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ORIGINAL ARTICLE

Underweight vs. overweight/obese: which weight category do we prefer? Dissociation of weight-related preferences at the explicit and implicit level

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Summary

Objective

Although stigma towards obesity and anorexia is a well-recognized problem, no research has investigated and compared the explicit (i.e. conscious) and implicit (i.e. unconscious) preferences between these two conditions. The present study conducted this investigation in a sample of 4,806 volunteers recruited at the Project Implicit website (https://implicit.harvard.edu).

Methods

Explicit and implicit preferences were assessed among different weight categories (i.e. underweight, normal weight and overweight/obese) by means of self-reported items and the Multi-category Implicit Association Test, respectively.

Results

Preferences for the normal weight category were found both at the explicit and implicit levels when this category was compared with overweight/obese and underweight categories. On the contrary, when the underweight category was contrasted with the obese/overweight category, results differed at the explicit and implicit levels: pro-underweight preferences were observed at the explicit level, while pro-overweight/obese preferences were found at the implicit level.

Conclusions

These results indicate that preferences between overweight/obese and underweight categories differ at the explicit and implicit levels. This dissociation may have important implications on behaviour and decision-making.

Keywords: Anorexia, implicit attitudes, obesity, weight bias.

Introduction

Several studies have demonstrated that the weight-related stigma is widespread in our society (1–6).

Individuals with obesity face inequalities in many areas of living (e.g. employment settings, educational institutions and healthcare facilities), because of negative stereotypes that assume them to be lazy, less competent, sloppy or lacking in will-power and self-discipline (1,2). Similarly, negative stereotypes have been reported towards anorexia nervosa (AN), a condition like obesity is associated with body weight (i.e. extreme thinness) and body dissatisfaction (7). Negativity towards people with AN has been documented among medical professionals, nursing staff (4), university students (5) and the general public (6). People with AN are believed to be boring, weak, self-destructive and psychologically vulnerable and to have less desirable traits (e.g. openness, agreeableness or extroversion) (3).

Interestingly, recent studies comparing attitudes towards these two weight-related conditions suggested that people with obesity are more stigmatized than people with AN. For example, Ebneter and Latner (8) found that persons with obesity were more blamed and

held more responsible for their condition than AN. In addition, individuals with obesity were perceived as more lacking of self-discipline. Similarly, Zwickert and Rieger (9) found that participants reported more blame to people with obesity compared with people with AN.

Although these studies provided valuable information concerning weight-related stigmatization, they are limited both by a lack of a direct comparison between obesity and AN stigma and by the use of explicit measures (i.e. self-reports) to assess attitudes. Indeed, in the studies cited earlier, participants were asked to read vignettes describing a person with AN or obesity and respond to explicit items examining stigmatizing attitudes towards each condition.

Investigating attitudes towards weight categories by means of implicit (i.e. indirect behavioural) measures is crucial to have a more comprehensive and accurate evaluation of the weight-related stigma. Indeed, explicit measures reflect conscious and controllable evaluations, while implicit measures permit to assess automatic evaluations and associations that exist in memory and occur outside of awareness or conscious control (10). Explicit measures are thus more influenced by intentional and social desirability processes that might prevent people from accurately reporting attitudes towards a group if they think this could be viewed negatively by others. Implicit measures are instead less influenced by social desirability, and they are thus instrumental to detect spontaneous attitudes that might not be evident at an explicit and conscious level.

Previous studies already showed that weight-related attitudes can differ at an explicit and implicit level. For example, Teachman and Brownell (11) have found strong evidence for implicit obesity stigma among health professionals who specialized in obesity treatment and in the general population. In contrast, this study found only very weak evidence for explicit obesity stigma. Similarly, a recent research by Marini *et al*. (12) found evidence of a positive relationship between the average body mass index (BMI) of a nation and its obesity stigma only in implicit measures but not in explicit self-reports. Furthermore, it has been shown that implicit attitudes may predict prejudiced behaviours more effectively than explicit attitudes (13–15). For example, Bessenoff and Sherman (16) have demonstrated that the implicit obesity stigma predicted how far participants chose to sit from an overweight woman, whereas explicit obesity stigma did not.

