Obesity and Mental Health

EVIDENCE OVERVIEW
June 2019

Commissioned by Obesity Action Scotland

Obesity Action Scotland
Healthy weight for all

Obesity and mental health: what are the links? A scoping review

This evidence overview was commissioned by Obesity Action Scotland and written by Dr Jan Pringle[1], Dr Yvonne Laird[1], Dr Divya Sivaramakrishnan[1]

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Executive summary

Obesity, and its impact on health, is a topic of global importance. By definition, obesity is associated with having a body mass index (BMI) in excess of 30kg per m^2. In addition to impacts on general health, there may be specific links between obesity and mental health. These associations are considered to be complex, multi-dimensional, and often poorly understood. However, it is important to recognise such links in order to target support and resources appropriately. To further investigate the evidence relating to the connections between obesity and mental health (or vice versa), and assess current understanding, we carried out a structured scoping review.

The review aimed to search for, and critically appraise, literature that examined the links between obesity and mental health, and the influence of one condition on the other. We specifically sought studies that identified associations between the two factors, rather than only the co-existence of mental health issues and obesity. We were also interested in findings that might be relevant to a Scottish population, given the prevalence of obesity in Scotland.

We identified 207 papers that fulfilled the inclusion criteria for the review. From these, 6 specific areas of interest were identified within the included studies:

- Physiological linkages (including pharmaceutical effects)
- Gender differences
- Psychological and psychosocial aspects
- Geographical and cultural considerations
- Early life and predispositions (impact in adulthood)
- Protective factors

In brief, our findings indicated that direction of impact between obesity and mental health is complex, may be bi or multidirectional, with many physiological and psychosocial influencing factors. However, the healthy lifestyle interventions reported in the included studies were generally well received and often successful in achieving weight loss and/or improved mental well-being. Interventions had the potential to raise awareness of diet quality, in conjunction with physical activity, in improving mental well-being and healthy BMIs. The need for interventions to be adaptable to suit individual coping styles, ethnicity, cultural norms, and trends within individual groups, was highlighted.

With regard to motivation, apathy may need to be addressed as part of interventions to achieve greater advantage. In addition to community based interventions, workplace environments may also have the potential to offer healthy lifestyle support, and can act to reduce the negative impact of weight discrimination and stigma. In addition, the role and benefit of affordable healthy foods was noted as an important issue in some studies.

The review helped to identify specific groups of people who may require greater support to address obesity: people with severe mental health disorders, especially if taking anti-psychotic medication, women with obesity, single men with obesity, those in the 30-50yr age range, those in stressful occupations, those with co-morbidities, in rural locations, or with socio-economic risk factors.

Such information can assist in the allocation of resources, or indicate where a change of approach is required, and may be of interest to inform practice and policy guidelines.

Certain limitations do need to be borne in mind when reading this review. Many of the included studies were cross-sectional in design and therefore direct links to effect or causality could not be fully established. There were also differences between the way obesity and health outcomes were measured (e.g. obesity measures included BMI, fat mass, waist circumference, lean body mass, visceral or subcutaneous adiposity; mental health outcomes similarly used a range of measurement tools); this made direct comparisons more difficult. Where possible, we have grouped studies reporting similar findings together, to allow for a body of evidence to be presented and discussed.

Introduction

Obesity, and its impact on health, is a topic of global importance. By definition, obesity is associated with having a body mass index (BMI) in excess of 30kg per m^2 (WHO, 2019). In addition to impacts on general health, there may be specific links between obesity and mental health (and vice versa). Associations between high BMI and mental health are considered to be complex, multi-dimensional, and often poorly understood (Assari, 2014; Papadopoulos & Brennan, 2015). However, it is important to recognise such links in order to target support and resources appropriately. To further investigate the evidence relating to links between obesity and mental health, and assess current understanding, we carried out a structured scoping review.

Aims and objectives: To search for, and critically review, literature that examined the links between obesity and mental health (or vice versa). Studies that identified associations between the two factors were specifically sought, rather than only the co-existence of mental health issues and obesity. Findings that might be relevant to a Scottish population were of particular interest, given the prevalence of obesity in Scotland (The Scottish Government, 2018a).

Review team: The review team consisted of academic researchers (Scottish Collaboration for Research and Policy, University of Edinburgh) with expertise in systematic reviewing, public health, nutrition, and obesity. The review was overseen by professional staff at Obesity Action Scotland.

Methods

A systematic approach to searching, screening, and study selection was undertaken using the inclusion and exclusion criteria detailed in Table 1.

Table 1: Inclusion and exclusion criteria

Domain	Inclusion criteria	Exclusion criteria
Study design	Any research design (e.g. quantitative, qualitative, mixed methods)	Protocols, or study outlines without results; dissertations (due to resource limitations)
Population	Adult humans, >18yrs of age (including post-natal studies), with BMI > 30kg/m^2	Non-human studies; child or adolescent populations; anti-natal studies, or studies involving people with developmental or intellectual disabilities, due to the unique needs of these populations
Interventions/variables	Studies investigating the impact of obesity on mental health, and vice versa	Studies where there are no discernible links between mental health and

	(where the links are detailed/discussed, rather than the two conditions co-existing)	obesity; studies investigating anti-obesity drugs/agents (e.g. drug trials). Studies relating to gastric band/bypass surgery
Outcomes	Any mental health outcomes; any obesity related outcomes	Outcomes that do not relate to obesity; outcomes that do not relate to mental health
Other variables	Studies conducted within the last 10years (to ensure 'currency'); English language paper available	Studies conducted over 10yrs ago; non-English language papers, where a translation is not available

Search strategy: Searches were conducted using the following terms: obese /obesity /adiposity /fat /body mass /bariatrics /body weight /skinfold thickness /weight to height ratio /BMI /waist circumference **AND** mental health /mental illness /well-being. These terms were adapted according to the database being searched, and combined terms were used, as appropriate.

Databases: Medline, Embase, PsycInfo, and the Cochrane libraries were searched for articles published between 2009 and March 2019.

Study selection: Following initial duplicate removal, title and abstracts were screened, followed by full papers, to ensure all inclusion criteria were met. Two reviewers screened independently, and in the event of inclusion/exclusion disagreement, a third reviewer mediated. This process was facilitated by using Covidence™, a healthcare evidence synthesis software package.

Data extraction and management: Data from each included study were extracted to a table, detailing date, population, geographical location, outcomes, findings, conclusions, and any factors noted as influencing rigour (see Appendix 1).

Quality appraisal: Study limitations and biases were critiqued during the data extraction process.

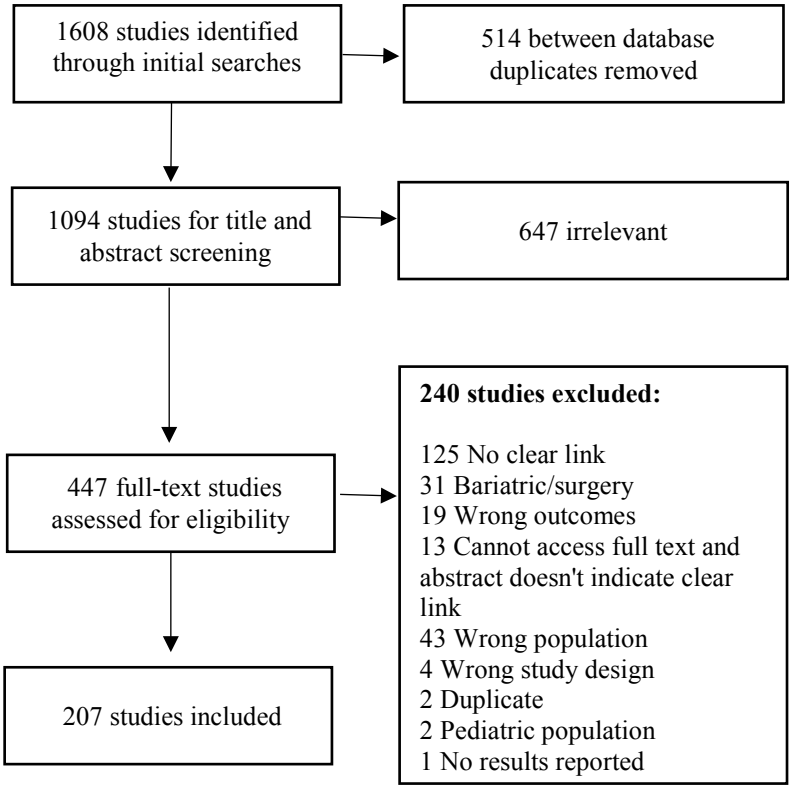
Time scale: Searches and screening were carried out February-March 2019; data extraction and analyses were conducted March – May 2019.

Funding: Funding for the scoping review was provided by Obesity Action Scotland.

Findings

Initial searches identified 1608 potentially relevant papers. Following removal of 'between database' duplicates (n=514), 1094 studies were identified for screening. Title and abstract, then full paper screening, yielded 207 papers that were considered to meet all inclusion criteria. This process is summarised in Figure 1, below.

Figure 1: Study selection process



General overview

The majority of the studies were from the USA (91), followed by Australia (27), Canada (14) and the UK (13). Several studies were from European countries (56), including Spain (10), Germany (7) and Netherlands (7). While varying study designs were used in the included 207 studies, around 58% of the studies used a cross-sectional design. There were approximately 46 longitudinal studies, 17 studies evaluated an intervention (either randomised or pre-post design), 10 studies were reviews, and 4 were qualitative.

The nature of the evidence was assessed according to the following hierarchy:

1. Systematic review and meta-analysis level evidence
2. Scoping and narrative review level evidence
3. Randomized Controlled Trial evidence
4. Longitudinal evidence
5. Non-randomised and pre-post trials
6. Cross-sectional evidence
7. Qualitative evidence

Details of each category of evidence are provided in Table 2. The table also reports the number studies falling under each category. This will aid the assessment of the strength of evidence presented in this review.

Table 2 Strength of evidence table (Higher to lower)

Study design	Some Characteristics	Evidence	Number of included studies
Systematic reviews and meta-analysis level evidence	Focused clinical question, comprehensive sources and explicit search strategy, selection based on specified criteria, rigorous critical appraisal, qualitative summary of results	1	3
Scoping and narrative review level evidence	Not systematically conducted. Summarizes a topic that is broad in scope	2	7
Randomized Controlled Trial (RCT)	Control of various aspects of the research; it is possible to identify causal links between interventions and outcomes of interest	3	12
Cohort studies (Longitudinal)	Non-controlled environment and no intervention. Following through time; it is possible to identify risk and protective factors	4	45
Non-randomised and pre-post trials	Give preliminary information about the effectiveness of an intervention. Results may be biased due to the lack of randomisation or a control group	5	5
Cross-sectional studies	Give information about a population at a given point in time to determine prevalence. They can infer correlations but not associations of causality	6	117
Qualitative studies	Typically smaller sample sizes than quantitative research. Methodologies such as interviews, focus groups, ethnography, among others. Data can	7	4

	include texts, images or videos. Can provide information about acceptability and feasibility of interventions		
Other/not clear			10
Total			207

Due to the scoping nature of the review, the findings reflect studies where direct connections between obesity and mental health (or vice versa) are reported, as well as other more generally associated links, especially where issues salient to clinical practice or service provision are examined.

With regard to the presence of obesity in people with mental health conditions, there was global acknowledgment across continents and cultures that people with mental health diagnoses were more likely to be obese and be at greater risk of cardiovascular disease (e.g. Bika et al, 2017; Cook et al, 2015; Jerome et al, 2012; Kim et al, 2017; Larsen et al, 2013; Lee et al, 2013; Gladigau et al, 2014). As an associated consequence, life expectancy is significantly reduced in people with serious mental illness (Blomqvist et al, 2018), with death occurring up to 25yrs earlier in some cases (Mangurian et al, 2016). There were many studies examining severe mental health conditions (e.g. psychosis and bipolar disorders), with 45-55% of people with these more severe conditions falling into obese or severely obese categories (e.g. Looijmans et al, 2017; Nasland et al, 2015; Ratliffet al, 2013; Scott & Happell, 2011).

