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Review

Weight-related stigma and psychological distress: A systematic review and meta-analysis

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SUMMARY

Background & aims: Individuals who are overweight or who have obesity are likely to perceive or experience unfriendly treatment (i.e., weight-related perceived stigma) from different sources such as work colleagues because of the stigma towards excess weight. People who are overweight may accept such stigma and devalue themselves (i.e., weight-related self-stigma).
Methods: A systematic review and meta-analysis was conducted to examine the relationship between weight stigma (including weight-related self-stigma and weight-related perceived stigma) and psychological distress (including depression and anxiety) using random-effects meta-analyses. Utilizing five academic databases (PubMed, Scopus, WOS, Embase and ProQuest) and keywords related to weight stigma and psychological distress, empirical studies focusing on the association between weight stigma and psychological distress were selected. The timeline for the searched papers was from the inception of each database to the end of August 2019.
Results: Eligible studies (N = 30; 25 on weight-related self-stigma and eight on weight-related perceived stigma) were analyzed with a total of 9345 participants experiencing weight-related self-stigma, and 15,496 experiencing weight-related perceived stigma. The pooled associations were moderate between weight-related self-stigma and psychological distress (corrected Fisher's Z = 0.40 for depression; 0.36 for anxiety) and between perceived stigma and depression (Fisher's Z = 0.44).
Conclusions: Results of the meta-analysis demonstrated that weight stigma is associated with psychological distress. The comprehensive search of the literature and rigorous methodology employed are the two major strengths in the present study. Because self-stigma and perceived stigma are different concepts, their associations with psychological distress should not be merged together.

1. Introduction

Weight stigma comprises negative attitudes and beliefs related to the weight of individuals, often expressed as stereotypes (e.g., those who are overweight are lazy), negative emotions (e.g., being angry or disliking those who are overweight), and discriminatory behaviors (e.g., socially isolating or bullying individuals with obesity) [1,2]. Experiencing weight-related discrimination in a variety of situations, such as employment settings (e.g., inequality in employment opportunities) [3] and medical and health care settings (e.g., views of health care providers towards individuals with obesity, inappropriate communication to patients with obesity, biased decision-making in providing health care to patients with obesity) are examples of such social problems [4,5]. In addition, discriminatory weight-related behaviors have been reported among healthcare professionals including doctors, nurses, and

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psychologists [3,5], employers and co-workers [6], teachers and educators [7,8], peers [9], parents [6,10], and children [11,12]. Therefore, weight stigma can lead to negative consequences on individuals' emotions and health [13]. Consequently, individuals who have obesity have increased risk of psychological problems (e.g., depression, anxiety) and social problems (e.g., social isolation) in addition to physiological problems because of the stigmatization [1,14–17].

Different types of stigma have been proposed in the literature. For example, Pescosolido and Martin summarized two perspectives through which stigma can be categorized, namely, the experiential nature of stigma (which indicates stigma is perceived, endorsed, anticipated, received, or enacted) and stigma with an action-oriented perspective (which indicates who or what supplies the stigma) [18]. Therefore, public stigma, structural stigma, courtesy stigma, provider-based stigma, and self-stigma (also known as internalized stigma) have been classified [19]. Additionally, Livingston and Boyd used hierarchical levels to define different types of stigma: structural stigma (system or macro level), public stigma (group or meso level), and self-stigma (individual or micro level) [20]. Brohan et al. and Corrigan and Rao classified stigma into perceived stigma, experienced stigma, and self-stigma in individual-level [21,22].

Because the present systematic review and meta-analysis focused on stigmatization among individuals who are overweight, studies on perceived stigma (defined as stigmatized individuals who are aware of the stereotype, prejudice, and discrimination on their characteristics), experienced stigma (defined as stigmatized individuals who receive prejudice and discrimination from others), and self-stigma (defined as stigmatized individuals who accept and endorse the stereotype, prejudice, and discrimination on their characteristics) [17] were searched for and analyzed. Furthermore, all the perceived stigma, experienced stigma, and self-stigma discussed in the present systematic review and meta-analysis all indicates weight-related stigma (defined as bias or discriminatory behaviors, attitudes, feelings, and thinking on individuals, because of their weight). Furthermore, perceived stigma and experienced stigma (and hereafter, perceived stigma indicates both perceived and experienced stigma) were combined for meta-analysis while self-stigma was singly used for meta-analysis because (i) studies on weight stigma rarely explicitly distinguish perceived and experienced stigma; and (ii) there are fewer studies on weight-related perceived stigma and experienced stigma than studies on weight-related self-stigma.

Weight-related stigma becomes crucial in the development of biopsychosocial health outcomes [23]. Studies showed that weight stigma is associated with adverse short-term and long-term physical and psychological consequences for children and adolescents [24–27]. The impact of weight stigma on physical health among individuals who are overweight or who have obesity has been reviewed and summarized by Papadopoulos and Brennan, who reported an association between weight stigma, BMI, and difficulty in weight loss, poor treatment compliance, and quality of life [28]. Similarly and more recently, Pearl and Puhl conducted a systematic review on how weight-related self-stigma negatively associates with health (including both physical and mental health) [29]. Other literature reviews have reported lower motivation for exercising and a tendency for over-eating in children and adults among those who experienced weight stigma [28,30]. In a systematic review conducted by Wu and Berry (2018), results showed the positive association between weight stigma and various outcomes, including physical health, some physiological parameters, and eating disorders [31]. Apart from physical consequences, weight stigma may lead to psychological consequences. Previous systematic reviews have reported a positive association between weight stigma and depression, anxiety, low self-efficacy [23,26,28,31], body image [32], and substance abuse [23,28,32].

Despite the fact that association between weight stigma and psychological outcomes (e.g., depression and anxiety) has been reported in previous systematic reviews [23,26,28–32], no quantitative synthesis (i.e., using meta-analysis) has been conducted to investigate the severity of this association in quantitative terms and moderator factors. Also, to the best of the present authors' knowledge, previous reviews did not separate weight stigma into different types (i.e., perceived stigma and self-stigma). Consequently, the aim of the present study was to investigate the association between weight-related stigma (especially in the individual-level stigma mentioned above: perceived stigma and self-stigma) and psychological distress including depression (defined as having depressed mood or losing interest/pleasure) and anxiety (defined as having excessive worry and nervous).

2. Methods

The present study was reported based on the PRISMA guidelines [33]. The preliminary protocol of the study was registered in the international prospective register of systematic reviews (PROSPERO) with the reference code of CRD42019119127.

2.1. Search strategy

An electronic search was carried out during the first week of September 2019. Five academic databases including *PubMed, Scopus, WOS, Embase* and *ProQuest* were systematically searched. Search syntax was compiled using the related entry terms from MESH and relevant keywords. Boolean operators (AND, OR, NOT) were used to compile the search syntax. Syntax adaptation was carried out based on guidelines for advanced searches for every database. The search syntax for all databases is provided in Appendix 1. In the search process, in addition to the electronic searches, the list of references of the included papers was searched by hand. The purpose of this hand search was to increase the chance of retrieving relevant papers.

