Received: 14 March 2019 | Revised: 26 June 2019 | Accepted: 14 July 2019

DOI: 10.1111/obr.12935

WILEY obesityreviews

The association between weight stigma and mental health: A meta-analysis

Christine Emmer[1] | Michael Bosnjak[2] | Jutta Mata[1]

[1] Health Psychology, University of Mannheim, Mannheim, Germany

[2] ZPID—Leibniz Institute for Psychology Information and University of Trier, Trier, Germany

Correspondence
Prof Dr Jutta Mata, Health Psychology Lab, University of Mannheim, L13, 17, 68159 Mannheim, Germany.
Email: mata@uni-mannheim.de

Summary

In recent years, there has been considerable research on the relation between weight stigma and mental health, but no quantitative synthesis of the empirical evidence is available to date. This meta-analysis (105 studies, 59 172 participants, and 497 effect sizes) fills this gap by quantifying the association between weight stigma and mental health. Age, gender, and factors presumed to exert a protective role (i.e., adaptive coping strategies and perceived social support) were tested as potential moderators. The three-level meta-analytic model estimated under a random effects assumption revealed a medium to large negative association between weight stigma and mental health (r = −0.35). The overall association remained significant when controlling for publication year, education, and body weight. There was substantial heterogeneity in effect sizes between studies (I^2 = 43%) and within studies (I^2 = 56%). Surprisingly, all moderator hypotheses had to be rejected. Body weight was a significant moderator, indicating a stronger association between weight stigma and diminished mental health with increasing body mass index. Future research might focus on explaining the heterogeneity of findings and on testing causality as well as potential underlying mechanisms.

KEYWORDS

meta-analysis, obesity, overweight, weight stigma

1 | INTRODUCTION

In 2016, more than 300 million children and adolescents and nearly 2 billion adults were affected by overweight or obesity, with rates still rising.[1] For adults, the WHO[2] defines overweight as a BMI between 25 and 30 kg/m^2 and obesity as a BMI ≥ 30 kg/m^2. For children and adolescents, overweight is defined as a BMI-for-age greater than 1 SD above the WHO growth reference median, and obesity as a BMI-for-age greater than 2 SDs above the reference median.[3]

Even though stigma and discrimination generally are considered a threat to the fundamental values of inclusion and equality in Western societies,[4] weight stigma is frequently propagated and tolerated.[5] Weight stigma (*weight bias*, *weightism*, or *weight-based discrimination*) describes the societal degradation through negative attitudes or beliefs directed towards a person based on his or her weight.[6] Weight stigma is usually expressed through stereotypes, that is, unreasoned judgements such as being lazy or unmotivated or lacking willpower and discipline.[5,6] These stereotypes may lead to prejudice, including

Abbreviations: WHO, World Health Organization; BMI, body mass index; CI, confidence interval; MeSH, Medical Subject Heading

The study was preregistered using the Open Science Framework (OSF): https://osf.io/6a7zt/

social rejection, unfair treatment, or overt discrimination.[4,5] Reasons for weight stigma include the widespread beliefs that weight control is a consequence of personal willpower[7] and that discrimination motivates individuals to lose weight.[5] However, weight stigma and discrimination have no known positive effects and no motivating function in weight loss efforts.[8-11] Instead, the experience of weight stigma is associated with weight gain and other detrimental consequences for mental and physical health.[8-10] Given the high prevalence of both overweight and corresponding weight stigma, this study focuses on weight stigma based on overweight.

Stigma is a multidimensional phenomenon that comprises individual (microsocial) and structural (macrosocial) forms of discrimination. The stigma constructs include *public stigma* and *self-stigma* on the microsocial level of discrimination, and *structural stigma* on the macrosocial level of discrimination.[12] Public stigma includes perceived weight stigma and experienced weight discrimination. It is the most obvious and widely recognised form of discrimination. Public stigma is characterised by person-to-person discrimination based on explicit or implicit weight stigma and stereotypes.[13] In current research, public stigma is often operationalised as the experience of a weight stigma situation, that is, perception of negative attitudes, prejudice, or inappropriate behaviour of others.[6,14] Self-stigma describes the belief that the stereotypes are true for oneself.[15] Hence, self- and public stigma are related to each other and form the concept of weight stigma as an experience of negative attitudes towards individuals with overweight.[8,14] Structural stigma occurs when an institution issues stigmatising messages and frames a group negatively, spreading prejudice and discrimination.[12] Structural stigma is institutionalised and formed by socio-political forces, usually in the form of policies that restrict the opportunities of a stigmatised group, for example, in the form of laws or mass media communication.[12]

Weight stigma and discrimination occur explicitly and implicitly in nearly every important area of life.[6] On the macrosocial level, stigma occurs mostly through the media. In a wide range of media types, such as newspapers, television shows, books, and even children's media, individuals, and characters with overweight are frequently portrayed in a stigmatising way.[16] Even in obesity-related health campaigns, weight stigma is pervasive.[17] Further, in social media, both weight stigma (e.g., "fat shaming") and supportive communities, such as the "fat acceptance" movement,[18] are present. Weight stigma in the offline social domain is prevalent and consists mainly of exclusion from social groups or negative talk about individuals with overweight.[19] The social consequences of weight stigma, such as social isolation and poor social support,[20] represent a serious health risk.[21] The most frequent form of peer harassment for children and adolescents is weight-based teasing and bullying in the context of education settings,[5] not only by peers but also by educators and teachers.[22,23] To escape from stigma in the education sector, some adolescents avoid going to school, which can result in poor academic outcomes.[24] Weight stigma in education settings starts as early as preschool age[5] and continues in the work environment with on-the-job discrimination, discrimination in the hiring process, and inequity in pay.[25] Frequent stigmatisation in education and employment settings might negatively impact a person's socioeconomic status, which in turn is a significant predictor of health.[26] Further, weight stigma and prejudice towards patients with overweight or obesity are common amongst health care professionals,[6] signifying a major barrier to health care utilisation.[27] This results in decreased quality of care and health prevention for individuals with overweight and consequentially in poorer health outcomes.[6]

Perceiving weight stigma is a stressful experience[9] that is stable over time and across important areas of life.[28] Therefore, weight stigma is a chronic stressor for many individuals and an important social determinant of health. Even though stigma is a unique contributor to adverse health outcomes,[8,9] it is rarely targeted in prevention and intervention for individuals affected by overweight or obesity. Mental health consequences especially are frequently ignored.[10] Importantly, the mechanisms underlying the link between weight stigma and mental health are poorly understood to date. Several qualitative reviews have summarised the current state of research and suggest that weight stigma is associated with a range of adverse mental health outcomes, such as depression, anxiety, psychological distress, dysfunctional and disordered eating, and decreased quality of life, self-esteem, and body satisfaction (see[8,9]). The increased risk for a wide spectrum of adverse psychological consequences of weight stigma is thought to apply to adults as well as children and adolescents.[5] The findings from the numerous primary studies on the association between weight stigma and mental health are heterogeneous and complex.[8,9] A quantitative synthesis of results across primary studies, such as the current meta-analysis, additionally shows the overall effect size of the association between weight stigma and mental health and also identifies sources of variations in effects, such as moderators. The following moderators were tested:

Gender. Current research describes weight stigma as a risk factor for a range of emotional and psychological consequences for both girls and women, and boys and men. However, empirical findings regarding gender are inconsistent. While some studies suggest that men are equally often targets of weight stigma and are just as vulnerable as women,[29,30] others report more weight stigma experiences in women than in men,[31,32] including in heterosexual relationships,[20] education,[33] and employment settings.[25] One explanation might be the pervasive ideal of physical attractiveness, which emphasises being thin as central to feminine beauty.

