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Title page

Interpersonal difficulties in obesity: A systematic review and meta-analysis to inform a rejection sensitivity-based model

Short title

Interpersonal difficulties in obesity

Gaia Albano^{a, b+}, Katie Rowlands^{a+}, Luigi Baciadonna^c, Gianluca Lo Coco^b, & Valentina Cardi^{a*}

^aSection of Eating Disorders, Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK.

^bDepartment of Psychology, Educational Science and Human Movement, University of Palermo, Palermo, Italy.

^cQueen Mary University of London, Biological and Experimental Psychology, School of Biological and Chemical Sciences, London, UK

⁺Gaia Albano and Katie Rowlands are joint first authors.

^{*}Corresponding author

Postal address: 103 Denmark Hill, London, SE5 8AF

Phone number: 0044 (0)207 848 5972

Fax number:

Email address: valentina.cardi@kcl.ac.uk

Email addresses of co-authors

gaia.albano@unipa.it

katie.rowlands@kcl.ac.uk

luigi.baciadonna@qmul.ac.uk

gianluca.lococo@unipa.it

Abstract

Obesity is associated with difficulties due to stigma and loneliness. These impact negatively on individuals' quality of life and behaviour change efforts. Increased sensitivity to others' negative feedback might play a role in the maintenance of these difficulties and could be addressed in psychological interventions. We conducted a systematic review of interpersonal difficulties in individuals with obesity, across the lifespan. We investigated early interpersonal adversity (i.e. frequency of teasing/bullying), perceived interpersonal stress and quality of social life, based on a rejection sensitivity model. The databases PubMed, Web of Knowledge and AGRIS, Embase, Medline and PsychINFO were searched for published peer-reviewed journal articles (1980-June 2018). Thirty-two studies met inclusion criteria. Results from the meta-analyses (n=16 studies) indicated that overweight/obese individuals reported more frequent experiences of teasing/bullying, greater interpersonal stress and poorer quality of social life than healthy weight individuals. Findings in the systematic review aligned to this evidence. Psychological interventions targeting increased sensitivity to negative interpersonal feedback could improve interpersonal functioning and, in turn, eating behaviours in individuals with obesity.

Key words: Binge eating disorder; interactions; isolation; overweight

1. Introduction

Obesity is a chronic disease characterised by excessive accumulation of adipose tissue [1]. In adults, it is defined by a body mass index greater than 30 (BMI= person's weight divided by the square of their height) [1]; in children, it is defined by a BMI percentile of 95th or above (i.e. if a child is in the 95th percentile, it means that 95% of children of the same sex and age have a lower weight or BMI compared to them). Adult obesity is associated with many significant health problems, including cancer, cardiovascular diseases and type 2 diabetes mellitus and with a decreased life expectancy of seven years at the age of 40 [2]. Similarly, obesity in children is associated with significant physical health problems, such as high blood pressure and cholesterol, insulin resistance, type 2 diabetes and musculoskeletal discomfort (e.g. [3]). Obesity is not only characterised by physical health issues, but also by psychological distress including high levels of anxiety and depression across the lifespan [4]. Overweight children are also at risk of problems later in life, such as low self-esteem and loneliness [5].

Despite the fast growing and wide spread nature of this disease (e.g. obesity nearly tripled since 1975 and in 2016, about 13% of the world's adult population were obese [6]), health care services are yet to develop an effective strategy to manage the illness and its multiple comorbidities [7]. One of the main challenges in the treatment of obesity is that the disease is multifactorial, with genetics, epigenetics, temperamental and environmental factors contributing to it. The vast array of risk and maintaining factors renders it difficult to identify specific underlying mechanisms. These are likely to vary on an individual basis and also to include factors that are less modifiable than others (e.g. genetics and macroenvironmental factors are less amenable to change than parenting styles). Currently, obesity treatment has a strong focus on weight loss and national and international guidelines recommend meal replacement, pharmacological treatments and

bariatric procedures to achieve this goal [8]. However, these interventions are characterised by scarce availability, low uptake and poor adherence (e.g. [9]).

High levels of stigmatization towards obesity plays a key role in the suboptimal engagement with, and success of currently available treatments (e.g. [10]). A growing body of evidence indicates that people with obesity experience frequent and pervasive weight-related stigma [11-13], which is associated with isolation, unhealthy lifestyle and poor treatment adherence and health outcomes [14-16]. This alarming evidence has led professionals to issue position statements to mitigate the risks and effects of weight stigma in clinical services [14-16]. At the individual-level, these initiatives include strengthening individuals' resilience to social adversities and negative social evaluation.

Based on theories of rejection (or interpersonal) sensitivity (e.g. [17, 18]) lifetime experiences of criticism or rejection from others increase people's awareness of and vigilance to negative feedback, resulting in social isolation and submissive behaviours. There is evidence that early interpersonal adversity, including episodes of bullying and teasing with regards to body weight and shape are prospectively associated with the development of abnormal eating behaviours over adolescence [19] and with obesity and disordered eating later in life [20]. Furthermore, individuals with eating and weight disorders display increased sensitivity to others' negative feedback, as indicated by an attention and interpretation bias towards social threat (e.g. [21, 22]) and unfavourable social comparison and submissive behaviours [13, 23]. This evidence has led to the proposal that abnormal eating behaviours, such as overeating, can develop as strategies to deal with negative emotions associated with interpersonal difficulties (e.g. [24-26]).

