
predisposing factors for depression, particularly in populations with co-morbid OW/OB
(D'Argenio et al., 2009; Faith, 2002; Stunkard et al., 2003). Female gender and low
socioeconomic status increase risk, especially for adults with co-morbid OW/OB (Faith,
2002).

Psychological factors. Severity of past major depression and major stressful life
events may predispose, precipitate or exacerbate depression (Faith, 2002; Stunkard et al.,
2003). Three or more prior episodes of depression, or having poor social support predisposes
individuals to further depression, even in response to more minor stressful life events (Carr &
McNulty, 2006). Symptoms of binge eating disorder (BED) or night eating syndrome are
particularly prevalent in populations with OW/OB and who experience depression.
Furthermore, binge-eating behaviours often precede the onset of depression in individuals
who are also OW/OB (Faith, 2002; Faulconbridge & Bechtel, 2014).

Specific cognitive factors such as negative internal verbal commentary, concern with
eating, weight and body shape, dietary restraint, body dissatisfaction and self-criticism/self-
doubt have been implicated in maintaining depression in OW/OB adults (Cooper & Fairburn,
2001; Decaluwé & Braet, 2005; Werrij et al., 2006). Interestingly, Wiltink et al. (2013) found a much stronger association between somatic-affective components of depression (e.g. lack of energy, fatigue) and obesity than cognitive-affective components. Research has linked the early maladaptive schemas of Mistrust/Abuse, Emotional Deprivation, Insufficient Self-Control, Failure, Abandonment/Instability and Enmeshment with clinical depression (Renner, Lobbestael, Peeters, Arntz, & Huibers, 2012) and to reduced quality of life in obese adults (Bidadian, Bahramizadeh, & Poursharifi, 2011) suggesting a unique constellation of core beliefs may contribute to both conditions. Taken together, somatic-affective factors and core schemas may be a priority target for intervention.

**Behavioural factors.** Depression has been conceptualised as a state in which an individual develops a narrow response class, with limited engagement in behaviours that elicit positive reinforcement (Turner & Leech, 2012). Indeed, reduced activity levels are associated with increased risk for depression in the general population (Lopresti, Hood, & Drummond, 2013), however, OW/OB populations may be at even greater risk. Research conducted by Vallance et al. (2011) indicated that sedentary OW/OB adults were at far greater risk for developing depression relative to OW/OB adults who engaged in regular moderate to vigorous exercise as measured by ActiGraph accelerometers (OR = 3.09, CI 95% 1.25 to 7.68). Sub-clinical binge eating behaviour is a significant risk factor for depression in overweight adults whilst anhedonia itself has been associated with uncontrolled eating, emotional eating and binge eating in the same population (Leehr et al., 2015). Such behaviours appear to temporarily improve mood. This also suggests the possibility of a downward spiral in which anhedonia and binge eating perpetuate each other (Keranen, Rasinaho, Hakko, Savolainen, & Lindeman, 2010). Chronic pain, sleep disturbance, weight discrimination, teasing and perceived negative verbal commentary, particularly in childhood and adolescence are common predisposing factors for depression in OW/OB adults, and are evident within an adult OW/OB population (Boutelle, Hannan, Fulkerson, Crow, & Stice,
2010; Gilbert, 2009; Luppino et al., 2010; Simon et al., 2008). Indeed, many of these factors increase the likelihood of social withdrawal (e.g. due to fatigue, pain or fear of teasing) and likely contribute to the emergence of unhelpful or self-critical cognitions described above. From the perspective of behavioural activation, such withdrawal would lead to a narrowing of response classes and reduced exposure to opportunities for positive reinforcement, subsequently increasing risk for depression and reduced activity (Turner & Leech, 2012).

**Physiological factors.** Increased levels of pro-inflammatory markers such as C-reactive protein (CRP), Interlukin-1 (IL-1), Interlukin-6 (IL-6) and Tumor necrosis factor-α (TNF- α) have been identified in individuals with depression and individuals with obesity, and have therefore been implicated in the development of each condition (Dowlati et al., 2010; Emery et al., 2007; Howren, Lamkin, & Suls, 2009; Liu, Ho, & Mak, 2012). In OW/OB, the major source of these pro-inflammatory markers are the adipocytes (adipose cells), with an accumulation of adipose tissue leading to increased circulating pro-inflammatory markers (Greenberg & Obin, 2006). Shelton and Miller (2011) proposed that this adiposity-induced pro-inflammatory state linked OW/OB and depression. Weight gain may also be induced via the effect of chronic inflammation on insulin and leptin resistance (Milaneschi et al., 2012; Shoelson, Lee, & Goldfine, 2006) both of which help regulate glucose and fat metabolism and suppress appetite respectively.

Increased adiposity has also been linked to stress reactivity, with Pasquali and Vicennati (2000) asserting that abdominal obesity dysregulates the hypothalamic-pituitary-adrenal axis leading to ‘functional hypercortisolism’ (i.e. supranormal cortisol production) further perpetuating weight gain via stress-induced calorie consumption (Epel, Lapidus, McEwen, & Brownell, 2001; Newman, O’Connor, & Conner, 2007). In patients with major depression, stress reactivity appears to be partially mediated by early-life stress and adverse events (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008; Pace et al., 2006). Given the association early-life events have with the aetiology of co-morbid depression and OW/OB,
this reinforces the probability of a mediating link between early-life stress (e.g. childhood teasing), current stress reactivity, systemic inflammation, obesity and depression (Miller & Cole, 2012). Furthermore, there is typically a significant reduction in adipose tissue, pro-inflammatory markers and symptoms of depression following weight loss and exercise interventions (Febbraio, 2007; Hamer, David Batty, & Kivimaki, 2011; Lopresti et al., 2013; Shelton & Miller, 2011; Vissers et al., 2013) indicating that treatments that target the cycle of inflammation, adiposity and depression require further investigation.

In summary, there are a range of genetic, experiential, psychological, behavioural and physiological risk factors and comorbidities associated with depression in overweight or obese adults. Discrimination, adolescent teasing and perceived negative verbal commentary are further predisposing factors for depression in OW/OB adults. Historical depression, negative internal verbal commentary, self-criticism, shame, body dissatisfaction and a range of early maladaptive schemas may contribute to and perpetuate depression in OW/OB persons. Uncontrolled eating, binge eating and reduced physical activity is associated with depression in OW/OB persons. Finally, a variety of associations have been described between adiposity, stress reactivity and systemic inflammation which may contribute to depression in OW/OB populations.

1.3. Current Treatments for Depression with Comorbid Overweight or Obesity

International guidelines for treatment of clinical depression - irrespective of an individual’s weight - frequently include cognitive behaviour therapy, behavioural activation or structured physical exercise at 45 minutes per week at least three times per week for 10 weeks or more (e.g. NICE, 2009; SIGN, 2010). Nevertheless, specific recommendations for individuals with co-morbid clinical depression and OW/OB are yet to be made. The OW/OB population may experience unique challenges not confronted by normal weight peers in engaging with and benefiting from various interventions. For example, depression often reduces motivation and engagement (Barlow, 2014; Beck, 1991; Carr & McNulty, 2006)
whilst weight related stigma is known to significantly impact treatment provision, experience and outcome (Fruh et al., 2016; Puhl & Heuer, 2010). Some clinicians describe that it can be difficult to activate a patient with depression and that low levels of general activity, low self-worth, helplessness, hopelessness and withdrawal make engagement especially difficult (Seime & Vicers, 2006). Indeed, for depressed persons, obesity is associated with a lower likelihood of receiving psychotherapy as treatment and with shorter than recommended durations of psychotherapy (Boudreau et al., 2013). This is not surprising in light of the predisposing factors discussed above – patients who have experienced discrimination, teasing, or frequent negative verbal commentary may fear further shame, criticism or failure (Carr & McNulty, 2006; Cooper & Fairburn, 2001; Decaluwe & Braet, 2005). These factors may contribute to poorer initiation of treatment seeking behaviour, lower adherence or reduced benefit from interventions - especially exercise interventions - which have experienced increasing research attention and popularity in the community, including popular media (e.g. Mosley, 2013; Otto & Smits, 2011).

Despite substantial research supporting a link between OW/OB and depression, weight is rarely a measure of interest in non-pharmacological treatment trials for depression (Aherne et al., 2017; Cuijpers et al., 2010) whilst individuals with clinical depression are regularly screened out of treatment trials involving OW/OB samples (e.g. Andersen et al., 1999; Annesi & Unruh, 2008; Rubin et al., 2005). Researchers indicate this is often because psychototropic medication can interfere with weight change, low mood can prompt relapse to over-eating, and depression can reduce adherence to interventions. As a result, much of the literature in this field is based on mood-change in sub-clinical or euthymic individuals (Faulconbridge & Bechtel, 2014). Whilst some weight-loss trials have been conducted on individuals with depression, (e.g. Linde et al., 2011) to our knowledge there are very few published papers investigating treatments for clinical depression in OW/OB adults. This
points to an important need for future research to investigate treatments for depression in OW/OB adults.

The fundamental approach to research to date investigating co-morbid depression and OW/OB seems to be one of component integration; i.e. combining existing evidence-based treatments for clinical depression (e.g. psychotherapy, pharmacotherapy or exercise) and OW/OB (e.g. lifestyle intervention or behavioural weight-loss) concurrently. Pioneering combined interventions in the field, Faulconbridge, Wadden, Berkowitz, Pulcini, and Treadwell (2011) implemented two concurrent evidence-based treatment approaches; CBT for depression and behavioural treatment for obesity. Twelve women with clinical depression and co-morbid OW/OB attended group sessions conducted by a Clinical Psychologist weekly for 16 weeks (n of 6 per group, 90mins sessions). Half of each session was devoted to weight management (LEARN program, Fairburn & Brownell, 2002) and half to CBT for depression. Seventy-five per cent of participants completed the program (n = 9) for whom scores on the HRSD reduced from an average of 20.4 to 9.3. Six of the nine completers achieved remission (score of < 8 on HRSD). In a similar study, Pagoto et al. (2013), randomly assigned 161 women with co-morbid obesity and depression to either Behavioural Activation, consisting of brief behaviour therapy for depression plus lifestyle intervention or Lifestyle Intervention alone over 6-months. The lifestyle intervention included recommendations regarding modifications for diet and exercise regimes. Depression scores (BDI-II) in the Behaviour Activation group (21.1 ± 5.7) and Lifestyle Intervention group (21.0 ± 5.9) reduced by 12.5 ± 0.8 and 9.2 ± 0.8 post intervention and were maintained at 6 months follow-up. Interestingly, the primary intervention arms implemented by Faulconbridge et al. and Pagoto et al.’s included a substantial component of regular exercise (approx. 150-180mins per week at a moderate intensity), although the component effect of exercise was not investigated further. Investigations into exercise interventions may be of particular interest for this population. First, as mentioned, regular exercise is recommended as part of clinical guidelines for
treatment of depression (e.g. NICE, 2009; SIGN, 2010). Second, regular exercise can potentially ameliorate the negative effects of adiposity, inflammation, low activity and depression (Febbraio, 2007; Ford, 2002).

Indeed, recent research has started combining incrementally refined modalities of treatment. For example, Berman, Morton, and Hegel (2015) discuss the development of an 11-week intervention program for women experiencing co-morbid clinical depression and OW/OB which integrates the acceptance-based Health at Every Size (HAES) paradigm and an evidence based cognitive-behavioural treatment for depression known as Acceptance and Commitment Therapy (ACT). Likewise, in a 12-month collaborative care model for primary care treatment of comorbid depression and obesity, Ma et al. (2015) outlined a yet to be conducted RCT investigating a technology enhanced (i.e. Fitbit, MyFitnessPal) treatment approach which integrates problem solving therapy, pharmacotherapy for depression and standard behavioural treatment for obesity. Despite these promising developments, utilising combined intervention options for clinical depression and OW/OB as discrete rather than co-morbid concerns are not yet optimal. Future treatment protocols could be refined following careful consideration of extant literature investigating treatments for depression in an OW/OB population.

These recent studies illustrate consecutive and concurrent treatment of depression and OW/OB is feasible and promising. Many of them utilised physical exercise. It remains unclear however, whether particular formats or types of exercise are more likely to increase engagement or treatment effect compared to alternative formats or types of exercise in OW/OB persons. The role of exercise as a treatment for depression in individuals with OW/OB therefore needs further attention.

1.3.1. Exercise for Depression

Research has indicated that exercise, i.e. planned, structured and repetitive bodily movement with the purpose of improving or maintaining one or more components of physical
fitness (Caspersen, Powell, & Christenson, 1985) may be a useful adjunctive approach to weight loss (Shaw, Gennat, O'Rourke, & Del Mar, 2006) and that CBT can be enhanced when a general “physical activity” program is included in therapy (Faulconbridge et al., 2011; Gary, Dunbar, Higgins, Musselman, & Smith, 2010). This is especially so when structured exercise is included (Cooney et al., 2013). Research illustrates that exercise can be as effective as psychotherapy or pharmacotherapy in treating adults with clinical depression (Cooney et al., 2013), reduces depression in SSRI resistant populations (Trivedi et al., 2011), allows for a reduction in anti-depressant medication and reduces relapse for depressed patients (Deslandes et al., 2009). Subsequently, treatment guidelines have recommended exercise as a treatment or adjunctive treatment for mild to moderate depression for some time now (e.g. NICE, 2009, SIGN, 2010). Given that exercise may reduce the negative effects of adiposity, inflammation, low activity and low mood inherent in a depressed, OW/OB population, it is an excellent contender for inclusion in treatment and is worthy of further investigation.

1.4. The Current Research

The overarching aim of the present research is to propose an evidence-based intervention for clinical depression in individuals with OW/OB. Given the previous literature, it was anticipated that the program would incorporate professionally delivered psychotherapy and regular supervised exercise, both tailored to this particular population. Therefore, the studies were developed with several key defined themes, outlined here and further elaborated in the description of studies below.

First, a critical aim was to systematically identify and evaluate existing interventions that are effective at reducing symptoms of depression in OW/OB adults. Such an analysis should help to inform the development of any future interventions. Second, given the likelihood that physical activity will be a component across intervention approaches (CBT, behavioural activation, structured exercise), and because exercise recommendations may
form part of primary care approaches (RACGP, 2018; Short et al., 2016; RACGP, 2018; Short et al., 2016). Another aim was to further explore exercise as a specific intervention in this population. Specifically, this included examining the feasibility and effectiveness of various exercise interventions with potential for suitability and efficacy in ameliorating clinical depression in OW/OB adults. In addition, to evaluate engagement and responsivity, another aim included identifying and elucidating important factors in intervention design and implementation pertaining to clinical depression and OW/OB, by exploring client (i.e. participant) experience in exercise interventions. Finally, a fourth outcome was to propose, by way of integrating the above research and findings, a protocol for a randomised controlled trial (RCT) to assess the impact of a coherent intervention which includes psychotherapy and exercise for clinical depression in OW/OB adults. In support of the aims outlined above, four studies were conducted. These are outlined below.

1.4.1. Overview of Studies

1.4.1.1. Study One

Study One (Chapter 2) – reports on a meta-analytic review exploring peer reviewed controlled trials investigating the efficacy of existing interventions on symptoms of depression in OW/OB adults. The meta-analytic review collates relevant intervention studies that might inform development of an evidenced based treatment program for depression in OW/OB adults. Because so few studies exist examining interventions for clinical depression in OW/OB adults, we expanded the pool of potential studies by screening any study measuring symptoms of depression as an outcome in this population. Our review suggests that various forms of pharmacotherapy, psychotherapy, exercise and lifestyle interventions hold promise for reducing symptoms of depression in OW/OB adults. At this stage, it seems the most beneficial treatments are those that include targeted treatment for depression (i.e.
cognitive behavioural approaches) alongside robust exercise and lifestyle modification programs. There is a clear need for further research on interventions specifically for clinical depression in OW/OB adults.

1.4.1.2. Study Two

Study Two (Chapter 3) includes an RCT examining the feasibility and efficacy of three formats of exercise interventions for clinical depression in OW/OB adults and associations between physiological variables and symptom reduction. Whilst a large body of research confirms that exercise is as effective as pharmacotherapy or psychotherapy in treatment of mild to moderate clinical depression and confers several health benefits to OW/OB persons (Cooney et al., 2013; Deslandes et al., 2009; Faulconbridge et al., 2011; Gary et al., 2010; Trivedi et al., 2011), little is known about whether such benefits confer to individuals with clinical depression and co-morbid OW/OB nor if these interventions are feasible within this population. Indeed, some recent commentary has suggested that certain formats of exercise e.g. high intensity intermittent exercise (HIIE), are not feasible for public health interventions (Biddle & Batterham, 2015) despite gaining increasing coverage in the general community and media (e.g. Mosley, 2013). Yet the impact of different formats on outcomes in this population remain relatively unknown. Given that exercise interventions may confer meaningful mood, metabolic and health benefits to a depressed person with OW/OB, it is important to address these questions. This RCT produced interesting findings. All formats of exercise had a similar effect on severity of depression, anxiety and stress and providing clinically significant change in depression severity in over half of participants who completed the 18-session trial. These findings help inform clinicians (general practitioners, psychiatrists, psychologists and exercise physiologists) that at least several types of exercise may be potentially beneficial for treating depression in adults with OW/OB, and that specific prescriptions beyond adequate intensity, volume and personal preference may not be
necessary. Our findings also show that HIIE is possible in an OW/OB population with clinical depression.

1.4.1.3. Study Three

The previously described study focused on clinical outcomes regarding depression, anxiety, stress and physiological variables of body composition and aerobic fitness over the course of an 18-session randomised controlled clinical trial of three exercise interventions for clinical depression in OW/OB adults. Yet exercise intervention studies that only examine outcome scores for depression may miss critical aspects of the patients’ experience, including those that relate to feasibility, engagement and adherence. Study Three (Chapter 4) therefore was a mixed-methods study which investigated participant experiences of exercise interventions in the RCT above. These issues are pertinent to using exercise as an adjunct, integrated or independent therapy for depression in OW/OB populations. This is especially so since, as mentioned, these individuals may experience unique challenges not confronted by normal weight peers such as exacerbated barriers with regard to motivation, engagement (Barlow, 2014; Beck, 1991; Carr & McNulty, 2006) and experience of treatment provision (Fruh et al., 2016; Puhl & Heuer, 2010). This mixed-methods study includes qualitative analysis of participant interviews and analysis of self-report measures, exploring factors relating to engagement, self-efficacy and the subjective experience of the exercise programs evaluated in the RCT (Study Two).

In this study, exercise self-efficacy, subjective confidence to exercise, motivation and positive anticipation to and toward exercise were comparable between the three exercise conditions. Qualitative analysis revealed the importance of exercise variety, personal choice and intensity for ensuring engagement. A critical finding was that rapport within the relationship between personal trainer and client was described as a chief facilitator of and motivator to exercise regularly. This was attributed to the trainer’s knowledge and expertise, and the sense of partnership, safety, trust and accountability that grew between participant
and exercise trainer. Further considerations for clinicians include recognising that participants may also bring a unique history and context to the intervention which seemed to activate self-critical, punitive and discouraging intrapsychic dynamics, resulting in a sense of failure, shame and guilt. We discuss also the use of compassion-based approaches as a potential aspect of a tailored intervention for OW/OB, depressed individuals.

1.4.1.4. Study Four

Study Four (Chapter 5) draws together the findings from the three prior studies and describes an evidenced based intervention for clinical depression in OW/OB adults by way of a protocol paper (Study Four). Given the findings derived from research and our prior chapters, we sought to include elements of schema therapy and compassion focused therapy in our tailored cognitive behaviour intervention for depression in OW/OB adults. Gilbert (2009) outlined how attention tasks, imagery, and cognitive therapy for motivation, emotions, behaviour, and thinking or reasoning patterns can assist in fostering sensitivity, empathy, distress tolerance and a non-judgmental self-orientation that may be especially useful for persons with clinical depression and co-morbid OW/OB and we suggested this might be a valuable foundation for future interventions to be based on. Given the promise of exercise as an intervention for depression and its benefits related to OW/OB, the protocol includes a significant exercise component based on the findings and research discussed in preceding chapters. Chapter 5 therefore describes a protocol paper for a randomised controlled clinical trial comparing tailor-made intervention for depression in individuals with co-morbid OW/OB which includes psychotherapy and exercise to exercise alone or treatment as usual (i.e. standard cognitive behaviour therapy for depression). The tailor-made intervention aims to target the key factors we believe contribute to depression in this population whilst also improving engagement and adherence.

1.4.1.5. Chapter 6 – General Discussion and Conclusion
Finally, Chapter 6 provides a general discussion and overall conclusion to the research project.
References


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doi:10.1007/s10615-015-0565-y


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Chapter 2 – Study One

Systematic Review with Meta-analysis of Treatments of Symptoms Depression in Adults with Overweight or Obesity.

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Systematic Review with Meta-analysis of Treatments of Symptoms Depression in Adults with Overweight or Obesity.

2.1. Introduction

Clinical depression is a significant social and economic burden worldwide. Lifetime prevalence rates vary from 6.6 per cent in Japan to 21 per cent in France with high-income nations in Europe and the Americas averaging life-time prevalence rates of 14.6 per cent (Bromet et al., 2011; Meyer et al., 2001), a substantial increase over previous estimates (Andrade et al., 2003; Carta et al., 1995; Robins et al., 1984). Elevated symptoms of depression impair intra-psychic, interpersonal, vocational and physical well-being (Judd, Akiskal, Zeller, & et al., 2000; Keitner & Miller, 1990; Wella et al., 1989; Whisman & Bruce, 1999) and presents as a major risk-factor for overweight and obesity and obesity-related morbidities and consequences (Malnick & Knobler, 2006; Manson et al., 1995).

Overweight (BMI\(^1 > 25\)) and Obesity (BMI > 30) are estimated to directly affect 36.9% of men and 29.8% of women in developed countries worldwide – almost one-third higher than in 1980 (Ng et al., 2014). Prevalence rates in Australasia (62 per cent) North America (65.4 per cent) and Western Europe (54.5 per cent) are much higher than the global average (Ng et al., 2014). Together, overweight and obesity (OW/OB) are considered one of the most preventable health conditions and increase risk for a variety of significant cardiovascular diseases (National Heart Foundation of Australia, NHFA; 2007).

Research has indicated a bi-directional relationship between OW/OB and clinical depression, with either condition alone increasing risk for developing the other (Luppino et al., 2010; Simon et al., 2008). Individuals with co-morbid depression and OW/OB may face particular risks to health and well-being (Markowitz et al., 2008) and are likely to experience

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\(^{1}\) BMI (Body Mass Index) is a commonly used index measure of weight and height (kg/m\(^2\)).
unique challenges not confronted by normal weight peers. For example, depression often reduces general activity, motivation and engagement (Barlow, 2014; Beck, 1991; Carr & McNulty, 2006) and can be exacerbated by chronic health conditions associated with OW/OB (Norberg & Danielsson, 2012). Co-morbid obesity also significantly reduces the likelihood of receiving treatment for depression and is associated with reduced treatment duration relative to normal weight peers (Boudreau et al., 2013). Furthermore, weight related stigma is known to significantly impact treatment provision, experience and outcome for clinical depression (Fruh et al., 2016; Puhl & Heuer, 2010) whilst depression negatively affects weight loss outcomes and health behaviour change (Pagoto et al., 2007). These factors may contribute to less frequent treatment seeking behaviours, lower adherence or reduced benefit from interventions. It is therefore important that clinicians are able to make well-informed decisions regarding the treatment of depression in OW/OB adults.

2.1.1. Treatments for Comorbid Depression and Overweight or Obesity

Treatment-as-usual for depression often involves psychotropic medication - most commonly SSRI’s - and/or psychotherapy. The National Institute for Health and Care Excellence (NICE) guidelines recommend cognitive-behavioural therapy (CBT) or Interpersonal Psychotherapy with medication for treatment of moderate-severe depression, with short-term Psychodynamic Psychotherapy and Behavioural Activation also included for mild to moderate depression (NICE, 2009). Nevertheless, specific recommendations for individuals with co-morbid clinical depression OW/OB are yet to be made.

Based on the preceding discussion, one might postulate greater efficacy for clinically depressed, OW/OB persons when treatments include modules addressing the salient concerns most relevant to this population. To date however, few interventions for clinical depression in individuals with co-morbid OW/OB have been researched. Two studies, including one randomised control trial and a prospective pilot study showed significant reductions in
depression. In the RCT – researchers also found higher levels of remission compared to lifestyle intervention alone (Faulconbridge, Wadden, Berkowitz, Pulcini, & Treadwell, 2011; Pagoto et al., 2013). These studies used standard group CBT or Behavioural Activation for depression alongside weight reduction programs (i.e. lifestyle programs, exercise or behavioural weight loss). Such combined treatments offer a strong foundation for treatments of comorbid depression and OW/OB. Nevertheless, current guidelines on managing clinical depression do not distinguish between non-OW/OB versus OW/OB persons with the condition (e.g. NICE, 2009; SIGN, 2010). Given that there are unique psychological and psychosocial challenges for this population, it is important to identify and understand which treatments are most effective at reducing depression in OW/OB persons. This systematic review aims to identify treatments (psychological, behavioural, pharmacological) for reducing symptoms of depression in individuals with co-morbid OW/OB and to evaluate their effectiveness relative to control conditions. We intended to use these findings to inform the development of a tailored intervention for depression in OW/OB adults, subsequently discussed in Chapter 5. A further aim of this review was to identify the factors which may contribute (or fail to contribute) to positive treatment outcomes in individuals with symptoms of depression and co-morbid OW/OB. We addressed the following questions:

i. What are likely to be superior treatments compared to other treatments or control conditions for symptoms of depression in overweight or obese adults?

ii. What are the common features of treatment associated with superior outcomes of depression in overweight or obese adults?

2.2. Method

2.2.1. Literature Search Strategy

Several search strategies were piloted based on full-text searches of key words or subject headings related to symptoms of depression, dysthymia and to overweight and obesity. Combinations of keywords Depress*, Dysth*, Obes*, Overweight, Adipos*, Weight
Loss, Body Fat, Adult, RCT, "randomized controlled trial", "clinical trial" were searched through full-text, title and abstracts in the following databases: CINAHL, Cochrane Database of Systematic Reviews, Cochrane Trials Register, EMBASE, Medline, ProQuest, (including PsychINFO and PsychArticles), ScienceDirect, Scopus, SportDiscus and Wiley Online Library (See Appendix A). Duplicates were discarded and the title and abstract of remaining papers reviewed for relevance. Eligibility assessment was performed independently by at least two authors (N.B. and either H.C. or S.B.). Papers considered potentially eligible were read independently and in full (N.B. and S.B.). Studies meeting the inclusion criteria were added to the review. Disagreement between the reviewers was resolved by consensus. The literature search was updated most recently in January 2017. Hand searching of reference lists from applicable papers, reviews and meta-analysis was conducted to identify further relevant publications. The last hand search was completed in March 2017. The review was conducted in accordance with PRISMA guidelines (Liberati et al., 2009).

2.2.2. Study Selection

As there are few studies investigating clinical depression in OW/OB adults and to gain a broad perspective on potentially effective treatments, we reviewed controlled trials measuring the effect of any treatment on symptoms of depression assessed via an established psychometric questionnaire (e.g. BDI-II or HAM-D) or interview in adults (aged ≥ 18 years) who were overweight or obese (BMI² ≥ 25 kg/m²). Populations were generally healthy, however incidental health conditions (such as diabetes, hypertension) were permitted. Excluded were case studies, prospective cohort studies, studies reporting on child populations or animal research. Papers directly investigating interventions on specific medical conditions which may influence depression were excluded (e.g. CHD, DMII, PCOS, cancer) as were studies investigating the effect of interventions on age-related cognitive decline, bipolar

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2 In studies where BMI was not an established inclusion criteria but was reported, 95.45% of participants were required to have a BMI ≥ 25 kg/m²
disorder, psychosis or anorexia nervosa. Given the potential for elevated disordered eating behaviours in OW/OB populations (Faith, 2002; Faulconbridge & Bechtel, 2014; Fitzgibbon, Stolley, & Kirschenbaum, 1993), samples with co-morbid binge eating disorder (BED) were included. Studies of duplicate populations were excluded and the largest sample with applicable data used. Only peer-reviewed studies available in English language prior to January 2017 were included.

2.2.3. Data Extraction

Outcome measures for depression severity were extracted independently by two authors (N.B. and S.B.). We extracted the mean and standard deviation or standard error for all reported conditions. When multiple measures of depression were reported, we used the most complete data available pre and post intervention. Where two or more outcome measures were available in these cases, we used data from clinician rated assessments in preference to self-report measures. The following additional data were extracted: study and condition sample size, demographic information including age, gender, ethnicity, co-morbid conditions; treatment description including duration, frequency, provider and format and; study design, including use of power analysis, allocation ratio, intention to treat (ITT) and trial registration. Where appropriate data was not reported in the study manuscript, the listed contact author was e-mailed and/or telephoned and the necessary data requested.

2.2.4. Risk of Bias and Data Analysis

Risk of bias was assessed using the Cochrane Risk of Bias tool provided in the online systematic review platform, Covidence™. Where no detail was provided in the article manuscript, risk of bias was deemed unclear.
2.2.5. Data Synthesis

Data were organised according to type of control group, i.e. treatment as usual or active control vs. wait-list or placebo control, or minimum control - then by intervention. Intervention strategies included pharmacotherapy; evidenced-based psychotherapy; lifestyle intervention; diet; exercise; alternative therapy or combined interventions. Evidence-based psychotherapies were defined as any psychotherapy recommended in current guidelines on managing clinical depression. Furthermore, within the data synthesis, research on populations with clinical depression (i.e. Major Depression, Dysthymia) were summarised independently from research on non-clinical populations. A meta-analysis was conducted on 29 studies with sufficient data available, including data on sub-groups where applicable. We examined standard mean difference scores with 95 per cent confidence intervals (CI) between treatment and control conditions such that an outcome favouring treatment was indicated by a negative value, and outcomes favouring control or treatment as usual had a positive value.

2.3. Results

2.3.1. Study Selection

Figure 2.1 illustrates the PRISMA flowchart of study selection. The key word search initially identified 5902 records. This included 59 citations from CINAHL, 1277 from Cochrane Database of Systematic Reviews and Cochrane Trials Register, 725 from EMBASE, 23 from Medline, 853 from ProQuest, (including PsychINFO and PsychArticles), 738 from ScienceDirect, 709 from Scopus, 1 from SportDiscus and 1517 from Wiley Online Library. Following removal of duplicate records, 5371 records remained. Two-hundred-ninety-four studies were available for full-text review after initial title and abstract screening. Of these, 33 were excluded on the basis of not being a controlled study. Sixty-eight were excluded being investigations on mixed-weight populations or non-overweight or obese populations, 19 were conducted on populations with co-morbid conditions influencing
depression (e.g. CHD or alcohol dependence) and 42 studies excluded participants with a diagnosis of depressive disorders or elevated symptoms of depression. Eighty-seven studies had no standardised measure of depression pre and post intervention. Duplicate sub-samples were found in 5 studies. Five papers were not available with full-text in English. A thorough and full assessment was conducted on the subsequent yield of studies.

**Figure 2.1.** PRISMA flowchart

### 2.3.2. Characteristics of Included Trials

The systematic review included 36 studies (Figure 2.1), comprising a total of 2940 participants. Sample sizes of the 36 studies varied between 15 and 231. Most studies recruited exclusively female (n = 20; 55.6%) or mostly female participants (i.e. > 75% to 99%; n = 12). Two studies (5.6%) recruited only male participants whilst one study (2.7%) predominantly recruited males (i.e. > 75% to 99%). Publication year ranged from 1981 to 2016. Twenty-six studies (72.2%) were conducted from out-patient, health clinic or university clinic settings whilst nine (25.0%) were conducted within the community. One
study was conducted with shipboard U.S. Navy personnel (Dennis, Pane, Adams, & Qi, 1999).

Three studies (8.3%) examined samples with co-morbid clinical depression and overweight or obesity (Guerdjikova et al., 2012; Linde et al., 2011; Pagoto et al., 2013). A further three studies included a substantial number of participants with current or historical Major Depression (Arnold et al., 2002; McElroy et al., 2003; White & Grilo, 2013). Co-morbid conditions additional to OW/OB and depression were present in 14 studies (38.9%). The majority of studies reported co-morbid BED alone (n = 9; 25.0%).

The effect of the intervention on symptoms of depression was a main focus for fewer than a third of studies (n = 11; 31.6%). Thirteen studies (36.1%) reported between group results of treatment superior to alternative treatment or placebo. Two reported marginal but not significant results in favour of a treatment group. Of the remaining 21 studies without between group differences, 17 (47% of total sample) reported significant within group declines in depressive symptoms in the main intervention group. The lack of between group difference was primarily due to similar reductions in an active control condition and occasionally due to floor effects or large sample variance.

2.3.3. Risk of Bias in Included Trials

Table 2.1 below illustrates the risk of bias of included trials. Very few studies reported sequence generation or allocation concealment procedures, despite being randomised trials. Two of the studies were non-randomised controlled trials (Fossati et al., 2004; Park & An, 2006). As depression symptomatology is either self-reported or clinician rated, where the outcome-rating was not provided by an independent person, such studies were recorded as ‘high risk’ of being open to influence of bias. Two studies had levels of dropout that may have influenced outcome data (Cook, Howard, & Mills, 1981; Gorin, Grange, & Stone, 2003). Four studies reported Trial Registration (Appelhans, Pagoto, Peters,
& Spring, 2010; Lutze et al., 2013; McElroy et al., 2003; Pagoto et al., 2013). Two studies included other sources of potential bias (i.e. participation by family members and sponsorship from industry bodies ‘The Sugar Company’ and ‘Kellogg’s’; Esmaily et al., 2015; Surwit et al., 1997).
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<th>Study</th>
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Note: Green dot = low risk of bias; Orange dot = unclear risk of bias; Red dot = high risk of bias
### 2.3.4. Summary of Results

Table 2.2. Summary of included trials.

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<tr>
<th>Study</th>
<th>Overview</th>
<th>DESIGN; POWER ANALYSIS (Y/N/NR); ALLOCATION RATIO; ITT/Y/N/MODIFIED; TRIAL REGISTRATION (Y/N/NR)</th>
<th>DEPRESSION MEASURE; BASELINE SCORE MEAN (SD)</th>
<th>TREATMENT GROUPS</th>
<th>DESCRIPTION (DURATION, FREQUENCY, PROVIDER, FORMAT)</th>
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<tr>
<td>Annesi 2010</td>
<td>Overall: n = 114; Age: 42.4(10.1); 100% female; 61% White, 30% African American BMI: 36.8(4.3); Comorbid Dx: NR.</td>
<td>RCT, NR, 2:1 (CA condition had 2 participants assigned for every 1 in the other conditions), ITT with LOCF, NR</td>
<td>NR</td>
<td>Coach Approach exercise support treatment (CA); Exercise demonstration (EX); Information only (INFO)</td>
<td>All groups: Access to YMCA wellness facility. 3x 20-40 minute sessions per week of moderate-intensity cardiovascular exercise. Six nutrition information sessions following ACSM guidelines. CA condition: One-to-one exercise support protocol emphasizing goal setting, relapse prevention, and other self-regulatory during monthly one-on-one meetings over 6 months. Based on social cognitive and self-efficacy theory. EX condition: Proper use of exercise apparatuses was demonstrated and followed up at the same frequency as the CA condition. Duration: 6 months.</td>
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<td>Appolinario 2003</td>
<td>Overall: BMI 30-45, Co-morbid Dx; BED with BES &gt; 17 (moderate), Hx of MDD: 37%. Sibutramine: n = 23; Age: 35.2(9); 87% female; % White NR; BMI: NR, Weight 102.8(13.2), BES 29.2(7.2), Binge days/week: 4.1(1.8). Placebo: n = 25, Age: 36.6(1.2); 90% female; % white NR; BMI: NR; Weight 98.7(12.9); BES: 29.1(5.9), Binge days/week: 3.9(1.8).</td>
<td>Randomised, double-blind, placebo-controlled, parallel group; Y; 1:1; Y, NR</td>
<td>BDI-II; Sibutramine Hydrochloride: 17.3 (9.7); Placebo: 18.6 (9.1)</td>
<td>Sibutramine Hydrochloride; Placebo</td>
<td>Sibutramine hydrochloride (antiobesity agent) provided at 15 mg/d. Placebo: Identical appearance placebo pill. Duration: 12 weeks; Frequency: Daily, Provider: 2 Medical Centres; Format: Individual.</td>
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Arnold 2002

Fluoxetine: n = 30; Age: 41.9(9.7); 93% female, 90% White, BMI: 39.6(7.0); Placebo: n = 30; Age: 40.8(9.0); 93%; 87%; 36.7(6.8), Co-morbid Dx: BED, current or prior MDD: 63%.

Single-centre, parallel-group, randomised, placebo-controlled, double-blind, forced-titration, flexible-dose, NR, NR, Y, NR

HAM-D; Fluoxetine: 4.8(4.3); Placebo: 4.2(2.9).

Fluoxetine; Placebo

Fluoxetine: 20mg/day titrated to 60mg/day over 6 days. After two weeks on 60mg/day dosage could be increased to 80mg/day. Placebo: Identical protocol, placebo pill Duration: 6 weeks; Frequency: Daily, Provider: Clinic; Format: Individual.

Bacon 2002

Overall: n = 78 (Diet-group: n = 23, Non-diet: n = 29); Age: 39.3(4.5); 100% female; 100% White; BMI: 35.7(3.6); Eating Restraint Scale score > 15.

RCT; Y; N; N

BDI-II; Diet: 10.9 (10.2); Non-diet: 10.8 (7.6)

Traditional behavioural weight loss; Non-dieting wellness program


Bennett 1986

Overall: n = 74; Age: 40.1; 100% female; % White NR; BMI: 32.7(NR); Co-morbid Dx: NR.

RCT; N; N, N, N

MHQ-d; Group Control: 4.84(2.71); Cognitive Rehearsal: 6.68(3.11); Insight Control: 5.41(2.55); Individual Contact Control: 6.37(1.95).

Cognitive rehearsal; Insight control; Individual contact control; Group contact control

All groups: Duration: 16 weeks; Frequency: (Group sessions wks 1, 2, 3, 10, 15 & 16) individualised nutritional advice and social support. Cognitive Rehearsal: 1hr x 7 session in self-instructional training for eating behaviour modification; Insight Control: 1hr x 7 sessions training for ability to gain insight to automatic thoughts about eating, without behaviour change; Individual Contact Control: Contact session of 20mins x 7 non-directive discussion. Group Control: Group sessions only.

Bowen 2006

Overall: n = 172 (Exercise group: n = 86, Control group: n = 86); Age: 61.0(NR); % Female: 100%; % White: 86%; BMI: > 24.99; Co-morbid Dx: NR.

RCT; N; N; Y; N

BSI subscale; Exercise: 93.56 (11.19) Control: 91.96 (9.63).

Moderate-vigorous intensity exercise; Stretching control

Moderate-vigorous intensity aerobic exercise at home or an exercise facility. Gradual increase in intensity from 40% VO2max for 16mins/session to 60-75% VO2max for 45mins by week 8. Included 5-10 minutes of light weight training. Included additional group contact, newsletters, phone contact and social outings. Control group: 45mins stretching once weekly.
**Carels 2004**

**Overall:** BMI > 30; 100% female; 100% White; Co-morbid Dx: Post-menopausal. **Lifestyle only:** n = 21; Age: 55.1(8.3); BMI: 37.8(5.9).