Age. Weight stigma is extremely detrimental for children and adolescents.[22,34] Particularly adolescence is characterised by increased attention to physical appearance and exertion of pressure to conform to ideals of appearance concerning body shape and size.[22] In addition, children and adolescents are still developing a self-identity, a stable body image, and self-esteem, which are crucial for well-being and can be strongly affected by weight stigma.[22,34] Individuals gain greater emotional stability, psychological resilience, and acceptance for a broader range of body sizes and shapes with increasing age.[35,36] The tolerance of overweight increases in adulthood.[37]

Coping strategies. Coping strategies may be important contributors to reducing the negative health consequences of weight stigma.[29] Currently, there is limited evidence and synthesis in coping research related to weight stigma.[19,29] The Coping Response Inventory distinguishes between adaptive (e.g., positive self-talk, self-love, and self-

acceptance) and maladaptive (e.g., negative self-talk, crying, and isolating oneself) coping strategies for dealing with weight stigma. Adaptive coping strategies are associated with greater well-being and increased mental health, maladaptive coping strategies with poorer well-being, and decreased mental health.[14] Importantly, it remains unclear if specific adaptive coping strategies vary in their impact on the association of weight stigma and mental health.

Social support. Social support may also reduce the negative health consequences of weight stigma.[29] According to the stress-buffering hypothesis,[38] social support is utilised to buffer the adverse effects of stress on mental health. Social support has different functional aspects that might buffer stress[21,38]: Emotional support describes an offer of empathy, comfort, or compassion.[39] Instrumental support consists of assistance with resources, whereas appraisal represents help in decision making.[39] Informational support consists of advice or information.[39] The current literature does not provide evidence for a buffering effect of social support against the consequences of weight stigma. In their review, Papadopoulos and Brennan[8] identified only one study[40] that investigated the moderating effect of social support; here, social support did not buffer against adverse consequences of weight stigma. However, other studies investigating general stigma have found that social support could buffer the adverse consequences of stigma-related stress for mental health.[41] Hence, further research is necessary to identify potential effects of different types of social support on the relation between weight stigma and mental health.

1.1 | Hypotheses

Given the literature reviewed above, we propose the following hypotheses:

1. Weight stigma is negatively correlated with mental health.

In addition to this main effect, we hypothesize that the following factors moderate the relation between weight stigma and mental health:

2. Gender: The correlation between weight stigma and mental health is stronger in women than in men.
3. Age: The correlation between weight stigma and mental health is stronger in younger than in older people.
4. Coping strategies: The correlation between weight stigma and mental health is weaker when adaptive coping strategies are used.
5. Social support: The correlation between weight stigma and mental health is weaker when perceived social support is high.

1.2 | Control variables

To ensure that the overall association of weight stigma and mental health and the potential moderator effects were examined independently and were not confounded by other factors, we included the following control variables in the analyses:

Publication year. Given the strong increase of overweight over the last decades, it is possible that the frequency or intensity of perceived weight stigma changed during this time. Moreover, important methodological changes in the young weight stigma research field could influence the study findings. One example of the impact of publication year is the contradictory findings regarding weight stigma for women versus men: Current studies report similar results for women and men[29] and girls and boys.[5] However, earlier studies emphasised weight stigma as a phenomenon for women only, for instance, in the context of heterosexual romantic relationships,[20] education,[33] or employment settings.[25] These findings may reflect methodological issues (e.g., general vs. context-specific stigma) or real changes in the experience of weight stigma and its consequences for women and men.

Education level. A higher education level leads to an increased probability of greater income and wealth and is associated with enhanced competence to obtain and effectively use health-related information and cope with stressors.[26] Accordingly, education level is a significant predictor of health and may influence the association of weight stigma and mental health as well as the effect of potential moderators.

Body weight. Weight stigma can be experienced independently of body weight and consequently might lead to adverse mental health outcomes also for individuals whose body weight is not classified as overweight based on BMI.[42] Nevertheless, the risk of becoming a target of weight discrimination increases with each BMI percentile.[5] Thus, we controlled for BMI in the analyses.

1.3 | Exploratory research questions

As stated above, the different types of weight stigma and mental health outcomes are entangled in current weight stigma research. Hence, one of the aims of this meta-analysis was to test the role of specific types of stigma as well as differential aspects of mental health for the association between weight stigma and mental health. The following exploratory research questions were addressed:

1. Do the specific types of weight stigma, namely, public, self-, and structural stigma, show different strengths of association with mental health?
2. Is the strength of the association similar for weight stigma and different types of mental health outcomes?

Following the advice of an anonymous reviewer, we additionally tested the moderating effect of ethnicity on the overall association between weight stigma and mental health.

3. Does ethnicity have a moderating effect on the overall association between weight stigma and mental health?

2 | METHOD

2.1 | Inclusion and exclusion criteria

To be included in the meta-analysis, studies had to contain quantitative data that determined the bivariate statistical association between the assessed weight stigma and mental health outcomes. Published and unpublished manuscripts written in English or German were considered without any restriction of the publication year.

2.2 | Literature search strategy and study selection

The keywords were identified, and the search strategy was developed jointly with a research librarian. First, systematic literature searches (last search performed on 14 May 2019) were conducted using the following databases: PsycINFO, PsycARTICLES, PubPsych, PSYNDEX, PubMed, Sociological Abstracts, Web of Science, Academic Search Premier, ProQuest Dissertation and Theses Global, and PsyArXiv. Stigma-related keywords were used with each of the overweight-related and mental-health-related keywords in turn. Note that because both free and controlled vocabulary (e.g., MeSH terms in PubMed, thesaurus in PsycINFO, or subjects in Sociological Abstracts) were used, the search strategy was adapted to the different databases. For the detailed search strategy, please refer to Tables S1 to S10.

To identify unpublished studies, authors who have published frequently on weight stigma as well as relevant scientific societies (e.g., The Obesity Society and Society for Health Psychology) were contacted via mail or mailing lists and asked to provide unpublished articles or data. We did not receive any unpublished data for inclusion in this meta-analysis.

The search was cross-referenced using backward and forward searches. The backward search was implemented by examining the reference list of relevant reviews or non-quantitative manuscripts manually. We used Web of Science for the forward search.

Eligibility of studies was assessed in two steps: (a) Titles and abstracts of 2 739 records were screened to exclude irrelevant studies (e.g., examining psychological effects of diabetes or cardiovascular diseases), and (b) the remaining 311 manuscripts were screened in full for eligibility. In the first step, the inclusion of 200 randomly chosen studies was determined independently by the first author and a trained second rater. Because we obtained a perfect agreement rate (100%), the remaining studies were screened by only one rater. The full-text review-eligible studies that were not electronically accessible were obtained through interlibrary loan or contact with the authors. If neither method was successful, the manuscripts were excluded (n = 2 dissertations). Further, two studies with only longitudinal data were excluded for methodological inconsistency as all other included data were correlational. Longitudinal and experimental studies were included if they reported eligible zero-order correlative baseline data. After the exclusion of a total of 207 ineligible manuscripts, 104 manuscripts were included in the analysis (for references of included studies see Table S11), yielding 105 studies with 497 effect sizes (see Figure 1 for a PRISMA[43] flowchart).

2.3 | Coding procedure

For the data extraction, a standardised coding manual was developed and independently piloted by two coders, using three randomly chosen eligible studies. Any discrepancy encountered was solved by consensus, and the manual was changed accordingly. The relevant data of each manuscript were coded in three hierarchically linked levels: (a) study level, (b) sample level, and (c) effect-size level. Not reported information (not available, *NA*) was treated as a missing value and omitted from the analyses. The coding manual is provided in Table S12. The data were extracted independently by two coders. To determine the intercoder reliability, Krippendorff's alpha was calculated using the reliability calculator ReCal.[44] Krippendorff's alpha was adequate for the variables of interest (range: .76 to .97; see Table S13 for detailed information).[45] Disagreements between the coders were reviewed and corrected using the source text of the respective primary study.