Taken together, these studies suggest that assessing the weight-related stigma only by means of explicit measures might be inadequate because people may not accurately report at a conscious level the social evaluations associated with body weight. Thus, investigating implicit weight-related preferences may be crucial to have a more comprehensive and accurate evaluation of the weight stigma and to evaluate its impact on the behaviour.

The main goal of the present study was to perform such an investigation and directly compare social preferences among different weight categories (i.e. underweight, normal weight and overweight/obese) by means of both implicit and explicit measures. In the present study, the underweight category was used to represent the AN condition. Explicit weight preferences were assessed by means of self-reports and implicit weight preferences by means of a Multi-category Association Test (MC-IAT) (17). The MC-IAT is a modified version of the Implicit Association Test (IAT) (18). Similarly to the IAT, it uses reaction times to detect automatic associations between mental representations that exist in memory. It differs from the IAT because it permits to directly compare the implicit attitudes between more than two focal categories. Specifically, in the present study, the MC-IAT was used to compare social evaluations among three weight categories (i.e. underweight, normal weight and overweight/obese). In addition, to have a more comprehensive view of the weight-related stigma, implicit and explicit preferences were examined by socio-demographical predictors (i.e. gender, age, race/ethnicity, educational level and BMI).

Methods

Participants

A sample of 4,806 volunteers (mean age = 28.32 years, SD = 11.65; 67.7% women) participated in the present study. Participants were recruited through Project Implicit (https://implicit.harvard.edu), a website that offers visitors an opportunity to participate in research and receive educational feedback on a variety of social attitudes and stereotypes. Participants selected the present study from among a list of options.

Procedure and stimuli

Implicit preferences

Implicit preferences were measured by means of an MC-IAT (17). The MC-IAT assessed implicit preferences among the following weight categories: underweight, normal weight and overweight/obese. Obese and overweight categories were randomly assigned across participants. That is, two MC-IATs were used, each consisting of three weight categories, (i) underweight, normal weight and overweight and (ii) underweight, normal weight and obese.

Pictures of persons belonging to different weight categories were generated using DAZ 3D (DAZ Productions, Inc., Salt Lake City, UT, USA), a 3D character illustration/animation software that permits to control in a parametric manner the degree of thinness/obesity of a computer-generated character. In the present study, a total of 64 pictures were generated by manipulating the following variables: weight category (i.e. underweight, normal weight, overweight and obese), gender (i.e. female and male) and race (i.e. Caucasian, African–American, Asian and Indian–American). Weight categories were defined according to the BMI, i.e. under 18.5 for underweight, from 18.5 to 25 for normal weight, from 25 to 30 for overweight and over 30 for obese. Specifically, for each one of the four weight categories, 16 pictures were used: two Caucasian women, two Caucasian men, two African–American women, two African–American men, two Asian women, two Asian men, two Indian–American women and two Indian–American men (Figure 1).