With regard to direction of linkages or correlation/causality, Kivimaki and colleagues (2009) conducted a 19 year longitudinal study, which reported a cumulative effect of chronic or repeating episodes of mental illness on obesity levels. Likewise, Hamer et al (2016) found the direction of association to be from depression to adiposity, rather than the reverse, which was consistent with the study by Henriksen et al (2014). However, Jung & Chang (2015) found that obesity lead to greater mental distress over time, especially for women and those in the mid-life age range (36-45yrs of age), while Keating et al (2013) reported lower quality of life with increasing BMI subclass (see definitions at the end of the report), with similar links between long term depression and increasing BMI being reported by Walter et al (2015). Sikorski et al (2015) conducted a systematic review on the impact of obesity on psychological wellbeing, and found greater risk of stigma and poor psychological outcomes associated with obesity.

Clearly defined linkages, and the direction of association, may often be complex. For example, while Fezeu et al (2015) suggest the direction of impact is from mental health disorder to increase future risk of adiposity, other studies are less clear, or suggest a reverse correlation (e.g. Florez et al, 2015; Gadalla, 2009). A systematic review carried out by Papadopoulos & Brennan (2015) examined the impact of obesity and weight stigma on psychiatric symptoms and psychological distress, concluding that while there is evidence for psychosocial consequences of weight stigma, these factors are not often considered in combination in research.

Obesity was also considered to impact on the progression of mental health disorders. For example, in people with existing serious conditions, such as bipolar disorder, obesity may increase their likelihood of more frequent mood-related episodes (Bond et al, 2010; Buoli et al, 2017), or hospital readmission (Manu et al, 2014).

The presence of obesity in people with severe mental illness was suggested as being due to several factors, including drug treatments, illness-related lifestyles, gender, and genetic factors (Santini et al, 2016). These aspects will be discussed further in the following sections.

Further examination of the included studies suggested 6 more specific areas of interest:

- Physiological linkages (including pharmaceutical/co-morbidity effects)
- Gender differences
- Early life and predispositions (impact in adulthood)
- Psychological and psychosocial aspects
- Geographical and cultural considerations
- Protective or risk reduction factors

Additional detail, under each of these 6 sub-sections, is given below. The review aims to explain the complexities (especially in relation to physiological effects) in general terms, and this has necessitated some of the finer detail being absent. However, all references will be given, and full papers can be accessed for this greater detail, if required.

Physiological linkages

In this section, studies that examined the influence of hormones, neuro transmitters etc., on mental health and obesity are discussed. The pharmaceutical effects of medications are also considered, particularly in relation to the impact of mental health treatments on BMI.

Antipsychotic medications for serious mental illness conditions, while beneficial in many respects for symptom control (Teff et al, 2013), were seen as a major contributory factor to obesity (e.g. Abdus & Zuvekas, 2015, Mangurian et al, 2016; McDaid & Smyth, 2015; Park, 2009), with multiple drugs considered to have a greater effect than monotherapy, and women being affected to a greater extent (Thonsai et al, 2016). Cardiovascular risk factors, such as obesity, may present early in treatment (Correll et al, 2011), but may equally increase with the duration of drug therapy (Curtis et al, 2011).

Teff et al (2013) examined antipsychotic drug effects on the mechanisms regulating eating behaviour, such as post-meal hormone levels, and insulin resistance, and concluded that the metabolic changes occur in the absence of weight gain, increased food intake, or psychiatric disease, suggesting that antipsychotic medications may exert direct effects on tissues, independent of the physiological mechanisms that regulate eating behaviour.

In physiological terms, chronic stress, even without the presence of serious mental illness, was considered to lead to increased basal sympathetic nervous system and hypothalamic activity, which, in turn, can lead to insulin resistance, diabetes, and associated obesity (Saxena et al, 2014).

In further relation to physiological influences, increased depression was noted in those considered to have obesity and be 'metabolically' unhealthy (i.e. with unhealthy metabolic perimeters, such as having increased insulin resistance, raised blood pressure etc) as opposed to those who had obesity but were metabolically healthy (Phillips & Perry, 2015). Phillips & Perry (2015) concluded that these differences may partly explain the inconsistent results found in other studies relating to obesity and mental health.

With regard to other contributory factors, Coin-Araguez et al (2018) discuss the potential involvement of mental health disorders and inflammation in 'visceral adipose tissue' (fatty tissues around major abdominal organs, which has detrimental health effects, such as altering hormonal levels/functions, increased diabetes risk etc). They concluded that mental health conditions may influence such risks by increasing systemic inflammation, and that further research into this area may serve to explain some of the complexities.

In addition to these factors, co-morbid physiological influencing factors may include sleep deprivation (Lima et al, 2015; Paine et al, 2019), or the presence of long term conditions such as diabetes (Pacanowski et al, 2018), fibromyalgia (Aparicio et al, 2011), or cancer (Blanchard et al, 2010). These studies therefore illustrate the complexity and multidimensional nature of the physiological factors that link obesity and mental health.

Gender differences

With regard to gender differences, many studies found that women with mental health conditions were significantly more likely to have obesity than men (e.g. Abdus & Zuvekas, 2015; Carpiniello et al, 2009; Jonikas et al, 2016; Lazarevich et al, 2013). Massetti et al, 2017 reported links between being overweight or having obesity and depression in women, and associated unhealthy eating behaviours. Beutel et al (2018) also reported that stressors were more likely to affect overeating to a greater extent for women. DeCarvlho-Ferreira et al (2012) found associations between depression and binge eating in females, while for males, anxiety and body image dissatisfaction were linked.

DeMontigny et al (2017) reported on marital status differences, with single men with obesity being more likely to have lower psychological and social wellbeing. In contrast, in the study by McLeod et al (2016), obesity was associated with greater economic and employment advantage in males aged 30-35 yrs.

Some of these differences may be linked to gender body image perceptions; with Garner et al (2012) noting the fact that male health-related quality of life (HRQoL) may be reduced if they are underweight, whereas for women, HRQoL reduced as weight increased. Perceptions of weight gain

amongst women may also be associated with greater depression, even if they are not classified as having obesity (Kim et al, 2013).

Obesity was noted as a risk factor for reduced mental health during the postpartum period (Mina et al, 2015; Nagl et al, 2015), and following childbirth women may experience both depression and difficulty losing pregnancy weight gain (Ko et al, 2013). However, it was found that lifestyle intervention programmes could positively help both weight and quality of life postnatally in studies by Ko et al (2013) and Hagberg et al (2019).

Other gender-related differences were noted with regard to early life experiences, as will be discussed in the section below.

Early life and predispositions (impact in adulthood)

Although studies involving children and adolescents were excluded from this review, there were certain aspects of early life, and predispositions, which had an impact on later mental health and likelihood of obesity in adulthood.

Several studies reported on the links between adverse childhood experiences (ACEs) and the likelihood of obesity and mental health conditions in adulthood (e.g. Boyton-Jarrett et al, 2012; Campbell et al, 2016, Dube et al, 2010; Renkopf et al, 2016). Women who had faced ACEs were more likely to gain weight pre-pregnancy, and have increased gestational weight gain, according to Diesel et al, 2016; this was found to have a subsequent impact on the health and weight of their children, in the study by Ranchod et al (2016). Other studies (Fuller-Thomson et al, 2013; Guenzel et al, 2016; Ramirez & Milan, 2016) also suggest that the link between childhood adversity and obesity was particularly found in women, rather than men.

Apart from those with ACEs, obesity in childhood in general was noted as being related to increased risk of mood disorder in adulthood for both sexes (White et al, 2012), but more especially for overweight girls who progressed to having obesity in adulthood (Sanderson et al, 2011). For young adults, obesity during young adulthood appeared to be associated with a high risk of mental health distress (Dreber et al, 2015, 2017; Frisco et al, 2013). The converse association was also reported by Goodwin et al (2009), who found that mental health problems in childhood increased the risk of obesity in early adulthood for men. The impact of either mental health illness, or obesity, in childhood was therefore seen to impact on adult health for both those with and without ACEs.

Psychological and psychosocial aspects

The literature in this section reflects the impact of obesity on psychological wellbeing. Of particular interest is the literature relating to the attitudes of others and stigma, with self-esteem, and impact

on employment, being amongst some of the affected outcomes. For example, Ciciurkaite & Perry (2018) reported on the psychological consequences of weight related discrimination and found that higher social status had a buffering effect. Increased self-esteem and a sense of coherence may also impact more positively on mental health in people with obesity (Lerdal et al, 2011), as may better educational attainment (Nichele & Yen, 2016).

The concept of potential legislation that might prohibit weight discrimination was viewed positively in terms of possible mental health outcomes by people with obesity (Pearl et al, 2017). In further relation to the impact of the views and messages aired by other parties, Shentow-Bewsh et al (2016) found exposure to anti-obesity messages resulted in reduced body esteem for women, whereas Sutin & Terracciano (2013) not only reported poorer mental health outcomes as a result of weight discrimination, but also reduced motivation to action weight loss.

With regard to health behaviour, there were suggestions that having a mental health conditions might be associated with poorer nutritional intake (Kim et al, 2013; Jakabek et al, 2011), and that women and people with personality disorder conditions might be affected to a greater extent (Stanley et al, 2013). Younger, newly diagnosed people with schizophrenia, for example, may transition to developing overweight or obesity within as little as one year following diagnosis (Srihari et al, 2013), with long term (20yr) obesity consequences in patients with psychosis being noted by Strassnig et al (2017). Increasing physical activity and weight reduction support was seen as a priority for these groups, as a result (Jerome et al, 2012).

The boundary between eating disorders and obesity was somewhat blurred, with Jimenez-Murcia et al (2017) regarding obesity as a result of addictive (food related) behaviour, with associated psychologically detrimental effects. Burrows et al (2017) also considered the links between depression, food addiction, and the increased likelihood of poor dietary choices.

Associations with the wider economic climate were referred to by Jofre-Bonet et al (2018), who noted that, while the most recent recession did lead to lower alcohol and cigarette use, obesity and poorer mental health increased; possible links to healthier foods being more expensive, and economic uncertainty were made. Job insecurity was also associated with significantly higher obesity levels, and poorer mental health, in the study by Khubchandani & Price (2017). In addition, people in stressful or low paid work situations may have higher incidences of obesity and poorer mental health (Kaks et al, 2016; Kyle et al, 2017; LaVela et al, 2015), with weight stigma being suggested as one possible contributory factor (Proper et al, 2012); however, employment in general was found to be supportive of improved quality of life in people with severe obesity (Lund et al, 2011).

With further regard to employment, certain occupations were observed to carry greater risk of obesity, such as for army veterans (Maguen et al, 2013) or farmers (Brumby et al, 2012).

Geographical, ethical and cultural considerations

While this review is predominately interested in the relevance of findings to the Scottish population, there were geographical and ethnicity/cultural differences that, in a multicultural society, may be important to take into account. This section considers some of these aspects.

With regard to race and culture, there were marked differences between populations noted by a number of studies (e.g. Beydoun et al, 2009 and 2016; Roen-Reynoso et al, 2011; Westby et al, 2014). As an example of reported differences, while Cook et al (2016) found greater levels of obesity in African American mental health patients, Bentley et al (2011) and Kim et al (2014) both reported that black participants in their studies had higher quality of life or mental health alongside overweight or obesity than other populations. Within black populations, however, there may be further differences, with Assari (2014) reporting greater risk of depression in Caribbean women with severe obesity, as opposed to African American women. Jung & Chang (2015) also found greater mental distress over time in obese white women. Interestingly, Kuebler et al (2016) reported that in countries with higher BMI prevalence and acceptance in the general population, better mental health existed in those with greater BMI, perhaps reflecting the impact of societal norms within different cultures/countries.

With regard to geographical locations, while people living in more rural areas were reported as having a greater likelihood of having obesity; Batsis et al (2018) found no mental health differences between people with obesity living in rural and urban environments. However, Brumby et al (2012) found positive links between psychological distress and cardiovascular risk factors (including obesity) in Australian rural farming communities.

There were also age-related differences within populations: in a UK study, increased adiposity was linked to poorer mental health functioning in the 30-50yr age range, with the association increasing with age within this age grouping (Davillas et al, 2016). This result was consistent with the findings of Morris et al (2010), who found poorer mental health in people with obesity in the 45-54yr age range in Australia. In older age groups, the impact of obesity on mental health may be less marked (Davillas et al, 2016).