2.4 | Effect size

Pearson's product-moment correlation coefficient r was used to determine the quantitative bivariate association between weight stigma and the corresponding mental health outcomes. Negative coefficients indicated lower mental health with higher levels of perceived weight stigma: decreased self-esteem, well-being, quality of life, or body image satisfaction; or increased frequency and intensity of psychopathological symptoms (e.g., depression, anxiety) or psychological distress. If statistics other than r were reported, such as means and standard deviations, the statistics were converted into r using the Lipsey and Wilson[46] formulas. Spearman's rank-order correlation r was treated equally to Pearson's r in the data extraction and analysis. Regression coefficients differed fundamentally in the type of control variables (e.g., some studies controlled for age and gender, whereas others controlled only for BMI). Accordingly, regression coefficients were not used for the analysis. When authors reported insufficient statistics to calculate r (e.g., incomplete data, or partial regression coefficients), the authors were contacted and asked to provide the respective correlative data. Twelve authors provided data (n = 14 manuscripts); the remaining manuscripts (n = 20) were excluded from the analysis. For stabilising variance in the analyses, the effect size r was transformed into Fisher's Z_r.[47] For figures and plots, as well as for the report of results, the back-transformed r values were used.

2.5 | Meta-analysis procedure

Eligible primary studies reported mostly more than one effect size, for example, the association of weight stigma with multiple mental health outcomes. This interdependence of effect sizes (i.e., sampling covariation) leads to a nested data structure in the form of three hierarchical

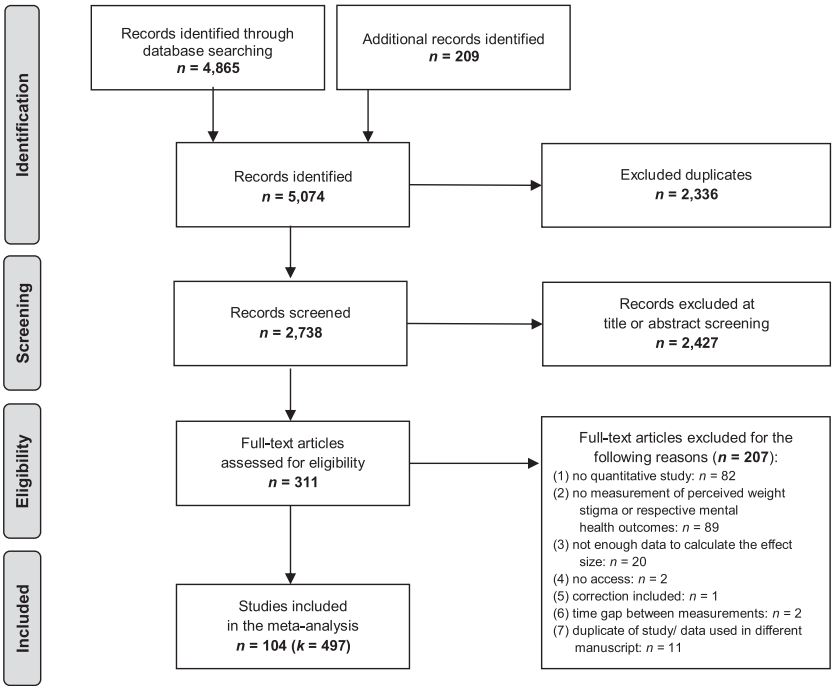

FIGURE 1 Study selection flowchart according to the PRISMA standard[43]

levels. To account for the sampling covariation while simultaneously preserving all information and maximising the statistical power, a three-level meta-analytic model was fitted to the data.[48] The model considers three variance components, distributed over the hierarchical linked levels: the sampling variance of effect sizes at Level 1, the variance between effect sizes from the same sample at Level 2 (within-study variance, accounts for sampling covariation), and the variance between studies at Level 3.[49] As the primary studies differed in the way weight stigma and mental health outcomes were assessed, potential systematic variance between studies was considered with a Hedges/Olkin-type random effects assumption.[50]

The data synthesis was conducted with the statistic software RStudio version 1.1.456,[51] using the R package metafor.[52] To assess the significance of model coefficients, the Knapp and Hartung[53] adjustment was used to decrease the probability of unjustified significant results.[48] For significance testing, a 95% CI was used. Missing values were omitted from the analyses.

2.5.1 | Overall association of weight stigma and mental health

To investigate Hypothesis 1, a three-level random effects model was applied to the data to estimate the overall association of weight stigma and mental health. For estimation, the average of the Fisher's Z_r was weighted by an inverse variance component containing respective sampling variance and covariance.[52]

2.5.2 | Heterogeneity

Following the recommendations of the Cochrane Collaboration,[54] Cochran's Q test was used to assess homogeneity[55] and I^2 to assess heterogeneity.[54] To estimate the parameters that describe the variance of the estimated true scores within studies (σ^2_1 at Level 2) and between studies (σ^2_2 at Level 3), the restricted maximum likelihood estimation method was used.[52] The intraclass correlation for true effects within a study (ρ) represents the correlation of underlying true effects within studies. A medium to high correlation indicates the necessity of modelling a three-level structure. To determine the significance of within-study and between-study variance, two separate one-sided log-likelihood-ratio tests (null hypotheses of variance component equals zero) were performed. An adapted version of I^2 was used to evaluate the proportions of total variation of true effects due to the three levels.[48] Higgins and Green[54] suggested the following conventions for the interpretability: I^2 < 40% might not be important and I^2 = 30% to 60% might indicate medium, 50% to 90% substantial, and 75% to 100% considerable heterogeneity.

2.5.3 | Moderator analyses

If heterogeneity assessment indicated that there was significant variance on Levels 2 and 3, moderator analyses were conducted to test variables that may explain the heterogeneity. Accordingly, moderator analyses contribute to the understanding of the effect of individual and contextual factors on the association of weight stigma and mental health. To determine whether the included moderators are significant, omnibus tests were performed.[48] To test our hypotheses, the effects of the following potential moderator variables were tested in three-level mixed effects meta-regressions: gender proportion of the sample (percentage female participants), mean age of the sample, use of adaptive coping strategies (use vs. non-use), and perceived social support (perceived vs. non-perceived)

2.5.4 | Control variables

The following variables were centred around their means and were included separately as moderators: publication year of study, education level of sample, and body weight (mean BMI of sample). Education level was classified according to the International Standard Classification of Education (ISCED)[56] and aggregated into low, medium, and high education according to the suggestions from Eurostat.[57] For body weight, the mean BMI of the samples was used. For further details on the coding procedure and operationalisation of variables, please see the coding manual in Table S12.

2.6 | Exploratory moderator analyses

2.6.1 | Type of weight stigma and mental health outcomes

To test if different types of weight stigma show different strengths of association with mental health and whether weight stigma is differentially associated with different mental health outcomes, independent meta-regression models examining the association of weight stigma and mental health were tested. Separate three-level random effects meta-analyses were conducted for all subtypes, that is, meta-analyses for the association of a specific weight stigma type and mental health, or for the association of weight stigma and a specific mental health outcome.

2.6.2 | Moderating effect of ethnicity on the association between weight stigma and mental health

Given the overwhelming focus on White samples in the literature, we could only undertake a crude analysis (White vs. non-White) to test the effect of ethnicity on the association between weight stigma and mental health. As one of the dominant assumptions in the weight stigma literature is that weight stigma affects people of colour less than it does White people (e.g.,[58-60]), we operationalised the information on ethnicity as the proportion of individuals referring to themselves as White in the respective sample.