2.2. Eligibility criteria

The title and abstract of retrieved studies was scrutinized based on inclusion criteria of studies. The inclusion criteria were set as follows: original research papers; being published in the English language; being published from the inception of each database to the end of August 2019; having cross-sectional or longitudinal design; reporting the association of weight stigma and psychological distress (depression and or anxiety) in any format including correlation coefficient, odds ratio (OR), or mean difference; and using valid instruments to assess weight-related stigma, depression, and anxiety. There was no limitation regarding the characteristics, including gender, age, and body mass index (or weight status). After reviewing the title and abstract of retrieved studies, the full texts of selected papers were downloaded and carefully reviewed based on the aforementioned inclusion criteria. This stage was carried out independently by two members of the research team (ZA & FG). Kappa score showed moderate agreement of these reviewers ($\kappa = 0.48$). Disputes were resolved via a third-party strategy.

2.3. Data extraction

Data on the surname of the first author; the year of publication; title of the study; design of the study; instruments used to

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assess weight stigma, depression and anxiety; sample size; percentage of female participants; target group of participants (e.g., general population, college or school students, individuals who are overweight or have obesity); mean age and body mass index; data related to the association of weight stigma and depression or anxiety [reported as correlation coefficient] were extracted using predefined forms. It should also be noted that in longitudinal studies, the baseline data were extracted. This stage was carried out independently by two members of the research team (ZA & FG). Kappa score showed moderate agreement of these reviewers ($\kappa = 0.52$). Disputes were resolved via a third-party strategy.

2.4. Risk of bias assessment in the individual studies

In the present study, the Newcastle–Ottawa Quality Assessment Scale (NOS) was used to assess the quality of selected studies. The NOS can be used for both case-control and longitudinal (prospective) studies. Cross-sectional studies are evaluated as case control studies. The NOS evaluates three quality parameters: selection, comparability, and outcome. The NOS is divided into eight specific items, which slightly differ when scoring case control and longitudinal studies. Each item on the scale is scored with 1 point, except for the comparability, which can be adapted to the specific topic of interest to be scored up to 2 points. Therefore, the maximum score for each study is 9. Any study less than 5 points is identified as high risk of bias [34]. This stage was carried out independently by two members of the research team (ZA & FG). Kappa score showed moderate agreement between these two reviewers ($\kappa = 0.46$). Disputes were resolved via a third-party strategy.

It should be noted that three stages of study selection, data extraction, and quality assessment were carried out independently by two members of the research team (ZA & FG). Disputes were resolved via a third-party strategy. All procedures were supervised by AHP, who also resolved any disagreements.

3. Statistical analysis

Due to the number of retrieved studies, the data were combined quantitatively using STATA Version 14 software. Data regarding the association of weight-related stigma and depression or anxiety reported as Pearson correlation coefficients was selected as the target effect size for meta-analysis. Because the variance might be dependent upon correlation coefficients, the correlation coefficient for each study was converted to Fisher's z, and all analyses were performed using the Fisher's z values as effect size [35]. Fisher's z-transformation used the following formula: $z = 0.5 \times [\ln(1 + r) - \ln(1-r)]$. The variance of z is: $Vz = 1/(n-3)$. The standard error of z is: $SEz = 1/\sqrt{(n-3)}$ [36].

Considering that the included studies might be conducted in different settings, the random effect model with DerSimonian and Laird weighting was used because this model takes the between study heterogeneity into account [37]. The random-effects estimate was calculated using the Knapp-Hartung-Sidik-Jonkman random-effects meta-analytic method (HSJK). This estimates the variance as the weighted mean squared error divided by the degrees of freedom and assumes a *t*-distribution [38].

The heterogeneity was evaluated statistically using Cochran's Q test and the I-squared statistic [39]. Moderator analysis was performed using subgroup analysis and meta-regression. Potential moderators were: gender, geographical location of research (by continent), sample size, study design, scales of stigma, depression and anxiety, mean age, and mean body mass index.

Finally, publication bias was evaluated using the funnel plots and the Begg's and Eggers' asymmetry tests based on the number of included studies. When included studies were more than 20, Begg's method was used whereas Egger's test was used when having less than that [40]. In the case of probable publication bias, trim-and-fill method was used to correct the results [41]. In addition, sensitivity analysis was carried out using the Jackknife method (known as the 'leave-one-out method') [42].

4. Results

4.1. Identification of studies

The search process led to the retrieval of 2165 potentially relevant papers. During this process, 437 papers were excluded due to duplication. Screening based on the title and abstract resulted in the exclusion of 1621 papers. The full-texts of remaining 107 potentially eligible papers were reviewed. In this process, 30 papers were selected based on the aforementioned inclusion criteria [43–68]. The list of 30 included and 77 excluded papers are provided in Appendix 2. Figure 1 shows the search process according to the PRISMA flowchart.

Due to the different concepts of self-stigma and perceived stigma, findings of eligible studies are categorized and presented based on these concepts. Of the 30 papers, 25 were found to be eligible for weight-related self-stigma [16,43,44,46,47,49–64,68–71], and eight were eligible for weight-related perceived stigma [45,46,48,54,56,65–67]. It should be noted that three studies had data concerning both subgroups of self-stigma and perceived stigma [46,54,56]. Summarized characteristics of included studies are provided in Table 1 (related to self -stigma) and Table 4 (related to perceived stigma). Also, results of the quality assessment of included studies based on the NOS checklist are provided in Appendix 3. In addition, almost all included studies adopted a cross-sectional design to examine the associations, only two studies on weight-related self-stigma [59,61] and another two on weight-related perceived stigma [66,67] used a longitudinal design. In these cases, data regarding baseline assessments of these studies were used.

4.2. Weight-related self-stigma

4.2.1. Study description

A total of 25 studies examined the association between weight-related self-stigma and psychological distress including depression and anxiety. Some studies [45,46,57,59,61] did not report the relationship between weight stigma and depression or anxiety as a total score (the scores were reported based on subscales of the instrument used). To increase the accuracy of data extraction and synthesis, items of the subscales of all instruments were carefully examined. Only the shame subscale of the Weight-Related Shame and Guilt Scale was independently related to stigma. Consequently, in the data extraction stage, correlations of depression or anxiety with this subscale were extracted [59,61]. In other instruments where the semantic differentiation of the sub-scales was not possible in terms of stigma, the results were reported but were not entered in the meta-analysis [46,47,57]. It should be noted that Himmelstein et al. reported data on two separate samples in one article [69]. Data of these two samples were extracted and synthetized separately. Finally, findings of 22 studies were quantitatively synthesized. All of them reported a correlation of weight-related self-stigma with depression, whereas only seven reported findings on anxiety. Overall, most of eligible studies ($n = 9$) were conducted in the USA [43,50,54,58,60,62,64,68,69]. Cross-sectional designs were the most frequently used methodology ($n = 21$) [43,46,47,49,51–58,60,62–64,68]. The most frequent measure for assessing weight-related self-stigma was the Weight Bias Internalization Scale (WBIS; $n = 14$) [16,43,44,50,52,53,55,58,60,62,64,69–71], while the most

