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Does weight bias depend on educational attainment and level of income? A systematic review

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Abstract

Objectives: Obesity is considered a worldwide health issue, not only because of its health-related consequences, but also because of its impact on social status as a result of stigma. The aim of this study is to review the quantitative state of research regarding to socioeconomic characteristics' impact on weight-related attitudes. Based on Bourdieu's Theory of Class and his concept of "habitus", it is assumed that people with a higher level of education and income show greater and more negative attitudes toward people with obesity.

Method: A systematic literature review was conducted in 2017 using PubMed, PsychINFO, Web of Science, and the Cochrane Library. Fifteen studies that measured weight bias and either educational attainment or level of income were included in the analysis.

Results: The results of the studies included were inconsistent: six of these studies were found to support the hypothesis, whereas two of the studies contradicted it. The remaining seven studies did not show any significant correlation between weight bias and either education or income.

Conclusion: In light of these inconclusive and overall heterogeneous results, we cannot determine a reliable correlation between level of education or income with weight bias. Controversial findings might be caused by cultural and governmental differences. Furthermore, educational attainment seems to be more likely to predict weight bias than income. The review revealed a lack of research when it came to examining the impact of socioeconomic capital on weight bias.

Keywords: obesity, stigma, discrimination, education, income

Strength and limitations of this study

- Systematic review of the correlation between weight bias and socioeconomic status
- Considering macro level structures as moderating determinants of weight bias
- Attempt to explain heterogeneous and inconclusive results by appealing to governmental and cultural differences

Introduction

According to the World Health Organization (WHO), the worldwide prevalence of obesity, defined by a body mass index (BMI) of over 30 kg/m², nearly tripled between 1975 and 2016 [1]. To give but two examples, current data reveal an obesity rate of over 21% in Germany and 37.7% in the US [2, 3]. In regard to its escalating rate, obesity can be classified as a worldwide health issue, especially because it is associated with numerous comorbid diseases, such as diabetes mellitus, cardiovascular diseases, and certain forms of cancer [4].

Not only health-related consequences are connected to obesity, but also psychological implications that affect those concerned on a social level [5]. In particular, obesity is classified as a stigmatized condition. Therefore, being obese is a characteristic that sets those affected apart from people with normal weight. Since obesity is mislabeled as a self-inflicted situation, numerous negative stereotypes, such as laziness, lack of willpower, unhealthy lifestyle, and being unintelligent are associated with the condition [6]. Stigmatization leads to discriminating behavior toward people with obesity in the form of mistreatment in several areas of life, such as labor market, healthcare , and educational system [6, 7].

The systematic review of Spahlholz [8] revealed an increased perceived discrimination toward people with obesity in comparison to people with normal weight, especially toward people with more extreme obesity (BMI >35 kg/m²) as well as toward women. Moreover, the prevalence of weight-related discrimination accelerated over time. In the US, the prevalence of weight-related discrimination was nine times higher (66%) in 2005 than in 1995 (7.3%) [7, 8] and is thus similar to the rate of racial discrimination, particularly against women [9]. To prevent discriminating behavior, it is necessary to understand the origin of stigma, which can be seen as the catalyst of structural discrimination.

Determinants of stigmatizing attitudes and weight bias can be found, for example, in sociodemographic variables. There is some evidence that older age is associated with greater stigmatizing attitudes [10–12] and stronger evidence that men show greater weight bias than women [13–16]. When looking at the body and beauty

perception of people, the cultural framework also needs to be considered as a determinant of stigma. According to Bourdieu, the predominant cultural framework determines which values and characteristics can be seen either as desirable or traits to be stigmatized [17]. Depending on regional characteristics, weight is perceived as a sign of class distinction. In undeveloped countries, overweight was associated positively with well-being and wealth, while in developed countries a negative view of being overweight was widespread. Thus, in developed countries thinness has been viewed as a sign of beauty, success, and an overall high (socioeconomic) status [18]. Although, in the last decades the perception of obesity or rather slim-body ideals in developing countries might have changed [19, 20], results indicate that educational attainment and level of income seem to be relevant in regard to divergent weight bias.

Although, socioeconomic variables and obesity correlate closely, the impact of educational attainment and level of income on weight bias remain ambiguous. Several studies have shown the negative impact of being overweight on the labor market, especially for women [21, 22] as well as in the education system [23]. In addition, a lower level of education and income is associated with obesogenic behavior such as a poor diet and a lack of exercise caused by factors such as stress [24]. Moreover, Bourdieu [25] sees in socioeconomic class the most decisive determinant of healthy lifestyle. While people that belong to the working class preferred tasty and nutritious food, people from the upper-middle class preferred tasty food that can be described as light, healthy, and low in calories, according to his study. Subsequently, people with a higher level of education and income might choose a healthier lifestyle in order to distance themselves from people with obesity [26].

As a superior framework to generate missing hypotheses, Bourdieu's Theory of Class can be applied [25]. In accordance with his concept of "habitus", a person's general attitude, lifestyle, and even body shape can be seen as a metaphor for social status [18]. Furthermore, Bourdieu considers stigma as a form of symbolic power and a tool to serve the interests of the powerful [27]. Phelan and collogues [28] continue with his line thought and presented three motives of stigma, namely *keeping people*

in, *away,* or *down.* Particularly, *keeping people down* applies to the review's theoretical framework. Link and Phelan [17] discuss stigma as an instrument of a dominant group to keep another group down in order to attain or rather maintain a high social status, wealth, and power. However, a person's educational attainment and level of income are mainly invisible characteristics; thus, there are other attributes that more readily show social status. Assuming that obesity is perceived as a metaphor for lower social status, groups with higher social status might be aware of this link and keep people with obesity down in order to empower themselves. In this review, it is therefore assumed that people with a higher level of education and income display negative attitudes toward people with obesity in comparison to people with lower educational attainment and income. The impact of educational attainment and level of income on weight bias will be examined and compared.

Based on a sociological perspective, this systematic literature review attempts to outline the current state of research and reveal the relationship between weight bias and educational attainment and/or level of income. Such as Tyler and Slater [29] criticized inter alia "*that one of the major limitations of existing understandings of stigma is the ways in which they have 'bracketed off' key questions, such as where stigmatizing attitudes come from, how and by whom is stigma crafted, mediated, produced and why […].",* the general aim of this review is to identify social and economic groups that stigmatize and discriminate against those who are obese. In the future, this information could help researchers to develop and implement interventions in a more targeted manner.

Methods

Search Strategy

A systematic review of published studies reporting anti-fat attitudes held by differing socioeconomic status groups was conducted by using the relevant scientific electronic databases: PubMed, PsychINFO, Web of Science, and the Cochrane Library. The review followed the Prisma Guidelines [30].

The systematic review of literature was performed independently by two reviewers from November 2016 until January 2017 using the following key words: stigma*,

discrimination,“weight bias", or prejudice; education*, income, salary, wage, status, socio-economic, socioeconomic*, SES, sociodemographic, or socio demographics; and obes*, overweight, or fat. Giving of the very high number of results, the search was limited to the publications’ titles and abstracts. Only work published in English or German was included. There was no restriction in regard to the year of publication.

Data extraction

The systematic search of literature revealed 1,788 studies, whereby 1,234 studies remained after removing duplicates. Furthermore, 1,100 studies were excluded because screening their titles and abstracts for eligibility revealed no association to the research question that will be examined in this review. Disagreement and uncertainty between the two reviewers over the eligibility of certain abstracts were resolved by reinspecting the papers in detail and discussing disparate perspectives. For the remaining 134 studies, full papers were screened in detail to assess their eligibility by applying the following inclusion and exclusion criteria. The stages of the systematic literature search are provided in Figure 1.

Inclusion criteria

Studies were only included if they investigated weight bias in form of stigmatizing attitudes, discrimination (e.g., measured, for example, by policy and law support), or beliefs about causes of obesity. These causes included a lack of willpower as a proxy measure for stigmatizing attitudes. Furthermore, studies included had to report some kind of association between weight bias and either educational attainment or level of income.

Exclusion criteria

The following exclusion criteria were used to eliminate studies that were not applicable: (a) studies with a sample of health care professionals, dietitians, psychologists, and physical educators; (b) studies that investigated stigmatizing attitudes of children and/or adolescents; (c) studies that investigated stigma toward childhood obesity; (d) studies with an overweight and/or obese sample that investigated perceived stigmatization; (e) studies with a homogenous sample in regard to educational attainment (e.g., students) or level of income; (f) studies that

investigated weight bias toward extended stigma groups (e.g., obese and binge eating); and (g) reviews or qualitative studies.

The stages of the systematic literature search are provided in Fig. 1. In summary, 41 studies were excluded because they did not report the participants' educational attainment or income. In addition, 8 studies provided a lack of information with regard to the samples' socioeconomic variance and 21 studies were excluded because of the samples' characteristic (overweight/obese sample n=10; children/adolescents sample n=11). Two studies were excluded because they followed a qualitative approach, and 22 studies were excluded because they could be categorized as reviews. Twenty-one studies were found that did not meet the criteria for the aimed outcome of weight bias. Two studies were neither published in English nor in German. Moreover, one paper had to be excluded because of its lack of academic background.

After excluding the studies that did not meet our criteria, 15 studies were identified as relevant for in-depth investigation. Therefore, sampling characteristics, study design, assessment of weight bias, and measurement of educational attainment and income were systematically examined.

Patient and Public Involvement

Within this study no data was assessed. We conducted a systematic review and analyzed therefore data that has already been collected. Thus, patients were not involved in this study.

Results

The 15 studies included were tabulated according to the following characteristics: origin of the sample, sample size (N), sample characteristics, study design, instruments to assess weight bias, educational attainment or income, and a brief summary of results. Studies reviewed in detail are tabulated by either educational attainment (Table 1) or by level of income (Table).

Study characteristics

All relevant study characteristics are summarized in Table 1 and Table , respectively. Six out of fifteen studies are based entirely on an American sample [31–36, 36]. Two other studies are based on an American and an Icelandic adult sample [37, 38]. These two studies also provided data based on a Canadian sample of health care professionals and American, Australian, and Icelandic student samples that did not meet the inclusion criteria and therefore all four samples had to be excluded. Two studies were based on a German sample [10, 39], and five studies based on one sample, from Paraguay [40], Mexico [41], Sweden [42], Denmark [43], and Great Britain [44] respectively. The study by [40], based on a Paraguayan sample also provided data of a comparison group of US-undergraduate students that was not considered in the analysis because of the homogenous study sample in terms of educational attainment. The fifteen studies included showed a wide variation of sample sizes ranging from 146 [36] to 3,331 participants [32].

Since the aim of the study was to outline the impact that socioeconomic status in form of educational attainment and level of income have on weight bias, attention was paid to a variation in these variables within the samples. The studies included therefore focused either on a population-based sample [10, 33, 34, 39, 42] or an adult sample [31, 32, 36–38, 43]. Although Jiminez-Cruz and colleagues [41] investigated stigmatizing attitudes of an entirely low-income sample, but divided the socioeconomic factors (level of education and income) into five and four categories respectively; thus, variation within the sample could be ensured. Moreover, an investigation of weight bias in different gradations of lower status groups could provide further insight into the topic. In one study [35], the general population was included, whereby the overweight participants received an alternative questionnaire assessing the perceived stigmatization and not their stigmatizing attitudes toward obesity. Therefore, only the normal weight sample could be included.

The distribution of women and men was equally considered in the majority of studies, even though more women than men were included. However, two studies posed an

exception. The study of Brewis et al. [40] and the study of Jiminez-Cruz [41] investigated only the stigmatizing attitudes of female participants.

Table 1. Summary of Selected Studies: Weight Bias Depending on Educational Attainment

Study	N	Sample description	Study Design	Instruments Weight bias	Educational attainment	Association education/ weight bias	Direction of Correlation
[35]; USA	396	General, not overweight population (ø age: 42.7 years; 43.7% female)	Experimental online survey	Short-FPS[45]	Educational attainment	FPS: No	–
[31]; USA	1,118	US adult sample (ø age: 43.8 years; 50.2% female)	Online survey	Opinions about obesity as a disease [31]	Educational attainment (High School or less, Some college/Technical or vocation degree, college graduate or higher)	No	–
[37]; USA and ISL	899	US adult sample (ø age: 40.9 years; 46.1% female)	Online survey	Short-FPS [45]; UMB-FAT [46]	Educational attainment (High school or less; some college/technical or vocation degree; College graduate or higher)	FPS: inconsistent findings; greater fat phobia in some college vs. reference category (high school or less) ($p<0.05$) UMB-Fat: inconsistent findings; greater stigma in some college vs. reference category (high school or less) ($p<0.05$)	–
	659	ISL adult sample (ø age: 45.9 years; 55.1% female)			Educational attainment (High school or less/ College)	FPS: No UMB-Fat: Yes; Higher education leads to higher stigmatizing attitudes ($p<0.05$)	Positive
[34]; USA	981	US representative sample (62% female)	CATI	Beliefs about obesity as a burden for society Beliefs about the controllability of obesity	Educational attainment (less than some high school; High-school graduate; some college; higher than a college degree)	Beliefs about obesity as a burden for society: Yes; Higher educational attainment leads to higher agreement on stigmatizing statement	Positive
						Beliefs about the controllability: No	–
[39]; GER	3003	population based (ø age: 51.7 years; 52.8% female)	CATI with vignette-based approach	Short-FPS[45]	Educational attainment (no degree, 9th grade degree; 10th grade degree, 12th grade degree)	Yes; Higher educational attainment leads to less stigmatizing attitudes	Negative
[10]; GER	1,000	Population based sample (ø age: 45.9 years; 56.9% female)	CATI	WCB [47]; Support for obesity prevention	Educational attainment (low= <13 years of education high= ≥ 13 years of education)	WCB: Yes; Higher educational attainment leads to less stigmatizing attitudes	Negative
						Support for obesity prevention: No	–
[40]; PRY	200	Women (ø age: 38.9 years)	Questionnaires in personal interview	ATOP [48]; IAT [49]	Educational Attainment (years of formal education)	ATOP: No	–
						IAT: No	–
[42]; SWE	2,436	Representative Swedish population aged 25-64 (ø age: 47.8 years; 63% female)	Face-to-face interview	ATOP [48]	Educational attainment (low; medium; high)	ATOP: No	–

Table 1 (continued)

Study	N	Sample description	Study Design	Instruments Weight bias	Educational attainment	Association education/ weight bias	Direction of Correlation
[44]; GB	198	Community-based (ø age: 32.58 year; 50.5% female)	Paper-pencil questionnaire	PFRS [50]	Educational attainment	No	–
[41]; MEX	1,100	Women aged 18-40 of low SES (ø age: 37.5 years)	Questionnaires in personal interviews	Beliefs about the causes of obesity	Educational attainment (none, some elementary, elementary, middle, high school)	Yes; Higher education leads to higher agreement with stigmatizing statements (self-responsibility as cause for obesity) (P<0.001)	Positive
[32]; USA	3,331	Adults (age 21-65; 61.9% female)	Online survey	Support for three weight-related antidiscrimination laws 1. Law: protections for people with disabilities 2. Law: civil rights statutes 3. Law: reducing weight-based workplace discrimination	Educational attainment (High school or less; some college/ technical or vocation degree; College graduate or higher)	Chi-square test: Yes; Higher education leads to less support for disability and civil rights for people with obesity	Positive
						Logistic regression model: Yes; Higher education leads to less support for disability and civil rights for people with obesity	Positive
[38]; USA and ISL	893	US adult sample (ø age:40.9 years; 46.1% female)	Online survey	Support for policies/laws to prohibit weight discrimination (antidiscrimination laws specific to employment/ broader antidiscrimination laws and policies)	Educational attainment (High school or less; some college/technical or vocation degree; College graduate or higher)	No	–
	658	ISL adults sample (ø age:45.9 years; 55.1% female)			Educational attainment (High school or less/ College)	Yes; Higher education leads to less agreement with Broad Policies/Laws	Positive
[33]; USA	1,001	Population based sample (ø age:43.8 years; 51% female)	Online survey	Assessing support for measures to prohibit weight discrimination by evaluating 6 different laws	Educational attainment (High School; college degree; Postgraduate degree)	Yes; Higher education leads to less agreement with antidiscrimination laws	Positive
[43]; DNK	1,003	Citizens aged 18-65	Online survey	Attitudes toward weight-loss surgery & medical treatment of obesity	Educational attainment	No	–

Note: Positive = demonstrates greater anti-fat attitudes with increasing educational attainment; Negative = demonstrate greater anti-fat attitudes with decreasing educational attainment; N = sample size; FPS = Fat Phobia Scale; UMB = Universal Measure of Bias; WCB = Weight Control/Blame of the Anti-Fat Attitudes Test; ATOP = Attitudes to Obese People; IAT = Implicit Association Test; PFRS = Photographic Figure Rating Scale; SES = Socioeconomic status

Table 2. Summary of Selected Studies: Weight Bias Depending on Level of Income

Study	N	Sample description	Study Design	Instruments Weight bias	Level of income	Association level of income/ weight bias	Direction of Correlation
[35]; USA	396	General, not overweight population (ø age: 42.7 years; 43.7% female)	Experimental online survey	Short-FPS [45]	Annual household income	FPS: No	–
[36]; USA	272	US adults (ø age:32.7 years; 64% female)	Questionnaire study with vignette-based approach	UMB [46]; Belief in stereotypes; Acceptability of weight stigmatization	Family income level (divided in seven categories including the category "I don't know")	UMB: No Beliefs in stereotypes: No Acceptability of weight stigmatization: No	–
	146	US adults (ø age:33.2 years; 63.6% female)				UMB: No Beliefs in stereotypes: No Acceptability of weight stigmatization: No	–
[31]; USA	1,118	US adult sample (ø age:43.8 years; 50.2% female)	Online survey	Opinions about obesity as a disease [31]	Household income (divided in five categories)	No	–
[34]; USA	981	US representative sample (62% female)	CATI	Beliefs about obesity as a burden for society Beliefs about the controllability of obesity	Income (divided in six categories)	Beliefs about obesity as a burden for society: Yes; A higher income level leads to higher agreement on stigmatizing statement	Positive
						Beliefs about the controllability: No	–
[39]; GER	3003	population based (ø age:51.7 years; 52.8% female)	CATI with vignette-based approach	Short-FPS [45]	Income (divided in four categories)	No	–
[10]; GER	1,000	Population based sample (ø age: 45.9 years; 56.9% female)	CATI	WCB [47]; Support for obesity prevention	Household income (low=2.000€; high=≥2.000€)	WCB: No	–
						Support for obesity prevention: Yes; Higher income leads to higher financial support (P<0.01)	Negative
[41]; MEX	1,100	Women aged 18-40 of low SES (ø age: 37.5 years)	Questionnaires in personal interviews	Beliefs about the causes of obesity	Weekly income (divided in four categories)	No	–
[42]; SWE	2,436	Representative Swedish population aged 25-64 (ø age: 47.8 years; 63% female)	Face-to-face interview	ATOP [48]	Yearly income	ATOP: No	–

Table 2 (continued)

Study	N	Sample description	Study Design	Instruments Weight bias	Level of income	Association level of income/ weight bias	Direction of Correlation
[32]; USA	3,331	Adults (age 21-65; 61.9% female)	Online survey	Support for three weight-related antidiscrimination laws 1. Law: protections for people with disabilities 2. Law: civil rights statutes 3. Law: reducing weight-based workplace discrimination	Household income (divided in five categories)	Chi-square test: Yes; Higher income leads to less support for disability right and civil rights for people with obesity	Positive
						Logistic regression model: No	–
[33]; USA	1,001	Population based sample (ø age: 43.8 years; 51% female)	Online survey	Assessing support for measures to prohibit weight discrimination by evaluating 6 different laws	Annual income (divided in five categories)	Yes; Higher income leads to less agreement with antidiscrimination laws	Positive
[43]; DNK	1,003	Citizens (age 18-65)	Online survey	Attitudes toward weight-loss surgery & medical treatment of obesity	Income	No	–

Note: Positive = demonstrates greater weight bias with increasing level of income; Negative = demonstrate greater weight bias with decreasing level of income; N = sample size

Instruments

Educational attainment and level of income

Fifteen studies were found that assessed attitudes toward obesity in association with participants' educational attainment and/or level of income. Out of fifteen studies, fourteen reported the participants' educational attainment [10, 31–35, 37–44]. Depending on the origin of the sample and the analogous countries' educational system, categories were formed or years of educational attainment were gathered.

