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Effects of weight stigma on BMI and inflammatory markers among people living with obesity

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ABSTRACT

Objective: Weight stigma (WS) and prejudice are one of the most prevalent ways of discrimination among adults, comparable with rates of racial discrimination. Exposure to WS among patients with obesity (PWO) may make the adoption of healthy dietary patterns and regular physical activity even more challenging and, therefore, the achievement of weight loss. Additionally, WS could also induce physiological responses such as increased levels of inflammatory markers, due to stress exposure.
Method: Subjects attending two obesity clinics were evaluated at baseline and after a minimum follow-up of six months. The weight Bias Internalization Scale (WBIS) and the Stigmatizing Situations Inventory (SSI) were administered to evaluate WS. Also, anthropometric and inflammatory markers, including cortisol, ferritin and C-reactive protein (CRP), were recorded at baseline.
Results: 79 PWO (87.3%♀, 45.5 ± 1.3 years, 35.9 ± 6.3 kg/m^2) were included. At baseline, 72.2% started liraglutide as anti-obesity drug. Baseline body mass index (BMI) correlated positively with both WBIS ($r = 0.23$; $p = 0.03$) and SSI ($r = 0.25$; $p = 0.02$) scores. Mean percentual weight loss after a mean follow-up of six months was -7.28%. However, there was a negative, but not statistically significant, correlation between weight loss and both WBIS (r=-0.14; $p = 0.2$) and SSI (r=-0.19; $p = 0.08$). Regarding inflammatory markers, plasma cortisol levels at baseline correlated positively with WBIS ($p = 0.005$) and SSI ($p = 0.02$). CRP at baseline also presented a positive correlation with SSI ($p = 0.03$). No significant correlations were found for stigma tests and ferritin levels.
Discussion: As weight increases among PWO, so does stigma. Despite we did not find a significant negative association between the presence of WS and weight loss outcomes, there was an increase in inflammatory markers among PWO who experienced higher levels of WS.

1. Introduction

Obesity is a chronic, relapsing, and complex disease with a continuous increase in incidence worldwide [1]. In Spain, it is estimated that the prevalence of obesity among adult population accounts for 20.5% of women and increases up to 22.8% in men [2]. Obesity is not only associated with metabolic and mechanical comorbidities, but also with psychological complications, including weight stigma (WS) and prejudice. Patients with obesity (PwO) are usually included in a stereotype characterized by their laziness, with lack of willpower, careless and with few ambitions or successes in their life. These false beliefs can lead to negative attitudes towards PwO and can lead to extreme situations such as verbal or physical aggression as well as discrimination [3–5].

In this sense, the prevalence of weight discrimination has increased dramatically in the recent years, and it is now comparable with rates of racial discrimination, particularly among women [4,6].

Moreover, exposure to WS has been related to negative psychological outcomes and an increased predisposition for developing mood or eating disorders, such as depression or binge eating disorder [7–9]. Furthermore, exposure to WS can have negative consequences in many areas of

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an individual's life, from employment to educational and even health environment, and affecting interpersonal relationships [3–5].

Conversely, WS among PwO may lead to greater difficulty in adopting healthy dietary habits that promote weight loss. Increasing evidence suggests that the presence of weight stigma among PwO could lead to overeating and an exaggerated desire to consume junk food. WS not only has been associated to the engagement of unhealthy dietary patterns, but also to sedentary behaviors and a difficulty in the acquisition of a regular exercise habit, especially when referring to younger populations [10–13].

However, evidence about the effect of WS among PwO on weight loss is, nowadays, contradictory. While some authors conclude that the presence of WS interferes significantly with weight loss outcomes, others have shown neutral or even opposite associations [6,14–17].

On the other hand, WS perception among PwO, and due to its psychological impact, could increase inflammatory markers, such as plasma cortisol among others, aggravating the low-grade chronic inflammatory state situation present in obesity and, therefore, making weight loss more difficult to achieve [10,18,19].

In the present study we aimed to assess the impact of weight stigma on weight loss among PwO attending an Obesity Unit. We also wanted to know whether PwO with a greater degree of WS would present with increased levels of inflammatory markers compared to PwO but without weight discrimination perception.