Based on the eating disorder literature on interpersonal difficulties, Figure 1 illustrates an adaptation of models of interpersonal sensitivity [17, 18] to obesity. The model indicates that lifetime experiences of rejection from others, such as weight-related stigma, bullying and teasing, can trigger increased perception of interpersonal stress and

in turn motivate the use of unhelpful behaviours such as isolation and overeating to regulate the painful emotions associated with negative social evaluation. This systematic review will test the proposal that individuals with overweight/obesity experience greater interpersonal adversity, increased perception of interpersonal stress and poorer quality of social life compared to healthy-weight peers. The findings of this critical evaluation of the literature can inform the development of interventions to strengthen individuals' resilience to negative social feedback and in turn, reduce the impact of social stigma and abnormal eating behaviours. Given the relevance of social consequences of obesity in children and adolescents (e.g. stigmatization, bullying, social exclusion), studies investigating interpersonal difficulties in children and adolescents were included. The review also extended to individuals with binge eating disorder or loss of control over eating because these conditions are very often associated with overweight or obesity [27].

-----Figure 1-----

2. Materials and methods

2.1 Information sources and searches

A systematic search was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [28] and using the following electronic databases: PubMed, Web of Knowledge and AGRIS (1991), Embase (1974-present), Medline (1946-present), PsychINFO (1806-present) through Ovid. The key words used in the search were selected to tap into the macro-areas of interpersonal difficulties documented in eating and weight disorders [24] and represented in Figure 1, namely: interpersonal adversity (including bullying), interpersonal stress/sensitivity and quality of social life. The key words were: “social criticism”, “social rejection”, “negative evaluation”, “social adversity”, “bullying” (for the macro-area “interpersonal adversity”); “interpersonal

stress", "interpersonal problems", "interpersonal functioning", "interpersonal deficits", "interpersonal sensitivity" (for the macro-area "interpersonal stress") and "social life", "social anxiety", "loneliness", "submissiveness" (for the macro-area "quality of social life"). These words were used in combination with the key words "obesity" and "binge eating disorder". The search was limited to journal articles published in English between 1980 and June 2018 and to studies conducted with human subjects. The reference lists of the studies selected for inclusion were checked for additional potentially eligible papers.

2.2 Eligibility criteria and study selection

Studies were eligible for the systematic review if they met the following criteria: 1) included individuals with overweight/obesity or with a diagnosis of binge eating disorder according to the Diagnostic and Statistical Manual of Mental Disorders IV – TR and 5th edition (DSM 5) [29] or self-reported episodes of binge eating or loss of control eating as assessed through validated self-report questionnaires, 2) included a comparison group of healthy weight individuals and 3) measured variables of interest as described by the key words. Studies were included in the meta-analyses if quantitative data (i.e. sample size, means and standard deviations or frequencies) were available for the interpersonal measure of interest. Studies resulting from the search and where the data were reported by third-parties (e.g. family member, peers, teachers) were also included.

G.A and K. R. conducted the literature search and both screened all papers for eligibility against the inclusion criteria. Disagreements were resolved through consensus meetings with V.C.

2.3 Statistical analyses for the meta-analyses

All statistical analyses were performed in R 3.5.1 [30] using the “Metafor” package [31] and a random-effects models was used to account for heterogeneity between studies. For studies with a between-subject design, the Restricted maximum-likelihood (REML) was calculated to estimate unbiased effect size with 95% confidence intervals. Effect sizes (ES) and associated 95% confidence intervals were calculated as standardized mean difference (SMD ‘escalc’ or odd-ratios (OR) function in ‘Metafor’). Significance threshold was set at $p \leq 0.05$ unless otherwise reported and ESs were interpreted as small (≥ 0.20), medium (≥ 0.50) or large (≥ 0.80). Between-study heterogeneity was assessed with the Cochran’s Q test and I^2 statistics. Where significant between-studies heterogeneity was found, meta-regressions were calculated. To explore the moderator effects of age and gender, these two variables were entered into the meta-regression using the factor function. The impact of each moderator was assessed using a single model. Publication bias was investigated with Begg's rank correlation test for funnel plot asymmetry [32].

2.4 Quality assessment of studies included in the meta-analyses

The quality of the studies included in the meta-analyses was examined using an *a-priori* defined checklist for case-control studies formulated in the context of the Critical Appraisal Skills Programme [33]. Eleven items were used to assess the quality of the studies. These included the evaluation of parameters such as appropriateness of methods selected to answer the research question, participants’ recruitment and allocation to study groups and potential confounding factors present in the design or statistical analyses. All the studies included in the meta-analyses met at least seven of the eleven criteria considered for the qualitative assessment (Table 1).

3. Results

3.1 Study selection

The literature search identified 4361 records, of which 1202 duplicates were removed and 3107 studies were excluded after screening titles and abstracts against the inclusion criteria (Figure 2). An additional twenty papers were excluded following inspection of full-texts. Thirty-two studies were eligible for inclusion in the systematic review [26, 34-64]. Of these, sixteen papers were also eligible for inclusion in the meta-analyses [26, 35, 36, 38, 44, 48-51, 53, 55, 56, 60, 62-64].