From fifteen studies, eleven assessed participants' level of income [10, 31–36, 39, 41–43]; therefore, income was either assessed by the annual, weekly, household, or individual income.

Weight Bias

The studies included were divided with regard to the dependent variable (weight bias) into two groups. The first group consists of studies that investigated participants' discriminatory attitudes toward people with obesity [32, 33, 38, 43, 44] the second group included studies that examined either participants' stigmatizing attitudes or participants' beliefs about the causes of obesity [10, 31, 34–37, 39–42, 42, 44]. As described before, beliefs about the causes of obesity in form of evaluating obesity as a controllable condition – which is supposedly preventable by a higher extent of self-discipline – can consequently be seen as one decisive factor in determining stigmatizing attitudes [51]. The instruments used in both groups are presented in Figure 2.

Findings

The studies included showed a very heterogeneous picture regarding their results. Eight out of the fifteen studies significantly associated educational attainment with stigmatizing and/or discriminatory attitudes toward people with obesity [10, 32–34, 37–39, 41]. These studies are presented in Table 3.

Associations between educational attainment and weight bias

Six of the overall fifteen studies showed a positive association between higher educational attainment and each of the following three factors: greater stigmatizing attitudes, higher perceptions of personal responsibility, and lower support for antidiscrimination measures [32–34, 37, 38, 41]. However, two German studies [10,

39] showed an inverse correlation. Both of these studies found evidence that higher education is associated with lower stigma [39] and less belief in individual responsibility [10] for an obese condition.

Associations between level of income and weight bias

Three out of 15 studies showed a significant association between income and weight bias [10, 32–34, 38, 39, 41]. Two American studies [10, 32–34, 38, 39, 41] revealed higher weight bias with increasing income, whereas one German study [10] found an inverted association.

Two additional studies [37, 38], using the same instruments and the same US and Iceland sample, found no significant association between weight bias and educational attainment in the US sample, but did find an association in the Icelandic sample. The statistical analysis of these two studies revealed significant correlation between educational attainment and discriminating ($p<0.01$) and stigmatizing ($p<0.05$) attitudes, respectively, in the Icelandic sample [37, 38].

Table 3. Studies That Show Significant Associations Between Weight Bias and Educational Attainment or Level of Income

Study	Direction of correlation	Instrument Weight Bias	SES indicator	Result	Adjusted for
[39]	Negative	Short-FPS	Education	Higher educational attainment leads to lower stigmatizing attitudes	Gender, age, income, residence, emigrational background
[10]	Negative	WCB	Education	Higher educational attainment leads to less stigmatizing attitudes (P<0.001)	Causal attributions to behavior, Labeling obesity as an illness, Age, Causal attributions to heredity
[37]	Positive	UMB-Fat	Education	Higher educational attainment leads to higher stigmatizing attitudes (ISL sample; P<0.05)	Gender, race/ethnicity, BMI, perceived causes of obesity, weight-related attributions
[41]	Positive	Beliefs about the causes of obesity	Education	Higher educational attainment leads to greater belief in individual responsibility (P<0.001)	Unadjusted
[34]	Positive	Belief in obesity as a burden for society	Education	Higher educational attainment leads to greater belief in statement" Obesity is a major burden to society in terms of healthcare costs" (P<0.01)	Race/ethnicity, sex, income, employment, age group, marital status, BMI, smoking status
[32]	Positive	Support for weight-related laws	Education	Higher educational attainment leads to lower support for weight-related laws (P<0.01)	Other socio-demographic variables
[38]	Positive	Support for weight-related laws	Education	Higher educational attainment leads to less support for weight-related laws (P<0.01)	Sex, age, race/ethnicity, BMI
[33]	Positive	Support for weight-related laws	Education	Higher educational attainment leads to lower support for weight-related laws	Sex, body weight, age, education, income, race, political affiliation, history of weight-based victimization
[10]	Negative	Financial support of obesity prevention	Income	Lower income leads to lower financial support (P<0.01)	Unadjusted
[34]	Positive	Belief in obesity as a burden for society	Income	Yes; A higher income level leads to greater belief in statement" Obesity is a major burden to society in terms of healthcare costs" (P<0.05)	Race/ethnicity, sex, education, employment, age group, marital status, BMI, smoking status
[33]	Positive	Support for weight-related laws	Income	Higher income leads to lower support for weight-related laws	Sex, body weight, age, education, income, race, political affiliation, history of weight-based victimization

Discussion

The systematic literature review conducted reveals heterogeneous results based on factors such as country of origin, study type, and instruments used. Overall, eight out of the fifteen studies showed that weight bias is significantly associated with either educational attainment or level of income. Of these eight studies, six, based on American [32–34, 38, 41], Icelandic [37, 38], or Mexican [41] samples, indicate support for the working hypothesis that weight bias is in fact greater with increasing educational attainment or level of income. In contrast, two German studies [10, 39] found the reverse association, i.e. diminished weight bias with increasing educational attainment or level of income. However, the remaining seven studies did not show any significant association between weight bias and socioeconomic determinants. The heterogeneous and inconclusive results might be caused by diverging study designs, sample sizes, and instruments assessing weight bias, educational attainment, and level of income. In light of these inconclusive and overall heterogeneous results, a reliable correlation between level of education or income with weight bias cannot be determined.

Studies that did not show a significant association between weight bias and either educational attainment or level of income excluded the overweight portion of the sample [35] or were characterized by a small sample (ranging from n=146 to n=396) size [35, 36, 40, 44]. Furthermore, the association between weight bias with either educational attainment or level of income were not seen in instruments such as the Attitudes to Obese People scale (ATOP) [40, 42], the Implicit Association Test (IAT) [40] agreement ratings as to whether obesity can be classified as a disease [31], and measurement of attitudes toward weight-loss surgery and medical treatment [43].

However, it remains unclear why in the eight studies that indicate significant associations, the correlations between weight bias and socioeconomic variables found seem to be inconsistent. American, Mexican, and Icelandic studies were found to support the working hypothesis, whereas two German studies revealed findings to the contrary. These contradicting findings might be ascribed at a macro level to

Bourdieu's theory about how cultural frameworks determine how certain values and characteristics are perceived. It can be assumed that cultural frameworks shape governmental systems and are strengthened at the same time through them, especially through the national health and welfare systems. Tyler and Slater [29], for example, outline the political and social function of stigma as a form of power. They discuss macro level structures, particularly those used actively and passively by governments, as determinants shaping stigmatizing attitudes, a level of understanding often left out in social psychology. Hence, stigma is not only an instrument used by individuals to enforce personal interests but also one put in place (intended or not) by governments.

Since all four counties here discussed can be considered as developed, a deeper insight in cultural differences is needed. In cultures in which individual responsibility is considered as one of the main causes for self-fulfillment, health, and wealth, obesity might be perceived as a self-inflicted condition. Highly educated and more affluent people might attempt to keep people down in order to maintain their high social status. In contrast, in cultures in which individuals' situations are principally considered as a result of manifold circumstances, obesity might consequently not only be seen as self-inflicted. In these cultures especially highly educated and more affluent people might be aware of social barriers as determinants for self-fulfillment, wealth, and health, i.e. body weight. In conclusion, it might be possible that our working hypothesis is more applicable in countries or rather cultures in which the governmental and cultural structures enforce stigma as an instrument to 'nudge people into desired patterns of behavior' [29]. Hence, future research should consider an expansion and reorientation of stigma's theoretical framework by focusing on the meso and macro socio-cultural structures, as Bonnington and Rose [52] suggest.

Furthermore, it seems striking that educational attainment is more likely to predict weight bias than participant's level of income. While educational attainment associates significantly with weight bias in eight out of fifteen studies, only three studies indicated an association between income and weight bias. Therefore, a possible explanation might be that income can be seen as a proxy variable for education. Suh and colleagues [32], for example, found a significant association

between low income and higher support for weight-related laws until they controlled for other sociodemographic variables, such as educational attainment.

Limitations

Every review has its limitations, nor is this one immune to them. First, the current research only includes papers written in English or German. Second, just as any overview must contend with heterogeneous samples and instruments, this systematic review has likewise attempted to cope with varying data. The studies reviewed differed with respect to the instruments used to assess education and income. In particular, the measurement of educational attainment was strongly influenced by the different organization and structure of the varied local educational systems. In addition, the instruments to assess weight bias were also heterogeneous, particularly those used to measure stigmatizing attitudes. Furthermore, some studies used validated scales, whereas other studies used single items only. Thus, the manner of gathering data and classifying categories can be described as heterogeneous itself – and therefore caused the study team to decide against a meta-analysis.

In addition, the study aimed to investigate socioeconomic determinants of weight bias in the general population, as discussed in the inclusion and exclusion section. Therefore, we excluded inter alia studies that focused on overweight and/or obese samples only. We assumed that people try to differentiate themselves from lower status groups, which might be characterized by varying body sizes, i.e. excess weight or obesity. However, overweight and obese samples were included as part of the general population in some studies. Also, these studies did not differentiate their results by participants' body sizes. In the general population we assume that people try to differentiate themselves not only by socioeconomic status but by other status markers as well, such as excess weight. Although we attempted to explain the heterogeneous and inconclusive results by appealing to governmental and cultural differences, there was insufficient evidence to reach a conclusion about the role of cultural and governmental structures on weight bias.

Conclusion

The aim of the literature review was to investigate to what extent weight bias can be traced back to socioeconomic variables, such as educational attainment and level of income. It was assumed that a higher level of education or income leads to greater stigmatization and discrimination. Therefore, the current study situation was analyzed systematically. Although data of education and income are always collected as mandatory sociodemographic information, research is lacking when it comes to examining their impact on weight bias. Since this question has not yet been answered in a sufficient manner, this review was supposed to close this research gap.

Our working hypothesis that weight bias increases with higher educational attainment or level of income could not be verified. Particularly, we found 6 studies that supported our hypothesis, two German studies indicating the reverse conclusion, and seven studies that did not show a significant association at all.

The key to identifying effective interventions to battle stigmatization, discrimination, and consequences for those affected, might lie in exposing the characteristics of stigmatizing groups and their motivations. Therefore, future research should pay more attention to the link between weight bias and socioeconomic factors and cultural or rather governmental structures. Moreover, meta-analysis should be considered as an important direction for future research.

Figure legends

Figure 1. Phases of the systematic review

Figure 2. Instruments assessing weight bias

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Disclosure Statement

The authors have no conflicts of interest to declare.

Author contributions

MB, CLS and SRH outlined and specified the research question. MB and CLS conducted the systematic search of literature. Furthermore MB, CLS and TH discussed papers in detail in case of disagreement and uncertainty over the eligibility of abstracts. MB wrote the first draw of the manuscript. TH, SRH and CLS revised it critically for important intellectual content. All authors contributed to and have approved the final manuscript.

Data sharing statement

No unpublished data is available following this study.

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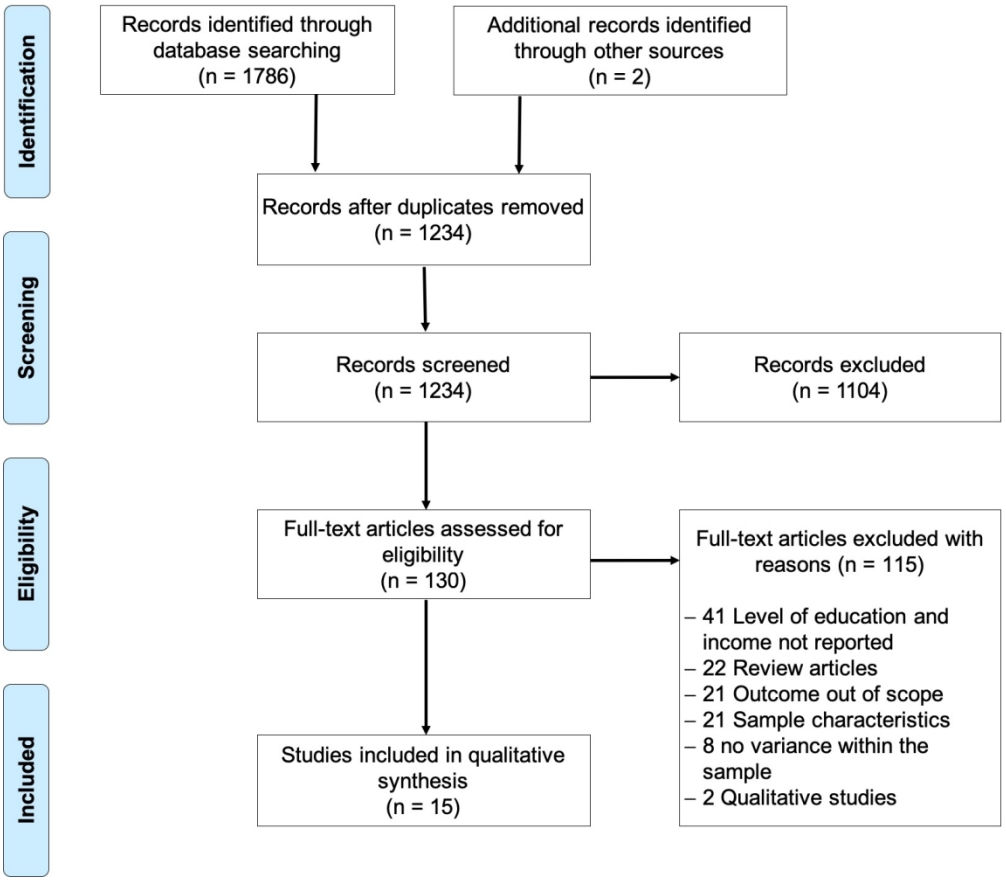

Figure 1. Phases of the systematic review

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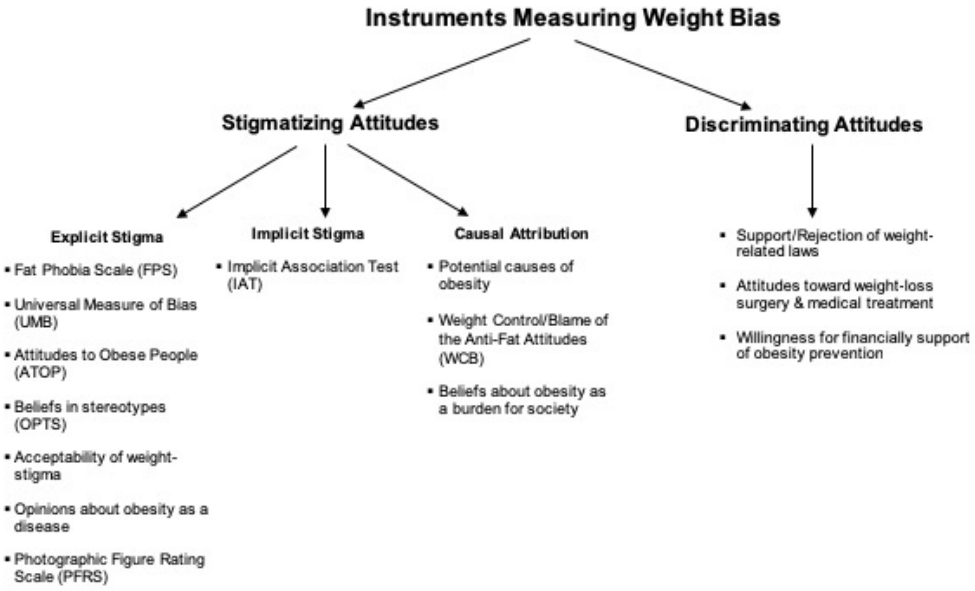

Figure 2. Instruments assessing weight bias

203x125mm (72 x 72 DPI)

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6-7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6-7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	14-15
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	No meta-analysis

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	No meta-analysis
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-14
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	No meta-analysis
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	15-18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18-20
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	22

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

BMJ Open

Does weight-related stigmatization and discrimination depend on educational attainment and level of income? A systematic review

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Secondary Subject Heading:	Sociology, Public health
Keywords:	obesity, stigma, discrimination, education, income

Does weight-related stigmatization and discrimination depend on educational attainment and level of income?