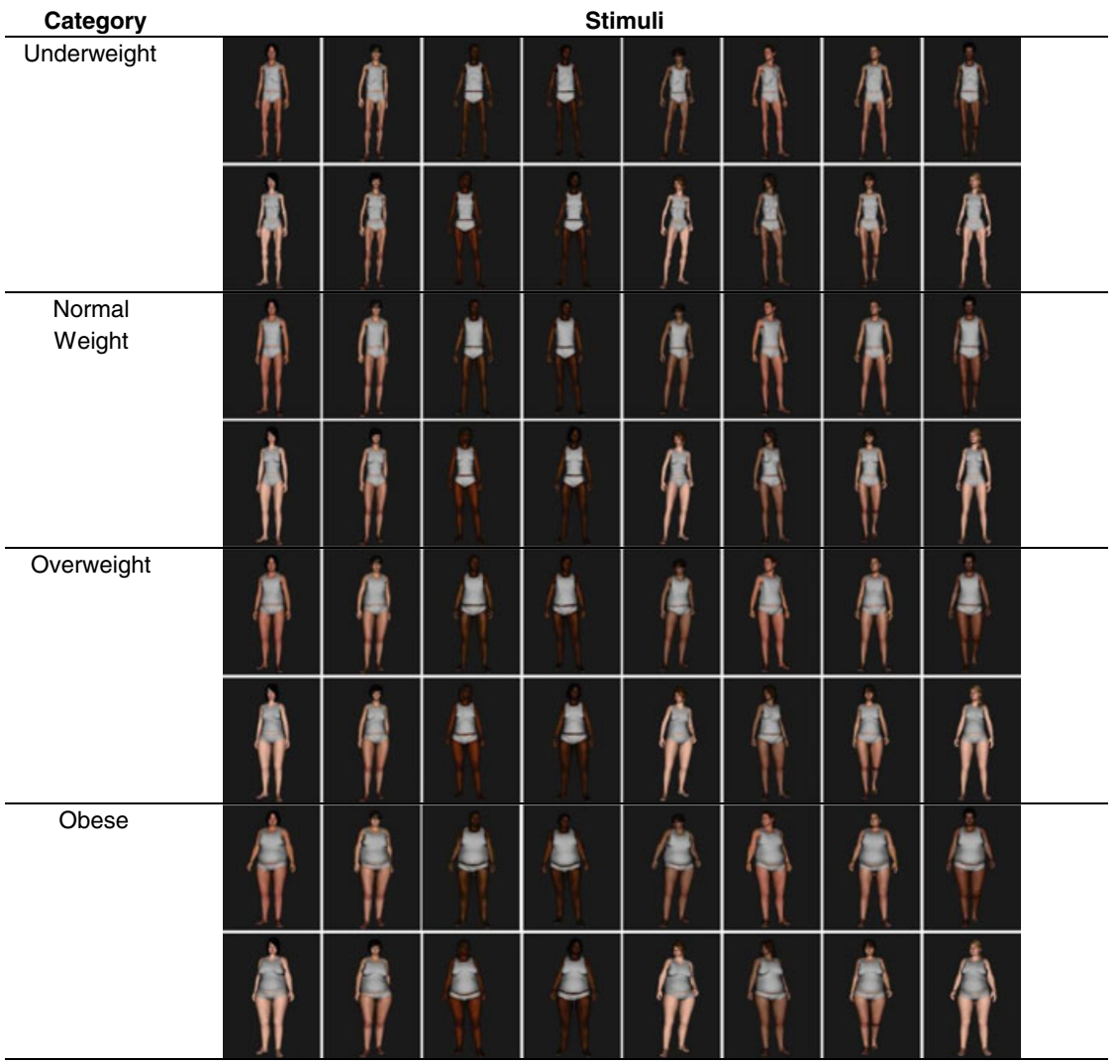

Figure 1 Stimuli used in the Multi-category Implicit Association Tests (see Methods section for further details). The pictures presented in the figure are a subset of the stimuli used in the present study.

On each trial, subjects categorized the items presented on the screen (e.g. good or bad words or pictures displaying people belonging to different weight categories) by pressing either the 'I' or the 'E' key.

For all participants, the MC-IAT contained a total of 10 blocks, of which the first four were practice blocks. In all blocks, items were presented one at a time and participants were requested to categorize them as quickly as possible. Categorization errors had to be corrected before continuing to the next trial.

In the first block (12 trials, practice), participants were instructed to press the 'I' key to categorize *good words* (e.g. happy, great, smile and joy) and the 'E' key to categorize *bad words* (e.g. hell, terrible, awful and hate).

In the second block (16 trials, practice), participants were instructed to press the 'I' key to categorize *good words* and pictures belonging *to one* of three weight categories (target category, e.g. normal weight people) and the 'E' key to categorize *bad words* and pictures belonging *to any* of the other weight categories (i.e. underweight and overweight/obese people).

The third and the fourth blocks (28 trials each, practice) had the same structure as the second block with the only difference that the target weight category changed (e.g. if in the second block the target category was normal weight, in the third and fourth blocks the target categories were underweight and overweight/obese, respectively).

The remaining six blocks (28 trials each) were considered for analysis purpose. Their structure was the same as the second, third and fourth blocks with the target category and the other two weight categories rotating between all possible combinations.

Explicit preferences

Three items assessed the explicit weight preferences on a 7-point scale ranging from −3 "I strongly prefer X people to Y people" to +3 "I strongly prefer Y people to X people" for all possible pairings among the weight categories (i.e. underweight, normal weight and overweight/obese). As in the MC-IAT, obese and overweight categories were randomly assigned across participants. Thus, two versions of explicit items were used, each assessing the preferences among three categories, (i) underweight, normal weight and overweight and (ii) underweight, normal weight and obese.