Protective factors or interventions

Across the included papers, several protective factors, or interventions, were suggested as being beneficial. Although these cannot be detailed in-depth within the scope of the review, an overview is given.

Several studies (e.g. Arrebola et al, 2011; Fernandez-Ruiz et al, 2018; Wallace et al, 2016) reported quality of life and general health improvements following lifestyle modification programmes for obese individuals, while Daumit et al (2013), and Holt et al (2010) found weight loss/lifestyle interventions to be effective for people with obesity and serious mental health conditions, even those on

antipsychotic medication (Skouroliakou et al, 2009). A significant reduction in depressive symptoms in such participants, following weight loss of 10% or greater, was reported by Naslund et al (2017).

Physical activity, even if not rigorous, was seen as a protective factor for improving quality of life and mental health in people with obesity in some studies (e.g. Connoy et al, 2017; Megakli et al, 2016), while Imayama et al (2011) and Jimenez et al (2016) suggested that interventions combining both diet and exercise components may be more effective at improving psychological health than either alone.

Dietary factors were also considered by Clerici et al (2014) who examined the beneficial effects of a Mediterranean diet on cardiovascular risk factors in people with obesity and serious mental health conditions. Florez et al (2015) and Meegan et al (2017) concurred that improved dietary quality, including associated weight loss, may improve mental health symptoms and psychological wellbeing; Saneei et al (2016) also report that having a healthy lifestyle score is associated with a reduced risk of depression and anxiety. While offering more limited choice and portion control for mental health in-patients was suggested as a possible means of reducing obesity (Cohn et al, 2010), there were also questions raised about a person's right to make their own food choices.

There were suggestions that employment may support improved quality of life (Lund et al, 2011), although people in stressful or low paid work situations also had higher incidences of obesity and poorer mental health (Kaks et al, 2016; Kyle et al, 2017; LaVela et al, 2015).

Treating apathy as a mental health problem may increase the success of weight management interventions, according to DeSouza et al (2012), with care and encouragement considered as vital to improvement. Aschbrenner et al (2016) reported the benefits of peer support in relation to group interventions for weight loss, while Bica et al (2017) suggested a good patient/provider relationship as benefiting outcomes in mental health interventions.

Obesity did not always impact negatively on mental health outcomes, however, and was reported as a protective factor for certain groups; for example obese men were reported as at less risk of suicide than those with a 'healthy' weight by Goldney et al (2009), and overweight men may have better mental health in middle age than their normal weight comparators (Ul-Haq et al, 2014).

Discussion

This review has examined the findings of 207 papers that have studied the influence of obesity on mental health, and vice versa. The direction of association between obesity and mental health is undoubtedly complex, and bidirectional (Cameron et al, 2012). Interventions that were successful were noted for their supportive nature, either via health professionals or peers.

Due to differences across genders and ethnic or cultural groups, interventions addressing mental health and cardiovascular risk reduction may impact differently between individuals and settings (Beyoun, 2009). Cultural awareness is therefore necessary within interventions (Cook et al, 2016).

Building self-esteem, confidence and educating people (potentially from an early age) about the meaning and importance of a healthy BMI, are important factors in the prevention of both obesity and improving psychological well-being (The Scottish Government, 2018a). As has been reported, poorer mental health outcomes were not only seen as a result of weight discrimination and stigma, but such attitudinal factors may also reduce motivation to lose weight (Sutin & Terracciano, 2013), or even precipitate weight gain (Udo & Grilo, 2016). This is important, given the longer term benefits to psychological health that can result from greater BMI improvements (Thieszen et al, 2011). It is debatable whether weight discrimination legislation, as suggested by Pearl et al, 2017, is the answer to these issues, but certainly supportive weight loss interventions appeared to be well received and effective in many studies within the review that reported on these outcomes.

With employment potentially offering some mental health benefits to obese individuals (Lund et al, 2011), workplace support for weight loss and increased physical activity may be a potential route to improved employee mental and physical health, which is consistent with Scottish Government healthy weight and activity delivery plans (The Scottish Government, 2018a and 2018b). In addition, employers can develop cultures that inhibit weight discrimination and stigma.

With physical activity being difficult for some people with obesity (Ball et al, 2000), it is important that barriers are identified and addressed, again without discrimination or stigma. It has been identified that activity does not necessarily have to be vigorous to be of benefit, especially where reduced ability or co-morbidities exist (Connoy et al, 2017).

For people with serious mental health conditions, increasing physical activity and weight reduction support was seen as a priority (Jerome et al, 2012), and where obesity was related to anti-psychotic medication, weight loss management was viewed as important by patients (Vandyk & Baker, 2012).

Barriers to health behaviour change were noted in certain groups (e.g. army veterans with post-traumatic stress disorder: Klingaman et al, 2016) and therefore an awareness of groups who may need greater support is necessary. However, with appropriate support many of the lifestyle interventions reported in the included papers achieved improvements in weight loss and psychological wellbeing.

Limitations

A number of limitations within the included studies, and the review, should be recognised when interpreting the findings: firstly, due to the broad scoping nature of the review, it is possible that some relevant evidence is missing. The inclusion of cross-sectional studies limits the cause-and-effect conclusions that can be drawn. There were also differences in how individual studies measured body

weight and mental health, which made comparisons more difficult (for example, obesity measures included BMI, fat mass, waist circumference, lean body mass, visceral or subcutaneous adiposity). However, the large number of studies in the review allowed for a broad overview of many different aspects to be made.

Conclusions and recommendations

In summary, this broad scoping review has highlighted a number of important aspects relating to the links between obesity and mental health. There are several key points from the review that may assist interventions that seek to support people with obesity and mental health issues.

These include:

- Acknowledgement that direction of impact between obesity and mental health is complex, may be bi or multidirectional, with physiological and psychosocial influencing factors
- Awareness of people who may require greater support; for example: people taking anti-psychotic medication, women with obesity, single men with obesity, those in the 30-50yr age range, those in stressful occupations, those with co-morbidities, in rural locations, or with socio-economic risk factors
- Workplace environments may have potential to offer healthy lifestyle support, but equally the school environment, and childhood education relating to healthy diet, weight, and attitudes, is important
- Awareness of diet quality, and the role of affordable healthy foods, in conjunction with physical activity, in improving mental well-being and healthy BMIs
- Acknowledging, and acting to reduce, the impact of weight discrimination and stigma
- Ethnicity awareness, including cultural norms, and trends within individual groups
- Acknowledgment of individual coping styles, and motivation; awareness that apathy may need to be addressed as part of interventions

Definitions

Body Mass Index (BMI) greater than 30.00 – 34.99 kg/m^2 is considered obese class I, a BMI 35.00 – 39.99kg/m^2 is obesity class II and over 40.0 kg/m^2 is considered obesity class III, often referred to as severe or morbid obesity (World Health Organisation, 2019).

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Appendix 1: Table of included studies

Lead Author(s) Date Country	Study design	Population	Outcomes/ Variables	Findings
Aarts (2014), Netherlands	Cross-sectional study.	299 morbidly obese patients	Adult attachment style, coping style, mental health and physical functioning	Coping mediates the association between attachment anxiety and attachment avoidance on the one hand, and mental health and physical functioning in patients with morbid obesity on the other hand.
Abdus (2015), USA	Cross-sectional study.	Adults aged 21 years or older. N= 53,603	Obesity, depression, racial/ethnic subgroups	The association between obesity and depression-related medication was significant for white women but not for black or Hispanic women. The results for men were mixed and inconsistent.
Abraham (2013), USA	Cross-sectional study.	Obese patients (OB) with at least two features of Cushing's syndrome (CS) from an outpatient weight management clinic (n=327). Untreated patients with CS (n=66)	Health-related quality of life (HRQL): physical component summary (PCS) score, mental component summary (MCS)	Obese patients had a significantly higher physical component summary (PCS) score than CS patients. However, the mean mental component summary (MCS) score was lower in the OB group.
Alizai (2015), Germany)	Prospective cohort study	Morbidly obese individuals seeking treatment (n=159)	Psychiatric syndromes	84 % of patients were screened positive for at least one mental health disorder. A high somatic symptom burden (46 %), depressive syndromes (62 %) and anxiety disorders (29 %) were the most frequent psychiatric syndromes.
Aparicio (2011), Spain	Cross-sectional study	Spanish female fibromyalgia patients (51.2 ± 7 years) (n=175)	Quality of life, anxiety, depression, cardiorespiratory fitness, muscular strength, flexibility, agility, and static and dynamic balance, BMI	Anxiety and depression levels increased across the weight status categories. Obese patients had higher anxiety and depression levels compared to normal-weight patients.

Arrebola (2011), Spain	Pilot clinical trial	Patients with grade II overweight and non-morbid grade I-II obesity aged 18 to 50 years (n=60)	Body composition parameters (body mass index, body fat percentage, and waist circumference), HRQL (SF-36 questionnaire)The lifestyle modification program (LMP) evaluated focused on diet, exercise, and psychological support	The lifestyle modification program (LMP) achieved improvements in health related quality of life subscales at the end of the intervention. Psychological support may improve quality of life in moderately obese patients.
Aschbrenner (2016), USA	Intervention experimental study	32 obese individuals with serious mental illness	Weight loss, participants' perceptions of peer-group support The study evaluated a peer-group lifestyle intervention enhanced with mHealth (mobile health) technology and social media	Most participants (72%) lost weight, including 28% achieving clinically significant weight loss. Weight loss was associated with perceived peer-group support.
Assari (2014), USA	Cross-sectional study	Black adults in the USA (n= 5,191)	Major depressive disorder (MDD)	Direction of association between BMI and MDD was reversed among men and women. Among men, there was a positive association between BMI and MDD, while among women, the association was negative.
Bair (2010), USA	Cross-sectional study	Community-dwelling persons with Type 2 diabetes (n=11,689)	Pain severity, health related quality of life (SF-Mental and Physical Component Summary Scores)	Participants reporting extreme pain were likely to be more obese, depressed or anxious, and report fair or poor health compared with those without pain.
Basen-Engquist (2014), USA	Longitudinal study	100 post-treatment endometrial cancer survivors	Cardiorespiratory fitness, anthropometrics, quality of life (QOL) and psychological distress	Obese survivors had lower physical functioning and ratings of general health, and more pain and somatization. Significant improvements were seen in multiple QOL domains over the course of the intervention.

Batsis (2017), USA	Cross-sectional analysis	Subjects aged =>60 (n=22,307)	Self-reported health, rural/urban status, BMI	Obese or underweight persons had lower physical health status than normal or overweight persons. Differences were less pronounced for mental health.
Bentley (2011), USA	Cross-sectional study	US adults (n=3710)	BMI, health related quality of life (HRQoL): Physical component score (PCS), Mental component score (MCS)	HRQoL was significantly lower with increasing BMI category except for MCS. Obese individuals were 5.3 units lower on PCS (1–100 scale) and 0.05–0.11 lower on the HRQoL indexes (0–1 scale) than those with normal weight.
Beutel (2018), Germany	Cross-sectional study	Data of outpatients from a mental health care department (n = 2326)	Health behaviours included obesity, uncontrolled eating, smoking and physical inactivity	'Financial stress' and 'having no one to turn to with problems' were mainly associated with adverse health behaviours. The most affected health behaviours were uncontrolled eating in both sexes and obesity in women.
Beydoun (2009), USA	Cross-sectional study	US adults aged 30–64 years from the Healthy Aging in Neighbourhoods of Diversity across the Life Span (HANDLS) study (*n* = 1789)	Depression (CES-D) scores, central adiposity outcomes	A CES-D (depression) score ≥16 was positively associated with waist circumference (WC) and with trunk fat among white women and men, respectively
Beydoun (2016), USA	Cross-sectional study	Representative sample of White women (WW, n = 236), white men (WM, n = 159), African American women (AAW, n = 395), and African American men (AAM, n = 274)	Depression [CES-D, central adiposity outcomes	Findings were indicative of depressive symptoms (DS) and central adiposity's (CA) marginally significant bidirectional association
Bica (2017), Spain	International Integrative Review	24 published studies of depression and physical illness and disease from five countries	Depression, physical illnesses/disease, obesity	Seven studies identified unhealthy lifestyles, including smoking, obesity, and physical inactivity as potential mechanisms connecting depression to physical illness.
Black et al., (2013), USA	A Cross-sectional study	Subjects with Pathological gambling (PG) and community controls N= 186	Psychotropic drugs taken, BMI, chronic medical condition	Pathological gambling is associated with obesity and worse quality of life.