2.7 | Publication bias

A critical issue in meta-analyses is the risk of publication bias. Primary studies with significant results are more likely to get published and therefore included in the analysis compared with studies with non-significant results.[61] In the current meta-analysis, the risk of publication bias is low because the included data are almost exclusively descriptive and a great effort was made to include unpublished data. Nevertheless, the risk of publication bias was assessed using funnel plot asymmetry as an indicator. To test for publication bias, the inferential Egger's regression test was used.[62] As the available methods to identify publication bias have not been evaluated in multilevel meta-analytic research,[48] a univariate linear mixed effects model was used for data synthesis. If there was a significant funnel plot asymmetry, the trim-and-fill method[63] was used to provide an estimate of the number of missing studies resulting from publication bias and an adjusted effect size.[54] Additionally, to evaluate the robustness of the analysis, failsafe N[64] was used, which estimates the number of studies with non-significant results required to nullify the overall mean association.

3 | RESULTS

3.1 | Study and sample characteristics

The publication year of the 104 manuscripts ranged from 1991 to 2019. Of the included studies, 85% were journal articles and 15% dissertations. Of the journal articles, 40% reported projects that received public funding. Only one project received commercial funding, indicating no risk of bias due to a possible conflict of interest. Within the 105 included studies, an average of 4.78 (range: 1–21) effect sizes from n = 118 unique samples, with a total of N = 59 172 (range: 23–12 074) participants, were included.

Most effect sizes (93%) assessed weight stigma in general daily life; only 33 (6%) measured weight stigma in specific life domains (k = 32 in interpersonal and k = 1 in health care settings). Regarding the type of weight stigma, 51% of effect sizes referred to public stigma, 45% to self-stigma, and only 2% to structural stigma (the remaining 2% to implicit weight bias). For an overview of the assessed mental health outcomes, see Figure S1. For detailed information about each included study and corresponding effects (e.g., weight stigma measures), see Table S14. Validated and non-validated measures for weight stigma and mental health outcomes were included in the analysis to ensure comprehensiveness. To examine whether the methodological quality of tools used affects the strength of the overall association between weight stigma and mental health, dummy-coded moderator variables were added simultaneously to the meta-regression. The extended meta-regression model revealed a significant result of the omnibus test, $F(2, 494) = 5.28$, $P = .005$. The coefficient for weight stigma measures was significant ($\beta = -0.086$, $P = .002$), indicating that validated weight stigma measures do produce slightly stronger effects for the association between weight stigma and mental health compared with non-validated measures for weight stigma. The coefficient for mental health measures was not significant ($\beta = -0.028$, $P = .062$).

Sociodemographic information about the sample is shown in Table 1. Education level was not reported for 37% of included samples; 14% had a high education level, 6% a low or medium education level; 19% of included samples consisted of university students, and 24% consisted of students in schools (please see Figure S2 for an overview of the distribution of education level among the effect sizes). For a graphical illustration of the distribution of the sample characteristics gender, age, and BMI among effect sizes in relation to the publication year, see Figure 2. The distribution of ethnicity among effect sizes in relation to the publication year is illustrated in Figure S3.

3.2 | Hypothesis 1: overall association of weight stigma and mental health

The three-level random effects meta-regression revealed a mean effect of $r = -0.35$ ($P < .001$, 95% CI [−0.38, −0.32], $SE = 0.02$) between perceived weight stigma and mental health across all studies. For a summary of the results, see Figure 3 for a funnel plot. All parameter estimates of the meta-regression model are presented in Table S15, the profile likelihood plots in Figure S4.

3.3 | Heterogeneity

The Q test of homogeneity revealed significant variation between all effect sizes in the data set, $Q(496) = 125\,309.45$, $P < .001$. The variance components $\sigma^2_1 = 0.15$, $\chi^2(1) = 4222.18$, $P < .001$, and $\sigma^2_2 = 0.13$, $\chi^2(1) = 93.01$, $P < .001$, were significant (for profile likelihood plots see Figure S4). The intraclass correlation $\rho = .57$ indicated a medium to large correlation of the underlying true effects within studies. Of the total heterogeneity, $I^2 = 56\%$ could be attributed to variance at Level 2 and $I^2 = 43\%$ to variance at Level 3. Only 0.2% of the total variance could be attributed to sampling variance (Level 1).

3.4 | Moderator analyses

Moderator analyses were performed to investigate variables that may explain the significant within-study and between-study variance. All parameter estimates of the meta-regression models are presented in Table S15, the profile likelihood plots in Figure S5.

3.4.1 | Hypothesis 2: Moderating effect of gender

The extended meta-regression model with gender as moderator ($k = 496$ effect sizes) revealed a non-significant result of the omnibus test, $F(1, 494) = 1.58$, $P = .209$. The residual heterogeneity was significant, $Q_e(494) = 121\,400.71$, $P < .001$; thus, gender did not explain the heterogeneity in the findings.

TABLE 1 Descriptive statistics of the total sample based on the data extracted from primary studies

Sample characteristic	*n*	*M* (*SD*)	*Mdn*	Range
Age of sample (years)	111	30.54 (15.44)	32.74	9.00 - 67.50
Gender of sample (% female)	117	70%	73%	0% - 100%
Ethnicity (% white)	71	64%	76%	0% - 98%
BMI (kg/m^2)	86	32.29 (8.44)	32.29	16.27 - 49.55
Obesity (% obese)	66	57%	59%	0% - 100%

Note. *n* = number of samples.

3.4.2 | Hypothesis 3: Moderating effect of age

For age ($k = 463$), the omnibus test was not significant, $F(1, 461) = 3.79$, $P = .052$. The residual heterogeneity was significant, $Q_e(461) = 18\,938.76$, $P < .001$.

3.4.3 | Hypothesis 4: Moderating effect of adaptive coping strategies

The omnibus test for use of adaptive coping strategies ($k = 497$) was not significant, $F(1, 495) = 0.75$, $P = .387$; the residual heterogeneity was significant, $Q_e(495) = 117\,098.26$, $P < .001$.

3.4.4 | Hypothesis 5: Moderating effect of perceived social support

No included studies reported perceived social support of the participants; hence, a potential moderating effect of social support was not examined. Please note that the data from the only identified study assessing social support in the review by Papadopoulos and Brennan[8] could not be included due to insufficient description of the data.

3.5 | Control variables

Adding control variables separately did not change the significance and size of the mean effect for weight stigma and mental health, which therefore remained robust while controlling for publication year, education, or BMI (all estimates in Table S15). The omnibus tests for publication year ($k = 495$), $F(1, 493) = 2.76$, $P = .097$, and education ($k = 96$), $F(1, 94) = 0.12$, $P = .728$, were not significant. For BMI ($k = 387$), the omnibus test was significant, $F(1, 385) = 4.68$, $P = .031$. The regression coefficient, $\beta = -0.04$ ($P = .031$), indicates a slightly stronger association between weight stigma and diminished mental health with increasing BMI of the participants.

3.6 | Publication bias

To detect a potential publication bias, a two-level random effects model was used ($r = -0.33$, $P < .001$, 95% CI [−0.35, −0.31]).[48] The trim-and-fill plot imputed no effect sizes but showed funnel plot asymmetry. Egger's regression test supported this result and revealed a significant funnel plot asymmetry with a positive skew ($z = 4.96$, $P < .001$), indicating that highly negative correlations seem to be missing, that is, that the meta-analytic model might underestimate the real strength of the association between weight stigma and mental health. The estimate for the adjusted effect size was $r = -0.33$ ($P < .001$, 95% CI [−0.35, −0.31]), thus similar to the non-adjusted overall effect size. Failsafe N indicated a robust correlation between weight stigma and mental health since at least 21 914 386 effect sizes with non-significant findings are required to invalidate the overall association.[64]