**Lifestyle + self-control:** n = 23; Age: 54.3(7.8); BMI: 35.1(5.0).

RCT, N, NR, N, N

BDI; Lifestyle change 9.1 (10.0); Lifestyle + self-control 7.3 (5.9)

Lifestyle change (LEARN Program) + self-control skills; Lifestyle change only

**All groups:** Duration: 24 weeks. Weekly sessions of 60-75 minutes. Provider: Clinical Health Psychologist and graduate student. Format: Group (n = 7-12). The LEARN Program emphasized self-monitoring, eating related stimuli control, physical activity, nutrition education, cognitive therapy associated with dieting and body image, goal setting, relationships and relapse prevention and weight maintenance. **Lifestyle + self-control skills:** Additional content within class, didactic instruction, individual activities, and weekly out-of-class assignments. Based on Baumeister’s self-control theory.

**Cook 1981**

**Overall:** n = 45 (Diet + Miansarin: n = 21; Diet only, n = 24); Age: 38.0(11.0); 95% Female; % White: NR; BMI: > 37.0; Co-morbid Dx: NR.

Double-blind RCT, N; N; N; N

BDI; Diet + Miansarin 14.0 (8.0); Diet only 14.0 (7.0)

Diet + Mianserin; Diet + Placebo

**All groups:** Duration: 16 weeks, Frequency: Daily. Format: Individual. Diet: 320 kcal supplement containing 31g Protein, 44g Carbohydrate, 2g Fats with vitamins and minerals. Diet + Miansarin: Additional single daily dose Mianserin 10mg/d. Diet only: Identical appearance placebo pill.

**Dennis 1999**

**Overall:** 0% female; % White: NR; Co-morbid Dx: NR. **Treatment group:** n = 21; Age = 31.9(7.1); BMI = 33.9(2.7); **Control group:** n = 18, Age = 30.4 (5.8); BMI = 33.0 (2.9).

RCT; NR; NR; NR; NR

CES-D; Weight-loss group: 20.1 (11.0); Control group: 17.8 (11.4).

Behavioural weight-loss; TAU (Mandated US Navy remediation program "Level 1").

**All groups:** Duration 16 weeks. Exercise 1hr resistance and aerobic exercise 4x per week. **Behavioural weight-loss:** Frequency 1x per week 1hr meeting. Format: Group (7-12). Behaviour modification (eating slowly, keeping food out of sight); cognitive and emotional strategies to enhance self-efficacy, manage stress, increase social support and manage relapses. Diet: NCEP Step I Heart Health Guideline diet decreasing portions to reduce daily intake by 500kcal/day. Calorie counting and food exchange. Provider: Navy Dietician. **Control group:** Nutrition fact-sheets and brochures provided at request. Format; Frequency; Provider NR.
Devlin 2005

Overall: 78% female, % White NR; Co-morbid Dx of BED. Combined group: n = 28; Age = 39.4 (12.1); BMI = 42.1 (6.9); Current MDD = 2; Past MDD = 8. Pharmacotherapy alone: n = 32, Age = 45.9 (13.6); BMI = 40.1 (6.6); Co-morbid dx, Current MDD = 3, Past MDD = 14. CBT alone: n = 25, Age = 43.4 (11.8); BMI = 41.1 (7.6), Current MDD = 3, Past MDD = 6. Control group: n = 31, Age = 44.1 (10.2); BMI = 40.3 (7.1); Current MDD = 2, Past MDD = 12.

Esmaily 2015

Overall: % White: NR; Co-morbid Dx: NR. Curcumin-placebo: n = 15; Age: 38.84(11.12); 13% female; BMI: 33.95(3.81). Placebo-curcumin: n = 15; Age: 37.81(12.31); 11% female; BMI: 32.66 (4.69).

Fossati 2004

Overall: 100% female; % White: NR; Co-morbid Dx: BED. CBT alone: n = 13; Age: 45.6(2.9); BMI: 36.4(1.9). CBT + N: n = 23; Age: 42.3(1.7); BMI: 34.4(1.4); CBT + N + PA: n = 25; Age: 37.4(2.0); BMI: 35.6(1.1). Non-randomised trial: N; N; N; N

All groups: Duration: 5 months; Frequency: 16 weekly 90-minute sessions (last 4 sessions bi-weekly); Provider: Supervised Psychiatrist/Doctoral level Psychologists; Format: Group and/or Individual. Modified LEARN program (Brownell) to include cessation of BE, reduction in overall distress, increased self-acceptance and weight loss. Focus on adopting 'healthy' lifestyle behaviours rather than achieving an ideal weight. Individual CBT: Based on treatment manual from Fairburn et al. Pharmacotherapy: Target dose of 60mg/d Fluoxetine (initial 20mg dose increased over 5 weeks)

All groups: Duration: 30 days; Frequency: Daily; Provider: Clinic; Format: Individual. Curcumin: C3 Complex® formula (comprising 500mg curcumin, demethoxycurcumin and bisdemethoxycurcumin). Co-administration with 5mg bioperine® was used to enhance bioavailability of curcuminoids. hard gelatine capsules containing 500 mg C3 Complex® plus 5 mg bioperine®. Placebo: Identical appearance contained bioperine® 5 mg alone.

All groups: Duration: 12 weeks. Frequency: Weekly, 1.5hr sessions of CBT for BED. Provider: NR Format: Group. CBT+N: Addition of 'psychoeducative dietetic mistakes'. CBT+N+PA: Additional to above of physical activity recommendations of PA 30mins 3x weekly and increasing ADL's and 3x weekly planned exercise (swimming, aerobics, cycling etc).
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<tr>
<th>Year</th>
<th>Overall</th>
<th>Sample Size</th>
<th>Sample Description</th>
<th>Randomisation</th>
<th>Exercise Details</th>
<th>Outcome Measures</th>
<th>Study Design</th>
<th>Provider</th>
<th>Format</th>
<th>Duration</th>
<th>Frequency</th>
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<tr>
<td>Ghroubi 2016</td>
<td>Overall: n = 40 (split 50:50); 90% female; % White: NR; Co-morbid Dx: METS. <strong>Aerobic + Isokinetic exercise:</strong> Age: 41.6(NR); BMI: 37.9(NR).</td>
<td>Aerobic exercise: Age: 41.6(NR), BMI: 37.0(NR).</td>
<td>Randomised, prospective study, N, NR, N</td>
<td>HADS-D; Combined: 8.98(3.34).</td>
<td>Isokinetic and aerobic exercise + calorie restriction; Aerobic exercise + calorie restriction</td>
<td>All groups: Duration: 8 weeks; Frequency: 3 sessions/week, Provider: Rehabilitation Facility; Format: NR. Dietary reduction of 25-35% baseline calories. Balanced diet of 15% protein, 30-35% fats; 50-55% carbohydrate and 2l fluid per day. <strong>Aerobic + Isokinetic group:</strong> 20mins moderate intensity exercise (70% HRmax) aerobic exercise and 15mins isokinetic strengthening exercise for knee and spine. <strong>Aerobic exercise alone:</strong> 30mins of moderate intensity exercise at 70% HRmax.</td>
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<td>Gorin 2003</td>
<td>Overall: n = 94 (CBT alone: n = 32; CBT-spouse: n = 31, Control: n = 31); Age: 45.20(10.03), 100% female; 86% White; BMI = 39.42(7.72); Co-morbid Dx: BED.</td>
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<td>RCT; Y; Y; NR</td>
<td>BDI; CBT alone: 18.71(8.89); CBT-spouse: 20.41(9.96); Control: 17.41(9.93).</td>
<td>CBT individual; CBT with spouse</td>
<td>All groups: Duration: 12 weeks, Frequency: 12 weekly sessions 90 minutes each. Provider: Advanced Clinical Psychology doctoral students (supervised). Format: Group (6-11 participants). <strong>CBT-individual:</strong> CBT for BED developed by Telch and Agras (1992). Included self-monitoring, establishing healthy eating patterns (regular meal and snacks), relapse prevention strategies. Encouraged regular exercise program. <strong>CBT-spouse:</strong> Further informed by the CBT transactional model of family functioning and the interpersonal expectation model. Collaborative approach to treatment, facilitation of behaviour change and goal setting between spouse dyads.</td>
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<td>Guerdjikova 2012</td>
<td>Overall: Co-Morbid Dx: MDD &amp; BED. <strong>Duloxetine:</strong> n = 20; Age: 44.4(12.1); 80% female; % White: 90%; BMI: 38.7(6.8). <strong>Control:</strong> n = 20; Age: 35.7(10.4); 95% female; % White: 65%; BMI: 42.8(7.7).</td>
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<td>Double-blind, placebo-controlled; NR; Y; Y</td>
<td>IDS-C; Intervention: 35.6(7.9), Control: 35.4(5.4))</td>
<td>Duloxetine; Placebo</td>
<td>All groups: Duration: 12 weeks; Provider: NR; Format: Individual. <strong>Duloxetine:</strong> 30mg /day increased as tolerated to maximum 120mg after 42 days. <strong>Placebo:</strong> As intervention, Identical placebo pill.</td>
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<td>Kiernan 2001</td>
<td>Overall: % White: 88.7%; Co-morbid Dx: NR; <strong>Males:</strong> Diet-plus-exercise: n = 39, BMI: 30.7(2.1); Diet-only: n = 40, BMI: 30.4(2.1); <strong>Females:</strong> Diet-plus-exercise: n = 42, BMI: 28.0(2.4); Diet-only: n = 31, BMI: 28.0(2.1); Control: n = 39, BMI: 28.1(2.4).</td>
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<td>RCT; N; N; N</td>
<td>BDI; MALES: Diet-plus-exercise 5.4(5.0); Diet-only 4.3(3.2); Control 5.5(4.7); FEMALES: Diet-plus-exercise 6.0(4.9); Diet-only 5.8(4.1); Control 6.0(5.9).</td>
<td>Diet-only; Diet + aerobic exercise; Control</td>
<td>All groups: Duration: 12 months; Frequency: Variable; Format: Group. <strong>Diet-only:</strong> low-saturated fat and low-cholesterol diet (National Cholesterol Education Program Step 1 recommendations). Weekly, fortnightly or monthly classes with a registered dietitian. <strong>Diet + exercise:</strong> As diet-only + group based aerobic exercise 3d per week, increasing from 25-45+ minutes of exercise at 60-80% of HRmax over 4 months. <strong>Control:</strong> Assessment only.</td>
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<td>Kristeller 2014</td>
<td>Overall: n = 150 (MB-EAT: n = 53; Psycho-ed: n = 50; Waitlist Control n = 47); Age: 46.55(NR); 88% female; % White: 87%; BMI: 40.26(NR), Co-morbid Dx: BED et al.</td>
<td>RCT; Y; NR; Y; NR</td>
<td>BDI-II; MB-EAT: 19.75(11.31), Psycho-ed: 21.19(12.33), Waitlist: 17.27(10.20).</td>
<td>Mindfulness-Based Eating Awareness Training; Psychoeducational CBT</td>
<td>All groups: Duration: 9 weeks + 3 monthly boosters; Frequency: Weekly sessions of 1.5hrs; Provider: Clinical or Counselling Psychology Doctoral student or Masters level professional; Format: Group. MB-EAT: General and ED-specific mindfulness techniques, body awareness, self-acceptance, chair-yoga, body scan, elements of CT. Psychoeducational CBT: Based on Duke Diet and Fitness Centre treatment for clients with BED (e.g. identifying triggers, stress management, lifestyle modification, PMR, problem solving, social support). Waitlist control: No treatment, single contact mid intervention period only to encourage retention.</td>
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<td>Linde 2011</td>
<td>Overall: 100% female; % White: &gt; 75%; Co-morbid Dx: MDD; Weight loss only: n = 102; Age: 52.1(6.5); BMI: 39.5(7.7). Combined Weight loss + CBT: n = 101; Age: 52.3(6.2); BMI: 38.6(6.8).</td>
<td>RCT, Y, NR, Y, N</td>
<td>SCL-20 Depression; Weight loss only: 1.82(0.59); Combined CBT + weight loss: 1.87(0.62).</td>
<td>Behavioural weight loss only; Combined weight loss/CBT for Depression.</td>
<td>All groups: Duration: 12 months; Frequency: 26 sessions total, tapering after 16 weeks and maintenance after 6 months; Format: Group (3-16 per group); Behavioural weight loss: 90mins sessions centred on behavioural goal setting, self-monitoring of caloric intake (1200-1500kcal/d), non-specified physical activity (500-2500kcal/wk), and body weight. Provider: Weight counsellor. Combined condition: 120mins sessions incorporating behavioural weight loss program above and essential elements of CBT for depression, based on ‘Coping with Depression’ manual. Provider: Clinical Psychologist.</td>
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<td>Lutze 2013</td>
<td>Overall: n = 117 (HP n= 57; HC n=61); Age: 49.6(9.2); 0% female; % White: NR; BMI: 31.1(4.2); Co-morbid Dx: NR.</td>
<td>RCT; NR; Block allocation by BMI and age; Y; Y (ANZCTR)</td>
<td>POMS-D; HP-group: 23.40(1.09), HC-group: 23.04(1.05).</td>
<td>Energy restricted high protein diet (HP); Isocaloric high carbohydrate diet(HC)</td>
<td>All groups: Duration: 52-weeks; Frequency: Daily; Format: Individual, in community. Provider: NA. Targeted isocaloric with moderate energy restriction macronutrient diet comprising high protein (HP; 35% protein, 40% carbohydrate, 25% fat) or high carbohydrate (HC; 17% protein, 58 % carbohydrate, 25% fat). Specific quantities of food were provided to 60% of caloric intake. Daily food diaries were recorded for first 12-weeks of intervention.</td>
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<td>McElroy 2003</td>
<td>Citalopram: n = 19, Age: 42.0(9.0); Female: 95%; White: 79%; BMI: 41.4 (6.9); Co-morbid Dx: 100% BED, 21% MDD, 63% Lifetime MDD. Placebo: n = 19; Age: 39.2(21.0); 95% female; % White: 95%; BMI: 34.2(7.4); Co-morbid Dx: 100% BED, MDD: 42%, Lifetime MDD: 74%.</td>
<td>Single-centre, parallel-group, randomised, placebo-controlled, double-blind, forced-titration, flexible-dose; N, NR, N, N</td>
<td>HAM-D; Citalopram: 3.1(3.2); Placebo: 2.7(3.7).</td>
<td>Citalopram; Placebo</td>
<td>All groups: Duration: 6-weeks; Frequency: Daily; Format: Individual; Provider: Medical Centre. Binge episodes were recorded in a diary, along with compliance. Citalopram: 20mg/d titrated to 60mg/d as tolerated. Placebo: As intervention, Identical placebo pill.</td>
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Melanson 2004

**Combined:** n = 43; Age: 43(5.3); 86% female; %White: NR; BMI: 31.7(3.0); Co-morbid Dx: NR. **Exercise alone:** n = 47; Age: 42.3(6.6); 85% female; %White: NR; BMI: 31.3(2.6); Co-morbid Dx: NR.

**Exercise alone:**
- **Exercise: n = 47**
  - Age: 42.3(6.6)
  - 85% female
  - %White: NR
  - BMI: 31.3(2.6)
  - Co-morbid Dx: NR

**Exercise + Diet vs Exercise alone**
- All groups: Duration: 24 Weeks; Provider: Exercise Physiologist and/or Registered Dietician; Frequency: Weekly first 12 weeks then bi-weekly assessment without instruction. Exercise frequency: 5d/week. Moderate pace walking expending 300-500kcal per day. Daily physical activity recorded in log. **Diet + Exercise group:** RD counselling on weight loss including meal replacement of 4x meal replacement daily and hypocaloric meal plan based on fruit, vegetable, whole grains, low-fat dairy, protein sources and water. Recorded with daily checklist for 12 weeks.

Nauta 2000

**Overall:** n = 74; Age: 38.3(7.1); 100% female; % White: NR BMI: 33.1(4.3); Co-morbid Dx: 50% BED.

**Beck Depression Inventory (BDI) Scores stratified by BED.**
- Non-BED participants: CBT: 7.3(5.1); Behavioural group: 8.4(5.0).
- BED-participants: CBT: 19.2(6.5); Behavioural group: 19.3(8.5).

**CBT vs Behavioural treatment for BED.**
- All groups: Duration: 15 weeks. Frequency: 1 day per week, 150 minute session; Format: Group (7-8pp). Provider: Experienced therapist; **CBT:** Psychoeducation, cognitive therapy, behavioural experiments, self-monitoring and problem solving, maintenance, relapse prevention and recovery from relapse. **Behavioural treatment:** Nutrition education, healthy eating behaviours, exercise goals and calorie targets of 1500-1800kcal/day, behavioural monitoring and stimulus control techniques.

Pagoto 2013

**Overall:** 100% female; Co-morbid Dx: MDD. **Behaviour Therapy + Lifestyle Intervention:** n = 78; Age: 45.6(11.0); % White 82.1%; BMI: 36.0(3.2); Co-morbid Dx: Anxiety 24%, BED: 21%, ADHD: 26%.

**Lifestyle Intervention alone:** n = 83; Age: 46.2(10.8); % White 88.0%; BMI: 34.8(3.3); Co-morbid Dx: Anxiety 30%, BED: 17%, ADHD: 35%.

**Behaviour Therapy & Lifestyle intervention; Lifestyle intervention alone**
- Behaviour Therapy + Lifestyle Intervention alone: Added attention control of 10 individual health education sessions and telephone calls during maintenance. **Lifestyle Intervention alone:** Added attention control of 10 individual health education sessions and telephone calls.

Painot 2001

**Overall:** n = 60 (CBT: n = 35; CBT+N: n = 25); Age: 42(2); 100% female; %White: 100%; BMI: 33(1); Co-morbid Dx: BED.

**CBT (TAU) vs. CBT + nutritional approach (fat content)**
- CBT (TAU): Duration: 12 weeks. Frequency: 1x weekly, 1.5hrs each; Provider: NR; Format: Group. **CBT:** Introduction of eating schedules, modifying contents of meals, modification of behaviour toward forbidden/avoided food. Cognitive restructuring, identifying psychological patterns relating to food. **CBT + nutritional approach:** As CBT group + daily food records were kept to identify triggers and perpetuating factors. Information (qualitative and quantitative) about fat contents in food was integrated into CBT program.
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Overall:</th>
<th>% Female:</th>
<th>% White:</th>
<th>Co-morbid Dx:</th>
<th>Intervention:</th>
<th>Control:</th>
<th>Duration:</th>
<th>Provider:</th>
<th>Format:</th>
<th>Exercise:</th>
<th>Diet:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Park</td>
<td>2006</td>
<td>100%</td>
<td>NR</td>
<td>NR</td>
<td>21; Age: 39.29(4.43); BMI: 27.36(2.39); Control: n = 21; Age: 42.0(6.65); BMI: 28.02(3.94).</td>
<td>Nonequivalent control group pretest-posttest design; Y; N; N; N</td>
<td>CES-D: Intervention: 18.24(5.28); Control: 18.00(6.92).</td>
<td>Self-efficacy behaviour weight-loss; Control</td>
<td>12 weeks.</td>
<td>Resistance Training; Aerobic exercise; Control (Information only)</td>
<td>2x per week</td>
<td>Diet education session: 1x prior to intervention start. Phone contact 2x per week on each of the above elements. Phone contact involved self-efficacy based strategies (checking HR, consultation on effects, obstacles, positive feedback). Exercise included aerobic and resistance training. Provider: Master of Athletics Prescription and Dietician Format: Individual, group and phone contact. Control group: NR.</td>
</tr>
<tr>
<td>Riva</td>
<td>2003</td>
<td>n = 36, Age: 33.07(8.08), 100% female; % White: NR; BMI: 39.80 (6.10); Co-morbid Dx: BED.</td>
<td>RCT, Y, NA, N, Y</td>
<td>(ISRCTN:59019572)</td>
<td>BDI-II; ECT: 22.23(NR); CBT: 20.55(NR).</td>
<td>Experiential Cognitive Therapy (ECT); CBT (TAU)</td>
<td>All groups:</td>
<td>6 weeks. Frequency: Weekly/bi-weekly, Provider: Chartered Clinical Psychologists or Psychotherapist; Format: Individual and group. ECT: 15 sessions, including individual therapy (skills, psycho-pharmacological assessment, virtual reality therapy) group therapy (assertiveness, motivation), bi-weekly nutritional groups and physical activities (2hrs/day) primarily aerobic in nature. CBT group: 15 CBT individual and group sessions focusing on assertiveness, motivation to change, modifying eating behaviours and improving self-esteem)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ruusune</td>
<td>2012</td>
<td>% White: NR; Co-morbid Dx: NR; Intervention: n = 69; Age = 57.7(6.5); BMI: 31.2 (4.7).</td>
<td>RCT, NR, NR</td>
<td>BDI-II; Lifestyle: 6.8(5.6); Control: 6.7(5.5).</td>
<td>Lifestyle intervention; Control (information only)</td>
<td>All groups:</td>
<td>3 years; Provider: Nutrition Counsellor; Format: Individual (or Group; Control only). Lifestyle intervention: 30mins moderate exercise based on daily physical activities, endurance exercise and no-cost, supervised circuit-type resistance training. Diet counselling included 7 face-to-face sessions in the first year and one session every 3 months thereafter, focusing on reducing fat intake &lt; 30% of total calories, reducing total calories, increasing fibre intake 15g/1000kcal. Consumption of wholegrain cereal products, vegetables, fruit, low-fat milk and meat products, fats rich in unsaturated fatty acids were encouraged. Control: Verbal and written information regarding benefits of exercise, weight and diet medication at one session per year.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sarsan</td>
<td>2006</td>
<td>n = 76 (Resistance: 26; Aerobic: 26; Control: 24); % Female: 100%; % White: NR; Co-morbid Dx: NR. Resistance Group: Age: 42.50(10.07); BMI: 33.73(2.92). Aerobic Group: Age: 41.65(7.62); BMI: 35.38(4.98); Control: Age: 43.60(6.46); BMI: 35.54(3.67).</td>
<td>RCT; Y; N; N</td>
<td>BDI-II; Resistance group: 13.95(7.27); Aerobic group: 12.2(5.14); Control: 14.85(9.25).</td>
<td>Resistance Training; Aerobic exercise; Control (Information only)</td>
<td>All groups:</td>
<td>12 weeks: Provider: Rehabilitation Clinic Format: Group. Exercise groups: Flexibility exercises before and after the exercise. Frequency: 3d/week. Resistance group: 6-station resistance circuit involving upper, lower and core muscle groups progressing from 40% 1RM to 80% 1RM. Rest of 15-30s between sets. Aerobic group: Brisk walking for 15mins and stationary cycling at 50-85% heart rate reserve for 12-45mins. Control group: No exercise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Shrocco 1999  Overall: 100% female; % White: NR, Co-morbid Dx: NR. **TBT**: n = 12; Age: 43.1(10.3); BMI: 32.45(3.62). **BCT**: n = 12; Age: 39.6(10.7); BMI: 32.82(3.20).

RCT, N, NR, N  BDI; BCT: 6.75(6.56); TBT: 8.33(6.25).  Behavioural Choice Treatment (BCT) vs. Traditional Behavioural Treatment (TBT).

All groups: Duration: 13 weeks; Frequency: 1x per week; Provider: Clinical Psychologist; Format: Group. All participants received 2-week low fat meal plans and recipe booklets that differed only in the amount of food and macronutrients (60% carbohydrate, 25% fat, and 15% protein). Encouraged to walk 30 mins/day, 3 days/week in a single bout. **BCT**: CBT based on a decision-making model of women's food choice. Meal plan for 1800kcal/day. **TBT**: Traditional weight loss approach with moderate calorie restriction. Meal plan for 1200kcal/day.

Shelley-Ummenhoffer 2007  Overall: n= 22 (CBT Group: n = 13 Waitlist Control: n = 9. ); Age 20-60, BMI > 30, 100% female; % White NR. Co-morbid Dx: BED.

RCT; N; N; N  BDI; CBT Group: 19.69(9.66); Control: 16.44(8.56).  CBT; Control (waitlist)

All groups: Duration: 6 weeks. **CBT**: Frequency: Once weekly (90mins per session). Format: Group; Provider: Dietician. Shortened Apple & Agras CBT treatment for eating disorders, with discussion of homework followed by new content. **Control**: Waitlist control NS.

Surwit 1997  Overall: 100% female; Co-morbid Dx: NR. **High Sucrose**: n = 20; Age: 40.6(8.2); % White: 60%; BMI: 35.93(4.8). **Low Sucrose**: n = 22; % White: 55%; BMI: 34.93 (4.4).

RCT; Y; N; N  BDI; High Sucrose: 9.05(10.19); Low Sucrose: 6.23(4.00).  High Sucrose LCD vs Low Sucrose LCD

All groups: Duration: 6 weeks; Frequency: Daily; Provider: NS; Format: Group/Individual. Description: Low-fat, high sucrose vs low sucrose diet (hypoenergetic, 4606kJ/d). All meals and snacks were pre-packed consumed in community with dinner consumed at the SWS Nutrition Centre.

Tanco 1998  Overall: Age: > 19yrs; 100% female; % White: NR. Co-morbid Dx: NR. **CT**: n = 20; BMI: 39.4(5.2); **BT**: n = 21; BMI: 38.7(5.8); **Control**: n = 19; BMI: 40.7 (5.5).

Controlled, comparative treatment outcome random assignment; N; N; N  BDI; CT: 17.9(10.5); BT: 15.8(8.4); Control: 19.6(7.8).  CT; BT; Waitlist Control

Intervention Groups: Duration: 8 weeks, Frequency 2hrs/week, Provider: Clinical Psychology Grad Students; Format: Group. **BT**: 1,200–1,500 kcal/day directly aimed at weight reduction via fat reduced diets and exercise adoption; **CT**: eclectic cognitive treatment program aimed at fostering insight into maladaptive behaviours, enhancing emotional well-being, and promoting regular physical exercise and non-disordered eating in the absence of any attempt at weight reduction; **Waitlist Control**: No treatment.

Wadden 1985  Overall: n = 19 (PSMF: n = 9; PLFD: n = 10.); Age: 38.1(NR); 89.47% female; % White: NR. BMI: NR; % Overweight: 82.3%; Co-morbid Dx: NR.

RCT, N, N, N  BDI (Mean and SE); PSMF: 7.6(2.6); Liquid diet 9.1(2.2).  Protein Sparing Modified Diet (PSMF) vs. Protein Liquid Formula Diet (PLDF)

All groups: Duration: 8 weeks; Frequency: Daily; Provider: Researcher; Format: Individual. 1st Month: 1000-1200 kcal balanced diet (< 30% kcal from fat). Multivitamin and mineral supplement provided. Diet Diary kept. **PSMF**: 2nd Month: Protein Sparing Modified Fast, daily Protein 60-75g from lean meats. No more than 450kcal/day. **PLDF**: 2nd Month: Optifast Protein Formula Liquid Diet, daily Protein 70g from drinks and 420kcal.
Wadden 1990 Overall: 100% female; % White: NR; Co-morbid Dx: NR. **VLCD:** n = 8; Age: 44.3(9.0); BMI: 40.7(10); **Balanced Diet Group:** n = 7; Age: 44.69(7.0); BMI: 44.6(9.0).

RCT; N; N; N
BDI; VLCD+BT: 14.0(13.0); Balanced Diet+BT: 14.30(9.0).

VLCD+BT vs Balanced LCD+BT

All groups: Unspecified Behaviour Therapy; Duration 18 weeks. Frequency: Weekly sessions of 90 minutes; Provider: Doctoral level clinical psychologists; Group (4-7 persons). **VLCD group:** Very low-calorie diet (400-500 kcal/day 15% Protein, 55% Carbohydrate, 30% Fat during weeks 1-2 then 70% Protein, 30% Fat following and return to prior diet in final two weeks). **Diet group:** 1200 kcal/day balanced diet (15% Protein, 55% Carbohydrate, 30% Fat)

Werrij 2009 Overall: n = 200 (CT Group: n = 96, Exercise Group: n = 104); Age: 45 (12); 81% female; % White: NR; BMI: 33.4 (4.6); Co-morbid Dx: NR;

RCT; N; N; Y; N
BDI; CDT: 10.01 (6.82); EDT: 8.94 (7.1).

Group dietic + CT (CDT); Group dietic + Exercise (EDT)

All Groups: Duration: 10 weeks. Frequency: Weekly, 2hr each, first half dietary intervention followed by 2nd hour CT/exercise as allocation. Provider: Dietician + CBT Therapist/Physiotherapist; Format: Group (max 12 pp). Common dietic program: Nutritional education, food diaries, healthy cooking classes. Regular meal timing, mindful eating and food habit modification. Social support seeking. Guidelines on a healthy diet were provided, but not prescribed. CDT: Cognitive therapy to identify, challenge and change dysfunctional cognitions concerning eating, control, weight, shape and related schemas. Workbook was "Pleasantly Plump". EDT: 1-hour low intensity exercise program at gym.

White 2013 Overall: 100% female; Co-morbid Dx: BED (approx. 50% w lifetime mood disorder). **Bupropion:** n = 31; Age: 45.2(12.1); % White: 90%; BMI: 36.2(6.6); **Control:** n = 30; Age: 43.1(13.0); % White: 77.4%; BMI: 35.4 (7.4).

Randomised double-blind treatment trial (efficacy trial); Y; N; UNCLEAR; Y, NCT00414167.

BDI; Bupropion: 13.4(9.8); Placebo: 10.8(6.1).

Bupropion; Placebo

All groups: Duration: 8 weeks, Frequency: Daily; Provider: Research pharmacist; Format: Individual. **Bupropion:** Sustained release bupropion 300mg/d. **Placebo:** Identical appearance placebo pill.

Notes: Demographic variables are reported as Mean ± Standard Deviation; NR = Not Reported; NS = Not Specified; Y = Yes; N = No; Dx = Diagnosis; BED = Binge Eating Disorder; BE = Binge Eating; MDD = Major Depressive Disorder; BMI = Body Mass Index; HRmax = % of Maximum Heart Rate; % 1RM = % of One Repetition of Maximum Weight; ITT = Intention to Treat Analysis; LOCF = Last observation carried forward; TAU = Treatment as Usual; CBT = Cognitive Behaviour Therapy; CT = Cognitive Therapy; BT = Behaviour Therapy; PMR = Progressive Muscle Relaxation; VLCD = Very Low Calorie Diet; LCD = Low Calorie Diet; BDI = Beck Depression Inventory; BDI-II Beck Depression Inventory-II; HAM-D = Hamilton Rating Scale for Depression; MHQ-d = Middlesex Hospital Questionnaire depression subscale; BSI = Brief Symptom Inventory; CES-D = Centre for Epidemiological Studies Depression Scale; HADS-D = Hospital Anxiety and Depression Scale depression subscale; IDS-C = Inventory of Depressive Symptoms (Clinician); SCL-20 = Symptom Checklist; POMS-D = Profile of Mood States depression subscale.
### 2.3.5. Assessment of Publication Bias

Visual inspection of the funnel plot (Appendix B) showed some asymmetry indicating possible small study effects. We then examined funnel plots based on control condition (active vs. inactive), and evidence of asymmetry occurred only for studies in the inactive control condition, supported by a statistically significant Egger’s test ($p < .05$, two-tailed).

### 2.3.6. Meta-analysis on Selected Trials

#### Analysis 1: Overall Intervention vs Inactive Control

<table>
<thead>
<tr>
<th>Study name</th>
<th>Statistics for each study, Std diff in means</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>p-Value</th>
<th>Sample size</th>
<th>Std diff in means and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appolonia 2003</td>
<td>-0.811</td>
<td>-1.453</td>
<td>-0.270</td>
<td>0.604</td>
<td>23</td>
<td>-0.811 [-1.453 to -0.270]</td>
</tr>
<tr>
<td>Arnett 2002</td>
<td>-0.846</td>
<td>-1.355</td>
<td>-0.338</td>
<td>0.619</td>
<td>23</td>
<td>-0.846 [-1.355 to -0.338]</td>
</tr>
<tr>
<td>Bennett 1986</td>
<td>6.119</td>
<td>-0.242</td>
<td>1.081</td>
<td>0.214</td>
<td>17</td>
<td>6.119 [-0.242 to 1.081]</td>
</tr>
<tr>
<td>Bosco 2006</td>
<td>0.776</td>
<td>-0.024</td>
<td>0.576</td>
<td>0.672</td>
<td>36</td>
<td>0.776 [-0.024 to 0.576]</td>
</tr>
<tr>
<td>DeVlin 2003a</td>
<td>-0.393</td>
<td>-0.883</td>
<td>0.115</td>
<td>0.132</td>
<td>32</td>
<td>-0.393 [-0.883 to 0.115]</td>
</tr>
<tr>
<td>Devlin 2003b</td>
<td>-0.988</td>
<td>-1.017</td>
<td>0.020</td>
<td>0.060</td>
<td>28</td>
<td>-0.988 [-1.017 to 0.020]</td>
</tr>
<tr>
<td>Devlin 2003c</td>
<td>-0.871</td>
<td>-0.970</td>
<td>0.142</td>
<td>0.322</td>
<td>23</td>
<td>-0.871 [-0.970 to 0.142]</td>
</tr>
<tr>
<td>Gürün 2003a</td>
<td>-0.522</td>
<td>-1.140</td>
<td>0.095</td>
<td>0.697</td>
<td>27</td>
<td>-0.522 [-1.140 to 0.095]</td>
</tr>
<tr>
<td>Gozo 2003b</td>
<td>-0.213</td>
<td>-0.423</td>
<td>0.396</td>
<td>0.492</td>
<td>23</td>
<td>-0.213 [-0.423 to 0.396]</td>
</tr>
<tr>
<td>Gredeski 2002</td>
<td>-0.206</td>
<td>-0.965</td>
<td>0.551</td>
<td>0.594</td>
<td>14</td>
<td>-0.206 [-0.965 to 0.551]</td>
</tr>
<tr>
<td>Krivoy 2004a</td>
<td>-0.853</td>
<td>-1.327</td>
<td>-0.379</td>
<td>0.600</td>
<td>46</td>
<td>-0.853 [-1.327 to -0.379]</td>
</tr>
<tr>
<td>Krivoy 2004b</td>
<td>-0.727</td>
<td>-1.218</td>
<td>-0.236</td>
<td>0.004</td>
<td>33</td>
<td>-0.727 [-1.218 to -0.236]</td>
</tr>
<tr>
<td>McEwen 2003</td>
<td>-0.184</td>
<td>-0.950</td>
<td>0.542</td>
<td>0.609</td>
<td>16</td>
<td>-0.184 [-0.950 to 0.542]</td>
</tr>
<tr>
<td>Saran 2006a</td>
<td>-0.637</td>
<td>-1.273</td>
<td>-0.002</td>
<td>0.049</td>
<td>20</td>
<td>-0.637 [-1.273 to -0.002]</td>
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<tr>
<td>Saran 2006b</td>
<td>-1.340</td>
<td>-2.025</td>
<td>-0.654</td>
<td>0.000</td>
<td>20</td>
<td>-1.340 [-2.025 to -0.654]</td>
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<tr>
<td>Shirley-Connor 2007</td>
<td>-0.319</td>
<td>-1.247</td>
<td>0.468</td>
<td>0.373</td>
<td>13</td>
<td>-0.319 [-1.247 to 0.468]</td>
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<tr>
<td>Tauss 1998a</td>
<td>-0.698</td>
<td>-1.420</td>
<td>0.047</td>
<td>0.067</td>
<td>18</td>
<td>-0.698 [-1.420 to 0.047]</td>
</tr>
<tr>
<td>Tauss 1998b</td>
<td>-0.451</td>
<td>-1.145</td>
<td>0.236</td>
<td>0.236</td>
<td>19</td>
<td>-0.451 [-1.145 to 0.236]</td>
</tr>
<tr>
<td>White 2013</td>
<td>-0.990</td>
<td>-6.592</td>
<td>4.012</td>
<td>0.725</td>
<td>51</td>
<td>-0.990 [-6.592 to 4.012]</td>
</tr>
<tr>
<td>White 2013</td>
<td>0.627</td>
<td>-0.630</td>
<td>-0.227</td>
<td>0.600</td>
<td>563</td>
<td>0.627 [-0.630 to -0.227]</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.35$; $\chi^2 = 45.18$, df = 18, ($P < .001$), $I^2 = 60.16\%$

*Figure 2.2. Standard mean difference in depression scores between psychotherapy and inactive controls.*

Thirteen studies and 19 intervention arms examined treatment against inactive or minimally active control ($n = 981$). Overall there was a moderate effect size in favour of treatment, $d = -0.43$, (95% CI = -0.64 to -0.22 $p < .001$).
### Analysis 2: Overall meta-analysis vs TAU

<table>
<thead>
<tr>
<th>Study name</th>
<th>Std diff in means</th>
<th>Standard error</th>
<th>Variance</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacon 2002</td>
<td>0.115</td>
<td>0.184</td>
<td>0.034</td>
<td>-0.247</td>
<td>0.476</td>
<td>0.023</td>
<td>0.533</td>
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<tr>
<td>Carole 2004</td>
<td>0.002</td>
<td>0.209</td>
<td>0.095</td>
<td>-0.604</td>
<td>0.608</td>
<td>0.007</td>
<td>0.995</td>
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<tr>
<td>Cook 2005</td>
<td>-0.399</td>
<td>0.464</td>
<td>0.215</td>
<td>-1.218</td>
<td>0.510</td>
<td>-0.860</td>
<td>0.390</td>
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<tr>
<td>Denis 1993</td>
<td>-1.105</td>
<td>0.556</td>
<td>0.389</td>
<td>-2.197</td>
<td>-0.019</td>
<td>-1.994</td>
<td>0.046</td>
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<tr>
<td>Foss et al 2004</td>
<td>-0.465</td>
<td>0.402</td>
<td>0.214</td>
<td>-1.774</td>
<td>0.438</td>
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<tr>
<td>Foss et al 2004b</td>
<td>-0.247</td>
<td>0.314</td>
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<td>-0.863</td>
<td>0.369</td>
<td>-0.786</td>
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<td>Ghoubi 2016</td>
<td>0.292</td>
<td>0.294</td>
<td>0.081</td>
<td>-0.215</td>
<td>0.549</td>
<td>1.026</td>
<td>0.305</td>
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<td>Lurie 2012</td>
<td>-0.161</td>
<td>0.329</td>
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<td>-0.817</td>
<td>0.485</td>
<td>-0.489</td>
<td>0.625</td>
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<td>Malanaro 2004</td>
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<td>0.252</td>
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<td>0.237</td>
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<td>-0.236</td>
<td>0.330</td>
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<td>-1.005</td>
<td>0.232</td>
<td>-1.290</td>
<td>0.197</td>
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<td>Paino 2001</td>
<td>-0.446</td>
<td>0.246</td>
<td>0.120</td>
<td>-1.165</td>
<td>0.193</td>
<td>-1.404</td>
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<td>Sbrocco 1999</td>
<td>-1.387</td>
<td>0.344</td>
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<td>-2.101</td>
<td>-0.713</td>
<td>-4.015</td>
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<td>Swart 1997</td>
<td>0.222</td>
<td>0.419</td>
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<td>-0.598</td>
<td>1.043</td>
<td>0.251</td>
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<td>-0.019</td>
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<td>-0.297</td>
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<td>Wadding 1990</td>
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<td>0.241</td>
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<td>-0.297</td>
<td>1.242</td>
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<td>Weir 2009</td>
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<td>0.070</td>
<td>-0.137</td>
<td>0.899</td>
<td>1.483</td>
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</tbody>
</table>

Heterogeneity: Tau\(^2\) = 0.38; Chi\(^2\) = 41.23, df = 15, (P < .000), \(I^2 = 63.6\%

**Figure 2.3.** Standard mean difference in depression scores between psychotherapy and treatment as usual.

Fifteen studies and 16 intervention arms investigated treatment against treatment as usual (n = 855). Overall there was no effect of treatment (d = -0.13; 95% CI = -0.37 to 0.11).