Blanchard (2010), Canada	Cross-sectional study	3241 cancer survivors	BMI, HRQoL	Overweight colorectal cancer survivors reported significantly better mental health compared with obese survivors
Blomqvist (2018), Sweden	Cross-sectional study	57 participants (aged 25-66) undergoing treatment at a psychiatric outpatient settings	BMI, self-rated health, Sense of Coherence questionnaire	High prevalence of obesity/overweight among individuals with SMI.
Bond (2010), Canada	Longitudinal study	46 patients with bipolar I disorder (BD-I) who recently recovered from their first manic episode.	Clinically significant weight gain (CSWG) over 12 months, amount of time spent with mood symptoms, functioning at 12 months (assessed using Multidimensional Scale of Independent Functioning)	Patients with clinically significant weight gain (CSWG) had significantly poorer 12-month global functioning than those without CSWG
Bourke-Taylor (2015), Australia	Cross-sectional study	Mothers of school-aged children in Victoria (n = 263)	Depression, anxiety, stress, participation in health-promotion activities, BMI	Higher BMI was associated with poorer mental health (depression, anxiety) and lower participation in health-promoting activities
Bowen (2017), USA	Cross-sectional study	918 African-American and Caucasian adults aged 65 and over	Depressive symptoms, diabetes, obesity	Older adults who were obese and had diabetes were more likely to exhibit depressive symptoms. There was no strong association between depressive symptoms and people who were only obese.
Boynton-Jarrett (2012), USA	Prospective cohort study	59000 black women ages 21 to 69 years at baseline in 1995	BMI, exposure to abuse in childhood or as a teenager	Early life sexual and physical abuse was associated with an increased risk of overall and central obesity in adulthood.
Brewer-Smyth (2016), USA	Cross-sectional study	636 adult inmates in a southern state prison	BMI, childhood adversity, social support, psychopathy, drug dependence, other mental health conditions	Obese individuals more likely were victims of childhood sexual abuse, suffered greater severity of childhood sexual abuse, attempted suicide, reported drug dependency than non-obese. Psychopathy predicted lower BMI.
Brumby (2012), Australia	Cross-sectional study	Data of men (n=957) and women (n=835) farmers from Australia	Overweight, obesity, body fat percentage and psychological distress	There was a positive significant association between the prevalence of psychological distress and obesity, abdominal adiposity,

				body fat percentage and metabolic syndrome in older (age 50 years) participants.
Brumby (2013), Australia	Cross-sectional study	1,792 adults within Australian farming communities	Alcohol consumption patterns, mental health, psychological distress, BMI, abdominal adiposity and other physical health parameters	There was a significant positive association between the prevalence of high-risk alcohol consumption and the prevalence of obesity and abdominal adiposity in psychologically distressed participants
Buckley (2013), Australia	Longitudinal study	South Australian baby boomers (n= 1,448 for 2000-2002; n = 1,179 for 2004-2006)	HRQoL (SF-36 summary scales), obesity (BMI ≥ 30)	Obesity was associated with deterioration in physical HRQoL
Bulcun (2012), Turkey	Observational study	111 subjects who diagnosed obstructive sleep apnoea (OSA) and 18 non-OSA snoring subjects	Quality of life, with short form (SF)-36, BMI	Obese patients with OSA had lower physical and mental components compared with non-obese patients with OSA
Buoli (2017), Italy	Cross-sectional study	238 bipolar patients	Presence of rapid cycling, obesity and history of obstetric complications	Obesity and obstetric complications are risk factors for the development of rapid cycling in bipolar disorder.
Burrows et al., (2017), Australia	Cross-sectional study	A sample of Australian adults using the revised Yale Food Addiction Survey (YFAS) tool. N= 1,344	BMI, depression, anxiety, stress, anxiety sensitivity.	People with “severe” or extremely severe depressive symptoms had the highest odds of having severe food addiction. Addictive food behaviours are associated with a complex pattern of poor dietary choices and a clustering with mental health issues, particularly depression.
Cameron (2012), Australia	Longitudinal Study	5985 men and women aged 25 years at study entry	BMI, waist circumference, self-report data on health-related quality of life (SF-36 questionnaire)	For men and women, each of the quality-of-life domains related to mental health as well as the mental component summary were inversely associated with BMI change (except vitality, which was significant in women only)
Campbell (2016), USA	Cross-sectional study	48,526 U.S. adults	Psychological, physical, and sexual forms of abuse as well as household dysfunction, obesity	Sexual abuse and verbal abuse were the two ACE components that independently affected most of the outcomes investigated in this study, including obesity.

Carpiniello (2009), Italy	Cross-sectional study	150 patients attending a University Centre for the Diagnosis and Treatment of Obesity over a six-month period	Axis I disorders (major depression, dysthymia and other depressive and Bipolar disorders, Mood disorders), Axis II disorders (Personality Disorder), BMI	The present study confirms the high prevalence rates of mental disorders in obese patients seeking treatment.
Castilla-Puentes et al., (2011), USA	Cross-sectional study	Emergency department (ED) patients in Latin America (N= 1,505)	BMI, DSM IV-criteria interview and the Mood Disorder Questionnaire (MDQ).	Compared to non-BPD (bipolar disorder) patients, BPD patients were more likely to report obesity (39.7% vs. 26.9%)
Castillo-Sánchez et al., (2017), Spain	Cross-sectional study	A total of 4911 patients in the schizophrenia group, 4157 in NS-TAD (antipsychotic drugs) group, and 98644 in the control group	BMI, schizophrenia	Schizophrenia patients were screened for dyslipidaemia and diabetes more frequently than the control group, while for obesity or hypertension, they were screened equal to controls.
Chee (2019), Australia	Qualitative study	24 young consumers (18 - 35 years) who were case managed by one metropolitan community mental health service	Young people's health literacy, physical healthcare needs, and interest and knowledge about their physical health	Participants reflected that mental health professionals did not focus on physical health. Preventable physical illnesses such as reducing their risk for obesity associated with the adverse effects of antipsychotic medications were not addressed at this stage of their illness journey.
Chen et al (2018), USA	Two longitudinal studies	Study 1: African American participants aged 19-25 years (n = 516) Study 2: African American participants aged 17-29 years (n = 992)	Study 1: BMI, marijuana use. (data was collected at age 11, 19 and 25 years) Study 2: Depression, delinquency, marijuana use (data collected at 1, 7, and 14 years post baseline)	18%–27% of participants in both studies showed increasing obesity over time. Substance use trajectories were associated with poorer mental health in adulthood; obesity trajectories with poorer physical health in adulthood.
Cheney (2014), USA	Cross-sectional study	948 women veterans	Lifetime Sexual Assault (LSA), Mental Health History, Posttraumatic Stress Disorder, Depression, Substance Use and	Greater BMI was positively associated with LSA, depression, and borderline personality disorder (BPD) and negatively associated with current substance use disorder in multivariate models. The relationship

			Substance Use Disorders, BMI	between sexual assault and BMI was completely mediated by BPD and depression.
Cheng et al., (2016), Australia	Review	Young adults	Obesity, psychosocial health outcomes	Obesity in young adulthood is associated with a variety of poor psychosocial health outcomes. Stigma and discrimination can exacerbate feelings of guilt and body related shame, which in turn mediate the relationship between obesity and low self-esteem.
Chwastiak (2011), USA	Cross-sectional study	Veterans (n=501,161) Data from the 1999 Large Health Survey of Veterans	Psychiatric diagnoses, Obesity (BMI)	There were statistically increased odds of co-occurrence of obesity, among veterans with each of the psychiatric diagnoses, with the exception of drug use disorders
Ciciurkaite & Perry (2018), USA	Cross sectional study	Females aged 35 to 89 (n = 2,203)	Psychological wellbeing from Short Form Health Survey, BMI, socio-demographic characteristics, weight-based discrimination	Higher social status has a buffering effect of weight stigma on psychological well-being.
Clerici et al (2014), Italy	Cross sectional study	Inpatients admitted to San Gerardo University Hospital with severe mental illness (n = 119) and without severe mental illness (n = 119)	BMI, waist circumference, fasting triglycerides and total/HDL cholesterol ratio, mean systolic blood pressure, severe mental illness diagnosis	People with severe mental illness (SMI) may not necessarily have higher CVD risk, as compared with general population.
Coco et al., (2011), Italy	Cross-sectional study	Participants were recruited from a mental health care service specializing in eating disorders in Palermo (Italy). N=224	BMI, psychopathologic factors	Interpersonal problems (low-self-esteem etc) were associated with binge behaviours and self-esteem in obese participants.
Cohn et al (2010), Canada	Uncontrolled natural experiment	Residents at a psychiatric rehabilitation unit in Toronto (n = 53)	Weight, BMI, schizophrenia/schizoaffective diagnosis	A relatively simple modification in food delivery was associated with weight loss which increased after 6 months
Coin-Araguez (2018), Spain	Observational study	Patients waiting for weight-related or abdominal laparoscopic surgery in two hospitals in Malaga, Spain consisting of non-obese (n = 31) and obese (n = 34)	BMI, insulin resistance, glucose levels, total cholesterol, high and low density lipoproteins, gene	There is potential involvement of visceral adipose tissue in anxiety and mood disorders with complex mechanisms strongly impacted by obesity.

		subjects, who were diagnosed with anxiety or mood disorders; and non-obese (n = 25) and obese (n = 19) subjects, who were not diagnosed with anxiety or mood disorders	expression of adiponectin, leptin, and inflammatory markers (IL6, IL1B, TNF, CCL2, CSF3, ITGAM, and PLAUR)	
Connor et al (2016), USA	Follow-up study of breast cancer cases/survivors and controls	Breast cancer survivors (339 Hispanic and 388 Non-Hispanic White) and population-based controls (391 Hispanic and 453 Non-Hispanic White)	Physical and mental health from the SF-36 Quality of Life Survey, BMI, ethnicity, comorbidities	Baseline obesity was significantly associated with decreased mental health among survivors, but not controls. No significant interactions between ethnicity and BMI.
Conroy et al (2017), USA	Secondary analysis of baseline data	Older (≥65 years), overweight or obese breast, prostate, or colorectal cancer survivors (n = 641, 54% female)	Physical activity, quality of life (vitality, emotional role functioning, social role functioning and mental health), BMI, comorbidities, healthy eating index, fruit and vegetable servings a day	Some activity appears to be better than none for important dimensions of mental quality of life.
Cook (2013), USA	Retrospective review	Includes chart reviews of patients in residential care (April - December 2009) N= 194	Depression and mood disorder, BMI	Patients seen in primary care practices have non-alcoholic fatty liver disease (NAFLD), but patients in treatment centres for mental health disorders are also affected.
Cook et al., (2015), USA	Cross-sectional study	457 adults with serious mental illnesses in four U.S. states	Obesity, alcohol abuse, drug abuse	Sixty percent of outpatients with mental illnesses were obese compared to 36% in the general population
Cook et al., (2016), USA	Cross-sectional study	457 adults with serious mental illnesses in four U.S. states	BMI, Psychiatric diagnoses	Co-occurring diabetes and obesity was almost three times as likely among African Americans with serious mental illnesses. Older persons and those with poorer self-rated physical health also were more likely to have these co-occurring conditions.
Copeland et al (2012), USA	Retrospective study	254,051 obese primary care patients within the Veterans Health Administration, with primary care visit in fiscal year 2002 and surviving through fiscal year 2006	Receipt of obesity related care (counselling, drugs, surgery), long term weight loss or gain.	Psychiatric patients were relatively more likely to receive obesity care