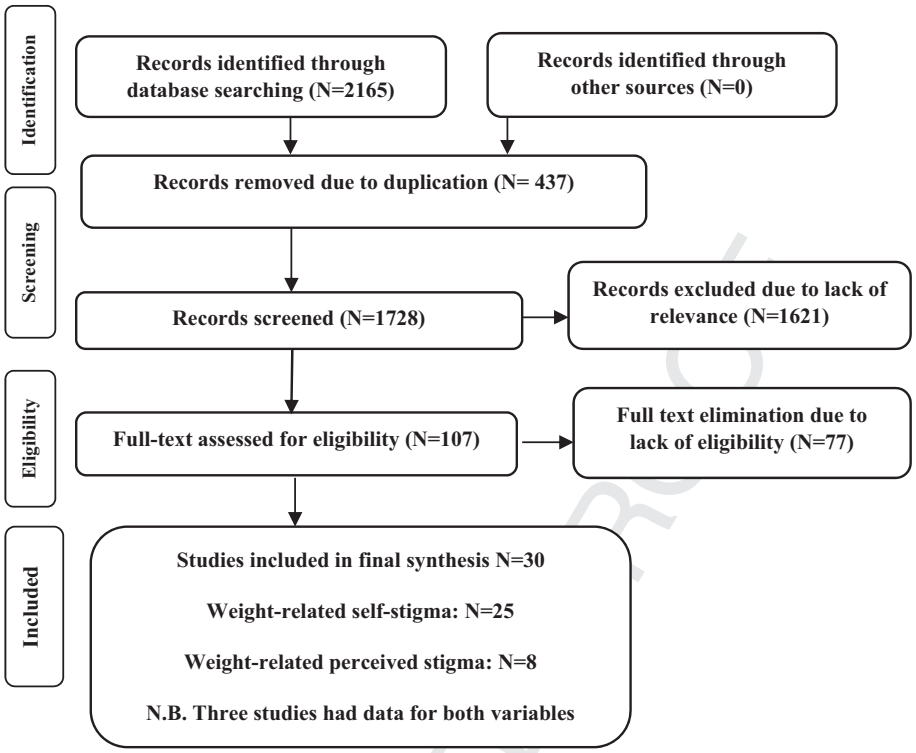

Fig. 1. PRISMA flowchart of selected studies.

frequently used measures for assessing psychological distress were the Beck Depression Inventory (BDI; n = 6) [51,53,60,62,63,68] and Depression Anxiety Stress Scale (DASS; n = 6) [46,47,49,50,58,71]. The total number of participants was 9345 of which females comprised 63.12% of participants. Table 1 shows the summarized characteristics of these studies.

4.2.2. Pooled effect size

All eligible studies (N = 25) showed mild to moderate correlations between weight-related self-stigma and psychological distress (i.e., depression and anxiety). Results of the meta-analysis (N = 22 studies) of pooled correlation coefficients based on Fisher's z-score correction for depression was 0.51 (HSJK 95% CI: 0.44, 0.58; $I^2 = 90.6\%$; Q test = 235.06, $p > .001$, $tau^2 = 0.03$). The overall pooled effect size for anxiety based on corrected coefficient of Fisher's z-score was 0.36 (HSJK 95% CI: 0.22, 0.50; $I^2 = 75.7\%$; Q test = 24.66, $p > .001$; $tau^2 = 0.01$). As it is reported both pooled effect sizes showed high heterogeneity. Due to variation in context, measures used to assess stigmatization, depression and anxiety, this high heterogeneity was expected. The forest plots are shown in Fig. 2.

4.2.3. Moderator analysis

The moderator analysis, using the ANOVA, showed that the pooled effect size for association of weight-related self-stigma and depression were significantly higher based on geographical location of the study (America vs. Europe and Asia), the gender group of the study (female or male only vs. both sexes) and study design (cohort vs. cross sectional or baseline of RCT). While subgroup analysis comparing WBIS as most frequent used measure to assess self-stigma vs. other measures of stigma did not show significant difference on pooled effect size (Table 2). Also, meta-regression confirmed that other variables (including measure of depression, sample size, mean BMI and AGE, NOS score) were not significant moderators for correlation of self-stigma with depression or anxiety (Table 3).

4.2.4. Publication bias

Two measures of funnel plot (Fig. 3a) and Begg's test (p = 0.17) showed the probability of publication bias in estimated overall pooled effect size for association of weight-related self-stigma and depression.

4.2.5. Fill-and-trim correction

Due to probability of publication bias for the association of weight-related self-stigma and depression, the fill-and-trim method was used to correct the results. In this method, eight studies were imputed and the corrected results based on this method showed that pooled Fisher's z-score for association of weight-related self-stigma and depression was 0.40 (95% CI: 0.32, 0.48; $p < .001$). The corrected funnel plot using the fill-and-trim method is shown in Fig. 3b.

4.2.6. Sensitivity analysis

A sensitivity analysis was performed using the Jackknife method. After removing a study sequentially and calculating the overall effect size for the remaining studies, no significant change was observed in the results. So single study effect on overall pooled effect size was ruled out (Fig. 4).

4.3. Weight-related perceived stigma

4.3.1. Study characteristics

Eight studies examined the association between weight-related perceived stigma and psychological distress (i.e., depression and anxiety). One study reported the findings based on sub-scales [67]

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Table 1
Summarized characteristics of selected studies regarding weight-related self-stigma.