### Analysis 3: Pharmacotherapy interventions

<table>
<thead>
<tr>
<th>Study name</th>
<th>Std diff in means</th>
<th>Standard error</th>
<th>Variance</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appolinario 2003</td>
<td>-0.601</td>
<td>0.302</td>
<td>0.091</td>
<td>-1.453</td>
<td>-0.270</td>
<td>-2.352</td>
<td>0.014</td>
</tr>
<tr>
<td>Arnold 2002</td>
<td>-0.486</td>
<td>0.341</td>
<td>0.130</td>
<td>-1.533</td>
<td>-0.358</td>
<td>-2.365</td>
<td>0.019</td>
</tr>
<tr>
<td>Devlin 2005</td>
<td>-0.383</td>
<td>0.254</td>
<td>0.105</td>
<td>-0.641</td>
<td>-0.135</td>
<td>-1.766</td>
<td>0.032</td>
</tr>
<tr>
<td>Greenhew 2002</td>
<td>-0.206</td>
<td>0.160</td>
<td>0.049</td>
<td>-0.863</td>
<td>0.351</td>
<td>-0.533</td>
<td>0.594</td>
</tr>
<tr>
<td>McEaly 2003</td>
<td>-0.144</td>
<td>0.160</td>
<td>0.130</td>
<td>-0.890</td>
<td>0.322</td>
<td>-0.511</td>
<td>0.609</td>
</tr>
<tr>
<td>White 2013</td>
<td>-0.430</td>
<td>0.256</td>
<td>0.066</td>
<td>-0.659</td>
<td>-0.112</td>
<td>-3.511</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Heterogeneity: Tau\(^2\) = 0.13; Chi\(^2\) = 5.94, df = 5, (P = .31), \(I^2 = 15.75\%

**Figure 2.4.** Standard mean difference in depression scores between drug and placebo.

Six studies (n = 266) examined the effectiveness of discrete pharmacological intervention on symptoms of depression (Appolinario et al., 2003; Arnold et al., 2002; Devlin
et al., 2005; Guerdjikova et al., 2012; McElroy et al., 2003; White & Grilo, 2013). Active medication included sibutramine hydrochloride (Appolinario et al., 2003), fluoxetine (Arnold et al., 2002; Devlin et al., 2005), duloxetine (Guerdjikova et al., 2012), citalopram (McElroy et al., 2003) or bupropion (White & Grilo, 2013). These studies varied from six to 20 weeks duration. All were individual format, with medication administered by a psychiatrist or pharmacist. All but one were conducted on mixed gender samples (White & Grilo, 2013) with co-morbid diagnosis of BED. All studies recorded prevalence of lifetime depressive disorders yet only one study (Guerdjikova et al., 2012) was conducted on participants with current Major Depression. Three studies were conducted in populations with elevated scores of depression at baseline (Appolinario et al., 2003; Devlin et al., 2005; Guerdjikova et al., 2012). We found a moderate effect in favour of pharmacotherapy, $d = -0.41$, (95% CI = $-0.68$ to $-0.14$, $p < .05$).

**Analysis 4: Psychotherapy vs Inactive control**

<table>
<thead>
<tr>
<th>Study name</th>
<th>Std diff in means</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>p-Value</th>
<th>Sample size</th>
<th>Std diff in means and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bennett 1986</td>
<td>-0.419</td>
<td>-0.242</td>
<td>1.081</td>
<td>0.214</td>
<td>17</td>
<td>-0.15, 0.00, 0.15</td>
</tr>
<tr>
<td>Devlin 2005</td>
<td>-0.267</td>
<td>-0.796</td>
<td>0.262</td>
<td>0.322</td>
<td>22</td>
<td>-0.35, -0.14, 0.06</td>
</tr>
<tr>
<td>Gorin 2003a</td>
<td>-0.522</td>
<td>-1.140</td>
<td>0.095</td>
<td>0.097</td>
<td>23</td>
<td>-0.55, -0.13, 0.27</td>
</tr>
<tr>
<td>Gorin 2003b</td>
<td>-0.023</td>
<td>-0.032</td>
<td>0.049</td>
<td>0.492</td>
<td>23</td>
<td>-0.04, 0.03, 0.03</td>
</tr>
<tr>
<td>Kristeller 2014a</td>
<td>-0.053</td>
<td>-0.297</td>
<td>0.190</td>
<td>0.880</td>
<td>40</td>
<td>-0.15, 0.00, 0.05</td>
</tr>
<tr>
<td>Kristeller 2014b</td>
<td>-0.772</td>
<td>-1.218</td>
<td>-0.236</td>
<td>0.004</td>
<td>33</td>
<td>-0.90, -0.54, -0.06</td>
</tr>
<tr>
<td>Shelley-Ummenhofer 2007</td>
<td>-0.390</td>
<td>-1.247</td>
<td>0.468</td>
<td>0.373</td>
<td>13</td>
<td>-0.52, -0.07, 0.33</td>
</tr>
<tr>
<td>Tanco 1998a</td>
<td>-0.686</td>
<td>-1.420</td>
<td>0.047</td>
<td>0.067</td>
<td>18</td>
<td>-0.83, -0.23, 0.17</td>
</tr>
<tr>
<td>Tanco 1998b</td>
<td>-0.431</td>
<td>-1.145</td>
<td>0.282</td>
<td>0.236</td>
<td>19</td>
<td>-0.57, -0.16, 0.04</td>
</tr>
<tr>
<td>Tanco 1998c</td>
<td>-0.436</td>
<td>-0.687</td>
<td>-0.185</td>
<td>0.001</td>
<td>211</td>
<td>-0.70, -0.21, 0.00</td>
</tr>
</tbody>
</table>

Heterogeneity: Tau$^2 = 0.22$; Chi$^2 = 12.15$, df = 8, ($P = .15$), $I^2 = 34.13\%$

*Figure 2.5.* Standard mean difference in depression scores between psychotherapy and inactive controls.

Six studies ($n = 368$) examined the effectiveness of evidence-based psychotherapy against inactive controls (Bennett, 1986; Devlin et al., 2005; Gorin et al., 2003; Kristeller, Wolever, & Sheets, 2014; Shelley-Ummenhofer & MacMillan, 2007; Tanco, Linden, &
Earle, 1998). In total, 9 intervention arms were available for analysis. All trials utilised cognitive behaviour therapy or in the case of Kristeller et al., mindfulness-based therapy. Three of these were RCTs involving evidenced based cognitive behaviour therapy for BED (Gorin et al.; Kristeller et al.; Shelley-Ummenhofer & MacMillan). These studies utilised brief interventions of six to 16 weeks, usually 90 – 120 minutes duration of group therapy with faded contact, administered by a Psychologist, Clinical Psychology, Doctoral Psychology students or a Dietician. Whilst no study was focused on populations with clinical depression per se, all cohorts had elevated severity of depression at baseline on their respective measures. Collectively, there was a moderate effect size in favour of psychotherapy, $d = -0.45$ (95% CI = –0.69 to –0.19, $p = .001$).

### Analysis 5: Psychotherapy vs Treatment as usual

<table>
<thead>
<tr>
<th>Study name</th>
<th>Statistics for each study</th>
<th>Sample size</th>
<th>Std diff in means and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sbrocco 1999</td>
<td>0.222 -0.598 1.043 0.596</td>
<td>11 12</td>
<td>-1.30 -0.65 0.00 0.65 1.30</td>
</tr>
<tr>
<td>Werrij 2009</td>
<td>-0.019 -0.297 0.258 0.891</td>
<td>96 104</td>
<td>-1.30 -0.65 0.00 0.65 1.30</td>
</tr>
<tr>
<td>Nauta 2000</td>
<td>0.769 0.297 1.242 0.001</td>
<td>37 37</td>
<td>-1.30 -0.65 0.00 0.65 1.30</td>
</tr>
<tr>
<td>Painot 2001</td>
<td>0.381 -0.137 0.899 0.149</td>
<td>25 35</td>
<td>-1.30 -0.65 0.00 0.65 1.30</td>
</tr>
<tr>
<td>Fossati 2004</td>
<td>-0.398 -1.085 0.288 0.255</td>
<td>23 13</td>
<td>-1.30 -0.65 0.00 0.65 1.30</td>
</tr>
<tr>
<td>Fossati 2004a</td>
<td>-0.486 -1.165 0.193 0.160</td>
<td>25 15</td>
<td>-1.30 -0.65 0.00 0.65 1.30</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.36; \chi^2 = 14.52, df = 5, (P < .05), I^2 = 65.57\%$

*Figure 2.6. Standard mean difference in depression scores between psychotherapy and treatment as usual.*

Five studies examined evidenced based psychotherapy versus treatment as usual (n = 427; Fossati et al., 2004; Nauta, Hospers, Kok, & Jansen, 2000; Painot, Jotterand, Kammer, Fossati, & Golay, 2001; Sbrocco, 1999; Werrij et al., 2009). A total of 6 intervention arms were available for analysis. Intervention duration ranged from 10 to 15 weeks of weekly group sessions, usually of 120 to 150 mins duration. Interventions were delivered by psychologists (Sbrocco et al.; Nauta, 2000) and dieticians (Werrij et al.). Two studies did not
report intervention provider (Fossati et al., Painot et al.) Each intervention included some form of dietary modification. One study was a randomised control trial for treatment of BED (Nauta, 2000). The interventions by Fossati et al. (2004) included dietary advice and physical activity alongside dietary advice respectively in parallel to CBT and appear to be the most effective interventions compared to control (CBT alone) within this subgroup. The population investigated by Fossati et al. was the only sample with elevated symptoms of baseline depression in this analysis. Treatment as usual were evidenced based forms of cognitive and behaviour therapies or, in the case of Werrij et al., exercise and dietary advice alone. Overall, there was no difference between psychotherapy treatments and treatments as usual, $d = 0.11$ (95% CI = –0.26 to 0.48, $p = .563$).

Analysis 6: Lifestyle vs Treatment as usual

<table>
<thead>
<tr>
<th>Study name</th>
<th>Statistics for each study</th>
<th>Sample size</th>
<th>Std diff in means and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Std diff in means</td>
<td>Lower limit</td>
<td>Upper limit</td>
</tr>
<tr>
<td>Bacon 2002</td>
<td>0.292</td>
<td>-0.265</td>
<td>0.849</td>
</tr>
<tr>
<td>Carels 2004</td>
<td>-0.161</td>
<td>-0.807</td>
<td>0.485</td>
</tr>
<tr>
<td>Dennis 1999</td>
<td>-0.383</td>
<td>-1.019</td>
<td>0.252</td>
</tr>
<tr>
<td>Park 2006</td>
<td>-1.387</td>
<td>-2.061</td>
<td>-0.713</td>
</tr>
<tr>
<td></td>
<td>-0.395</td>
<td>-1.084</td>
<td>0.294</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.63; \chi^2 = 14.53, df = 3, (P < .05), I^2 = 79.35\%$

Figure 2.7. Standard mean difference in depression scores between Lifestyle interventions and treatment as usual.

Four studies (Bacon et al., 2002; Carels, Darby, Cacciapaglia, & Douglass, 2004; Dennis et al., 1999; Park & An, 2006) were available to examine standalone lifestyle interventions against control ($n = 169$). Two studies were conducted on participants with elevated symptoms of depression at baseline (Dennis et al., 1999; Park & An, 2006). All studies compared to TAU, which were traditional weight loss (Bacon et al.), lifestyle (Carels...
et al.) or exercise programs (Dennis et al.). Park & An, (2006) did not specify the control condition. Lifestyle programs ran from 12 to 24 weeks, consisting of group sessions of 60 to 90 minutes duration. All were provided by trained personnel. There was no treatment effect between lifestyle treatment and treatments as usual, \( d = -0.40 \), (95% CI = -1.08 to 0.26, \( p = .261 \)).

**Analysis 7: Exercise or diet vs control**

<table>
<thead>
<tr>
<th>Study name</th>
<th>Statistics for each study</th>
<th>Sample size</th>
<th>Std diff in means and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Std diff in means</td>
<td>Lower limit</td>
<td>Upper limit</td>
</tr>
<tr>
<td>Bowen 2006</td>
<td>0.276</td>
<td>-0.024</td>
<td>0.576</td>
</tr>
<tr>
<td>Lutze 2013</td>
<td>0.115</td>
<td>-0.247</td>
<td>0.476</td>
</tr>
<tr>
<td>Sarsan 2006a</td>
<td>-0.637</td>
<td>-1.272</td>
<td>-0.002</td>
</tr>
<tr>
<td>Sarsan 2006b</td>
<td>-1.340</td>
<td>-2.025</td>
<td>-0.654</td>
</tr>
<tr>
<td>Sarwit 1997</td>
<td>0.002</td>
<td>-0.604</td>
<td>0.608</td>
</tr>
<tr>
<td>Wadden 1985</td>
<td>-0.399</td>
<td>-1.308</td>
<td>0.510</td>
</tr>
<tr>
<td>Wadden 1990</td>
<td>-1.108</td>
<td>-2.197</td>
<td>-0.019</td>
</tr>
<tr>
<td></td>
<td>-0.350</td>
<td>-0.796</td>
<td>0.096</td>
</tr>
</tbody>
</table>

Heterogeneity: \( \tau^2 = 0.463 \); \( \chi^2 = 26.67 \), df = 7, (\( P < .001 \)), \( I^2 = 73.75\% \)

**Figure 2.8.** Standard mean difference in depression scores between exercise or diet and treatment as usual or inactive control (Sarsan, 2006). Note: (e) represents exercise intervention, (d) represents dietetic intervention.

Six studies and seven intervention arms were available to examine exercise (Bowen et al., 2006; Sarsan, Ardiç, Ozgen, Topuz, & Sermez, 2006) or dietary interventions (Lutze et al., 2013; Surwit et al., 1997; Wadden, Mason, Foster, Stunkard, & Prange, 1990; Wadden, Stunkard, Brownell, & Day, 1985) against control (\( n = 446 \)). Dietary interventions focused on calorie restriction, using various forms of either low calorie or very low-calorie diets.

Exercise intervention arms included aerobic (Sarsan, 2006a; Bowen, 2006) and resistance training (Sarsan, 2006). Bowen et al., (2006) compared exercise to weekly group stretching classes as control. Sarsan et al., compared aerobic or resistance training to an inactive information only control. All dietary interventions compared to alternative macronutrient allocations within an isocaloric low-calorie (1000-1200kcal) or very low-calorie diet (400-
500 kcal/day). Two studies were conducted over 12-months (Bowen et al.; Lutze et al.) whilst the remainder were of 6 to 18 weeks duration. Three studies included populations with elevated symptoms of depression (Lutze et al., 2013; Sarsan et al., 2006; Wadden et al., 1990). There was a no treatment effect between exercise or diet and control treatments, \( d = -0.35, (95\% \text{ CI} = -0.77 \text{ to } 0.10, p = .124) \).

### 2.3.7. Studies Not Included in Meta-analysis

We were unable to include seven studies in the meta-analysis due to insufficient data following author contact (Annesi & Gorjala, 2010; Esmaily et al., 2015; Ghroubi et al., 2016; Kiernan, King, Stefanick, & Killen, 2001; Linde et al., 2011; Pagoto et al., 2013; Riva, Bacchetta, Cesa, Conti, & Molinari, 2003; Ruusunen et al., 2012). We discuss them here as they remain a rich source of information regarding suitable interventions for clinical depression in overweight or obese populations.

Two studies examined the effect of evidence-based psychotherapy for clinical depression. Linde et al. (2011) randomly assigned overweight women with comorbid clinical depression (Major Depressive Disorder; MDD) to group therapy of either standard behavioural weight loss or a tailored weight loss and depression intervention. The tailored intervention consisted of CBT based on the *Coping with Depression* manual. Both interventions led to a significant reduction in moderate to severe depressive scores on the SCL-20, however no between group differences were found at post-treatment or follow-up. More recently, Pagoto et al. (2013) randomly assigned overweight adults with a diagnosis of clinical depression (MDD) to 10 weeks of behavioural activation followed by lifestyle intervention (BA) for the remainder of 6-months or lifestyle intervention alone with attention control over 6 months. Whilst weight loss was similar between groups, the condition including BA led to significantly greater reductions in depression at post treatment and 6-month follow-up. Participants in the BA condition were also more likely to be in remission at
post-treatment and follow-up compared to individuals experiencing lifestyle intervention alone.

A further two studies examined the effect of lifestyle interventions. Annesi and Gorjala (2010) found the Coach Approach (regular exercise, nutrition and one-on-one support over 6 months) reduced depressive symptoms significantly more than exercise alone or information alone. In a large-scale 36-month, Finnish diabetes prevention study, Ruusunen et al. (2012) found overall reductions in relatively normal baseline depressive symptomatology and no group difference between standard lifestyle intervention and an information only control. One study examined a cognitive behavioural weight-loss program. In that study, Riva et al. (2003) compared standard CBT with exercise and nutritional therapy for BED in overweight adults to an enhanced nutritional and exercise program using Experiential Cognitive Therapy (ECT) that utilised 10 bi-weekly virtual reality sessions aiming to follow an exposure and response prevention protocol. Riva et al. suggested a greater reduction of BDI-II scores in the ECT group compared to the CBT group post-treatment (11-weeks). Both groups reduced symptom scores significantly. Ghroubi et al. (2016) examined the effect of adding isokinetic resistance training to aerobic exercise and calorie restriction – by up to 35% or baseline calories - over 8 weeks. The authors found both groups responded similarly on the Hamilton Rating Scale of Depression (HAM-D), reducing depression symptoms over time. Finally, one study investigated an alternative nutritional intervention. Esmaily et al. (2015) conducted a double-blind randomised, placebo control, cross-over trial providing Curcuminoids or placebo capsule over 30 days with a 2-week washout between treatments (curcumin-placebo vs placebo-curcumin). No significant effect of Curcumin on symptoms of depression was found in either condition.
2.4. Discussion

To the best of our knowledge, this is the first systematic review to investigate treatments for symptoms of depression in OW/OB adults. We aimed to identify which treatments are superior to alternative treatments or control conditions in this population and to better understand which treatment features were associated with better outcomes for depression.

Overall, treatment was statically superior to inactive or minimally active control. Pharmacotherapy and evidence-based psychotherapy especially were statistically superior to inactive control. In this regard, fluoxetine, sibutramine hydrochloride (now discontinued) and various forms of cognitive and behaviour therapy including those incorporating mindfulness-based therapy were associated with improvements in depression. This suggests that clinicians can consider these existing psychotherapy or pharmacotherapy treatments for depression when targeting depression in OW/OB adults.

Compared to treatment as usual, overall and within sub-group analysis, there were only marginal differences between modified treatments and treatment as usual, however Fossati et al. (2004) illustrated traditional CBT could be enhanced with nutritional advice and regular physical exercise. Whilst there was large methodological variability between studies (i.e. treatment type, adjunctive treatments, duration, sample size, severity of initial depressive symptomatology), these results suggest that existing treatments, specifically pharmacotherapy or cognitive and behavioural therapies are useful in treating symptoms of depression in OW/OB adults compared to no treatment or minimal intervention. This helps establish evidence in favour of current treatments as effective for treating symptoms of depression in this population. Studies that appeared to have the larger effect on symptoms of depression were conducted in populations with elevated symptoms at baseline (e.g. Appolinario et al., 2003; Fossati et al., 2004; Gorin et al., 2003; Kristeller et al., 2014; Park & An, 2006; Sarsan
et al., 2006; Tanco et al., 1998). Nevertheless, given that few studies in our sample examined clinically depressed samples and only one of these contributed to meta-analysis, there should be caution in generalising results to clinical depression.

Only three studies were conducted on overweight or obese populations with a current diagnosis of MDD (Guerdjikova et al., 2012; Linde et al., 2011; Pagoto et al., 2013). Three further studies had samples with substantial numbers of participants with MDD (Arnold et al., 2002; McElroy et al., 2003; White & Grilo, 2013). Fluoxetine was superior to placebo (Arnold et al.). Evidence-based psychotherapy, either CBT or BA were as effective or superior to standard weight loss or lifestyle interventions alone (Linde et al., 2011; Pagoto et al., 2013). There were some common treatment components in these studies. For example, Linde et al., pointed out that both interventions in their trial (behavioural weight loss vs. CBT) included substantial components of behavioural activation, problem solving skills, cognitive restructuring and social support. Pagoto et al. effectively utilised a behavioural activation approach to treating depression. Therefore, clinicians might find these components are worthwhile inclusions in effective interventions. It may also be important for clinicians to sequence depression treatment prior to weight loss interventions where weight loss or eating behaviour change is a focus of therapy (Pagoto et al.). Indeed, Pagoto et al. found that participants who remitted from depression also experienced greater weight loss than those who continued to meet criteria for depression post-treatment. Nevertheless, the lifestyle intervention also produced reasonable remission rates (approx. 60-70% in BA vs 40-50% Lifestyle alone) suggesting it is a useful component in treatment. Furthermore, there is some evidence that lifestyle interventions are superior to exercise alone or information only control conditions (Annesi & Gorjala, 2010) but as our meta-analysis revealed, general attempts to enhance existing lifestyle interventions (e.g. with non-dieting approaches, self-control or self-efficacy skills) have proven challenging. This is in part because lifestyle interventions - as they stand - are reasonable interventions for depression in many populations (Cezaretto,
Ferreira, Sharma, Sadeghirad, & Kolahdooz, 2016). Generalisations regarding clinical depression are problematic for many of the included studies examining lifestyle interventions, which were conducted with individuals experiencing normal or mild depressive symptomatology.

Only two studies investigated exercise alone (Bowen et al., 2006; Sarsan et al., 2006). This is surprising given the evidence supporting the use of exercise as a treatment for mild to moderate depression – either alone or as an adjunct to pharmacotherapy/psychotherapy and the benefits of physical activity for OW/OB populations (Cooney et al., 2013; Deslandes et al., 2009; Krogh, Nordentoft, Sterne, & Lawlor, 2011; Silveira et al., 2013). Data from our review indicates that aerobic or resistance exercise may be most useful when added to nutritional and/or cognitive-behavioural approaches to treatment (Fossati et al., 2004; Melanson, Dell'Olio, Carpenter, & Angelopoulos, 2004). Our findings are similar to two recent meta-analytic reviews which found that aerobic and resistance exercise are effective in treating depression in the general population (Krogh et al., 2011; Silveira et al., 2013). The pooled SMD calculated from these studies was -0.40 (95% CI: -0.66 to –0.14) to -0.61 (95% CI: -0.88 to –0.33) respectively, in favour of exercise. However, the beneficial effect on mood appears to persist only as long as one engages in regular exercise (Krogh et al., 2011). At the very least, exercise seems to be superior to information only controls in the treatment of mild symptoms of depression (Sarsan et al., 2006) in overweight adults. One reason for the dearth of data on exercise studies in the present review is likely that investigations into the effect of exercise on depression do not typically recruit populations with co-morbid OW/OB, and such individuals may be less likely to engage in a study that includes exercise as a central component regardless of whether they are a population of interest or not. Future studies could aid research into this population by reporting psychological findings stratified by BMI, recruiting specifically from populations that are also OW/OB and investigating participant experience of exercise interventions to determine what factors contribute to engagement and
adherence for adults with clinical depression and OW/OB. Exercise interventions in OW/OB adults with clinical depression warrant further research, especially investigations seeking to increase engagement in exercise, examining exercise type, or exercise as an adjunct to pharmacotherapy and/or psychotherapy.

All dietary interventions considered in our study were low or very low-calorie interventions either in isolation or combined with exercise. Results were mixed. Very low calorie diets may be superior to balanced low calorie diets when combined with behaviour therapy (Wadden et al., 1990), however conferred no further advantage when paired to cognitive therapy relative to pairing with exercise (Painot et al., 2001). Very low calorie diets might lead to problems with adherence in this population (e.g. Cook et al., 1981). One study showed adding exercise to dietary interventions did not seem to enhance outcomes of dietary intervention alone (Kiernan et al., 2001) whilst adding diet to an exercise intervention had a superior effect on depressive symptoms compared to exercise alone in one study (Melanson et al., 2004). Generalisations in this case would be unreasonable given the methodological variability and limited number of studies available for consideration. We can only conclude, as Cezaretto et al. (2015), recently did, that the impact of specific changes in dietary habits on depression in OW/OB populations remains unclear.

These findings build on previous guidelines (e.g. NICE, 2009) and meta-analytic reviews which indicate that exercise (Silveira et al., 2013), lifestyle interventions (Cezaretto et al., 2016), psychotherapy and pharmacotherapy (Pampallona, Bollini, Tibaldi, Kupelnick, & Munizza, 2004) are effective interventions for symptoms of depression. Specifically, our research suggests that psychotherapy (CBT, BA, mindfulness-based therapy), pharmacotherapy (fluoxetine, duloxetine), exercise (aerobic or resistance) and lifestyle or behavioural weight loss interventions could be useful treatments for depression in populations with co-morbid clinical depression and OW/OB. Clinicians should keep patient
goals (e.g. to improve mood, reduce disordered eating, reduce weight etc.) in mind alongside the underlying factors contributing to depression in each case.

### 2.4.1. Limitations of the Current Study

The current study has some limitations. Very few studies documented the prevalence of current or historical major depression in their samples and even fewer sought to include populations with current clinical depression. Indeed, most studies were conducted on populations with relatively normal or mild depressive features or in which depression was an outcome of secondary interest. Although those samples that did have elevated severity of depression at baseline also appeared to have the largest change relative to control conditions, given the lack of clinically depressed individuals across studies, caution should be used when interpreting our pooled outcome data.

We chose to exclude studies that removed participants if they had clinical depression or elevated symptoms of depression. This criterion led to the removal of several studies that may have shed more light on our primary research question, although at the cost of applicability. We did however include a large number of studies ($n = 13$) that included populations with BED. This enhances the ecological validity of our findings as disordered eating, clinical depression and OW/OB frequently co-occur (Appelhans et al., 2012; Faulconbridge & Bechtel, 2014). We also excluded studies that did not utilise a control condition. There are likely to be many studies, particularly in emerging fields of interventional research that used alternative designs. However, excluding studies without a control condition likely improved the quality of the data and ensured we could make some conclusions about relative superiority across studies. The majority of studies were conducted on female or mostly female (> 75% of $n$) populations precluding confident generalisation of the findings above to males. Furthermore, heterogeneity in intervention (type, duration, frequency of contact) amongst the studies included was relatively high within some analysis.
This makes it difficult to determine from pooled outcome data the precise mechanisms contributing to most favourable outcomes and suggests researchers are searching for the most optimal interventions to apply for this population. Until a greater body of research exists behind each variation of intervention, precise treatment guidelines are difficult prescribe.

2.4.2. Conclusion

There is a well-established body of research addressing pharmacotherapy, psychotherapy, lifestyle modification and exercise for depression in the general population. However, recommendations regarding treatment of depression in OW/OB adults have not been widely identified. In this review, we found that existing treatments for depression, including behavioural activation, cognitive behaviour therapy, pharmacotherapy, lifestyle and behavioural weight loss interventions, and exercise are commendable to clinicians seeking to treat depression in an OW/OB population. Mindfulness based cognitive therapy warrants further research. Compared to inactive control or placebo, pharmacotherapy or psychotherapy were effective at reducing symptoms of depression. In contrast, no class of modified intervention was superior to active treatment-as-usual, primarily due to modified and active TAU being effective for reducing symptoms of depression. Dietary and exercise interventions for clinical depression in adults who have OW/OB remain under-researched. Future research should seek to clarify which types of exercise or dietary protocols may be most effective for reducing symptoms of clinical depression in adults with OW/OB. Finally, with regard to reporting of research, randomisation procedures and outcome data (i.e. mean and variance) should be clearly described, even in the absence of statistically significant differences.
References


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Chapter 3 – Study Two

Effects of High Intensity Intermittent, Steady State and Personal Preference Exercise on Clinical Depression in Adults with Overweight or Obesity: A Randomised Controlled Clinical Trial.
Effects of High Intensity Intermittent, Steady State and Personal Preference Exercise on Clinical Depression in Adults with Overweight or Obesity: A Randomised Controlled Clinical Trial.

3.1. Introduction

Clinical depression and overweight/obesity (OW/OB) are considered common conditions in modern Western society (Bromet et al., 2011; Ng et al., 2014). Depression has a 12-month prevalence of approximately 5.4 per cent (Australian Bureau of Statistics; ABS, 2008) and 63 per cent of Australians are overweight or obese (ABS, 2015). It is not surprising then to find that depression and OW/OB frequently co-occur (Werrij, Mulkens, Hospers, & Jansen, 2006). Indeed, within Australia, Carey et al. (2014) found that the prevalence of depression among normal-weight primary care patients was 12% (95% CI = 8.5 to 14.0) yet depression among obese patients increased to 23% (95% CI = 17.8 to 29.0). Research also shows that the presence of one condition greatly increases risk for developing the other (Simon et al., 2008). Overweight particularly increases risk for somatic symptoms of depression (e.g. lack of energy, sleep disturbance) and suicidal ideation (Carpenter, Hasin, Allison, & Faith, 2000; Wiltink et al., 2013). Despite this co-occurrence, few programs currently exist to treat co-morbid depression and overweight/obesity.

Research has indicated that exercise—planned, structured and repetitive bodily movement with the purpose of improving or maintaining one or more components of physical fitness (Caspersen, Powell, & Christenson, 1985)—is a useful adjunctive approach to weight loss (Shaw, Gennat, O'Rourke, & Del Mar, 2006) and that standard cognitive behaviour therapy (CBT) for mood and anxiety concerns can be enhanced when a general “physical activity” program is included in therapy (Faulconbridge, Wadden, Berkowitz, Pulcini, & Treadwell, 2011; Gary, Dunbar, Higgins, Musselman, & Smith, 2010). This is especially so when structured exercise is applied in treatment (Cooney et al., 2013). Systematic reviews indicate that exercise can be as effective as psychotherapy or pharmacotherapy in treating
adults with clinical depression (Cooney et al., 2013), and further research has shown it reduces depression in SSRI resistant populations (Trivedi et al., 2011), allows for a reduction in anti-depressant medication and reduces relapse for depressed patients (Deslandes et al., 2009). Furthermore, treatment guidelines recommend exercise as a treatment or adjunctive treatment for mild to moderate depression in the general population (e.g. NICE, 2009, SIGN, 2010).

Despite such promising findings, only 40 per cent of mental health care practitioners recommended physical activity to their clients (Phongsavan, Merom, Bauman, & Wagner, 2007), substantially less than prior reports, which indicated 83 to 93 per cent of psychologists had recommended physical activity to clients (Barrow, English, & Pinkerton, 1987; Burks & Keeley, 1989). In a primary health care context, Australian General Practitioners provide advice about exercise to approx. 18 per cent of patients (Short et al., 2016). Furthermore, fewer than 25 per cent of primary health care patients receive information about the type of exercise to engage in (Short et al., 2016). Together, these findings suggests that medical and mental health clinicians might have sub-optimal understanding of how to construct and implement evidenced-based exercise programs for mental health concerns and that this limitation may influence their decision not to consider exercise as a component of evidence-based practice (Phongsavan et al., 2007; Ranjbar et al., 2015). Previous intervention studies on depression in adults with OW/OB have followed general treatment approaches, incorporating increases in physical activity alongside evidence-based psychotherapy and/or lifestyle modification (Faulconbridge et al., 2011; Linde et al., 2011; Pagoto et al., 2013). These treatments achieve significant weight loss and reductions in depressive symptoms. A relative shortcoming regarding these and similar interventions has been the limited research regarding feasibility, suitability and efficacy of the physical activity/exercise components employed as treatment for depression in adults with OW/OB with clinical depression. This is especially important since individuals with co-morbid depression and OW/OB may face
particular risks to health and well-being (Markowitz et al., 2008) and are likely to experience unique challenges not confronted by normal weight peers. It is well established that depression often reduces general activity, motivation and engagement (Barlow, 2014; Beck, 1991; Carr & McNulty, 2006) and can be exacerbated by chronic health conditions associated with OW/OB (Norberg & Danielsson, 2012). Furthermore, individuals with clinical depression and OW/OB are less likely than normal weight peers to receive treatment for depression, often engage in treatment for less time (Boudreau et al., 2013), confront substandard treatment experience due to weight related stigma and benefit to a lower degree in terms of treatment outcome (Fruh et al., 2016; Puhl & Heuer, 2010) and health behaviour change (Pagoto et al., 2007). It is therefore important that clinicians are able to make well-informed decisions regarding the use of exercise for treatment of depression in adults with co-morbid OW/OB and that we understand how this population responds to such exercise and physical activity in treatment.

Current research indicates important exercise variables in treatment of depression for the general population include type (aerobic, resistance or combined), intensity (above 65-75% VO$_{2\text{max}}$), volume (around 1000Cal per week), frequency (3-5 sessions per week), and compliance (Chu, Buckworth, Kirby, & Emery, 2009; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Krogh, 2009; Rethorst, Wipfli, & Landers, 2009; Singh et al., 2005; Trivedi et al., 2011). Supervision and individual tailoring of interventions may also be important, although findings have been mixed (Ranjbar et al., 2015; Silveira et al., 2013). A recent meta-analysis confirms the above (Silveira et al., 2013). An element of personal preference (e.g. client selection of exercise type, intensity) may also be relevant, however such research is in its infancy (Busch, Ciccolo, Puspitasari, & Nosrat, 2015). Given this, two formats of exercise in particular – High Intensity Intermittent Exercise (HIIE) and personally selected interventions warrant further investigation. High Intensity Intermittent Exercise consists of brief repeated bouts of intense exertion (e.g. 30 seconds of cycling at 100% VO$_{2\text{peak}}$ power output) followed by recovery bouts (e.g. 2 minutes of cycling at 50% VO$_{2\text{peak}}$ power output)
repeated in alternating fashion throughout the session. High intensity exercise especially has gained recent popularity in the community, in part thanks to wide media coverage (e.g. Mosley, 2013) but is not without criticism. For example, Biddle and Batterham (2015) argued high intensity exercise could not be an effective public health intervention due to the psychologically aversive nature of intense exercise. Indeed, to date, no studies have examined high intensity aerobic exercise above 90% of aerobic capacity (VO$_{2peak}$) as a treatment for depression. Similarly, few studies have examined personal selection of exercise format or type, yet exercise interventions with an element of personal preference may improve symptoms of depression over and above interventions which are prescribed in their entirety (Doose et al., 2015). This warrants further investigation.

In Chapter 1, we outlined in detail the potential moderators and mediators between obesity and depression. A leading hypothesis regarding moderators of the obesity-depression relationship has been the idea of HPA axis dysregulation (Lopresti, Hood, & Drummond, 2013). The typical presentation is one of increased corticotropin-releasing hormone (CRH), hypersecretion of cortisol, impaired responsiveness to glucocorticoids and insulin resistance. Notably, it has been suggested that these changes are a consequence of two factors. The first is altered secretory dynamics of corticotropin (ACTH) and hyper-responsiveness of the HPA axis - especially during chronic or acutely stressful events. The second seems to be the functional hypercortisolism, possibly due to increased liver, abdominal or visceral adipose tissue (Pasquali & Vicennati, 2000). Regular, moderate intensity exercise has been shown to be protective against future HPA axis dysfunction and may be useful in remediating such dysfunction in certain populations (Aslam, Imanullah, Asim, & El-Menyar, 2013; Tsatsoulis & Fountoulakis, 2006).

Early studies found no or mixed relationships between body fat and depression. For example, Annesi (2004) found no association between body fat and change in depression score in older, overweight women enrolled in a 10 week weight-loss program. Nevertheless, a number of studies have found abdominal fat (also called ‘central fat’) appears to mediate an obesity-depression relationship, more so than BMI and even after controlling for lifestyle factors (Rivenes, Harvey,
Mykletun, 2009; Zhao et al., 2011). Wyshak (2011) illustrated that independent of weight status, greater body fat was associated with depression (OR = 2.22, 95% CI: 1.39 to 3.54) although in this study, body fat was estimated by demographic parameters rather than direct measurement. Visceral but not subcutaneous fat and Beck Depression Inventory scores are correlated (r = 0.45; Ludescher et al., 2008). Indeed, visceral fat is three times higher in individuals with clinical depression relative to non-depressed controls and is associated with impaired insulin sensitivity and dysregulation of glucocorticoids (Greggersen et al., 2011). More recently, Yamamoto et al. (2016) found elevated depression scores and impaired fasting insulin levels in men with higher levels of visceral fat mass but not subcutaneous fat. This suggests that visceral fat especially contributes to the obesity-depression pathway, via dysregulation of the HPA-axis and impairments to insulin sensitivity.

It is well documented that even light exercise can modify visceral fat mass in overweight individuals. Systematic reviews indicate that aerobic exercise is particularly effective and may be superior to resistance training for altering visceral fat mass and body composition (Ismail, Keating, Baker, & Johnson, 2012; Ohkawara, Tanaka, Miyachi, Ishikawa-Takata, & Tabata, 2007). Higher intensity and greater volumes of exercise enhance visceral fat loss (Irving et al., 2008; Ohkawara et al., 2007). Specifically, a minimum of 10 METS/week or approximately 150mins/week of moderate intensity exercise has been found adequate to reduce visceral fat mass (Ismail et al., 2012). Higher intensity appears especially important for resistance training, where high intensity is superior to lower intensities (Dutheil et al., 2013). Recent commentators have asserted that whilst the physiological benefits of high intensity exercise are fairly clear, it is not a feasible intervention for the general population due to its physically uncomfortable and psychologically aversive nature (Biddle & Batterham, 2015). Given that HIIE holds promise regarding some of the aetiologial factors of co-morbid depression and OW/OB, research should confirm whether it is an effective and suitable exercise for this population and determine the most suitable formats before clinical recommendations are made.
Whilst much is known about exercise for depression in the general population (Cooney et al., 2013), very little is understood about the efficacy of exercise programs in adults with depression and comorbid OW/OB. The aim of the present study is to understand which formats, types and intensities of exercise may be effective at reducing clinical depression in adults with OW/OB. We also sought to determine the suitability of high intensity exercise above 90% VO\textsubscript{2peak} as a treatment for clinical depression and in particular, for adults with co-morbid OW/OB. Finally, we aim to explore how such interventions affect potential mediators of the obesity-depression relationship, including body composition, body fat and visceral fat mass in this population. These are important foundational stones within the field, informing development of evidenced based exercise interventions that can be integrated into a cognitive-behavioral treatment program for depression in individuals with co-morbid OW/OB.

We employed a 3 (condition: moderate intensity steady state, vs moderate intensity personal preference vs high intensity intermittent exercise) x 3 (time: pre, mid, post) design. We chose an active control intervention (Moderate Intensity Steady State; MISS) which represents a basic exercise recommendation to an individual with comorbid overweight and depression from a General Practitioner (e.g. Short et al., 2016). Such an active control is likely to improve depressive symptoms to a reasonable degree.