Correll, (2014), USA	Cluster-randomized comparison study	Patients with first-episode schizophrenia spectrum disorders (FES) from community mental health clinics across the United States. (n = 394)	Body composition (BMI, fat mass, fat percentage), psychiatric illness duration, antipsychotic exposure/cardio-metabolic risk	48.3% of participants were obese or overweight. Total psychiatric illness duration correlated significantly with higher body mass index, fat mass, fat percentage, and waist circumference.
Curtis (2010), Australia	Retrospective case record Audit/naturalistic study	85 patients 16–27 years old attending an Early Psychosis Service between October 2006 and June 2008	BMI, sociodemographic variables, current medication, metabolic abnormalities	Over a third of young patients being treated for their first episode of psychosis either had metabolic syndrome or showed metabolic abnormalities.
Daumit (2013), USA	Randomised weight-loss trial	Overweight or obese adults (≥18 years of age) who attended a community psychiatric rehabilitation program (N = 291)	BMI, blood pressure, waist circumference, fasting blood chemical levels, psychiatric diagnoses	A behavioural weight-loss intervention significantly reduced weight over a period of 18 months in overweight and obese adults with serious mental illness.
Davillas, Benzeval and Kumari (2016), UK	Cross sectional study	11,257 participants (aged 18+) of Understanding Society: the UK Household Longitudinal Study	Mental health functioning (GHQ-12 and MCS-12), measures of adiposity (BMI, body fat %, abdominal obesity)	Higher adiposity was associated with poorer mental health functioning. This emerged in the 30s, increased up to mid-40s or early 50s and then decreased with age.
Davin & Taylor (2009), USA	Review	Populations with obesity	Psychosocial factors, obesity	Findings support the need for further psychological consideration following surgical and non-surgical treatments for obesity.
de Carvalho-Ferreira (2012), Brazil	Intervention evaluation	49 obese adults (12 male and 37 female)	Binge eating, body shape dissatisfaction, Beck depression inventory, Beck anxiety inventory, quality of life (WHO), anthropometric measurements (body mass, stature, BMI)	The interdisciplinary therapy was effective in promoting positive physical and psychological changes and in improving the quality of life of obese adults.
De Miguel Diez(2012), Spain	Cross sectional study	Data obtained from the European Health Interview Survey for Spain (EHISS, 2009) (n = 19,598)	Asthma sufferer, chronic bronchitis sufferer, depression, anxiety, psychological dysfunction, positive mental health state, lifestyle related habits	Healthy individuals have better mental health than patients with asthma and CB.

			(smoking, alcohol, physical exercise), BMI	
De Montigny et al (2017), Canada	Cross sectional study	645 men aged between 19 and 71 were randomly recruited through membership of four major unions in Quebec, Canada	Positive mental health – Mental Health Continuum Short Form (emotional wellbeing, psychological wellbeing, social wellbeing), BMI	Overweight single men have marginal associations with higher emotional well-being, but obese single men have associations with lower psychological well-being and marginal lower social well-being. Men in a relationship have no significant associations with any variables.
De Wit et al (2009), Netherlands	Cross sectional study	43,534 individuals, aged between 18–90 years from Netherlands.	BMI, depression (Mental Health Inventory)	Evidence for a significant U-shaped trend in the association between BMI and depression
De Wit et al (2010), Netherlands	Cross sectional study	1,854 women and 955 men aged 18–65 years were recruited from the community, general practices, and specialized mental health care	Depressive and anxiety disorders (major depressive disorder, dysthymia, generalized anxiety disorder, social phobia, panic disorder, and agoraphobia), BMI, physical activity status, social activity status	There is a link between depressive disorders and obesity influenced by lower social and physical activities among the depressed.
Desouza et al (2012), USA	Randomised prospective pilot study	Obese patients (n=101)	Apathy evaluation scale, Hamilton Depression Scale, Patient Activation Measure, absolute changes in weight (kg)	Apathy might be an important factor in the success of weight management programmes.
Diesel et al., (2016), USA	Longitudinal study	Pregnant women recruited from a prenatal clinic in Pittsburgh, USA, that served predominantly low-income women.N=1,360	BMI, depression.	Women who were parous, smoked heavily, had excessive weight gain and elevated depression in early pregnancy were more likely to be obese.
Dreber (2015), Sweden	Cross sectional study	Treatment seeking adults (16-25 years) with severe obesity and mental health comorbidities, 165 participants (132 women, 33 men)	Anxiety, depression, and attention-deficit/ hyperactivity disorder, self-esteem, suicide attempts, health-related quality of life, psychosocial functioning	Many health issues including mental health problems were prevalent in treatment seeking young adults with severe obesity

			related to obesity, somatic and psychiatric comorbidities	
Dreber (2017), Sweden	Cross sectional study	Treatment seeking young adults (18-25 years) with severe obesity (n=121) and population controls of normal weight (n=363)	Mental distress (GHQ-12 scores - depression, anxiety, suicide attempts), BMI, quality of life	There was significantly more mental distress in treatment seeking young adults with obesity compared to their non-treatment-seeking counterparts
Duarte (2010), Finland	Longitudinal study	2209 young adults for whom child mental health was measured at 8	Child mental health at 8 years (depression, emotional problems, conduct problems, and hyperactivity), BMI in early adulthood	Conduct problems in childhood are prospectively associated with overweight and obese in young adulthood.
Dube (2010), USA	Cross-sectional study	5,352 noninstitutionalized adults aged 18 years or older	Obesity (BMI of ≥30), adverse childhood experiences	For those with both abuse and household dysfunction, the odds of obesity were 1.3. Childhood adversities appear to be associated with health problems such as obesity among Texas adults.
El-Gabalawy (2010), USA	Cross-sectional study	34,653 adults, aged ≥ 20 years, residing in the United States	Borderline personality disorder, Obesity (BMI > 30)	Obesity was not associated with borderline personality disorder in the most stringent models.
Eldridge et al., (2011), UK	Cross-sectional study	Participants are from the Well-Being Support Program (WSP). N= 782	BMI, Self-esteem, Alcohol use, Substance use	The majority of the sample was overweight or obese. Lifestyle risk factors for cardiovascular disease (CVD) were common and the patients had low self-esteem.
Emerson (2017), USA	Cross-sectional study	711 mothers of infants < 13 months	Depression, stress, anxiety, emotional and restrained eating attitudes. Obesity (BMI ≥ 30)was explored as a moderating variable	Obesity did not moderate the association between mental health and odds of emotional and re-strained eating attitudes
Esteban (2010), Spain	Case-control epidemiological study	Patients with diabetes and matched controls (n = 1074)	Mental health (12-item General Health Questionnaire), HRQL (COOP/WONCA questionnaire), s obesity	Obesity was one of the variables that determined a poorer perception of HRQL among diabetes sufferers

			(body mass index [BMI] ≥30 kg/m2),	
Fan (2009), USA	Cross-sectional study	10,283 Florida adults	Self-rated current depression, lifetime diagnosis of depression and anxiety, obesity (BMI was 30 kg/m2 or more)	Obesity was one of the factors independently associated with current depression and lifetime diagnosis of depression and anxiety
Fernandez-Mendoza et al., (2012), USA	Longitudinal study	A random, general population sample of the adult Penn State Cohort N=1,741 (1,395 were followed up after 7.5 yrs)	Physical and mental condition, incidence of poor sleep.	Physical conditions such as obsity, mental health conditions (e.g., depression) and behavioural factors (e.g., smoking and alcohol consumption) increased the odds of incident poor sleep as compared to normal sleep.
Fernández-Ruiz (2018), Spain	Randomized controlled clinical trial	74 subjects diagnosed with obesity	The intervention consisted of a 12-month interdisciplinary program. Outcomes: Health-related quality of life (SF-36), anxiety (State-Trait Anxiety Inventory)	The interdisciplinary program led by nursing professionals has improved the quality of life related to health and has prevented the increase of anxiety-trait in participants, maintaining the long-term effects.
Fezeu (2015), UK	Prospective cohort study	3 388 men aged ≥ 18 years	BMI, waist circumference, self-reported common mental disorder	These findings of the present study suggest that the direction of association between common mental disorders and adiposity is from common mental disorder to increased future risk of adiposity as opposed to the converse.
Florez (2016), USA	Cross-sectional study	Adults who self-identified as the primary food shopper of the household in low-income African-American neighbourhoods (n = 639)	BMI, depressive symptomatology	A higher score in depressive symptomatology was associated with higher BMI
Frisco et al., (2013), USA	Longitudinal Study	Participants' data are from wave 2 (in 1996) and wave 3 (in 2000–2001) of the US-based National Longitudinal Study of Adolescent Health N=5,243	Body weight, depression	Overweight adolescent girls who were obese by young adulthood, as well as young women who were consistently obese during adolescence and young adulthood, had roughly twice the odds of depression onset as young women who were never overweight.

Fuller-Thomson (2013), Canada	Cross-sectional study	12,590 participants from the 2005 Canadian Community Health Survey	Childhood physical abuse, obesity	Among women with childhood physical abuse compared to no abuse, the odds of obesity were 35% higher, even when controlling for confounding factors. Childhood physical abuse was not associated with adult obesity among men.
Gadalla (2009), Canada	Cross-sectional study	Adults aged 20 to 64 years	Obesity, mood disorders, anxiety disorder, depression	Obesity was significantly associated with mood disorders, but not with anxiety disorders.
Garner (2013), Canada	Longitudinal study	3864 males and 4745 females who were 40+ years in 1998/99 and followed through 2006/07	HRQL (measured with the Health Utilities Index Mark 3), BMI	For males, there was a large HRQL decrement for being underweight. For females being underweight was associated with higher HRQL at younger ages but lower at older ages.
Gladigau et al., (2014), Australia	Cross-sectional study	People with severe mental illness (SMI) engaged in community psychiatric rehabilitation N= 60	Body mass index, waist circumference, SMI	Patients with psychiatric disorders were more likely to smoke, be obese, have dyslipidaemia and the metabolic syndrome compared with the general and ATSI populations of Australia.
Glintborg (2013), Denmark	Cross-sectional study	598 older men	HRQoL (measured by SF-36 dimensions), waist, lean body mass, visceral adipose tissue and subcutaneous adipose tissue (SAT)	The SF-36 dimensions such as physical function, general health, vitality and role limitations functional were inversely associated with waist and subcutaneous adipose tissue (SAT). Waist had a strong negative association with SF-36 dimension scores.
Goldney (2009), Australia	Cross-sectional study	Representative samples from the South Australian population (n = 33,248)	BMI, mental health, suicidal ideation, psychological distress	Obese and morbidly obese men were significantly less likely to have major depression or suicidal ideation than those of a healthy weight. Overweight women reported less psychological distress than those of a healthy weight.
González-Chica et al., (2017), Australia	Cross-sectional study	2912 South Australian adults	Obesity, mental health, quality of life	In the context of multi-morbidity, musculoskeletal diseases are a key determinant group of the physical

				component score, amplifying the association of other chronic conditions on physical but not on mental health.
Goodwin et al., (2009), Finland	Longitudinal study	Participants are from: 'From Boy to Man' study, a 15-year follow-up study N= 2,712	BMI, mental health problems: conduct, hyperkinetic depressive symptoms, emotional	There is an association between mental health problems during childhood and increased risk of obesity, during early adulthood.
Greenwood-Hickman et al., (2016), USA	Qualitative cross-sectional study	24 overweight and obese older adults aged 60 and older (following a sedentary behaviour reduction intervention)	Motivators and barriers to reducing SB, BMI	Participants reported impacts on physical and mental health and changes in awareness, exercise, and daily activity. Barriers to reducing sedentary behaviour included fatigue.
Guenzel et al., (2016), USA	Cross-sectional study	Individuals with schizophrenia (n = 181) or bipolar disorder (n = 299), and a control group (n = 5,161)	Adverse childhood event data (variables of abuse, neglect), BMI	Among females, a history of physical abuse from parents or paternal emotional neglect was associated with an increased risk for obesity
Guenzel & Schober., (2017), USA	Cross-sectional study	20,013 community dwelling individuals over the age of 18	BMI, mental disorders	Bipolar disorder, agoraphobia, attention-deficit hyperactivity disorder, and panic disorder had the greatest number of comorbid disorder associations linked with elevated BMI.
Hagberg et al., (2019), Sweden	Randomised controlled trial	Postpartum women within the primary health care setting in Sweden. N= 110	Weight, mental health	A diet intervention that produced clinically relevant postpartum weight loss also resulted in increased QOL and was cost-effective.
Hamer et al., (2016), UK	Cohort study	4,733 mother-child pairs	BMI, depression	Maternal mental health influences offspring obesity through mechanisms other than depression.
Happell et al., (2014), Australia	Cross-sectional study, Randomised controlled trial	Adult mental health care consumers of a regional hospital community mental health service in Australia N= 21	BMI, mental disorders	There was a high prevalence of obesity among those with serious mental illness.
Haskell et al., (2017), USA	Cohort study	Iraqi veterans N= 267,305	BMI, mental disorders	The increased risk of obesity for women was greater in black women, and those with depression.