A systematic review

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Abstract

Objectives: Obesity is considered a global health issue, not only because of its health-related consequences but also because of its impact on social status as a result of stigma. This study aims to review the quantitative state of research regarding socioeconomic characteristics' influence on weight-related stigmatization and discrimination. Based on Bourdieu's Theory of Class and his concept of "habitus," it is assumed that people with a higher level of education and income show stronger negative attitudes toward people with obesity.

Method: A narrative systematic literature review was conducted in 2017 using PubMed, PsychINFO, Web of Science, and the Cochrane Library. Seventeen studies that measured weight bias and either educational attainment or level of income were included in the analysis.

Results: The results of the studies included were inconsistent: six of these studies were found to support the hypothesis, whereas two of the studies contradicted it. The remaining seven studies did not show any significant correlation between weight bias and either education or income.

Conclusion: In light of the inconsistent and heterogeneous results of the studies that report a significant association between weight bias and socioeconomic variables, the findings must be discussed concerning their cultural context, i.e., cultural and governmental differences. Furthermore, educational attainment seems to be more likely to predict weight bias than income. The review revealed a lack of research when it came to examining the impact of socioeconomic capital on weight bias.

Keywords: obesity, stigma, discrimination, education, income

Strength and limitations of this study

- A systematic review following the PRISMA guidelines was conducted to investigate the relationship between weight bias and the socioeconomic status of studies published in English or German.
- Study selection was performed by two independent reviewers to minimize subjectivity and random errors.
- This study is limited since no meta-analysis could be performed due to divergent study designs, instruments used, or different ways items were operationalized for statistical analysis

Introduction

According to the World Health Organization (WHO), the worldwide prevalence of obesity, defined by a body mass index (BMI) of over 30 kg/m², nearly tripled between 1975 and 2016 [1]. To give but two examples, current data reveal an obesity rate of over 21% in Germany and 37.7% in the US [2, 3]. With its escalating rate, obesity can be classified as a global health issue, primarily because it is associated with numerous comorbid diseases, such as diabetes mellitus, cardiovascular diseases, and certain forms of cancer [4].

Not only health-related consequences are connected to obesity, but also psychological implications that affect those concerned on a social level [5]. In particular, obesity is classified as a stigmatized condition. Therefore, being obese is a characteristic that sets those affected apart from people with normal weight. Since obesity is mislabeled as a self-inflicted situation, numerous negative stereotypes, such as laziness, lack of willpower, unhealthy lifestyle, and being unintelligent are associated with the condition [6, 7]. Stigmatization leads to discriminating behavior toward people with obesity in the form of mistreatment in several areas of life, such as labor market, healthcare, and educational system [6, 7].

The systematic review of Spahlholz [8] revealed increased perceived discrimination toward people with obesity in comparison to people with normal weight, especially toward people with more extreme obesity (BMI >35 kg/m²) as well as toward women. Moreover, the prevalence of weight-related discrimination accelerated over time. In the US, the prevalence of weight-related discrimination was nine times higher (66%) in 2005 than in 1995 (7.3%) [7, 8] and is thus similar to the rate of racial discrimination, particularly against women [9]. Understanding the origin of stigma, which can be seen as the catalyst for structural discrimination, is necessary to prevent discriminating behavior. Although weight-related stigmatization and discrimination are closely linked, they need to be considered as two divergent concepts. However, in the following, we will refer to weight-related stigmatization and discrimination as “weight bias”, but will differentiate between both concepts whenever needed.

Some people are more prone to display weight bias than other: There is some evidence that older age is associated with stigmatizing attitudes [10–12] and stronger evidence

that men show stronger weight bias than women [13–16]. When looking at the body and beauty perception of people, the cultural framework also needs to be considered as a determinant of stigma. According to Bourdieu, the predominant cultural context determines which values and characteristics can be seen either as desirable or traits to be stigmatized [17]. Depending on regional characteristics, weight is perceived as a sign of class distinction: In undeveloped countries, overweight was associated positively with well-being and wealth, while in developed countries a negative view of being overweight was widespread. Thus, in developed countries, thinness has been viewed as a sign of beauty, success, and an overall high (socioeconomic) status [18]. Although in the last decades the perception of obesity or rather slim-body ideals developing countries might have changed [19, 20], results indicate that educational attainment and level of income seem to be relevant regarding weight bias.

Although socioeconomic variables and obesity correlate closely, the impact of educational attainment and level of income on weight bias remain ambiguous. Several studies have shown the negative impact of being overweight on the labor market, especially for women [21, 22] as well as in the education system [23]. In addition, a lower level of education and income is associated with obesogenic behavior such as a poor diet and a lack of exercise caused by factors such as stress [24]. Moreover, Bourdieu [25] sees the most decisive determinant of a healthy lifestyle in socioeconomic class. While people that belong to the working class preferred tasty and nutritious food, people from the upper-middle class preferred food that can be described as light, healthy, and low in calories, according to his study. Subsequently, people with a higher level of education and income might choose a healthier lifestyle to distance themselves from people with obesity [26].

As a superior framework to generate missing hypotheses, Bourdieu's Theory of Class can be applied [25]. Following his concept of "habitus," a person's general attitude, lifestyle, and even body shape can be seen as a metaphor for social status [18]. Furthermore, Bourdieu considers stigma as a form of symbolic power and a tool to serve the interests of the powerful [27]. Phelan and colleagues [28] continue with his line thought and presented three motives of stigma, namely *keeping people in*, *away,* or *down.* Particularly, *keeping people down* applies to the review's theoretical

framework. Link and Phelan [17] discuss stigma as an instrument of a dominant group to keep another group down to attain or maintain high social status, wealth, and power. However, a person's educational attainment and level of income are mainly invisible characteristics; thus, there are other attributes that more readily show social status. Assuming that obesity is perceived as a metaphor for lower social status, groups with higher social status might be aware of this link and keep people with obesity down to empower themselves. In this review, it is therefore assumed that people with a higher level of education and income display negative attitudes toward people with obesity in comparison to people with lower educational attainment and income. The impact of educational attainment and level of income on weight bias will be examined and compared.

Based on a sociological perspective, this systematic literature review attempts to outline the current state of research and reveal the relationship between weight bias and the level of education and income. Tyler and Slater [29] criticized inter alia "*that one of the major limitations of existing understandings of stigma is the ways in which they have 'bracketed off' key questions, such as where stigmatizing attitudes come from, how and by whom is stigma crafted, mediated, produced and why […].".* The general aim of this review is thus to identify social and economic groups that stigmatize and discriminate against those who are obese. In the future, this information could help researchers to develop and implement interventions in a more targeted manner.

Methods

Search Strategy

A systematic review of published studies reporting weight-related attitudes held by differing socioeconomic status groups was conducted by using the relevant scientific electronic databases: PubMed, PsychINFO, Web of Science, and the Cochrane Library. The review followed the Prisma Guidelines [30].

The systematic review of literature was performed independently by two reviewers using the following keywords: stigma*, discrimination,"weight bias", or prejudice; education*, income, salary, wage, status, socio-economic, socioeconomic*, SES, sociodemographic, or socio-demographics; and obes*, overweight, or fat. Giving a very

high number of results, the literature search was limited to the publications' titles and abstracts. Only published studies written in English or German were included. There was no restriction regarding the year of publication. The stages of the systematic literature search are provided in Fig. 1. The literature review was conducted for all studies that have been published until June 2019.

Data extraction

The systematic search of the literature revealed 2,331 studies, whereby 1,708 studies remained after removing duplicates. Furthermore, 1,510 studies were excluded because screening their titles and abstracts for eligibility showed no association with the research question. Disagreement and uncertainty between the two reviewers over the eligibility were resolved by reinspecting the papers in detail and discussing disparate perspectives. For the remaining 198 studies, full articles were screened in detail to assess their eligibility. For data extraction we used an adjusted PICO scheme [31]: Studies that collected data of an adult sample (P) which assessed stigmatizing and discriminating attitudes (I) depending on socioeconomic variables (C) to investigate if weight bias is associated with socioeconomic status (O). The detailed inclusion and exclusion criteria are presented in the following.

Inclusion criteria

Studies that report associations between weight bias and either educational attainment or level of income were included. Weight bias was operationalized to reflect stigmatizing and discriminating attitudes. Therefore, studies that measured stigmatizing attitudes by applying explicit and implicit instruments will be included, but also studies that assessed causal beliefs about obesity, which can be considered as proxy variable as previously done before [32]. Studies that assessed discriminating attitudes, for example, by measuring the support for weight-related antidiscrimination policies and law, or considering obesity as a financial burden are considered for inclusion. According to Woolford et al. [33], who found less support to cover obesity-related costs by public health insurances, the public's opinion can be seen as a potential guideline for insurance funds [33]. In other words, based on the public's view, discrimination might occur in the field of health insurance policies. This assumption

might be of particular importance when considering the increased obesity-related healthcare cost [34].

Exclusion criteria

The following exclusion criteria were used to eliminate studies that were not applicable: (a) studies with a sample of health care professionals, dietitians, psychologists, and physical educators; (b) studies that investigated stigmatizing attitudes of children and/or adolescents; (c) studies that investigated stigma toward childhood obesity; (d) studies with an overweight and/or obese sample that investigated perceived stigmatization; (e) studies with a homogenous sample in regard to educational attainment (e.g., students) or level of income; (f) studies that investigated weight bias toward extended stigma groups (e.g., obese and binge eating); and (g) reviews or qualitative studies. The flowchart (Figure 1) displays how many studies were excluded in accordance with the exclusion criteria. In summary, 50 studies were excluded because they did not report the participants' educational attainment or income. In addition, 29 studies did assess data of a sample with no variance concerning socioeconomic characteristics, and 23 studies were excluded because of the samples' characteristics (overweight/obese or children/adolescents sample). Five studies were excluded because they followed a qualitative approach, and 34 studies were excluded because they could be categorized as reviews. Thirty-nine studies were found that did not meet the criteria for the aimed outcome of weight bias. Two studies were neither published in English nor German.

Moreover, one paper had to be excluded because of its lack of academic background. After excluding the studies that did not meet our criteria, 17 studies were identified as relevant for in-depth investigation (Figure 1). Therefore, sampling characteristics, study design, assessment of weight bias, and measurement of educational attainment and income were systematically examined.

Assessment of Risk of Bias

We assessed the risk of bias of all studies included using the Appraisal tool for Cross-Sectional Studies (AXIS) developed by Downes and colleagues [35]. The studies were therefore examined regarding potential causes that might induce a specific risk of bias. Despite a risk of bias due to non-responds that might occur among every study, the

majority of studies included showed a low risk of bias. Only a few studies were detected to be at moderate risk of bias concerning the sampling procedure [36–41]. The summarized risk of bias assessment of all studies included is provided as supplementary material.

Patient and Public Involvement

Within this study, no patient data was collected. We conducted a systematic review and analyzed data that had already been collected. Thus, patients were not involved in this study.

Results

The 17 studies included were tabulated according to the following characteristics: the origin of the sample, sample size (N), sample characteristics, study design, instruments to assess weight bias, educational attainment or income, and a summary of results. Studies reviewed in detail are tabulated by either educational attainment (**Error! Reference source not found.**) or by the level of income (Table 2).

Study characteristics

All relevant study characteristics are summarized in Table 1 and Table 2, respectively. Eight out of seventeen studies are based entirely on an American sample [10, 42, 42, 42]. Two other studies are based on an American and an Icelandic sample [43, 44]. These two studies also provided data based on a Canadian sample of health care professionals and American, Australian, and Icelandic student samples that did not meet the inclusion criteria and therefore all four samples had to be excluded. Three studies were based on a German sample [10, 42], and five studies based on one sample, from Paraguay [36], Mexico [38], Sweden [37], Denmark [40], and Great Britain [41] respectively. The study by Brewis and Wutich [36], based on a Paraguayan sample also provided data of a comparison group of US-undergraduate students that were not considered in the analysis because of the homogenous study sample in terms of educational attainment. The seventeen studies included showed a wide variety of sample sizes ranging from 198 [41] to 3,502 participants [45].

Since the aim of the study was to outline the impact that socioeconomic status in the form of educational attainment and level of income have on weight bias, attention was

paid to a variation in these variables within the samples. The studies included therefore focused either on a population-based sample [10, 37, 42, 46–48] or an convenience sample [40, 43–45, 49, 50]. Although Jiminez-Cruz and colleagues [38] investigated stigmatizing attitudes of an entirely low-income sample, they divided the socioeconomic factors (level of education and income) into five and four categories respectively; thus, variation within the sample could be ensured. Moreover, an investigation of weight bias in different gradations of lower status groups could provide further insight into the topic. In one study [39], the general population was included, whereby the overweight participants received an alternative questionnaire assessing the perceived stigmatization and not their stigmatizing attitudes toward obesity. Therefore, only the normal weight sample could be included.

The distribution of women and men was equally considered in the majority of studies, even though more women than men were included. However, two studies posed an exception. The study of Brewis et al. [36] and the study of Jiminez-Cruz [38] investigated only the stigmatizing attitudes of female participants.

257 **Table 1 Summary of Selected Studies: Weight Bias Depending on Educational Attainment**

Study	N	Sample Discription	Instruments Weight bias	Educational attainment	Association's Direction[1]	Magnitude of Association
Form of weight bias: stigmatizing attitudes						
[42]; GER	3003	population based (ø age: 51.7 years; 52.8% female)	Short-FPS[1]	4 subgroups: - No degree - 9th grade degree - 10th grade degree - 12th grade degree	**Negative**	Multivariate Regression: - No degree = reference category - 9th grade: β = -0.278, p<0.01, (std. error 0.0852) - 10th grade: β = - 0.251, p<0.01 (std. error 0.0838) - Upper secondary school: β= -0.214, p<0.05, (std. error 0.0835)
[10]; GER	960	US adults (ø age: 43.8 years; 50.2% female)	WCB [2];	2 subgroups: - Low; <13 years of education) - High; ≥ 13 years of education)	**Negative**	Multiple linear regression - β= -0.16, p<0.001 Zero-order association - r= -0.18, p<0.0001
[38]; MEX	1,100	Women aged 18-40 of low SES (ø age: 37.5 years)	Beliefs about the causes of obesity	5 subgroups: - None - some elementary - elementary - middle - high school	**Positive**	Logistic regression - "Having an unhealthy lifestyle": unadjusted OR=2.56, p<0.001, Confidence Interval 1.88-3.49
[43]; USA and ISL	899	US adults (ø age: 40.9 years; 46.1% female)	Short-FPS [1]; UMB-FAT [3]	3 subgroups: - High school or less - Some college/technical or vocation degree - College graduate or higher	FPS: Mixed	Linear regression: - High school or less = reference category - Vocational training/some college (β=0.202, p<0.05) - College (β=0.141, p>0.1) - Postgraduate (β=-0.017, p>0.1)
					UMB-Fat: Positive	Linear regression: - High school or less = reference category - Vocational training/some college: β=0.102, p>0.1 - College: β=0.189, p<0.05 - Postgraduate: β=0.034, p>0.1
	659	ISL adults (ø age: 45.9 years; 55.1% female)		2 subgroups: - High school or less - College	FPS: Positive	Linear regression: - High school or less = reference category - College: β=0.068, p>0.1
					UMB-Fat: **Positive**	Linear regression: - High school or less = reference category - College: β=0.160, p<0.05

[37]; SWE	2,436	Representative Swedish population aged 25-64 (ø age: 47.8 years; 63% female)	ATOP [4]	3 subgroups: - Low - Medium - High	Negative	Spearman zero-order correlations: - r= −0.023, p=0.260
[49]; USA	1,118	US adults (ø age: 43.8 years; 50.2% female)	Opinions about obesity as a disease [5]	3 subgroups: - High school or less - Some college/ Technical or vocation degree - College graduate or higher	Mixed	Linear regression - High school or less = reference category Agreement with statements in support of classification - Some college/ technical degree: β= -0.036, p>0.1 - College graduate or higher: β=0.035, p>0.1 Agreement with statements in support of classification - Some college/ technical degree: β= -0.03, p>0.1 - College graduate or higher: β= 0.095, p<0.1 but >0.05
[41]; GB	198	Community-based (ø age: 32.58 year; 50.5% female)	PFRS [6]	5 subgroups - General Certification of Secondary Education - Advanced Level - Undergraduate degree - Postgraduate degree - other qualification	/	Univariate analysis of variance (ANOVA): - F(1, 197) = 0.47, p = .705, ηp ² < 0.01
[39]; USA	396	General, not overweight population (ø age: 42.7 years; 43.7% female)	Short-FPS[1]	3 subgroups: - High school or less - Some college/associate degree - Bachelor's degree or higher	/	Adjusted model of correlates: - F(2) = 0.026, p=0.974
[36]; PRY	200	Women (ø age: 38.9 years)	ATOP [4]; IAT [7]	Metric measurement: years of formal education	/	/
Form of weight bias: both, stigmatizing and discriminating attitudes						
[47]; USA	981	US representative sample (62% female)	Beliefs about obesity as a financial burden for society	4 subgroups: - Less than some high school - High-school graduate - Some college - Higher than a college degree	**Positive**	Logistic regression - ≤ some HS: adjusted OR= 0.25, p<0.05 - Some College: adjusted OR= 1.61, p<0.05 - ≥ College: adjusted OR= 1.97, p<0.01
			Beliefs about the controllability of obesity		Mixed	Logistic regression - ≤ some HS: adjusted OR= 0.99, p>0.05 - Some College: adjusted OR= 0.90, p>0.05 - ≥ College: adjusted OR= 1.68, p>0.05