Socio-demographic predictors

Participants completed a demographic questionnaire, including items related to gender, age, race/ethnicity, education, weight and height. Weight and height were used to compute the BMI for each participant.

Data analysis

Following the guidelines outlined in Nosek, Bar-Anan, Sriram, Axt and Greenwald (19), participants' weight bias were assessed by means of five D scores, representing five pairwise comparisons among the investigated weight categories: *normal weight–obese, normal weight–overweight*, *normal weight–underweight*, *underweight–obese* and *underweight–overweight*.

D scores for each participant were computed by subtracting the mean latency for the congruent block from the incongruent block and then dividing by the standard deviation of the latencies across both blocks. For each pairwise comparison among weight categories, 'congruent' and 'incongruent' blocks were defined by considering a preference for the first category. Thus, positive D scores indicated a preference for the first category, while negative scores indicated a preference for the second category. For example, in the normal weight–obese comparison, a 'congruent' block was one in which normal weight pictures and good words were associated with one response key and obese pictures and bad words were associated with the other response key. Conversely, an 'incongruent' block was one in which normal weight pictures and bad words were associated with one response key and obese pictures and good words were associated with the other response key. A positive D score indicated thus a preference for the normal weight category, and a negative score indicated a preference for the obese category.

The following data cleaning procedures were employed (20): responses slower than 10,000 ms were removed, as well as the first four practice blocks and the first four trials of each block. In addition, response times lower than 400 ms were recoded to 400 ms, and all response times greater than 2,000 ms were recoded to 2,000 ms. Participants' MC-IAT data were excluded if more than 10% of their responses were faster than 400 ms, indicating careless responding (2.1% of participants that completed the MC-IAT).

To investigate the socio-demographic factors associated with implicit and explicit weight-related biases, linear regression analyses were conducted. A separate regression analysis was performed for each of the five pairwise comparisons among weight categories (i.e. *normal weight–overweight*, *normal weight–obese, normal weight–underweight*, *underweight–overweight* and *underweight–obese*) at both the implicit and explicit levels and included in each regression model five socio-

demographic predictors (i.e. gender, age, race/ethnicity, educational level and BMI).

Results

Implicit and explicit preferences overall

In the present study, participants' explicit and implicit preferences among different weight categories were assessed by means of a set of pairwise comparisons. More specifically, we performed five comparisons: *normal weight–overweight, normal weight–obese*, *normal weight–underweight*, *underweight–overweight* and *underweight–obese*.

In the three comparisons of the *normal weight* category with the *overweight, obese* and *underweight* categories, participants showed, both at the implicit and explicit levels, preferences for the normal weight category (*normal–overweight*: implicit mean = 0.24, SD = 0.46, Cohen's $d = 0.52$; explicit mean = 1.29, SD = 1.30, Cohen's $d = 0.99$; *normal–obese*: implicit mean = 0.21, SD = 0.46, Cohen's $d = 0.46$; explicit mean = 1.44, SD = 1.27, Cohen's $d = 1.13$; *normal–underweight*: implicit mean = 0.33, SD = 0.45, Cohen's $d = 0.74$; explicit mean = 1.17, SD = 1.37, Cohen's $d = 0.85$).

Interestingly, in the two comparisons of the *underweight* category with *overweight* and *obese* categories, a dissociation between the implicit and explicit levels was observed. At the implicit level, participants showed pro-overweight/obese preferences (*underweight–overweight*: implicit mean = −0.09, SD = 0.50, Cohen's $d = -0.18$; *underweight–obese*: implicit mean = −0.10, SD = 0.47, Cohen's $d = -0.21$), whereas, at the explicit level, they showed pro-underweight preferences instead (*underweight–overweight*: explicit mean = 0.19, SD = 1.35, Cohen's $d = 0.14$; *underweight–obese*: explicit mean = 0.46, SD = 1.28, Cohen's $d = 0.36$).

All explicit and implicit scores were significantly different from 0 (p-value < 0.01) and positively correlated (r range = 0.16–0.26, $p < 0.01$; Table 1).