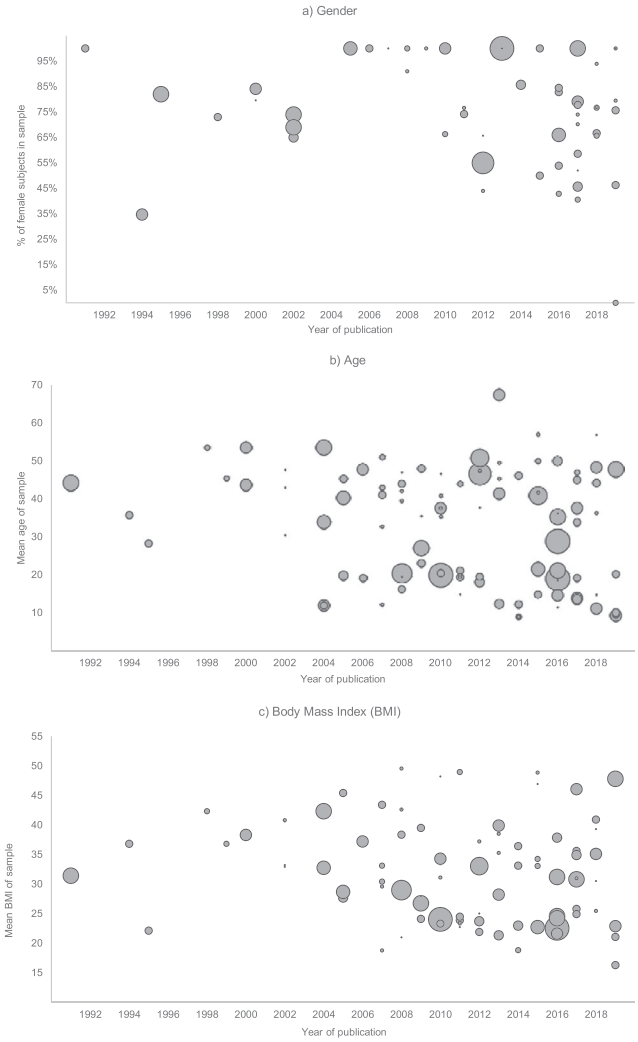

FIGURE 2 Distribution of (A) gender: proportion of female participants in the sample (*y* axis), (B) age: mean age of participants in the sample (*y* axis), and (C) body mass index (BMI): mean BMI of participants in the sample (*y* axis) and the corresponding number of effect sizes (represented by the diameter of the circles) in relation to the publication year of the manuscripts (*x* axis)

3.7 | Exploratory analyses

3.7.1 | Type of weight stigma

The different types of weight stigma were used to build subsets to conduct separate three-level random effects meta-analyses. The meta-analytic model for self-stigma (k = 222) revealed a larger effect (r = −0.39, P < .001) compared with estimates for public stigma (k = 241; r = −0.33, P < .001), structural stigma (k = 8; r = −0.28, P < .001), and implicit weight bias (k = 11; r = −0.17, P < .001). The estimated parameters of the models can be obtained from Table S16; for funnel plots see Figure S6.

3.7.2 | Type of mental health outcome

The extracted mental health outcomes were self-esteem, well-being, quality of life and life satisfaction, symptoms of depression, symptoms of anxiety, body image dissatisfaction, eating disorders and dysfunctional eating, psychological distress and other psychopathological symptoms, and a residual category (based on a small number of effect sizes) mainly consisting of self-concept-related mental health outcomes that emerged during coding: self-evaluation, self-worth, self-efficacy, self-confidence, and negative self-statements (Figure S1). For each individual mental health outcome, separate three-level random effects meta-analyses were conducted. Note that a negative correlation coefficient indicates diminished mental health, for example, decreased quality of life and life satisfaction, increased psychological distress or frequency and intensity of psychopathological symptoms, or a negative self-concept. The meta-analytic models showed comparable effects for the different mental health outcomes: the strongest effects for body image dissatisfaction (k = 85; r = −0.39, P < .001), quality of life (k = 49; r = −0.38, P < .001), symptoms of depression (k = 89; r = −0.37, P < .001), dysfunctional eating (k = 96; r = −0.35, P < .001), symptoms of anxiety (k = 25; r = −0.35, P < .001), and psychological distress (k = 60; r = −0.33, P < .001). The effects for self-esteem (k = 82; r = −0.29, P < .001), other self-concept-related outcomes (k = 10; r = −0.20, P < .001), and well-being (k = 4; r = −0.22, P = .003) were slightly smaller compared with the overall association

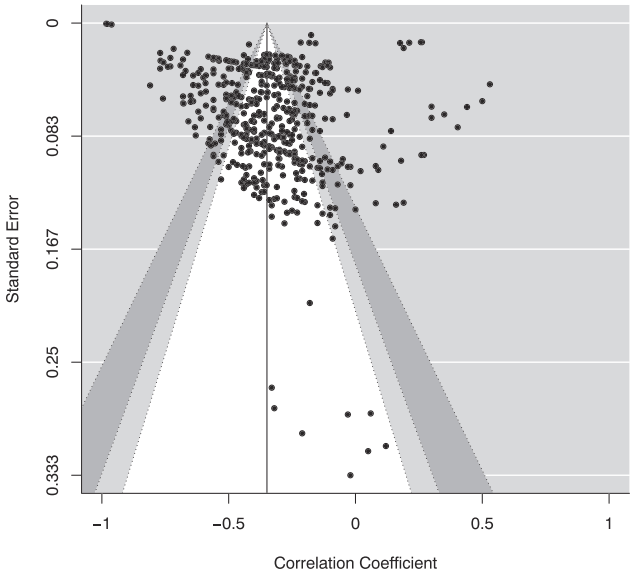

FIGURE 3 Funnel plot of the overall association between weight stigma and mental health. The diagonal lines represent confidence intervals, and the white region corresponds to $P > .10$, the light grey region to $P = .10$ to .05, the dark grey region to $P = .05$ to .01, and the region outside of the funnel to $P < .01$

of weight stigma and all mental health outcomes. Please note that the number of effect sizes vary widely between the different mental health outcomes (see Table S17 for all parameter estimates, Figure S7 for funnel plots).

3.7.3 | Moderating effect of ethnicity

For ethnicity ($k = 277$), the omnibus test was not significant, $F(1, 275) = 0.41$, $P = .523$; the residual heterogeneity was significant, $Q_e(275) = 26\,720.35$, $P < .001$. The parameter estimates of the meta-regression model are presented in Table S15, the profile likelihood plots in Figure S5.

4 | DISCUSSION

The current meta-analysis quantified the relation between weight stigma and mental health, using data from more than 59 000 participants from 105 studies. The results show that higher perceived weight stigma is significantly associated with diminished mental health. This association remained significant and comparable in size even when controlling for different study and sample characteristics, namely, publication year, education level, and body weight. Body weight was a significant moderator, indicating a stronger association between weight stigma and diminished mental health with increasing BMI. None of the hypothesised moderators (gender, age, adaptive coping strategies, and social support) influenced the relation between weight stigma and mental health. Importantly, no data were available for the proposed moderator perceived social support.

4.1 | Interpretation of the results

This meta-analysis showed a medium to large effect for the association between weight stigma and mental health: the greater the perceived weight stigma, the worse the mental health status. By adding a quantitative estimate, the current meta-analysis builds on and extends the evidence from prior reviews, which also reported a negative impact of weight stigma on mental health (e.g.,[8,9]). The overall effect remained significant and comparable in size when controlling for moderator and control variables, supporting Hypothesis 1.

The heterogeneity analyses showed a substantial amount of unexplained within-study and between-study variance. To explain the heterogeneity, the moderating effects of gender, age, adaptive coping strategies, and perceived social support in the relationship between weight stigma and mental health were tested. Contrary to our prediction (Hypothesis 2), no moderating effect was found for gender. This might be due to several reasons: First, studies reporting a differential impact of weight stigma for women and men specifically focussed on relationship outcomes[20,33] or employment settings.[25] However, less than 10% of included studies focussed on these life domains; the vast majority of studies focussed exclusively on weight stigma in general. Second, the majority of extracted effect sizes stem from populations that consisted nearly exclusively of women. The lack of male participants could be a methodological explanation for the absence of a moderating effect of gender. Importantly, more recent studies included more male participants. Therefore, future meta-analyses should again consider gender as a potential moderator.