3.1.1. Hypothesis

Given that higher intensity exercise may have a greater effect on symptoms of depression in normal weight adults (Chu et al., 2009; Singh, 2005), we expect that individuals engaging in High Intensity Intermittent Exercise (HIIE) will experience a greater reduction in depressive symptoms than individuals engaged in the active control condition. Similarly, because Doose et al. (2015) indicated that personal preference is an important aspect of treating depression with exercise, we hypothesise that participants in the Moderate Intensity Personal Preference (MIPP) condition will experience a greater reduction in depression than active control (MISS). It is well documented that depression’ has a high comorbidity with anxiety and stress. Correspondingly, it is understood that
anxiety and stress abate with exercise interventions (Salmon, 2001). As such, we expect all conditions to improve on measures of anxiety and stress. Since the duration of the intervention program is brief and due to the lack of a nutritional component including calorie restriction or dietary advice, we expect only small reductions in BMI, body weight or fat mass. We expect significant improvements in aerobic capacity across all conditions.

3.2. Method

3.2.1. Recruitment

Individuals from the metropolitan community of Perth, Western Australia were recruited via community notices posted at local shopping centre and town tall notice boards, cafés, Universities and third parties including General Practitioners and Psychologists. Recruitment methods included posters, flyers, a newspaper advertisement and social media advertising from February 2014 to February 2016. The study protocol was approved by Murdoch University Research Ethics and Integrity Office (Project No. 2013/204) and was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN: 12614000097640).

3.2.2. Inclusion and Exclusion Criteria

Enrolment was open to men and women aged 18-45 years, who were experiencing a current episode of depression according to Structured Clinical Interview. Participants had to be willing to delay new therapy for the duration of participation1, had a BMI greater than 25 and understood written and spoken English. Anti-depressant use was permitted provided unchanged dose 3 weeks prior to participation and throughout the intervention. Exclusion criteria included regular psychotherapy, previous cardiovascular incident or cardiovascular disease, intellectual impairment, serious or unstable medical conditions, substance dependence requiring rehabilitation, personality disorder, current or historical mania, hypomania or anorexia nervosa, current or recent bulimia

1To ensure participants received appropriate treatment, they were informed that professional evidence-based treatment for any psychological issue could be commenced at any time. In such cases the participant’s data would be excluded from analysis.
nervosa, current suicidal ideation, self-harm of a clinically significant nature or a suicide attempt in the prior 2 years. Women who were pregnant or attempting to become pregnant were also excluded from participation.

3.2.3. Randomisation Protocol

A random series was generated using an online random number generator (www.random.org). After collection of baseline measures, each participant was assigned to a condition via sealed envelope drawn in sequence.

3.2.4. Initial Screening and Semi-Structured Clinical Interview

Applicants were provided with an information letter regarding the study and participation (Appendix C). Phone screening was conducted by a member of the research team who was completing postgraduate training in Clinical Psychology. Individuals who did not meet obvious exclusion criteria were invited to provide informed consent and undergo a thorough screening via the Research Version of the Structured Clinical Interview for DSM-IV (SCID-I/NP). During this intake, individuals also completed Stage 1 of the Exercise and Sports Science Australia Adult Pre-Exercise Screening System (ESSA APSS, Appendix D), the Beck Depression Inventory-II (BDI-II), Depression, Anxiety and Stress Scale (DASS-21) and had their height and weight measured. Individuals who endorsed exercise risk items on the ESSA APSS were required to provide a written statement from their doctor or specialist reporting them safe to exercise and in particular, engage in supervised maximal exertion required by the VO₂peak assessments. Demographic data (see Appendix E) were also collected. Eligible persons were invited to take part in the study. Those who met exclusion criteria at any stage or who withdrew from the study were debriefed and provided with information regarding relevant psychological services.

3.2.5. Participants

A total of 41 adults were invited to take part in the study. Four participants withdrew due to scheduling difficulties prior to the first week of the program and one withdrew prior to commencing their first week due to a decline in their clinical condition, which warranted direct
psychological treatment. As a result, 36 participants completed the program and were included in the analysis. Demographic data and baseline characteristics are shown in Table 3.1, below.

### 3.2.6. Materials

#### 3.2.6.1. Primary Clinical Outcome Scales

Primary outcome measures were assessed at baseline and post intervention.

**Depression.** Severity of depression was measured via the Beck Depression Inventory (BDI-II; Beck, Steer, and Brown, 1996, see Appendix F). The BDI-II is a 21-item self-report questionnaire with excellent validity (Wang & Gorenstein, 2013) and reliability (e.g. Cronbach’s $\alpha = .93$; Beck et al., 1996). Scores range from zero to 63, with scores below 13 indicating lower than mild depression, above 13 suggesting mild depression, with moderate (20-28) and severe (29 and above) depression represented by higher scores. BDI-II scores correlate strongly to SCID-I endorsement of items corresponding to Major Depressive Episode with scores above 16 having high sensitivity (84%) to clinical depression (Sprinkle, Sprinkle, Lurie, Insko, & Atkinson, 2002).

**Depression, Anxiety and Stress.** The short form Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a 21 item self-report questionnaire measuring depression, anxiety and stress symptoms over the previous week. Reliability of the DASS-21 is high in clinical and community samples (Cronbach’s $\alpha = .87-.91$) with adequate subscale convergent and discriminant validity to validated measures of depression and anxiety and an excellent three factor structure (Antony, Bieling, Cox, Enns, & Swinson, 1998). Scores are multiplied by two to allow comparison to normative data for the DASS-42, producing a score up to 42 per subscale. Symptom severity is illustrated along with the DASS-21 in Appendix G.

#### 3.2.6.2. Secondary Outcome Scales

**VO$_{2peak}$ assessment.** To accurately tailor exercise intensity and assess aerobic capacity, maximal exertion (VO$_{2peak}$) assessments were conducted on Velotron Pro Cycle Ergometric units pre, mid and post intervention (See Appendix H for protocol). Participants experienced
incrementally increased workload every 2 minutes until they could no longer maintain a cadence of 60 revolutions per minute or elected to discontinue the assessment due to fatigue or discomfort.

**Body composition, visceral fat mass, height and weight.** Body composition including visceral fat mass were measured via whole body scan on a Hologic Discovery Series W, Model: 010-1549 Dual-energy X-Ray Absorptiometry (DXA) Scanner. Height was measured using a wall mounted stadiometer. Weight was measured using a digital industrial platform scale (accuracy to .005 kg). Body composition, height and weight were measured with participants barefoot and dressed in light sports attire.

### 3.2.7. Procedure

Participants progressed through the intervention as depicted in the flow diagram below. All sessions were individual format and took place between 7am and 7pm weekdays under supervision of an allocated 4th year exercise physiology student receiving supervision from an Accredited Exercise Physiologist. Sessions took place in the environmentally controlled Exercise Physiology, Performance or Strength and Conditioning Laboratory at Murdoch University at a time of day mutually agreed upon by participant and the allocated trainer.
3.2.7.1. Structured Exercise Program

Each session commenced with a 5-minute warm up and concluded with a 5-minute cool down (stretching and light aerobic activity). Participants wore Polar T31 Heart Rate monitors throughout, provided an overall session RPE and session rating as positive, neutral or negative (data not shown). Appropriate exercise intensity was achieved by calculating the VO$_{2\text{peak}}$ power relationship from the initial aerobic capacity assessment and subsequently used as workload on selected equipment (e.g. Wattbike Pro cycle).
3.2.7.2. Interventions

*Moderate intensity steady state condition (MISS) – active control.* Participants were asked to ride a Wattbike Pro stationary cycle at 60% V\(_{2\text{peak}}\) for 30 minutes per session. The trainer encouraged participants to maintain this intensity at a consistent rate. Power output was monitored on the Wattbike Pro on-board computer.

*Moderate intensity personal preference condition (MIPP).* Individuals in the MIPP condition were asked to exercise at a moderate intensity (i.e. 60% V\(_{2\text{peak}}\) or an RPE of 13-14 if power output could not be directly measured). Participants were encouraged to self-select the type of exercise they performed (e.g. aerobic or resistance training) and the equipment used (e.g. stationary cycle, rowing machine, treadmill, circuit machines or free-weights, medicine balls, swiss balls etc.) with guidance from the trainer. Indoor (as above) and outdoor activities (e.g. jogging, walking, outdoor resistance training with dumbbells or medicine balls) were available. The trainer provided instruction and modification of exercise performance and technique as required. Participants were encouraged to use a similar protocol for at least 2-3 weeks to allow progression but were able to modify their program via novel equipment or exercises as desired.

*High-intensity intermittent exercise condition (HIIE).* Participants in the HIIE condition performed 12 alternating bouts of 30 seconds high-intensity cycling (100% V\(_{2\text{peak}}\)) followed by 2 minutes of lower intensity cycling (50% V\(_{2\text{peak}}\)) per session on a Wattbike Pro stationary cycle. This equated to 6 minutes of high-intensity cycling and 24 minutes of recovery cycling at the lower intensity during each 30-minute session. This protocol was based on a number of cycle protocols adopted by this lab in similar cohorts i.e. sedentary adults with OW/OB (e.g. Raman et al., 2018; Sim, Wallman, Fairchild, & Guelfi, 2014, 2015). Trainers encouraged participants to fully engage with high-intensity bouts. Power output was monitored on the Wattbike Pro’s on-board display.
3.3. Results

3.3.1. Demographic and Baseline Data

Table 3.1 below shows the demographic and baseline data for the sample and by condition. A series of one-way ANOVA indicated the baseline demographics, anthropomorphic and psychological variables were not significantly different across conditions.
## Table 3.1. Demographic, and baseline anthropomorphic and psychological variables.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall ($n = 36$)</th>
<th>HIIE ($n = 11$)</th>
<th>MIPP ($n = 13$)</th>
<th>MISS ($n = 12$)</th>
<th>Difference between conditions ($p$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (SD), years</td>
<td>30.39 (8.17)</td>
<td>31.64 (8.02)</td>
<td>29.31 (8.95)</td>
<td>30.42 (7.97)</td>
<td>$p = .794$</td>
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<tr>
<td>Female, %</td>
<td>77.8</td>
<td>72.7</td>
<td>76.9</td>
<td>75.0</td>
<td>$p = .769$</td>
</tr>
<tr>
<td>BMI (SD), kg/m²</td>
<td>33.74 (6.84)</td>
<td>32.75 (8.42)</td>
<td>32.71 (5.89)</td>
<td>35.75 (6.31)</td>
<td>$p = .472$</td>
</tr>
<tr>
<td>Body Fat (SD), %</td>
<td>40.69 (7.16)</td>
<td>38.64 (7.82)</td>
<td>40.89 (7.67)</td>
<td>42.35 (6.03)</td>
<td>$p = .472$</td>
</tr>
<tr>
<td>Visceral Fat (SD), g</td>
<td>720.53 (283.18)</td>
<td>746.27 (316.95)</td>
<td>671.84 (301.18)</td>
<td>749.67 (245.92)</td>
<td>$p = .751$</td>
</tr>
<tr>
<td>Aerobic Capacity (SD), ml/kg/min</td>
<td>22.45 (5.16)</td>
<td>24.19 (5.77)</td>
<td>22.40 (4.29)</td>
<td>20.90 (5.35)</td>
<td>$p = .321$</td>
</tr>
<tr>
<td>Ethnicity, n</td>
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<td></td>
<td></td>
<td></td>
<td>$p = .338$</td>
</tr>
<tr>
<td>European</td>
<td>28</td>
<td>10</td>
<td>11</td>
<td>7</td>
<td>$p = .834$</td>
</tr>
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<td>1</td>
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<tr>
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<td>1</td>
<td>-</td>
<td>-</td>
<td></td>
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<tr>
<td>Other</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>Marital Status, n</td>
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<td></td>
<td>$p = .532$</td>
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<td>Married</td>
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<td>2</td>
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<tr>
<td>Single</td>
<td>24</td>
<td>6</td>
<td>11</td>
<td>7</td>
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<td>11</td>
<td>8</td>
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<td>Vocational/Diploma</td>
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<td>2</td>
<td>1</td>
<td></td>
</tr>
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<td>High School</td>
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<td>-</td>
<td>1</td>
<td></td>
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<td>Employment, n</td>
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<td></td>
<td></td>
<td></td>
<td>$p = .179$</td>
</tr>
<tr>
<td>Full-time</td>
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<td>5</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>14</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Psychometrics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDI-II score (SD)</td>
<td>25.17 (7.61)</td>
<td>22.82 (5.23)</td>
<td>24.15 (6.38)</td>
<td>28.42 (9.85)</td>
<td>$p = .179$</td>
</tr>
<tr>
<td>DASS-21 sub scale scores*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$p = .179$</td>
</tr>
<tr>
<td>Depression (SD)</td>
<td>17.66 (9.52)</td>
<td>21.64 (9.11)</td>
<td>12.67 (9.66)</td>
<td>19.00 (8.15)</td>
<td>$p = .179$</td>
</tr>
<tr>
<td>Anxiety (SD)</td>
<td>10.51 (8.17)</td>
<td>9.45 (5.37)</td>
<td>7.58 (5.32)</td>
<td>14.42 (11.16)</td>
<td>$p = .179$</td>
</tr>
<tr>
<td>Stress (SD)</td>
<td>19.34 (7.44)</td>
<td>22.00 (5.14)</td>
<td>16.58 (7.41)</td>
<td>19.67 (8.76)</td>
<td>$p = .179$</td>
</tr>
</tbody>
</table>

*DASS-21 scores scaled to DASS-42 equivalency as per Lovibond & Lovibond (1995).
3.3.2. Data Analysis

Data analysis were performed using commercially available software program (SPSS Inc., Version 24 for OSX; IBM, 2017). To manage small sample size, variance and a missing data point, the primary data were analysed using a linear mixed model with each primary outcome as the dependent variable. We conducted a 3 (condition: MISS vs MIPP vs HIIE) x 2 (time: pre vs post) ANOVA on each secondary outcome. Main effects of condition indicate between condition differences in psychometric/anthropomorphic measures, the main effect of session represents change from baseline to completion of the program. An interaction suggests differential efficacy between conditions, over time. Finally, we explored correlational relationships between baseline depression and baseline anthropomorphic data and change in anthropomorphic data. We also examined the associations between change in depression and change in anthropomorphic data.

3.3.2.1. Anthropomorphic Data
Table 3.2. Change in BMI, Weight, Total Body Fat, Visceral Fat and Aerobic Capacity (Pre – Post)

<table>
<thead>
<tr>
<th>Measure</th>
<th>HIIE</th>
<th>MIPP</th>
<th>MISS</th>
<th>Condition x Time Interaction (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Change</td>
<td>Pre</td>
</tr>
<tr>
<td>BMI (SD), kg/m²</td>
<td>32.75 (8.03)</td>
<td>32.44 (8.10)</td>
<td>-0.32 (0.47)</td>
<td>32.71 (8.50)</td>
</tr>
<tr>
<td>Body weight (SD), kg</td>
<td>96.90 (22.88)</td>
<td>95.95 (23.09)</td>
<td>-0.95 (1.30)</td>
<td>90.68 (18.74)</td>
</tr>
<tr>
<td>Total Body Fat (SD), %</td>
<td>38.64 (7.45)</td>
<td>37.27 (8.12)</td>
<td>-1.36 (1.46)</td>
<td>40.89 (7.67)</td>
</tr>
<tr>
<td>Visceral Fat Mass (SD), g</td>
<td>746.27 (316.95)</td>
<td>724.72 (315.43)</td>
<td>-21.54 (102.36)</td>
<td>671.85 (301.18)</td>
</tr>
<tr>
<td>VO₂peak Aerobic Capacity (SD), ml/kg/min</td>
<td>24.19 (5.50)</td>
<td>28.21 (7.10)</td>
<td>4.53 (4.16)</td>
<td>22.40 (4.29)</td>
</tr>
</tbody>
</table>

* significant at p = .05 level, decimals may not sum due to rounding differences.
Table 3.2 (previous page) shows pre and post intervention mean BMI, body weight and body fat percentage, visceral fat mass and mean aerobic capacity (VO$_{2\text{peak}}$) by condition. Mean body mass index values did not change significantly with time, or by conditions. Both the HIIE and MISS conditions reduced BMI slightly, whilst the MIPP condition showed slight increases in BMI. The HIIE condition lost a similar amount of body weight as the MISS condition, whilst those in the MIPP condition gained a small amount of body weight. However, mean weight change over time was not significant, nor was the difference in mean weight change between conditions. Mean body fat percentage did not differ significantly across time or by condition, however a small crossover interaction was observed $F (2,33) = 4.06, p < .05$. Whilst simple contrasts revealed no significant differences, participants in the HIIE condition reduced body fat by 1.36 percentage points, and those in the MIPP condition reduced body fat by 0.82 percentage points. Individuals in the MISS condition gained on average 0.51 per cent body fat points. All conditions tended to reduce visceral fat mass over time $F (1,33) = 3.674, p = 0.06$, and across conditions, there was large within-participants variability. Whilst individuals in the MIPP condition lost approximately two to three times the visceral fat mass of individuals in the alternate conditions, no main effect of condition or interaction was observed. There was a significant improvement in aerobic capacity across time $F (1,33) = 22.763, p < .000$. Individuals in the HIIE condition improved the most (4.53ml/kg/min vs 2.52ml/kg/min; MIPP vs 2.55ml/kg/min MISS) however the difference between conditions was not significant, nor was the interaction between time and condition.

Analysis examining the relationships between initial depression severity and physiological measures indicated a moderate positive association between baseline visceral fat mass and DASS-21 baseline depression scores ($r = .40, p = .018$) which remained significant when controlling for overall body fat and BMI. No other correlational analysis was significant.
3.3.3. Primary Outcomes

Beck Depression Inventory

Figure 3.2. Mean scores (± SEM) for the Beck Depression Inventory-II, pre, mid and post intervention.

Mean BDI-II scores are presented in Figure 3.2 above. Symptoms of depression improved significantly across sessions one to nine, 95% CI (4.61, 10.95) and one to 18, 95% CI (8.07, 14.30) respectively. No main effect of condition or condition by session interaction was significant.
Depression severity scores as measured on the DASS-21 are displayed in Figure 3.3 above. A main effect of session $F(2, 63.76) = 9.62, p < .001$ indicated that symptoms of depression improved significantly across sessions one to nine, 95% CI (1.89, 8.14) and sessions one to 18, 95% CI (3.37, 9.50). There was no significant main effect of condition, however the condition by session interaction was significant, $F(4, 52.07), p = .01$. A significant pairwise comparison indicated that individuals in the HIIE condition experienced more severe DASS-21 depression at baseline than individuals in the MIPP condition 95% CI (1.29, 16.22). Pairwise comparisons indicated HIIE, 95% CI (5.79, 16.76) and MISS 95% CI (2.58, 13.08) but not MIPP condition, improved significantly across sessions one to 18.
Severity of anxiety scores (DASS-21) are presented in Figure 4 above. Linear mixed model indicated a main effect of session, indicating significant change between session one and 18, 95% CI (0.64, 5.49). There was no main effect of condition nor a was there a condition by session interaction.
DASS-21 Stress scores

![Graph showing DASS-21 Stress scores for HIIE, MIPP, and MISS conditions across pre, mid, and post intervention.]  

Figure 3.5. Mean scores (± SEM) for DASS-21 Stress, pre, mid and post intervention.

Figure 3.5 shows the mean scores for DASS-21 Stress, pre and post intervention. Linear mixed modelling revealed a main effect of time, $F(2, 63.68) = 10.354, p < .001$. Overall, severity of stress experienced by participants improved significantly across sessions one to nine, 95% CI (0.45, 5.56) and sessions one to 18, 95% CI (3.20, 8.21). Whilst the main effect of condition was not significant, the condition by session interaction was $F(4, 63.67), = 5.3, p = .001$, with pair-wise comparisons indicating significantly lower scores in the HIIE and MISS condition relative to the MIPP condition mid intervention, 95% CI (-14.58, -1.13); 95% CI (-14.16, -1.01).

3.3.4. Reliable and Clinically Significant Change

For psychological outcomes, reliable change was calculated for each participant. According to Jacobson and Truax (1991), the Reliable Change Index is a function of the sample pre and post-test means, the standard error of the difference between pre and post-test for the sample and test-reliability. Index scores above 1.96 indicate a statistically reliable change on a specific measure toward functional improvement. Where an individual displayed
reliable change in mood, we examined whether their post intervention score fell below a cut-off representing clinically significant change. These values were determined based on normative values for out-patients with a diagnosis of Major Depressive Disorder (Antony et al., 1998; Steer, Ball, Ranieri, & Beck, 1999) and population norms for adults in the Australian community (Crawford, Cayley, Lovibond, Wilson, & Hartley, 2011). The results were extremely similar to those computed using alternative clinically significant change methods (i.e. Button et al., 2015; Ronk, Korman, Hooke, & Page, 2013).

Figure 3.6. Percentage of participants by condition with clinically significant change for all psychometric outcome variables.

Figure 3.6 above shows the percentage of individuals in each condition exhibiting clinically significant change over time. Chi-square calculations indicated the only significant effect of condition was on the DASS-21 measure of depression, $\chi^2 (2, n = 36) = 2.76, p = .05$. Following examination of Chi-squared residual values with Bonferroni adjustment of type I error to $\alpha = .008$, there was a trend toward significance ($\chi^2 = 5.78, p = .016$) indicating fewer individuals in the MIPP condition improved on the DASS-21 measure of depression than would be expected by the null hypothesis compared to both alternative conditions.
3.4. Discussion

Previous studies investigating treatments for clinical depression in adults with OW/OB have followed general approaches incorporating increases in physical activity alongside evidence-based psychotherapy and/or lifestyle modification (Faulconbridge et al., 2011; Linde et al., 2011; Pagoto et al., 2013). Individuals engaging in these treatments achieve significant weight loss and reductions in depressive symptoms. A relative shortcoming has been the limited investigation regarding suitability and efficacy of physical activity/exercise employed in such treatments, especially given that adults with OW/OB with clinical depression may face particular difficulties with exercise specific motivation, initiation (activation), adherence and weight associated stigma compared to normal weight peers.

The primary aim of the present study was to understand which evidenced based formats, types and intensities of exercise are feasible and effective interventions for clinical depression in adults with co-morbid OW/OB. To our knowledge, this is the first study to directly investigate structured, supervised exercise as a treatment for clinical depression in adults with OW/OB. We observed substantial improvements in depression across conditions. While there were no significant differences between conditions on physical or psychological outcome variables, a trend toward favorable physiological outcomes was found across conditions.

3.4.1. Clinical Effect of Exercise on Psychological Symptoms

Depression. As expected, all conditions showed significant reductions in depression across sessions, however the between condition differences anticipated i.e. that HIIE and MIPP conditions would improve to a greater degree than those in the MISS condition, were not observed. Approximately 55 per cent of participants across conditions experienced clinically significant change as measured on the BDI-II. This treatment effect is similar to prior findings showing a 61 per cent remission rate for adults with OW/OB and depression following 6 months of behaviour activation therapy for depression and lifestyle intervention.
Similar clinically significant change (CSC) scores for depression were identified for the HIIE and MISS conditions as measured by the DASS-21. The relatively lower proportion of individuals in the MIPP condition experiencing CSC for DASS-21 depression could be due to their lower baseline scores compared to the other conditions. Given the random allocation procedure, this would most likely be an artifact of smaller sample size and randomisation (i.e. chance). Nevertheless, given the consistent trend seen in Figure 3.6, in which HIIE and MISS CSC scores are greater than those in the MIPP condition across outcomes, it is possible that exercise type contributed to this effect.

Specifically, future research should examine the nuances of how exercise type (aerobic vs. resistance), format (interval vs. continuous) and preference (selected vs. prescribed) interact with treatment outcomes in this population.

Our findings suggest that exercise - even over relatively short durations – can be an effective anti-depressant in a clinically depressed adults with co-morbid OW/OB. One potential advantage of this is the relatively lower cost of exercise interventions compared to psychotherapy and lifestyle intervention which usually require highly trained professionals (dieticians and psychologists) to administer therapy over several months. Given that individuals who are OW/OB and experience clinical depression are typically less likely to receive and make full use of traditional treatment for depression than normal weight peers (Boudreau et al., 2013), the possibility of an alternative treatment with good face validity is an important consideration. Our findings also indicate that format (i.e. interval, steady state) or type (aerobic, anaerobic, personal preference) of exercise may not be especially pertinent to treatment efficacy, provided sufficient dosages are met and that exercise remains engaging for the individual. This is important because it allows variety, patient choice and practicality (e.g. of access to equipment, financial resources) to determine exercise treatment within previously defined parameters (i.e. of volume and dose).
To our knowledge, this study is the first to examine exercise intensities above 90% $\text{VO}_{2\text{max}}$ in a sample with clinical depression. We found high intensity and moderate intensity exercise formats lead to similar reductions in depression. These results are similar to a recent randomised controlled trial by Helgadóttir, Hallgren, Ekblohm, and Forsell (2016) which illustrated that light, moderate and vigorous exercise produced comparable reductions in depression for clinically depressed, normal weight adults following 12-weeks of exercise. In contrast, prior research indicated that higher intensity (i.e. 65-75% $\text{VO}_{2\text{max}}$) exercise can be superior relative to lower intensity exercise for reducing symptoms of depression (Chu et al., 2009; Singh, 2005). Several factors may contribute to this apparent contradiction. In the present study, participants were overweight or obese and depressed. It may be that higher intensity exercise holds a relatively less potent advantage in this population than in a non-overweight population i.e. that compared to normal weight peers with depression, adults with depression and OW/OB, who have differences in body weight, body composition, hormonal or neuroendocrine dysfunction, or differences in self-perception and engagement, may have differential capacity to benefit from HIIE for symptoms of depression. Nevertheless, given the mixed results of prior research it is important to consider alternative explanations. Participants in Singh’s (2005) study were aged over 60 years and engaged in weight-lifting for 8 weeks. Differences in age, exercise type (resistance training vs cycling) and duration of intervention may have been contributing factors. Furthermore, resistance training may have improved mobility and stability in this older adult population, reducing falls-risk and associated anxiety thereby indirectly reducing depression. This could over-state the impact of high intensity activity on depression in general older adult populations relative to middle aged adults. In finding higher intensity exercise superior to lower intensities, Chu et al. (2009) utilized aerobic activity over 5 weeks. Participants in the low intensity condition exercised at a lower intensity (40-55% $\text{VO}_{2\text{peak}}$) than participants in our MISS condition (60% $\text{VO}_{2\text{peak}}$).
Furthermore, participants in their high intensity condition (65-75% VO$_{2\text{max}}$) exercised at an intensity only slightly above the intensity in our lower intensity conditions. It may be that these between conditions difference in intensity are sufficient to account for our current finding. That is, whilst higher intensity (65-75% VO$_{2\text{max}}$) may be superior to low intensities around 40% VO$_{2\text{max}}$, there may be little difference between 70% and 90-100% VO$_{2\text{max}}$ – at least regarding depression outcomes.

A further consideration is that by administering high intensity training in interval format, the overall session intensity was reduced, potentially leading to a smaller effect compared to a session of high intensity exercise without intermittency or with a higher average intensity. Specifically, whilst participants in our HIIE condition exercised in alternating bouts of 100% VO$_{2\text{peak}}$ and 50% VO$_{2\text{peak}}$, the average time-weighted session load was 60% of VO$_{2\text{peak}}$ power output. It could be argued that overall session intensity is more important than maximum in session intensity or that HIIE sessions should be modified to increase the average session intensity - e.g. work intervals of 120% VO$_{2\text{peak}}$ or a 1:3 work:rest ratio, as opposed to the 1:4 work:rest ratio employed in the present study. Finally, contrary to recent commentary by Biddle and Batterham (2015), HIIE under supervision in the current study appeared well tolerated.

Ultimately, our findings support prior research indicating that various exercise intensities are similarly effective for reducing symptoms of clinical depression (Helgadóttir et al., 2016) and extends this to adults with co-morbid OW/OB.

While reduced CSC scores in the MIPP condition may be in part attributable to between condition differences in baseline severity and small sample size, it is important that future research considers the interplay between personal preference and treatment outcomes. Few studies have examined the role of personal preference on clinical outcome in trials involving exercise for depression. Doose et al., (2015) showed that self-selected intensity (averaged at moderate) led to large reductions in depressive symptoms and
improvements in aerobic capacity in women with major depression. Our research extends these findings and indicates that type and format of exercise can be self-selected whilst achieving clinically significant gains at least as robust as HIIE and MISS exercise over time. A key difference between our research and that of Doose et al. was that the latter prescribed the exercise activity (treadmill use) but allowed participants to select a preferred intensity, whilst we employed a prescribed intensity (moderate) but within a personally selected exercise activity (weight lifting, running, cycling etc.). Individuals within Doose et al. ’s study were also within a normal weight range. These findings, taken together suggest that personal preference (type, intensity and format) may be a variable of interest in future research and in treatment of depression, regardless of weight status. Interestingly, Doose et al. found nearly one quarter of participants dropped out, and those that completed the 8-week program attended only 58 per cent of sessions. It may be that allowing participants to select the type and format of exercise increases adherence over and above simply selecting intensity - perhaps due to increased engagement, self-efficacy, control or ownership participants take as a result of the broader self-selection. Future research should endeavor to clarify the key aspects of personal preference are optimal for engagement and treatment effect.

The above are key findings given the importance exercise interventions may have in improving mood, body composition and reducing inflammation (Chu et al., 2009; Keating et al., 2014; Shiraev & Barclay, 2012) in a clinically depressed population with co-morbid OW/OB. Until now, no studies have examined the psychological effect of exercise alone in populations with clinical depression and OW/OB. These findings broaden the scope of potential evidenced-based exercise interventions available to psychologists and deepen our understanding of exercise interventions for depression.

**Anxiety & Stress.** We expected all conditions to show reductions in anxiety and stress across sessions. A main effect of session but not condition was observed for anxiety
and stress. Floor effects for anxiety and stress are not uncommon in exercise literature (Ensari, Greenlee, Motl, & Petruzzello, 2015) and even in our sample experiencing depression, individuals in the HIIE and MIPP conditions had mild symptoms of anxiety. Anxiety was on average, moderate in the MISS condition. Stress was within the mild to low moderate severity range across conditions (Lovibond & Lovibond, 1995). Our findings indicate that HIIE and MISS interventions are effective in reducing mild to moderate levels of anxiety and stress in adults with clinical depression and OW/OB. This is similar to previous meta-analytic findings in non-overweight and depressed individuals (Ensari et al., 2015) which indicated that exercise was effective for reducing anxiety in adults and that high intensity exercise was superior for this purpose compared to lower intensities. Interestingly, other meta-analytic research indicated the anxiolytic effects of exercise on trait anxiety require a minimum of 10-weeks, whereas Petruzzello, Landers, Hatfield, Kubitz, and Salazar (1991) reported that anxiety may improve after just one session of exercise (Ensari et al.). Our findings are therefore important given the paucity of research on such symptomatology in this population and adds to the literature which indicate that moderate and higher intensity exercise are effective at reducing state anxiety and stress over relatively short periods (Ensari et al., 2015; Salmon, 2001) in a clinically depressed population of adults with OW/OB.

3.4.2. Physiological Findings

We found a moderate positive correlation between visceral fat mass and initial depression scores, similar to prior research (Ludescher et al., 2008). Improvement in body composition, body weight and aerobic fitness were not the main focus in the present study. Nevertheless, we found a trend toward reduced visceral fat mass and greater aerobic capacity across conditions over time. In general, no condition was clearly superior to others at improving physiological variables, however individuals in the HIIE condition lost a significantly greater amount of body fat than individuals in the MISS condition and
somewhat more (66%) than individuals in the MIPP condition, although the latter was not significant.

No association was found between change in depression and baseline or change in physiological variables. Systematic reviews indicate that aerobic exercise is particularly effective at improving visceral fat mass and may indeed be superior to resistance training (Ismail et al., 2012; Ohkawara et al., 2007). Higher intensity and greater volumes of exercise typically enhance visceral fat loss (Irving et al., 2008; Ohkawara et al., 2007). Indeed, a minimum of 10 METS/week or approximately 150mins/week of moderate intensity exercise has been found adequate to reduce visceral fat mass (Ismail et al.). This is a greater dose than the present study, (i.e. typically 90-minutes of exercise per week). Higher intensity appears especially important for reducing visceral fat mass via resistance training, where it is superior to lower intensities (Dutheil et al., 2013) and we found a similar phenomenon as with respect to overall body fat reductions. Overall, the trend toward improvements in body composition and visceral fat mass are promising and indicate all formats of exercise examined may hold utility for reducing adipose and visceral fat mass thereby leading to less systemic inflammation which has been implicated in the aetiology of depression in obese individuals (Lopresti et al., 2013).

Future research should continue to explore associations between body composition, visceral fat mass and depressive symptoms especially when such research also examines inflammatory markers (e.g. TNF-α, CRP, IL-1, IL-6) which may play a mediating role within the bidirectional obesity-depression relationship (Lopresti et al., 2013).

3.4.3. Summary of Results

This is the first study to examine the efficacy of exercise alone in a clinically depressed, OW/OB cohort of adults. We found that all interventions were similarly effective at reducing elevated depression symptomatology and at reducing mild to moderate levels of anxiety and stress. This is the first study to show HIIE and moderate intensity,
personally selected interventions are well tolerated in clinically depressed adults with co-morbid OW/OB. Our findings suggest that format, type and intensity may be of secondary importance to dose, engagement and adherence. The present study contributes to the need for research into effective exercise interventions for this population.

3.4.4. Limitations

It is noteworthy that individuals volunteering for a trial such as ours must have enough interest and motivation to enquire, attend screening and enroll such that they may be on a pre-existing trajectory of recovery from depression. Therefore, without a wait-list control, we cannot exclude the possibility of spontaneous recovery from an episode of depression during study enrollment. We recognize the methodological limitation inherent in the relatively small number of participants in each condition. One effect of this was reduced power available for statistical analysis. Nevertheless, the present study builds on previous research in a consistent and logical manner.

Although the differences in pre-intervention depression, anxiety and stress on the DASS-21 were not significant, some might argue that with greater power a significant difference may have occurred and that using each baseline variable as a covariate in statistical analysis would have been appropriate (alternatively however, greater sample size may have reduced the discrepancy as randomisation took effect). To make the most of a relatively small sample size in this feasibility study, we chose to use GLMM – a more robust analysis considering the effects of missing data. A second concern was the relative low baseline score for depression as rated by the DASS-21 of the MIPP condition. This may have contributed to a floor effect within the sample. It is important to note however that with a larger sample, such differences would likely reduce and between condition differences may be more apparent. Future research implementing methodological modifications - i.e. increased sample size or randomisation based on severity of depression - could help to ameliorate these concerns.
A further limitation was the short duration of the programs. The exercise intervention programs in our trial were designed for completion over 18 sessions. Most participants concluded the program within 6-7 weeks. Whilst this is clearly promising from a treatment perspective, whether such interventions are viable in this population over longer periods requires further investigation. A final limitation was the lack of follow-up. The small-scale pilot nature of the program limited additional follow-up, however future intervention studies should enquire if and to what extent participants have continued exercising and the relative stability of any recovery from depressive symptoms following initial treatment to at least 12-months following the initial intervention. Follow-up is important for exercise based interventions for depression because it appears that the treatment effect of exercise on depression persist only for as long as one continues to exercise (Krogh, Nordentoft, Sterne, & Lawlor, 2011). The results of the present study should spur further research into exercise for depression in adults with OW/OB and help practitioners make suitable recommendations to clients with OW/OB and patients seeking exercise treatment for depression.

3.4.5. Future Research and Clinical Implications

Whilst we have outlined some general areas for future research the following specific areas are ripe for investigation. The present study did not seek to replicate prior research on depressed, non-overweight samples examining frequency or dose response to exercise (e.g. Dunn et al., 2005; Trivedi et al., 2011). Future research should seek to clarify these fundamental relationships in a clinically depressed population who are also OW/OB. To gain a better understanding of how exercise protocols similar to the ones described in our preceding research are experienced by individuals in treatment, investigators should seek a more nuanced understanding of how individuals with depression and OW/OB experience various types of exercise. Specifically, qualitative analysis of interview data may yield
answers regarding how best to implement such protocols and which factors are may affect engagement, adherence and clinical efficacy.

Regarding future quantitative investigations, examining the differential effects of various high intensity exercise protocols comparing maximum in session versus session average intensity on symptoms of depression would be clinically useful. That is, understanding the impact of various work-rest ratios or maximum intensities corresponding to a greater percentage of VO$_{2peak}$. Such a design would provide answers regarding the differential importance of intensity and the best format within HIIE from which to deliver an adequate ‘dose’ of intensity. Similarly, research on personal preference should confirm which aspects of preference are beneficial (e.g. preference directed toward activity type, format, intensity etc.) and if, or at what point personal preference becomes deleterious factor in exercise treatments for depression.

Finally, whilst the pairing of optimal evidence-based exercise interventions with CBT requires further research, we offer the following tentative ideas about how exercise might be utilised within CBT for depression in a population that is also OW/OB: Given past research (Busch et al., 2015; Chu et al., 2009; Doose et al., 2015; Dunn et al., 2005; Singh, 2005; Trivedi et al., 2011) and our current results, we advocate evidence-based exercise interventions apply aerobic or resistance training exercises in high intensity interval or moderate intensity steady state format. Such exercise interventions should aim to engage individuals in 45 to 60-minute sessions, 3-5 per week over at least 10-12 weeks. Personally selected intensities or activities may be utilised provided sufficient dosages are met.

The current research adds to our understanding of exercise interventions for treating depression in adults with OW/OB. We found meaningful and comparable reductions in depression for all intervention formats, and promising results regarding anxiety and stress. It is hoped future research will continue to refine evidence-based exercise interventions to
compliment tailored cognitive behavioural interventions targeting clinical depression in overweight adults.
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Chapter 4 – Study Three

Engagement and Experience in Exercise Programs for Clinical Depression as an Adult with co-morbid Overweight or Obesity: A Mixed Methods Evaluation.
Engagement and Experience in Exercise Programs for Clinical Depression as an Adult with co-morbid Overweight or Obesity: A Mixed Methods Evaluation.

4.1. Introduction

There is an emerging understanding that a specific focus on populations with comorbid depression and overweight or obesity (OW/OB) is important in providing clearer treatment recommendations (e.g. Faulconbridge, Wadden, Berkowitz, Pulcini, & Treadwell, 2011; Pagoto et al., 2013). In part, this requires research, such as randomised controlled trials (RCT’s), that evaluates outcomes of specific interventions. Perhaps just as important however, is an exploration of process and engagement in such interventions to maximise the translation of such research into clinical practice.

Research exploring the subjective experience of clinically depressed and overweight or obese (OW/OB) adults during exercise interventions is sparse. Relatively more has been said about the treatment of depression with exercise from a quantitative than qualitative perspective. Often RCT’s, this research tends to focus on outcome rather than process and engagement. Yet a qualitative analysis is likely to enrich our understanding of such individuals’ experience of exercise interventions that might otherwise be missing from a singular focus on quantitative outcomes. Important qualitative aspects may include motivations, perceived barriers, benefits and facilitators. It is also essential to identify these issues as they relate to exercises’ utilisation as therapy for adults with clinical depression and OW/OB, which may help address concerns for clinicians hesitant to employ exercise in treatment of depression (Pollock, 2001).