Implicit and explicit bias by socio-demographic predictors

To investigate the potential socio-demographic factors associated with implicit and explicit weight-related preferences, linear regression analyses were conducted. In all regression models, five socio-demographic predictors were included and implicit and explicit preferences representing each paired comparison of the weight categories (i.e. *normal weight–obese, normal weight–overweight, normal weight–underweight*, *underweight–overweight* and *underweight–obese*) were used as dependent variables. The results of all the performed regressions are reported in Table 2. Regressions that reached statistical significance are reported as follows.

Normal weight–obese and normal weight–overweight comparisons

Implicit level: BMI was negatively related with implicit preferences for the *normal weight* category when this category was compared with *obese* ($\beta = -0.14$, $t(1, 604) = -5.72$, $p < 0.01$) and *overweight* categories ($\beta = -0.15$, $t(1, 465) = -5.51$, $p < 0.01$), indicating that leaner participants showed stronger implicit preferences for *normal weight* category.

Explicit level: Gender, educational level and BMI were significantly associated with explicit preferences for the

Table 1 Implicit and explicit scores overall among weight categories and correlations between implicit and explicit scores for each of the five comparisons performed in the study

	Implicit				Explicit				Implicit–Explicit correlations	
	N	Mean	SD	Cohen's *d*	*N*	Mean	SD	Cohen's *d*	*N*	*r*
Normal weight–overweight	1,946	0.24	0.46	0.52	2,164	1.29	1.30	0.99	1,847	0.20
Normal weight–obese	2,117	0.21	0.46	0.46	2,390	1.44	1.27	1.13	2,018	0.16
Normal weight–underweight	4,049	0.33	0.45	0.74	4,547	1.17	1.37	0.85	3,852	0.16
Underweight–overweight	1,939	−0.09	0.50	−0.18	2,150	0.19	1.35	0.14	1,832	0.26
Underweight–obese	2,119	−0.10	0.47	−0.21	2,385	0.46	1.28	0.36	2,012	0.17

Leftmost eight columns: implicit and explicit scores overall among weight categories. Each row shows the results for one of the five comparisons performed in the study. All implicit and explicit scores were significantly different from 0 ($p < 0.01$). For every comparison (e.g. normal weight–obese), a positive score indicates a preference for the first weight category (i.e. normal weight), while a negative score indicates a preference for the second weight category (i.e. obese). Explicit and implicit scores for the normal–underweight comparison were computed by aggregating data collected in both the two versions of the self-items and Multi-category Implicit Association Test. Rightmost two columns: correlations between implicit and explicit scores for each of the five comparisons performed in the study. All the correlations were significant ($p < 0.01$).

Table 2 Implicit and explicit preferences among weight categories by socio-demographic predictors

Normal weight–overweight					Normal weight–obese					Normal weight–underweight					Underweight–overweight					Underweight–obese				
df	R^2	Predictors	β	t	df	R^2	Predictors	β	t	df	R^2	Predictors	β	t	df	R^2	Predictors	β	t	df	R^2	Predictors	β	t
												Implicit												
1,465	0.02	Gender	0.05	1.86	1,604	0.02	Gender	0.04	1.61	3,071	0.01	*Gender*	*0.08*	*4.30*	1,468	0.02	Gender	−0.01	−0.43	1,602	0.02	Gender	−0.01	−0.40
		Age	0.04	1.35			Age	0.03	1.17			Age	0.04	1.74			Age	−0.03	−0.90			Age	0.02	0.69
		Race/ethnicity	0.00	−0.14			Race/ethnicity	0.01	0.24			Race/ethnicity	0.02	0.98			Race/ethnicity	0.01	0.25			Race/ethnicity	0.01	0.32
		Education	−0.02	−0.65			Education	−0.03	−1.17			*Education*	*0.05*	*2.48*			*Education*	*0.12*	*4.18*			*Education*	*0.10*	*3.50*
		BMI	*−0.15*	*−5.51*			*BMI*	*−0.14*	*−5.72*			BMI	0.01	0.36			*BMI*	*0.11*	*3.96*			*BMI*	*0.09*	*3.56*
Explicit																								
1,601	0.07	*Gender*	*0.09*	*3.69*	1,775	0.07	*Gender*	*0.11*	*4.90*	3,374	0.02	*Gender*	*0.05*	*2.93*	1,591	0.08	*Gender*	*−0.09*	*−3.54*	1,773	0.08	*Gender*	*−0.12*	*−5.12*
		Age	−0.05	−1.75			*Age*	*−0.10*	*−3.62*			*Age*	*−0.10*	*−4.88*			Age	0.00	−0.12			Age	−0.03	−1.00
		Race/ethnicity	−0.04	−1.66			*Race/ethnicity*	*−0.10*	*−4.33*			Race/ethnicity	−0.02	−1.04			*Race/ethnicity*	*0.07*	*3.00*			*Race/ethnicity*	*0.09*	*3.75*
		Education	*0.07*	*2.33*			*Education*	*0.11*	*4.11*			*Education*	*0.09*	*4.79*			Education	−0.04	−1.48			Education	0.01	0.19
		BMI	*−0.23*	*−9.19*			*BMI*	*−0.19*	*−7.98*			*BMI*	*0.09*	*5.05*			*BMI*	*0.26*	*10.58*			*BMI*	*0.24*	*10.11*