Author, year	Country	Study design	Measure of stigma	Measure of depression	Sample size	Females (%)	Target sample	BMI: Mean (SD)	Weight status of participant (% of total sample)				Age: Mean (SD) -range	Pearson Correlation coefficient of Stigma with		NOS Score
									underweight	Normal weight	overweight	Obese		Depression	Anxiety	
Himmelstein 2019-Sample 1 [69]	USA	Cross-sectional	WBIS	CESD	1249	0	General community	27.38 (6.35)	4.4	31.2	39	25.4	45.45 (16.26)	0.59	–	12
Himmelstein 2019-Sample 2 [69]	USA	Cross-sectional	WBIS	CESD	504	0	General community	26.41 (6.99)	8.3	37.3	30.6	23.8	33 (12.1)	0.52	–	12
Jung 2019 [70]	Germany	Cross-sectional	WBIS	PHQ-9	1000	44.8	Obese					100	56.4 (14.9)	0.38	–	10
Chan 2019 [16]	Hong Kong	Cross-sectional	WBIS	Brief Symptom Rating Scale	355	44.23	Overweight (OW) vs. None over weight (NOW) adolescent	23.21 (OW) vs. 16.22 (NOW)		67.8	32.2		10.03	0.30	0.37	11
Lin 2019 [71]	Iran	Cross-sectional	WBIS	DASS-21	737	52	Overweight and obese adolescent	30.0 (4.8)	–	–	100	15.8 (1.3)	0.43	0.39	10	
Pila, 2018 [59]	Canada	Cohort with three times follow -up (mean score of all times are reports and extracted)	WEB-SG	CES-D	173	100	Breast cancer patients	25.95 (5.54)	1	48.30	28.80	18.5	55	0.45	–	11
Maïano, 2017[a] [57]	Canada	Cross-sectional	WSSQ	HADS	156	48	Overweight and obese	–			76.3	23.7	16.31 (0.85)	Self-devaluation = .26 Fear of enacted stigma = .26	Self-devaluation = .24 Fear of enacted stigma = .25	10
Magallares, 2017 [56]	Spain	Cross-sectional	WSSQ	HADS	170	34.7	Obese	42.75 (8.32)				100	46.96 (13.21)	.45	.49	10
Duarte, 2017[a] [46]	UK	Cross-sectional	Weight focused self-criticizing and self-reassuring scale (WFSCRS)	DASS-21	2,23	100	Overweight and obese	31.62 (6.10)			19.1	80.9	41.71 (12.34)	Inadequate Self = .57 Reassured Self = −.50 Hated Self = .61	–	8
Duarte, 2016 [47]	Portugal	Cross-sectional	BISS	DASS-21	853	100	General community	22.69 (3.59)	7.5	69.3	18.7	4.5	28.74 (10.94)	.38	–	9
Sienko, 2016 [64]	USA	Cross-sectional	WBIS	PHQ-9	172	100	Overweight	29.71	.6	19.3	39.8	40.3	21.11	.55	–	10
Durso, 2016 [50]	USA	Baseline assessment of RCT	WBIS	DASS-21	90	64.4	Obese or overweight	35.80 (7.93)	Not reported				49.65 (12.33)	.24	.02	7
Hunger, 2015 [54]	USA	Cross-sectional (Study 1 was extracted)	Weight stigma concerns	Depression subscale of Brief Symptom Inventory	171	59.6	General Community	25.44 (5.41)	Not reported				36.31 (12.41)	.47	–	7
Hilbert, 2015 [53]	Germany	Cross sectional	WBIS	BDI	1158	45.7	Overweight or obese	≥25.0 kg/m^2			80.4	19.6	53.56 ± 16.22	.28		12
Hilbert, 2014 [52]	Germany	Cross-sectional	WBIS	PHQ, GAD	1158	45.7	Overweight or obese	≥25.0 kg/m^2			80.4	19.6	53.56 (16.22)	.31	0.28	12
Burmeister, 2014 [43]	USA	Cross -sectional	WBIS	CES-D	116	74	Overweight and obese	38.5 (8.8)			100		45.3 (13.5)	.56		7
Duarte, 2018[a] [49]	UK	Cross-sectional	Weight-Focused Self-Criticizing/ Self-Reassuring Scale (WFSCRS)	DASS-21	724	100	Overweight and obese	32.81 (6.40)			41.3	58.7	44.89 (11.30)	Inadequate self = .60 Hated self = −.52 Reassured self = .69	Inadequate self = .48 Hated self = −.31 Reassured self = .52	11
Innamorati, 2017 [55]	Italia	Cross-sectional	WBIS	CES-D	386	76.7	Overweight and obese	Outpatient = 29.79 ± 4.92 Inpatient = 44.82 ± 8.32			100		Outpatient = 42.84 ± 12.05 Inpatient = 50.28 ± 13.56	.61	–	10
Schulte, 2016 [61]	United Arab Emirates	Longitudinal (baseline is extracted)	WEB-SG	20-item Zung Self-Rating Depression Scale	236	64.8	Undergraduates students	–	13	57	21	8	19.78 (1.45)	.28	–	11
Hain, 2015 [51]	Germany	Cross sectional	WSSQ	BDI	94	66	Obese patients	45.4 (7.6)				100	45.3 (12.0)	.44	–	9
Schvey, 2015 [62]	USA	Cross sectional	WBIS	BDI	197	89.3	Normal weight or underweight	22.28 ± 1.89	9	91			31.58 ± 10.87	.54	–	10

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Table 1 (*continued*)

Author, year	Country	Study design	Measure of stigma	Measure of depression	Sample size	Females (%)	Target sample	BMI: Mean (SD)	Weight status of participant (% of total sample)				Age: Mean (SD) -range	Pearson Correlation coefficient of Stigma with		NOS Score
									underweight	Normal weight	overweight	Obese		Depression	Anxiety	
Pearl, 2014 [58]	USA	Cross sectional	WBIS	DASS-21	148	50	General Community	27.97 (7.27)	3.4	35.8	29.7	31.1	35.57 (11.95)	.51		10
Rosenberger, 2006 [68]	USA	Cross-sectional	ISS	BDI	131	100	Extremely obese	50.2 (8.2)				100	41.8 (10.9)	.77	–	8
Roberto, 2011 [60]	USA	Cross-sectional	WBIS	BDI & Multidimensional Anxiety Scale for Children (MASC)	65	80.7	Severely obese adolescents	46.92 ± 7.86				100	15.65 ± 1.08	0.52	.47	9
Sevincer, 2017 [63]	Turkey	Cross-sectional	WSSQ	BDI & Beck Anxiety Inventory	120	80	Severely obese	46.05 ± 6.052				100	37.65 ± 12.419	.51	.33	9
Carels, 2013 [44]	USA	Baseline assessment of RCT	WBIS	CES-D	62	79.1	Overweight and obese adults	27.7–58.1			9.7	90.3	43.7 (13.3)	.66	–	7

ISS=Internalized Shame Scale; WBIS=Weight Bias Internalization Scale; WSSQ=Weight Self-Stigma Questionnaire; WEB-SG=Weight- and Body-Related Shame and Guilt Scale; BISS=Body Image Shame Scale; BDI=Beck Depression Inventory; GAD = Generalized Anxiety Disorder; DASS = Depression Anxiety Stress Scales; HADS=Hospital Anxiety Depression scale.
[a] These studies are not entered in meta-analysis, because correlation coefficients are reported based on subscales of stigma measure.

and one reported findings based on the mean difference between the two groups [66]. Consequently, these two studies were not entered in the meta-analysis. Therefore, six out of the eight studies which reported Pearson correlation coefficients of weight-related perceived stigma and depression were quantitatively analyzed [45,46,48,54,56,65]. While only one study reported the related effect size regarding anxiety [56], no further analysis was conducted. Overall, most of the eligible studies (n = 4) were conducted in USA [54,66] and UK [46,67], each with two studies. Cross-sectional designs were the most frequently used methodology (n = 6) [45,46,48,54,56,65]. The most frequent measure for assessing weight-related perceived stigma was Perceived Discrimination (n = 3) [45,54,65], and the most frequent measure used to assess psychological distress was the DASS (n = 3) [45,46,48]. The total number of participants was 15,496 in which females comprised 65.13% of participants. Table 4 shows the summarized characteristics of these studies.

4.3.2. Pooled effect size

The overall pooled effect size based on Fisher's z-score correction for association of weight-related perceived stigma and depression was .44 (HSJK 95% CI: 0.23, 0.65, I^2 = 94.5%; Q test = 90.32, $p > .001$; $tau^2 = .05$). As it is reported both pooled effect sizes showed high heterogeneity, may be due to variation in context, measures used to assess perception of stigmatization, depression. Figure 5 shows the relevant forest plot.

4.3.3. Moderator analysis

The moderator analysis using meta-regression confirmed that sample size was the only significant moderator in association of weight-related perceived stigma and depression (Table 5).

4.3.4. Sensitivity analysis

A sensitivity analysis was performed using the Jackknife method. After removing a study sequentially and calculating the overall effect size for the remaining studies, no significant change was observed in the results. So no single study effect on overall pooled effect size was verified (Table 6).