Limitations that impact the use of exercise in treating depression exist. In general, clinical depression leads to low levels of activity, including physical exercise (Patten, Williams, Lavorato, & Eliasziw, 2009). Within the general population, up to 50% of those commencing an exercise program discontinue within 6-months (Turley, 2000, as cited in Pollock, 2001). Given that individuals with depressive symptoms are more likely to
discontinue exercise programs than non-depressed peers (DiMatteo, Lepper, & Croghan, 2000; Teixeira et al., 2004) it is paramount that research explore what factors affect acceptability, engagement, and adherence. It is unfortunate, yet not surprising that only 40 per cent of mental health care practitioners and around 18 per cent of General Practitioners recommended physical activity to their clients (Phongsavan, Merom, Bauman, & Wagner, 2007; Short et al., 2016). Clinicians may have a limited understanding of how best to construct and implement evidenced-based exercise programs for mental health conditions, which may influence their decision not to consider exercise as a component of evidence-based practice (Phongsavan et al., 2007; Ranjbar et al., 2015). Indeed, clinicians often describe that it can be difficult to activate a patient with depression and that low levels of general activity, low self-worth, helplessness, hopelessness and withdrawal make engagement especially difficult (Seime & Vicers, 2006). Research also indicates that individuals with depression have significantly lower levels of motivation and volition but similar outcome expectations regarding exercise behaviours compared to non-depressed controls (Kramer, Helmes, Seelig, Fuchs, & Bengel, 2014). This suggests that initiating and adhering to a regular exercise plan would be a common difficulty for individuals with clinical depression.

Since individuals with depression have lower levels of self-efficacy (Robinson-Smith, Johnston, & Allen, 2000; Sacco et al., 2005) it has been proposed that exercise self-efficacy may influence adherence and ultimately, treatment outcomes. In respect of regular exercise, this moderating effect appears to be even greater for individuals with depression or with higher BMI (Kangas, Baldwin, Rosenfield, Smits, & Rethorst, 2015). Prior research on exercise interventions and subsequent exercise self-efficacy is mixed. Studies have reported increases in exercise self-efficacy following regular exercise (Jung, Bourne, & Little, 2014; McAuley, Bane, & Mihalko, 1995; Singh et al., 2005) although not exclusively so (e.g. Singh, Clements, & Fiatarone, 1997). Exercise intervention studies that examine solely
outcome scores for depression may miss critical aspects of the patients’ experience, including those that relate to engagement and adherence. Some of these issues are pertinent to using exercise as an adjunct or independent therapy for depression in OW/OB populations. Such findings may also inform development of tailored cognitive-behaviour therapies for depression in adults with OW/OB, where treatments employ exercise or physical activity as a key component.

Within the general community, the most common motivations to exercise are to lose or maintain weight, improve appearance or to manage a health condition (Hoare, Stavreski, Jennings, & Kingwell, 2017). Similar results are found in overweight individuals (Guess, 2012). To our knowledge, qualitative research on populations with co-morbid depression and OW/OB involved in exercise interventions is yet to be published. However, a number of studies have examined normal weight participants perception of physical activity in treatment of depression within a primary care or community context. Individuals with depression often find exercise an acceptable treatment (Searle et al., 2011) and typically believe the benefits of exercise are due to distraction from negative thoughts, modification of neurochemical and hormonal pathways or via the structure, routine and socialization that can come with regular exercise (Carter, Morres, Repper, & Callaghan, 2016; Searle et al., 2011). Common perceived barriers include low mood, amotivation, lack of confidence, low self-efficacy, limited understanding of exercise techniques or regimes and situational factors including work demands, limited spare time or no one to exercise with (Carter et al., 2016; Danielsson, Kihlbom, & Rosberg, 2016; Hoare et al., 2017; Rogerson, Murphy, Bird, & Morris, 2012). Individuals in the depths of a depressive episode often feel unable to exercise by themselves and the relationship with an exercise therapist seems to be integral to treatment benefits (Danielsson et al., 2016). Indeed, prior research indicated that GP referral schemes which include ongoing contact between doctor and patient may enhance exercise program adherence compared to referrals made without such support (Isaacs et al., 2007; Taylor,
Doust, & Webbom, 1998). There are also some key considerations which may inhibit engagement in exercise for this population. For example, individuals with depression regularly describe feeling “inadequate” when they experience difficulties completing exercise successfully (Searle et al., 2011). Danielsson et al. noted many participants “feel like an outsider” during exercise sessions. These issues may be particularly important in the context of working with adults who have OW/OB, for whom shame, self-criticism and social stigma can be regular and distressing (Gilbert et al., 2014; Gilbert, Baldwin, Irons, Baccus, & Palmer, 2006). These concerns may perpetuate unhelpful cognitions related to clinical depression (e.g. critical self-schemas, excessive worthlessness and guilt and a sense of being a failure). Therefore, individuals with co-morbid depression and OW/OB potentially experience a particular set of challenges compared to normal weight depressed peers or individuals who are OW/OB and euthymic.

Important variables in treatment of depression with exercise include type (aerobic, resistance or combined), intensity (i.e. above 65-75% VO$_{2\text{max}}$), volume (around 1000Cal per week), frequency (3-5 sessions per week), and compliance (Chu, Buckworth, Kirby, & Emery, 2009; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Krogh, 2009; Rethorst, Wipflli, & Landers, 2009; Singh, 2005; Trivedi et al., 2011). Collaborative supervision, individual tailoring and personal preference within sessions also appear to be important characteristics involved in engagement (Busch, Ciccolo, Pusptasari, & Nosrat, 2015; Ranjbar et al., 2015). Given this, two formats of exercise in particular – High Intensity Intermittent Exercise (HIIE) and personally selected interventions may engage individuals experiencing depression in an effective exercise treatment.

High Intensity Intermittent and personally selected exercise might afford individuals with depression a greater sense of exercise mastery compared to moderate or prescribed interventions via either perceived control (self-selection) or repeated exposure (as in HIIE). These factors may in turn enhance motivation, enjoyment of sessions and engagement, subsequently contributing to greater symptom reduction. Indeed, enjoyment is considered an important predictor of long-term exercise
adherence, at least in non-depressed samples (Dishman et al., 2005). Recent literature suggests that HIIE may be more enjoyable than moderate-intensity steady state exercise whilst increasing exercise self-efficacy comparably to moderate intensity steady state exercise (Bartlett et al., 2011; Jung et al., 2014). High intensity interval exercise has also received criticism, with assertions that whilst it confers benefits, its psychologically aversive nature makes it unviable as a longer term intervention (Biddle & Batterham, 2015), therefore clarification is required regarding individual preferences and motivations to engage in and experience of HIIE if it is to be considered a viable exercise intervention.

Recently, Busch et al. (2015) asserted that due to the high variability in preferred form and structure of exercise amongst individuals with depression, programs should be flexible to increase acceptability and engagement. Since there is some evidence suggesting at least moderate intensity is required to ensure a treatment effect (Cooney et al., 2013; Dunn et al., 2005), it is expected that personally selected exercise (e.g. a mix of cycling, jogging, resistance training, indoor rowing, medicine ball work etc.) may be more engaging and acceptable to individuals than prescribed exercise. Very little research has been conducted on how different types of exercise programs are perceived by exercisers (Foster et al., 2015) and to our knowledge, there has been no investigation into exercise preferences of adults who with OW/OB and depression. This research is essential if engaging intervention programs are desired.

The aim of the present study therefore, is to gain a more nuanced insight into the experience of exercise as a treatment for depression in adults with clinical depression and OW/OB, including the specific challenges facing this particular group. We sought to combine a qualitative exploration with quantitative evaluation of self-efficacy, motivation, confidence to exercise and positive anticipation of future sessions for participants who had engaged in one of three conditions within a randomised control clinical trial of exercise sessions with a personal trainer over approximately 6 weeks. This research is part of a larger study, described previously (Chapter 1). The three conditions included
HIIE, Moderate Intensity Steady State (MISS) and Moderate Intensity Personal Preference (MIPP) exercise.

4.1.1. Hypotheses

i) We expect self-efficacy and confidence to exercise to improve across sessions for all groups.

ii) We expect motivation, enjoyment and positive anticipation to improve to a greater extent and to a higher absolute level across sessions in the HIIE and MIPP conditions relative to the MISS condition.

4.2. Methods

4.2.1. Design and Context

To explore OW/OB participants experience of exercise as treatment for depression and understand factors which may contribute to engagement, we employed a mixed methods design. This research was part of a larger randomised controlled clinical trial investigating the feasibility and effects of exercise on clinical depression in adults who are OW/OB (ANZCTRN: 12614000097640). The present study was approved by Murdoch University Research Ethics and Integrity Office (Project No. 2013/204) under the parent study. Individuals taking part in the trial were invited to participate in a semi-structured interview held within one to four weeks of their final exercise session. Participants had experienced 18 sessions of individually supervised exercise in one of the three conditions, over approximately 6 weeks. Typically, three 30-minute sessions occurred per week with 5-minute warm up and cool down. Exercise conditions consisted of either steady-state stationary cycling at moderate intensity (MISS), moderate intensity personal preference exercise (MIPP; a collaboratively designed resistance program, interval training, other aerobic or a combination, either indoors or outdoors) or high intensity intermittent exercise performed on a stationary cycle (HIIE). Participants had their fitness (VO$_{\text{peak}}$) and body composition accurately measured (body weight, BMI and Dual-energy X-ray Absorptiometry (DXA))
scan) pre and post intervention; heart rate, RPE and power output were measured and displayed (as available) within each session.

4.2.2. Inclusion and Exclusion Criteria

All participants were required to provide informed consent for the interview and to have completed their program of exercise in the RCT. Enrolment to the RCT was open to men and women aged 18-45 years, who were experiencing a current episode of depression according to Structured Clinical Interview. Participants had to be willing to delay new therapy for the duration of participation, had a BMI greater than 25 and understand written and spoken English. Anti-depressant use was permitted provided unchanged dose 3 weeks prior to participation and throughout the intervention. Exclusion criteria included regular psychotherapy, previous cardiovascular incident or cardiovascular disease, intellectual impairment, serious or unstable medical conditions, substance dependence requiring rehabilitation, diagnosed (or suspected) personality disorder, current or historical mania, hypomania or anorexia nervosa, current or recent bulimia nervosa, current suicidal ideation or self-harm of a clinically significant nature or a suicide attempt in the prior 2 years. Women who were pregnant or attempting to become pregnant were also excluded from participation. Further details of the RCT can be found in Chapter 3.

4.2.3. Participants

Eighteen adults agreed to take part in the interviews. Five had been allocated to each of the MISS and HIIE conditions and eight to the MIPP condition. Sixty-one per cent were classified as obese. Baseline quantitative data are presented in Table 4.1 below. Collection of demographic and mood data occurred during the screening interview for the RCT, whilst anthropomorphic data were collected at baseline (weight, height) and once enrolled (body fat, aerobic capacity) described in Chapter 3.
Table 4.1. Baseline Demographic, Mood and Anthropomorphic participant data.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (SD), years</td>
<td>31.39 (8.64)</td>
</tr>
<tr>
<td>Female, %</td>
<td>72.22%</td>
</tr>
<tr>
<td>BMI (SD), kg/m2</td>
<td>33.78 (7.28)</td>
</tr>
<tr>
<td>Body Fat (SD), %</td>
<td>38.26 (7.99)</td>
</tr>
<tr>
<td>Aerobic Capacity (SD), ml/kg/min</td>
<td>23.03 (4.32)</td>
</tr>
<tr>
<td>Ethnicity, n</td>
<td></td>
</tr>
<tr>
<td>European</td>
<td>15</td>
</tr>
<tr>
<td>African</td>
<td>0</td>
</tr>
<tr>
<td>Asian</td>
<td>2</td>
</tr>
<tr>
<td>Indian</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Marital Status, n</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>8</td>
</tr>
<tr>
<td>Single</td>
<td>9</td>
</tr>
<tr>
<td>Divorced</td>
<td>1</td>
</tr>
<tr>
<td>Widowed</td>
<td>0</td>
</tr>
<tr>
<td>Education (part or completed), n</td>
<td></td>
</tr>
<tr>
<td>Higher Degree</td>
<td>3</td>
</tr>
<tr>
<td>Bachelors</td>
<td>11</td>
</tr>
<tr>
<td>Vocational/Diploma</td>
<td>2</td>
</tr>
<tr>
<td>High School</td>
<td>2</td>
</tr>
<tr>
<td>Employment, n</td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>5</td>
</tr>
<tr>
<td>Part-time</td>
<td>6</td>
</tr>
<tr>
<td>Unemployed</td>
<td>7</td>
</tr>
<tr>
<td>Psychometrics</td>
<td></td>
</tr>
<tr>
<td>BDI-II score (SD)</td>
<td>26.89 (7.20)</td>
</tr>
<tr>
<td>DASS-21 sub scale scores*</td>
<td></td>
</tr>
<tr>
<td>Depression (SD)</td>
<td>17.41 (7.84)</td>
</tr>
<tr>
<td>Anxiety (SD)</td>
<td>10.06 (7.07)</td>
</tr>
<tr>
<td>Stress (SD)</td>
<td>22.18 (7.01)</td>
</tr>
<tr>
<td>Co-morbid Anxiety Disorder</td>
<td>7</td>
</tr>
<tr>
<td>Co-morbid Binge Eating Disorder</td>
<td>4</td>
</tr>
</tbody>
</table>

*DASS-21 scores scaled to DASS-42 equivalency as per Lovibond & Lovibond (1995).

4.2.4. Interviews

Participants were informed that the semi-structured interview was expected to take approximately 30-minutes and would occur individually. Participants were told the interview was an opportunity to reflect upon their experience of the program with a researcher and to provide feedback regarding the program. Semi-structured interviews took place one to two weeks following completion of the program at the University Psychology Clinic in a quiet and private interview room. One interview was conducted from this room via Skype™ as the
participant had travelled overseas. Interviews were based on a topic guide and conducted by a member of the research team. The topic guide was developed over three pilot interviews with other participants on exit from the controlled trial. The interviewer started with the open question ‘Tell me about your experience of the program’ and continued with the natural conversation of the participant and with the guide serving as a prompt. Topics covered by the guide included i) aspects found enjoyable or motivating, ii) barriers or challenges faced, and iii) desired modifications to the program. We also promoted participants to share any perceived iv) changes in their emotional, cognitive or physical state, and v) changes to their views on exercise. The spontaneous reflections of participants were explored. When the relationship with the personal trainer was brought up by the participant, we also asked how they experienced it and to share what factors they found helpful or challenging about it. Leading questions were avoided. Reflective questions were used to clarify or expand participants’ responses. Most interviews lasted 20 to 45 minutes, were audio recorded and subsequently transcribed by a professional transcription service with substantial academic transcription experience. Research indicates qualitative data collection should continue to ‘saturation’ - until no new themes emerge and data replication begins to occur (Schreier, 2012).

4.2.5. Self-Report Measures

The quantitative data for this study were collected during participation in the RCT. These scales were administered between the first and second session, at mid-point and at completion of the 18th session. Administration between the first and second session was designed to provide participants with some initial exposure to their exercise program so that a subjective assessment based on experience could be made via the self-report scales.

Exercise self-efficacy. Self-efficacy to engage in exercise was measured via the Bandura Self-Efficacy to Regulate Exercise Scale (SERES; Bandura (2006), see Appendix I). Respondents were asked to rate 18 statements from 0 to 100, reflecting their confidence to engage in their regular
exercise routine under a variety of circumstances (e.g. ‘After a vacation’ or ‘when I feel physical discomfort from exercise’). The SERES has demonstrated excellent reliability (e.g. Cronbach’s α of .95) and robust concurrent validity with maximal exertion tests of physical fitness in clinical samples (Everett, Bronwyn, Yenna, & Patricia, 2009). Exercise self-efficacy was measured pre and post intervention only.

**Visual analogue scales (VAS).** VAS scales of 110mm length were used to assess subjective motivation, enjoyment, positive anticipation of and confidence to engage in exercise (See Appendix J) following session one yet prior to session three then post intervention. Such scales are commonly used to measure motivation and attitudes toward exercise in samples of mood and anxiety patients engaged in exercise interventions (e.g. Knapen et al. (2009); Stenström, Boestad, Carlsson, Edström, and Reuterhäll (1997)). Administration following session one was designed to allow participants some exposure to the exercise format prior to rating.

### 4.2.6. Data Analysis

Given the exploratory nature of the study, we analysed the interview data using a multi-step iterative inductive approach, undertaking thematic analysis as suggested by Braun and Clarke (2006). Initially, familiarisation with interview data was essential. The primary analyst (N.B.) read and re-read the transcriptions - immersing in the content. During this process, reflective observations and thoughts were noted. Second, preliminary coding took place across the entire data set. Third, emergent themes were identified by looking for patterns, connections and divergences in the coded material. Simultaneously the codes were passed through these themes generating new themes or until saturation occurred. Fourth, themes were reviewed in relation to the coded extracts and the data set. This included collapsing themes deemed to be sub-themes into a higher-level class. A thematic map was then generated. Fifth, themes were clearly defined and refined to distill their essence and determine what aspect of the data each theme captured. Finally, selected extracts were identified to provide vivid and compelling examples of the themes. To enhance
confirmability of the data (Nowell, Norris, White, & Moules, 2017), a second researcher (H.C.) also engaged in the thematic analysis of the interview data using the same iterative multistep process described. Independent analysis was complimented with peer debriefing and testing for referential adequacy by comparing codes against raw data, to facilitate credibility and confirmability of the data analysis and identification of emerging themes.

Quantitative data were analysed using a 3 (condition) by 3 (session) way repeated measures ANOVA and 3 x 2 way ANOVA. A main effect of session indicates change in the respective dependent variable over time whilst a main effect of condition indicates a between condition difference in dependent variable. An interaction reflects contrasting effects between conditions, over sessions.

**4.3. Results**

To explore participant experiences, we present subjective self-report measures of exercise self-efficacy, confidence and motivation to exercise, positive anticipation and subjective enjoyment of sessions. We follow this with a description of participant experiences during the exercise interventions, by way of qualitative interview data.
### 4.3.1. Quantitative Results

#### 4.3.1.1. Exercise Self-efficacy

Figure 4.1. Mean Self-efficacy to Regulate Exercise scores (±SEM), pre and post intervention.

Mean self-efficacy to regulate exercise scores are displayed in Figure 4.1 above. Although Figure 4.1 indicates marginal improvements in self-efficacy across sessions for the HIIE condition, and no apparent change in either the MIPP or MISS condition, overall, mean self-efficacy did not change significantly following the intervention (i.e. no main effect of session), nor were there any significant main effects of condition. The interaction between condition and session was not significant.
4.3.1.2. Perceived Confidence to Engage in Exercise Routine for 12 Weeks

![Confidence to Exercise Routine](image)

Figure 4.2. Mean scores (±SEM) of Confidence to engage their exercise routine for 12 weeks as measured on a 110 point VAS, pre and post intervention.

Mean scores of confidence to exercise in their respective routine for 12 weeks is featured in Figure 4.2 (above). Neither main effect of session or condition, nor their interaction was significant.

4.3.1.3. Motivation to Exercise

![Motivation to Exercise](image)
Figure 4.3. Mean Motivation scores (±SEM) as measured on a 110 point VAS, pre and post intervention.

Figure 4.3 (above) displays means for subjective motivation to exercise. Motivation increased significantly across sessions, \(F(2,29) = 4.25, p < .05\). The main effect of condition was not significant.

4.3.1.4. Positive Anticipation of Exercise Sessions

![Graph showing positive anticipation scores across conditions and sessions.]

Figure 4.4. Mean Positive Anticipation scores (±SEM) as measured on a 110 point VAS.

Figure 4.4 above shows mean positive anticipation to engage in their intervention, for each condition. Overall, positive anticipation increased significantly across sessions, \(F(2,29) = 11.83, p < .001\), yet neither the main effect of condition nor the condition by session interaction were significant.
4.3.1.5. Enjoyment of Exercise Sessions

![Figure 4.5](image_url)

Figure 4.5. Mean Session Enjoyment scores (±SEM) as measured on a 110 point VAS.

Mean session enjoyment scores are charted in Figure 4.5 above. Enjoyment of sessions increased significantly across sessions, $F(2,29) = 4.97, p < .05$. Neither the main effect of condition nor the condition by session interaction was significant, indicating similar levels of enjoyment between conditions across sessions.

4.3.2. Qualitative Results

Themes relating to participant’s experience in the program are summarised in Table 4.2. Analysis revealed six main themes and 16 sub-themes. The themes included: A) Awareness of self in relation to exercise and exercisers, B) Looking for change, C) Managing competing demands, D) Importance of rapport and relationship with the personal trainer, E) Sustainability of new behaviours, F) Suggestions regarding a more desirable program. Selected quotes from participants have been included to illustrate respective themes.
Table 4.2. *Participants broad experience of the exercise intervention*

<table>
<thead>
<tr>
<th>Topic/Category</th>
<th>Theme/Subcategory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Awareness of self in relation to exercise and exercisers</strong></td>
<td>i. Can I do this?</td>
</tr>
<tr>
<td></td>
<td>ii. What do they think of me?</td>
</tr>
<tr>
<td></td>
<td>iii. Not belonging (Sense of being apart)</td>
</tr>
<tr>
<td><strong>B. Looking for change</strong></td>
<td>i. I’m (not) changing and it’s slow</td>
</tr>
<tr>
<td></td>
<td>ii. Identifying benefits</td>
</tr>
<tr>
<td></td>
<td>iii. Creating ways to find success</td>
</tr>
<tr>
<td><strong>C. Managing competing demands</strong></td>
<td>i. Barriers and Challenges</td>
</tr>
<tr>
<td></td>
<td>ii. Facilitators</td>
</tr>
<tr>
<td><strong>D. We’re in this together</strong></td>
<td>i. Creating a sense of trust and safety</td>
</tr>
<tr>
<td></td>
<td>ii. Knowledge and expertise</td>
</tr>
<tr>
<td></td>
<td>iii. Adequate still works, perhaps not as well</td>
</tr>
<tr>
<td><strong>E. Sustainability of new behaviours</strong></td>
<td>i. Exercising into the future</td>
</tr>
<tr>
<td></td>
<td>ii. I’m having doubts</td>
</tr>
<tr>
<td></td>
<td>iii. Problem solving for sustainability</td>
</tr>
<tr>
<td><strong>F. A more desirable program</strong></td>
<td>i. Qualities of a good program</td>
</tr>
<tr>
<td></td>
<td>ii. Exercise alone is not enough</td>
</tr>
</tbody>
</table>

**4.3.3. Awareness of Self in Relation to Exercise and Exercisers**

Many participants discussed feeling self-aware and self-conscious, particularly in relation to exercising and at the beginning of the program. Individuals expressed a sense they did not belong amongst ‘exercisers’ and most participants discussing self-awareness conveyed an expectation of negative social evaluation from others. Some expressed doubt about being able to complete an exercise program.
Can I do this?

Doubts about completing the program were not uncommon during the initial weeks, P047-44 (21F, MIPP) said: “I think that at the start of it, I probably thought, you know, I wonder if I’ll be able to do the full six weeks or if I will go to every single one every single week…[in the past] in relation to exercise I probably would not exercise that much or would have ideas that I was going to exercise and going to do something and then I wouldn’t do it.”. P039-36 (25F, HIIE) expressed her doubts this way: “It felt like too much effort, I feared I would fail. I wouldn’t be able to do it, because I had gotten so big.”.

What do they think of me? – I don’t belong here.

In articulating their sense of self-consciousness and not belonging, one participant P046-43 (43F, MIPP) said: “There’s all these fit people and they’re all - you know, they look good and they obviously know what they’re doing and stuff and I just felt I don’t really have a place here”. Another, P008-6 (27M, MIPP), talked of being self-conscious because of his weight: “There’s sort of a self-conscious aspect to it, you know what I mean, being like overweight and not being fit and not really knowing what I’m doing. Sort of especially, like quite a few times, you know, it’s obviously – what’s it called – the sports centre or whatever it’s called. And often there’s other people and stuff in there, so just sort of shutting that out and ignoring it and just focusing on what I need to do.” Comparisons like this, of self to other exercisers, differentness and not belonging, were not uncommon. Participant P030-27 (26M, HIIE) discussed his self-awareness in relation to other gym goers: “I was just generally looking a bit awkward really, because when you go to gyms and things, everyone’s usually quite muscly and fit there, and you feel a bit out of place sometimes. So I feared I could look a bit awkward.” Participant P008-6 (27M, MIPP) expanded on their prior response with similar sentiment: “Feeling self-conscious, you know what I mean, especially around the [gym], mostly everyone else is pretty fit and they obviously know what they’re doing and there’s guys doing ridiculous things on bikes and everything else, you know. And
it’s sort of like – I suppose, like, a lot of doubts were there in that regard. You know, just feeling incompetent if you will or like I shouldn’t be there, you know what I mean.”.

In discussing expectations regarding social judgement, P046-43 (43F, MIPP) postulated what others might be thinking: “Just the thought of what people would – they would look at me and go, “Oh my God, no wonder you’re going to the gym. You really need to and you shouldn’t be wearing that” and it’s like well suck it up, I’ve got a budget, this is all that fits, so hey that’s what I’m wearing….”. Some participants had a more diffuse sense of awkwardness – P043-40 (28M, MISS) said: “I was most concerned about people, clothing, don’t know what to wear. Perceptions, I guess. I don’t actually recall any specific thoughts. I just kind of assumed that it would be awkward, I guess.” Over time, some of these concerns abated, if only slightly. The same participant talked about finding it far easier to consider exercising publicly after the program. But not without some trepidation, especially if they were known to the onlooker: “Yeah, so it’s much easier now to imagine exercising in front of other people. To go to the gym and not sort of feel freaked out that you would have to exercise. Like, I still kind of – like, I’m not sure if I would actually exercise regularly at the gym here at the university because not only is it in front of people, but it is in front of people that you may potentially know. And that sort of, for some reason for me, just does cause some anxiety and I retreat from that quite quickly.”.

In sum, for these participants, engagement in exercise - especially in a gym environment - came with a sense of “otherness” through social comparison, fear of negative evaluation, and negative self-judgements or shame. Whilst some of these concerns were on general self-doubt about capacity to master exercise, others were specific to weight related stigma and appearance which might persist despite exposure to the exercise context.
4.3.4. Looking for Change

I’m (not) changing and it’s slow

A majority of participants described regularly looking for changes that might be occurring. Many highlighted the benefits of exercise yet noted that change was slow. Some wondered about how to move forward when change was not readily apparent. Participant’s commentary highlighted the importance of creating multiple ways to measure change. Progress in these areas seemed to be a wellspring for their sense of accomplishment, motivation and exercise self-efficacy.

Participant P045-42 (43F, MIPP) said making changes was what motivated her to take part in the trial – “I think it came at a time where I was going - I was searching things out because I was really starting to slip back into where I’d been a couple of years previous and I could feel the walls sort of closing in on me, and I knew that at some point I needed to start doing something to address that. I had spoken to my GP and I hadn't really had a satisfactory outcome from that. So I just happened to see this and thought, you know what, why not give it a go? It might do some changes or it might start me on a path that helps me with some changes.”. In contrast, participant P049-46 (20F, MIPP) disclosed she had considered withdrawing from the program having not seen expected results early on: “Actually, I was just thinking if I should just drop out because I was like this is so difficult and I have to drive to school and just do this thing. But at that point in time, when I still hadn’t seen the results, I was just like ‘oh my god, I’m wasting my time, I’m wasting my fuel coming down to do the exercise and wasting time’, like I should just drop out and stuff like that. In the end, when I think about it, I’m like it’s actually quite worth it because I drive down to school to exercise three times a week and I end up losing weight. So that should be considered an improvement as such.”. Describing the slow nature of change in desired outcomes, participant P007-5 (36F, MISS) recalled “We [the trainer and her] used to make comments about like, “The weight’s still intact.” I’m just paddling away and so we just had a joke about it.”. She
further explained her evolution: “But then I was starting to feel, I guess, when I was on the bike and I just started thinking about being nicer to myself and then, I finally got - I kinda felt myself come out a little bit, come out of my shell and just I felt - it’s much more quicker to talk to people before.”

**Identifying benefits**

Often when discussing change, participants shared subjective benefits of the program. These included elevated mood, distraction from unhelpful thoughts or unpleasant mood states, socialisation with trainer, improved fitness, greater energy levels, improved sleep quality, less day-time fatigue, a sense of relaxation, reduced somatic symptoms, the pleasure of exercise, greater general activity levels and changes in eating habits. In particular, the framing of these benefits were used to maintain motivation and commitment to engage in exercise.

Discussion around improved mood and using exercise to help regulate mood was common: “I’m really enjoying exercise, my mood definitely improved as well. I just have more energy, which is nice. I was definitely really unfit before I started and I was quite down and tired all the time and I reckon that’s definitely changed.....Like I said I did not like the gym at all, now I do. Just small things like that. Maybe [I] see it differently, because I know if I don’t exercise I’m just going to be in a crap mood all day. Whereas I know if I go then I’ll be in a good mood after. When I’m in a really crap mood and I don’t want to go, I still go because I know that it will improve it. My fitness improved a lot and I know I did lose a lot of weight, like I said before, so clothes were fit better. I could see changes which was good.” - P038-35 (21F, HIIE). Participant P022-19 (43F, HIIE) mentioned that following exercise, “I think generally I was happier, my body pains had eased. They hadn’t gone away, but they had eased. So I was a little bit more lively say in the morning. I wasn’t cramping as much as I do. So yeah I could attribute a sense of wellbeing to the program.”. Whilst P011-8 (33F, HIIE) said: “I felt calmer because I was exercising. I did get pretty sick. I had – I think it was a
sinus infection, during it, but apart from that, I went through a couple of sort of life events that were very, very stressful. And I think that doing that exercise really assisted my coping skills and it was something to pour my negative – what I view as my negative energy into, and that was quite a conscious thought in some of the sessions. During the 30 seconds where you had push yourself, during that 30 seconds, that thought whatever it was on that particular session that that was what was driving those 30-second bursts, so – Yeah. It – So I think allowed me to be a bit – go in there, push it out and then when you leave, you kind of leave it behind.”

One regularly mentioned subjective benefit was a sense of satisfaction and achievement. Participant P008-6 (27M, MIPP) said: “I was kind of pleased and surprised that I got through it, if you know what I mean. Like, it felt quite rewarding for me, I thought, that I finished it – even though there were, like I said, a couple of delays and I missed a couple of sessions for reason X, Y, Z. But I did manage to see it through and didn’t give up half way through or sort of, you know, pike out. I don’t know, it was a good feeling – it was like I had accomplished something, do you know what I mean. I think the actual finishing was a goal almost, you know. Like, achieving it sort of always feels pretty good, I think. Especially because that, for me, like I said, it was sort of stepping outside the comfort zone, you know what I mean. It wasn’t something that I was familiar with, it wasn’t something I sort of – I wasn’t sure if I’d be able to finish it, you know. So getting through it, for me, was – like, I felt great about it.”

Some participants appeared to use their new exercise habit as a platform for making additional health behaviour changes. Participant P045-42 (43F, MIPP) reported “…I’ve got more energy, and that happened, as I said to you, really quite quickly in the program. It's changed my eating habits, I don’t feel as hungry as I used to. Even come that 3:00 o'clock kind of blood sugar dip kind of thing I didn't experience any problems or anything like that, and some times I've eaten, I eat fruit. So I'm eating less, but I've also changed what I'm eating
as well.”. Another participant P039-36 (25F, HIIE) recalled “I used to find myself getting depressed quite a lot and I’d comfort eat. And yes, since then I just haven’t really - I’ve had, like, small moments like that, but I’ve been able to recognise them and I’ll make myself go to the gym instead of sitting and eating comfort food, or I’ve been able to make those changes, whereas before I would have just sat home and ate two packets of Pringles.”. Participant P030-27 (26M, HIIE) talked about their experience during the program “so usually I might take the car to somewhere, but during - just down to the shopping centre of whatever. But during - when I felt fitter, I actually did walk the short distances, a couple of kilometers instead of driving there.”. This participant discussed improvements more broadly too “I think my mood was generally improved, less sort of nervous sometimes, less worryful. Instead of getting up in the morning without much sense of purpose, it gave me a sense of purpose to get up and get ready, get out.”.

Creating ways to find success

In looking for changes, participants talked about the elusiveness of expected markers for change – often scale weight loss - and then discussed the value of having several measures of change. These alternative measures included subjective well-being or decreased depressive symptomology, increased fitness capacity measured by the VO2peak testing, greater strength or endurance in daily activities or during exercise, measured via on the onboard computer or by achieving additional repetitions/lifting more weight, within-session recovery measured by heart-rate normalisation and weight loss and body recomposition measured by DXA.

In contrast to participants struggling to find change, described previously, P030-27 (26M, HIIE) said “I felt quite positive about the improvement I made over the course of the six weeks. Especially with the VO2 results, that was a tangible one and the [DXA] scan, it gives some tangible numbers on the changes that had happened over that time.”. Participant P011-8 (33F, HIIE) used onboard technology to track their progress and develop exercise
self-efficacy: “So the whole thing’s challenging, but over the weeks, because of the technology and I could see what my heart rate was doing and things like that, I could see that during the rest times that my heart rate was coming down quicker. So all of that was a challenge to see how hard I could push myself in the cycling and see instantly how quick – it took to get my heart rate back down to a certain point”. Several other participants described the DXA scan highlighted changes not otherwise clearly apparent: “I was really - though I didn't actually say it or show it to you, after we did that scan thing, I thought that was really good. Because it was such a concrete measure to say something, and I think if everybody did exercise periods and knew you could do that [a DXA scan] then it would be so much more encouraging for people to continue exercising. I was pretty proud of myself, even though I said to other people I was unhappy about [gaining] the three kilos of muscle weight... I gained more muscle than I lost fat. I was pretty proud of myself at the same time” – P045-42 (43F, MIPP). Participant P024-21 (43F, HIIE) noticed that despite not noticing changes in their appearance, their body composition had improved: “After you did that [DXA] scan it made me realise even though I didn't see a lot of difference it [the exercise] did make a difference.”.

In summary, exposure to exercise and the experience over time provided evidence and reasons for maintaining adherence to their program. Whilst change could be slow, looking broadly for benefits (e.g. in mood, energy levels, sense of achievement, fitness, eating behaviours or body composition) seemed to give participants greater satisfaction with their achievements and subsequent motivation and determination to continue.

4.3.5. Managing Competing Demands

Fourteen participants discussed the challenges of managing competing demands involved in regularly exercising one to one with a trainer at an exercise facility. Several voiced psychological and practical aspects of their experience that seemed to facilitate their adherence.
**Barriers and Challenges**

A number of barriers and challenges were identified by participants. The most common were insufficient time or time management that was perceived as sub-optimal, other commitments – including family responsibilities, work and study, travel time, limited motivation, low mood, fatigue or illness. Some participants described anxiety as a barrier.

Time and effective time management were often cited as challenges: “There were time clashes because my timetable was very hectic and I was often rushing to get – like, I was late numerous times... But it was just my own time management. A chairing session could run late, had to drop my son home, came back, so I was about five minute[s] late, but I was still coming.... But the time to get there and organise myself is sometimes a little bit hectic, but that’s just poor time management on my behalf, so I can work that out.” – P046-43 (43F, MIPP).

As in the quote above, these challenges were tied not just to exercise being in competition with other commitments but also with low mood states: “I would sit at work going oh God, I've had a horrible day, or I'm really tired, I've got lots on after work, and now I've got to go and exercise kind of thing, or I've got to stop what I'm doing and I'd really rather finish this and run. But I have to go because I have to go. So actually turning up was by far the hardest thing. Once I was here, I was great. Afterwards - but it was just that get my act together to go, yeah.” – P045-42 (43F, MIPP). Illness could also play a role and was mentioned by three participants, for instance, P011-8 (33F, HIIE) said: “When I was sick I didn’t make some sessions, and then on two occasions – Excuse me – I was away for work, but the – my study just got pushed back a week, so – But – Yeah. When I wasn’t well, I always sort of spoke to [my trainer] about that anyway. If I ever didn’t make a session, that was why.”.

Three participants raised anxiety regarding social evaluation (described in greater detail previously) as a barrier; P043-40 (28M, MISS) illustrated: “When I’m thinking about
it, because it was so often where I’d be five or ten minutes late, and the fact that it only took me five minutes to walk there, did make me think that there was some sort of anxiety sort of thing going on where it was pushing me to not go and it was kind of only the urgency of being late that finally pushed me up and over. So that was something I still really kind of need to think about a bit more. Because I probably wanted the experience, but just the anxiety about being in front of other people, I guess, new people, being exposed.”

**Facilitators**

In describing factors that facilitated adherence, participants mentioned scheduling, flexibility in making up for missed sessions, noticing progress, accountability and the relationship with their trainer.

P045-42 (43F, MIPP), citing their challenges above, elaborated on how they managed to overcome these and remain engaged: “So if I’d made an appointment, I agreed to turn up, and she and I got on well and we had fun during our sessions. I think it was probably two things, I think it was [my trainer] herself and the fact that I’d made an appointment with her. Also, very early on I saw the benefits of having more energy, and that became really apparent to me, because I had been really struggling with tiredness up until that point, and as I saw that so quickly I just wanted to keep that going.”. P047-44 (21F, MIPP) said: “I think that, like I said, having the accountability for the exercise was really good, it was really beneficial. I probably just always did exercise a bit begrudgingly. But without the accountability there, I probably wouldn’t do it as often as I should.”.

P035-32 (23F, MISS) meanwhile put their thoughts like this: “I’ve always wanted to do exercise, it’s just expensive and hard to find the time. I was pretty nervous at the start because I hadn’t exercised in so long. I was kind of just looking forward to being forced into being active.”. Scheduling sessions and flexibility to make up for missed sessions emerged as a helpful facilitator for maintaining momentum and engagement. “I found it pretty easy to
stick to. Once I set my mind to it I just made sure I was free to do it. If I couldn’t come in for one session, we worked out another one.”

P024-21 (43F, HIIE) also discussed these themes: “I guess I push myself a bit more now after having to make that commitment to go, have someone else depend on you...One week I think I did an extra one because if the following week I was only doing two I might’ve done an extra one the week before or week after. So it kind of evened out. I think one week I might’ve been away but then just got back into it, and because we planned ahead a bit it wasn't left up in the air.”

Therefore, participants experienced contextual (e.g. time, competing responsibilities), personal (e.g. illness), and psychological (e.g. mood, fatigue, anxiety) concerns as barriers to exercise. The sense of negative social evaluation described in preceding themes recurred here creating a sense of internal resistance. In contrast, facilitators of engagement included scheduling of ‘make-up’ sessions, accountability to the personal trainer and being aware of positive changes.

4.3.6. We’re in this Together: Importance of Rapport and Relationship with the Trainer

One of the key themes to emerge was from participant’s reflections on the relationship and rapport with their personal trainer. Almost all indicated their trainer was instrumental to adherence and gaining benefit from the program. Three aspects of this relationship emerged as particularly important. Creating a sense of trust and safety between participant and trainer, the value of the trainer’s knowledge and expertise and having a trainer to commit or be accountable to were commonly described as important. In this way, creating a healthy and robust rapport was a key element for engagement. Past experiences often seemed to colour expectations of this relationship.
Creating a sense of safety and trust

When the exerciser-trainer relationship worked well, it frequently seemed to establish a quality of trust and safety which created a place from which participants could risk making changes whilst being vulnerable through exercise: “It was nice to be able to like – because usually when I go to the gym I feel very conscious and having [my trainer] encourage me, it’s kind of like okay, so you’re not making fun of me, you have my back. I kind of realise that people don’t usually care about me when I go to the gym – which, I mean, yeah, like in a good way like that. People are not like making fun of me or something like that. Because I’ve had bad experiences where in the past I would go with my cheer team when I was in secondary school and then they would judge people, so I get worried that people will judge me, but that’s not the case, I guess... [my trainer] understood I had a lot of things going on, so she was very flexible. If I said I suddenly can’t make it, and she would go ‘it’s okay, we can just push it to this date’... So she was very nice about it. And she was very encouraging. Like, if I said I really don’t want – it’s like I’m trying to give up, especially the first few lessons, and she was like ‘it’s okay, just three more’ or ‘12 more’. And she’d just really focus on that. And the whole company thing, because I didn’t use my phone, so I talked to her instead and she was just talking back and stuff like that. So it was kind of nice having a person to talk to.” – P049-46 (20F, MIPP).