2. Methods

2.1. Subjects

This observational prospective study included 79 PwO who attended the outpatient clinic of three Endocrinology Departments aiming to lose weight. Inclusion criteria were as follows: (1) Patients older than 18 years with a BMI equal or greater than 27 kg/m^2 with comorbidities related to obesity or a BMI equal or greater than 30 kg/m^2 regardless of metabolic or mechanical comorbidities. (2) Patients who were able to understand the information given and capable to answer different self-administered tests as well as maintain a regular follow-up. (3) Caucasian ethnicity. (4) Patients who did consent to participate in the study. Exclusion criteria were as follows: (1) A severe medical condition with a life expectancy of less than 6 months. (2) Mental retardation or unstable psychiatric disease. (3) Subjects who refuse to participate in the study. Additionally, in order to exclude a potential effect in plasma inflammatory markers, patients on certain medications like glucocorticosteroids, NSAIDs, or other biological immunomodulators were also excluded. This study was conducted according to the World Medical Association Declaration of Helsinki. The study was approved by the Ethics Committee of all hospitals involved. Written informed consent was obtained from all subjects prior to study participation.

2.2. Weight stigma assessment

The Weight Bias Internalization Scale (WBIS) and the Stigmatizing Situations Inventory (SSI) was administered to measure WS.

2.2.1. Weight bias internalization scale (WBIS)

WBIS is a useful tool to assess the internalization of prejudices about the excess of weight among PwO, and to identify patients who need the support of health professionals to face stigmatization. WBIS is an 11-item self-report scale that measures the extent to which a person believes that negative stereotypes about overweight and obesity apply to them. Possible answers are measured on a 7-point Likert scale, ranging from "strongly disagree" to "strongly agree". The result is obtained by calculating the mean of all responses, and high scores on the scale are related to strong attitudes against obesity. The maximum value with WBIS is 77 [20,21].

2.2.2. Stigmatizing situations inventory (SSI)

This self-administered test aims to assess the stigmatizing experiences associated with excess weight that may have occurred to a subject at least once throughout his life. The 10 proposed items are scored on a 10-point scale (0 = "never", 1 = "once in a lifetime", 2 = "many times in a lifetime", 3 = "once a year", 4 = "many times a year", 5 = "once a month", 6 = "many times a month", 7 = "once a week", 8 = "many times a week", and 9 = "daily"). The result is obtained by calculating the mean of all responses, and the higher the score, the greater the exposure to stigmatizing situations. The maximum value of SSI score is 90 [22].

2.3. Interventions

Diet counselling included a tailored and structured diet with an average of 500–750 kcal/day reduction from calculated baseline metabolic rate adjusted by physical activity. The type of prescribed diet was based on patients' preferences to increase their adherence. Besides, a minimum of 150 min of exercise per week, both aerobic and resistance, was also prescribed.

PwO who failed to lose a minimum of 5% of weight after three months of lifestyle interventions were offered liraglutide as an adjunctive treatment. Regarding liraglutide titration, patients started with a dose of 0.6 mg per day for the first week and, depending on the tolerance and side effects, mostly gastrointestinal, this dose was titrated up to a maximum dose of 3 mg per day after four weeks of treatment. There was a high adherence to liraglutide 3 mg throughout the whole study follow up period. Gastrointestinal side effects (*i.e.* nausea, abdominal pain and constipation) were common, but mostly mild to moderate and transient, with no discontinuations observed during the follow up period due to them [23].

2.4. Anthropometric variables

Height and weight were measured while each participant was wearing indoor clothing without shoes. Body mass index (BMI) was calculated as weight divided by height squared.

2.5. Inflammatory markers

Inflammatory markers used for assessing the low-grade inflammatory state were high sensitivity C-reactive protein (CRP), ferritin, and cortisol. All plasmatic measurements were made at 8:00 a.m. after an overnight fast of at least 8 h.

2.6. Statistical analysis

Regarding baseline variables, their normal distribution was first analyzed and confirmed, which allowed the use of a parametric statistical analysis. The internal cohesion of the SSI and WBIS questionnaires was evaluated using the Pearson correlation test. Likewise, a multivariate regression analysis was performed to evaluate the correlation between the scores in the SSI and WBIS questionnaires, respectively, and baseline BMI on one hand, and plasmatic levels of inflammatory markers, on the other.