No moderating effect of age was found. This finding is contrary to Hypothesis 3, in which a stronger association between weight stigma and mental health was assumed for younger compared with older individuals. A potential explanation might be that even though younger individuals may be more vulnerable to stigma and discrimination, older individuals experienced weight stigma more often during their prolonged lifetime. This chronic stigma-related stress and respective accumulation of adverse health outcomes might have led to similar effects for weight stigma and mental health independently of the age of participants.

The extracted data on coping consisted of only weight loss attempts, rather than strategies specifically used to cope with stress related to weight stigma. Coping did not influence the relation between weight stigma and mental health. For perceived social support, no eligible data were available at all. Consequently, the assumed stress-buffering effect of adaptive coping strategies in Hypothesis 3 and postulated protective function of social support in Hypothesis 4 were not supported by the available data.

We found no influence of ethnicity on the overall association between weight stigma and mental health (Exploratory Research Question 3). The vast majority of participants in included studies on weight stigma identified as White. Therefore, we could assess only whether the relation between weight stigma and mental health differs between people who identify as White versus non-White. This might be a methodological reason for the non-significant result of the influence of ethnicity on the association between weight stigma and mental health.

Moreover, separate meta-analyses were conducted for the association of different types of weight stigma and different types of mental health outcomes (Exploratory Research Questions 1 and 2). Especially self-stigma, with a medium effect, had a strong association with mental health; a slightly smaller effect was found for public stigma and corresponding mental health outcomes (Research Question 1). This finding is in accordance with the meta-analytic estimates provided by Livingston and Boyd,[65] who found similar medium to large effect sizes for the association of internalised mental health stigma and various mental health outcomes. Also, the medium effect for public stigma is comparable to meta-analytic estimates for the association of perceived general stigma and mental health.[66] The marginally larger effect for internalised stigma might be a consequence of the acceptance of prejudice and negative stereotypes being true for oneself. Hence, weight stigma becomes relevant for the self, which might impact mental health in a strong way. Furthermore, it is potentially more difficult or even impossible to escape the adverse stigma-related stress when weight stigma is internalised.

Further, a particularly strong association was found for the relation between weight stigma and body image dissatisfaction, quality of life, and symptoms of depression, whereas the relationships between weight stigma and self-esteem, well-being, and other mental health outcomes related to self-concept were smaller compared with the mean effect (Exploratory Research Question 2). These findings imply that weight stigma differs in association strength between specific mental health outcomes.

In sum, a significant amount of heterogeneity remained unexplained, even after adding a variety of potential moderator and control variables. Importantly, the association of weight stigma and mental health remains significant while controlling for publication year, age, and body weight. This implies that weight stigma has a unique effect on mental health.

4.2 | Risk of bias

The positive skewness of the funnel plot indicates that studies with no effect, a small negative effect, or even a positive association between weight stigma and corresponding mental health outcomes tend to be overreported. This suggests that the meta-analytic model might underestimate the real strength of the association, which seems unusual, as typically studies with large significant effects tend to be overreported.[61] A possible methodological explanation might be the inclusion of non-validated measures for weight stigma, as validated weight stigma measures did produce stronger effects for the association between weight stigma and mental health compared with non-validated measures. At the same time, as a random effects model was used and substantial heterogeneity is present in this meta-analysis, the probability is high that the funnel plot is asymmetric regardless of the presence of publication bias. Besides, failsafe *N* indicated that the overall estimate seems to be largely unaffected by selective publication practice.

Another bias that could have affected the results is reporting bias. It describes the tendency of authors who report only a few effects to pick the large effects and omit the smaller effects.[49] As a three-level approach was used in this meta-analysis, the sampling covariation of effect sizes was considered. Thus, effect sizes from studies reporting a higher number of effects were given less weight in the results than studies reporting a lower number of effects. Consequently, the use of a three-level approach might have led to a larger mean estimate of the overall association.[49]

At the moment, promising new methods to correct for publication bias are being developed (e.g.,[67]), although these are still at an early stage of development. Therefore, reducing the risk of bias in primary studies (e.g., by incentivising preregistration and open science) needs to be a priority.

4.3 | Limitations and future research

Although a strong relation between weight stigma and mental health was found, the current data provide merely correlative evidence. Additionally, the estimates are based on exclusively cross-sectional data, which does not allow us to draw conclusions about the direction of the effect or causality. It remains uncertain whether weight stigma affects mental health, or whether individuals with a diminished mental health status, particularly decreased levels of quality of life, are especially vulnerable to weight stigma. Future research needs to examine the causal relationship using experimental and longitudinal designs. Even though conducting experimental research on weight stigma is challenging due to ethical restrictions, some studies have manipulated weight stigma experimentally (e.g.,[68-70]). However, given ethical limitations and the artificial nature of experiments on weight stigma, conducting cohort studies or intensive longitudinal studies using experience sampling seems more feasible and informative (e.g., concerning ecological validity). Moreover, qualitative research is needed to disentangle the complex concepts of stigma and discrimination experiences, such as teasing, unfair treatment, or bullying, which are still intertwined in current weight stigma research. Currently, little is known about the different phenomena of weight stigma, about their specific subjective meanings, individual biopsychosocial consequences, and their interactions. Theoretical-conceptual work on mechanisms underlying the effect of the different types of weight stigma in specific life areas could further advance this research area. Future studies should focus on the investigation of moderators to provide an understanding of individual and contextual factors affecting the association of weight stigma and mental health.

4.4 | Implications

The current meta-analysis for the first time quantified the strength of association between weight stigma and mental health, showing a strong association that remained comparable in size even after controlling for other relevant factors, namely, publication year, education level, and BMI. Importantly, this meta-analysis also showed that the studies included are largely of a cross-sectional nature. Thus, despite general agreement that stigmatisation is unfair and harmful and should

be reduced, these findings cannot be informative about an improvement in mental health as a consequence of reduced weight-related stigma. This meta-analysis also highlights what is not yet known about weight stigma and mental health, as only a few potential moderators have been investigated. Particularly, the lack of research on protective factors such as social support and adaptive coping is striking. Also, more frequently including men and different life domains in this research seems important and could contribute to a better explanation of the great heterogeneity of findings.

Despite the correlational nature of the current findings, the strong association between weight stigma and various mental health outcomes suggests that weight stigma should be addressed in society at large, with health professionals, policy makers, and importantly, people with overweight and obesity. Surprisingly, most health-related interventions working with individuals affected by overweight or obesity do not address weight stigma but rather focus on weight loss.[71] Broadening the focus by considering weight stigma might enhance the currently comparably low effectiveness of these interventions.[72] Further, it is not certain that all individuals with overweight want to reduce their weight, but they might need support to deal with the harmful consequences of perceived weight stigma.

4.5 | Conclusions

This meta-analysis quantifies the correlative evidence for the negative consequences of weight stigma for a range of mental health outcomes. To improve the well-being and protect the psychological functioning of individuals with overweight or obesity, addressing weight stigma is a promising avenue. One third of the world's population are affected by overweight and consequently at high risk of being affected by weight stigma. Education about overweight and weight stigma as well as policies to protect people with overweight against stigma is an important challenge for better mental health on a global level.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

ACKNOWLEDGEMENTS

We are grateful to Anita Todd for editing the manuscript. We also thank the library of the University of Mannheim, particularly Angela Leichtweiß, for help with the literature search, and Emelie Letzsch, Aline Kelber, and Letizia Motel for their support in preparing the manuscript.