P046-43 (43F, MIPP) contrasted her current experience with her trainer in the randomised control trial with a trainer she worked with when much younger: “I didn’t think I was able to do something like that, like, even with a back injury and then progressing through slowly with the help of my trainer and being supported through all of that, it made me feel quite good about myself... I’ve had personal training before and, I mean, this was when I was in my mid-20s, and I’m 40 now. And it was literally like Commando yelling. You know, ‘you’re useless’, ‘you’re this’. I didn’t need belittling. I feel belittled enough as it is
within myself and I didn’t know what to expect as far as how they were going to be and so on. So it was nice that they weren’t that way. I thought I’m going to get grilled and I’m going to feel even worse in something else that I know I’m already bad at. But it wasn’t like that at all.”

P008-6 (27M, MIPP) described how this safety and trust lent itself to achieving breakthroughs without being overcome by a sense of failure: “[My trainer] knew just how to push me a bit further than I would have myself, but not too far that I’d fail, if you know what I mean. I suppose you could say she could read it very well, you know. She knew what she was doing and then she’d push me sort of enough, but not too much, you know what I mean. So you felt like you’d broken through some barriers and stuff, but not that you’d fall in a heap and not want to come back… She was very professional, but she was also – you could just chat to her, you know what I mean. Like, she was very approachable.”.

This sense of rapport through safety and trust most commonly took time to develop – P007-5 (36F, MISS) put it this way: “I felt like I didn’t know if I was able to connect [with my trainer] or I felt - I really felt vulnerable to be honest. I can definitely say that in the first few weeks, I was very closed up with - in my mind and just trying to shift ‘why am I here? What am I doing?’ There was some kind of resistance in myself and then I was scared and a bit desperate in the beginning and stuff. And then I kinda saw it shift after a while at the third or so week or something like that... It took a few weeks... then we started having conservations and connected and then that’s how it shifted. So then all of a sudden, it became a pleasure to - I was looking forward to seeing [my trainer] every time and that kind of helped.” This rapport seemed to buffer more challenging experiences: “[My trainer was] friendly and approachable and he’s really positive. So even if, on some days, I wasn’t doing very well and I said to him, you know, ‘I really don’t feel like doing this today’, he would kind of encourage me to keep going or to give it a go and then I would end up doing it and I would feel happier for doing it because of just his nature.” – P047-44 (21F, MIPP).
Knowledge and expertise

Participants described leaning heavily upon the knowledge and expertise of the trainer in helping them learn more enjoyable, effective and engaging exercise techniques and surmount challenges. This was especially so in the Moderate Intensity Personal Preference condition, where participants could select the exercise type and format with support from their trainer. For instance, participant P047-44 (21F, MIPP) said: “I liked having the really good rapport with my trainer. That was really good because it was good to have that constant, like I said, the same trainer the whole time and have the really good feedback coming and have, you know, the knowledge of the different exercises. So if I wanted to ask why I was doing a particular thing, it was good because he could actually tell me exactly the reason why I was doing that exercise and what it would do and why we were doing so many reps and all of that. So I found that really helpful.”

For some, the trainer became a sounding board for future planning whilst the knowledge of the trainer added an extra element to the relationship: “being able to interact with someone who is a trained professional, perhaps could help me develop strategies for my own exercise program, see what would work. I learned a lot about just general exercise techniques and stretching and fitness, and that was a very positive relationship, that encouraged me to come back. Yeah it was very important to me I think. If I had a trainer that didn’t get along with me so much, perhaps it would have been less motivated to do it.” – P030-27 (26M, HIIE).

Accountability

A sense of accountability, discussed above as facilitating adherence, was often implicit within the relationship with the trainer. This seemed to occur through encouragement and enjoyment of the relationship yet at other times, through fear about breaking a social contract and inconveniencing the trainer. P038-35 (21F, HIIE) recalled: “...having someone there to actually push me, to actually get there and do the exercise, because I found it hard to
go unless I have someone to say come on, let’s go, let’s go. I found that good. Just motivating sort of thing.”. P030-27 (26M, HIIE) said: “We had a really good rapport and it was something to look forward to, something regular to keep coming back to. [He was] very supportive and I felt that if I didn’t go I would let him down or waste his time.”. During times when it was challenging to exercise regularly, accountability to the trainer seemed to defend against the desire to give up: “There were quite a few times where we only did two sessions a week just because scheduling didn’t work out. And even though it was hard to gear myself up sometimes, I knew I kind of didn’t really have a choice because I’d be letting down my trainer and I’d have to do it at some point anyway.” - P035-32 (23F, MISS). For participant P014-11 (20F, MISS), the social contract was key: “I told myself I was obligated to come because I made an agreement. That was the only reason I went.”.

Adequate relationships still work, but perhaps not as well

There were also times when the rapport was described as adequate, but not as robust as was experienced by others. Participant P017-14 (42M, HIIE): “I think she tried to chat, but I had nothing to talk to her and we didn’t connect, she was very nice but we didn’t connect. And I noticed that after a couple of sessions she’d say okay, well done but she just let me do it myself. I wasn’t chatting or anything so she just let me do - and she’d do things she needed to do and just timed me.”. Participant P011-8 (33F, HIIE) recalled: “It was pretty – And don’t mean this in a bad way, but it was a pretty shallow relationship, and I guess, for me, you go in knowing that you’re gonna have three sessions for six weeks and that’s kind of the end of it, so it’s not – You’re not looking to make a friend or anything in it. He just sort of an ‘exercise type’ and I guess that’s what it was all about anyway...but that was a little weird, not bad, just something that I noticed. It was what it was. So he – shallow – I just mean no – there was no – just ‘how was your day?’ ‘Oh. Yeah. Cool.’ Straight into it, bit of general chit chat, nothing deep, but I thought [my trainer] was a nice guy, who was encouraging.”
These quotes underscore how important robust rapport with the personal trainer was in creating an engaging program, encouraging adherence, problem solving challenges and reducing anxieties and fears associated with perceived failures and expected negative social judgement. The individuals who had adequate yet not robust rapport with their trainer managed to complete the program without having felt fully engaged by, or with their personal trainer.

**4.3.7. Sustainability of New Behaviours**

Several participants discussed the sustainability of regular exercise. Some of these participants had doubts about being able to maintain regular exercise whilst others had made plans or were engaged in regular exercise since completing the program.

**Exercising into the future**

Ten out of 18 participants interviewed continued exercising regularly after the program, at home, a local gym, at work or in a range of settings within the community: “I’m doing a lot more variety at the gym now, like with a personal trainer I’m doing weights and everything as well. But I’m actually still doing the interval training on the bike and stuff as well, which is good. I’ve been going consistently for the last three weeks, because I ended up with bronchitis so I had to give it a break for a little bit, but yes, I’ve been doing it consistently three days a week for three weeks now.” – P039-36 (25F, HIIE). Another returned to a boxing class she had done previously: “And before the program - late last year I did some boxing classes and I really enjoyed it - and so after the program I decided I wanted to keep going and I knew that was something I enjoyed, so I’ve been going 2-3 times a week since I finished the program.” P035-32 (23F, MISS).

**I’m having doubts**

Participants sometimes described doubts about continuing exercise, often citing barriers identified previously: “I have reduced my level of exercise...not having the right equipment for me - so that was an exercise bike with a variable intensity. I don’t have that
equipment or access to that equipment. So I’ve changed exercise and also not having a fixed
time or a reason to have a fixed time. So I’m not meeting up with a person at specific times,
and it’s just left up to myself and my own motivation to continue.” P030-27 (26M, HIIE).

Other participants who continued exercising after the program experienced doubts
about the sustainability of their new habits: “I felt accomplished, I felt quite accomplished. I
don’t know if I ever want to do it again. At first at the very, very end, I was like I am never
going to ride a bicycle again….and because the gym is quite far from my home, I couldn’t
really go there very often, but I wanted to” – P049-46 (20F, MIPP). Likewise, participant
P045-42 (43F, MIPP) recalled: “my concern was, when I didn’t have that structure in place,
that I would fall off the wayside…. I think the trick now is to find ways to replicate that in
the real world, and I’m not sure that that’s a necessarily easy thing to do. But that’s what I have
to do to keep going.”.

Problem solving for sustainability

Several participants spoke of difficulties in continuing exercise but approached this
with a problem-solving attitude: “[I’d like to] get back to being physically capable of doing
different things and also being able to release that stress through doing other exercises, other
team sports or whatever. Because I’ve had to give up everything [due to prior injuries]. I’m
not able to play volleyball anymore… Now I’m looking at what else I can do… And I think
that’s got a lot to do with [my trainer] having the ‘Well you can’t do that, okay, what else can
we do’ – it’s kind of changed my way of thinking through her encouragement –so if I say to
myself, ‘Put aside this time in the morning, get yourself up, go for a walk, go and do some
lunges or step-ups or whatever’, it’s not going to be a huge time thing because the way that
[my trainer] has designed it, I can do it at home, so there’s no travel time. I don’t have to go
to a gym to do it. I can do it at home.” – P046-43 (43F, MIPP).

The theme of accountability, this time through exercising with a friend or companion
was common in those who remained active, as P024-21 (43F, HIIE) recalled: “Now that I’ve
finished [the program] I’m like I’ve got to keep that up so I’ve started jogging with a friend
couple of times a week and going to yoga twice a week and doing my soccer. So I probably
do at least three or four things a week at least now, and if I do any less than that I feel like
I’m not really doing enough. So it’s made me know that I can make that time now and just put
it in my diary and make sure I work around it." Similarly, participant P045-42 (43F, MIPP)
modeled her exercise habit on the accountability she found helpful during the program: “So I
actually went for a couple of runs, because before we finished - this was one of my concerns
with [my trainer], was because I had that regular appointment with her, I’d always come and
show up, because that's what I'm like as a person, if I make an appointment I move hell and
high water to get there. So I've spoken to one of the girls at work and I've said to her, you
know when I come in with my stuff, you need to make sure that I keep that appointment with
myself to go out and do something. This participant also used environmental strategies to
ensure she was able to continue exercising: “I moved an exercise bike [we have] at home into
the bedroom, right next to my bed so that - because it was tucked away in a spare room
somewhere...I put it in my bedroom so that I see it all the time, and [you] can't keep walking
past it and ignoring it or hanging the clothes on it to hide it or anything like that. So I've sort
of made room in my days to do those things to keep the exercise going.

These excerpts highlight that whilst some participants experienced doubts about
ongoing exercise, often exacerbated by barriers to exercise described previously. Those that
continued a program after their enrollment used a variety of social (i.e. accountability),
behavioural (e.g. scheduling) and environmental strategies (e.g. proximity to equipment) to
assist with adherence.

4.3.8. A MoreIdeal Program

Participants often considered qualities they thought could contribute to a more ideal
program, including desirable aspects from and potential modifications to their program. Some
participants realised that whilst exercise alone was helpful, it was not enough in combating
depression. Most articulated a desire for a more complete program that included psychotherapy and psychoeducation. Within this subgroup, some expressed a desire to address their eating behaviours which they believed went hand in hand with being OW/OB and clinically depressed.

**Qualities of a good program**

Variety, choice of exercise and companionship were frequently mentioned by participants across all conditions and exercise choice especially in the MIPP condition. P004-2 (42F, MIPP) asserted: “I liked that the program was not just one thing, the exercises were different. And I think that’s what kept me and also my trainer was quite good too. So he was quite interactive. And that kept me coming back to the sessions. Yes, no I can say probably exercise that I hadn’t done before like the rowing, things like that. So doing some of the exercises that I’ve never done before. So I did mixed cardio and weights, like things like that.”. P045-42 (43F, MIPP) seemed to feel a similar way: “I liked the fact that I could pick what I wanted to do, because I find that I can't just do one type of exercise. If I just had to cycle or I just had to walk or whatever, unless I was doing it with someone - but by doing it by myself, I have to be able to have the option of changing what I do to stay engaged and interested in it. The other thing is, if I just had to - like the first day, we just cycled, and there was no change in speed or anything like that, it was just cycling, I found that mind numbing, I found I got far more enjoyment - because I felt like I'd actually achieved something by doing interval work than just riding a bike or going for a walk or something.”

P049-46 (20F, MIPP), did the same program throughout their study enrollment reflected: “I think it would have been nice to do a variety. It would have been more difficult because I think it got easier for me because I kept doing the same thing. But then if we kept switching it up, it would have been more interesting and I feel like it would have been more of a workout because I would have been exercising different parts.”. Participant P030-27 (26M, HIIE) mentioned group programs as potentially appealing, along with greater variety: “Previously I
came to understand I preferred exercising with other people around, or interaction with other people, rather than doing it with myself. Perhaps time for a group instead of just the one other person, just have a group exercise or something. Also more variety, the cycling and doing the same pattern every day did get a bit tedious.” Those whose program was on a stationary cycle often cited resistance training as an appealing alternative: “I did not like the bike. I prefer weights and that stuff. I was the interval cardio one, I don’t know if that’s the right name for it. Pretty much only on the bikes.” - P038-35 (21F, HIIE). Participant P011-8 (33F, HIIE) said “I quite enjoy cycling anyway, but I would’ve enjoyed a weights session as well.” For others, the interval training in the HIIE condition added enough variety: “It would’ve been pretty boring just doing the same speed the whole time. So I think the intervals were good and broke it up a bit.” – P024-21 (43F, HIIE).

A number of participants made mention of exercise intensity, particularly in regard to increasing engagement: “At the beginning it [the exercise session] was kind of hard, but then it would sort of be this 15 minutes of, you know, ‘are we there yet?’ kind of thing. For myself, because I’m aware of the benefits of high intensity interval training, I probably would do that. Plus, it kind of breaks it up so that it’s not just one long 30 minute thing.” – P043-40 (28M, MISS). Another suggested: “…you could only go moderate intensity. You couldn’t like really go hard, which was a bit of a bummer sometimes.” – P035-32 (23F, MISS).

Only one participant made mention of the duration of the program, and suggested that a longer duration might be useful: “Maybe make it run longer... If nothing else was an issue, I’d say maybe like 12 weeks or something like that, you know.” – P008-6 (27M, MIPP).

**Exercise alone is not enough**

Some participants described that whilst exercise was helpful in many respects, exercise alone might not be sufficient or have a sense of completeness of intervention for clinical depression in an OW/OB population. The three broad topics brought up included i) desire for formal psychotherapy, ii) an aspect concerning eating behaviours and nutrition and
iii) psychoeducation on the essential aspects regarding how exercise programs improve depression.

For example, participant P017-14 (42M, HIIE) wondered: “I thought the research, like, okay, through the exercise I’m going to feel better. Really I was thinking there was going to be something built in this program will demonstrate to you how by exercising you’re going to feel better. I don’t know, how hormones work or how they stimulate what and why it’s important.”. Participant P006-4 (36F, MISS) recalled: “I guess I was hoping there was gonna be a bit of a dietician side of things involved as well, like just guidelines to follow through the process ‘cause you have to be overweight to be able to do it There was none of that so that was disappointing.”. Participants seemed to understand that exercise alone might not change things overnight, pointing toward a desire for further intervention. Participant P004-2 (42F, MIPP) said: “But I think that, you know, I’m still obese but I think also my perception about my physical appearance is still the same. You know, there hasn’t – like even though my fitness has improved and I feel better about that. There’s still body image issues and how do I feel about appearing to other people that kind of stuff. So, you know, many years of thoughts like that don’t change overnight. So there’s a sense that okay, my mind has changed in the sense that okay I might not be able to do that now, but I can work my way towards that if I want too.” Another participant said they had sought psychotherapy following completion of the trial program: “I think I have taken steps forward, but when I finished the study, I still felt that I needed more. So I booked in to see a counsellor at ... and had five sessions after the study finished, up until this week.” – P011-8 (33F, HIIE).

In short, these excerpts illustrate that key components of good programs may include within and between session variety (e.g. type of exercise, intensity, format), personal preference, and companionship with an element of accountability. Further, exercise alone is not necessarily sufficient for all participants to feel optimally supported, engaged and
underscores the potential benefits that could be derived from incorporating exercise into an evidence based psychotherapy designed specifically for this population.

4.3.9. **Summary of Qualitative Results**

The primary aim of the qualitative study was to better understand the experience of adults with clinical depression and co-morbid OW/OB in an exercise intervention. We also sought to understand what aspects of these interventions might be important for future program design. Six main themes included: A) Awareness of self in relation to exercise and exercisers, B) Looking for change, C) Managing competing demands, D) Importance of rapport and relationship with the personal trainer, E) Sustainability of new behaviours, F) Suggestions regarding a more desirable program. A further 16 sub-themes were identified each of which elaborated on participants views and experiences.

4.4. **Discussion**

Made-to-measure interventions for clinical depression in adults with OW/OB are scarce. To date, these interventions have combined standard treatments for depression and weight-loss (Faulconbridge et al., 2011; Pagoto et al., 2013). Exemplars typically involve weight management, lifestyle programs and/or cognitive and behaviour therapies for depression and often including physical exercise programs in treatment. The aim of the present study was to gain a more nuanced insight into the experience of adults with OW/OB engaged in exercise as a treatment for clinical depression. Such findings can inform development of tailored therapies for depression in adults with OW/OB. Our findings should also enhance research understanding and effective utilisation of exercise for depression and general health in this population.

4.4.1. **Exercise Self-Efficacy and Confidence to Exercise**

Research indicates that depression leads to lower levels of exercise than the general population (Patten et al., 2009), that individuals with depression are likely to discontinue exercise (Teixeira et al., 2004) and have lower self-efficacy (Sacco et al., 2005) than
euthymic peers. More recent research has suggested this moderating effect of depression on self-efficacy may be even higher in individuals with high BMI (Kangas et al., 2015). Increasing self-efficacy in clinically depressed, OW/OB populations may be particularly challenging.

We expected all conditions to improve on measures of exercise self-efficacy and subjective confidence. We found no substantial change in exercise self-efficacy or confidence to exercise over time. Furthermore, no format or type of exercise was superior at improving self-efficacy or confidence to exercise. Our qualitative findings however, indicated that some participants acquired a subjective increase in confidence and self-efficacy to exercise over time. These individuals emphasised feeling supported by their trainer in constructing and engaging with their program. They also clearly enunciated a reduction in self-doubts and social fears, which amelioration occurred progressively as they continued with the program and internalised a problem solving approach to challenges.

Previous research on exercise interventions and self-efficacy is mixed. To our knowledge, no studies exist on exercise self-efficacy in clinically depressed and adults with OW/OB. Self-efficacy is frequently lower in adults with depression than within the general population (Craft, 2005; Kangas et al., 2015), yet several studies have reported increases in exercise self-efficacy in non-depressed and depressed but not exclusively OW/OB samples following regular exercise (Jung et al., 2014; McAuley et al., 1995; Singh et al., 2005). Across conditions, participants in the present study scored in the lower range of exercise self-efficacy compared to these and other populations (Everett et al., 2009). This is consistent with the described initial levels of self-doubt and low self-efficacy during qualitative interviews. These low scores are not surprising, as our inclusion criteria required that participants were not engaged in regular physical activity. The lack of improvement in exercise self-efficacy suggests the importance of directly targeting exercise efficacy (e.g. via cognitive and behavioural strategies) may be important in depressed, OW/OB cohorts.
There is some evidence that programs which incorporate targeted approaches to improving exercise self-efficacy are important in the general population. In a 6-month program based on self-efficacy theory, obese, sedentary women derived small but significant improvements in exercise self-efficacy (Annesi, Unruh, & Whitaker, 2007). Buckley (2014) compared changes in self-efficacy following either a 12-week program which included daily cognitive therapy exercises based on Social Cognitive Theory (e.g. identifying why exercise is important to oneself, self-regulation tasks and relapse management) or an information only control condition for OW/OB women. Buckley found that exercise self-efficacy improved for individuals in the intervention group who were inactive at baseline yet remained stable for individuals who were active at baseline. Given that individuals with clinical depression are often inactive, these findings are very relevant and indicate that structured cognitive interventions delivered alongside an exercise program may be required for exercise self-efficacy to increase in populations with depression and OW/OB. These findings are also in line with the comments from participants described previously, in that those who used a variety of strategies to enhance exercise and were able to self-regulate were able to continue exercising following the program.

4.4.2. Motivation, Enjoyment and Positive Anticipation

Motivation, enjoyment and positive anticipation of exercise improved significantly over time. This was consistent with qualitative findings, in which participants discussed approaching sessions in search of change and, when identifying areas of improvement, subsequently feeling motivated to continue exercising.

Clinical depression leads to behavioural repertoires that limit the opportunity for change and especially achievement. In concert, unhelpful cognitions common in depression tend discount or minimise success when it occurs (Beck, 1991). Our research indicated that participants sometimes felt disappointed with their progress, especially when measured by only circumscribed outcomes - often scale weight. Indeed, overweight individuals engaged in
exercise report weight loss as a primary motivator to exercise and that failure to lose weight strongly dampens motivation for continuing physical activity (Guess, 2012). This is particularly important because in such populations, weight loss is rarely mentioned as a benefit of exercise (Alvarado, Murphy, & Guell, 2015). When afforded the opportunity to measure progress in a variety of ways (i.e. regulation of mood or anxiety, reduced fatigue, improved energy, heart rate recovery, body composition, aerobic capacity, strength or muscular endurance and completion of goals) participants in our study experienced a sense of achievement which became a motivating factor for continuation. Similar to overweight women in prior research (Sabiston, McDonough, Sedgwick, & Crocker, 2009), our participants typically improved fitness and strength yet described limited changes in physical appearance. Several participants remarked with surprise that body composition (i.e. fat loss and muscle maintenance or muscle gain) had altered significantly while scale weight remained unchanged. This suggests that having multiple markers of progress is especially important for persons with co-morbid depression and OW/OB, who may discount success or fail to notice achievements other than those more commonly associated with exercise for overweight individuals, i.e. primarily weight-loss.

When considering specific exercise types and formats, individuals in the HIIE condition showed the most absolute improvement in motivation, enjoyment and positive anticipants yet contrary to our expectations, participant’s post-intervention levels of motivation, enjoyment and positive anticipation were comparable across conditions. We noted lower scores in the initial week of the intervention within the HIIE condition, which having normalised, may account for a large portion of the improvement in motivation and positive anticipation seen across conditions. This indicates that whilst HIIE may be experienced initially as relatively more challenging, uncomfortable or otherwise aversive, this discomfort seems to reduce over time. Indeed, prior research on HIIE interventions has shown increasing enjoyment over time (Bartlett et al., 2011; Jung et al., 2014). Bartlett et al.
(2011) suggested this may be because HIIE sessions are typically shorter, and that briefer activity bouts may be perceived as more enjoyable than longer ones or, that HIIE is more enjoyable than alternative exercise formats. Our research provides some support for the latter assertion, since participants exercised for the 30-minute duration irrespective of condition. These are important findings as they indicate HIIE is well tolerated and experienced as enjoyable, motivating and positively anticipated as alternative forms of exercise (including personal preference) and contrary to recent commentary on HIIE that asserts it is not a viable intervention for improving a range of health outcomes due to its psychologically aversive nature (Biddle & Batterham, 2015).

Non-specific factors occurring across conditions may have contributed to a lack of differentiation between conditions. As exercise trainers worked with participants from each condition, the impact of individual trainer rapport cannot be quantitatively accounted for in the present study. Nevertheless, participants in the HIIE condition recalled sessions as enjoyable and motivating whilst having a goal to achieve specific power output or heart rate recovery as displayed via on-board feedback of the Wattbike Pro (i.e. power output and heart rate). Participants described variation within sessions as engaging. This was consistent with the experience of participants in the MIPP condition and in contrast to participant’s experience of steady state cycling (MISS), who indicated that subjective in-session boredom was salient. These findings expand upon previous research. Tjønna et al. (2008) asked overweight individuals to take part in a 16-week trial of HIIE (treadmill running) vs continuous intensity steady state or a control condition. Participants indicated that the interval format was motivating due to the varied procedure within each session, where-as participants in the continuous exercise format described sessions as not engaging. The current study replicates this finding and further suggests that exercise programs based on personal preference and HIIE may be engaging due to program and within-session variation and in-session feedback provided by technology. Our findings also indicate that factors relating to
knowledge, expertise, safety, trust and accountability imbedded in the relationship with the trainer may be important in ameliorating the negative effects of lower exercise self-efficacy. Future research therefore, should clarify how motivation, enjoyment, positive anticipation and exercise-self efficacy might be associated with participant-trainer rapport.

4.4.3. Importance of Social Context

Comparable to recent work by Danielsson et al. (2016), we found themes centred around separateness and not belonging, challenging oneself to achieve some worthwhile goal and the importance of the relationship to the trainer. The present research expands on this work in several ways. The first is the historical intrapsychic and interpersonal context the OW/OB individual brings and the second, how the relationship with the trainer becomes a catalyst for change. Participants described that public exercise had often become a powerfully self-critical interpersonal and intrapsychic space. This seemed to amplify future expectations vis-à-vis negative social evaluation, especially in an exercise context. Similarly, self-criticism and over attending to perceived failures show how individuals internalised past experiences, ruminating upon them when intending to exercise. In turn, these dynamics might contribute to reduced readiness for, less regular use of and lower adherence to exercise to improve mental health and wellbeing in this population.

4.4.4. Facilitating Change, Benefits and Barriers

The benefits from, and challenges to regular exercise for mental health populations has received some qualitative attention (Carter et al., 2016; Danielsson et al., 2016; Rogerson et al., 2012; Searle et al., 2011). Exercise for adults with OW/OB who were not clinically depressed has been qualitatively examined (Alvarado et al., 2015; Guess, 2012). We believe the current research represents the first report of benefits and challenges to regular exercise in clinically depressed, OW/OB persons.

Our research echoes previous findings and confirms similar benefits and challenges to overweight, non-depressed and depressed, normal weight persons (Alvarado et al., 2015;
Carter et al., 2016; Danielsson et al., 2016; Guess, 2012; Rogerson et al., 2012; Searle et al., 2011). Benefits reported in the current study included elevated mood, distraction from unhelpful thoughts or distressing mood states, socialisation with trainer, a fulcrum for structure during one’s day, improved fitness, greater energy levels, better quality sleep, less day-time fatigue, relaxation, reduced somatic symptoms, enjoyment of exercise, greater general activity levels and changes in eating habits. Many of these benefits became facilitators (e.g. improved fitness) and motivators for exercise (e.g. reduced somatic symptoms, socialization with trainer). Participants mentioned scheduling, flexibility in making up for missed sessions, noticing progress, accountability and the relationship with their trainer were additional facilitators to exercise. These findings are similar to prior research reporting that psychoeducation (e.g. about specific psychological benefits of exercise), social support, provision of strategies (e.g. goal setting) monitoring (e.g. with heart rate equipment) and personal preference are common facilitators of adherence to programs (Carter et al., 2016; Danielsson et al., 2016; Searle et al., 2011).

Ten participants (55%) interviewed continued exercising following the program. This is slightly lower than in previous quantitative research that reported approximately 64 per cent of individuals assigned to an exercise intervention for clinical depression continue to exercise at least 12 weeks later (Babyak et al., 2000). One crucial difference between the present study and Babyak et al.’s research was that we did not prompt participants to continue physical activity following the program, whilst Babyak et al. directly encouraged individuals to continue exercise as experienced in the research program. At least three participants in the present study made plans yet had not carried them out. Within this latter cohort, barriers to exercise were brought up including financial limitations which was not a concern whilst participating in the controlled trial. Of those who had continued exercise, themes of problem solving, scheduling, goal setting and accountability to a friend or trainer were discussed. Many of those who continued exercising based their own programs on
templates they learned in the exercise intervention trial. This illustrates that for some, the strategies developed over the course of the intervention naturally generalised to use within the community. Our research demonstrates the importance of a flexible and collaborative problem-solving approach to managing adherence to an exercise intervention and that direct encouragement or planning may be necessary to ensure continued use exercise following cessation of treatment programs.

Typical challenges included difficulties with time management, competing demands, low moods states, anxiety, fatigue, and low motivation. In overweight but euthymic populations, common barriers to exercise include lack of understanding correct technique or programming, feeling self-conscious or socially judged, (especially for adults with BMI > 40), inadequate access to affordable facilities or equipment, narrow awareness of inexpensive options and discouraging stereotypes regarding gender oriented activities - for example, resistance exercise being perceived as ‘male oriented’ activity or only for those interested in ‘muscle building’ (Alvarado et al., 2015; Guess, 2012; Sabiston et al., 2009). A unique challenge in a population with co-morbid depression and OW/OB that emerged in the present study seemed to be the activation of an intrapsychic voice that was critical and punitive, discouraging engagement in exercise and discounting success. Over time, a minority of participants described becoming ‘kinder’ to themselves and more self-compassionate. Future interventions for depression in OW/OB populations, particularly those including cognitive therapy might benefit from directly targeting self-critical schemas and cognitions by fostering self-compassionate and self-motivating attitudes and beliefs.

4.4.5. Self-compassion for Clinical Depression in Overweight or Obese Adults

There is a growing body of evidence supporting compassion focused therapy for depression and psychological problems associated with obesity (Gilbert et al., 2006). Compassion focused therapy may be especially useful when self-esteem, self-criticism, affect-regulation and eating behaviours are significant contributors to distress (Gilbert et al.,
It is interesting that approximately one third of participants in the primary study met criteria for binge eating disorder and several more engaged in sub-clinical binge eating behaviours. Compassion focused therapy may therefore be a clinically useful intervention for this population.

In a compassion focused model it is hypothesised that the affect regulation system underpinning a feeling of safety, well-being and reassurance is poorly accessible (Gilbert, 2009). This is especially so in individuals with high shame and self-criticism. Goss (2011) outlined three affect regulation systems: The threat system alerts an individual to social and physical threats provoking feelings of anger, anxiety or disgust. In OW/OB persons, this might include self-criticism or expected criticism from others and shame. The flight/fight/submission behaviours, serotonin and HPA axis dysregulation are hypothesised to play a role in the threat system (Gilbert, 2009). Goss notes that threat system activation may inhibit positive feelings and lead to the activation of the drive system designed to self-sooth. The drive system is posited to orient a person toward pleasure and attainment of important rewards and resources. These include food, sexual opportunities, social alliances, nesting sites and territories (Gilbert, 2009). Goss suggested that individuals who are OW/OB or depressed may be caught oscillating between the threat and drive systems. For example, in seeking to exercise or lose weight, being met with slow progress, getting angry, upset and self-critising might subsequently produce pleasure seeking by way of eating to moderate the threat system. For individuals who binge eat, the subsequent cycle of guilt, shame and over-compensation is well established (Burney & Irwin, 2000; Sanftner & Crowther, 1998). Depression may compound the issue by keeping failure salient and success discounted (Beck, 1991). This oscillation is common unless the third system is active. The affiliative soothing system only becomes active in the absence of threat or deprivation. It is associated with feelings of contentment, attachment or social-connectedness, kindness, compassion and well-being and may draw on mechanisms of the opiate and oxytocin system (Gilbert, 2009).
Furthermore, Gilbert suggested the affiliative soothing system regulates the threat and drive systems. One of the critical activators of the affiliative soothing system are caring behaviours in an interpersonal context. This is not dissimilar to the dynamic that participants in the current research described between themselves and personal trainer whereby they would more gently encourage themselves to continue amidst challenging sessions or problem solve difficulties that occurred. Therapeutically, Gilbert (2009) outlined how attention tasks, imagery, and cognitive therapy for motivation, emotions, behaviour, and thinking or reasoning patterns can assist in fostering sensitivity, empathy, distress tolerance and a non-judgmental self-orientation that may be especially useful for persons with clinical depression and co-morbid OW/OB. This compassion focused model may be a valuable framework for future cognitive-behavioural interventions for individuals with clinical depression and co-morbid OW/OB, especially where exercise guided by a compassionate, understanding other is part of therapy.

4.4.6. Importance of Participant-Trainer Relationship

It is very well established that the relationship between client and therapist is important in psychotherapy (Ardito & Rabellino, 2011; Horvath & Luborsky, 1993; Krupnick et al., 1996). Recent research also highlights the importance of the relationship between participant and physical therapist in exercise based treatments of depression (Danielsson et al., 2016). Our findings support especially the idea of collaborative change, in which the personal trainer joins with the participant in the process of moving toward a healthier self. Our research suggest three key factors might underpin this relationship. The first is the knowledge and expertise the personal trainer brings to the partnership. This knowledge and expertise allowed the participant to be guided or coached in exercise techniques and habits and to navigate challenges and failures effectively. Secondly, when the partnership worked well, there was a sense of safety and trust. This was especially important in allowing participants to risk being vulnerable in making changes and entering a relationship (i.e. with a
personal trainer or close other) which may in the past have been experienced as critical and aversive. This relationship may also contribute to a sense of belonging or reduce the negative impact of feeling like an outsider in an exercise environment. From this base, the relationship appears to become a model of relating-to-self for the participant. When the trainer adopts a kind, non-judgmental and problem-solving approach the participant had the opportunity to internalise these attitudes and skills. In some cases, participants described applying the same approach to broader areas in their lives (e.g. to changing eating habits). This suggests that the relationship with the personal trainer permitted greater activation of the affiliative soothing system and reduced the impact of the threat system. Finally, the accountability to the trainer was helpful for many participants in ensuring adherence. Like participants in Danielsson et al.’s study, individuals in the current study needed to exercise with an ally. Exercising for oneself was often perceived as an inadequate motivation. This accountability is what allowed the participant to engage in exercise in the midst of depression or when intrinsic motivation was low. When participants spoke of re-scheduling a session, they did not describe feeling criticized or reprimanded. In contrast, they felt supported and encouraged to work with the trainer to find a time to reschedule and return to exercising regularly. It could be useful for future research to examine whether more robust participant-trainer relationships are associated with greater reductions in depression, or improvements in adherence among individuals with depression and co-morbid OW/OB who are engaged in exercise.

4.4.7. Considerations for Future Programs

We asked participants how they would modify their program if there were no limitations to what was possible. Several themes emerged about what might constitute an ideal program for this population. Variety and choice of exercise were frequently mentioned. Many participants raised the idea of cross training i.e. being able to engage in various aerobic activities alongside resistance training. In this and prior themes, partnership with a personal trainer was desirable due to their knowledge, expertise and the accountability provided.
Intensity of exercise was often mentioned for individuals in the steady state cycling condition (MISS). These participants commented that at some junctures in the program, they longed for higher intensity and more engaging exercise. Finally, a sub-group of individuals noted that exercise alone was not enough to combat depression. These participants mentioned seeking psychotherapy following the program, having hoped for information on nutrition and modification of eating habits and psychoeducation regarding the mechanisms and essential features of exercise programs for depression. Searle et al. (2011) interviewed 33 participants engaged in an exercise based controlled trial for depression and similarly found a subset of participants believed counselling or medication were a necessity in managing depression. As mentioned previously, we believe that evidence-based psychotherapy could be usefully informed by compassion focused therapy.

Broadly speaking, the exercise program became a place where the individual experienced a heightened self-awareness, joined in partnership with a supportive other – in this case, a personal trainer – and subsequently worked through challenges and made constructive changes to their lives; intrapsychic and behavioural. This is an essential parallel fragment to what occurs in many forms of evidence-based psychotherapy. Exercise became a conduit for achievement, problem solving capacity and a new platform from which to make other lifestyle changes.

4.4.8. Implications for Practice, Limitations and Areas for Future Research

It is important this research can be applied to clinical practice. Of key importance is that health providers, including general practitioners, psychologists, exercise physiologists and personal trainers be aware of important issues regarding exercise as treatment for depression in an OW/OB population. This includes the value of a good rapport and relationship with the personal trainer, working to foster a non-punitive or non-judgemental problem-solving approach between clients and clinicians. Furthermore, psychologists should consider whether self-criticism, shame and self-compassion are perpetuating concerns for
OW/OB clients with depression. If so, clinical benefits could be found in targeting these issues. Secondly, when utilising exercise as an intervention for clinical depression in persons with low exercise self-efficacy, specific cognitive approaches can be employed to improve exercise self-efficacy. Additionally, when measuring success, clinicians should encourage clients to consider a broad array of potential indicators of achievement, including reduced mood symptoms, fatigue, improved energy, sleep, aerobic capacity, strength, endurance, socialisation with others, completion of sessions and faster physiological recovery within sessions. Although the emphasis of our research is on amelioration of depression, where weight loss may be a consideration for clients, measuring body composition rather than scale weight is encouraged. Drawing on described facilitators may help clinicians increase adherence and engagement (e.g. through flexibility of scheduling, accountability, in-session feedback, enjoyment) and helping clients plan for continued exercise following cessation of supervised programs seems important.

Participants from the current study were drawn from volunteers engaged in a randomised control trial. Whilst meeting criteria for clinical depression, it is possible individuals were following a trajectory of recovery that facilitated motivation to engage with our program. Thus, recovery may have continued without intervention. Without a waitlist control, this remains unknown. The applicability of current findings must be interpreted cautiously regarding people at various stages of depression.

The focus on feasibility and piloting the program was such that the primary randomised controlled clinical trial was somewhat underpowered. We recruited from various locations and online within an Australian metropolitan city however all participants were required to attend Murdoch University, typically three times per week. Prior research indicates that proximity and travel time are all significant barriers to engagement in exercise (Alvarado et al., 2015; Firth et al., 2016). Therefore, future research might consider a multi-site approach to ensure adequate power is achievable. That the qualitative data drew from a
sample of 17 participants, in line with prior research can be considered a strength of this mixed methods design, ensuring saturation of themes could occur. A second issue with the pilot program was its relative brevity. Motivation, enjoyment and positive anticipation measured over 6 weeks are not necessarily indicative of long term engagement with an exercise program. Given the benefits of exercise on mood are likely to persist only for as long as one regularly ‘takes the medicine’ (Krogh, Nordentoft, Sterne, & Lawlor, 2011) research should investigate which factors maintain or enhance engagement in such interventions over the long term.

Following recent research intimating that self-compassion, depression and over-eating might occur from common underlying processes, future investigations should aim to shed light on targets for treatment via a compassion informed model. Future research should seek to clarify what aspects of the relationship between individual and personal trainer are important for enhancing adherence, engagement and psychological recovery. This research ought to examine interpersonal, programming and contextual factors. We recommend future studies investigate tailor-made interventions utilising regular one-to-one moderate to high intensity exercise with programming that allow for variety and are developed in collaboration with a qualified personal trainer. Group or individual cognitive-behavioural therapy for individuals with depression and OW/OB should be incorporated – it is suggested additional benefits could be derived if such therapy is informed by compassion focused approaches.
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Chapter 5 – Study Four.

Assessing the efficacy of enhanced cognitive behavioural group therapy and individual supervised exercise intervention for clinical depression in overweight and obese adults: Study protocol for a randomised controlled trial.
Assessing the efficacy of enhanced cognitive behavioural group therapy and individual supervised exercise intervention for clinical depression in overweight and obese adults: Study protocol for a randomised controlled trial.