All factors in italics were significant ($p < 0.05$).
BMI, body mass index.

normal weight category when this was compared with *obese* (gender: β = 0.11, t(1, 775) = 4.90, $p < 0.01$; education: β = 0.11, t(1, 775) = 4.11, $p < 0.01$; BMI: $\beta = -0.19$, t(1, 775) = -7.98, $p < 0.01$)) and *overweight* categories (gender: β = 0.09, t(1, 601) = 3.69, $p < 0.01$; education: β = 0.07, t(1, 601) = 2.33, $p < 0.05$; BMI: $\beta = -0.23$, t(1, 601) = -9.19, $p < 0.01$). That is, male, more educated and leaner participants showed stronger explicit preferences for the normal weight category. In addition, in the comparison *obese–normal weight*, a significant effect of age ($\beta = -0.10$, t(1, 775) = -3.62, $p < 0.01$) and race/ethnicity ($\beta = -0.10$, t(1, 775) = -4.33, $p < 0.01$) was found, indicating stronger explicit preferences for the *normal weight category* among younger, Caucasian or Asian (vs. Hispanic or African–American) participants.

Normal weight–underweight comparison

Implicit level: Gender (β = 0.08, t(3, 071) = 4.30, $p < 0.01$) and educational level (β = 0.05, t(3, 071) = 2.48, $p < 0.01$) were positively related with implicit preferences for the *normal weight* category when this category was compared with the *underweight* category, indicating stronger implicit preferences for the *normal weight* category among male and more educated participants.

Explicit level: Gender (β = 0.05, t(3, 374) = 2.93, $p < 0.01$), age ($\beta = -0.10$, t(3, 374) = -4.88, $p < 0.01$), educational level (β = 0.09, t(3, 374) = 4.79, $p < 0.01$) and BMI (β = 0.09, t(3, 374) = 5.05, $p < 0.01$) were significant predictors of explicit preferences for the *normal weight* category in the *normal weight–underweight* comparison. That is, male, younger, more educated and heavier individuals reported stronger explicit preferences for the *normal weight* category.

Underweight–overweight and underweight–obese comparisons

Implicit level: Educational level and BMI were associated with implicit pro-overweight/obese preferences when *underweight* category was compared with both *obese* (BMI: β = 0.09, t(1, 602) = 3.56, $p < 0.01$; education: β = 0.10, t(1, 602) = 3.50, $p < 0.01$) and *overweight* categories (BMI: β = 0.11, t(1, 468) = 3.96, $p < 0.01$; Education: β = 0.12, t(1, 468) = 4.18, $p < 0.01$). That is, more educated and heavier participants showed stronger implicit pro-overweight/obese preferences.

Explicit level: Gender, race/ethnicity and BMI were significant predictors of explicit pro-underweight preferences when the *underweight* category was contrasted with both the *obese* (gender: $\beta = -0.12$, t(1, 773) = -5.12, $p < 0.01$; race/ethnicity: β = 0.09, t(1, 773) = 3.75,

$p < 0.01$; BMI: $\beta = 0.24$, $t(1, 773) = 10.11$, $p < 0.01$) and *overweight* (gender: $\beta = -0.09$, $t(1, 591) = -3.54$, $p < 0.01$; race/ethnicity: $\beta = 0.07$, $t(1, 591) = 3.00$, $p < 0.01$; BMI: $\beta = 0.26$, $t(1, 591) = 10.58$, $p < 0.01$) categories. That is, male, leaner, Caucasian or Asian (vs. Hispanic or African–American) participants reported stronger pro-underweight preferences.