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Form of weight bias: discriminating attitudes						
[50]; USA	1,114	Adults (ø age: 44.87 years; 48% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	3 subgroups: - High school or GED completed - 2-Year vocational/technical degree or some college - College graduate	**Positive**	Ordinal logistic regression, for all 6 statements - High school/GED = reference category - College: OR 0.28-0.49, p<0.05)
[45]; USA	3,502	Adults (age 21-65; 61.9% female)	3 statements assessing support of legal protection and employment-specific antidiscrimination laws or policies	3 Subgroups: - High school or less - some college/ technical or vocation degree - College graduate or higher	**Positive**	Multiple logistic regression - High school or less = reference category - Some college/Technical or vocation degree ▪ Law 1: adjusted OR=0.7, p>0.01 ▪ Law 2: adjusted OR=0.9, p>0.05 ▪ Law 3: adjusted OR=1.2, p>0.05 - College graduate or higher ▪ Law 1: adjusted OR=0.7, p>0.01 ▪ Law 2: adjusted OR=0.8, p<0.05 ▪ Law 3: adjusted OR=0.3, p=0.05
[44]; USA and ISL	893	US adults (ø age:40.9 years; 46.1% female)	13 statements assessing support for employment-specific and broader antidiscrimination laws or policies	3 Subgroups - High school or less - some college/technical or vocation degree - College graduate or higher	Positive	Tobit Regression - High school or less = reference category Broad laws and policies - Vocational training/some college: Coeff= -0.135, p>0.05 - College: Coeff = -0.223, p>0.05 - Postgraduate: Coeff = -0.040, p>0.05 Employment-specific laws and policies - Vocational training/some college: Coeff= -0.115, p>0.05 - College: Coeff= -0.220, p>0.05 - Postgraduate: Coeff.= -0.087, p>0.05
	658	ISL adults (ø age:45.9 years; 46.1% female)		2 subgroups - High school or less - College	**Positive**	Tobit Regression - High school or less = reference category Broad Policies - College: OR= -0.221, p<0.01 Employment Specific laws College: OR= -0.059, p>0.05
[46]; USA	1,001	Population-based sample (ø age:43.8 years; 51% female)	6 statements assessing support for general, employment-specific and broader policies/ antidiscrimination laws or policies	3 subgroups - High school - college degree - Postgraduate degree	**Positive**	Logistic regression, five of six statements - High school = reference category - Higher degree: OR= 0.56-0.72, p<0.05

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[51]; USA	909	US adults	2 statements assessing support for antidiscrimination policies	Only 2 subgroups reported: - less than High school - College degree	**Positive**	Probit Model - Less than High school = reference category "Government should do more to protect obese" - College degree: β= -0.100, p<0.05 "Overweight should get same protections as disabled" - College degree: β= -0.136, p<0.01
[48]; GER	2,531	Population-based sample (ø age: 48.79 years; 55.5% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	2 subgroups: - Low (<12 years of education) - High (≥ 12 years of education)	General laws **Positive**	Logistic regression - Education ≥ 12 years: OR= 0.60, p=0.005
					Employment-specific laws: **Negative**	Logistic regression - Education ≥ 12 years: OR= 1.25, p=0.016
[40]; DNK	1,003	Citizens aged 18-65	Attitudes toward weight-loss surgery & medical treatment of obesity	No details reported	/	/

Note: [1] Bold characters display significant association, Positive = demonstrates greater anti-fat attitudes with increasing educational attainment; Negative = demonstrate greater anti-fat attitudes with decreasing educational attainment; N = sample size; FPS = Fat Phobia Scale; UMB = Universal Measure of Bias; WCB = Weight Control/Blame of the Anti-Fat Attitudes Test; ATOP = Attitudes to Obese People; IAT = Implicit Association Test; PFRS = Photographic Figure Rating Scale; SES = Socioeconomic status

Table 2 Summary of Selected Studies: Weight Bias Depending on Level of Income

Study	N	Sample Discription	Instruments Weight bias	Level of income	Direction of Correlation[1]	Magnitude of Association
Form of weight bias: stigmatizing attitudes						
[38]; MEX	1,100	Women aged 18-40 of low SES (ø age: 37.5 years)	Beliefs about the causes of obesity	Weekly income, 4 subgroups: - USD < 1,200 - USD 1,200-2,000 - USD 2,000-4,000 - USD ≥ 4,000	Negative	Logistic regression - "Having an unhealthy lifestyle: unadjusted OR= 1.13, p>0.05, Confidence Interval 0.78-1.62
[10]; GER	960	Population based sample (ø age: 45.9 years; 56.9% female)	WCB [2]	Monthly Income, 2 subgroups: - EUR < 2,000 - EUR ≥ 2,000	Negative	Zero-order association - r= -0.02, p>0.01
[37]; SWE	2,436	Representative Swedish population aged 25-64 (ø age: 47.8 years; 63% female)	ATOP [4]	Annual household income; no subgroups reported	Positive	Pearson and Spearman zero-order correlations: - r=0.018, p= .382
[49]; USA	1,118	US adults (ø age:43.8 years; 50.2% female)	Opinions about obesity as a disease [5]	Annual household income, 5 subgroups - USD < 25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	Mixed	Linear regression - Less than $25,000 = reference category Agreement with statements in support of classification - USD 25,000 - 49,999: β= 0.045, p>0.1 - USD 50,000 - 74,999: β= 0.113, p<0.1 - USD 75,000 - 99,999: β= 0.084, p>0.1 - > USD 100,000: β= -0.026, p>0.1 Agreement with statements in opposition of classification - USD 25,000 - 49,999: β=0.06, p>0.1 - USD 50,000 - 74,999: β=-0.0.019, p>0.1 - USD 75,000 - 99,999: β=0.041, p>0.1 - > USD 100,000: β=0.061, p>0.1
[42]; GER	3003	population based (ø age:51.7 years; 52.8% female)	Short-FPS [1]	Monthly household income, 4 subgroups: - EUR < 999 - EUR 1,000-1,999 - EUR 2,000-2,999 - EUR > 3,000	/	/

[39]; USA	396	General, not overweight population (ø age: 42.7 years; 43.7% female)	Short-FPS [1]	Annual household income,5 subgroups: - USD < 20,000 - USD 20,000-39,000 - USD 40,000-59,000 - USD 60,000-79,000 - USD > 80,000	/	Correlation: - Unadjusted, correlation coefficient not reported, p= 0.305
Form of weight bias: Both, stigmatizing and discriminating attitudes						
[47]; USA	981	US representative sample (62% female)	Beliefs about obesity as a financial burden for society	Annual household income, 4 subgroups: - USD< 25,000 - USD 25,000 < 50,000 - USD 50,000 < 75,000 - USD ≥ 75,000	**Positive**	Logistic regression - USD< 25,000 = reference category - USD 25,000 < 50,000: adjusted OR= 1.02, p>0.05 - USD 50,000 < 75,000: adjusted OR= 1.57, p>0.05 - USD ≥ 75,000: adjusted OR= 3.18, p<0.001
			Beliefs about the controllability of obesity		Negative	Logistic regression - USD< 25,000 = reference category - USD 25,000 < 50,000: adjusted OR= 0.82, p>0.05 - USD 50,000 < 75,000: adjusted OR= 0.96, p>0.05 - USD ≥ 75,000: adjusted OR= 0.51, p>0.05
Form of weight bias: discriminating attitudes						
[51]; USA	710	US adults (aged 18 – 65)	2 statements assessing support for civil protections for the obese	Annual household income - USD < 15,000 - USD > 100,000	**Positive**	Probit Model - USD < 15,000 = reference category "Government should do more to protect obese" - USD > 100.000: β= -0.098, p<0.01 Overweight should get same protections as disabled" - USD > 100.000: β= -0.077, p<0.01
[48]; GER	2,531	Population-based sample (ø age: 48.79 years; 55.5% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	Monthly Income, 2 subgroups: - EUR < 2,000 - EUR ≥ 2,000	**Positive**	Logistic regression General laws or policies - EUR < 2,000 = reference category - EUR ≥ 2,000: OR=0.67, p=0.002
					Positive	Logistic regression Employment-specific laws or policies - EUR < 2,000 = reference category - EUR ≥ 2,000: OR=0.91, p=0.376
[46]; USA	1,001	Population based sample (ø age: 43.8 years; 51% female)	6 statements assessing support for general, employment-specific and broader policies/ antidiscrimination laws or policies	Annual household income, 5 subgroups - USD 15,000-25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	**Positive**	Logistic regression, five of six statements - USD 15,000-25,000 = reference category - Adjusted OR= 0.52-0.64, p<0.05

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[50]; USA	1,114	Adults (ø age: 44.87 years; 48% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	Annual household income, 5 subgroups: - USD < 25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	**Positive**	Ordinal logistic regression - USD < 25,000 = reference category - Significant results among women but not men "Obesity should be considered a disability under the ADA to protect obese people from weight discrimination in the workplace" - USD 75,000-99,999: OR= 0.52, p<0.05 "Congress should pass the WDEA to protect overweight Americans from discrimination in the workplace" - USD 75,000-99,999: OR= 0.49, p<0.05
[45]; USA	3,502	Adults (age 21-65; 61.9% female)	3 statements assessing support of legal protection and employment-specific antidiscrimination laws or policies	Annual household income, 5 subgroups - USD < 25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	Mixed	Logistic Regression Model - USD 15,000-25,000 = reference category - USD 25,000-49,999 - Law 1: OR=1.0, p>0.05) - Law 2: OR=1.2, p>0.05) - Law 3: OR=1.0, p>0.05) - USD 50,000-74,999 - Law 1: OR=1.0, p>0.05) - Law 2: OR=1.2, p>0.05) - Law 3: OR=1.0, p>0.05) - USD 75,000-99,999 - Law 1: OR=1.2, p>0.05) - Law 2: OR=1.3, p>0.05) - Law 3: OR=0.9, p>0.05) - USD > 100,000 - Law 1: OR=0.8, p>0.05) - Law 2: OR=1.0, p>0.05) - Law 3: OR=0.9, p>0.05)
[40]; DNK	1,003	Citizens (age 18-65)	Attitudes toward weight-loss surgery & medical treatment of obesity	No details reported	/	/

Note: [1] Bold characters display significant association, Positive = demonstrates greater weight bias with increasing level of income; Negative = show greater weight bias with decreasing level of income; N = sample size

Instruments

The studies included were found to be heterogeneous with regard to the instruments used (Table 3 and 4). Therefore, the study team has decided against a meta-analysis and for a systematic narrative literature review.

Educational attainment and level of income

Seventeen studies were found that assessed attitudes toward obesity in association with participants' educational attainment and/or level of income. All of these seventeen studies reported the participants' educational attainment [10, 36–51]. Depending on the origin of the sample and the analogous countries' educational system, categories were formed or years of educational attainment were gathered. From seventeen studies, thirteen assessed participants' level of income [10, 37–40, 42, 45–51]; therefore, income was either assessed by the annual, weekly, household, or individual income.

Weight Bias in Form of Stigmatizing Attitudes

Studies that examined either participants' stigmatizing attitudes or participants' beliefs about the causes of obesity [10, 36, 37, 37–39, 41–43, 47, 49] were included. Stigmatizing attitudes were thereby measured with instruments such as the Fat Phobia Scale (FPS), the Universal Measure of Bias (UMB), the Weight Control/Blame of the Antifat Attitude Test (WCB), the Attitudes to Obese People (ATOP), the Implicit Association Test (IAT), or the Photographic Figure Rating Scale (PFRS). As described before, beliefs about the causes of obesity in the form of evaluating obesity as a controllable condition – which is supposedly preventable by a greater extent of self-discipline – can consequently be seen as one decisive factor in determining stigmatizing attitudes [52] and was therefore included. The instruments used are presented in Table 3.

Table 3 Overview of the instruments used to measure stigmatizing attitudes

Instruments measuring Stigmatizing attitudes	Studies that apply the instrument
Explicit Stigma	
- Fat Phobia Scale (FPS)	[39, 42, 43]
- Universal Measure of Bias (UMB)	[43]
- Attitudes to Obese People (ATOP)	[36, 37]
- Opinions about obesity as a disease	[49]
- Photographic Figure Rating Scale (PFRS)	[41]
Implicit Stigma	
- Implicit Association Test (IAT)	[36]
Causal Attribution	
- Weight Control/Blame of the Anti-Fat-Attitudes (WCB)	[10]
- Potential causes of obesity	[38]
- Individuals responsibility ("Obese people can do something about their weight")	[47]

Weight Bias in the form of Discriminating Attitudes

We found eight studies that investigated participants' discriminating attitudes toward people with obesity [40, 44–48, 50, 51]. All instruments used to measure discriminating attitudes are listed in Table 4. Discrimination was measured for example, by examining policy and law support, but also the ratings on the statement "Obesity is a major burden to society in terms of healthcare costs" as well as attitudes toward weight-loss surgery and medical treatment. We found some studies [44–46, 48, 50, 51] that investigated support for the same or almost identical laws or policies (Law/policy a-i). However, these items were analyzed in such heterogeneous way, for example, by merging different items into one, that a meta-analysis could not be conducted.

Table 4 Overview of the instruments used to measure discriminating attitudes

Instrument measuring discriminating attitudes	Studies that apply the instrument
Attitudes toward weight-loss surgery & medical treatment	[40]
Beliefs about obesity as a financial burden for society	[47]
Statements measuring support/rejection of weight-related laws or policies	
[a] My country/state should include body weight in our civil rights law in order to protect people from discrimination based on their body weight	[44–46, 48, 50]
[b] It should be illegal for an employer to refuse to hire a qualified person because of his or her body weight.	[44–46, 48, 50]
[c] It should be illegal for an employer to terminate or fire a qualified employee because of his or her body weight.	[44–46, 48, 50]
[d] Fat/overweight persons should be subject to the same legal protections and benefits offered to people with physical disabilities.	[44–46, 48, 50, 51]
[e] It should be illegal for an employer to deny a promotion or appropriate compensation to a qualified employee because of his or her body weight.	[44–46, 50]
[f] Obesity should be considered a disability (under the ADA) so that people will be protected from weight discrimination in the workplace	[44, 46, 48, 50]
[g] Congress/Government should pass the Weight Discrimination in Employment Act (WDEA) to protect overweight Americans from discrimination in the workplace/employees from discrimination in the workplace based on their body-weight.	[44, 46, 50]
[h] The government should play a more active role in protecting overweight people from discrimination.	[46, 50, 51]
[i] It should be illegal for an employer to assign lower wages to a qualified employee because of his or her body weight.	[44, 48]
[j] The government should have specific laws in place to protect people from weight discrimination.	[44]
[k] The government should penalize (or fine) those who discriminate against persons because of their weight.	[44]
[l] Individual companies should have the right to determine whom to hire based on an employee's personal body weight.	[44]
[m] Employers should be allowed to assign different salaries to employees based on their body weight.	[44]
[n] My country should pass a Healthy Workplace Law to address workplace bullying	[44]

Findings

The studies included showed a very heterogeneous picture regarding their results. Eleven out of the seventeen studies significantly associated educational attainment (Table 5) and/or level of income (Table 6) with stigmatizing and/or discriminatory attitudes toward people with obesity [10, 38, 42–48, 50, 51].

Associations between educational attainment and weight-related stigmatization

We found ten studies that reported an association between educational attainment and stigmatizing attitudes, whereas only two of them [38, 43] showed a positive association between higher educational attainment and weight-related stigmatization. In addition, the study of Puhl and colleagues [43, 44] found a significant association in the Icelandic (Beta=0.160, p<0.05), but not in the American sample. However, two German studies [10, 42] showed an inverse correlation. Both of these studies found evidence that higher education is associated with lower stigma [42] and less belief in individual responsibility [10] for an obese condition. The remaining studies did not report significant associations.

Associations between educational attainment and weight-related discrimination

Six studies [44–47, 50, 51] reported increased discriminating attitudes with higher education. The study of Puhl and colleagues found no significant association between weight bias and educational attainment in the US sample, but did find an association in the Icelandic sample (Beta = -0.221, p<0.01). The study of Hilbert and colleagues [48] revealed inconsistent findings: Higher education is associated with less support for general but more support for employment specific weight-related antidiscrimination laws or policies.

Associations between the level of income and weight-related stigmatization

We found no study that reported a significant association between the level of income and weight-related stigmatization.Associations between the level of income and weight-related discrimination

Four American [46, 47, 50, 51] revealed stronger weight-related discrimination with increasing income. One German study [48] found less support for general, but not for employment specific policies and laws among more affluent people. Although the study of Suh et al. [45] found a significant positive association between level of income and support for two laws and policies (law a: χ^2=6.06. p=0.01; law d: χ^2=3.81, p=0.05), these results could not be validated by logistic regression analysis. Moreover, the assumption that discrimination, in the form of views on the funding for medical or weight-loss surgery, is somehow associated with income was not found [40].