5.1. Introduction

There is a paucity of research into interventions for clinical depression in individuals with co-morbid overweight or obesity (OW/OB). Lifetime prevalence for clinical depression is almost 15 per cent whilst societal levels of overweight (35%) and obesity (28%) are high and rising (Australian Bureau of Statistics, 2012; Bromet et al., 2011). Individuals with depression are at elevated risk for developing OW/OB and overweight individuals at elevated risk of developing subsequent depression (Faith et al., 2011; Luppino et al., 2010; Stunkard, Faith, & Allison, 2003). Nevertheless, many individuals with depression are routinely screened out of trials involving overweight individuals, including interventions aimed at reducing depressive symptoms (e.g. Andersen et al., 1999; Annesi & Unruh, 2008; Rubin et al., 2005).

Treatments for co-morbid depression and OW/OB currently focus on providing concurrent but discrete evidence-based interventions for depression and obesity – usually cognitive behaviour therapy and behavioural weight loss or lifestyle change (Faulconbridge, Wadden, Berkowitz, Pulcini, & Treadwell, 2011; Pagoto et al., 2013). These could be enhanced with elements designed specifically for the underlying difficulties individuals with clinical depression and OW/OB face. Recently, interventions based on acceptance and commitment therapy or compassion focused therapy have been designed for use with individuals with depression or overweight (Berman, Morton, & Hegel, 2015; Gilbert et al., 2014; Gilbert, 2009) but to our knowledge, few programs have been designed specifically to treat clinical depression within an OW/OB population.

One of the proposed mediators of depression in OW/OB persons relates to an imbalance
Many pro-inflammatory markers are present in individuals with depression and individuals with obesity (Dowlati et al., 2010; Emery et al., 2007; Howren, Lamkin, & Suls, 2009; Liu, Ho, & Mak, 2012). Furthermore, administration of anti-inflammatory compounds has been shown to reduce symptoms of depression (Köhler et al., 2016). In overweight individuals, the major source of pro-inflammatory markers are adipocytes (adipose cells). As such, this adiposity-induced pro-inflammatory condition has been associated with depression and co-morbid overweight and depression in particular (Shelton & Miller, 2011) and is currently a research area of interest. Interventions that reduce adiposity and/or inflammation may improve clinical outcomes for adults with clinical depression and OW/OB (Emery et al., 2007; Köhler et al., 2016; Lopresti, Hood, & Drummond, 2013). Because treatments that target the cycle of depression, adiposity and inflammation are few, it is important to shed further light on these associations and examine the impact of interventions on inflammation.

5.2. Development of the Current Intervention

Cognitive behaviour therapy (CBT) for depression usually focuses on i) psychoeducation about depression and the nature of emotions; ii) behavioural techniques to reduce symptoms and increase engagement, for example, pleasant or mastery activity scheduling; and iii) cognitive therapy to help identify and modify unhelpful automatic thoughts or beliefs. Between session tasks are often used to reinforce and generalise these skills and techniques. More recent research has highlighted the importance of targeting early maladaptive schema’s, especially for chronic depression. Finally, mindfulness-based CBT interventions have gained significant interest for re-current depression in particular and are often incorporated into traditional CBT interventions (Barlow, 2014; Carr & McNulty, 2006; Teasdale et al., 2000).

The present study will employ group-based CBT for depression with a component of
formal, one-to-one supervised exercise sessions. This program is designed specifically to target maintaining factors described by adults with co-morbid depression and OW/OB, being informed by recent research and our preceding findings. When participants in our randomised control trial (RCT) commenced exercise, they described moving through several common phases. Initial feelings self-consciousness, not belonging, self-doubt, and self-criticism were described. This was often followed by building an alliance with the personal trainer, beginning to feel capable and subsequently, looking for changes in mood, fitness or body composition that indicated they were making progress. Finally, some individuals started making other general health behaviour changes and preparing for completion of the program and continuing exercise themselves. We therefore developed our program to broadly move with participants as they progress through these phases.

**Overview**

Participants commence exercise with their personal trainer, who will have been trained by a Clinical Psychologist to work from a compassion informed approach, from the outset. Meanwhile, the group psychotherapy starts with psychoeducation specific to adults with clinical depression and OW/OB, and outlines the rationale for treatment and for combining exercise, psychotherapy and modules on nutrition and healthier eating habits. We then introduce the compassion focused model which underpins much of the program, linking this to aetiological factors described previously. We build on this with exploration of early maladaptive schemas and then incorporate specific cognitive and behavioural exercises throughout the program, drawn from compassion focused therapy and schema therapy, outlined below. After having established a compassionate foundation and progression through much of the cognitive and behavioural treatment, we expect to explore nutrition and healthier eating habits and to help participants develop strategies for continued self-regulation, goal setting and maintenance of exercise following completion of the program.
Compassion and schema informed interventions will continue throughout the program. The program modules are expanded upon below.

_Psychoeducation_

Alongside typical psychoeducation regarding depression and emotions included in CBT programs, we developed a conceptualisation of depression that integrates the psychological (e.g. failure focus, shame, self-criticism, early maladaptive schemas) physiological (e.g. chronic systemic inflammation, adipose tissue build-up, neurochemical and endocrine changes, particularly insulin and HPA-axis dysregulation) and behavioural (e.g. reduced activity and engagement, discorded eating) factors that predispose and perpetuate symptoms in this population. We include psychoeducation on the aetiology of depression and OW/OB, the role of exercise on mood states and depression, endocrine and inflammatory pathways. A compassion informed model of treatment for ameliorating specific cognitive and behavioural patterns is introduced as outlined below in Figure 5.1. These specifically are added to the proposed program given that a side effect of engaging in exercise – especially in the presence of others - may be to activate self-criticism and shame experiences that may perpetuate depression and negatively impact engagement in exercise unless addressed appropriately.
Many of the pathways depicted in Figure 5.1 have relevance to the aetiological factors for depression in adults with OW/OB, as described in Chapter 1. For example, a history of teasing or negative verbal commentary as a child or adolescent could contribute to feelings of being rejected, hurt, powerless and worthless. Internalised negative internal verbal commentary, concern with weight, body shape or eating behaviours, self-criticism and self-doubt have all been implicated in maintaining depression in adults with co-morbid OW/OB (Cooper & Fairburn, 2001; Decaluwe & Braet, 2005; Werrij, Mulkens, Hospers, & Jansen, 2006) and are not an unlikely outcome of such a background. Individuals might subsequently become more sensitive to threat, socially withdraw or engage in other safety behaviours, such as inhibition of affect, avoidance of conflict, or emotional eating (Gilbert & Procter, 2006;
Goss & Allan, 2014). Meanwhile the ‘unintended consequences’ described in Figure 5.1 (e.g. self-attack, cognitive rumination, feeling worthless) are hypothesised to take hold and to perpetuate symptoms of depression. These maintaining factors become useful targets for treatment.

**Cognitive-techniques**

Thought diary records, functional analysis (e.g. TRAP analysis), identification of values, goal-setting and problem solving are included in the basic intervention. Advanced techniques targeting shame, self-criticism and focus on failure are linked to a compassion model of treatment whilst identifying various opportunities for success is linked to treatment goals and exercise related goals. Gilbert (2009) has outlined how attention tasks, imagery, and cognitive therapy for motivation, emotions, behaviour, and thinking or reasoning patterns can assist in fostering sensitivity, empathy, distress tolerance and a non-judgmental self-orientation that may be especially useful for persons with clinical depression and co-morbid OW/OB. Further, developing compassionate imagery (e.g. compassionate friend) may enhance capacity to engage the soothing system, especially when confronting situations that form part of treatment (i.e. exercise) that have historically elicited threat.

Research also indicates that focusing on core schema’s is important in short-term therapy for depression (Barlow, 2014). In particular, early maladaptive schemas Mistrust / Abuse, Emotional Deprivation, Insufficient Self-Control, Failure, Abandonment/Instability and Enmeshment are linked with clinical depression (Renner, Lobbestael, Peeters, Arntz, & Huibers, 2012) and reduced quality of life in obese adults (Bidadian, Bahramizadeh, & Poursharifi, 2011). We therefore include components of compassion focused approaches and basic elements of Young’s Schema Therapy as outlined in (Young, Klosko, & Weishaar, 2003) as a way of understanding each individual’s core beliefs, increasing psychic continuity and to inform experiential opportunities for cognitive and behavioural change.
**Behavioural-techniques**

We include standard CBT techniques for increasing activity and socialisation, and schema techniques for challenging early maladaptive schema’s including pleasant and mastery activity scheduling, role-playing, self-monitoring, goal-setting and behavioural experiments. Similar to the implementation of cognitive techniques, behavioural strategies are applied in the context of a compassion-oriented frame. Regular exercise has also been conceptualised as a ‘behavioural cusp’ (Turner & Leech, 2012) that can provide exposure to novel environments and new opportunities for positive reinforcement. We therefore include exercise as an adjunct to the techniques described above.

**Exercise**

Exercise is an established treatment for mild to moderate depression (Cooney et al., 2013; Krogh, Nordentoft, Sterne, & Lawlor, 2011) and a frequent adjunct to standard CBT (Pilu, 2007). It may also play a role in reducing inflammation and adiposity (Lopresti et al., 2013; Vissers et al., 2013). Our research (Chapter 3) indicated that High Intensity Interval Exercise, Steady State Exercise and Personal Preference Exercise were effective at reducing depression over 18 supervised sessions. Qualitative analysis revealed that exercise intensity, ability to select exercises, variety (i.e. ability to utilise various forms of aerobic and resistance training) and rapport with the trainer were key to enhancing engagement and enjoyment. We therefore provide a template for training that can be modified by the participant, in collaboration with their personal trainer. The basic format of exercise is for three one-to-one supervised 45-minute exercise sessions per week. Aerobic, including high intensity interval training and resistance training techniques are taught and a program developed with the personal trainer to ensure moderate or greater average session intensity as measured by power output, RPE or % HR_{max}. Exercise progression, personal preference (i.e. of format, goals, exercises etc.) and variety are encouraged. Over the 16-week period, we expect participants
will have an opportunity to engage in 48 supervised exercise sessions.  

**Nutrition and overeating**

Our qualitative research highlighted a cohort of participants desired and believed they would benefit from support and direction in improving nutrition and eating habits. Given the subjective, physiological and clinical importance diet and eating behaviour we chose to include modules on nutrition and overeating in the current program. Given that systemic inflammation, oxidative stress, HPA-axis reactivity and low serotonin are important factors in the aetiology and maintenance of depression (Dowlati et al., 2010; Emery et al., 2007; Howren et al., 2009; Milaneschi et al., 2012; Miller & Cole, 2012; Newman, O'Connor, & Conner, 2007; Pasquali & Vicennati, 2000; Shelton & Miller, 2011). Research illustrates that Mediterranean based diets and certain food constituents including Omega-3 fatty acids and saffron can reduce depression, anxiety, systemic inflammation, oxidative stress and HPA-axis reactivity to clinically meaningful degrees (Feldeisen & Tucker, 2007; Lopresti & Drummond, 2014; Parletta et al., 2017; Su, Matsuoka, & Pae, 2015). Diets low in the amino acid Tryptophan, commonly found in nuts, are associated with low serotonin (Heninger, Delgado, Charney, Price, & Aghajanian, 1992).

Whilst the majority of obese adults do not meet clinical diagnosis for Binge Eating Disorder (BED) (American Psychiatric Association, 2013) overeating, emotional eating, BED and night eating syndrome are more common in OW/OB populations than normal weight controls (Faith, 2002; Faulconbridge & Bechtel, 2014; Fitzgibbon, Stolley, & Kirschenbaum, 1993). Approximately one third of the sample in our RCT met criteria for BED and many more described sub-clinical levels of over-eating and associated feelings of guilt. Research shows that components of mindfulness and intuitive eating reduce the likelihood of disordered eating (Bush, Rossy, Mintz, & Schopp, 2014; Goss, 2011). Compassion informed eating programs include mindfulness skills and focus on establishing
regular eating patterns, reducing ‘high-risk’ foods that are habitually over-eaten, balancing energy intake with physiological requirements, developing healthy nutritional balance, responding to hunger and satiety cues and learning to enjoy food and eating (Goss, 2011). These habits are accompanied by tasks that facilitate and reinforce behaviour change (e.g. use of food diary, meal planning, identifying triggers and self-soothing alternatives).

**Relationship with personal trainer**

We view rapport between the individual and personal trainer as important to improvement in depression. However, we do not intend to draw participant attention to this possibility directly during treatment. Rather, trainers are provided education and training from a Clinical Psychologist, informed by previous qualitative data about qualities of beneficial trainer relationships. The emphasis will be on working with these clients in compassion informed ways, i.e. in a non-judgemental, self-compassionate and empathic manner, as outlined previously. This has the advantage of providing an ecological valid platform for individuals to engage in a new relationship and partnership.

**5.3. Methods**

**5.3.1. Design**

The randomised controlled trial will compare the Schema and Compassion, Exercise and Nutrition Enhanced CBT (SCENE-CBT) intervention above to group-based CBT as treatment as usual (TAU) and Exercise Alone (EA). Group size will be restricted to 8 – 12 participants. Both group interventions will be focused on reducing symptoms of clinical depression in adults with co-morbid OW/OB. The trial will be conducted at Murdoch University, near Perth, Western Australia. Exercise sessions as applicable will take place in the University’s Exercise and Sports Science Laboratory which includes a gymnasium equipped with stretching stations and modern aerobic, circuit and free-weight equipment.
5.3.2. Aims and Hypotheses

The primary aim of the trial is to compare the efficacy of SCENE-CBT, EA and TAU in reducing symptoms of clinical depression in adults with OW/OB. The secondary aims are to compare the effect of these interventions on psychological factors and metabolic health. Psychological variables include symptoms of anxiety, disordered eating, self-criticism, shame, self-compassion and body-image/dissatisfaction disturbance. We aim to compare the effect of these interventions on metabolic health, as measured by body composition, aerobic capacity, total physical activity, blood pressure, systemic inflammation and 3-day diet records. A tertiary aim is to refine research understanding and clinical implementation of individualised and tailored interventions for depression in this population.

The primary study hypothesis is that individuals in the SCENE-CBT, EA and TAU conditions will demonstrate significant improvements in depression, however those in the SCENE-CBT condition will improve to a greater degree relative to the alternate conditions.

5.3.3. Inclusion and Exclusion Criteria

Participation will be open to men and women aged 18-45 years, who are experiencing an episode of depression according to Structured Clinical Interview. Participants must be willing to delay alternative therapy for the duration of participation\(^1\), have a BMI greater than 25 and understand written and spoken English. Anti-depressant use is permitted provided unchanged dose 3 weeks prior to participation and throughout the intervention.

Exclusion criteria include regular psychotherapy, previous cardiovascular incident or cardiovascular disease, intellectual impairment, serious or unstable medical conditions, substance dependence requiring rehabilitation, personality disorder, current or historical mania, hypomania or anorexia nervosa, current or recent bulimia nervosa, current suicidal ideation or self-harm of a

\(^1\)To ensure participants receive appropriate treatment, they will be informed that seeking alternative treatment, including starting or changing anti-depressant medication is important and permissible at any time. In such cases, the associated data will be excluded from analysis.
clinically significant nature or a suicide attempt in the prior 2 years. Women who are pregnant or attempting to become pregnant are also excluded from participation.

5.3.4. Recruitment

Individuals from the metropolitan community of Perth, Western Australia will be recruited via community notices posted at local shopping centre and town tall notice boards, cafés, Universities and third parties including General Practitioners and Psychologists. Planned recruitment methods include posters, flyers, a newspaper advertisement and social media advertisements.

5.3.5. Randomisation Procedure

Block randomisation as described by Altman and Bland (1999). A computerised random number generator (www.random.org) will be used to create the random number series. Random block sizes of 24 with an equal allocation to groups will be used. All assessors and clinicians will be blind to block size and condition allocation prior to treatment, with a group list provided to the treating psychologists immediately prior to commencement of each group. The randomisation schedule will be provided to participants in sealed and concealed sequentially numbered envelopes only after their pre-treatment assessment.

5.3.6. Planned Interventions

SCENE-CBT, outlined above, is a fully manualised treatment informed by Schema and Compassion Focused Therapies and the latest research on exercise and nutrition and clinical depression. Treatment as usual will follow the CBT for depression, group therapy guidelines as outlined in Bieling, McCabe, and Antony (2006). Both interventions are professionally led by Clinical Psychologists and co-facilitated by postgraduate students of Clinical Psychology who are under supervision. Groups of 8 to 12 participants engage in the program over 16-weeks. Between session tasks will be completed by both groups, however the nature of these tasks varies. Participants in the SCENE-CBT and EA condition receive up to 48 individually supervised exercise sessions (i.e. an average of 3 per week) of 45 minutes
duration. Exercise sessions are supervised by a 4th year Exercise Physiology student receiving supervision from an Accredited Exercise Physiologist. Participants in the EA condition receive no psychological intervention, however are offered participation in either the superior group treatment or 16 weeks of individual psychological therapy provided by Masters or Doctorate level post-graduate students at the Murdoch University Psychology Clinic following completion of all data collection.

5.3.7. Treatment Fidelity

Treatment fidelity is the ongoing assessment and monitoring of treatment implementation, which when done effectively can enhance reliability and internal validity of a study (Borrelli, 2011). Graduate students in Clinical Psychology students will be supervised by an endorsed Clinical Psychologist and trained in the intervention prior to commencing the intervention with participants. The psychological intervention will be video recorded to ensure treatment fidelity by a study investigator. Observation of trainer skills and role-play type practice for working with participants from a self-compassion frame-work will occur for exercise trainers prior to assignment of participants. Exercise session fidelity will be ensured via the individual trainer assigned to each participant.

5.3.8. Assessments and Outcome Measures

**Initial Screening and Semi-structured Clinical Interview**

Initial Screening and Semi-Structured Clinical Interview will take place as described previously, in Chapter 3. Individuals ineligible to take part will be debriefed appropriately and provided with information regarding community resources for psychological or weight-loss support. Demographic data will be collected during the initial screening phase.

**Primary Outcomes**

Primary outcomes will be measured pre, mid and post assessment and subsequently at 6-month follow-up.
Depression. Severity of depression was measured via the Beck Depression Inventory (BDI-II; Beck, Steer, and Brown (1996), see Appendix F). The BDI-II is a 21-item self-report questionnaire with excellent validity (Wang & Gorenstein, 2013) and reliability (e.g. Cronbach’s $\alpha = .93$; Beck et al., 1996). Scores range from zero to 63, with scores below 13 indicating lower than mild depression, above 13 suggesting mild depression, with moderate (20-28) and severe (29 and above) depression represented by higher scores. BDI-II scores correlate strongly to SCID-I endorsement of items corresponding to Major Depressive Episode with scores above 16 having high sensitivity (84%) to clinical depression (Sprinkle, Sprinkle, Lurie, Insko, & Atkinson, 2002).

Depression, anxiety and stress. The short form Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a 21 item self-report questionnaire measuring depression, anxiety and stress symptoms over the previous week. Reliability of the DASS-21 is high in clinical and community samples (Cronbach’s $\alpha = 0.87 - 0.91$) with adequate subscale convergent and discriminant validity to validated measures of depression and anxiety and an excellent three factor structure (Antony, Bieling, Cox, Enns, & Swinson, 1998). Scores are multiplied by two to allow comparison to normative data for the DASS-42, producing a score up to 42 per subscale. Symptom severity is illustrated along with the DASS-21 in Appendix G.

Secondary Outcomes

Secondary psychological outcomes will be assessed pre and post intervention, then again at 6-month follow-up. We chose to administer secondary outcome measures thrice only to reduce the quantity of items and tasks participants would be subject to. Physiological measures will be taken pre and post intervention with the exception of the aerobic capacity, which will occur pre, mid and post intervention.

Disordered eating. Eating attitudes and behaviour will be assessed using the Eating Disorders Examination-Questionnaire (EDE-Q, Appendix K; Fairburn & Beglin, 2008), a 28 item self-report questionnaire comprising of four subscales. These subscales measure Dietary
Restraint, Shape Concerns, Weight Concerns and Eating Concerns. The EDE-Q has high reliability (Cronbach’s α 0.95) for global eating disorder symptomatology. Binge eating severity will be assessed with the Binge Eating Scale (BES, Appendix L; Gormally, Black, Daston, & Rardin, 1982). The BES is a 16 item self-report questionnaire with sound reliability (Cronbach’s α .0.84). Scores range from 0 to 46. Scores above 26 indicate severe binge eating.

*Self-criticism and shame.* Body related guilt and shame will be measured with the Weight and Body Related Shame and Guilt Scale (WEB-SG, Appendix M; Conradt et al., 2007). This 12-item, self-report questionnaire has excellent internal consistency (0.87 – 0.92) and adequate test-retest reliability (r = 0.72 – 0.79).

We will employ the Self-Critical Rumination Scale – (SCRS, Appendix N; Smart, Peters, & Baer, 2016) to measure self-critical rumination. The 10 item self-report questionnaire has excellent reliability (Cronbach’s α = 0.92), excellent test-retest reliability (r = 0.82) and maps to a single factor structure. The SCRS has a moderate positive correlation to DASS-21 total scores.

The Self-Judgement subscale of the Self-Compassion Scale (SCS, Appendix O; Neff, 2003) will be used to assess self-judgemental attitudes toward the self. Self-judgement is defined as being judgemental or disapproving of one’s inadequacies or failures. The SCS is described below.

*Self-compassion.* Self-compassion will be measured with the Self-Compassion Scale (Neff, 2003). This scale measures three components of self-compassion over six subscales; self-kindness vs. self-judgement, common humanity vs. isolation and mindfulness vs over-identified. Overall, the SCS has excellent test-retest reliability (r = 0.93). Internal consistency is adequate for each of the subscales, ranging from 0.75 to 0.81.

*Body-image and dissatisfaction.* The Physical Self-Description Questionnaire-Short Version (PSDQ-S, Appendix P; Marsh, Martin, & Jackson, 2010) is a 40 item questionnaire
used to assess physical self-concept. The full questionnaire includes 11 subscales that have reliability of at least 0.80 and adequate test-retest reliability of 0.77. We intend to use three sub-scales related to body image and body dissatisfaction as follows; the Appearance Subscale (3 items, e.g. “I am good looking”), Global Physical Self-Concept Subscale (5 items, such as “physically, I feel good about myself”) and the Self-esteem Subscale (5 items, for example “overall, I have a lot to be proud of”). Scales are rated on a 6-point Likert scale ranging from (1) – ‘false’ to (6) – ‘true’.

**Aerobic capacity.** To accurately tailor exercise intensity and assess changes in aerobic capacity, the maximum rate (per minute) of oxygen consumption ($\text{VO}_{2\text{peak}}$) will be assessed using a metabolic cart (Parvo Medics; True One) during an incremental exercise test on the Velotron Pro Cycle Ergometer (See Appendix H for protocol). Participants experience incrementally increased workload every 2 minutes until they can no longer maintain a cadence of 60 revolutions per minute or elect to discontinue the assessment due to fatigue or discomfort. The $\text{VO}_{2\text{peak}}$ assessments will occur pre, mid and post intervention.

**Anthropometric measures and blood pressure.** Body composition including visceral fat mass will be measured via whole body Dual-energy X-Ray Absorptiometry (DXA) scan (Hologic Discovery Series W, Model: 010-1549). Height will be measured using a wall mounted stadiometer. We will measure weight using a digital industrial platform scale (accuracy to 0.005 kg). Body composition, height and weight are measured with participants barefoot and dressed in light sports attire. Blood pressure will be measured using an automated BP monitor (Ormon) by a researcher blinded to treatment condition. Measurements will be taken with participants in the seated position following 5-minutes rest.

**Inflammation.** Following an overnight (>8 h) fast, a venous blood sample (5 ml) will be collected by a trained phlebotomist into serum-separating tubes (SST; Becton Dickinson, NJ, USA) via venepuncture of the antecubital vein. The sample will be allowed to clot for at least 30 min at room temperature, before centrifugation at 1,300g for 15-min. The supernatant will then immediately
be aliquoted into Eppendorf containers and stored at -80°C. Samples will then be batch analysed for a broad-range of cytokines (Bio-Plex Pro Human TH17 Assay, CA, USA; Inter-assay coefficient of variation: 5.9%; Limit of detection: 16.9pg/ml) using the Bio-plex MAGPIX multiplex reader (Bio-Rad, CA, USA) and for C-reactive protein (CRP) using the COBAS INTEGRA system.

**Total physical activity & 24 hr diet recall.** Prior to commencing the program, participants will engage in a one week control period at which time they will be instructed to maintain normal activities of daily living and dietary habits. During this period, physical activity will be monitored with the use of an Accelerometer (Actigraph® GT3X Activity Monitor, Pensacola, FL) worn around the hip. Estimates of food intake will be collected by random 24-hour recall (via telephone) two times per week using the USDA 5-step multiple-pass method (Conway, Ingwersen, Vinyard, & Moshfegh, 2003). The same researcher will conduct all diet-recall assessments and will be blind to treatment condition. Mean total daily energy intake, together with the quantity of carbohydrate, fat, and protein consumed will be determined from the combined 24 h food recall diaries using a commercially available software program (Foodworks; Xyris Software, Queensland, Australia).

5.3.9. Monitoring Additional Treatments

Participants will be asked during screening to if they are currently engaged in work with a psychologist and what medication they currently use. We will request participants voluntarily postpone any changes to their treatment regimens until completion of the study and follow-up period. Only participants not currently engaged in psychotherapy will be enrolled in the program. Those who seek psychotherapy or who have a change in psychopharmacology or blood pressure medication (dose, type) once enrolled will have subsequent data excluded from the study.

5.4. Statistical Considerations and Data Analysis

**Sample size estimation**

The present study intends to recruit a total sample of $n = 189$ participants. We based this calculation on pilot data and clinical trials of similar interventions compared to treatment
as usual. We assumed a small effect size of $d = .15$, an alpha level of .05 and a 90% probability of detecting an effect assuming an intraclass correlation coefficient of 0.39 estimated from pilot data and effect size from meta-analytic data of psychological interventions compared to TAU cited in Chapter 2. Sample size calculation includes provision for a 30% drop-out rate.

**Statistical analysis plan**

Data will be analysed using the latest version of SPSS Software (IBM Analytics). Primary outcomes will be analysed using Generalised Linear Mixed Model (GLMM). This will permit exploration of standard mean difference and effect sizes which can be compared to existing trials. Employment of GLMM will make use of all observations and help protect against missing data. Secondary analysis will be analysed using 3 (condition) by 2 (time) ANOVA. Type I error will be maintained at 0.05 (two-tailed). To confirm between condition homogeneity, demographic data will be examined with a series of One-way ANOVAs ($\alpha = 0.05$, two-tailed).

**5.5. Ethics**

Prior to recruitment, the study protocol will be approved by the Human Research Ethics Committee at Murdoch University, Australia. The trial will be run according to CONSORT guidelines and maintain registration with the Australian and New Zealand Clinical Trials Registry. Participants will not be paid for taking part in the research however all interventions are provided at no-cost excluding incidental costs such as transportation to and from and parking at Murdoch University and purchase of clothing or footwear suitable for exercising. The purpose of the research will be concealed from participants, who will be given a brief over-view indicating the investigation is examining treatments for clinical depression. Following completion of the research, findings will be made available to participants at request. Participants will be assigned a unique identification code upon entry to the study which will be paired with their results. All data, including the participant identification key
will be held in password protected computer files or secure filing cabinets. Should an applicant’s condition require alternative care or a participant’s clinical condition deteriorate appropriately debrief and removed from the study. For participants who remain clinically depressed following completion of the program, resources will be provided for community mental health engagement, including encouragement to discuss with their General Practitioner.

5.6. Discussion

Clinical depression is common, especially amongst adults with OW/OB. Treatment options typically combine standard interventions for depression and weight loss concurrently. This paper describes the protocol for an RCT for an evidence-based group treatment of depression in adults with co-morbid OW/OB. In this experimental design, this novel intervention will be compared to standard group-CBT or regular evidence based individually supervised exercise for depression. The evidence-based treatment combines individually supervised exercise, thorough psychoeducation regarding aetiology and development of depression in overweight adults (and vice-versa), perpetuating factors including physiological, intrapsychic and behavioural, and psychotherapy based on self-compassion, mindfulness and schema therapy for depression. It also includes modules on healthy nutrition and overeating, mindfulness, shame and self-criticism. Exercise for depression is a common existing treatment modality. We employ a basic framework for exercise as an intervention based on research evidence, including our prior findings. These attributes lead to an exercise program with suggested formats, types, volumes and intensities which participants are able to modify based on personal preference. Preliminary evidence suggests these modules and individually supervised evidence-based exercise should enhance CBT for depression when utilised for this population. In addition to measuring changes in depression, we will examine treatment effects on anxiety, stress, eating behaviour, shame, self-criticism, self-compassion, and body image. We will also investigate the effect on physiological variables including
aerobic fitness, blood pressure, body composition, visceral fat mass and inflammation. If SCENE-CBT enhances outcomes for depression beyond traditional approaches, it may have important implications for the prevention and treatment of depression in this population and could conceivably inform the treatment of other emotional disorders in overweight adults.
References


Chapter 6 – General Discussion and Conclusions
General Discussion and Conclusions

6.1. Introduction

As outlined in previous chapters, clinical depression is a major social and public health concern in modern society (Bromet et al., 2011; Ferrari et al., 2013; Spijker et al., 2004). Similarly, OW/OB is a significant issue in the western world (Aballay, Eynard, Diaz Mdel, Navarro, & Munoz, 2013; Cameron, Shaw, & Zimmet, 2004; Kahn, Hull, & Utzschneider, 2006; Ruhm, 2012). An important bi-directional relationship seems to exist between clinical depression and OW/OB such that either condition significantly increases risk for developing the other and makes treatment of the underlying issues more complex (de Wit et al., 2010; Faith et al., 2011; Luppino et al., 2010; Stunkard, Faith, & Allison, 2003). Indeed, it is likely a unique set of psychosocial and physiological risk factors exist in the OW/OB and depressed individual. To date however, treatment options have been limited to standard treatments for OW/OB and depression run in parallel or in sequence (e.g. Faulconbridge, Wadden, Berkowitz, Pulcini, & Treadwell, 2011; Pagoto et al., 2013). Despite some promising results, intervention options for co-morbid clinical depression and OW/OB as discrete concerns are not optimal. Furthermore, research investigating such interventions are scarce. A custom designed intervention for depression in OW/OB persons is likely to enhance treatment outcomes in this population. The overarching aim of the present research was to develop an evidence-based intervention for clinical depression in individuals with co-morbid OW/OB. Subsequently, there were four primary investigations in the current research project.

6.2. Summary of Main Findings and Conclusions

As prior chapters have compared the current research to existing literature, in this section, we provide a summary of our main findings and conclusions only. Study one (Chapter 2) sought to systematically understand existing interventions that are effective at
reducing symptoms of depression in adults with OW/OB, compared to existing treatments or waitlist controls.

We found that existing treatments for depression, including behavioural activation, cognitive behaviour therapy, pharmacotherapy, lifestyle and behavioural weight loss interventions, and exercise are commendable to clinicians seeking to treat depression in an OW/OB population. Compared to inactive control or placebo, pharmacotherapy or evidence-based psychotherapy were effective at reducing symptoms of depression. In contrast, no class of modified intervention was superior to active treatment-as-usual, primarily due to modified and active TAU being effective for reducing symptoms of depression. Dietary and exercise interventions for clinical depression in adults with OW/OB remain under-researched. Despite exercise and physical activity being included in several treatment arms, exercise alone appeared in only two investigations and in both cases, control groups were engaged in active interventions. Whilst results were positive, further research investigating the use of exercise interventions for treatment of clinical depression in adults with OW/OB is needed - especially given that exercise is recommended as a treatment for mild to moderate depression in the general population (NICE, 2004) and has well established benefits for OW/OB (Ekelund et al., 2015; Irving et al., 2008; Myers et al., 2015; Swift, Johannsen, Lavie, Earnest, & Church, 2014). Dietary interventions may be useful, however the studies included in our review differed in methodological approach so significantly as to preclude generalisations. Very few studies were conducted on clinically depressed adult with co-morbid OW/OB which clearly highlights the need for further research in the field. Overall, our meta-analytic and systematic review suggests that psychotherapy (CBT, BA, and possibly mindfulness-based therapy), pharmacotherapy (e.g. fluoxetine, duloxetine), exercise (aerobic or resistance) and lifestyle interventions could be useful in populations with co-morbid clinical depression and OW/OB.

Study two (Chapter 3) - a randomised controlled clinical trial - examined the feasibility and effectiveness of three exercise interventions for clinical depression in adults
with OW/OB. We found that all interventions were similarly effective for reducing elevated depression symptomatology and at reducing mild to moderate levels of anxiety and stress. Our findings suggest that format, type and intensity may be of secondary importance to dose, engagement and adherence. To our knowledge, this was the first study to show HIIE and moderate intensity, personally selected interventions are well tolerated and effective at reducing depressive symptoms in clinically depressed adults with co-morbid OW/OB.

Study three (Chapter 4) sought to expand on previous research and more holistically understand important factors associated with participant engagement and experience of exercise as treatment for clinical depression. It was also designed to inform the subsequent protocol paper via a mixed methods approach. We found that participant motivation, enjoyment and positive anticipation for sessions improved significantly over time. By mid-intervention, subjective motivation was similar across conditions. This is an important finding as prior commentary has discounted the utility of HIIE for regular use by the general public, due to a perception of it being psychologically aversive (Biddle & Batterham, 2015). Indeed, our qualitative findings suggested that repeated bouts, the challenging nature of sessions and onboard feedback of physiological recovery were engaging and rewarding aspects of HIIE. There were no substantive changes in exercise self-efficacy across conditions, nor any between condition differences. Whilst exercise self-efficacy often increases for the general population following an exercise program, individuals with depression and co-morbid OW/OB may require targeted cognitive interventions on a regular basis to improve exercise self-efficacy. Strategies including expanding markers of success, goal-setting, scheduling, accountability to a friend or trainer and collaboration and support from a personal trainer may also be of use to clinicians seeking to help clients increase exercise self-efficacy in this population.

Six categories and 16 sub-themes emerged from qualitative interviews. We discovered that participants experienced a heightened awareness of self in relation to exercise
and other exercisers, including frequent self-criticism and fear of negative social evaluation, questioning their ability to complete the program, and feeling like an outsider. Change was described as slow and at times frustrating. Participants who looked for a variety of markers for success seemed to experience greater satisfaction from their participation in the program that those more typically focused on weight-loss. The relationship between participant and exercise trainer emerged as a key contributor to engagement. Important aspects of this relationship were explored. Key to these were a sense of safety and trust; the trainer’s knowledge and expertise; and accountability to the trainer. From a compassion oriented model, these are conceptualised to have activated the soothing system and helped reduce the effects of the treat system (Gilbert, 2009). In the minds of participants, these factors appeared to contribute to greater engagement, enjoyment and benefit from the program. In turn, these led to increased motivation and commitment to exercise sessions. These factors also seemed to foster intrapsychic and behavioural change, possibly by way of internalisation of an encouraging, problem solving approach and modelling of trainer behaviour. Other facilitators included scheduling, flexibility in making up for missed sessions and noticing progress. Typical challenges included difficulties with time management, competing demands, low moods states, anxiety, fatigue, and low motivation. These challenges are potential targets for intervention.

Various aspects of more desirable programs were discussed. Suggestions included including evidence-based psychotherapy, psychoeducation regarding depression, exercise and mechanisms of benefit related to exercise, and nutritional or dietary recommendations. Regarding exercise, variety and choice were favourably mentioned by participants. We briefly discussed potential candidates for evidence-based psychotherapy in this population, particularly those targeting shame and self-critical schemas and cognitions. We suggest fostering self-compassionate and self-motivating attitudes and beliefs, via a compassion and schema informed approach to CBT may be useful. Indeed, research indicates these therapy
approaches may be especially useful for individuals with depression and who have difficulties with weight or over eating (Barlow, 2014; Gilbert, Baldwin, Irons, Baccus, & Palmer, 2006; Gilbert & Procter, 2006; Goss & Allan, 2014).

Finally, the closing paper (Study four, Chapter 5) discussed the design of a novel, evidence-based approach to treating depression in adults with OW/OB and proposes a viable investigation comparing this novel treatment to existing treatments (exercise alone or CBT) for clinical depression in adults with OW/OB. The 16-week intervention draws on elements of schema therapy, compassion focused therapy and cognitive behaviour therapy. It also incorporates modules on nutrition and eating behaviours and a regular exercise program with a personal trainer. The exercise program is founded on moderate to high intensity exercise of the individuals choice and selected in collaboration with the trainer. We believe this intervention is one of the first to propose a specific program for depression in adults with co-morbid OW/OB.

6.3. Overall Project Strengths

The current research has several strengths. Unlike past research, which has sought to treat depression in adults with OW/OB by applying existing treatments without modification, we sought to design an intervention “from the ground up”. We started with a meta-analytic review and followed this with a randomised control clinical trial, mixed methods research and finally a proposed intervention. We believe the meta-analysis, randomised controlled clinical trial, qualitative interviews and the protocol paper represent the first explicit series of investigations of clinical depression in adults with OW/OB in their respective field.

In respect to strengths of the meta-analytic review, we investigated changes to symptoms of depression in adults with OW/OB from any treatment. Furthermore, there was no date cut-off. We discussed several papers that did not quite meet inclusion criteria but were otherwise highly applicable to our research questions. These factors help develop our understanding within a very limited field of research on clinically depressed individuals with
co-morbid OW/OB by including a wide pool of studies. The methodological approaches in subsequent studies included a randomised control clinical trial and mixed methods approach to developing a proposed intervention. By doing so, we believe we have struck a sound and holistic balance between quantitative analysis and qualitative exploration of potential treatment efficacy and important clinical issues - especially in how these findings, stemming from knowledge and research can be translated into clinical practice. Inclusion of mixed methods in particular allows for an investigation into a more complete and broad range for research questions (Johnson & Onwuegbuzie, 2004). As revealed by our systematic review, registered clinical trials are rare in this field of research. The importance of trial registration should not be overlooked however, especially as it affects transparency, reducing publication bias and selective reporting (Aslam, Imanullah, Asim, & El-Menyar, 2013). We encourage it in future research.

Unlike prior research, which often screens out individuals with more severe depression (e.g. Andersen et al., 1999; Annesi & Unruh, 2008; Rubin et al., 2005) or measured changes in depressive symptoms in relatively euthymic individuals (e.g. Arnold et al., 2002; Bacon et al., 2002; Esmaily et al., 2015; Ghroubi et al., 2016; Ruusunen et al., 2012), our randomised control clinical trial and subsequent studies included individuals only with clinical depression regardless of severity (unless actively suicidal) and permitted inclusion of individuals with binge-eating or various anxiety disorders, further enhancing applicability and ecological validity. Measurement of a variety of other quantitative variables including anxiety, stress, exercise self-efficacy, engagement, enjoyment, positive anticipation, body composition, aerobic capacity allowed us to examine the impact of the intervention from a broad standpoint. The use of individually supervised exercise as opposed to unsupervised sessions inherently ensured treatment fidelity.

6.4. Overall Project Limitations and Areas for Future Research
Despite the promising findings in the current research, it is important to consider the limitations of the research project as a whole. We have discussed in prior chapters specific limitations of each study and so in this section, we highlight what we consider to be the primary limitations of the research overall.