-----Figure 2-----

3.2 Description of studies characteristics

The characteristics of the studies selected are reported in Table 2. All studies were case-control studies, in that they included a sample of overweight/obese individuals and compared them against a sample of normal weight individuals. Five studies included participants followed-up over time [35, 36, 41, 50, 51] and details of time points at which data between samples were compared are reported in Table 2. Twelve studies included adults [26, 37, 39, 44, 45, 48, 49, 52-54, 60, 63] and twenty studies included children and/or adolescents [34-36, 38, 40-43, 46, 47, 50, 51, 55-59, 61, 62, 64]. Details of mean age or age range of samples tested in the studies are included in Table 2. Twenty-three studies had a mixed sample of males and females [26, 34-40, 42, 43, 46, 47, 50, 51, 54-59, 61-63] and nine studies included only females [41, 44, 45, 48, 49, 52, 53, 60, 64].

All studies included overweight and/or obese participants, except for two studies which did not report information on weight for children with symptoms of loss of control eating and adults with symptoms of binge eating [40, 48]. Overweight was most often defined by a BMI within the 85th and 95th percentiles for age and gender for children and adolescents and by a BMI ranging from 25 to 29.99 for adults (15% above the females' ideal weight). Obesity was defined by a BMI within the 95th and 97th percentiles for age and gender in children/adolescents and a BMI greater than 30 for adults. Six studies included individuals with a diagnosis of BED [26, 45, 48, 49, 63, 64] and two studies

involved participants with symptoms of loss of control over eating [40, 43]. Binge eating and loss of control over eating were assessed using structured interviews [26, 40, 43, 49, 63, 64] or validated self-report measures [45, 48]. The sample sizes ranged from 37 [52] to 17,557 [61] participants. Eleven studies reported data from informants such as: peers [34, 42, 52, 57, 61], mothers [38] and parents [40, 41, 43, 46, 47].

3.3 *Meta-analyses*

Based on the goals of this work, three different meta-analyses were calculated. The first meta-analysis summarised data on frequency of lifetime events of teasing or bullying [31, 42, 47, 52, 59]; the second meta-analysis included measures of interpersonal sensitivity or reactivity to interpersonal stress [26, 38, 48-50, 56, 63, 64] and the third meta-analysis included measures of perceived quality of social relationships [44, 46, 53, 54]. Data from females only were used for studies that reported data for both genders.

3.3.1 Lifetime frequency of teasing or bullying

Five studies were included in the meta-analysis investigating the effect of BMI on frequency of teasing or bullying (Fig 3a). Overall, there was a significant effect of being overweight or obese on bullying and teasing, in that those in the overweight/obese group were more likely to report these negative experiences than individuals at healthy weight ($ES = -1.33$, $Z = -4.31$, $p = <0.001$, 95% CI $[-1.93, -0.72]$, $k = 5$). There was evidence of significant between-study heterogeneity ($Q = 16.01$, $p < 0.0003$, $I^2 = 78.65\%$), which was further explored with meta-regression. The meta-regression did not reveal a significant effect of moderators ($QM = 0.45$, $p = 0.79$), still leaving some residual heterogeneity ($QE = 13.92$, $p = 0.0009$, $I^2 = 87.67\%$). Begg's rank correlation test of funnel plot asymmetry was not significant, suggesting no publication bias ($T = 0$, $p = 1$; Fig. 3b).

-----Figures 3a, 3b-----

3.3.2 Interpersonal stress

Eight studies were included in the meta-analysis investigating the effect of BMI on perceived interpersonal stress (Fig. 4a). Overall, there was a significant effect of BMI on interpersonal stress, in that being overweight/obese was associated with greater interpersonal stress than being at a healthy weight ($ES = 0.72$, $Z = 3.78$, $p = 0.0002$, 95% CI $[0.34, 1.09]$, $k = 8$). There was evidence of significant between-study heterogeneity ($Q = 29.08$, $p < 0.0001$, $I^2 = 79.06\%$), which was further explored with meta-regression. The meta-regression did not reveal a significant effect of moderators ($QM = 5.19$, $p = 0.15$), still leaving some residual heterogeneity ($QE = 11.20$, $p = 0.02$, $I^2 = 67.18\%$). Begg's rank correlation test of funnel plot asymmetry was not significant, suggesting no publication bias ($T = 0.35$, $p = 0.27$; Fig. 4b).

-----Figures 4a, 4b-----

3.3.3 Quality of social life

Four studies were included in the meta-analysis investigating the effect of BMI on quality of social life (Fig. 5a). Overall, there was a significant effect of being overweight/obese on this variable, in that overweight/obese individuals reported worse quality of life than individuals at healthy weight ($ES = -0.28$, $Z = -1.97$, $p = 0.04$, 95% CI $[-0.57, -0.001]$, $k = 4$). There was no evidence of significant between-study heterogeneity ($Q = 7.53$, $p < 0.057$, $I^2 = 62.74\%$), and therefore no further investigation was undertaken. Begg's rank correlation test of funnel plot asymmetry was not significant suggesting no publication bias ($T = -0.33$, $p = 0.75$; Fig. 5b).

-----Figures 5a, 5b-----

3.4 Qualitative synthesis

3.4.1 Lifetime events of teasing or bullying

Three studies reported data on lifetime events of teasing/bullying and its consequences [32, 53, 55]. In two studies, participants in the overweight/obese group

experienced more teasing/bullying than the healthy weight group; overweight adolescents were more likely to experience verbal victimization [36], whilst obese boys reported more overt victimization and obese girls more relational victimisation [53]. In one study, being ostracised during a social task (Cyberball), led overweight/obese adolescents to work harder to gain access to food and to have a greater energy intake [58].