5. Discussion

The present systematic review and meta-analysis demonstrates a growing interest in understanding the relationship between weight stigma (especially weight-related self-stigma) and psychological distress. For analyzed weight-related self-stigma, 22 out of the 25 studies were published in the past five years [16,43,46,48–50,52–59,61–64,69–71]. two were published between past five to ten years [44,60], and only one was published more than ten years ago [68]. For analyzed weight-related perceived stigma, seven studies out of the eight were published in the past five years [45,46,48,54,56,65,66], and one was published in 2012 [67]. Nevertheless, given that the first study [68] in assessing weight stigma and psychological distress was published in 2006, the cumulative evidence on the association between the two aforementioned concepts across the 14 years need summarizing. Because no meta-analytic studies have previously been conducted in this topic, the present study is the first to study the in-depth association between weight stigma and psychological distress. After a rigorous selection method using PRISMA guidelines, 25 studies on weight-related self-stigma (21 utilizing a cross-sectional design) with 9345 participants, and eight studies on weight-related perceived stigma (six utilizing a cross-sectional design) with 15,496 participants, were included in the meta-analysis to provide evidence concerning the association between weight stigma and psychological distress.

Table 2
Subgroup analysis regarding weight-related self-stigma and depression.

Variables		Fisher's Z-score	95% CI		I^2 (%)	Q test	*p*	Tau^2
			UL	LL				
Continent	America	0.57	0.47	0.67	84.5	58.67	.02	.02
	Europe	0.43	0.34	0.58	89.9	77.32	<.001	.01
	Asia	0.43	0.30	0.56	74.4	7.81	<0.001	0.01
Study design	Cross sectional	0.52	0.45	0.60	89.9	179.02	<0.001	0.02
	Cohort	0.38	0.19	0.58	73.8	3.82	0.05	0.01
	Baseline RCT	0.52	0.03	0.58	93	14.32	<0.001	0.12
Measure of stigma	WBIS	0.510	0.42	0.60	92.3	182.11	<0.001	0.03
	other	0.505	0.37	0.64	86.7	52.70	<0.001	0.03
Gender group	Female	0.62	0.37	0.87	93.4	45.55	<0.001	0.06
	Male	0.63	0.53	0.73	72.7	3.67	0.05	0.003
	Both sex	0.46	0.39	0.53	84.4	102.77	<0.001	0.02

Table 3
Meta-regression regarding weight-related self-stigma.

Variable	Depression						Anxiety					
	β	SE	*p*	I^2 residual (%)	Adj.R^2 (%)	tau^2	β	SE	*p*	I^2 residual (%)	Adj.R^2 (%)	tau^2
Continent							.06	.14	.70	83.31	−32.82	.04
Study design							All of included studies were cross sectional					
Measure of stigma							.12	.14	.44	76.21	−5.54	.02
Measure of depression	−.01	.02	.41	90.71	−2.81	.03						
Measure anxiety							.014	.02	.51	76.91	−21.23	.02
Sample size	−.0001	.0001	.17	90.50	5.05	.03	−.00	.00	.87	75.84	−40.04	.02
Gender Group							All of the studies had both sex participants					
Target sample	0.05	.03	.13	88.85	10.07	.02	.03	.06	0.6	82.91	−29.43	0.3
NOS score	−.03	.02	0.24	90.87	2.13	.03	.04	.04	.39	79.16	−20.7	.02
BMI mean	.006	.004	.17	82.9	9.97	.02	.009	.01	.58	81.97	−35.45	.04
Age mean	.0002	.003	.95	90.37	−6.65	.03	−.004	.00	.34	69.73	−5.43	.02

Although the identified and analyzed studies used different instruments in assessing weight stigma, most studies on weight-related self-stigma used the Weight Self-Stigma Questionnaire (WSSQ) or the Weight Bias Internalization Scale (WBIS) to investigate the relationship between weight-related self-stigma and psychological distress. The reason may be due to the strong psychometric properties of the two instruments and the wide use of the two instruments [17,71,72]. Although previous studies have shown that WSSQ and WBIS may have different characteristics and may be suitable for different research conditions [71,72], a high correlation between the WSSQ and WBIS ($r = 0.82$) has been demonstrated [72]. Therefore, the results derived from either WSSQ or WBIS are valid. However, as for studies on weight-related perceived stigma, there was no consensus on which instrument was used. The main reason may be due to the lack of relevant instruments with demonstrable psychometric properties. Indeed, most of the studies adapted some discrimination questionnaires, which were not specifically designed for weight discrimination. For example, Duan and Wang (2018) and Hunger and Major (2015) used the questionnaire adapted from racial discrimination, Duarte et al. (2015) and Troop et al. (2012) adopted the Other as Shamer Scale to assess weight-related perceived stigma. Although different measures were used among the studies, both weight-related self-stigma and weight-related perceived stigma were found to be positively related to psychological distress, especially the meta-regression showed that measure of stigma was not significant ($p = 0.69$ and 0.41 for self-stigma, and $p = 0.57$ for perceived stigma). More specifically, the effect sizes were moderate: 0.52 for self-stigma and depression; 0.34 for self-stigma and anxiety; and 0.44 for perceived stigma and anxiety.

The comprehensive search of the literature and rigorous methodology employed are the two major strengths in the present study. More specifically, major databases were used for the search and clearly identified keywords according to PECO framework were adopted. The rigorous methodology in meta-analysis included quality assurance, meta-regression, and sensitivity testing. In addition to the aforementioned strengths, investigating different types of weight stigma (i.e., weight-related self-stigma and perceived stigma) separately gives additional insights for healthcare providers. As self-stigma and perceived stigma are different concepts [17], their associations with psychological distress should not be merged together. With the findings in the present study, healthcare providers can be educated that self-stigma and perceived stigma shared a similar association with depression. Therefore, interventions on both self-stigma and perceived stigma are equally important for people who are overweight.

5.1. Explanations of heterogeneity found in the meta-analysis

Regarding the potential sources of heterogeneity in the relationship between self-stigma and depression, subgroup analysis showed that study geography, type of study, and sex could be potential contributors to heterogeneity in the meta-analysis. However, analyses in the meta-regression models showed that type of assessment tool (either in stigma or depression), sample size, weight and weight status, and age were not potential sources for heterogeneity. Regarding the potential sources of heterogeneity in the relationship between self-stigma and anxiety, no variables were found to be a potential source for heterogeneity.

American studies had a significantly higher effect size than Asian and European studies (0.57 vs. 0.43). The cultural context could be a reason to explain such heterogeneity. In American culture, the body image is prone to be thin and slim, which may make the Americans have a higher level of self-stigma because of their excess weight [15,16]. As a result, an association between self-stigma and depression can be observed. The study design was

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Table 4
Summarized characteristics of selected studies regarding weight-related perceived stigma.