Participation in Study Two and Study Three were voluntary. Volunteering in itself has been shown to improve depression, especially when there is an inferred benefit for others (Yeung, Zhang, & Kim, 2018). Participants may have been more likely to have sufficient capacity to engage in the program as advertised and may not have been representative of more severely depressed individuals, particularly those with greater motivational or hedonic deficits. Nevertheless, research has indicated that symptomatic volunteers have very similar demographic backgrounds, compliance rates and treatment outcomes compared to clinically referred samples (Thase, Last, Hersen, Bellack, & Himmelhoch, 1984). We also cannot rule out spontaneous recovery i.e. that participants were on a natural trajectory toward recovery when they enrolled. Whilst we tried to minimise the impact of this issue by conducting structured clinical interviews, future research could use a wait-list control comparison.

Our overall research was constrained by lack of follow-up. Whilst short-term treatment effects of exercise for depression are well established, less is known about subsequent exercise continuation and continued remission. Regarding exercise as a stand-alone intervention, meta-analytic reviews indicate that mood enhancing effects persist only for as long as an individual regularly engages in adequate volumes of exercise (Krogh, Nordentoft, Sterne, & Lawlor, 2011). When considering combined interventions (i.e. those that include evidence-based psychotherapy) follow-up remains important and we encourage more investigations use reasonable long-term (e.g. 12-months) follow-up when possible. Assisting participants with strategies to continue exercise long after clinical intervention has ceased appears to be an important aspect of effective treatment.
The final paper proposed a tailored intervention for clinical depression in adults with OW/OB. It remains unknown whether such interventions actually confer benefit over and above existing treatments for depression. This is especially applicable considering that exercise alone is inexpensive and relatively simpler to engage in compared to comprehensive group therapy and exercise or lifestyle programs that must employ a team of professionals.

6.5. Final Conclusions

Our research revealed that certain pharmacotherapy, evidence-based psychotherapy, lifestyle, diet and exercise interventions may benefit people with symptoms of depression and co-morbid OW/OB compared to no treatment. Some commonalities of effective psychotherapy included behavioural activation, cognitive therapy, problem solving skills and social support.

We found that moderate intensity steady state, moderate intensity personal preference and high intensity intermittent exercise were comparably effective at reducing symptoms of depression in clinically depressed adults with OW/OB. These interventions also had positive effects on anxiety and stress. We showed that high intensity exercise is suitable and well tolerated in this population.

Qualitative analysis illuminated the importance of the relationship between participant and personal trainer, some common intrapsychic dynamics including concerns about failure, shame, self-criticism, feeling like an outsider and expectations of negative social evaluation. An important implication of our findings is for clinicians to keep these dynamics in mind when treating depression in adults with OW/OB and for exercise trainers to be educated in more compassionate approaches to engaging clients who may struggle with such concerns. Barriers and facilitators were examined in detail and were, in the main, similar to prior research regarding exercise and adults with OW/OB. Key parameters for a more ideal evidence-based program utilising exercise were discussed and included evidence-based psychotherapy, psychoeducation, modules on nutrition and over-eating, problem-solving
supports, variety of type, format and intensity within exercise sessions and scope for personal preference. We also put forward compassion-focused and schema-based therapies as potential candidates to be incorporated into an evidenced based cognitive behaviour program for depression. These findings should be useful in developing future interventions for depression in this population.

We then discussed a protocol paper outlining a 16-week, tailored group-based psychotherapy and individual exercise program and an experimental design comparing this to exercise alone or standard CBT for clinical depression. The results of this proposed investigation should provide a useful first iteration of a new generation of programs designed specifically for depression in individuals with co-morbid OW/OB.

The findings of the current research project will spur further investigations into treatments for clinical depression in adults with OW/OB and allow clinicians to take a more informed approach to delivering treatment programs for this population.
References


Appendix A

Combinations of keywords used in meta-analytic and systematic review:

1. \textit{Depress}^* \text{OR} \textit{Dysth}^*

2. \textit{Obes}^* \text{OR} \textit{Overweight} \text{OR} \textit{Adipos}^* \text{OR} \textit{Weight Loss} \text{OR} \textit{Body Fat}

3. \textit{Adult}

4. \textit{RCT} \text{OR "randomized controlled trial" OR "clinical trial"}
Appendix B

Above: Funnel Plot of all studies included in meta-analysis

Above: Funnel plot of all studies with inactive control conditions included in meta-analysis

Above: Funnel plot of all studies with active (TAU) control conditions included in meta-analysis
Appendix C

Information Letter, Consent Form and Ethics Approval Letter

We invite you to participate in a research study looking at exercise preferences in adults. This study is part of Nick Buckley's PhD Degree in Psychology and Claire Nicholls Master of Applied Clinical Psychology, supervised by Dr Helen Correia and Dr Timothy Fairchild at Murdoch University.

Nature and Purpose of the Study
It is common practice that exercise is prescribed to individuals experiencing symptoms of depression during the course of therapy. However, many researchers have questioned whether there is a particular format of exercise that individuals may find more enjoyable or be more motivated to continue with over the longer term which is likely to lead to better outcomes for clients undergoing therapy.

Therefore the aim of this study is to investigate how individuals experience different formats of exercise to find out whether there is a particularly more enjoyable or more motivating format which may be more effective and useful during therapy. If you consent to take part in this research study, it is important that you understand the purpose of the study and the tasks you will be asked to complete. Please make sure that you ask any questions you may have, and that all your questions have been answered to your satisfaction before you agree to participate.

What the Study will Involve:
The study involves the following inclusion criteria:

- Diagnosis of depression
- BMI > 25
- Willing and able to participate in exercise intervention
- Older than 18 years of age, younger than 45 years of age
- If using antidepressants, be at least 3 weeks on regular dose
- No current engagement in therapy and willingness to postpone new therapy for the duration of participation
- Understand written and spoken English

The following exclusion criteria apply:

- If female, must not be pregnant or attempting to become pregnant.
- Specific Diagnosed Mental disorders (Psychosis, Personality Disorder or other Mood Disorders)
- Previous cardiovascular incident (e.g. heart attack, stroke)
- Current cardiovascular disease (i.e. CHD)
- Intellectual impairment
- Serious or unstable medical conditions
- Substance dependence requiring rehabilitation/detoxification
- Current suicidal ideation or recent attempt (previous 24 months).

If you decide to participate in this study, you will be asked to complete the following tasks:

- Attend a structured interview
- Have your weight, height and body fat measured (body fat via DEXA) on two (2) occasions.
- Attend a supervised, individual exercise session at Murdoch University three (3) times per week for six (6) weeks
- Fill out brief questionnaires regarding your mood, sleep quality, energy levels and experience of exercise every 2 to 6 weeks

CIRCOSE Provider Code: 081253
ABN 61 016 369 313
- Refrain from commencing psychological therapy (therapy or psychotropic medication) or additional exercise (e.g. gym classes, yoga etc.) for the duration from the study.
- Have a brief follow-up interview one month after finishing exercise via phone or in person.

It is estimated that the structured interview will take approximately 60 minutes. Exercise sessions should take around 30 minutes. Questionnaires will take less than few minutes to complete. Weight, height and body fat measurements should take less than 30 minutes.

It is possible that you may experience some level of anxiety or stress during the session as a result of some of the tasks. You will be monitored closely during the study and you are free to withdraw at anytime during the session. If these feelings persist after the completion of the session, arrangements will be made for you to access support from your GP, Lifeline or a similar service.

**Voluntary Participation and Withdrawal from the Study**
Your participation in this study is entirely voluntary. You may withdraw at any time without discrimination or prejudice. All information is treated as confidential and no names or other details that might identify you will be used in any publication arising from the research. If you withdraw, all information you have provided will be destroyed.

**Privacy**
Your privacy is very important. All information will be de-identified upon collection and stored in a secure location on campus. All electronic information will be de-identified and password protected. It will thus not be possible to identify you; neither will you be identified in any publication arising out of this study.

For Murdoch University Students: Because some of the research team are staff members associated with Murdoch University, whether you elect to participate or not will be kept entirely confidential. Any members of the research team who are associated with you in other roles (e.g. coordination or teaching of a unit you undertake at Murdoch, if you are a student) will not know whether you have elected to participate and will view anonymous data only.

**Benefits of the Study**
It is possible that there may be no direct benefit to you from participation in this study. You may experience positive changes in mood, energy level and reduced fatigue after several weeks. You may feel better able to maintain an exercise program. You may find the exercise enjoyable.

While there is no guarantee that you will personally benefit, the knowledge gained from your participation may help others in the future. This information gained will also inform a future research study which will compare the most suitable exercise format across a variety of conditions, including combined with psychotherapy and on it’s own.

**Possible Risks**
There are a few potential risks anticipated with participation in this study. You may find exercise unpleasant or find it difficult. In some people, this could lead to anxiety or a sense of embarrassment. As with all physical activity, you may acquire a physical injury (e.g. mild sprain, torn muscle). Although very unlikely as with all exercise there is a very small risk of death (e.g. fatal heart attack). All exercise will be supervised by trained students undergoing their clinical placements with relevant first aid qualifications. Furthermore, all formats of exercise have been shown to be safe in adults, even with at risk populations (e.g. Individuals with heart failure). However, if you find that you are becoming distressed or experience concerning pain your exercise session will be terminated and you will be advised to receive support from your GP. If you take part in this study, you will be asked to undergo 2 DEXA scans (Dual-energy X-ray absorptiometry) to measure body composition.
This will expose you to a very small dose of radiation (equivalent to 10% of the dose from a chest x-ray or 2.5 hours of additional natural daily background radiation.

If you have any questions about this project please feel free to contact either myself, Nick Buckley or Yara Neto at murdoch.exercise.study@gmail.com or mobile: 0478037475 or my supervisor, Dr Timothy Fairchild, on ph. 9360-2959. We are happy to discuss with you any concerns you may have about this study or your participation. Once we have analysed the information from this study we will publish a summary of findings the on our web site. You can expect to receive this feedback within 24 months from the completion of the study.

If you are willing to consent to participation in this study, please complete the Consent Form.

Thank you for your assistance with this research project.

Sincerely

Nick Buckley & Claire Nicholls.

This study has been approved by the Murdoch University Human Research Ethics Committee (Approval 2013/204) and is registered with the Australian and New Zealand Clinical Trials Registry, ACTRN: 12614000097640. If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University’s Research Ethics Office (Tel. 08 9360 6677 or e-mail ethics@murdoch.edu.au). Any issues you raise will be treated in confidence and investigated...
Consent Form

Exercise Preference in Adults

1. I agree voluntarily to take part in this study.

2. I have read the Information Sheet provided and been given a full explanation of the purpose of this study, the procedures involved and of what is expected of me. I understand that if I do not meet eligibility criteria at any time I will not be able to participate further in the study but will be provided with information regarding appropriate services.

3. I understand that I will be asked to:
   - Attend a structured interview prior to enrolling in an exercise intervention
   - Have my weight, height and body fat measured (body fat via DEXA) on two (2) occasions.
   - Attend a 30-40 minute exercise session at Murdoch University three (3) times per week for six (6) weeks
   - Fill out brief questionnaires regarding my mood, energy levels, sleep quality, appetite and experience of exercise every 2 to 6 weeks
   - Refrain from commencing psychological therapy (therapy or psychotropic medication) or additional exercise (e.g. gym classes, yoga etc.) for the duration of the study.
   - Have a brief follow-up interview approximately 1 month after the exercise sessions are completed.

4. A researcher has answered all my questions and has explained possible problems that may arise as a result of my participation in this study.

5. I understand I am free to withdraw from the study at any time without needing to give any reason.

6. I understand I will not be identified in any publication arising out of this study.

7. I understand that my name and identity will be stored separately from the data, and these are accessible only to the investigators. All data provided by me will be analysed anonymously using code numbers and may be retained for future research.

8. I understand that all information provided by me is treated as confidential and will not be released by the researcher to a third party unless required to do so by law. I consent to the de-identified data being used in future research studies.

Name of participant: ____________________________

Signature of Participant: ____________________________ Date: ______/_____/_____

I confirm that I have provided the Information Letter concerning this study to the above participant; I have explained the study and have answered all questions asked of me.

Signature of researcher: ____________________________ Date: ______/_____/_____

(C) Murdoch University 2005)
Tuesday, 4 February 2014

Dr Helen Correia
School of Health Professionals
Murdoch University

Dear Helen,

Project No. 2013/204
Project Title Exercise Preference in Clinically Depressed and Overweight or Obese Adults: Pilot Study

Thank you for addressing the conditions placed on the above application to the Murdoch University Human Research Ethics Committee. On behalf of the Committee, I am pleased to advise the application now has:

OUTRIGHT APPROVAL

Approval is granted on the understanding that research will be conducted according the standards of the National Statement on Ethical Conduct in Human Research (2007), the Australian Code for the Responsible Conduct of Research (2007) and Murdoch University policies at all times. You must also abide by the Human Research Ethics Committee’s standard conditions of approval (see attached). All reporting forms are available on the Research Ethics web-site.

I wish you every success for your research.

Please quote your ethics project number in all correspondence.

Kind Regards,

Dr. Erich von Dietze
Manager of Research Ethics

cc: Dr Timothy Fairchild and Nick Buckley
Appendix D

Exercise and Sports Science Australia Pre-Exercise Screening Tool

ADULT PRE-EXERCISE SCREENING TOOL

This screening tool does not provide advice on a particular matter, nor does it substitute for advice from an appropriately qualified medical professional. No warranty of safety should result from its use. The screening system in no way guarantees against injury or death. No responsibility or liability whatsoever can be accepted by Exercise and Sports Science Australia, Fitness Australia or Sports Medicine Australia for any loss, damage or injury that may arise from any person acting on any statement or information contained in this tool.

Name:
Date of Birth: ___/___/____  Male  Female  Date:

STAGE 1 (COMPULSORY)

AIM: to identify those individuals with a known disease, or signs or symptoms of disease, who may be at a higher risk of an adverse event during physical activity/exercise. This stage is self administered and self evaluated.

Please circle response

1. Has your doctor ever told you that you have a heart condition or have you ever suffered a stroke?  Yes  No

2. Do you ever experience unexplained pains in your chest at rest or during physical activity/exercise?  Yes  No

3. Do you ever feel faint or have spells of dizziness during physical activity/exercise that causes you to lose balance?  Yes  No

4. Have you had an asthma attack requiring immediate medical attention at any time over the last 12 months?  Yes  No

5. If you have diabetes (type I or type II) have you had trouble controlling your blood glucose in the last 3 months?  Yes  No

6. Do you have any diagnosed muscle, bone or joint problems that you have been told could be made worse by participating in physical activity/exercise?  Yes  No

7. Do you have any other medical condition(s) that may make it dangerous for you to participate in physical activity/exercise?  Yes  No

IF YOU ANSWERED 'YES' to any of the 7 questions, please seek guidance from your GP or appropriate allied health professional prior to undertaking physical activity/exercise.

IF YOU ANSWERED 'NO' to all of the 7 questions, and you have no other concerns about your health, you may proceed to undertake light-moderate intensity physical activity/exercise.

I believe that to the best of my knowledge, all of the information I have supplied within this tool is correct.

Signature __________________________ Date __________________________

V1 (2011)
Appendix E
Demographics Questionnaire

Demographics

1. What is your age? ________________ years
2. Your sex □ Male □ Female
3. How would you describe your political preferences on most issues? Please tick one box that comes closest to your view. ‘Right or right-wing’ views mean a conservative political viewpoint; and ‘Left or left-wing’ means the opposite.
   □ Strongly left
   □ Somewhat left
   □ Centre
   □ Somewhat right
   □ Strongly right
   □ Don’t care
4. Your education level?
   □ Did not complete Secondary School
   □ Completed Secondary School
   □ Vocational Training (part or completed)
   □ Undergraduate Diploma (part or completed)
   □ Bachelor Degree (part or completed)
   □ Higher Degree (e.g., PhD, Masters) (part or completed)
5. Ethnic/Cultural Background
   Aboriginal and/or Torres Strait Islander
   African
   Asian
   Caucasian/European
   Indian
   Middle Eastern
   Pacific Islander
   Other ________________
6. What suburb do you currently live in? _______________________
7. What is your marital status?
   o Single (never married)
   o Married
   o Separated
   o Widowed
   o Divorced
8. How many hours per week do you USUALLY work at your job?
   o 35 hours a week or more
   o Less than 35 hours a week
   o I am not currently employed
9. Do you currently engage in regular exercise (i.e. walking, running, swimming, team sports, gym etc.)?
   o Yes
   o No
10. If you answered “yes” to the above question (# 9), how many times per week do you currently engage in regular exercise?
Appendix F

Beck Depression Inventory-II

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
   0  I do not feel sad.
   1  I feel sad much of the time.
   2  I am sad all the time.
   3  I am so sad or unhappy that I can’t stand it.

2. Pessimism
   0  I am not discouraged about my future.
   1  I feel more discouraged about my future than I used to be.
   2  I do not expect things to work out for me.
   3  I feel my future is hopeless and will only get worse.

3. Past Failure
   0  I do not feel like a failure.
   1  I have failed more than I should have.
   2  As I look back, I see a lot of failures.
   3  I feel I am a total failure as a person.

4. Loss of Pleasure
   0  I get as much pleasure as I ever did from the things I enjoy.
   1  I don’t enjoy things as much as I used to.
   2  I get very little pleasure from the things I used to enjoy.
   3  I can’t get any pleasure from the things I used to enjoy.

5. Guilty Feelings
   0  I don’t feel particularly guilty.
   1  I feel guilty over many things I have done or should have done.
   2  I feel quite guilty most of the time.
   3  I feel guilty all of the time.

6. Punishment Feelings
   0  I don’t feel I am being punished.
   1  I feel I may be punished.
   2  I expect to be punished.
   3  I feel I am being punished.

7. Self-Dislike
   0  I feel the same about myself as ever.
   1  I have lost confidence in myself.
   2  I am disappointed in myself.
   3  I dislike myself.

8. Self-Criticalness
   0  I don’t criticize or blame myself more than usual.
   1  I am more critical of myself than I used to be.
   2  I criticize myself for all of my faults.
   3  I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
   0  I don’t have any thoughts of killing myself.
   1  I have thoughts of killing myself, but I would not carry them out.
   2  I would like to kill myself.
   3  I know that it is murder if I had the chance.

10. Crying
    0  I don’t cry any more than I used to.
    1  I cry more than I used to.
    2  I cry over every little thing.
    3  I feel like crying, but I can’t.
### 11. Agitation
0  I am no more restless or wound up than usual.
1  I feel more restless or wound up than usual.
2  I am so restless or agitated that it’s hard to stay still.
3  I am so restless or agitated that I have to keep moving or doing something.

### 12. Loss of Interest
0  I have not lost interest in other people or activities.
1  I am less interested in other people or things than before.
2  I have lost most of my interest in other people or things.
3  It’s hard to get interested in anything.

### 13. Indecisiveness
0  I make decisions about as well as ever.
1  I find it more difficult to make decisions than usual.
2  I have much greater difficulty in making decisions than I used to.
3  I have trouble making any decisions.

### 14. Worthlessness
0  I do not feel I am worthless.
1  I don’t consider myself as worthwhile and useful as I used to.
2  I feel more worthless as compared to other people.
3  I feel utterly worthless.

### 15. Loss of Energy
0  I have as much energy as ever.
1  I have less energy than I used to have.
2  I don’t have enough energy to do very much.
3  I don’t have enough energy to do anything.

### 16. Changes in Sleeping Pattern
0  I have not experienced any change in my sleeping pattern.
1a  I sleep somewhat more than usual.
1b  I sleep somewhat less than usual.
2a  I sleep a lot more than usual.
2b  I sleep a lot less than usual.
3a  I sleep most of the day.
3b  I wake up 1-2 hours early and can’t get back to sleep.

### 17. Irritability
0  I am no more irritable than usual.
1  I am more irritable than usual.
2  I am much more irritable than usual.
3  I am irritable all the time.

### 18. Changes in Appetite
0  I have not experienced any change in my appetite.
1a  My appetite is somewhat less than usual.
1b  My appetite is somewhat greater than usual.
2a  My appetite is much less than before.
2b  My appetite is much greater than usual.
3a  I have no appetite at all.
3b  I crave food all the time.

### 19. Concentration Difficulty
0  I can concentrate as well as ever.
1  I can’t concentrate as well as usual.
2  It’s hard to keep my mind on anything for very long.
3  I find I can’t concentrate on anything.

### 20. Tiredness or Fatigue
0  I am no more tired or fatigued than usual.
1  I get more tired or fatigued more easily than usual.
2  I am too tired or fatigued to do a lot of the things I used to do.
3  I am too tired or fatigued to do most of the things I used to do.

### 21. Loss of Interest in Sex
0  I have not noticed any recent change in my interest in sex.
1  I am less interested in sex than I used to be.
2  I am much less interested in sex now.
3  I have lost interest in sex completely.

---

NOTICE: This form is printed with blue and black ink. If your copy does not appear this way, it has been photocopied in violation of copyright laws.
### Appendix G

**Depression, Anxiety and Stress Scale-21**

**DASS 21**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
</tr>
</thead>
</table>

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

**The rating scale is as follows:**

0  Did not apply to me at all
1  Applied to me to some degree, or some of the time
2  Applied to me to a considerable degree, or a good part of time
3  Applied to me very much, or most of the time

<table>
<thead>
<tr>
<th>Item</th>
<th>Statement</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I found it hard to wind down</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>2</td>
<td>I was aware of dryness of my mouth</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>3</td>
<td>I couldn’t seem to experience any positive feeling at all</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>4</td>
<td>I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>5</td>
<td>I found it difficult to work up the initiative to do things</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>6</td>
<td>I tended to over-react to situations</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>7</td>
<td>I experienced trembling (e.g., in the hands)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>8</td>
<td>I felt that I was using a lot of nervous energy</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>9</td>
<td>I was worried about situations in which I might panic and make a fool of myself</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>10</td>
<td>I felt that I had nothing to look forward to</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>11</td>
<td>I found myself getting agitated</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>12</td>
<td>I found it difficult to relax</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>13</td>
<td>I felt down-hearted and blue</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>14</td>
<td>I was intolerant of anything that kept me from getting on with what I was doing</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>15</td>
<td>I felt I was close to panic</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>16</td>
<td>I was unable to become enthusiastic about anything</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>17</td>
<td>I felt I wasn’t worth much as a person</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>18</td>
<td>I felt that I was rather touchy</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>19</td>
<td>I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>20</td>
<td>I felt scared without any good reason</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>21</td>
<td>I felt that life was meaningless</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>
Appendix H

Aerobic Capacity Assessment Protocol (VO$_{2\text{peak}}$)

Aerobic capacity was measured on a calibrated computerised gas analysis system (ParvoMedics TrueOne mortaraMetabolic System) whilst a customised script was created using VeletronCS2008 software (Velotron, Racemate, Inc.) for automatic control of and constant workload on the cycle ergometer. The protocol commenced at a workload of 50w and increased incrementally by 25w every 2 minutes to a maximum of 400w (maximum of 30 minutes). Heart rate (Polar T31 Transmitter) and Rate of Perceived Exertion (RPE; Borg and Löllgen (2001)), every 2 minutes were recorded throughout. The aerobic capacity assessment terminated when the participant could no longer maintain 60 revolutions per minute (RPM) or elected to discontinue the test due to fatigue or discomfort. Trainers were to terminate aerobic capacity assessments if testing became potentially unsafe (e.g. participant indicated pain, dizziness, nausea). Participants were instructed to abstain from alcohol or caffeine in the 12h prior to their aerobic capacity assessment.
Bandura Exercise Self-Efficacy Scale

Self-Efficacy to Regulate Exercise

A number of situations are described below that can make it hard to stick to an exercise routine. Please rate in each of the blanks in the column how certain you are that you can get yourself to perform your exercise routine regularly (three or more times a week).

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below:

<table>
<thead>
<tr>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
</table>
| Cannot do at all | Moderately can do | High certainty can do.

1. When I am feeling tired
2. When I am feeling under pressure from work
3. During bad weather
4. After recovering from an injury that caused me to stop exercising
5. During or after experiencing personal problems
6. When I am feeling depressed
7. When I am feeling anxious
8. After recovering from an illness that caused me to stop exercising
9. When I feel physical discomfort when I exercise
10. After a vacation
11. When I have too much work to do at home
12. When visitors are present
13. When there are other interesting things to do
14. If I don’t reach my exercise goals
15. Without support from my family or friends
16. During a vacation
17. When I have other time commitments
18. After experiencing family problems
Appendix J

Visual Analogue Scales

Participant ID:
Date:
Week:
Session:

Consider the following statements and select a point (draw an X) on the corresponding line which best approximates how you feel right now.

Based on my current exercise program,

I am not at all motivated to continue exercise

I am highly motivated to continue exercise

I cannot at all continue exercising three times a week at a high intensity for the next week

I'm certain I can continue exercising three times a week at a high intensity for the next week

I cannot at all continue exercising three times a week at a high intensity for the next 6 weeks

I'm certain can continue exercising three times a week at a high intensity for the next 6 weeks

I cannot at all continue exercising three times a week at a high intensity for the next 12 weeks

I'm certain I can continue exercising three times a week at a high intensity for the next 12 weeks
Consider the following statements and select a point (draw an X) on the corresponding line which best approximates how you have felt over the past week.

Based on my current exercise program,

- I feel no enjoyment from exercise sessions
- I feel high levels of enjoyment from exercise sessions

Over the past week,

- I do not look forward to exercise sessions
- I greatly look forward to exercise sessions

Over the past week,

- I have had much less day-to-day energy compared to normal
- I have had a much greater level of day-to-day energy compared to normal

Over the past week,

- I have not slept well at night
- I have slept very well at night
Appendix K

Eating Disorders Examination-Questionnaire

ID:   Date:

EATING QUESTIONNAIRE

Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all of the questions. Please only choose one answer for each question. Thank you.

Questions 1 to 12: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days) only.

<table>
<thead>
<tr>
<th>On how many of the past 28 days ......</th>
<th>No days</th>
<th>1-5 days</th>
<th>6-12 days</th>
<th>13-15 days</th>
<th>16-22 days</th>
<th>23-27 days</th>
<th>Every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Have you had a definite desire to have a totally flat stomach?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Have you had a definite fear of losing control over eating?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Have you had a definite fear that you might gain weight?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Have you felt fat?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Have you had a strong desire to lose weight?</td>
<td>0 1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Questions 13-18: Please fill in the appropriate number in the boxes on the right. Remember that the questions only refer to the past four weeks (28 days).

Over the past four weeks (28 days)........

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>....On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Over the past 28 days, how many DAYS have such episodes of overeating occurred (i.e. you have eaten an unusually large amount of food and have had a sense of loss of control at the time)?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Over the past 28 days, how many times have you exercised in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat or to burn off calories?</td>
</tr>
</tbody>
</table>

Questions 19-21: Please circle the appropriate number. Please note that for these questions the term “binge eating” means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Over the past 28 days, on how many days have you eaten in secret (ie, furtively)?......Do not count episodes of binge eating</td>
</tr>
<tr>
<td>No days</td>
<td>1-5 days</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>On what proportion of the times that you have eaten have you felt guilty (felt that you’ve done wrong) because of its effect on your shape or weight? ......Do not count episodes of binge eating</td>
</tr>
<tr>
<td>None of the times</td>
<td>A few of the times</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Over the past 28 days, how concerned have you been about other people seeing you eat? ......Do not count episodes of binge eating</td>
</tr>
<tr>
<td>Not at all</td>
<td>Slightly</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Questions 22-28: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days)

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Markedly</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Has your weight influenced how you think about (judge) yourself as a person?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23 Has your shape influenced how you think about (judge) yourself as a person?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24 How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25 How dissatisfied have you been with your weight?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26 How dissatisfied have you been with your shape?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27 How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28 How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

What is your weight at present? (Please give your best estimate). ............................................

What is your height? (Please give your best estimate). ..............................................................

If female: Over the past three-to-four months have you missed any menstrual periods? ............

If so, how many? ..............................................................

Have you been taking the “pill”? ..............................

THANK YOU  

Appendix L

Binge Eating Scale

Eating habits checklist

Instructions. Below are groups of numbered statements. Read all of the statements in each group and mark on this sheet the one that best describes the way you feel about the problems you have controlling your eating behavior.

#1
(0) 1. I don't feel self-conscious about my weight or body size when I'm with others.
(0) 2. I feel concerned about how I look to others, but it normally does not make me feel disappointed with myself.
(1) 3. I do get self-conscious about my appearance and weight which makes me feel disappointed in myself.
(3) 4. I feel very self-conscious about my weight and frequently, I feel intense shame and disgust for myself. I try to avoid social contacts because of my self-consciousness.

#2
(0) 1. I don't have any difficulty eating slowly in the proper manner.
(1) 2. Although I seem to “gobble down” foods, I don’t end up feeling stuffed because of eating too much.
(2) 3. At times, I tend to eat quickly and then, I feel uncomfortably full afterwards.
(3) 4. I have the habit of bolting down my food, without really chewing it. When this happens I usually feel uncomfortably stuffed because I've eaten too much.

#3
(0) 1. I feel capable to control my eating urges when I want to.
(1) 2. I feel like I have failed to control my eating more than the average person.
(3) 3. I feel utterly helpless when it comes to feeling in control of my eating urges.
(3) 4. Because I feel so helpless about controlling my eating I have become very desperate about trying to get in control.

#4
(0) 1. I don't have the habit of eating when I'm bored.
(0) 2. I sometimes eat when I'm bored, but often I'm able to “get busy” and get my mind off food.
(0) 3. I have a regular habit of eating when I'm bored, but occasionally, I can use some other activity to get my mind off eating.
(2) 4. I have a strong habit of eating when I'm bored. Nothing seems to help me break the habit.

#5
(0) 1. I'm usually physically hungry when I eat something.
(1) 2. Occasionally, I eat something on impulse even though I really am not hungry.
(2) 3. I have the regular habit of eating foods, that I might not really enjoy, to satisfy a hungry feeling even though physically, I don't need the food.
(3) 4. Even though I'm not physically hungry, I get a hungry feeling in my mouth that only seems to be satisfied when I eat a food, like a sandwich, that fills my mouth. Sometimes, when I eat the food to satisfy my mouth hunger, I then spit the food out so I won't gain weight.
1. I don't feel any guilt or self-hate after I overeat.
2. After I overeat, occasionally I feel guilt or self-hate.
3. Almost all the time I experience strong guilt or self-hate after I overeat.

1. I don't lose total control of my eating when dieting even after periods when I overeat.
2. Sometimes when I eat a "forbidden food" on a diet, I feel like I "blew it" and eat even more.
3. Frequently, I have the habit of saying to myself, "I've blown it now, why not go all the way" when I overeat on a diet. When that happens I eat even more.
4. I have a regular habit of starting strict diets for myself, but I break the diets by going on an eating binge. My life seems to be either a "feast" or "famine."

1. I rarely eat so much food that I feel uncomfortably stuffed afterwards.
2. Usually about once a month, I eat such a quantity of food, I end up feeling very stuffed.
3. I have regular periods during the month when I eat large amounts of food, either at mealtime or at snacks.
4. I eat so much food that I regularly feel quite uncomfortable after eating and sometimes a bit nauseous.

1. My level of calorie intake does not go up very high or go down very low on a regular basis.
2. Sometimes after I overeat, I will try to reduce my caloric intake to almost nothing to compensate for the excess calories I've eaten.
3. I have a regular habit of overeating during the night. It seems that my routine is not to be hungry in the morning but overeat in the evening.
4. In my adult years, I have had week-long periods where I practically starve myself. This follows periods when I overeat. It seems I live a life of either "feast or famine."

1. I usually am able to stop eating when I want to. I know when "enough is enough."
2. Every so often, I experience a compulsion to eat which I can't seem to control.
3. Frequently, I experience strong urges to eat which I seem unable to control, but at other times I can control my eating urges.
4. I feel incapable of controlling urges to eat. I have a fear of not being able to stop eating voluntarily.

1. I don't have any problem stopping eating when I feel full.
2. I usually can stop eating when I feel full but occasionally overeat leaving me feeling uncomfortably stuffed.
(2) 3. I have a problem stopping eating once I start and usually I feel uncomfortably stuffed after I eat a meal.
(3) 4. Because I have a problem not being able to stop eating when I want, I sometimes have to induce vomiting to relieve my stuffed feeling.

#12
(0) 1. I seem to eat just as much when I'm with others (family, social gatherings) as when I'm by myself.
(1) 2. Sometimes, when I'm with other persons, I don't eat as much as I want to eat because I'm self-conscious about my eating.
(2) 3. Frequently, I eat only a small amount of food when others are present, because I'm very embarrassed about my eating.
(3) 4. I feel so ashamed about overeating that I pick times to overeat when I know no one will see me. I feel like a "closet eater."

#13
(0) 1. I eat three meals a day with only an occasional between meal snack.
(0) 2. I eat 3 meals a day, but I also normally snack between meals.
(2) 3. When I am snacking heavily, I get in the habit of skipping regular meals.
(3) 4. There are regular periods when I seem to be continually eating, with no planned meals.

#14
(0) 1. I don't think much about trying to control unwanted eating urges.
(1) 2. At least some of the time, I feel my thoughts are pre-occupied with trying to control my eating urges.
(2) 3. I feel that frequently I spend much time thinking about how much I ate or about trying not to eat anymore.
(3) 4. It seems to me that most of my waking hours are pre-occupied by thoughts about eating or not eating. I feel like I'm constantly struggling not to eat.

#15
(0) 1. I don't think about food a great deal.
(1) 2. I have strong cravings for food but they last only for brief periods of time.
(2) 3. I have days when I can't seem to think about anything else but food.
(3) 4. Most of my days seem to be pre-occupied with thoughts about food. I feel like I live to eat.

#16
(0) 1. I usually know whether or not I'm physically hungry. I take the right portion of food to satisfy me.
(1) 2. Occasionally, I feel uncertain about knowing whether or not I'm physically hungry. At these times it's hard to know how much food I should take to satisfy me.
(2) 3. Even though I might know how many calories I should eat, I don't have any idea what is a "normal" amount of food for me.
Appendix M

Weight and Body Related Shame and Guilt Scale

Instructions: Please rate how often you experienced the following in the previous 6-months using the following 5-point scale:

0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = always.

1. When I have eaten more than I want, I experience feelings of guilt. _____

2. When I am in a situation where others can see my body (e.g. pool, changing room), I feel ashamed. _____

3. When I eat fattening food (e.g. tarts) I get distressed by the feeling that I did something wrong. _____

4. The appearance of my body is embarrassing for me in front of others. _____

5. When I can’t manage to work out physically, I feel guilty. _____

6. When I think of the possibility that others can see my naked body, I would rather hide somewhere. _____

7. I am ashamed of myself when others get to know how much I really weight. _____

8. When I can’t get a grip on my weight, I blame myself. _____

9. I blame myself when I break a good resolution concerning my eating. _____

10. I avoid exerting myself physically in front of others since I feel embarrassed. _____

11. When I watch myself in the mirror, I feel guilty and decide to do more for my figure. _____

12. Since the size of my clothes is embarrassing for me, I would rather avoid shopping for new clothes. _____
Appendix N

Self-Critical Rumination Scale

Instructions: Please rate how well each item describes you using the following scale:

1 = not at all, 2 = a little, 3 = moderately, 4 = very much.

1. My attention is often focused on aspects of myself that I’m ashamed of. ____
2. I always seem to be rehashing in my mind stupid things that I’ve said or done. ____
3. Sometimes it is hard for me to shut off critical thoughts about myself. ____
4. I can’t stop thinking about how I should have acted differently in certain situations. ____
5. I spend a lot of time thinking about how ashamed I am of some of my personal habits. ____
6. I criticize myself a lot for how I act around other people. ____
7. I wish I spent less time criticizing myself. ____
8. I often worry about all of the mistakes I have made. ____
9. I spend a lot of time wishing I were different. ____
10. I often berate myself for not being as productive as I should be. ____
Appendix O

Self-Compassion Scale

**HOW I TYPICALLY ACT TOWARDS MYSELF IN DIFFICULT TIMES**

Please read each statement carefully before answering. To the left of each item, indicate how often you behave in the stated manner, using the following scale:

<table>
<thead>
<tr>
<th>Almost never</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

___ 1. I'm disapproving and judgmental about my own flaws and inadequacies.
___ 2. When I'm feeling down I tend to obsess and fixate on everything that's wrong.
___ 3. When things are going badly for me, I see the difficulties as part of life that everyone goes through.
___ 4. When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world.
___ 5. I try to be loving towards myself when I'm feeling emotional pain.
___ 6. When I fail at something important to me I become consumed by feelings of inadequacy.
___ 7. When I'm down and out, I remind myself that there are lots of other people in the world feeling like I am.
___ 8. When times are really difficult, I tend to be tough on myself.
___ 9. When something upsets me I try to keep my emotions in balance.
___ 10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.
___ 11. I'm intolerant and impatient towards those aspects of my personality I don't like.
___ 12. When I'm going through a very hard time, I give myself the caring and tenderness I need.
___ 13. When I'm feeling down, I tend to feel like most other people are probably happier than I am.
___ 14. When something painful happens I try to take a balanced view of the situation.
___ 15. I try to see my failings as part of the human condition.
___ 16. When I see aspects of myself that I don't like, I get down on myself.
___ 17. When I fail at something important to me I try to keep things in perspective.
18. When I’m really struggling, I tend to feel like other people must be having an easier time of it.

19. I’m kind to myself when I’m experiencing suffering.

20. When something upsets me I get carried away with my feelings.

21. I can be a bit cold-hearted towards myself when I’m experiencing suffering.

22. When I’m feeling down I try to approach my feelings with curiosity and openness.

23. I’m tolerant of my own flaws and inadequacies.

24. When something painful happens I tend to blow the incident out of proportion.

25. When I fail at something that’s important to me, I tend to feel alone in my failure.

26. I try to be understanding and patient towards those aspects of my personality I don’t like.
Appendix P

Physical Self-Description Questionnaire - Short Version

**Physical Self-Description Questionnaire – Short**

The purpose of these next questions is to see how people describe themselves physically. You will be asked to think of yourself physically: for example, how strong you are, how flexible you are, or how attractive you are and so on. Answer each statement as quickly as you can and do not skip any.

There are six possible responses to each statement: “true” or “false”, and four responses in between. Select the answer that is most true for you.

1 = False
2 = Mostly False
3 = More false than true
4 = More true than false
5 = Mostly True
6 = True

1. I have a nice looking face
2. I am better looking than most of my friends
3. I am good looking
4. I feel confident when doing coordinated movements
5. Controlling movements of my body comes easily to me
6. I am good at coordinated movements
7. I can perform movements smoothly in most physical activities
8. I find my body handles coordinated movements with ease
9. I can run a long way without stopping
10. I can be physically active for a long period of time without getting tired
11. I am good at endurance activities e.g. distance run, aerobics, swim, cross country, ski
12. Overall, most things I do turn out well
13. Overall, I am no good*
14. Most things I do, I do well
15. Overall, I have a lot to be proud of
16. Nothing I do seems to turn out right*
17. I am quite good at bending, twisting, and turning my body
18. My body is flexible
19. I think I would perform well on a test measuring flexibility
20. Physically, I am happy with myself
21. Physically, I feel good about myself
22. I feel good about who I am physically
23. I am physically a strong person
24. I have a lot of power in my body
25. I would do well in a test of strength
26. I often do exercise or activities that make me breathe hard
27. I do physically active things (i.e. jog, dance, bicycle, aerobics, gym, swim) at least three (3) times per week
28. I do lots of sports, dance, gym, or other physical activities
29. I do sports, exercise, dance, or other physical activity almost everyday
30. My waist is too large
31. I have too much fat on my body