3.4.2 Interpersonal stress

Five studies reported data on perceived interpersonal stress [36, 37, 39, 45, 56]. Overall, more stress related to social relationships was reported in the overweight/obese group than the control group. Overweight adolescent participants were less likely to date in early young adulthood [36] and they were less satisfied with their relationships [56]. Adults with obesity were less selective about the physical traits of their potential partners [37] and had greater expectations of social rejection when their weight was seen [39]. Participants with obesity and binge eating reported poorer family functioning [45].

3.4.3 Perceived quality of social relationships

Six studies reported data on perceived quality of social relationships [43, 47, 52, 54, 57, 59]. In five of these studies, participants with obesity reported worse social quality of life than the control group, whereas in one study no between groups differences were found [57]. Children and adolescents with symptoms of loss of control over eating reported greater social problems [43, 47] and more shaming experiences [59]. However, another study found no differences in perceived competence in social acceptance or loneliness between obese adolescents and adolescents at a healthy weight [57]. Obese women reported lower social self-esteem [52] and emotional reliance on others [54].

3.4.4 Data provided from other informants

Nine studies reported data from other informants (peers, parents, families) on reciprocated friendships [34, 42, 57, 61] partners' approval [52] and presence of problematic social patterns in families [40, 41, 43, 47]. Overall, the overweight/obese group received fewer nominations and less approval from others, compared with the control group [34, 61] and they were more likely to receive dislike nominations from their peers [42]. One paper reporting data in adults found that obese women made a poorer impression (i.e. they were rated as being less socially skilled and less physically attractive) than non-obese women on their telephone partner [52]; however another study showed no differences in reciprocated friendships between the overweight/obese group and the control group [57].

Higher levels of parental criticism related to their child's weight were found in families of obese/overweight children [41] and less healthy patterns of family communication during meals were observed in those with symptoms of loss of control over eating [40]. Parents of children with symptoms of loss of control over eating also reported greater social problems in their child compared to the healthy weight group [43, 47].

4. Discussion

The aim of the systematic review and meta-analyses was to summarise and quantify data on interpersonal difficulties in people with obesity. Early episodes of social negative evaluation, such as social criticism and bullying, perception of interpersonal stress and quality of social life were investigated, based on the literature on interpersonal difficulties in eating disorders and on the predictions of a rejection sensitivity-based model. The hypotheses were that individuals with overweight/obesity would experience increased levels of interpersonal stress following lifetime episodes of rejection and that interpersonal stress would trigger isolation and abnormal eating behaviours, such as overeating. Although the relationships between variables could not be investigated, the review and

meta-analyses confirmed the relevance of these constructs in obesity. Data from 32 studies and 34,324 participants indicated that obese individuals report more frequent experiences of teasing or bullying, greater perception of interpersonal stress and poorer quality of social life compared to the healthy weight control group. Teasing and bullying were investigated among adolescents [35, 46, 51, 55, 62] and children [46], whereas perception of interpersonal stress was more often investigated in adult populations [26, 48, 49, 63], than adolescents [56, 64] or children [38, 50]. Similarly, quality of social life was mostly assessed among adults [44, 53, 60], with only one study reporting on social functioning in children [46]. The observed effect sizes ranged from moderate to large in each comparison and the pattern of findings was consistent through the studies included in the meta-analyses as well as those included in the systematic review. A moderate heterogeneity in effect sizes was found in the meta-analyses, which might reflect the variety of interpersonal variables and measures used across studies. The findings on greater interpersonal problems among individuals with obesity were further validated by reports of other respondents, including carers and peers. Taken together, results are in line with the literature reporting on social problems in eating disorders, such as anorexia nervosa and bulimia nervosa [19, 65-73].

Individuals with obesity and binge eating disorder showed greater insecurity, sadness and more stress following interpersonal situations [48, 49] and reported higher levels of social inhibition, negative emotions related to interpersonal situations and interpersonal sensitivity compared to the healthy weight group [26, 63, 64]. Less healthy patterns of communications and family functioning were observed in families of children with loss of control over eating [40] and parents of children with these symptoms also reported greater social problems in their children [43]. In line with these findings, adults suffering from binge eating reported poorer family functioning and more frequent experiences of abuse [45] than healthy weight controls.

A possible implication for the findings of this systematic review is that adaptations of psychological interventions targeting social difficulties in other forms of eating and weight disorders (e.g. Interpersonal Psychotherapy [74], The Maudsley Model of Anorexia Nervosa Treatment for Adults MANTRA [75] and the New Maudsley Approach [76] could be of some benefit for people with obesity also. This is particularly true when considering that perception of interpersonal stress and quality of social life are psychological processes that are amenable to change. Psychological interventions to remediate social difficulties in the context of abnormal eating are mostly focused on psychoeducation around the reciprocal impact of interpersonal relationships on abnormal eating behaviours and negative emotions, goal planning for positive behaviour change and the involvement of close others to break unhelpful habits. These elements, in combination with trainings to strengthen individuals' resilience to positive social feedback, such as cognitive bias modification trainings to modify negative attention and interpretations biases when exposed to ambiguous social information [77], might contribute to reduce individuals' perception of interpersonal stress and improve their quality of social life. Positive changes in the interpersonal domain might in turn determine positive changes in eating behaviours.