342 **Table 5. Studies That Show Significant Associations Between Education Attainment and Weight-Related Stigmatization and Discrimination**

Study	Direction of correlation	Form of Weight Bias	Instrument Weight Bias	Result	Adjusted for
[42]	Negative	Stigmatization	Short-FPS	Higher educational attainment is associated with lower stigmatizing attitudes	Gender, age, income, residence, emigrational background
[10]	Negative	Stigmatization	WCB	Higher educational attainment is associated with less stigmatizing attitudes (P<0.001)	Causal attributions to behavior, Labeling obesity as an illness, Age, Causal attributions to heredity
[43]	Positive	Stigmatization	UMB-Fat	Higher educational attainment is associated with higher stigmatizing attitudes (ISL sample; P<0.05)	Gender, race/ethnicity, BMI, perceived causes of obesity, weight-related attributions
[38]	Positive	Stigmatization	Beliefs about the causes of obesity	Higher educational attainment is associated with greater belief in individual responsibility (P<0.001)	Unadjusted
[47]	Positive	Discrimination	Belief in obesity as a financial burden for society	Higher educational attainment is associated with greater belief in the statement “Obesity is a major burden to society in terms of healthcare costs” (P<0.01)	Race/ethnicity, sex, income, employment, age group, marital status, BMI, smoking status
[45]	Positive	Discrimination	Support for weight-related laws or policies	Higher educational attainment is associated with lower support for weight-related laws or policies (P<0.01)	Other socio-demographic variables
[44]	Positive	Discrimination	Support for weight-related laws or policies	Higher educational attainment is associated with less support for weight-related laws or policies (P<0.01)	Sex, age, race/ethnicity, BMI
[46]	Positive	Discrimination	Support for weight-related laws or policies	Higher educational attainment is associated with lower support for weight-related laws or policies	Sex, body weight, age, income, race, political affiliation, history of weight-based victimization
[51]	Positive	Discrimination	Support for civil protections for the obese	Higher educational attainment is associated with lower support for civil protection of the obese	Sex, age, BMI, race/ethnicity, income, political orientation, perceived causes for obesity
[50]	Positive	Discrimination	Support for general and employment specific antidiscrimination laws or policies	Higher educational attainment is associated with less support for weight-related laws or policies	Body weight, age, race, political affiliation, income, history of weight-based discrimination, divergent vignettes describing obesity and obesity-related (workplace) discriminations
[48]	Positive	Discrimination	Support for general antidiscrimination laws or policies	Higher educational attainment is associated with less support for general antidiscrimination laws or policies	Sex, age, weights status, income, residence, church membership, readiness to vote in following week, weight-based victimization, weight bias internalization
	Negative		Support for employment-specific antidiscrimination laws or policies	Higher educational attainment is associated with stronger support for employment specific antidiscrimination laws or policies	

Positive = demonstrates greater weight bias with increasing educational attainment; Negative = show greater weight bias with decreasing educational attainment

343 **Table 6 Studies That Show Significant Associations Between Level of Income and Weight-Related Stigmatization and Discrimination**

Study	Direction of correlation	Form of Weight Bias	Instrument Weight Bias	Result	Adjusted for
[47]	Positive	Discrimination	Belief in obesity as a burden for society	Yes; A higher income level is associated with greater belief in statement "Obesity is a major burden to society in terms of healthcare costs" (P<0.05)	Race/ethnicity, sex, education, employment, age group, marital status, BMI, smoking status
[46]	Positive	Discrimination	Support for weight-related laws or policies	Higher income is associated with lower support for weight-related laws or policies	Sex, body weight, age, education, income, race, political affiliation, history of weight-based victimization
[51]	Positive	Discrimination	Support for civil protections for the obese	Higher income is associated with lower support for civil protection of the obese	Sex, age, BMI, race/ethnicity, education, political orientation, perceived causes for obesity
[50]	Positive	Discrimination	Support for general and employment specific antidiscrimination laws or policies	Higher income is associated with less support for weight-related laws or policies	Body weight, age, race, political affiliation, education, history of weight-based discrimination, divergent vignettes describing obesity and obesity-related (workplace) discriminations
[48]	Positive	Discrimination	Support for general antidiscrimination laws or policies	Higher income is associated with less support for general antidiscrimination laws or policies	Sex, age, weights status, education, residence, church membership, readiness to vote in following week, weight-based victimization, weight bias internalization

Positive = demonstrates greater weight bias with increasing level of income; Negative = show greater weight bias with decreasing level of income

Discussion

This systematic literature review aimed to summarize the current state of research on socioeconomic status and its impact on weight-related stigmatization and discrimination. As it was outlined earlier, the association between socioeconomic factors and weight bias has not been investigated sufficiently [50]. This review aimed therefore to address this gap. Although many studies were found that investigated various forms of weight bias and assessed socioeconomic data, an association was only reported in 17 studies. The underlying reason why an association was not reported might be a different research focus, but also insignificant findings. Overall, eleven out of the seventeen studies showed that weight bias is significantly associated with either educational attainment or level of income. In the following the results are discussed separated by education and income, as well as weight-related stigmatization and discrimination.

Educational Attainment, Level of Income, and Stigmatizing Attitudes

Overall, ten studies reported an association between educational attainment and stigmatizing attitudes. However, we found no systematic pattern in which way educational attainment and stigmatizing attitudes are associated: Two studies [38, 43] supported the hypothesis that stigmatizing attitudes are more likely in people with higher educational attainment, whereas two German studies [10, 42] contradict this. Moreover, six studies [36, 37, 39, 41, 47, 49] did not show any significant association, nor a clear direction of the assumed association. In light of divergent results of studies that report a significant association between socioeconomic variables and stigmatizing attitudes, the findings must be discussed with regard to their cultural context: American, Mexican, and Icelandic studies were found to support the working hypothesis, whereas two German studies [10, 42] revealed findings to the contrary.

These differences might be explained when considering cultural distinctions. In cultures, in which individual responsibility is considered as one of the leading causes of self-fulfillment, health, and wealth, obesity might be perceived as a self-inflicted condition. Highly educated people might attempt to keep people down to maintain their high(er) social status. In contrast, in cultures in which individuals' situations are principally considered as a result of various circumstances, obesity might consequently

not only be seen as self-inflicted. In these cultures, especially highly educated people might be aware of social barriers as determinants for self-fulfillment, wealth, and health, i.e., body weight. In conclusion, the direction of the relationship between weight bias and socioeconomic status might depend on divergent socio-cultural perspectives. Hence, future research should consider expansion and reorientation of stigma's theoretical framework by focusing on the meso and macro socio-cultural structures, as Bonnington and Rose [53] suggest.

Overall, we found eight studies that investigated (or rather reported) the association between level of income and stigmatizing attitudes. None of these studies showed a significant relationship. However, the direction of the (insignificant) associations did not show any pattern. We found three studies reporting an (insignificant) positive association [10, 38, 47], and one study each reporting an (insignificant) positive [37] or mixed associations [49].

Educational Attainment, Level of Income, and Discriminating Attitudes

Of the seventeen studies included, eight studies were found that reported an association between educational attainment and discriminating attitudes. Five of these studies reported a positive relationship, i.e., stronger discriminating attitudes (in the form of law and policy support) with increasing education. Another study [44] that applied the same instruments for an American and an Icelandic sample found only indications for our assumption (i.e., higher education is associated with stronger discriminating attitudes) in the Icelandic, but not in the American sample. This study [44] was also replicated by Hilbert et al. [48], who report heterogeneous findings as they found less support for general antidiscrimination laws with increasing level of education, but stronger support for employment specific laws and policies among the higher educated German sample. It should, therefore, be discussed whether general and employment specific antidiscrimination policies and laws can be viewed as similar outcomes or if they display different dimensions of discrimination. Moreover, views on who should pay for medical treatment or weight-loss surgery did not reveal significant associations [40]. Only one study [40] did not found a significant association between educational attainment and discriminating attitudes, nor did it report the direction of the insignificant association.

With regard to the association between level of income and discriminating attitudes we found overall seven studies in which an association was reported. Five studies [46–48, 50, 51] reported positive relationships, i.e., stronger discriminating attitudes with an increasing level of income. Suh et al. [45] found a significant association of stronger support for weight-related laws with decreasing income until they controlled for other sociodemographic variables, such as educational attainment. They reported mixed (insignificant) results concerning the direction of the assumed association. A possible explanation for these insignificant results after controlling for education might be that income can be seen as a proxy variable for education, in the way that the level of income depends on educational attainment. Again, Lund and colleagues [40] who asked Danish citizen by whom medical treatment and weight-loss surgery should be funded, found no significant association, nor did they report a direction of the association.

These findings support our assumption that higher socioeconomic status is associated with stronger discriminating attitudes. However, one German study [48] reported contradicting results that might be ascribed at a macro level to Bourdieu's theory about how cultural frameworks determine how specific values and characteristics are perceived. Governmental structures might enforce stigmatizing and discriminating attitudes as an instrument to 'nudge people into desired patterns of behavior' [29]. It can be assumed that cultural frameworks shape governmental systems and are strengthened at the same time through them, especially through the national health and welfare systems. Tyler and Slater [29], for example, outline the political and social function of stigma as a form of power. They discuss macro-level structures, particularly those used actively and passively by governments, as determinants shaping stigmatizing and discriminating attitudes, a level of understanding often left out in social psychology. As explained above, it might be possible that in countries in which obesity is merely perceived as self-inflicted, discriminating attitudes might be stronger - Hence, stigma is not only an instrument used by individuals to enforce personal interests but also one put in place (intended or not) by governments.

The different and to some extent inconclusive results might be caused by diverging study designs, sample sizes, and instruments assessing weight-related stigmatization and discrimination, educational attainment, and level of income: Studies that did not show a significant association between weight bias and either educational attainment or level of income excluded the overweight portion of the sample [39] or were characterized by a small sample (ranging from n=198 to n=396) size [36, 39, 41]. Furthermore, the association between weight bias with either educational attainment or level of income were not seen in instruments such as the Attitudes to Obese People scale (ATOP) [36, 37], the Implicit Association Test (IAT) [36] agreement ratings as to whether obesity can be classified as a disease [49], and measurement of attitudes toward weight-loss surgery and medical treatment [40].

However, there are findings diminishing this line of argument: The study of Hilbert et al. [48] found less support for general, but stronger support for employment specific laws with increasing socioeconomic status. In addition, the German population was found to be less supportive of laws and policies that would impede to refuse to hire, assign lower wages, and to fire qualified persons because of their body weight, compared to an American and Icelandic sample [44]. Moreover, the German population was less supportive of including body weight in the civil rights of law compared to the American, but not the Icelandic sample.

A final point of discussion might be whether the prevalence of obesity has an impact on the magnitude of weight bias. When comparing the prevalence and the stigmatization of obesity between the USA and Germany, for example, the following can be stated: In both countries, the prevalence of obesity increased over time (1995, USA 21.9%; GER 14.5%; 2005 USA 29%; GER 18%) [54]. However, not only the prevalence of obesity itself increased, but also the (perceived) stigmatization toward people with obesity in the US but also in Germany [7, 8, 10, 55].

Limitations

Just as any overview must contend with heterogeneous samples and instruments, this systematic review has likewise attempted to cope with varying data. The studies reviewed differed with respect to the instruments used to assess education and income. In particular, the measurement of educational attainment was strongly influenced by the different organization and structure of the varied local educational systems. In addition, the instruments to assess weight bias were also heterogeneous, particularly those used to measure stigmatizing attitudes. Some studies used validated scales, whereas other studies used single items only. Thus, the manner of gathering data and classifying categories can be described as heterogeneous itself – and therefore caused the study team to decide against a meta-analysis. However, studies that did use the same instrument, such as items weighing support for specific laws and policies differed with regard to how they were analyzed (as single items or as an item battery). Therefore, the authors had to decide again against a meta-analysis and applied a vote-counting approach despite its shortcomings.

Moreover, the study aimed to investigate socioeconomic determinants of weight bias in the general population, as discussed in the inclusion and exclusion section. Therefore, we excluded, among other things, studies that focused on overweight and/or obese samples only. We assumed that people try to differentiate themselves from lower status groups, which might be characterized by varying body sizes, i.e., excess weight or obesity. However, overweight and obese samples were included as part of the general population in some studies. Also, these studies did not differentiate their results by participants' body sizes. We also excluded studies based on homogenous samples, such as health care professionals and students. We considered these studies as inadequate since there would have been no possibility to compare and thus interpret these results with regard to the research question. Moreover, stigmatizing attitudes among some professions, such as dietitians and nutritionists, were already investigated systematically.

In the general population, we assume that people try to differentiate themselves not only by socioeconomic status but by other status markers as well, such as excess weight. Although we attempted to explain the heterogeneous and inconclusive results

by appealing to governmental and cultural differences, there was insufficient (and also inconclusive) evidence to conclude the role of cultural and governmental structures on weight bias.

Since the study team has only sufficient language skills in English and German, the current research includes only papers written in English or German

Conclusion

The literature review aimed to investigate to what extent weight bias can be traced back to socioeconomic variables, such as educational attainment and level of income. We assumed that a higher level of education or income is associated with greater stigmatization and discrimination. Therefore, the current study situation was analyzed systematically. Although data of education and income are always collected as mandatory sociodemographic information, research is lacking when it comes to examining their impact on weight bias. Since this question has not yet been answered sufficiently, this review was supposed to address this gap in research and aimed to contribute to closing this gap.

Our working hypothesis that weight bias increases with higher educational attainment or level of income could not be verified. Particularly, we found eight studies that supported our hypothesis, two German studies indicating the reverse conclusion, one German study reported heterogonous findings and seven studies that did not show a significant association at all.

The key to identifying effective interventions to battle stigmatization, discrimination, and consequences for those affected might lie in exposing the characteristics of stigmatizing groups and their motivations. Therefore, future research should pay more attention to the link between weight bias and socioeconomic factors and cultural or rather governmental structures. Moreover, meta-analysis should be considered as an important direction for future research.

Figure legends

Figure 1. Phases of the systematic review

Supplementary Material

Supplementary Table 1. Risk of Bias Assessment

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Disclosure Statement

The authors have no conflicts of interest to declare.

Author contributions

MB, CLS, and SRH outlined and specified the research question. MB and CLS conducted the systematic search of the literature. Furthermore, MB, CLS, and TF discussed papers in detail in case of disagreement and uncertainty over the eligibility of abstracts. MB wrote the first draw of the manuscript. TF, SRH, and CLS revised it critically for valuable intellectual content. All authors contributed to and have approved the final manuscript.

Data sharing statement

No unpublished data is available following this study.

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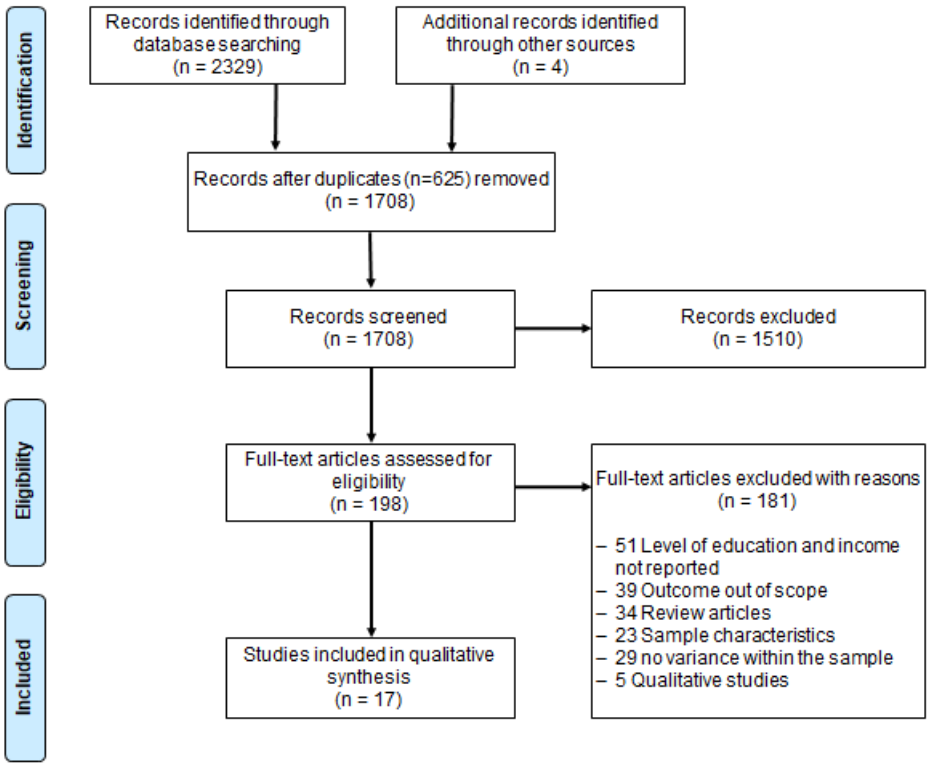
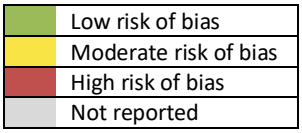


Figure 1 Phases of the systematic review



Supplementary Material 1. Assessment of Risk of Bias

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
(Brewis and Wutich, 2012)																				
(Hansson and Rasmussen, 2014)																				
(Hilbert et al., 2017)																				
(Jimenez-Cruz et al., 2012)																				
(Lippa and Sanderson, 2012)																				
(Lund et al., 2015)																				
(Oliver and Lee, 2005)																				
(Puhl et al., 2011)																				
(Puhl et al., 2015)																				
(Puhl and Heuer, 2011)																				
(Puhl et al., 2015)																				
(Puhl and Liu, 2015)																				
(Seo and Torabi, 2006)																				
(Sikorski et al., 2012)																				
(Suh et al., 2014)																				
(Swami and Monk, 2013)																				

AXIS – Tool to assess the quality of cross-sectional studies (Downes et al., 2016)

1. Were the aims/objectives of the study clear?
2. Was the study design appropriate for the stated aim(s)?
3. Was the sample size justified?
4. Was the target/reference population clearly defined? (Is it clear who the research was about?)
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7. Were measures undertaken to address and categorise non-responders?
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?
9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?
10. Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?
12. Were the basic data adequately described?
13. Does the response rate raise concerns about non-response bias?
14. If appropriate, was information about non-responders described?
15. Were the results internally consistent?
16. Were the results for the analyses described in the methods, presented?
17. Were the authors' discussions and conclusions justified by the results?
18. Were the limitations of the study discussed?
19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20. Was ethical approval or consent of participants attained?