Regarding variables evaluated at baseline and after 6 months of follow-up (weight loss/BMI), a multivariate regression analysis was performed to evaluate the presence of potential predictive factors, using baseline anthropometric and psychosocial data as covariates, the presence of behavior patterns diet, the use of liraglutide and physical activity.

In all cases, a two-tailed $p < 0.05$ value was used to consider statistical significance.

3. Results

3.1. Descriptive characteristics

A total of 79 PwO were included in the study. 87.3% of the sample were female (69/79) and mean age of PwO included was 45.5 ± 11.2 years. Baseline BMI was 35.9 ± 6.3 kg/m^2 and 72.2% (57/79) started with liraglutide 3 mg as antiobesity drug.

WBIS and SSI scores showed a positive and significant correlation with each other ($r = 0.6$; $p<0.0001$), validating the consistency of the test results. These data are shown in Fig. 1.

At baseline, there was a positive and significant correlation between baseline BMI and both SSI ($r = 0.25$; $p = 0.02$) and WBIS ($r = 0.23$; $p = 0.03$). These results are represented in Fig. 2and Fig. 3, respectively.

3.2. Impact of weight stigma on weight outcomes

After six months of follow-up, both weight loss and BMI reduction were statistically significant (97.9 ± 16 kg *vs* 91.3 ± 15.3 kg and 35.9 ± 6.3 kg/m^2 *vs* 33.6 ± 6.2 kg/m^2; $p<0.01$), with a mean percentual weight loss of −7.28%. There was a negative, but not statistically significant correlation between weight loss and both WBIS ($r=-0.14$; $p = 0.2$) and SSI ($r=-0.19$; $p = 0.08$). Furthermore, regression analysis was performed including weight loss as dependent variable and WS scores, baseline characteristics and liraglutide use as covariates. Weight loss remained significant ($p = 0.001$), and baseline WS severity did not have any significant effect on the magnitude of weight loss.

On the other hand, no differences were seen regarding the amount of weight loss achieved among PwO who started on liraglutide compared to those who did not use it during the follow-up (−7.1 ± 1.2 vs −5.1 ± 1.1 kg; $p = 0.2$).

3.3. Effect of weight stigma on inflammatory markers

When we looked at plasma morning cortisol levels at baseline, there was a positive and significant correlation with weight stigma with both SSI ($p = 0.02$) and WBIS ($p = 0.005$).

Highly sensitive CRP at baseline also presented a positive correlation with SSI ($p = 0.03$), but we could not find such result with WBIS ($p = 0.1$).

On the other hand, no associations were seen between plasma ferritin levels, neither with SSI ($p = 0.1$) nor WBIS ($p = 0.8$).

These data are summarized in Table 1.

4. Discussion

We found that the presence of WS among PwO was not associated with a significant negative impact on weight loss outcomes. In fact, the amount of weight loss was not influenced by the degree of discrimination related to weight. On the other hand, there was a positive association between the degree of WS, assessed with both SSI and WBIS questionnaires, and plasma acute inflammatory markers, both CRP and cortisol.

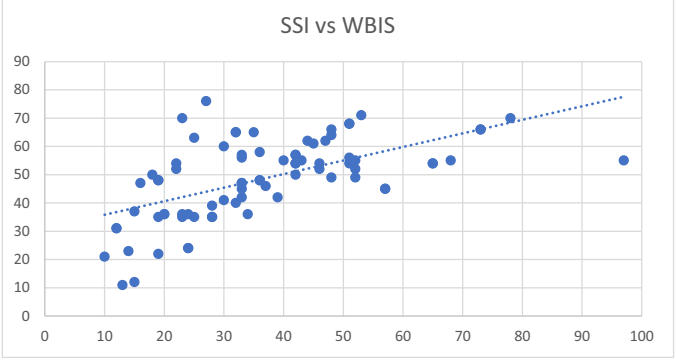

Fig. 1. Positive correlation between WBIS and SSI scores ($r = 0.6$; $p < 0.0001$).

WS carries out negative associated health consequences. The presence of internalization of weight bias has been related to the presence of abnormal eating patterns and binge eating disorder among PwO starting a weight loss program [7]. Regarding food consumption patterns, WS could predispose to the intake of caloric dense food or a greater desire for highly palatable food [5,24]. Moreover, weight discrimination could have a negative impact on regular physical activity and motivation to create this habit among PwO, especially in youths [12,13]. Consequently, it could be suggested that the presence of WS is associated with behaviors that enhance and perpetuate obesity, such as sedentary lifestyle, preference for calorie-dense foods or abnormal eating patterns.