4.1 Strengths and limitations

To date, this is the first systematic review and meta-analysis on interpersonal difficulties in obese individuals. Strengths of this work are the breadth of interpersonal domains investigated (i.e., lifetime events of teasing, bullying, ostracism; perception of interpersonal stress and quality of social relationships), the focus on findings across the lifespan and the inclusion of data reported by subjects themselves as well as other respondents. A limitation of this systematic review is that we did not register its protocol in an open access online database, such as the International Prospective Register of Systematic Reviews (or PROSPERO database), before the process of data screening

started. Further limitations include that theoretical models on the role played by interpersonal difficulties in the onset and maintenance of obesity could not be tested because most of the studies used a cross-sectional design. Key words explicitly tapping onto the “emotional” component of social behaviour were not included, however this is because we wanted to limit the scope of the review to its main focus.

The quality of the studies included in the review and meta-analyses was reasonably good, however findings were mostly based on self-report measures, generated by cross-sectional designs and drawn from different assessment measures. Furthermore, the majority of studies did not focus on the investigation of social difficulties as potential triggers for abnormal eating behaviours. This suggests that further research is needed to improve the understanding of social difficulties in obesity through the use of an experimental approach that investigates causal mechanisms across different levels of behaviour (e.g. by including the measurement of biological parameters, brain activations, cognitive functioning and genetics).

5. Conclusions

Obesity is associated with interpersonal difficulties, even in the absence of co-morbid psychiatric disorders, such as binge eating disorder. A lack of experimental research limits the conclusions that can be drawn regarding the mechanistic role of interpersonal difficulties in explaining abnormal eating behaviours. The hope is that this systematic review will encourage researchers and clinicians to join forces to expand this evidence base and develop feasible and effective interventions to improve perception of interpersonal stress and quality of social life in individuals with obesity.

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AUTHORS' CONTRIBUTIONS

Conceptualization, V.C., G.A., K.R., G.LC. Methodology, V.C., L.B., K.R., G.A. Software, L.B. Formal Analysis, L.B. Writing – Original Draft Preparation, V.C., K.R., G.A., L.B., G.LC. Writing – Review & Editing, V.C., K.R., G.A., L.B., G.LC. Supervision, V.C., L.B.

CONFLICTS OF INTEREST

The authors have no conflict of interests to disclose

FIGURES

Figure 1. Rejection sensitivity-based model of obesity.

Theoretical model to explain the relationships between lifetime adversity, perceived interpersonal stress, quality of social life and abnormal eating behaviours.

Figure 2. Flow-chart of studies' search, screening and selection.

The flow chart illustrates the outcomes of the processes of papers' search, screening and selection.

Figure 3. Meta-analysis of the effect of body mass index on frequency of teasing or bullying

a) Forest plot of the effect of body mass index on frequency of teasing or bullying. Positive effect sizes indicate more frequent episodes of teasing or bullying in the overweight/obese group. Negative effect sizes indicate more frequent episodes of teasing or bullying in the healthy weight group. N=sample size; n=frequency of episodes of teasing or bullying; **b)** Funnel plot of the effect of body mass index on frequency of teasing or bullying.

Figure 4. Meta-analysis of the effect of body mass index on perceived interpersonal stress

a) Forest plot of the effect of body mass index on perceived interpersonal stress. Positive effect sizes indicate increased interpersonal stress perceived in the overweight/obese group. Negative effect sizes indicate increased interpersonal stress perceived in the healthy weight group. SD=standard deviation; SMD= standardised mean difference; CI= confidence interval; **b)** Funnel plot of the effect of body mass index on perceived interpersonal stress.

Figure 5. Meta-analysis of the effect of body mass index on quality of social life

a) Forest plot of the effect of body mass index on quality of social life. Positive effect sizes indicate reduced quality of social life in the overweight/obese group. Negative effect sizes indicate reduced quality of social life in the healthy weight group. SD=standard deviation; SMD= standardised mean difference; CI= confidence interval; **b)** Funnel plot of the effect of body mass index on quality of social life.

TABLES

Table 1. Assessment of studies' quality based on the checklist for case-control studies formulated by the Critical Appraisal Skills Programme.

	Author, year	Did the study address a clearly focused issue?	Did the authors use an appropriate method to answer their question?	Were the cases recruited in an acceptable way?	Were the controls selected in an acceptable way?	Was the exposure accurately measured to minimise bias?	Aside from the experimental intervention, were the groups treated equally?	Have the authors taken into account potential confounding factors in the design and/or in the analyses?	How large was the treatment effect?	How precise was the estimate of the treatment effect?	Credibility of findings	Generalisability of findings
		Low risk = ⊕	High risk = ⊖	Unclear (Un) = Not Reported								
1	Almenara and Jezek, 2014	⊕	⊕	⊕	Un	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
2	Blanco et al., 2017	⊕	⊕	⊕	⊕	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
3	Ferreira et al., 2016	⊕	⊕	⊕	⊕	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊕
4	Gibson et al., 2007	⊕	⊕	⊕	⊕	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊕
5	Hansel and Wittrock, 1995	⊕	⊕	⊖	⊖	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
6	Hilbert et al., 2011	⊕	⊕	⊕	⊖	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
7	Jensen et al., 2013	⊕	⊕	⊕	⊕	⊕	⊕	⊖	Results in Table 1	⊕	⊕	⊕
8	Kjelgaard et al., 2016	⊕	⊕	⊕	⊕	⊕	⊕	⊖	Results in Table 1	⊕	⊕	⊕
9	Lo Coco et al., 2016	⊕	⊕	⊕	⊕	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊕
10	Miller et al., 1995	⊕	⊕	⊕	⊕	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
11	Neumark-Sztainer et al., 2002	⊕	⊕	⊕	⊕	⊕	⊕	⊖	Results in Table 1	⊕	⊕	⊕
12	Pearce et al., 2002	⊕	⊕	⊖	⊖	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
13	Stein, 1987	⊕	⊕	⊕	⊕	Un	⊕	⊕	Results in Table 1	⊖	⊕	⊖
14	Tayyem et al., 2017	⊕	⊕	⊕	⊕	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖
15	Vardar et al., 2004	⊕	⊕	⊕	⊕	Un	⊕	⊕	Results in Table 1	⊖	⊕	⊖
16	Zeeck et al., 2010	⊕	⊕	⊕	⊖	⊕	⊕	⊕	Results in Table 1	⊕	⊕	⊖