Hassapidou et al., (2011), Greece	Pre-post intervention	989 psychiatric patients	BMI, severe mental illness Evaluated a nutritional intervention	The nutritional intervention produced significant reductions in body weight, body fat and improved the cardiometabolic profile in patients with serious mental illness.
Hatzenbuehler et al., (2009), USA	Cross-sectional study	A subsample of overweight and obese individuals (N = 22,231) from a nationally representative study of noninstitutionalized US adults.	BMI, mood and anxiety disorders, substance use disorders, perceived stress	There was a relationship between perceptions of weight discrimination and prevalence of current psychiatric and substance use disorders. Perceived weight discrimination was also associated with greater psychiatric comorbidity.
Henriksen et al., (2014), Canada	Longitudinal study	Participants aged 30 to 86 years from the Baltimore Epidemiologic Catchment Area (ECA) study. N= 1,071	BMI, mental disorders, suicidality	No associations between baseline obesity and onset of mental disorders or suicidal behaviours between waves 3 and 4. However, baseline obesity predicted new-onset suicide attempts.
Heo et al., (2010), USA	Cross-sectional study	US adult respondents to the 2007 Behavioural Risk Factor Surveillance Survey N = 430,912	Mental health status, BMI	Functional impairment is associated with obesity, primarily due to medical comorbidity conditions (including emotional problems).
Hollingsworth et al., (2012), Australia	Cross-sectional study	Participants were recruited from antenatal care at an Australian tertiary hospital. N=239	BMI, pre-pregnancy and current mental health status	Pre-pregnancy obesity in women attending antenatal care was associated with a self-reported history of emotional or physical abuse with those exposed to moderate or severe emotional or physical abuse having increased odds of being obese prior to pregnancy.
Holt et al., (2010), UK	Longitudinal study	113 patients with severe mental illness from a self-referring weight management clinic	BMI, psychological health	Lifestyle advice within a group setting may be effective in long-term management of obese and overweight patients with severe mental illness.

Imayama et al., (2011), USA	Randomised controlled trial	439 overweight/obese postmenopausal women	HRQOL and psychosocial factors: depression, stress, BMI	Combination of dietary weight loss and exercise may have a larger beneficial effect on HRQOL compared with dietary weight loss or exercise alone.
Jakabek et al., (2011), Australia	Cross-sectional study	665 patients with serious mental illness attending out-patient clinics in Western developed countries and Palestine	Mental disorders, BMI	More participants with serious mental illness from Palestine were overweight or obese (62%) compared to Western countries (47%).
Jimenez et al., (2016), USA	Qualitative, semi-structured interview study	20 obese Latinos with serious mental illness (SMI) enrolled in a trial evaluating a health promotion intervention adapted for persons with SMI	BMI, self-esteem, mental health	Overweight and obese Latino participants believed that engaging in health behaviour change would have both physical and mental health benefits.
Jonikas et al., (2016), USA	Cross-sectional study	Adults attending public mental health programs in 4 U.S. states. N= 457	BMI, psychiatric conditions	Women were significantly more likely to be obese than men. Obesity also was more likely among those who were younger and not high school graduates, those with diabetes or hypertension, and those who did not smoke tobacco.
Jung & Chang, (2015), USA	Longitudinal study	Adult population recruited through a telephone survey from 1993 through 2010. N= more than 2 million	BMI, self-reported Mentally Unhealthy Days (a measure of non-specific mental distress)	Individuals with obesity experienced more mental distress compared to their counterparts without obesity over time. Such an increasing trend was much more prominent for women, Whites, adults aged 36–45, low-income earners, and individuals with some college education.
Keating et al., (2013), Australia	Cross-sectional study	10,959 individuals aged ≥ 25 years from Australia	Body weight, mental health, social functioning etc	Results confirmed an inverse dose–response relationship between body weight and utility-based quality of life.
Khubchandani & Price, (2017), USA	Cross-sectional study	Working adults in the US, data from the National Health Interview Survey. N= 17,441	BMI, psychological distress	Those who reported job insecurity had significantly higher odds of: being obese, sleeping less than 6 h/day, smoking every day, having work loss days >2 weeks, and

				worsening of general health in the past year. Job insecure individuals had a likelihood of serious mental illness within the past 30 days almost five times higher than those who were not job insecure.
Kim et al., (2014), USA	Cross-sectional study	2,017 adults aged 60 and older	BMI, and self-rated mental health (SRMH)	A significant interaction between BMI and race/ethnicity and self-rated mental health (SRMH) was found. Whites had a significant trend showing that SRMH decreased with increases in BMI, whereas Blacks had a significant trend showing that SRMH increased with increases in BMI.
Kingsbury (2018), Australia	Longitudinal study	3470 mothers	Birth outcomes, depression, sociodemographic and behavioural factors	Obesity was one of the variables that was significantly associated with women's moderate-rising depressive symptoms trajectory over 27 years
Kinley et al., (2015), Canada	Cross-sectional study	Representative sample of the noninstitutionalized, German population, aged 18–65. N= 4181	Obesity, depression, anxiety disorders	Anxiety but not depression is positively associated with metabolic and cardiac conditions in this sample.
Kivimaki et al., (2009), UK	Prospective cohort study	4363 adults from civil service departments in London	Mental disorder, overweight, obesity	Obesity predicted future risk of common mental disorder.
Klingaman et al., (2016), USA	Cross-sectional study	Veterans of the United States Armed Forces with posttraumatic stress disorder (PTSD), and veterans with no mental health disorders. (N = 171,884)	BMI, mental health disorders (e.g., PTSD, bipolar disorder, schizophrenia)	Compared to Veterans without mental health disorders, more Veterans with PTSD endorsed 27 of the 28 barriers to changing eating and physical habits.
Kuebler et al., (2013), USA	Cross-sectional study	Data from a large social media database, with users around the world. N= unknown, more than 200 million questions and over one billion answers	BMI, obesity, physical and mental health	Obese people residing in counties with higher levels of BMI may have better physical and mental health than obese people living in counties with lower levels of BMI by some measures, but these improvements are modest.
Laxy (2014), Germany	Longitudinal study	3,080 adults (KORA S4/F4 cohort study)	Health related quality of life, body mass index	Heavy weight gain (≥ 10% body weight) was associated with improvements in mental health among women. Authors note the need

				for more research to clarify the effects of weight change on mental health components.
Lazarevich (2013), Mexico	Cross-sectional study	1,122 university students	Abdominal obesity (BMI), depression (Beck Depression Inventory), Anxiety (General Anxiety Disorder Scale of Carrol and Davidson) and impulsiveness symptoms	An increased weight circumference was associated with depression symptoms, female sex, and age.
Lerdal (2011), Norway	Cross-sectional study	128 adults	Health-related quality of life	Obese participants scored lower on all the health related quality of life domains, particularly on the general health sub-domain and the physical component score.
Lima (2015), Brazil	Cross-sectional study	776 older adults	Excessive daytime sleepiness, obesity	Excessive day time sleepiness was associated with obesity.
Linardakis (2015), Greece	Cross-sectional study	20,026 adults aged 50 years or older from the Survey of Health, Ageing and Retirement in Europe (2004-2005)	Depression (Euro-D score); overweight or obesity (BMI)	There was a significant trend for increasing body weight with poorer depression scores
Lopuszanska et al., (2016), Poland	Cross-sectional study	91 persons suffering from mental illness (51 women and 40 men).	BMI, mental illness, MMSE	Negative correlations between cognitive functions and body mass, overweight and abdominal obesity was observed in women. In men these correlations were not observed.
Lund (2011), Norway	Cross-sectional study	143 treatment-seeking adults with morbid obesity	Mental health status, obesity and weight-loss quality of life	Employment is associated with the physical and mental health related quality of life of morbidly obese adults, but is not associated with the emotional aspects of quality of life.
Magallares (2014), Spain	Cross-sectional study	221 participants (111 obese individuals and 110 controls)	Psychological wellbeing	Obese participants reported less psychological wellbeing than normal weight adults but the difference was not significant.
Maguen (2013), USA	Retrospective longitudinal cohort study	496,722 Afghanistan and Iraq veterans	BMI, posttraumatic stress disorder, depression	Those with PTSD and depression were at the greatest risk of being either obese without weight loss or overweight or obese and continuing to gain weight. Adjustment for demographics and antipsychotic medication

				attenuated the relationship between BMI and certain mental health diagnoses.
Mangurian (2016), USA	Literature review	-	Obesity, mental illness	Identified associations between antipsychotics and weight gain.
Manu (2014), USA	Longitudinal study	945 readmitted patients	BMI, psychiatric readmission	Higher BMI was an independent predictor of psychiatric readmission.
Martin-Lopez (2011), Spain	Cross-sectional study	15,099 women aged ≥ 18 years	Self-declared diagnosis of psychiatric disorders or use of psychiatric drugs, obesity	Obese women had higher prevalence of psychiatric disease compared with women of normal weight.
Massetti (2017), USA	Cross-sectional study	90,821 adults, aged 18-39 years	Mental health problems, overweight or obesity	Mental health problems were associated with being overweight or obese among women only.
Mather (2009), Canada	Cross-sectional study	36,984, aged 15 years and older	Obesity, depression, mania, panic attacks, social phobia, agoraphobia, any lifetime mood or anxiety disorder, suicidal ideation, and s and drug dependence.	Obesity was positively associated with depression, mania, panic attacks, social phobia, agoraphobia, any lifetime mood or anxiety disorder, suicidal ideation, and suicide attempts, with most associations for women and some for men.
McCarthy (2014), USA	Longitudinal study	4,005,640 adults	BMI and suicide risk.	Overweight and obese status were associated with lower risk of suicide.
McDaid & Smyth, (2015), Ireland	Review	People with schizophrenia	Obesity and schizophrenia.	Obesity was identified as a metabolic abnormality associated with schizophrenia.
McLeod (2016), New Zealand	Longitudinal study	Data from the New Zealand birth cohort (n = 1265).	Adiposity, depressive symptoms, life satisfaction.	There was a statistically significant relationship between adiposity and depressive symptoms and life satisfaction.
Meegan (2017), Ireland	Cross-sectional study	2047 middle-aged adults	Diet (self-completed questionnaire), anxiety, wellbeing	There were significant associations between high diet quality and well-being in non-obese subjects only, not in obese subjects. There was no relationship between diet quality and anxiety.
Megakli (2016), Greece	Randomised controlled trial	72 women with obesity	Health-related quality of life	The intervention revealed effects for mental health, vitality, and emotional functioning but not social functioning. Changes in weight was