Moreover, it has been shown that not only the presence, but the impact of weight discrimination is significantly greater among Caucasian and young females. The stereotype of Western beauty in recent decades, more pronounced in the female sex, could be the cause of the social pressure to which young women are subjected [6,25]. In this sense, despite more than 85% of our sample were women, mean age was 45 years and, therefore, social pressure about body shape could have already diminished.

However, there is more controversy regarding the relationship between the presence of WS and both obesity and weight loss or regain. Among adult population, longitudinal studies have shown a significant association between WS and obesity and weight gain (OR=6.67, 95% CI 1.85–24.04). However, odds of remaining with obesity with interventions did not differ according to experiences of WS (OR=1.09, 95% CI 0.46–2.59) [14]. Sutin et al. recruited 6157 individuals from the Health and Retirement Study, a national survey of community-dwelling US residents. Subjects who experienced WS were 2.5 times more likely to have obesity during follow-up (OR=2.54, 95% CI 1.58–4.08). Likewise, PwO at baseline with weight discrimination were 3 times more likely to maintain this metabolic condition at follow-up (OR=3.20, 95% CI 2.06–4.97) [26].

There is less evidence about the real impact of weight stigma and weight loss outcomes after intervention programs to promote weight loss. Gudzune et al. aimed to assess the association between the perception of weight-judgement from primary care providers (PCP) and self-reported weight loss with a national internet-based survey. PwO who had the feeling of being negatively judged by their PCP were less likely to achieve $a \geq 10\%$ weight loss (OR= 0.87) [15]. Moreover, PwO attending obesity clinics who experienced WS tended to choose riskier weight loss strategies and their desired weight was significantly lower compared to PwO of similar BMI but without weight discrimination [17]. Carels at al suggested that great implicit weight bias could identify PwO motivated enough to make lifestyle changes needed for weight loss [16]. However, given that the studies published so far regarding the effect of WS on weight loss are both contradictory and scarce, more studies are needed to draw conclusions about whether weight loss interventions among PwO who experience weight discrimination have a lesser effect on this outcome or weight maintenance [6,16,27].

It has been suggested that WS could have and additional physiological impact on inflammatory markers, such as cortisol and CRP. In this sense, and in accordance with our results, Schvey et at assessed the effect of weight discrimination on salivary cortisol among 123 lean and overweight adult women. They found that individuals with a presence of weight discrimination expressed a greater cortisol reactivity compared with those women in a neutral WS condition. These findings were independent of weight status ($p = 0.009$) [28]. Sutin et al., in one national representative sample with 7394 PwO, found that there was a positive association with the degree of weight discrimination and circulating levels of CRP. Surprisingly, these results extended to internalized discrimination related to physical disability, but neither to race nor age [19].

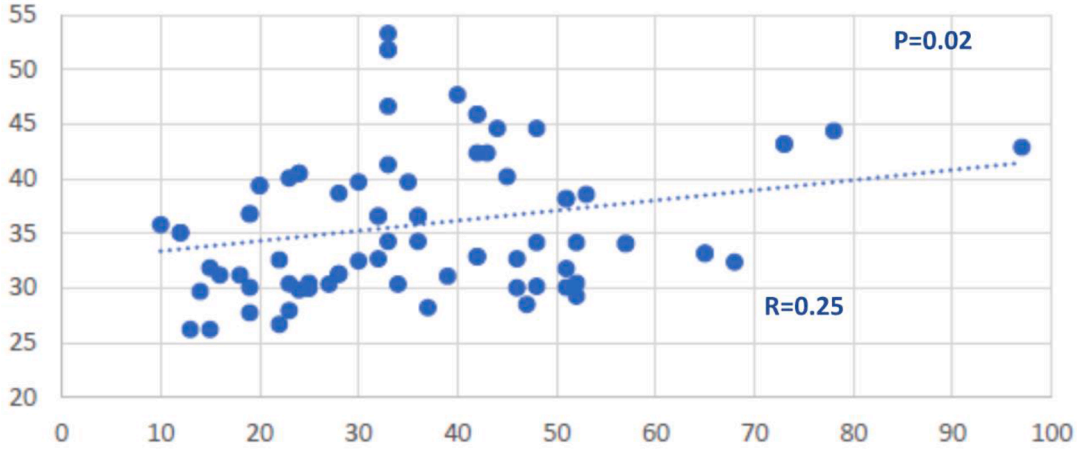

Fig. 2. Positive correlation between baseline BMI and SSI.