Table 2. Characteristics of the studies included in the systematic review and meta- analyses. Studies included in the meta-analyses indicated as “(Me)”. BED= Binge Eating Disorder; LOC= loss of control; BMI= Body Mass Index; M= Mean; SD= Standard deviation.

*=longitudinal studies

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Ali et al., 2012	N= 14339 males and females	Adolescents	M=16.17, SD= 1.60	Obese=1780	BMI $\geq$ 95 th percentile for age and gender	Not applicable	N=12559	Social connectedness	In group and out-group friendship nominations from peers (85% from same school as respondent)	Obese adolescents received fewer friendship nominations from peers.
Almenara and Jezek., 2014* (Me)	N=570 males and females	Adolescents	13	Overweight=67	BMI $\geq$ 21.91 kg/m ² for males and $\geq$ 22.58 kg/m ² for females	Not applicable	N=503	Appearance-related teasing (sources and impact of teasing)	A scale adapted from the Physical Experiences Survey	Overweight adolescents reported more appearance-related teasing by male classmates, siblings, and fathers, more body weight and body shape-related teasing, and reported that this teasing bothered them more.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight Obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Ames and Leadbeater, 2017*	N=662 males and females	Adolescents	M=15.5 years, SD 1.9 years	Overweight/obese aged 12= 29	BMI $\geq$ 85th percentile for age and gender	Not applicable	N=123	Peer victimization	The Social Experiences Questionnaire (self-report)	Overweight youth were more likely to experience verbal victimization and less social support from peers from mid-adolescence to early adulthood.
								Friend social support	Perceived Social Support Scale of the Friends Measure (self-report)	
								Dating status	Single item assessing romantic involvement with another person (self-report)	
								Romantic relationship worries	Items developed for the Victoria Healthy Youth Survey (self-report)	
Aruguete et al., 2009	N=1217 males and females	Adults	M=22.87, SD=7.13	Obese=146	BMI >30 kg/m ²	Not applicable	N=1071	Romantic selectivity	Partner preferences	Obese people were less likely to be selective about the physical traits of their potential partners.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight Obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Blanco et al., 2017 (Me)	N=100 males and females	Children and their mothers	8-12	Obese=50	BMI $\geq$ 97 th percentile for age and gender	Not applicable	N=50	Family expressed emotion and criticism Family adaptability and cohesion Quality of marital relationship	Family Questionnaire (mother-reported) Family Adaptability and Cohesion Evaluation Scale-III (mother-reported) Dyadic Adjustment Scale-13 (mother-reported)	Families with obese children showed significantly higher levels of criticism and over-protectiveness.
Blodorn et al., 2015	N=157 males and females	Adults	M = 20.88 SD = 2.95	Overweight=39 Obese=40	BMI 25 kg/m ² –29.99 kg/m ² BMI $\geq$ 30 kg/m ²	Not applicable	N=78	Rejection expectations	8-item questionnaire (pre-task, self-report measure) Dating speech whilst weight either seen or unseen	Women with higher body weight reported increased expectations of social rejection when weight was seen.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight Obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
De la Haye et al., 2017	N= 504 males and females	Children	M=11.38 SD = 0.48	Overweight=80	Age and gender specific BMI cut-off points	Not applicable	N=424	Peer relations (friendships and antipathies)	Peer nominations from and towards peers	Overweight children were less likely to receive friendship nominations and were more likely to receive dislike nominations. Overweight children were also more likely to nominate classmates that they disliked.
Elliott et al., 2009	N=219 males and females	Children and adolescents	M=13.10, SD=2.80	LOC eating=62 (overweight, on average)	BMI z-score	Structured interview	N=157	Children's interpersonal difficulties (being teased or acting lonely)	Child Behaviour Checklist, Social Problems scale (parent-report)	Parents of children with LOC eating reported greater social problems in their children.
Ferreira et al., 2016 (Me)	N=292 females	Adults	M=20.39 SD=1.64	Overweight=92	BMI ≥ 25 kg/m ²	Not applicable	N=200	Quality of social relationships	Social subscale of the World Health Organization Quality of Life -Bref (self-report)	No difference in quality of social relationships.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight Obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Friedman et al., 1997	N=48 females	Adults	Obese with BED M=34.60 Obese without BED M= 42.10 Healthy M=31.10	Obese with BED=37	BMI ≥ 27.3 kg/m ²	A score of 102 or higher on the Bulimia Test	N=38	Family togetherness, cohesion, rules, adaptability and social desirability Interpersonal relations and attitudes towards themselves Lifetime history of physical or sexual abuse	Family interactions survey (self-report) Structural analysis of social behaviour short-form (self-report) Presence or absence of abuse experiences (self-report)	Obese binge eaters reported poorer family functioning and higher frequencies of abuse experiences.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Gibson et al., 2008 (Me)	N=262 males and females	Children	M=10.30 SD=1.40	Obese=27 Overweight=77	Age and gender specific BMI cut-off points	Not applicable	N=158	Bullying in the last term Health-related quality of life Social competence (involvement in activities, social interaction patterns and school performance)	Bullying Questionnaire for Children (self-reported) Child Psychosocial Quality of Life (self-reported) The Child Behaviour Checklist (social problems subscale, parent-reported)	For the overweight group depression was associated with both social competence and lower quality of life, while in the healthy weight group depression was exclusively associated with social problems such as bullying.