ORCID

Christine Emmer https://orcid.org/0000-0003-0243-8463
Michael Bosnjak https://orcid.org/0000-0002-1431-8461
Jutta Mata https://orcid.org/0000-0003-2498-5054

REFERENCES

1. NCD Risk Factor Collaboration. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet*. 2017;390(10113):2627-2642. https://doi.org/10.1016/S0140-6736(17)32129-3
2. World Health Organization. *Obesity: preventing and managing the global epidemic*. Geneva, Switzerland: World Health Organization; 2000. http://www.who.int/entity/nutrition/publications/obesity/WHO_TRS_894/en/index.html. Accessed January 17, 2019.
3. De MO, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 2007;85(9):660-667. https://doi.org/10.2471/BLT.07.043497
4. Brownell KD, Puhl RM, Schwartz MB, Rudd L. *Weight Bias: Nature, Consequences, and Remedies*. New York, NY: Guilford Publications; 2005.
5. Pont SJ, Puhl R, Cook SR, Slusser W. Stigma experienced by children and adolescents with obesity. *Pediatrics*. 2017;140(6):e20173034. https://doi.org/10.1542/peds.2017-3034
6. Puhl RM, Heuer CA. The stigma of obesity: a review and update. *Obesity*. 2009;17(5):941-964. https://doi.org/10.1038/oby.2008.636
7. Mata J, Hertwig R. Public beliefs about obesity relative to other major health risks: representative cross-sectional surveys in the USA, the UK, and Germany. *Ann Behav Med*. 2018;52(4):273-286. https://doi.org/10.1093/abm/kax003
8. Papadopoulos S, Brennan L. Correlates of weight stigma in adults with overweight and obesity: a systematic literature review. *Obesity*. 2015;23(9):1743-1760. https://doi.org/10.1002/oby.21187
9. Wu Y-K, Berry DC. Impact of weight stigma on physiological and psychological health outcomes for overweight and obese adults: a systematic review. *J Adv Nurs*. 2018;74(5):1030-1042. https://doi.org/10.1111/jan.13511
10. Puhl R, Suh Y. Health consequences of weight stigma: implications for obesity prevention and treatment. *Curr Obes Rep*. 2015;4(2):182-190. https://doi.org/10.1007/s13679-015-0153-z
11. Puhl RM, Heuer CA. Obesity stigma: important considerations for public health. *Am J Public Health*. 2010;100(6):1019-1028. https://doi.org/10.2105/AJPH.2009.159491
12. Corrigan PW, Watson AC, Gracia G, Slopen N, Rasinski K, Hall LL. Newspaper stories as measures of structural stigma. *Psychiatr Serv*. 2005;56(5):551-556. https://doi.org/10.1176/appi.ps.56.5.551
13. Link BG, Phelan JC. Conceptualizing stigma. *Annu Rev Sociol*. 2001;27(1):363-385. https://doi.org/10.1146/annurev.soc.27.1.363
14. Myers A, Rosen JC. Obesity stigmatization and coping: relation to mental health symptoms, body image, and self-esteem. *Int J Obes (Lond)*. 1999;23(3):221-230. https://doi.org/10.1038/sj.ijo.0800765
15. Durso LE, Latner JD. Understanding self-directed stigma: development of the Weight Bias Internalization Scale. *Obesity*. 2008;16(suppl2):S80-S86. https://doi.org/10.1038/oby.2008.448
16. Ata RN, Thompson JK. Weight bias in the media: a review of recent research. *Obes Facts*. 2010;3(1):41-46. https://doi.org/10.1159/000276547
17. Puhl R, Luedicke J, Lee Peterson J. Public reactions to obesity-related health campaigns: a randomized controlled trial. *Am J Prev Med*. 2013;45(1):36-48. https://doi.org/10.1016/j.amepre.2013.02.010
18. Chou WS, Prestin A, Kunath S. Obesity in social media: a mixed methods analysis. *Transl Behav Med*. 2014;4(3):314-323. https://doi.org/10.1007/s13142-014-0256-1
19. Puhl RM, Brownell KD. Confronting and coping with weight stigma: an investigation of overweight and obese adults. *Obesity*. 2006;14(10):1802-1815. https://doi.org/10.1038/oby.2006.208