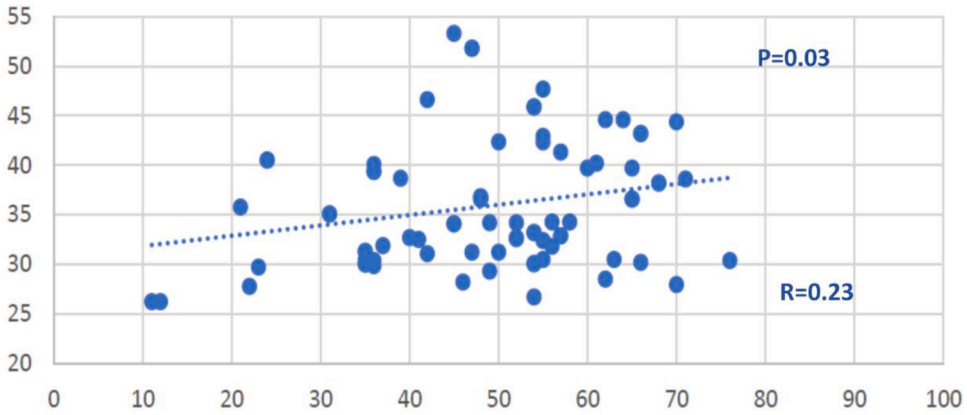

Fig. 3. Positive correlation between baseline BMI and WBIS.

Table 1
Association between inflammatory markers and weight stigma, measured with SSI and WBIS, at baseline.

R coeff	CPR	P	Ferritin	P	Cortisol	P
SSI	0.23	0.03	0.18	0.1	0.2	0.02
WBIS	0.17	0.11	0.02	0.8	0.32	0.005

CRP: highly sensitive C reactive protein. SSI: Stigmatizing Situations Inventory. WBIS: Weight Bias Internalization Scale.

We acknowledge that our study has several limitations. Patients included in the study attended specific consultations to lose weight, so it was unlikely that they would perceive a WS by the physician. On the other hand, non-treatment seeking PwO may not experience the same level of internalized WS. Also, we cannot generalize our results to other demographic or ethnic backgrounds. We did not collect psychological conditions that could influence weight stigma, such as binge eating disorder or a depression. Despite we found a significant correlation between inflammatory markers and weight stigma in a linear regression analysis, we did not assess the presence of comorbidities related to obesity, representing a potentially uncontrolled confounding factor. We acknowledge that midnight or hair cortisol could represent a more accurate marker, but the complexity and cost of its determination is higher. We highlight the significant positive correlation of the two tests used to rule out stigma, WBIS and SSI, which reinforces the cohesion of both tests and, therefore, the validity of the study. Having demonstrated the scarce evidence in this important area, our study adds more evidence regarding the extent to which weight discrimination influence weight loss efforts and weight outcomes over time.

WS has almost doubled in recent years in all population groups except the elderly. This increase cannot be explained by changes in obesity rates. It is mandatory to raise individual and social awareness of the magnitude of the problem of weight discrimination and fight against it. Otherwise, we will have devastating consequences both at the individual and public health levels. If this situation is maintained, PwO will not seek help in the health system, the efficacy of weight loss interventions will diminish, metabolic comorbidities related to obesity will worsen, there will be an increased in psychiatric conditions frequently associated to obesity and a decrease in quality of life, among others. Besides, anti-obesity policies issued by Public Health could be negatively affected, with impaired obesity prevention efforts as well as increased health and social disparities.

In conclusion, as weight increases among PwO, so does WS among PwO seeking anti-obesity interventions. Despite we could not find a significant negative association between the presence of weight discrimination and weight loss outcomes, there was a significant increase in inflammatory markers among subjects who experienced higher levels of WS.

Compliance with etical standards

All studies involved in studies performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

All participants included in the study understood the information

related to the study, understood, and signed a written informed consent.

All authors signed that there is no current or potential conflict of interest in relation to this article.

Declaration of Competing Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data availability

The data that has been used is confidential.

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