Griffiths et al., 2010	N=10837 males and females	Children	3	Overweight=2003 Obese=547	BMI $\geq$ 19.57 kg/m ² for males, $\geq$ 19.36 kg/m ² for females	Not applicable	N=8287	Peer relationship problems, pro-social behaviour	Strengths and Difficulties Questionnaire (parent-report)	At age 3, parents of obese boys reported more peer relationship problems and parents of obese girls reported more prosocial behaviours in their children.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Hillbert et al., 2011 (Me)	N=81 females	Adults	BED (overweight) M=32.70 SD=11.69 HC M=23.49 SD=4.44	BED=27	Not reported	Structured clinical interview for DSM-IV-TR disorders	N=27	Psycho-physiological response to interpersonal stress	Stress exposure task Psychological measures (i.e. sadness, insecurity, stress, hunger, desire to binge), physiological measures (heart rate, systolic and diastolic blood pressure, and skin conductance level (SCL))	The clinical group reported more insecurity and sadness in response to the stress exposure task.
Hansel and Wittrock., 1997 (Me)	N=56 females	Adults	Not reported	Binge eating symptoms=28	Not applicable	Binge Eating Scale (self-report)	N=28	Perceived stress in response to an interpersonal situation	Perceived Stress Scale and video task (exposure to a high or low stress interpersonal situation)	The binge eating group reported more stress following the video task.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Kjelgaard et al., 2016* (Me)	N=3990 males and females	Adolescents	11-15	Overweight=318 Obese=76	Age and gender specific BMI cut-off points	Not applicable	N=3596	Social relations (i.e. number and frequency of contact with friends, perceptions of close others as confidants, frequency of bullying and perceived peer acceptance)	Questions derived from the Health Behaviour in School Age Children Survey (self-report)	Overweight/obese girls spent less time with friends after school. Overweight/obese boys reported less frequent E-communication with friends. More overweight/obese adolescents did not perceive their best friend as a confidant and reported more experiences of bullying.
Jensen et al., 2013* (Me)	N=104 males and females	Preadolescents	9-12	Obese=25 Overweight=24	BMI ≥ 95 kg/m ² BMI ≥ 85 kg/m ²	Not applicable	N=55	Childs' experiences with teasing during participation in physical activity Social functioning	Teasing During Physical Activity (self-report) Health-Related Quality of Life Social Functioning Subscale (self-report)	Overweight group reported higher levels of teasing during physical activity at baseline and also one year later.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Lo Coco et al., 2016 (Me)	N=379 males and females	Adults	Obese M=45.1, SD=14.5 Obese with BED M=41.6, SD=12.8 Healthy M=37.1, SD=9.5	Obese=186 Obese with BED=93	BMI > 30 kg/m ²	DSM-V diagnosis	N=100	Social inhibition, non-assertiveness, and over-accommodation (excess of friendly submissiveness)	Socially Inhibited, Non-assertive and Overly Accommodating subscales from the Inventory of Interpersonal Problems, short-version (self-report)	Obese subjects with binge eating disorder reported greater social inhibition.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Miller et al., 1990	N=37 females	Adults	Obese M=40.10 Healthy weight M=32.30	Obese=15	20% over the midpoint for average weight for height	Not applicable	N=22	Social self-esteem Communication during a telephone conversation with an undergraduate student	Social Self-Esteem Inventory (self-report) Ratings of social skills (reported by college student judges and telephone partners, who were unaware of the subjects' weight)	Obese women reported lower social self-esteem, and were rated as less likable, less socially skilled and less physically attractive by college student judges. Telephone partners reported that obese women were less likable, less friendly, less comfortable, made a poorer impression on them, and that they did not get to know them well.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Miller et al., 1995 (Me)	N=155 females	Adults	Obese M=43.70	Obese=77	20% over the midpoint of the weight range for medium build for their height	Not applicable	N=78	Social avoidance	Social avoidance and distress scale (self-report)	No differences in social avoidance and distress, social self-esteem, social competence, social support, or involvement in social networks.
			Healthy weight M=39.90					Social self-esteem	Social self-esteem inventory (self-report)	
								Social competence	Positive behaviour subscale of the Social Performance Survey Schedule (self-report)	
								Social involvement		
								Social support	Social Network Index (self-reported)	
									Perceived Social Support from Friends and Family (self-report)	