20. Carr D, Friedman MA. Body weight and the quality of interpersonal relationships. *Soc Psychol Q*. 2006;69(2):127-149. https://doi.org/10.1177/019027250606900202
21. Kawachi I, Berkman LF. Social ties and mental health. *J Urban Health*. 2001;78(3):458-467. https://doi.org/10.1093/jurban/78.3.458
22. Neumark-Sztainer D, Eisenberg M. Weight bias in a teen's world. In: Brownell KD, Puhl RM, Schwartz MB, Rudd LE, eds. *Weight Bias: Nature, Consequences, and Remedies*. New York, NY: Guilford Publications; 2005:68-79.
23. Zavodny M. Does weight affect children's test scores and teacher assessments differently? *Econ Educ Rev*. 2013;34:135-145. https://doi.org/10.1016/j.econedurev.2013.02.003
24. Puhl RM, Luedicke J. Weight-based victimization among adolescents in the school setting: emotional reactions and coping behaviors. *J Youth Adolesc*. 2012;41(1):27-40. https://doi.org/10.1007/s10964-011-9713-z
25. Fikkan J, Rothblum E. Weight bias in employment. In: Brownell KD, Puhl RM, Schwartz MB, Rudd LE, eds. *Weight Bias: Nature, Consequences, and Remedies*. New York, NY: Guilford Publications; 2005:15-28.
26. Elo IT. Social class differentials in health and mortality: patterns and explanations in comparative perspective. *Annu Rev Sociol*. 2009;35(1):553-572. https://doi.org/10.1146/annurev-soc-070308-115929
27. Hilbert A, Braehler E, Haeuser W, Zenger M. Weight bias internalization, core self-evaluation, and health in overweight and obese persons. *Obesity*. 2014;22(1):79-85. https://doi.org/10.1002/oby.20561
28. Haines J, Hannan PJ, van den Berg P, Eisenberg ME, Neumark-Sztainer D. Weight-related teasing from adolescence to young adulthood: longitudinal and secular trends between 1999 and 2010. *Obesity*. 2013;21(9):E428-E434. https://doi.org/10.1002/oby.20092
29. Himmelstein MS, Puhl RM, Quinn DM. Weight stigma in men: what, when, and by whom? *Obesity*. 2018;26(6):968-976. https://doi.org/10.1002/oby.22162
30. Himmelstein MS, Puhl RM, Quinn DM. Weight stigma and health: the mediating role of coping responses. *Health Psychol*. 2018;37(2):139-147. https://doi.org/10.1037/hea0000575
31. Sattler KM, Deane FP, Tapsell L, Kelly PJ. Gender differences in the relationship of weight-based stigmatisation with motivation to exercise and physical activity in overweight individuals. *Health Psychol Open*. 2018;5(1):1-11. https://doi.org/10.1177/2055102918759691
32. Spahlholz J, Baer N, König H-H, Riedel-Heller SG, Luck-Sikorski C. Obesity and discrimination—a systematic review and meta-analysis of observational studies. *Obes Rev*. 2016;17(1):43-55. https://doi.org/10.1111/obr.12343
33. Crandall CS. Do heavy-weight students have more difficulty paying for college? *Pers Soc Psychol Bull*. 1991;17(6):606-611. https://doi.org/10.1177/0146167291176002
34. Latner JD, Schwartz MB. Weight bias in a child's world. In: Brownell KD, Puhl RM, Schwartz MB, Rudd LE, eds. *Weight Bias: Nature, Consequences, and Remedies*. New York, NY: Guilford Publications; 2005:54-67.
35. Rand CSW, Wright BA. Continuity and change in the evaluation of ideal and acceptable body sizes across a wide age span. *Int J Eat Disord*. 2000;28(1):90-100. https://doi.org/10.1002/(SICI)1098-108X(200007)28:1<90::AID-EAT11>3.0.CO;2-P
36. Charles ST, Carstensen LL. Social and emotional aging. *Annu Rev Psychol*. 2010;61(1):383-409. https://doi.org/10.1146/annurev.psych.093008.100448
37. Latner JD, Stunkard AJ, Wilson GT. Stigmatized students: age, sex, and ethnicity effects in the stigmatization of obesity. *Obes Res*. 2005;13(7):1226-1231. https://doi.org/10.1038/oby.2005.145
38. Cohen S, Wills TA. Stress, social support, and the buffering hypothesis. *Psychol Bull*. 1985;98(2):310-357. https://doi.org/10.1037/0033-2909.98.2.310
39. Berkman LF, Glass T. Social integration, social networks, social support and health. In: Berkman LF, Kawachi I, Glymour MM, eds. *Social Epidemiology*. New York, NY: Oxford University Press; 2000:158-162.
40. Hatzenbuehler ML, Keyes KM, Hasin DS. Associations between perceived weight discrimination and the prevalence of psychiatric disorders in the general population. *Obesity*. 2009;17(11):2033-2039. https://doi.org/10.1038/oby.2009.131
41. Pascoe EA, Richman LS. Perceived discrimination and health: a meta-analytic review. *Psychol Bull*. 2009;135(4):531-554. https://doi.org/10.1037/a0016059
42. Vartanian LR, Shaprow JG. Effects of weight stigma on exercise motivation and behavior: a preliminary investigation among college-aged females. *J Health Psychol*. 2008;13(1):131-138. https://doi.org/10.1177/1359105307084318
43. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med*. 2009;6(7). https://doi.org/10.1371/journal.pmed.1000097
44. Freelon D. ReCal OIR: ordinal, interval, and ratio intercoder reliability as a web service. *Int J Internet Sci*. 2013;8(1):10-16.
45. Krippendorff K. *Content Analysis: An Introduction to Its Methodology*. Thousand Oaks, CA: Sage Publications; 2004.
46. Lipsey MW, Wilson DB. *Practical Meta-Analysis. Applied Social Research Methods Series*. 49 Thousand Oaks, CA: Sage Publications; 2001.
47. Borenstein M. Effect sizes for dichotomous data. In: Cooper H, Hedges LV, Valentine JC, eds. *Effect Sizes for Continuous Data. The Handbook of Research Synthesis and Meta-Analysis*. 2nd ed. New York, NY: Russell Sage Foundation; 2009:221-235.
48. Assink M, Wibbelink CJM. Fitting three-level meta-analytic models in R: a step-by-step tutorial. *Quant Methods Psychol*. 2016;12(3):154-174. https://doi.org/10.20982/tqmp.12.3.p154
49. Van den Noortgate W, López-López JA, Marín-Martínez F, Sánchez-Meca J. Three-level meta-analysis of dependent effect sizes. *Behav Res Methods*. 2013;45(2):576-594. https://doi.org/10.3758/s13428-012-0261-6
50. Hedges LV, Olkin I. *Statistical Methods for Meta-Analysis*. San Diego: CA: Academic Press; 1985.
51. RStudio Team. *RStudio: Integrated Development for R*. Boston, MA: RStudio; 2016. http://www.rstudio.com/.
52. Viechtbauer W. Conducting meta-analyses in R with the metafor package. *J Stat Softw*. 2010;36(3):1-48. https://doi.org/10.18637/jss.v036.i03
53. Knapp G, Hartung J. Improved tests for a random effects meta-regression with a single covariate. *Stat Med*. 2003;22(17):2693-2710. https://doi.org/10.1002/sim.1482
54. Higgins JP, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0 [updated March 2011]. Chichester, UK: Wiley; 2011. https://doi.org/10.1002/9780470712184
55. Cochran WG. The combination of estimates from different experiments. *Biometrics*. 1954;10(1):101-129. https://doi.org/10.2307/3001666

56. UNESCO Institute for Statistics. *International Standard Classification of Education: ISCED 2011*. Montreal, Quebec: UNESCO Institute for Statistics; 2012.
57. Eurostat—statistics explained. *International Standard Classification of Education (ISCED)*. Eurostat, 2018. https://ec.europa.eu/eurostat/statistics-explained/index.php/International_Standard_Classification_of_Education_(ISCED). Accessed June 15, 2019.
58. Ali MM, Amialchuk A, Rizzo JA. The influence of body weight on social network ties among adolescents. *Econ Hum Biol*. 2012;10:20-34. https://doi.org/10.1016/j.ehb.2011.10.001
59. Himmelstein MS, Puhl RM, Quinn DM. Intersectionality: an understudied framework for addressing weight stigma. *Am J Prev Med*. 2017;53(4):421-431. https://doi.org/10.1016/j.amepre.2017.04.003
60. Puhl RM, Himmelstein MS, Quinn DM. Internalizing weight stigma: prevalence and sociodemographic considerations in US adults. *Obesity*. 2018;26(1):167-175. https://doi.org/10.1002/oby.22029
61. Rothstein HR, Sutton AJ, Borenstein M. *Publication Bias in Meta-Analysis: Prevention, Assessment and Adjustments*. Chichester, UK: Wiley; 2006.
62. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ*. 1997;315(7109):629-634. https://doi.org/10.1136/bmj.315.7109.629
63. Duval S, Tweedie R. Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*. 2000;56(2):455-463. https://doi.org/10.1111/j.0006-341X.2000.00455.x
64. Rosenthal R. The file drawer problem and tolerance for null results. *Psychol Bull*. 1979;86(3):638-641. https://doi.org/10.1037/0033-2909.86.3.638
65. Livingston JD, Boyd JE. Correlates and consequences of internalized stigma for people living with mental illness: a systematic review and meta-analysis. *Soc Sci Med*. 2010;71(12):2150-2161. https://doi.org/10.1016/j.socscimed.2010.09.030
66. Jones KP, Peddie CI, Gilrane VL, King EB, Gray AL. Not so subtle: a meta-analytic investigation of the correlates of subtle and overt discrimination. *J Manage*. 2016;42(6):1588-1613. https://doi.org/10.1177/0149206313506466
67. Carter EC, Hilgard J, Schönbrodt FD. Correcting for bias in psychology: a comparison of meta-analytic methods. Preprint. doi:https://doi.org/10.31234/osf.io/9h3nu
68. Rodriguez ACI, Heldreth CM, Tomiyama AJ. Putting on weight stigma: a randomized study of the effects of wearing a fat suit on eating, well-being, and cortisol. *Obesity*. 2016;24(9):1892-1898. https://doi.org/10.1002/oby.21575
69. Magallares A, Bolaños-Rios P, Ruiz-Prieto I, Benito de Valle P, Irles JA, Jáuregui-Lobera I. The mediational effect of weight self-stigma in the relationship between blatant and subtle discrimination and depression and anxiety. *Span J Psychol*. 2017;20:E4-E4. https://doi.org/10.1017/sjp.2017.1
70. Seacat JD. *Beyond Academic Performance: Stereotype Threat, Stigma Consciousness, and Implications for Personal Health Intentions [dissertation]*. Kent, OH: Kent State University; 2006.
71. Vitolins MZ, Crandall S, Miller D, Ip E, Marion G, Spangler JG. Obesity educational interventions in U.S. medical schools: a systematic review and identified gaps. *Teach Learn Med*. 2012;24(3):267-272. https://doi.org/10.1080/10401334.2012.692286
72. Puhl RM. Coping with weight stigma. In: Brownell KD, Puhl RM, Schwartz MB, Rudd LE, eds. *Weight Bias: Nature, Consequences, and Remedies*. New York, NY: Guilford Publications; 2005:275-284.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Emmer C, Bosnjak M, Mata J. The association between weight stigma and mental health: A meta-analysis. *Obesity Reviews*. 2019;1–13. https://doi.org/10.1111/obr.12935