Author, year	Country	Study design	Measure of weight-related stigma	Measure of depression	Sample size	Females (%)	Target sample	Weight status of participants (% of total sample)				BMI Mean (SD)	Age Mean -range	Correlation coefficient of perceived stigma with		NOS score	NOS Score
								Under weight	Normal weight	Overweight	Obese			Depression	Anxiety		
Sutin, 2019[a] [66]	USA	Longitudinal (baseline weight bias assessment with ten year follow up)	Everyday discrimination Leave-Behind Questionnaire including weight (yes/no)	CESD	12053	60	Adults more than 50 years	1	24	38	37	–	67.31 ± 10.05		–	9	
Duan, 2018 [45]	China	Cross-sectional	Perceived discrimination	DASS-21	254	45.3	Colleges and universities' students			100		30.17 (2.53)		0.502	–	7	
Duarte, 2017 [46]	UK	Cross- sectional	Weight-focused external shame scale (WFES)	DASS-21	2236	100	Overweight and obese			19.1	80.9	31.62 (6.10)	41.71 (12.34)	.61	–	8	
Duarte, 2015 [48]	Portugal	Cross-sectional	Other as Shamer Scale	DASS-21	73	100	Overweight and obese		15.1	12.3	72.6	34.42 (7.46)	38.10 (10.88)	.11	–	7	
Spahlholz, 2016 [65]	Germany	Cross-sectional	Perceived weight discrimination	Patient Health Questionnaire (PHQ)	484	45.9	obese				100	>30	57.01 (14.86)	.31	–	9	
Hunger, 2015 [54]	USA	Cross-sectional (Study 1 was extracted)	Perceived discrimination	Brief Symptom Inventory	171	.6	General community	Not reported				25.44 (5.41)	36.31 (12.41)	.38	–	6	
Troop,2012[ab] [67]	UK	Longitudinal panel design over 2.5 years using baseline measures	The Other as Shamer Scale	The Beck Depression Inventory	55	100	Individuals with a self-reported past or current eating disorder	Not reported				19.8 kg/m2 (SD = 4.8)	34.6 years (SD = 9.6)	Other as Shamer Scale with depression = 0.73 Personal Feelings Questionnaire = 0.55	–	9	
Magallares, 2017	Spain	Cross-sectional	Multidimensional Perceived Discrimination Scale	Hospital Anxiety and Depression Scale	170	34.7	Obese				100	42.75 ± 8.32	46.96 (13.21)	.45	.49	9	

*Studies not entered for meta-analysis: a = Mean Difference was reported; b = report effect size based on subscales.

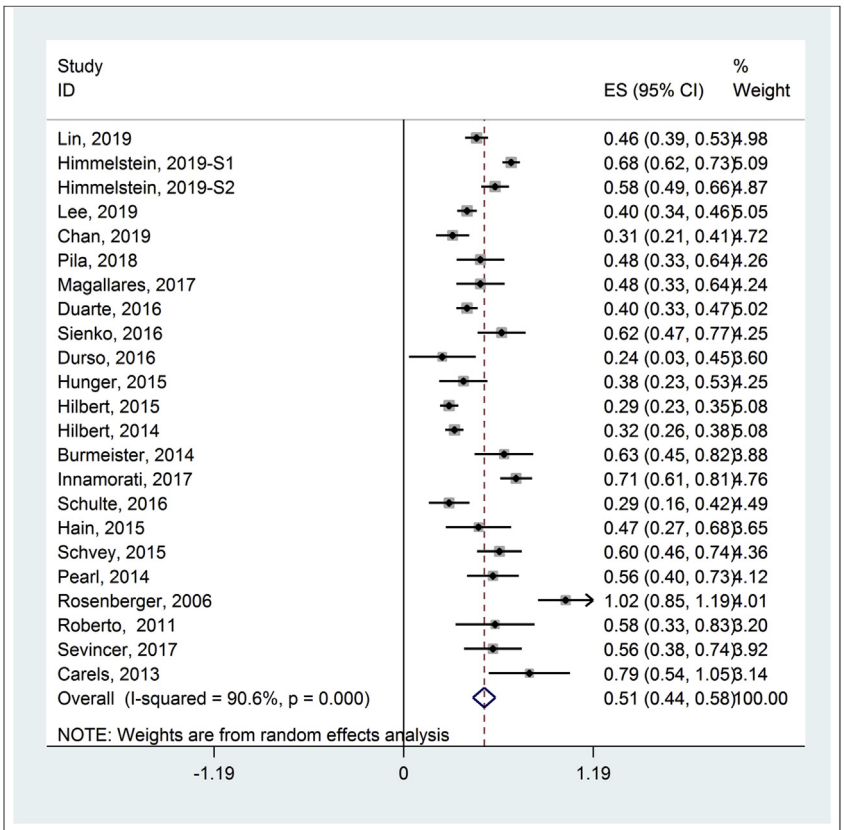
another potential factor on cumulative effect size, where studies with a cohort design showed a significantly smaller effect size than cross-sectional and baseline RCT studies (0.38 vs. 0.52). In cohort studies, the sample size and diversity of participants are usually greater than cross-sectional studies, which could be one of the reasons for this difference. More specifically, bigger sample sizes and greater variability among participants at baseline measurement of cohort studies appear to provide more accurate estimates of the association between self-stigma and depression. Additionally, the probability of publication bias was reduced from 0.51 to 0.40 after correction of cumulative effect size. The probability of this difference could also be due to the sample size and diversity of participants. That is, the overestimation of effect size could have occurred in the cross-sectional studies.

Sex of participants was also a factor that influenced cumulative effect size. The result of subgroup analysis showed that studies with participants of both sexes had closer effect size (0.46) to the corrected rate (0.40), whereas in studies with single-sex groups, the cumulative effect size was significantly greater (>0.6). One of the reasons for this difference is the small number of studies examining these subgroups. Men were only studied in the 2019 Himmelstein study (69) in two separate samples with 1259 and 504 individuals each. Women were selected as study participants in four studies [47,59,64,68]. In the remaining 17 studies [16,43,44,46,47,49–64,68–71], both sexes were examined. Given the large impact of sex on the magnitude of the effect in the relationship between self-stigma and depression, future studies should consider conducting studies utilizing single gender samples. If studies utilize both sexes, it would also be better to examine and report this relationship separately for each sex.

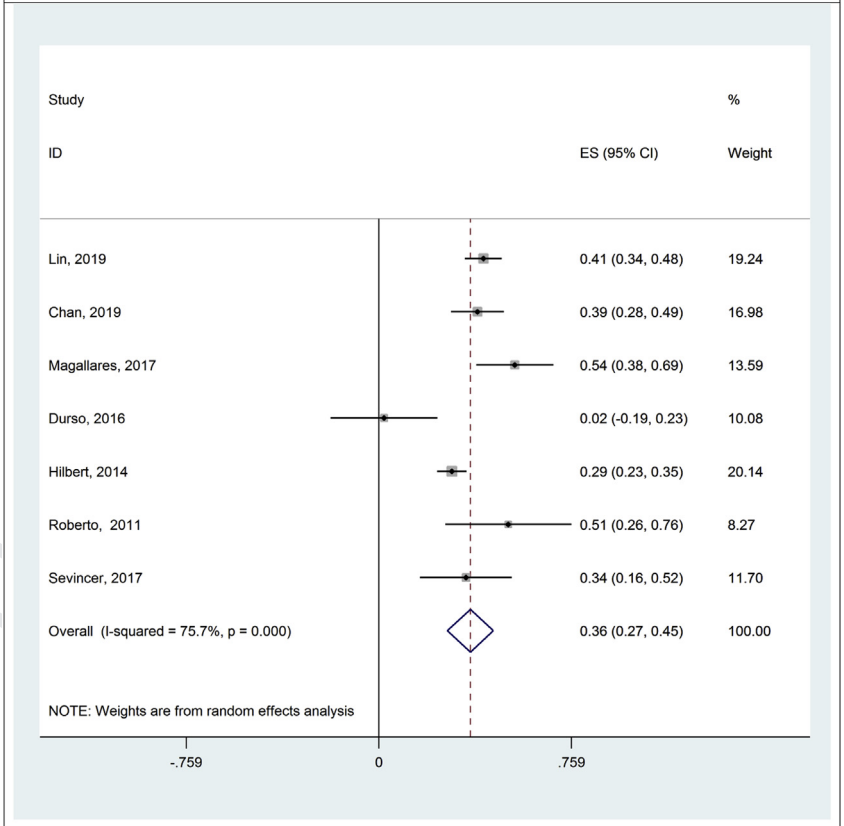
5.2. Methodological considerations, strengths and limitations of the review