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6-7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6-7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	14-15
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	No meta-analysis

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	No meta-analysis
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-14
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	No meta-analysis
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	15-18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18-20
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	22

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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Does weight-related stigmatization and discrimination depend on educational attainment and level of income? A systematic review

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Keywords:	obesity, stigma, discrimination, education, income

Does weight-related stigmatization and discrimination depend on educational attainment and level of income?

A systematic review

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Abstract

Objectives: Obesity is considered a global health issue, not only because of its health-related consequences but also because of its impact on social status as a result of stigma. This study aims to review the quantitative state of research regarding socioeconomic characteristics' influence on weight-related stigmatization and discrimination. Based on Bourdieu's Theory of Class and his concept of "habitus," it is assumed that people with a higher level of education and income show stronger negative attitudes toward people with obesity.

Method: A narrative systematic literature review was conducted in 2017 using PubMed, PsychINFO, Web of Science, and the Cochrane Library. Seventeen studies that measured weight bias and either educational attainment or level of income were included in the analysis.

Results: The results of the studies included were inconsistent: six of these studies were found to support the hypothesis, whereas two of the studies contradicted it. The remaining seven studies did not show any significant correlation between weight bias and either education or income.

Conclusion: In light of the inconsistent and heterogeneous results of the studies that report a significant association between weight bias and socioeconomic variables, the findings must be discussed concerning their cultural context, i.e., cultural and governmental differences. Furthermore, educational attainment seems to be more likely to predict weight bias than income. The review revealed a lack of research when it came to examining the impact of socioeconomic capital on weight bias.

Keywords: obesity, stigma, discrimination, education, income

Strength and limitations of this study

- A systematic review following the PRISMA guidelines was conducted to investigate the relationship between weight bias and the socioeconomic status of studies published in English or German.
- Study selection was performed by two independent reviewers to minimize subjectivity and random errors.
- This study is limited since no meta-analysis could be performed due to divergent study designs, instruments used, or different ways items were operationalized for statistical analysis

Introduction

According to the World Health Organization (WHO), the worldwide prevalence of obesity, defined by a body mass index (BMI) of over 30 kg/m², nearly tripled between 1975 and 2016 [1]. To give but two examples, current data reveal an obesity rate of over 21% in Germany and 37.7% in the US [2, 3]. With its escalating rate, obesity can be classified as a global health issue, primarily because it is associated with numerous comorbid diseases, such as diabetes mellitus, cardiovascular diseases, and certain forms of cancer [4].

Not only health-related consequences are connected to obesity, but also psychological implications that affect those concerned on a social level [5]. In particular, obesity is classified as a stigmatized condition. Therefore, being obese is a characteristic that sets those affected apart from people with normal weight. Since obesity is mislabeled as a self-inflicted situation, numerous negative stereotypes, such as laziness, lack of willpower, unhealthy lifestyle, and being unintelligent are associated with the condition [6, 7]. Stigmatization leads to discriminating behavior toward people with obesity in the form of mistreatment in several areas of life, such as labor market, healthcare, and educational system [6, 7].

The systematic review of Spahlholz [8] revealed increased perceived discrimination toward people with obesity in comparison to people with normal weight, especially toward people with more extreme obesity (BMI >35 kg/m²) as well as toward women. Moreover, the prevalence of weight-related discrimination accelerated over time. In the US, the prevalence of weight-related discrimination was nine times higher (66%) in 2005 than in 1995 (7.3%) [7, 8] and is thus similar to the rate of racial discrimination, particularly against women [9]. Understanding the origin of stigma, which can be seen as the catalyst for structural discrimination, is necessary to prevent discriminating behavior. Although weight-related stigmatization and discrimination are closely linked, they need to be considered as two divergent concepts. However, in the following, we will refer to weight-related stigmatization and discrimination as “weight bias”, but will differentiate between both concepts whenever needed.

Some people are more prone to display weight bias than other: There is some evidence that older age is associated with stigmatizing attitudes [10–12] and stronger evidence that men show stronger weight bias than women [13–16]. When looking at the body and beauty perception of people, the cultural framework also needs to be considered as a determinant of stigma. According to Bourdieu, the predominant cultural context determines which values and characteristics can be seen either as desirable or traits to be stigmatized [17]. Depending on regional characteristics, weight is perceived as a sign of class distinction: In undeveloped countries, overweight was associated positively with well-being and wealth, while in developed countries a negative view of being overweight was widespread. Thus, in developed countries, thinness has been viewed as a sign of beauty, success, and an overall high (socioeconomic) status [18]. Although in the last decades the perception of obesity or rather slim-body ideals developing countries might have changed [19, 20], results indicate that educational attainment and level of income seem to be relevant regarding weight bias.

Although socioeconomic variables and obesity correlate closely, the impact of educational attainment and level of income on weight bias remain ambiguous. Several studies have shown the negative impact of being overweight on the labor market, especially for women [21, 22] as well as in the education system [23]. In addition, a lower level of education and income is associated with obesogenic behavior such as a poor diet and a lack of exercise caused by factors such as stress [24]. Moreover, Bourdieu [25] sees the most decisive determinant of a healthy lifestyle in socioeconomic class. While people that belong to the working class preferred tasty and nutritious food, people from the upper-middle class preferred food that can be described as light, healthy, and low in calories, according to his study. Subsequently, people with a higher level of education and income might choose a healthier lifestyle to distance themselves from people with obesity [26].

As a superior framework to generate missing hypotheses, Bourdieu's Theory of Class can be applied [25]. Following his concept of "habitus," a person's general attitude, lifestyle, and even body shape can be seen as a metaphor for social status [18]. Furthermore, Bourdieu considers stigma as a form of symbolic power and a tool

to serve the interests of the powerful [27]. Phelan and colleagues [28] continue with his line thought and presented three motives of stigma, namely *keeping people in*, *away,* or *down.* Particularly, *keeping people down* applies to the review's theoretical framework. Link and Phelan [17] discuss stigma as an instrument of a dominant group to keep another group down to attain or maintain high social status, wealth, and power. However, a person's educational attainment and level of income are mainly invisible characteristics; thus, there are other attributes that more readily show social status. Assuming that obesity is perceived as a metaphor for lower social status, groups with higher social status might be aware of this link and keep people with obesity down to empower themselves. In this review, it is therefore assumed that people with a higher level of education and income display negative attitudes toward people with obesity in comparison to people with lower educational attainment and income. The impact of educational attainment and level of income on weight bias will be examined and compared.

Based on a sociological perspective, this systematic literature review attempts to outline the current state of research and reveal the relationship between weight bias and the level of education and income. Tyler and Slater [29] criticized inter alia "*that one of the major limitations of existing understandings of stigma is the ways in which they have 'bracketed off' key questions, such as where stigmatizing attitudes come from, how and by whom is stigma crafted, mediated, produced and why […].".* The general aim of this review is thus to identify social and economic groups that stigmatize and discriminate against those who are obese. In the future, this information could help researchers to develop and implement interventions in a more targeted manner.

Methods

Search Strategy

A systematic review of published studies reporting weight-related attitudes held by differing socioeconomic status groups was conducted by using the relevant scientific electronic databases: PubMed, PsychINFO, Web of Science, and the Cochrane Library. The review followed the Prisma Guidelines [30].

The systematic review of literature was performed independently by two reviewers using the following keywords: stigma*, discrimination,"weight bias", or prejudice; education*, income, salary, wage, status, socio-economic, socioeconomic*, SES, sociodemographic, or socio-demographics; and obes*, overweight, or fat. Giving a very high number of results, the literature search was limited to the publications' titles and abstracts. Only published studies written in English or German were included. There was no restriction regarding the year of publication. The stages of the systematic literature search are provided in Fig. 1. The literature review was conducted for all studies that have been published until June 2019.

Data extraction

The systematic search of the literature revealed 2,331 studies, whereby 1,708 studies remained after removing duplicates. Furthermore, 1,510 studies were excluded because screening their titles and abstracts for eligibility showed no association with the research question. Disagreement and uncertainty between the two reviewers over the eligibility were resolved by reinspecting the papers in detail and discussing disparate perspectives. For the remaining 198 studies, full articles were screened in detail to assess their eligibility. For data extraction we used an adjusted PICO scheme [31]: Studies that collected data of an adult sample (P) which assessed stigmatizing and discriminating attitudes (I) depending on socioeconomic variables (C) to investigate if weight bias is associated with socioeconomic status (O). The detailed inclusion and exclusion criteria are presented in the following.

Inclusion criteria

Studies that report associations between weight bias and either educational attainment or level of income were included. Weight bias was operationalized to reflect stigmatizing and discriminating attitudes. Therefore, studies that measured stigmatizing attitudes by applying explicit and implicit instruments will be included, but also studies that assessed causal beliefs about obesity, which can be considered as proxy variable as previously done before [32]. Studies that assessed discriminating attitudes, for example, by measuring the support for weight-related antidiscrimination policies and law, or considering obesity as a financial burden are considered for inclusion. According to Woolford et al. [33], who found less support to cover obesity-

related costs by public health insurances, the public's opinion can be seen as a potential guideline for insurance funds [33]. In other words, based on the public's view, discrimination might occur in the field of health insurance policies. This assumption might be of particular importance when considering the increased obesity-related healthcare cost [34].

Exclusion criteria

The following exclusion criteria were used to eliminate studies that were not applicable: (a) studies with a sample of health care professionals, dietitians, psychologists, and physical educators; (b) studies that investigated stigmatizing attitudes of children and/or adolescents; (c) studies that investigated stigma toward childhood obesity; (d) studies with an overweight and/or obese sample that investigated perceived stigmatization; (e) studies with a homogenous sample in regard to educational attainment (e.g., students) or level of income; (f) studies that investigated weight bias toward extended stigma groups (e.g., obese and binge eating); and (g) reviews or qualitative studies. The flowchart (Figure 1) displays how many studies were excluded in accordance with the exclusion criteria. In summary, 50 studies were excluded because they did not report the participants' educational attainment or income. In addition, 29 studies did assess data of a sample with no variance concerning socioeconomic characteristics, and 23 studies were excluded because of the samples' characteristics (overweight/obese or children/adolescents sample). Five studies were excluded because they followed a qualitative approach, and 34 studies were excluded because they could be categorized as reviews. Thirty-nine studies were found that did not meet the criteria for the aimed outcome of weight bias. Two studies were neither published in English nor German.

Moreover, one paper had to be excluded because of its lack of academic background. After excluding the studies that did not meet our criteria, 17 studies were identified as relevant for in-depth investigation (Figure 1). Therefore, sampling characteristics, study design, assessment of weight bias, and measurement of educational attainment and income were systematically examined.

Risk of Bias

We assessed the risk of bias of all studies included using the Appraisal tool for Cross-Sectional Studies (AXIS) developed by Downes and colleagues [35]. The studies were therefore examined regarding potential causes that might induce a specific risk of bias.

Patient and Public Involvement

Within this study, no patient data were collected. We conducted a systematic review and analyzed data that had already been collected. Thus, patients were not involved in this study.

Results

The 17 studies included were tabulated according to the following characteristics: the origin of the sample, sample size (N), sample characteristics, study design, instruments to assess weight bias, educational attainment or income, and a summary of results. Studies reviewed in detail are tabulated by either educational attainment (Table 1) or by the level of income (Table 2).

Study characteristics

All relevant study characteristics are summarized in Table 1 and Table 2, respectively. Seven out of seventeen studies are based entirely on an American sample [36–42]. Two other studies are based on an American and an Icelandic sample [43, 44]. These two studies also provided data based on a Canadian sample of health care professionals and American, Australian, and Icelandic student samples that did not meet the inclusion criteria and therefore all four samples had to be excluded. Three studies were based on a German sample [10, 45, 46] and five studies based on one sample, from Paraguay [47], Mexico [48], Sweden [49], Denmark [50], and Great Britain [51] respectively. The study by Brewis and Wutich [47], based on a Paraguayan sample also provided data of a comparison group of US-undergraduate students that were not considered in the analysis because of the homogenous study sample in terms of educational attainment. The seventeen studies included showed a wide variety of sample sizes ranging from 198 [51] to 3,502 participants [37].

Since the aim of the study was to outline the impact that socioeconomic status in the form of educational attainment and level of income have on weight bias, attention was paid to a variation in these variables within the samples. The studies included therefore focused either on a population-based sample [10, 38, 39, 45, 46, 49] or an convenience sample [37, 40, 41, 43, 44, 50]. Although Jiminez-Cruz and colleagues [48] investigated stigmatizing attitudes of an entirely low-income sample, they divided the socioeconomic factors (level of education and income) into five and four categories respectively; thus, variation within the sample could be ensured. Moreover, an investigation of weight bias in different gradations of lower status groups could provide further insight into the topic. In one study [36], the general population was included, whereby the overweight participants received an alternative questionnaire assessing the perceived stigmatization and not their stigmatizing attitudes toward obesity. Therefore, only the normal weight sample could be included.

The distribution of women and men was equally considered in the majority of studies, even though more women than men were included. However, two studies posed an exception. The study of Brewis et al. [47] and the study of Jiminez-Cruz [48] investigated only the stigmatizing attitudes of female participants.

We also assessed the risk of bias among all studies that fulfilled the inclusion criteria. None of these studies justified the sample size; however, despite a risk of bias regarding the non-responders (i.e., no categorization, description, and ratio between the response and non-response rate) the majority of the studies included showed a low risk of bias. Only a few studies were detected to be at moderate risk of bias based on the sampling procedure [36–41]. The summarized risk of bias assessment of all studies included is provided as a supplementary table (Supplementary Material 1)

268 **Table 1 Summary of Selected Studies: Weight Bias Depending on Educational Attainment**

Study	N	Sample Discription	Instruments Weight bias	Educational attainment	Association's Direction[1]	Magnitude of Association
Form of weight bias: stigmatizing attitudes						
[46]; GER	3003	population based (ø age: 51.7 years; 52.8% female)	Short-FPS[1]	4 subgroups: - No degree - 9th grade degree - 10th grade degree - 12th grade degree	**Negative**	Multivariate Regression: - No degree = reference category - 9th grade: β = -0.278, p<0.01, (std. error 0.0852) - 10th grade: β = - 0.251, p<0.01 (std. error 0.0838) - Upper secondary school: β= -0.214, p<0.05, (std. error 0.0835)
[10]; GER	960	US adults (ø age: 43.8 years; 50.2% female)	WCB [2];	2 subgroups: - Low; <13 years of education) - High; ≥ 13 years of education)	**Negative**	Multiple linear regression - β= -0.16, p<0.001 Zero-order association - r= -0.18, p<0.0001
[48]; MEX	1,100	Women aged 18-40 of low SES (ø age: 37.5 years)	Beliefs about the causes of obesity	5 subgroups: - None - some elementary - elementary - middle - high school	**Positive**	Logistic regression - "Having an unhealthy lifestyle": unadjusted OR=2.56, p<0.001, Confidence Interval 1.88-3.49
[43]; USA and ISL	899	US adults (ø age: 40.9 years; 46.1% female)	Short-FPS [1]; UMB-FAT [3]	3 subgroups: - High school or less - Some college/technical or vocation degree - College graduate or higher	FPS: Mixed	Linear regression: - High school or less = reference category - Vocational training/some college (β=0.202, p<0.05) - College (β=0.141, p>0.1) - Postgraduate (β=-0.017, p>0.1)
					UMB-Fat: Positive	Linear regression: - High school or less = reference category - Vocational training/some college: β=0.102, p>0.1 - College: β=0.189, p<0.05 - Postgraduate: β=0.034, p>0.1
	659	ISL adults (ø age: 45.9 years; 55.1% female)		2 subgroups: - High school or less - College	FPS: Positive	Linear regression: - High school or less = reference category - College: β=0.068, p>0.1
					UMB-Fat: **Positive**	Linear regression: - High school or less = reference category - College: β=0.160, p<0.05

[49]; SWE	2,436	Representative Swedish population aged 25-64 (ø age: 47.8 years; 63% female)	ATOP [4]	3 subgroups: - Low - Medium - High	Negative	Spearman zero-order correlations: - r= −0.023, p=0.260
[40]; USA	1,118	US adults (ø age: 43.8 years; 50.2% female)	Opinions about obesity as a disease [5]	3 subgroups: - High school or less - Some college/ Technical or vocation degree - College graduate or higher	Mixed	Linear regression - High school or less = reference category Agreement with statements in support of classification - Some college/ technical degree: β= -0.036, p>0.1 - College graduate or higher: β=0.035, p>0.1 Agreement with statements in support of classification - Some college/ technical degree: β= -0.03, p>0.1 - College graduate or higher: β= 0.095, p<0.1 but >0.05
[51]; GB	198	Community-based (ø age: 32.58 year; 50.5% female)	PFRS [6]	5 subgroups - General Certification of Secondary Education - Advanced Level - Undergraduate degree - Postgraduate degree - other qualification	/	Univariate analysis of variance (ANOVA): - F(1, 197) = 0.47, p = .705, ηp ² < 0.01
[36]; USA	396	General, not overweight population (ø age: 42.7 years; 43.7% female)	Short-FPS[1]	3 subgroups: - High school or less - Some college/associate degree - Bachelor's degree or higher	/	Adjusted model of correlates: - F(2) = 0.026, p=0.974
[47]; PRY	200	Women (ø age: 38.9 years)	ATOP [4]; IAT [7]	Metric measurement: years of formal education	/	/
Form of weight bias: both, stigmatizing and discriminating attitudes						
[39]; USA	981	US representative sample (62% female)	Beliefs about obesity as a financial burden for society	4 subgroups: - Less than some high school - High-school graduate - Some college - Higher than a college degree	**Positive**	Logistic regression - ≤ some HS: adjusted OR= 0.25, p<0.05 - Some College: adjusted OR= 1.61, p<0.05 - ≥ College: adjusted OR= 1.97, p<0.01
			Beliefs about the controllability of obesity		Mixed	Logistic regression - ≤ some HS: adjusted OR= 0.99, p>0.05 - Some College: adjusted OR= 0.90, p>0.05 - ≥ College: adjusted OR= 1.68, p>0.05