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Mills, 1994	N=203 males and females	Adults	Obese M=38.60, SD=14.50 Healthy M=21.00, SD=2.70	Obese=106	At least 50lb over ideal weight according to established normal height and weight tables	Not applicable	N=97	Emotional reliance on another person	Interpersonal Dependency Inventory Scale (self-report)	No differences in emotional reliance on others.
Neumark-Sztainer et al., 2002 (Me)	N= 3853	Adolescents	M=14.90, SD=1.70	Overweight=1286	BMI $\geq$ 85 th percentile	Not applicable	N=2567	Frequency and sources of lifetime weight teasing Degrees to which respondents were bothered by weight-teasing by peers and family members	Survey items asking from whom and how often they have been teased, and how much the teasing bothered them, based on items from the Perception of Teasing Scale (self-report)	Overweight youth reported higher levels of teasing from peers or family members and were more bothered by weight-teasing.
Pearce et al., 2002 (Me)	N=416 males and females	Adolescents	14-18	Obese=32 Overweight=59	BMI between 85 th and 94 th percentiles for age and gender	Not applicable	N=325	Frequency of overt and relational aggression/ victimization Dating behaviour and associated satisfaction	Revised Peer Experiences Questionnaire (self-report) Dating History Questionnaire (self-report)	Obese boys reported more overt victimization and obese girls reported more relational victimisation. Obese adolescents were less satisfied with their dating status and were less likely to date.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Purtill et al., 2010	N=163 males and females	Children and adolescents	Obese= M=12.44, SD=1.95 Healthy M=12.66, SD= 2.06	N=87 obese youth	BMI > 95th percentile for age and gender	Not applicable	N=76	Social acceptance Perceived competence in social acceptance Behavioural reputation (popularity as a leader; prosociality; aggressive-disruptiveness; sensitive-isolated behaviour) Loneliness	Peer nominations of 'three best friends', reciprocated friendships and like ratings (self and peer reports) Self-perception Profile for Children – social acceptance subscale (self-report) Revised Class Play (self and peer reports) Loneliness and Social Dissatisfaction Questionnaire (self-report)	No differences in reciprocated friendships, like-ratings, perceived competence in social acceptance, behavioural reputation or loneliness.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Salvy et al., 2010	N=59 males and females	Adolescents	M=13.6	Overweight/obese=21	BMI > 85th percentile for age and gender	Not applicable	N=38	Reinforcing value of food and food intake following ostracism	Relative Reinforcing Value of food task Cyberball task and test snack	Overweight participants worked harder to gain access to food in the reinforcing value of food task and had a greater energy intake following ostracism in the Cyberball task.
Sjoberg et al., 2005	N= 4703 males and females	Adolescents	15 or 17	Obese=131 Preobese=645	Obesity $\geq 30\text{kg/m}^2$	Not applicable	N= 4159	Frequency of shame experiences in the last 3 months	Shame Index (self-report)	Obese adolescents had more shaming experiences.
Stein, 1987 (Me)	N=86 females	Adults	18-25	Overweight=28	15% or more above in the ideal body weight	Not applicable	N=58	Perception of family and of self	Tennessee Self Concept Scale (TSCS) family and social self subscales (self-report)	Actual-obese subjects reported higher feelings of inferiority within their family and self-reported obese subjects reported poorer social self-esteem.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Strauss & Pollark, 2013	N=17557 males and females	Adolescents	13-18	Overweight=1852	BMI > 95 th percentile for age and sex	Not applicable	N=15705	Frequency and reciprocity of peer nominations	Peer nominations of five best female and five best male friends (self and peer reports)	Overweight adolescents listed similar numbers of friends as normal-weight adolescents, but received fewer friendship nominations from their peers and were more likely to receive no friendship nominations.
Tayyem et al., 2018 (Me)	N=795 males and females	Adolescents	15-18	Obese=43 Overweight=135	Overweight $\geq$ 23.29 kg/m ² for boys and $\geq$ 23.94 kg/m ² for girls Obese $\geq$ 28.30 kg/m ² for boys and $\geq$ 29.11 kg/m ² for girls	Not applicable	N=617	Opinions of parents and peers about their body weight	Perceived weight status, frequency of body shape-related criticism from parents or peers, and frequency of weight comparison to siblings from parents (self-report)	Approximately half of overweight and obese boys and over 80% obese girls thought that their parents and peers misclassified their weight.

Author, years	Total N and gender	Age group	Age	N overweight/ obese/ BED	Definition of overweight obesity	Classification of BED/LOC eating	N healthy weight	Interpersonal construct measured	Measure	Main findings
Vardar et al., 2004 (Me)	N=73 males and females	Adults	Obese M=30.20, SD=10.50 Obese with BED M=31.10 SD=6.60 Healthy M=28.60 SD=8.80	Obese=36 BED=8	Obese BMI $\geq$ 30kg/m ²	Structured Clinical Interview for DSM-IV disorders	N=37	Interpersonal sensitivity and related distress	Interpersonal sensitivity subscale from the revised 90-item Symptom-Checklist (self-report)	Obese patients with BED reported higher levels of interpersonal sensitivity.
Zeeck et al., 2010 (Me)	N=43 females	Adolescents	Obese M=45.40 SD=11.30 Obese with BED M=39.30 SD=12.70 Healthy M=39.70 SD=11.60	Obese=23 BED=20	BMI $\geq$ 30 kg/m ²	Clinical interview	N=20	Emotions linked to interpersonal experiences	Differential Affect Scale and items measuring interactional emotions (e.g. feeling helpless, powerful, hurt) from the Positive and Negative Affect Scale (self-report)	BED subjects reported more negative-interactional emotions and the strongest desire to eat when experiencing these emotions.

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