There are some limitations in the present study. First, the causality between weight stigma and psychological distress cannot be determined by the findings in the present study because most of the analyzed studies utilized cross-sectional designs. Only four studies [59,61,66,67] adopted a longitudinal design to investigate the association between weight stigma and psychological distress. Therefore, meta-analysis could not be performed to accumulate the evidence of temporal association. Nevertheless, all the four longitudinal studied indicating the temporal association between weight stigma (either self-stigma or perceived stigma) and psychological distress. Therefore, the temporal association is likely exist and future-related studies are needed to provide additional evidence. Moreover, no randomized controlled trials were included in this meta-analysis (i.e., whether the psychological distress can be relieved after reducing weight stigma or *vice versa*). Therefore, the direction between weight stigma and psychological distress cannot be conclusively delineated. However, to the best of the present study's authors' knowledge, almost no studies on this topic have been conducted utilizing a randomized controlled trial. Therefore, future studies are encouraged to use randomized controlled designs to examine the causality between weight stigma and psychological distress.

Second, the instruments assessing weight stigma and psychological distress were different in the analyzed studies. Therefore, the scores collected in different types of instruments are hard to compare and combine. Nevertheless, the present meta-analysis used the meta-regression to demonstrate that the impacts of different instruments on the findings were trivial and non-significant. However, future meta-analyses are needed when sufficient studies have used the same instruments on this topic. Accordingly, some of the instruments used in the included studies



A. Depression and self-stigma



B. Anxiety and self-stigma

Fig. 2. Forest plots of overall Fishers' Z cscore for association of weight-related self-stigma with depression and anxiety.

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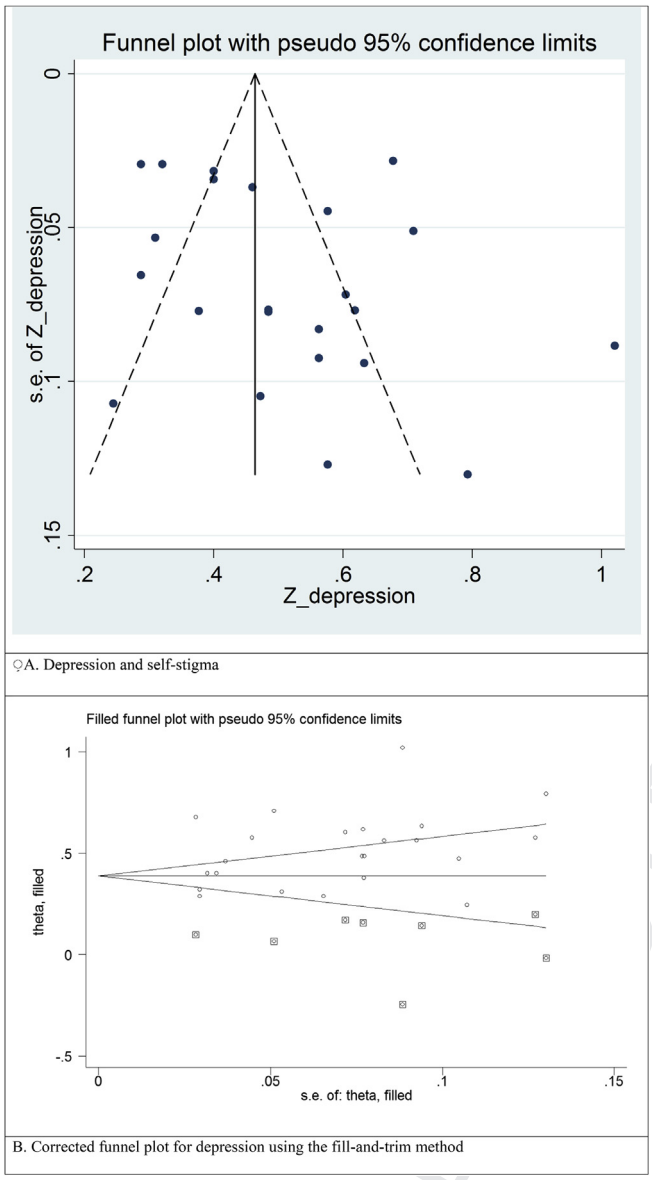

Fig. 3. Funnel plots to assess publication bias in association of weight-related self-stigma with depression and anxiety. A. Depression and self-stigma B. Corrected funnel plot for depression using the fill-and-trim method.

might not be standardized instruments in assessing weight stigma (e.g., Internalized Shame Scale [2006] and Body Image Shame Scale [2016]). However, these instruments are related to weight stigma (e.g., an item on WSSQ is talking about shame) and they were used maybe because standardized instruments on weight stigma were not developed when these studies were initially conducted. Therefore, including these studies in the present systematic review and meta-analysis is appropriate.

Third, although the present meta-analysis conducted subgroup analysis according to the geographical region, the generalizability of the findings was highly restricted when it came to Asian countries. More specifically, only individuals from United Arab Emirates [61] and Turkey [63] with a total sample size of 356 were included for the self-stigma analysis; only people from mainland China [45] with a sample size of 254 were included for