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Form of weight bias: discriminating attitudes						
[41]; USA	1,114	Adults (ø age: 44.87 years; 48% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	3 subgroups: - High school or GED completed - 2-Year vocational/technical degree or some college - College graduate	**Positive**	Ordinal logistic regression, for all 6 statements - High school/GED = reference category - College: OR 0.28-0.49, p<0.05)
[37]; USA	3,502	Adults (age 21-65; 61.9% female)	3 statements assessing support of legal protection and employment-specific antidiscrimination laws or policies	3 Subgroups: - High school or less - some college/ technical or vocation degree - College graduate or higher	**Positive**	Multiple logistic regression - High school or less = reference category - Some college/Technical or vocation degree ▪ Law 1: adjusted OR=0.7, p>0.01 ▪ Law 2: adjusted OR=0.9, p>0.05 ▪ Law 3: adjusted OR=1.2, p>0.05 - College graduate or higher ▪ Law 1: adjusted OR=0.7, p>0.01 ▪ Law 2: adjusted OR=0.8, p<0.05 ▪ Law 3: adjusted OR=0.3, p=0.05
[44]; USA and ISL	893	US adults (ø age:40.9 years; 46.1% female)	13 statements assessing support for employment-specific and broader antidiscrimination laws or policies	3 Subgroups - High school or less - some college/technical or vocation degree - College graduate or higher	Positive	Tobit Regression - High school or less = reference category Broad laws and policies - Vocational training/some college: Coeff= -0.135, p>0.05 - College: Coeff = -0.223, p>0.05 - Postgraduate: Coeff = -0.040, p>0.05 Employment-specific laws and policies - Vocational training/some college: Coeff= -0.115, p>0.05 - College: Coeff= -0.220, p>0.05 - Postgraduate: Coeff.= -0.087, p>0.05
	658	ISL adults (ø age:45.9 years; 46.1% female)		2 subgroups - High school or less - College	**Positive**	Tobit Regression - High school or less = reference category Broad Policies - College: OR= -0.221, p<0.01 Employment Specific laws College: OR= -0.059, p>0.05
[38]; USA	1,001	Population-based sample (ø age:43.8 years; 51% female)	6 statements assessing support for general, employment-specific and broader policies/ antidiscrimination laws or policies	3 subgroups - High school - college degree - Postgraduate degree	**Positive**	Logistic regression, five of six statements - High school = reference category - Higher degree: OR= 0.56-0.72, p<0.05

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[42]; USA	909	US adults	2 statements assessing support for antidiscrimination policies	Only 2 subgroups reported: - less than High school - College degree	**Positive**	Probit Model - Less than High school = reference category "Government should do more to protect obese" - College degree: β= -0.100, p<0.05 "Overweight should get same protections as disabled" - College degree: β= -0.136, p<0.01
[45]; GER	2,531	Population-based sample (ø age: 48.79 years; 55.5% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	2 subgroups: - Low (<12 years of education) - High (≥ 12 years of education)	General laws **Positive**	Logistic regression - Education ≥ 12 years: OR= 0.60, p=0.005
					Employment-specific laws: **Negative**	Logistic regression - Education ≥ 12 years: OR= 1.25, p=0.016
[50]; DNK	1,003	Citizens aged 18-65	Attitudes toward weight-loss surgery & medical treatment of obesity	No details reported	/	/

Note: [1] Bold characters display significant association, Positive = demonstrates greater anti-fat attitudes with increasing educational attainment; Negative = demonstrate greater anti-fat attitudes with decreasing educational attainment; N = sample size; FPS = Fat Phobia Scale; UMB = Universal Measure of Bias; WCB = Weight Control/Blame of the Anti-Fat Attitudes Test; ATOP = Attitudes to Obese People; IAT = Implicit Association Test; PFRS = Photographic Figure Rating Scale; SES = Socioeconomic status

Table 2 Summary of Selected Studies: Weight Bias Depending on Level of Income

Study	N	Sample Discription	Instruments Weight bias	Level of income	Direction of Correlation[1]	Magnitude of Association
Form of weight bias: stigmatizing attitudes						
[48]; MEX	1,100	Women aged 18-40 of low SES (ø age: 37.5 years)	Beliefs about the causes of obesity	Weekly income, 4 subgroups: - USD < 1,200 - USD 1,200-2,000 - USD 2,000-4,000 - USD ≥ 4,000	Negative	Logistic regression - "Having an unhealthy lifestyle: unadjusted OR= 1.13, p>0.05, Confidence Interval 0.78-1.62
[10]; GER	960	Population based sample (ø age: 45.9 years; 56.9% female)	WCB [2]	Monthly Income, 2 subgroups: - EUR < 2,000 - EUR ≥ 2,000	Negative	Zero-order association - r= -0.02, p>0.01
[49]; SWE	2,436	Representative Swedish population aged 25-64 (ø age: 47.8 years; 63% female)	ATOP [4]	Annual household income; no subgroups reported	Positive	Pearson and Spearman zero-order correlations: - r=0.018, p= .382
[40]; USA	1,118	US adults (ø age:43.8 years; 50.2% female)	Opinions about obesity as a disease [5]	Annual household income, 5 subgroups - USD < 25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	Mixed	Linear regression - Less than $25,000 = reference category Agreement with statements in support of classification - USD 25,000 - 49,999: β= 0.045, p>0.1 - USD 50,000 - 74,999: β= 0.113, p<0.1 - USD 75,000 - 99,999: β= 0.084, p>0.1 - > USD 100,000: β= -0.026, p>0.1 Agreement with statements in opposition of classification - USD 25,000 - 49,999: β=0.06, p>0.1 - USD 50,000 - 74,999: β=-0.0.019, p>0.1 - USD 75,000 - 99,999: β=0.041, p>0.1 - > USD 100,000: β=0.061, p>0.1
[46]; GER	3003	population based (ø age:51.7 years; 52.8% female)	Short-FPS [1]	Monthly household income, 4 subgroups: - EUR < 999 - EUR 1,000-1,999 - EUR 2,000-2,999 - EUR > 3,000	/	/

[36]; USA	396	General, not overweight population (ø age: 42.7 years; 43.7% female)	Short-FPS [1]	Annual household income,5 subgroups: - USD < 20,000 - USD 20,000-39,000 - USD 40,000-59,000 - USD 60,000-79,000 - USD > 80,000	/	Correlation: - Unadjusted, correlation coefficient not reported, p= 0.305
Form of weight bias: Both, stigmatizing and discriminating attitudes						
[39]; USA	981	US representative sample (62% female)	Beliefs about obesity as a financial burden for society	Annual household income, 4 subgroups: - USD< 25,000 - USD 25,000 < 50,000 - USD 50,000 < 75,000 - USD ≥ 75,000	**Positive**	Logistic regression - USD< 25,000 = reference category - USD 25,000 < 50,000: adjusted OR= 1.02, p>0.05 - USD 50,000 < 75,000: adjusted OR= 1.57, p>0.05 - USD ≥ 75,000: adjusted OR= 3.18, p<0.001
			Beliefs about the controllability of obesity		Negative	Logistic regression - USD< 25,000 = reference category - USD 25,000 < 50,000: adjusted OR= 0.82, p>0.05 - USD 50,000 < 75,000: adjusted OR= 0.96, p>0.05 - USD ≥ 75,000: adjusted OR= 0.51, p>0.05
Form of weight bias: discriminating attitudes						
[42]; USA	710	US adults (aged 18 – 65)	2 statements assessing support for civil protections for the obese	Annual household income - USD < 15,000 - USD > 100,000	**Positive**	Probit Model - USD < 15,000 = reference category "Government should do more to protect obese" - USD > 100.000: β= -0.098, p<0.01 Overweight should get same protections as disabled" - USD > 100.000: β= -0.077, p<0.01
[45]; GER	2,531	Population-based sample (ø age: 48.79 years; 55.5% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	Monthly Income, 2 subgroups: - EUR < 2,000 - EUR ≥ 2,000	**Positive**	Logistic regression General laws or policies - EUR < 2,000 = reference category - EUR ≥ 2,000: OR=0.67, p=0.002
					Positive	Logistic regression Employment-specific laws or policies - EUR < 2,000 = reference category - EUR ≥ 2,000: OR=0.91, p=0.376
[38]; USA	1,001	Population based sample (ø age: 43.8 years; 51% female)	6 statements assessing support for general, employment-specific and broader policies/ antidiscrimination laws or policies	Annual household income, 5 subgroups - USD 15,000-25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	**Positive**	Logistic regression, five of six statements - USD 15,000-25,000 = reference category - Adjusted OR= 0.52-0.64, p<0.05

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[41]; USA	1,114	Adults (ø age: 44.87 years; 48% female)	6 Statements assessing support of general and employment-specific antidiscrimination laws or policies	Annual household income, 5 subgroups: - USD < 25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	**Positive**	Ordinal logistic regression - USD < 25,000 = reference category - Significant results among women but not men "Obesity should be considered a disability under the ADA to protect obese people from weight discrimination in the workplace" - USD 75,000-99,999: OR= 0.52, p<0.05 "Congress should pass the WDEA to protect overweight Americans from discrimination in the workplace" - USD 75,000-99,999: OR= 0.49, p<0.05
[37]; USA	3,502	Adults (age 21-65; 61.9% female)	3 statements assessing support of legal protection and employment-specific antidiscrimination laws or policies	Annual household income, 5 subgroups - USD < 25,000 - USD 25,000-49,999 - USD 50,000-74,999 - USD 75,000-99,999 - USD > 100,000	Mixed	Logistic Regression Model - USD 15,000-25,000 = reference category - USD 25,000-49,999 - Law 1: OR=1.0, p>0.05) - Law 2: OR=1.2, p>0.05) - Law 3: OR=1.0, p>0.05) - USD 50,000-74,999 - Law 1: OR=1.0, p>0.05) - Law 2: OR=1.2, p>0.05) - Law 3: OR=1.0, p>0.05) - USD 75,000-99,999 - Law 1: OR=1.2, p>0.05) - Law 2: OR=1.3, p>0.05) - Law 3: OR=0.9, p>0.05) - USD > 100,000 - Law 1: OR=0.8, p>0.05) - Law 2: OR=1.0, p>0.05) - Law 3: OR=0.9, p>0.05)
[50]; DNK	1,003	Citizens (age 18-65)	Attitudes toward weight-loss surgery & medical treatment of obesity	No details reported	/	/

Note: [1] Bold characters display significant association, Positive = demonstrates greater weight bias with increasing level of income; Negative = show greater weight bias with decreasing level of income; N = sample size

Instruments

The studies included were found to be heterogeneous with regard to the instruments used (Table 3 and 4). Therefore, the study team has decided against a meta-analysis and for a systematic narrative literature review.

Educational attainment and level of income

Seventeen studies were found that assessed attitudes toward obesity in association with participants' educational attainment and/or level of income. All of these seventeen studies reported the participants' educational attainment [10, 36–51]. Depending on the origin of the sample and the analogous countries' educational system, categories were formed or years of educational attainment were gathered. From seventeen studies, thirteen assessed participants' level of income [10, 36–42, 45, 46, 48–50]; therefore, income was either assessed by the annual, weekly, household, or individual income.

Weight Bias in Form of Stigmatizing Attitudes

Studies that examined either participants' stigmatizing attitudes or participants' beliefs about the causes of obesity [10, 36, 39, 40, 43, 46–49, 51] were included. Stigmatizing attitudes were thereby measured with instruments such as the Fat Phobia Scale (FPS), the Universal Measure of Bias (UMB), the Weight Control/Blame of the Antifat Attitude Test (WCB), the Attitudes to Obese People (ATOP), the Implicit Association Test (IAT), or the Photographic Figure Rating Scale (PFRS). As described before, beliefs about the causes of obesity in the form of evaluating obesity as a controllable condition – which is supposedly preventable by a greater extent of self-discipline – can consequently be seen as one decisive factor in determining stigmatizing attitudes [52] and was therefore included. The instruments used are presented in Table 3.

Table 3 Overview of the instruments used to measure stigmatizing attitudes

Instruments measuring Stigmatizing attitudes	Studies that apply the instrument
Explicit Stigma	
- Fat Phobia Scale (FPS)	[36, 43, 46]
- Universal Measure of Bias (UMB)	[43]
- Attitudes to Obese People (ATOP)	[47, 49]
- Opinions about obesity as a disease	[40]
- Photographic Figure Rating Scale (PFRS)	[51]
Implicit Stigma	
- Implicit Association Test (IAT)	[47]
Causal Attribution	
- Weight Control/Blame of the Anti-Fat-Attitudes (WCB)	[10]
- Potential causes of obesity	[48]
- Individuals responsibility ("Obese people can do something about their weight")	[39]

Weight Bias in the form of Discriminating Attitudes

We found eight studies that investigated participants' discriminating attitudes toward people with obesity [37–39, 41, 42, 44, 45, 50]. All instruments used to measure discriminating attitudes are listed in Table 4. Discrimination was measured for example, by examining policy and law support, but also the ratings on the statement "Obesity is a major burden to society in terms of healthcare costs" as well as attitudes toward weight-loss surgery and medical treatment. We found some studies [37, 38, 41, 42, 44, 45] that investigated support for the same or almost identical laws or policies (Law/policy a-i). However, these items were analyzed in such heterogeneous way, for example, by merging different items into one, that a meta-analysis could not be conducted.

Table 4 Overview of the instruments used to measure discriminating attitudes

Instrument measuring discriminating attitudes	Studies that apply the instrument
Attitudes toward weight-loss surgery & medical treatment	[50]
Beliefs about obesity as a financial burden for society	[39]
Statements measuring support/rejection of weight-related laws or policies	
[a] My country/state should include body weight in our civil rights law in order to protect people from discrimination based on their body weight	[37, 38, 41, 44, 45]
[b] It should be illegal for an employer to refuse to hire a qualified person because of his or her body weight.	[37, 38, 41, 44, 45]
[c] It should be illegal for an employer to terminate or fire a qualified employee because of his or her body weight.	[37, 38, 41, 44, 45]
[d] Fat/overweight persons should be subject to the same legal protections and benefits offered to people with physical disabilities.	[37, 38, 41, 42, 44, 45]
[e] It should be illegal for an employer to deny a promotion or appropriate compensation to a qualified employee because of his or her body weight.	[37, 38, 41, 44]
[f] Obesity should be considered a disability (under the ADA) so that people will be protected from weight discrimination in the workplace	[38, 41, 44, 45]
[g] Congress/Government should pass the Weight Discrimination in Employment Act (WDEA) to protect overweight Americans from discrimination in the workplace/employees from discrimination in the workplace based on their body-weight.	[38, 41, 44]
[h] The government should play a more active role in protecting overweight people from discrimination.	[38, 41, 42]
[i] It should be illegal for an employer to assign lower wages to a qualified employee because of his or her body weight.	[44, 45]
[j] The government should have specific laws in place to protect people from weight discrimination.	[44]
[k] The government should penalize (or fine) those who discriminate against persons because of their weight.	[44]
[l] Individual companies should have the right to determine whom to hire based on an employee's personal body weight.	[44]
[m] Employers should be allowed to assign different salaries to employees based on their body weight.	[44]
[n] My country should pass a Healthy Workplace Law to address workplace bullying	[44]

Findings

The studies included showed a very heterogeneous picture regarding their results. Eleven out of the seventeen studies significantly associated educational attainment (Table 5) and/or level of income (Table 6) with stigmatizing and/or discriminatory attitudes toward people with obesity [10, 37–39, 41–46, 48].

Associations between educational attainment and weight-related stigmatization

We found ten studies that reported an association between educational attainment and stigmatizing attitudes, whereas only two of them [43, 48] showed a positive association between higher educational attainment and weight-related stigmatization. In addition, the study of Puhl and colleagues [43, 44] found a significant association in the Icelandic (Beta=0.160, p<0.05), but not in the American sample. However, two German studies [10, 46] showed an inverse correlation. Both of these studies found evidence that higher education is associated with lower stigma [46] and less belief in individual responsibility [10] for an obese condition. The remaining studies did not report significant associations.

Associations between educational attainment and weight-related discrimination

Six studies [37–39, 41, 42, 44] reported increased discriminating attitudes with higher education. The study of Puhl and colleagues found no significant association between weight bias and educational attainment in the US sample, but did find an association in the Icelandic sample (Beta = -0.221, p<0.01). The study of Hilbert and colleagues [45] revealed inconsistent findings: Higher education is associated with less support for general but more support for employment specific weight-related antidiscrimination laws or policies.

Associations between the level of income and weight-related stigmatization

We found no study that reported a significant association between the level of income and weight-related stigmatization. Associations between the level of income and weight-related discrimination

Four American [38, 39, 41, 42] revealed stronger weight-related discrimination with increasing income. One German study [45] found less support for general, but not for employment specific policies and laws among more affluent people. Although the study of Suh et al. [37] found a significant positive association between level of income and support for two laws and policies (law a: χ^2=6.06. p=0.01; law d: χ^2=3.81, p=0.05), these results could not be validated by logistic regression analysis. Moreover, the assumption that discrimination, in the form of views on the funding for medical or weight-loss surgery, is somehow associated with income was not found [50].