				not significantly associated with these aspects of health-related quality of life.
Metz (2009), Germany	Cross-sectional study	123 adults	BMI, quality of life, perceived stress	Restrictions in all parameters of mental health for overweight and obese patients in primary care were shown. Especially patients with a BMI above 30 kg/m2 reported a decreased level of quality of life.
Mina et al., (2015), UK	Cohort study	Pregnant women with a BMI ≥ 40 (N = 222), and lean controls with BMI ≤ 25 (N = 135)	BMI, mood assessment	Maternal very severe obesity (SO) is associated with increased anxiety and depression (A&D) symptoms during pregnancy, and with adverse effects on postpartum mood.
Morris (2010), Australia	Cross-sectional study	1212 adults	Obesity (BMI), categorised into normal weight, overweight and obese. Physical and mental health (SF-12).	Significant associations were observed between excess weight and poor mental health. Obesity had a significant association with poor mental wellbeing for adults aged 45-54 years. No sex differences were found.
Mulugeta (2018), Australia	Longitudinal study	9217 adults for cross-sectional; 7340 prospective from the 1958 British birth cohort	Depression, central obesity (weight circumference and BMI)	Depressive symptoms were associated with obesity among women and men in mid-life.
Mulugeta (2019), USA	Longitudinal study	1055 adults at a large refugee health centre.	Mental illness, obesity.	Compared to those without mental illness, refugees with mental illness had significantly higher rates of obesity and overweight.
Mumford (2013), USA	Longitudinal study	8230 youth aged 12-16 at baseline, US National Longitudinal Survey of Youth	BMI, poor mental health	The risk of developmental trajectories of poor mental health and BMI outcomes is greater for females, blacks, Hispanics, and individuals living below the poverty line.
Nagl et al., (2015), Germany	Systematic review: cross-sectional, prospective cohort,RCTs	General pregnant population, obese pregnant population, examining antenatal and post-natal outcomes N= 4,142	BMI, anxiety disorders	5/7 studies focusing on pregnancy obesity and anxiety suggest a positive association with ante-or post-natal anxiety.
Naslund (2017), USA	Secondary analysis of two Randomised controlled trials	343 overweight and obese adults	Depressive symptoms	Change in depressive symptoms did not differ between groups, but depressive symptoms decreased over time across the entire sample. Reduced depressive symptoms was

				associated with 10% or more weight loss across both groups.
Nichele & Yen, (2016), France	Cross-sectional study	13,628 adults ≥ 20 years old	Obesity, mental health	Overweight and obesity contribute to mental health disorders, more notably in men than women. Men with mental health disorders are less likely to be overweight or obese.
Odlaug et al., (2015), Denmark	Cross-sectional study	1765 college and graduate students from a large Midwestern United States University	BMI, Minnesota Impulsive Disorders Interview (MIDI), Perceived Stress Scale (PSS), Major Depressive Disorder, psychiatric disorders	Obese males had significantly higher rates of lifetime trichotillomania while overweight and obese females reported higher rates of panic disorder.
Ohayon & Roberts, (2014), USA	Cross-sectional & longitudinal study	The US non-institutionalized general population. N= 2,082	Depressive symptoms, BMI	Correlates for depressive mood and Major Depressive Disorder (MDD) such as female gender, dissatisfaction with social life, obesity, living with pain and other factors were identified across groups.
Okoro et al., (2014), USA	Cross-sectional study	Adults with disabilities- Data from the 2007 Behavioural Risk Factor Surveillance System (n= 430,912)	Psychological distress, mental health treatment, obesity	Those with mild to moderate psychological distress and severe anxiety or depressive disorders had higher unadjusted estimates for obesity compared with those with no psychological distress.
Ormel (2017), Netherlands	Longitudinal study	1778 youths were followed from pre-adolescence to young adulthood (Dutch TRAILS study)	Mental health disorders, obesity	Out of 19 mental health disorders, 2 were predicted by current obesity.
Pacanowski et al., (2018), USA	Randomised controlled trial, longitudinal study	Participants were recruited from Look AHEAD (a multicenter, randomized, clinical trial including overweight or obese adults with type 2 diabetes). N= 5,145	Mental health, depressive symptoms, binge eating, BMI.	The cross-sectional relationship between weight variability and psychological status is due primarily to poorer psychological function preceding greater weight instability.
Paine et al., (2019), New Zealand	Cross-sectional study	2002/03 New Zealand Health Survey data N= 12,500	physical health, mental health and health risk behaviours: BMI, depression.	Reporting any sleep complaint was associated with higher odds of poorer mental health.
Papadopoulos & Brennan, (2015), Australia	Systematic review including mainly cross-sectional studies	Clinical and community samples N=27,505	BMI, overall mental health, depression, anxiety, self-esteem , perceived stress,	While there is evidence for biopsychosocial correlates of weight stigma, these are not

			antisocial behaviour, Adaptive/maladaptive coping, Substance use, eating disorders.	considered in combination in research; thus their inter-relationships are unknown.
Park (2009), USA	Cross-sectional study	Data came from the 2004–2005 Minnesota Survey on Adult Substance Use, a statewide telephone survey N = 16,289	Mental health problems, BMI	Mental health problems were not related to relative body weight among men. However, overweight or obese women were more likely than were their healthy-weight counterparts to have a negative self-assessment of mental health, and obese women were more likely to have a mental health problem.
Pearl et al., (2017), USA	Randomised controlled trial	306 adults living in the United States were recruited for an online study about "experiences and attitudes related to being overweight"	BMI, History of weight bias experiences, Internalization of weight bias, Affect, Perceptions of discrimination and legislation support.	Mere knowledge of legislation prohibiting weight discrimination has the potential to reduce weight bias internalization and improve affective responses among individuals with obesity.
Phillips & Perry, (2015), Ireland	Cross-sectional study	Adults from a cross-sectional sample of 2047 middle-aged Irish men and women. N=2047	Metabolic health status, BMI, Anxiety and depressive symptoms, well-being.	The metabolically unhealthy obese (MUO) subjects had almost 2 fold greater risk of depressive symptoms, but not the metabolically healthy obese (MHO) individuals
Pinto et al., (2012), USA	Longitudinal cohort study, Randomised controlled trial	338 overweight and obese women with UI	Body weight, in urinary incontinence (UI) frequency, physical activity, and preference-based measures of HRQL.	Weight loss and increased physical activity, but not decreased frequency of urinary incontinence, were associated with improvement in measures of HRQL
Porter & Johnson, (2011), USA	Cross-sectional study	Individuals aged 60 years and older who received congregate meals from four senior centres in Georgia (N= 120)	BMI, cognitive restraint and emotional eating with obesity, mental health (depression, anxiety, stress)	Cognitive restraint and emotional eating were consistently associated with obesity.
Proper (2012), Netherlands	Cross-sectional survey, mixed-method approach	Data were used from the Netherlands Working Conditions Survey (NWCS), which is representative for Dutch employees (n = 43,928).	Self-reported body mass index (BMI), chronic psychological complaints, Emotional exhaustion.	Of the obese workers, 15.7% reported emotional exhaustion and 3.7% reported chronic psychological complaints. These

				prevalence rates were significantly higher than among healthy weight workers.
Ramirez & Milan, (2016), USA	Cross-sectional study	Participants included 186 women in a low-income city	BMI, Mental health symptoms, Sexual abuse history, Control variables	Women with a childhood sexual abuse (CSA) history and obesity may be very likely to experience clinically elevated depression, anxiety, and PTSD symptoms; however, obese women without this history may have the same mental health risk as women who are not obese, at least among low-income populations.
Ranchod et al., (2016), USA	Longitudinal study	6,199 pregnancies from 2,873 women followed from 1979 to 2012	Pregnancy BMI, household mental illness before age 18 years.	Physical abuse and household alcohol abuse were associated with a significant 20% increase in the risk of excessive gestational weight gain; mental illness was not.
Rehkopf (2016), USA	Longitudinal study	A nationally representative survey of U.S. men and women who were 14-22 years old in 1979. n for physical abuse= 7266; n for parental alcohol abuse = 7269; n for parental mental illness = 7269	Childhood physical abuse, alcohol abuse and mental illness in the household determined through participant self-report; BMI	There was an association between childhood physical abuse and obesity at age 40 years
Reynolds et al., (2018). USA	Cross-sectional study	Patients were recruited at a large, urban, level I trauma centre in the United States. Inclusion criteria were patients who were admitted to either the trauma or orthopaedic trauma service for at least 24 hrs. N=455	Physical (BMI), psychological and quality-of-life variables : Depression, symptoms of post-traumatic stress, pain, alcohol use and return to work.	Patients with obesity had higher odds of screening positive for depression, and overweight patients had lower odds of returning to work 3 months post-injury compared to patients of normal weight.
Robertson (2015), Australia	Cross-sectional study	260 community based Australians	BMI categories (normal, overweight, and obese classes one, two and three), SWB	The results of the present study support the hypothesis of differences in SWB across BMI categories in community based Australians, with Class two and three obese associated with poorer SWB outcomes compared to normal and overweight.
Rogers (2016), UK	Longitudinal study	49 healthy women with uncomplicated pregnancy	BMI at 1 week and 1, 3, 6 and 12 months postpartum; Postnatal depression symptoms at 1, 6 and 12 months	Postpartum BMI change was unrelated to postnatal depression at any time.

Romain (2018), Canada	Cross-sectional study	Sample of individuals with obesity (n = 1298) from Quebec	Mood disorder, Psychological well-being (depression, anxiety, psychological distress), HRQoL, perceived stress, Perceived global and mental health	People with obesity and mood disorders had poorer psychological well-being and mental health. People with obesity and mood disorders also reported more physical comorbidities and multi-morbidity.
Rosen-Reynoso (2011), USA	Cross-sectional study	Diverse sample of Americans (N = 13,837)	Obesity, psychiatric disorders	Mood or anxiety disorder was positively associated with obesity for certain racial/ethnic groups. Substance-use disorders were associated with decreased odds for obesity in African-Americans. The role of physical health status changes the pattern of associations between obesity and psychiatric disorders.
Saarni (2011), Finland	Cross-sectional study	7977 adults	BMI, depression	People with depression did not have increased BMI
Sanderson et al., (2011), Australia	20-year cohort longitudinal study	Participants' data are from a national Australian school survey. N= 2243 (1135 women, 1108 men).	BMI, mental disorders	Childhood overweight and obesity may increase risk for mood disorder in adulthood, especially among overweight girls who become obese women.
Sandoval (2012), USA	Cross-sectional study	974 (2%) residents of Missouri who identified themselves as Latino	BMI, mental health	Mental health demonstrated a small, but statistically significant, positive effect on BMI
Saneei (2016), Iran	Cross-sectional study	3363 Iranian adults	BMI, Hospital Anxiety and Depression Scale (HADS)	No significant associations were seen between BMI status and anxiety and depression
Santini (2016), Italy	Cross-sectional study	389 subjects of both sexes receiving one or more antipsychotic treatment	BMI	The BMI values were similar in the psychiatric sample and general population, despite a higher obesity rate in the clinical sample. The psychiatric females in the clinical sample tend to have higher obesity rate, (with more obesity, more normal weight, but less overweight) compared to the general population.

Schofield & Khan, (2014), Australia	Longitudinal Study	11,135 mid-aged women	Self- reported use in past 4 weeks of medications for depression, anxiety, stress, or sleep problems; depression; physical and mental health, stress, social support, BMI	Obese women had a 30 % higher odds of medication use for depression compared to those with normal weight
Scott & Happell, (2011), Australia	Narrative review	-	Serious mental illness, obesity	Those with serious mental illness have almost two times the prevalence of obesity compared with the general public
Scott (2012), UK	Cross-sectional study	91 adults	Health-related quality of life, body weight	BMI and HRQoL were significantly related. The BMI in subjects who were obese and had asthma negatively correlates with HRQoL.
Shentow-Bewsh (2016), Canada	Randomised controlled trial	120 female undergraduates	Body related self-esteem, BMI	Exposure to anti-obesity messages decreases weight-related body esteem in women who feel strong pressure to be thin, which was not moderated by BMI.
Shirazian (2016), USA	Cross-sectional study	2500 adults with stages 1–4 chronic kidney (CKD)	Mental health, obesity, CKD Awareness	No significant associations
Sielatycki (2016), USA	Longitudinal study	299 patients undergoing anterior cervical discectomy (ACDF) for degenerative conditions	Body mass index ≥35, The EuroQol-5D, Short-Form 12 (SF-12)	Preoperative BMI was not a predictor of less improvement in quality of life (EQ-5D), general mental and physical health (SF-12 MCS and PCS), 12 months after surgery.
Sikorski (2015), Germany	Systematic review	Individuals with obesity	Obesity, Self-esteem, Coping mechanisms, social support, body dissatisfaction	In adult populations, studies reported lower self-esteem (3 studies), impaired coping skills (3 studies), lower social support (1 study), and higher levels of body dissatisfaction (1 study) in adults with obesity.
Simon (2011), USA	Cross-sectional study	4462 women aged 40 to 65 enrolled in prepaid health plan in the Pacific Northwest	BMI, depression as measured by the Patient Health Questionnaire, health care costs	Association between obesity and health care costs is not explained by the confounding effect of co-occurring depression.