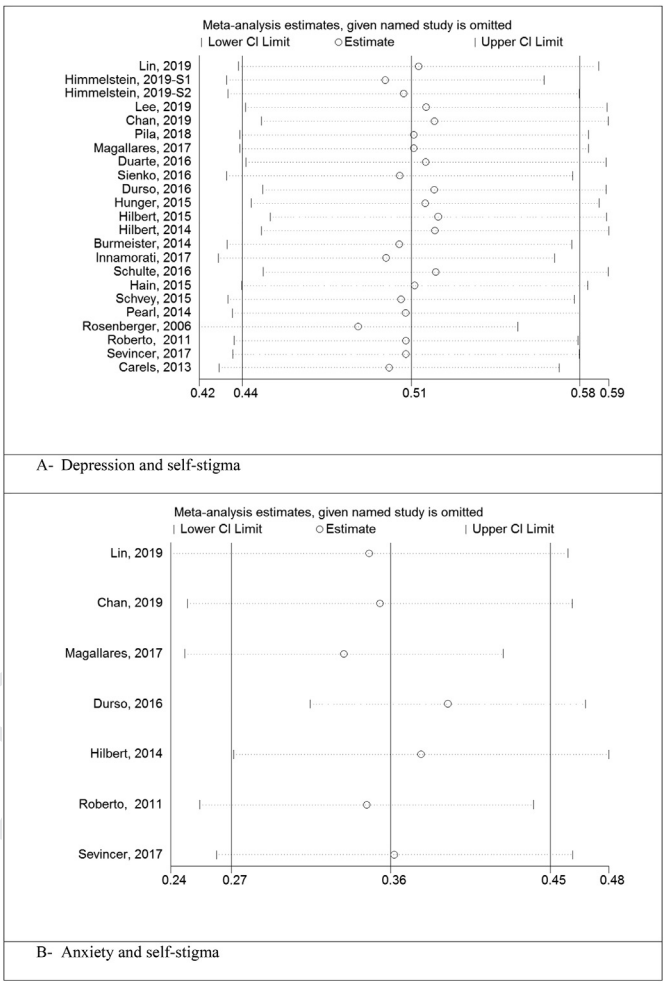

Fig. 4. -Results of sensitivity analysis for weight-related self-stigma A- Depression and self-stigma B- Anxiety and self-stigma.

the perceived stigma analysis. Therefore, studies on Asian population are required to see if there are any cultural differences.

Fourth, all the analyzed studies used self-reported questionnaires in assessing weight stigma or psychological distress. Therefore, the results may be biased by social desirability and/or memory recall errors. However, given that weight stigma and psychological distress are rarely assessed using objective instruments, the present study's findings might be trustworthy because almost all the analyzed studies used psychometrically validated questionnaires. Finally, weight-related perceived stigma and weight-related experienced stigma were not separated for meta-analysis due to the small number of publications. Therefore, the associations of perceived stigma and experienced stigma with psychological distress cannot be distinguished by the findings in the present study.

Finally, the statistical methods for evaluating publication bias are only good when the number of studies is large (at least 10) and heterogeneity is small. Although a sufficient number of studies were searched for, the heterogeneity in the present meta-analysis appeared not to be small. Therefore, the present study was unable to examine all the publication bias in this meta-analysis.

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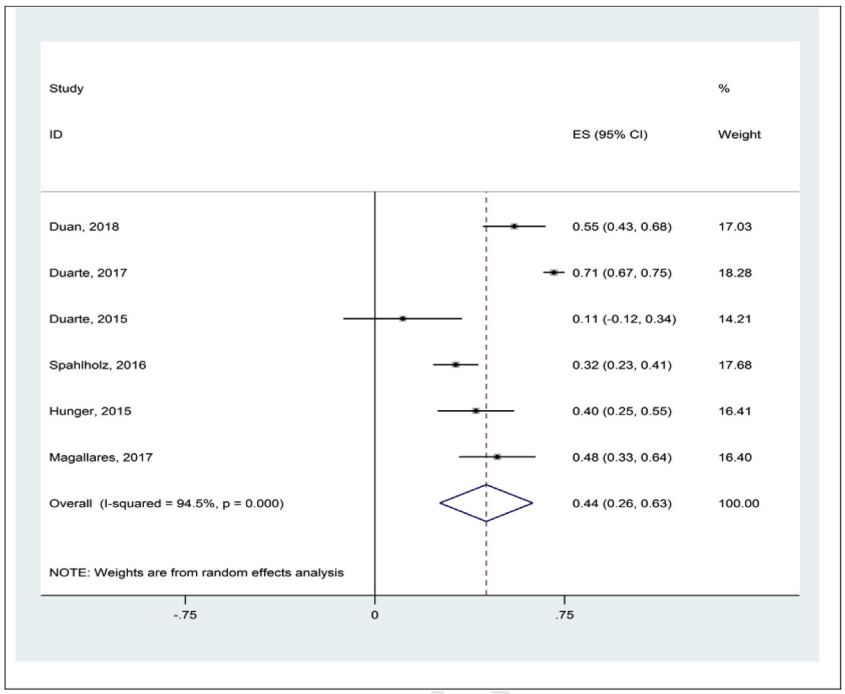

Fig. 5. Forest plot of overall pooled effect size regarding association of weight-related perceived stigma and depression.

Table 5
Meta-regression regarding weight-related perceived stigma.

Variable[a]	β	SE	p	I^2 residual (%)	Adj.R^2 (%)	tau^2
Continent	.077	.15	.66	95.52	−20.74	.50
Measure of Stigma	−.036	.06	.57	93.52	−15.26	.04
Measure of Depression	−.032	.07	.67	93.94	−19.86	.04
Sample Size	.0001	.00	.10	78.33	49.28	.02
Female participants (%)	−.00007	.004	.96	88.29	−28.53	.04
Target sample	−.025	.12	.85	95.18	−26.82	.04
NOS score	−022	.08	.80	95.52	−28.18	.04
BMI mean	−.002	.02	.91	93.35	−40.9	.05
Age mean	.0002	.01	.99	94.55	−38.49	.06

[a] Study design was not examined in moderator analysis, due to all six studies entered for meta-analysis was cross sectional.

Table 6
Results of sensitivity analysis for weight-related perceived stigma.

Excluded study	Pooled Fisher's z-score	95% Confidence interval	
		Lower Limit	Upper Limit
Duan, 2018	.416	.192	.640
Duarte, 2017	.390	.266	.514
Duarte, 2015	.496	.311	.681
Spahlholz, 2016	.471	.289	.652
Hunger, 2015	.448	.241	.656
Magallares, 2017	.431	.218	.645
Pooled Fishers' z (with all studies included)	.441	.257	.625

6. Conclusion

In conclusion, weight stigma including self-stigma and perceived stigma is an important topic for healthcare providers to tackle the psychological health of people who are overweight. The meta-analytic findings in the present study demonstrated that irrespective of gender or geographical regions, weight stigma is positively associated with psychological distress (i.e., depression and anxiety). With the high prevalence of obesity and weight stigma, healthcare providers may want to design effective and appropriate programs to fight or reduce weight stigma (including both self-stigma and perceived stigma) for individuals with weight problems.

Authors' contributions

Z.A. conceptualized the paper, undertook the searches, reviewed abstracts, undertook data extraction and analysis, assessed quality of included reviews, and drafted the paper. F.G. reviewed abstracts, checked data extraction, and quality assessed included reviews. A.H.P. checked data extraction and quality assessed included reviews. M.D.G. and A.B. advised on the meta-analysis. C.-Y.L. initiated the research question, advised on structuring the results section, and contributed to the drafting of the paper. M.D. G. revised and edited the final paper for submission. A.H.P. was the principal supervisor. All authors have seen and approved the final manuscript.

Conflicts of Interest

None to declare.

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List of Abbreviations

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PECO	Participants, Exposure, Comparison, Outcome
ISS	Internalized Shame Scale
WBIS	Weight Bias Internalization Scale
WSSQ	Weight Self-Stigma Questionnaire
WEB-SG	Weight- and Body-Related Shame and Guilt Scale
BISS	Body Image Shame Scale
BDI	Beck Depression Inventory

GAD	Generalized Anxiety disorder
DASS	Depression Anxiety Stress Scales
HADS	Hospital Anxiety Depression scale

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnu.2019.10.016.

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