355 **Table 5. Studies That Show Significant Associations Between Education Attainment and Weight-Related Stigmatization and Discrimination**

Study	Direction of correlation	Form of Weight Bias	Instrument Weight Bias	Result	Adjusted for
[46]	Negative	Stigmatization	Short-FPS	Higher educational attainment is associated with lower stigmatizing attitudes	Gender, age, income, residence, emigrational background
[10]	Negative	Stigmatization	WCB	Higher educational attainment is associated with less stigmatizing attitudes (P<0.001)	Causal attributions to behavior, Labeling obesity as an illness, Age, Causal attributions to heredity
[43]	Positive	Stigmatization	UMB-Fat	Higher educational attainment is associated with higher stigmatizing attitudes (ISL sample; P<0.05)	Gender, race/ethnicity, BMI, perceived causes of obesity, weight-related attributions
[48]	Positive	Stigmatization	Beliefs about the causes of obesity	Higher educational attainment is associated with greater belief in individual responsibility (P<0.001)	Unadjusted
[39]	Positive	Discrimination	Belief in obesity as a financial burden for society	Higher educational attainment is associated with greater belief in the statement “Obesity is a major burden to society in terms of healthcare costs” (P<0.01)	Race/ethnicity, sex, income, employment, age group, marital status, BMI, smoking status
[37]	Positive	Discrimination	Support for weight-related laws or policies	Higher educational attainment is associated with lower support for weight-related laws or policies (P<0.01)	Other socio-demographic variables
[44]	Positive	Discrimination	Support for weight-related laws or policies	Higher educational attainment is associated with less support for weight-related laws or policies (P<0.01)	Sex, age, race/ethnicity, BMI
[38]	Positive	Discrimination	Support for weight-related laws or policies	Higher educational attainment is associated with lower support for weight-related laws or policies	Sex, body weight, age, income, race, political affiliation, history of weight-based victimization
[42]	Positive	Discrimination	Support for civil protections for the obese	Higher educational attainment is associated with lower support for civil protection of the obese	Sex, age, BMI, race/ethnicity, income, political orientation, perceived causes for obesity
[41]	Positive	Discrimination	Support for general and employment specific antidiscrimination laws or policies	Higher educational attainment is associated with less support for weight-related laws or policies	Body weight, age, race, political affiliation, income, history of weight-based discrimination, divergent vignettes describing obesity and obesity-related (workplace) discriminations
[45]	Positive	Discrimination	Support for general antidiscrimination laws or policies	Higher educational attainment is associated with less support for general antidiscrimination laws or policies	Sex, age, weights status, income, residence, church membership, readiness to vote in following week, weight-based victimization, weight bias internalization
	Negative		Support for employment-specific antidiscrimination laws or policies	Higher educational attainment is associated with stronger support for employment specific antidiscrimination laws or policies	

Positive = demonstrates greater weight bias with increasing educational attainment; Negative = show greater weight bias with decreasing educational attainment

356 **Table 6 Studies That Show Significant Associations Between Level of Income and Weight-Related Stigmatization and Discrimination**

Study	Direction of correlation	Form of Weight Bias	Instrument Weight Bias	Result	Adjusted for
[39]	Positive	Discrimination	Belief in obesity as a burden for society	Yes; A higher income level is associated with greater belief in statement "Obesity is a major burden to society in terms of healthcare costs" (P<0.05)	Race/ethnicity, sex, education, employment, age group, marital status, BMI, smoking status
[38]	Positive	Discrimination	Support for weight-related laws or policies	Higher income is associated with lower support for weight-related laws or policies	Sex, body weight, age, education, income, race, political affiliation, history of weight-based victimization
[42]	Positive	Discrimination	Support for civil protections for the obese	Higher income is associated with lower support for civil protection of the obese	Sex, age, BMI, race/ethnicity, education, political orientation, perceived causes for obesity
[41]	Positive	Discrimination	Support for general and employment specific antidiscrimination laws or policies	Higher income is associated with less support for weight-related laws or policies	Body weight, age, race, political affiliation, education, history of weight-based discrimination, divergent vignettes describing obesity and obesity-related (workplace) discriminations
[45]	Positive	Discrimination	Support for general antidiscrimination laws or policies	Higher income is associated with less support for general antidiscrimination laws or policies	Sex, age, weights status, education, residence, church membership, readiness to vote in following week, weight-based victimization, weight bias internalization

Positive = demonstrates greater weight bias with increasing level of income; Negative = show greater weight bias with decreasing level of income

Discussion

This systematic literature review aimed to summarize the current state of research on socioeconomic status and its impact on weight-related stigmatization and discrimination. As it was outlined earlier, the association between socioeconomic factors and weight bias has not been investigated sufficiently [41]. This review aimed therefore to address this gap. Although many studies were found that investigated various forms of weight bias and assessed socioeconomic data, an association was only reported in 17 studies. The underlying reason why an association was not reported might be a different research focus, but also insignificant findings. Overall, eleven out of the seventeen studies showed that weight bias is significantly associated with either educational attainment or level of income. In the following the results are discussed separated by education and income, as well as weight-related stigmatization and discrimination.

Educational Attainment, Level of Income, and Stigmatizing Attitudes

Overall, ten studies reported an association between educational attainment and stigmatizing attitudes. However, we found no systematic pattern in which way educational attainment and stigmatizing attitudes are associated: Two studies [43, 48] supported the hypothesis that stigmatizing attitudes are more likely in people with higher educational attainment, whereas two German studies [10, 46] contradict this. Moreover, six studies [36, 39, 40, 47, 49, 51] did not show any significant association, nor a clear direction of the assumed association. In light of divergent results of studies that report a significant association between socioeconomic variables and stigmatizing attitudes, the findings must be discussed with regard to their cultural context: American, Mexican, and Icelandic studies were found to support the working hypothesis, whereas two German studies [10, 46] revealed findings to the contrary.

These differences might be explained when considering cultural distinctions. In cultures, in which individual responsibility is considered as one of the leading causes of self-fulfillment, health, and wealth, obesity might be perceived as a self-inflicted condition. Highly educated people might attempt to keep people down to maintain their high(er) social status. In contrast, in cultures in which individuals' situations are principally considered as a result of various circumstances, obesity might

consequently not only be seen as self-inflicted. In these cultures, especially highly educated people might be aware of social barriers as determinants for self-fulfillment, wealth, and health, i.e., body weight. In conclusion, the direction of the relationship between weight bias and socioeconomic status might depend on divergent socio-cultural perspectives. Hence, future research should consider expansion and reorientation of stigma's theoretical framework by focusing on the meso and macro socio-cultural structures, as Bonnington and Rose [53] suggest.

Overall, we found eight studies that investigated (or rather reported) the association between level of income and stigmatizing attitudes. None of these studies showed a significant relationship. However, the direction of the (insignificant) associations did not show any pattern. We found three studies reporting an (insignificant) positive association [10, 39, 48], and one study each reporting an (insignificant) positive [49] or mixed associations [40].

Educational Attainment, Level of Income, and Discriminating Attitudes

Of the seventeen studies included, eight studies were found that reported an association between educational attainment and discriminating attitudes. Five of these studies reported a positive relationship, i.e., stronger discriminating attitudes (in the form of law and policy support) with increasing education. Another study [44] that applied the same instruments for an American and an Icelandic sample found only indications for our assumption (i.e., higher education is associated with stronger discriminating attitudes) in the Icelandic, but not in the American sample. This study [44] was also replicated by Hilbert et al. [45], who report heterogeneous findings as they found less support for general antidiscrimination laws with increasing level of education, but stronger support for employment specific laws and policies among the higher educated German sample. It should, therefore, be discussed whether general and employment specific antidiscrimination policies and laws can be viewed as similar outcomes or if they display different dimensions of discrimination. Moreover, views on who should pay for medical treatment or weight-loss surgery did not reveal significant associations [50]. Only one study [50] did not found a significant association between educational attainment and discriminating attitudes, nor did it report the direction of the insignificant association.

With regard to the association between level of income and discriminating attitudes we found overall seven studies in which an association was reported. Five studies [38, 39, 41, 42, 45] reported positive relationships, i.e., stronger discriminating attitudes with an increasing level of income. Suh et al. [37] found a significant association of stronger support for weight-related laws with decreasing income until they controlled for other sociodemographic variables, such as educational attainment. They reported mixed (insignificant) results concerning the direction of the assumed association. A possible explanation for these insignificant results after controlling for education might be that income can be seen as a proxy variable for education, in the way that the level of income depends on educational attainment. Again, Lund and colleagues [50] who asked Danish citizen by whom medical treatment and weight-loss surgery should be funded, found no significant association, nor did they report a direction of the association.

These findings support our assumption that higher socioeconomic status is associated with stronger discriminating attitudes. However, one German study [45] reported contradicting results that might be ascribed at a macro level to Bourdieu's theory about how cultural frameworks determine how specific values and characteristics are perceived. Governmental structures might enforce stigmatizing and discriminating attitudes as an instrument to 'nudge people into desired patterns of behavior' [29]. It can be assumed that cultural frameworks shape governmental systems and are strengthened at the same time through them, especially through the national health and welfare systems. Tyler and Slater [29], for example, outline the political and social function of stigma as a form of power. They discuss macro-level structures, particularly those used actively and passively by governments, as determinants shaping stigmatizing and discriminating attitudes, a level of understanding often left out in social psychology. As explained above, it might be possible that in countries in which obesity is merely perceived as self-inflicted, discriminating attitudes might be stronger - Hence, stigma is not only an instrument used by individuals to enforce personal interests but also one put in place (intended or not) by governments.

The different and to some extent inconclusive results might be caused by diverging study designs, sample sizes, and instruments assessing weight-related stigmatization and discrimination, educational attainment, and level of income: Studies that did not show a significant association between weight bias and either educational attainment or level of income excluded the overweight portion of the sample [36] or were characterized by a small sample (ranging from n=198 to n=396) size [36, 47, 51]. Furthermore, the association between weight bias with either educational attainment or level of income were not seen in instruments such as the Attitudes to Obese People scale (ATOP) [47, 49], the Implicit Association Test (IAT) [47] agreement ratings as to whether obesity can be classified as a disease [40], and measurement of attitudes toward weight-loss surgery and medical treatment [50].

However, there are findings diminishing this line of argument: The study of Hilbert et al. [45] found less support for general, but stronger support for employment specific laws with increasing socioeconomic status. In addition, the German population was found to be less supportive of laws and policies that would impede to refuse to hire, assign lower wages, and to fire qualified persons because of their body weight, compared to an American and Icelandic sample [44]. Moreover, the German population was less supportive of including body weight in the civil rights of law compared to the American, but not the Icelandic sample.

A final point of discussion might be whether the prevalence of obesity has an impact on the magnitude of weight bias. When comparing the prevalence and the stigmatization of obesity between the USA and Germany, for example, the following can be stated: In both countries, the prevalence of obesity increased over time (1995, USA 21.9%; GER 14.5%; 2005 USA 29%; GER 18%) [54]. However, not only the prevalence of obesity itself increased, but also the (perceived) stigmatization toward people with obesity in the US but also in Germany [7, 8, 10, 55].

Limitations

Just as any overview must contend with heterogeneous samples and instruments, this systematic review has likewise attempted to cope with varying data. The studies reviewed differed with respect to the instruments used to assess education and income. In particular, the measurement of educational attainment was strongly influenced by the different organization and structure of the varied local educational systems. In addition, the instruments to assess weight bias were also heterogeneous, particularly those used to measure stigmatizing attitudes. Some studies used validated scales, whereas other studies used single items only. Thus, the manner of gathering data and classifying categories can be described as heterogeneous itself – and therefore caused the study team to decide against a meta-analysis. However, studies that did use the same instrument, such as items weighing support for specific laws and policies differed with regard to how they were analyzed (as single items or as an item battery). Therefore, the authors had to decide again against a meta-analysis and applied a vote-counting approach despite its shortcomings.

Moreover, the study aimed to investigate socioeconomic determinants of weight bias in the general population, as discussed in the inclusion and exclusion section. Therefore, we excluded, among other things, studies that focused on overweight and/or obese samples only. We assumed that people try to differentiate themselves from lower status groups, which might be characterized by varying body sizes, i.e., excess weight or obesity. However, overweight and obese samples were included as part of the general population in some studies. Also, these studies did not differentiate their results by participants' body sizes. We also excluded studies based on homogenous samples, such as health care professionals and students. We considered these studies as inadequate since there would have been no possibility to compare and thus interpret these results with regard to the research question. Moreover, stigmatizing attitudes among some professions, such as dietitians and nutritionists, were already investigated systematically.

In the general population, we assume that people try to differentiate themselves not only by socioeconomic status but by other status markers as well, such as excess weight. Although we attempted to explain the heterogeneous and inconclusive results

by appealing to governmental and cultural differences, there was insufficient (and also inconclusive) evidence to conclude the role of cultural and governmental structures on weight bias.

Since the study team has only sufficient language skills in English and German, the current research includes only papers written in English or German

Conclusion

The literature review aimed to investigate to what extent weight bias can be traced back to socioeconomic variables, such as educational attainment and level of income. We assumed that a higher level of education or income is associated with greater stigmatization and discrimination. Therefore, the current study situation was analyzed systematically. Although data of education and income are always collected as mandatory sociodemographic information, research is lacking when it comes to examining their impact on weight bias. Since this question has not yet been answered sufficiently, this review was supposed to address this gap in research and aimed to contribute to closing this gap.

Our working hypothesis that weight bias increases with higher educational attainment or level of income could not be verified. Particularly, we found eight studies that supported our hypothesis, two German studies indicating the reverse conclusion, one German study reported heterogonous findings and seven studies that did not show a significant association at all.

The key to identifying effective interventions to battle stigmatization, discrimination, and consequences for those affected might lie in exposing the characteristics of stigmatizing groups and their motivations. Therefore, future research should pay more attention to the link between weight bias and socioeconomic factors and cultural or rather governmental structures. Moreover, meta-analysis should be considered as an important direction for future research.

Figure legends

Figure 1. Phases of the systematic review

Supplementary Material

Supplementary Material 1. Risk of Bias Assessment

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Disclosure Statement

The authors have no conflicts of interest to declare.

Author contributions

MB, CLS, and SRH outlined and specified the research question. MB and CLS conducted the systematic search of the literature. Furthermore, MB, CLS, and TF discussed papers in detail in case of disagreement and uncertainty over the eligibility of abstracts. MB wrote the first draw of the manuscript. TF, SRH, and CLS revised it critically for valuable intellectual content. All authors contributed to and have approved the final manuscript.

Data sharing statement

No unpublished data is available following this study.

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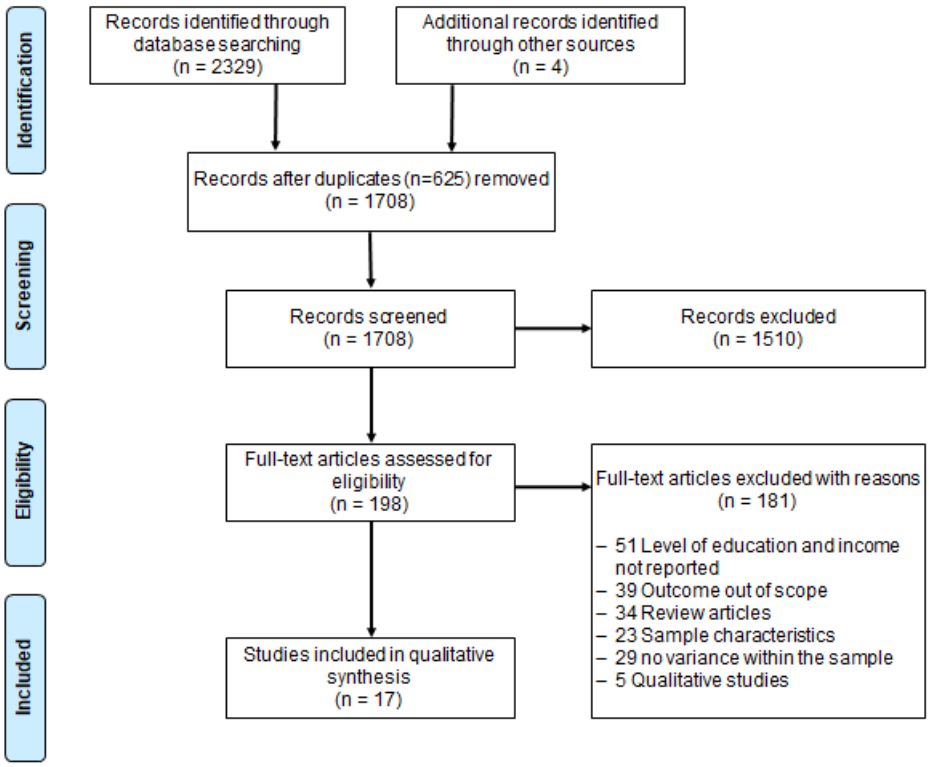
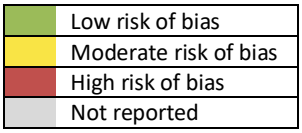


Figure 1 Phases of the systematic review



Supplementary Material 1. Assessment of Risk of Bias

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
(Brewis and Wutich, 2012)																				
(Hansson and Rasmussen, 2014)																				
(Hilbert et al., 2017)																				
(Jimenez-Cruz et al., 2012)																				
(Lippa and Sanderson, 2012)																				
(Lund et al., 2015)																				
(Oliver and Lee, 2005)																				
(Puhl et al., 2011)																				
(Puhl et al., 2015)																				
(Puhl and Heuer, 2011)																				
(Puhl et al., 2015)																				
(Puhl and Liu, 2015)																				
(Seo and Torabi, 2006)																				
(Sikorski et al., 2012)																				
(Suh et al., 2014)																				
(Swami and Monk, 2013)																				

AXIS – Tool to assess the quality of cross-sectional studies (Downes et al., 2016)

1. Were the aims/objectives of the study clear?
2. Was the study design appropriate for the stated aim(s)?
3. Was the sample size justified?
4. Was the target/reference population clearly defined? (Is it clear who the research was about?)
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7. Were measures undertaken to address and categorise non-responders?
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?
9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?
10. Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?
12. Were the basic data adequately described?
13. Does the response rate raise concerns about non-response bias?
14. If appropriate, was information about non-responders described?
15. Were the results internally consistent?
16. Were the results for the analyses described in the methods, presented?
17. Were the authors' discussions and conclusions justified by the results?
18. Were the limitations of the study discussed?
19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20. Was ethical approval or consent of participants attained?

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	-
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5-7
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6-7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6-7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	14-15
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	No meta-analysis

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	No meta-analysis
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-14
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	No meta-analysis
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	15-18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18-20
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	22

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