Skouroliakou (2008), Greece	Case control	82 patients with SMI treated with olanzapine (22 men, 60 women) and 58 healthy controls	Body weight, waist circumferences, body composition (body fat and fat-free mass)	Significant weight loss and fat loss were found in the healthy controls and patients with SMI from baseline to 3 months. Males (both healthy controls and SMI) demonstrated greater decreases in body weight and waist circumference compared with female participants.
Slagter (2015), The Netherlands	Cross-sectional study	13,686 individuals with obesity	HRQoL (measured with the RAND 36-Item Health Survey), BMI	The impact of obesity on an individual's quality of life is influenced by grade of obesity, T2D, MetS and inflammation, and is mainly related to impaired physical health. The mental wellbeing is less often impaired by grade of obesity
Slomka (2012), USA	Cross-sectional study (baseline data from the Self- Management Addressing Heart Risk Trial (SMAHRT) randomized controlled trial)	Veterans with bipolar disorder and CVD risk factors (N=118)	Mood symptoms (depressive, manic), BMI	Depressive symptoms were associated with elevated BMI.
Smith (2010), USA	Cross-sectional study	Heterosexual (n = 392) and lesbian (n = 475) women (age 35–64)	Obesity (BMI>30), self-reported sexual abuse, sexual orientation, demographic factors, and history of a depression or anxiety diagnosis	Obesity was associated with African American race, lesbian sexual orientation, intrafamilial childhood sexual abuse, and history of mental health diagnosis.
Smith (2014), USA	Cross-sectional study	15,195 military personnel (Department of Defense Health Related Behaviors Survey)	BMI, anxiety, Serious Psychological Distress (SPD), depression PTSD	For women, obesity was associated with symptoms of serious psychological distress (SPD), post-traumatic stress disorder, and depression. For men, obesity and overweight was associated with symptoms of generalized anxiety disorder and SPD, respectively.
Stapleton (2017), Australia	Randomized controlled trial	83 adults; BMI greater than 25; experiencing food cravings of a certain severity	Depression, anxiety, somatoform, alcohol, and	Depression symptoms significantly decreased pre-to post-intervention in the CBT group and this was maintained at 6- and 12-months.

			eating modules using the Patient Health Questionnaire Eight-week Cognitive-Behavioural Therapy (CBT), Emotional Freedom Techniques (EFT) intervention program	Anxiety and depression scores significantly decreased from pre-to post-intervention for the EFT group, and was maintained at 6- and 12-month follow-up. Somatoform scores significantly decreased from pre-intervention to all follow-up points for the CBT group.
Starr (2014), USA	Cross-sectional study	113 Older adults participating in the Older American's Act (OAA) congregate meal program	Depression, anxiety, stress, obesity as indicated by body mass index (OB-BMI) and obesity as indicated by waist circumference (OB-WC)	The odds of being obese were increased with anxiety, decreased with depression, and were not associated with stress.
Stranges (2014), UK	Cross-sectional study	13983 adults, aged 16 years and older with valid responses for the combined 2010 and 2011 Health Survey for England.	Mental well-being (Warwick Edinburgh Mental Well-being Scale), BMI	Obese individuals had increased odd for low mental well-being.
Strassnig (2017), USA	Prospective	County-wide sample of first-admission patients hospitalized with a psychotic condition (schizophrenia n=146) and bipolar disorder n=87) in the early 1990s.	BMI	Early overweight was a predictor of eventual obesity for both groups (schizophrenia and bipolar disorder). At the 20 year follow-ups, approximately 50% of the bipolar and 62% of the schizophrenia sample were obese, with greater prevalence of obesity in schizophrenia at each assessment except for year 4.
Sullins (2016), USA	Longitudinal study	Followed a representative sample of 15701 American adolescents from 1995 to 2008	Obesity, depression	Obesity has no direct association with depression risk itself but has the strongest association of any variable in the analysis with the higher risk ratio for depression for the children with same-sex parents.
Sutin & Terracciano, (2013), USA	Longitudinal study	6157 Community-dwelling US residents	Weight discrimination, obesity status based on BMI	Participants who experienced weight discrimination were approximately 2.5 times more likely to become obese by follow-up, and participants who were obese at baseline were three times more likely to remain obese

				at follow up than those who had not experienced such discrimination.
Svärd (2016), Finland	Prospective	8960 40–60-year-old employees of the City of Helsinki, Finland	BMI, psychotropic medication purchases	Severe obesity was associated with subsequent sedative medication among the men. Obese and severely obese men, but not women, were at risk of psychotropic medication.
Svärd (2017), Finland	Longitudinal study	5668 Finnish municipal employees aged 40 to 60	BMI, weight change, physical and mental health functioning (SF-36)	No statistically significant differences in the change in mental health functioning occurred.
Talen & Mann, (2009), USA	Review	Obese adults	Obesity, body-image satisfaction, self-esteem; emotions, mood, psychosocial functioning; personality characteristics; binge eating Disorders, and family and social-cultural context.	The focus of research includes several different perspectives of mental health functioning and obesity: (1) body-image satisfaction and self-esteem; (2) emotions, mood, and psychosocial functioning; (3) personality characteristics; (4) binge eating disorders and (5) the family and social-cultural context.
Thieszen (2011), USA	Randomized controlled trial	348 participants from metropolitan Rockford, Illinois	Body Mass Index (BMI), Beck Depression Inventory, social functioning, role-emotional, and mental health(from SF–36v2)	The greater the decrease in BMI at 6 weeks, the better the chance of improved depression score, role-emotional score, social functioning score, and mental health score. The CHIP intervention significantly improved psychological health for at least six months afterwards, in part through its influence on lowering BMI.
Thurber (2018), Australia	Cross-sectional study	1515 Aboriginal and 213 301 non-Aboriginal adults in New South Wales	Obesity, self-rated health; psychological distress	Membership in the poorest versus best health status category was associated with up to an 26.8% and 22.4% absolute increase in unadjusted obesity prevalence for Aboriginal and non-Aboriginal participants, respectively.
Tsai & Rosenheck (2013), USA	Cross-sectional study	Community sample of 436 chronically homeless adults across 11 U.S. cities	BMI, Mental health (mental health component of the SF-12)	There were no significant differences on any measures of physical and mental health.

Udo & Grilo, (2016), USA	Cross sectional study	21,357 men and women with overweight and obesity	Perceived weight Discrimination, BMI, childhood maltreatment	Perceived weight discrimination was associated with a significantly greater increase in BMI in both genders. Among all women with perceived weight discrimination, those who also reported having experienced childhood maltreatment had significantly less BMI increase compared to those reporting not having experienced childhood maltreatment.
Ul-Haq (2014), UK	Cross-sectional study	Representative sample of the Scottish adult population (n= 37272)	Mental health (the General Health Questionnaire-12), BMI, demographic and life-style information	Overweight participants had better mental health than the normal-weight group, and individuals who were underweight, class II or class III obese had poorer mental health. Being overweight was associated with significantly better mental health in middle-aged men only. Being obese at a young age was associated with significantly poorer mental health in women only.
van der Starre (2013), Netherlands	Baseline data from a Randomised controlled trial analysed	412 Office employees	Need for recovery (NFR), Overweight and obesity	A significant positive association found between obesity and need for recovery (NFR), but not between overweight and NFR.
Vandyk & Baker, (2012), Canada	Qualitative, constructivist research design	18 purposefully recruited participants from an outpatient clinic at a psychiatric hospital in Eastern Ontario	Subjective experience of weight and lifestyle	Three central themes emerged: (i) a life altering diagnosis: described how a diagnosis of schizophrenia affected their existence. (ii) weight management perceived as a complex phenomenon (iii) today's experiences shape tomorrow's outcomes: Most saw successful weight management as the result of an ongoing commitment. Weight management was seen as difficult yet important to the participants.
Vilhena (2014), Portugal	Cross-sectional	215 volunteer obese patients	Dispositional optimism, Positive Affect and Negative Affect, Stigma, Quality of Life	In an obese population, an optimist attitude, good social support, a lower perception of stigma, and more positive affect contribute to better general well-being and better

			(The 36-item Short-Form Health Survey (SF-36))	physical and mental health. Negative affect was a negative predictor of QoL.
Wallace (2015), UK	A one-group pre–post design	551 participants in a community-based weight management service for morbidly obese patients in Derbyshire county	Average weight loss (kg), mental health using the clinical outcomes of routine evaluation outcome measure (CORE-OM)	There was a statistically significant mean reduction in mental health score at each measurement point compared with baseline. Even as early as 12 weeks into the intervention there was a clinically meaningful reduction in psychological distress.
Walter (2015), USA	Observational	6989 Female Nurses' Health Study participants	Self-reported BMI, depression scaled to the Geriatric Depression Scale	Self-reported BMI significantly predicted depression. Each one unit increase in BMI was associated with 0.02 higher long-term depression.
Wang (2013), USA	Cross-sectional study	210 Overweight and obese adults seeking behavioural weight loss treatment	Health-related quality of life assessed by physical component score (PCS), mental component score (MCS), and eight domain scores of the SF-36 v2; BMI	BMI was identified as one of the predictors for both physical component and physical functioning domain of the SF-36. Those with lower BMI were more likely to have better physical health-related quality of life.
Warkentin (2014), Canada	Cross-sectional study	500 severely obese subjects	BMI, HRQoL	The clinical impact of BMI on physical and general HRQL was small, and mental health scores were not associated with BMI.
Westby (2015), USA	Cross-sectional study	1768 male and female cancer survivors	BMI, HRQoL (RAND-36 Health Status Inventory)	Higher BMI was significantly associated with lower physical HRQoL across gender. Race moderated the relationship between BMI and mental HRQoL for both genders.
Wheeler (2013), New Zealand	Cross-sectional study	404 adult mental health consumers	BMI in surveyed sample (mental health consumers) and respondents to the NZ Health Survey	There was increased obesity in the mental health consumer group as compared with the NZ Health Survey population.
Wheeler (2015), New Zealand	Cross-sectional study	404 adult mental health service users in a metropolitan district health board area in New Zealand	SF-36 used to assess participants' health-related quality of life, BMI	Those with a BMI of 25 and over had a significantly lower physical functioning score than the participants whose BMI was under 25.
White (2012), UK	Longitudinal study	A total of 16567 babies born in England, Wales and Scotland were enrolled in a	Obesity risk at 26, 30 and 34 years; maternal and teacher	General behavioural problems at age 5 years increased the risk of obesity at 30 and 34

		birth cohort and followed up at 5, 10, 16, 26, 29-30 and 34 years	reported child psychological function at 5 and 10 years (general behavioural, conduct, emotional or attentional/hyperactivity problems)	years. Inattention/hyperactivity at 10 years similarly increased risk of obesity at 30 years. Chronic conduct problems at 5 and 10 years also increased the obesity risk at 30 years.
Woynarowska-Sołdan (2018), Poland	Cross-sectional study	994 nurses	Behaviours related to mental health, overweight and obesity	Behaviours related to mental health were not significant predictors that predisposed nurses to overweight/ obesity
Zhang (2018), Germany	Prospective, longitudinal study	Population-based sample of 1196 young German women	BMI, Major depressive disorder (MDD)	BMI was a significant risk factor for new onset of Major depressive disorder (MDD). Specifically, women who were overweight at baseline were more likely to develop MDD at follow-up.
Zhao (2011), USA	Cross-sectional study	U.S. adults (1,325 men and 1,114 nonpregnant women) aged ≥ 20 years who were either overweight or obese with BMI of ≥ 25.0 kg/m2	Waist circumference, major depressive symptoms, moderate-to-severe depressive symptoms	Waist circumference was significantly associated with both major depressive symptoms and moderate-to-severe depressive symptoms. Adults with abdominal obesity were significantly more likely to have major depressive symptoms or have moderate-to-severe depressive symptoms than those without.
Zimbudzi (2016), Australia	Cross-sectional study	308 adults with diabetes and chronic kidney disease recruited from renal and diabetes clinics From hospitals in Australia	Physical composite summary, mental composite summary from Kidney Disease Quality of Life, BMI	Patients with a BMI in the obese range scored lower on the symptom/problem list and effect of kidney disease subscales than patients with a BMI in the normal range, but patients with a BMI in the normal range scored lower on the physical composite summary subscale than patients with a BMI in the overweight range.