Discussion

The current study is the first to investigate and directly compare weight-related preferences among different weight categories by means of both implicit and explicit measures.

In agreement with previous research suggesting negativity towards individuals with obesity and anorexia (1–3,6), results showed preferences for the normal weight category when this category was compared with overweight/obese and underweight categories. This result was observed both at the implicit and explicit levels, indicating that the stigma towards overweight/obese and underweight categories was present both at the conscious and unconscious levels.

In contrast, when overweight/obese category was directly compared with the underweight category, results showed a dissociation between preferences at implicit and explicit levels: participants showed pro-overweight/obese preferences at the implicit level and pro-underweight preferences at the explicit level. Such dissociation between implicit and explicit measures suggests that the pro-overweight/obese preferences observed at the unconscious level may be denied or rejected at a conscious level.

The pro-underweight preferences found at the explicit level in the present experiments may be explained by social pushes present in the Western societies (where our participants were recruited). Explicit measures assess conscious and controllable attitudes by means of self-reports, while implicit measures infer unconscious and automatic attitudes with behavioural measures (18). Explicit measures are thus more influenced by intentional and social desirability processes, and for this reason, they tend to reflect standards of own culture and society (21,22). In Western societies, the cultural ideal of beauty has become synonymous with thinness (23), and it is partially acceptable to denigrate people with obesity (24). In the USA, the rate of obesity is high and people are continuously exposed to media messages aimed at reducing this condition, and underweight individuals may be also viewed positively and elicit some level of admiration because they exert self-control to their own weight (25). Thus, the powerful contrast between model of beauty and problem of obesity in Western societies may further increase the desirability of thinness compared with obesity and affect weight-related preferences at a conscious level, leading participants to respond to subjective explicit self-reports by comparing themselves with models of Western culture and society.

The pro-overweight/obese preferences found instead at the implicit level may be the results of deeper concerns, whereby underweight individuals may be viewed negatively because an extreme low body weight has maladaptive and dangerous health consequences, including death. Such concerns may not be evident at the explicit level because of the present social pressure for thinness as discussed in the previous paragraph. However, they become evident at the implicit level as they are related to basic needs as that of self-preservation and survival of the individual firmly established in our mind. Indeed, the unhealthy and harmful consequences related to anorexia are well known. Although maintaining a low body weight can reduce some anxiety associated with body weight and shape, it has several adverse effects on one's physical (i.e. heart and circulation, sex hormones and fertility, bones, intestinal function, muscles, skin and hair, temperature regulation and sleep), psychological (i.e. thinking and concentration, feelings and mood and behaviour) and social functioning (26). In addition, the mortality rate in AN is the highest among all psychiatric disorders (27) and 5.86 times higher than the expected number of deaths in the general population (28). The severe health consequences associated with anorexia and its strong link with the concept of death may thus lead to increase the negativity towards underweight individuals at the implicit level. From an evolutionary point of view, this implicit negativity may be necessary to maintain an internal consistency towards survival. Indeed, according to evolutionary theories, humans possess mechanisms that allow them to detect and exclude pathogen-carrying conspecifics. Specifically, individuals are stigmatized if they are perceived or display features that are markers of disease, even when they neither pose a direct health risk nor are contagious to others (29,30). Disease-relevant cognitions and emotions may thus be more likely inspired by the perception of individuals who are skeletally thin than those with obesity.

Future research, using explicit references to a healthy or unhealthy condition, would be thus valuable to test whether the weight-related attitudes found here could be influenced by their potential health consequences. Indeed, although a low body weight is more likely to be associated with health problems, in Western societies, individuals with a BMI below the normal range might be also perceived as healthy.

Implicit pro-overweight/obese preferences may be also explained by additional automatic associations related to

Table 3 Implicit and explicit attitudes among healthcare professionals in the sample

	Health professionals							
	Implicit				Explicit			
	N	Mean	SD	Cohen's *d*	*N*	Mean	SD	Cohen's *d*
Normal weight–overweight	160	0.22	0.45	0.49	172	1.16	1.28	0.91
Normal weight–obese	179	0.22	0.43	0.51	194	1.22	1.25	0.98
Normal weight–underweight	337	0.29	0.46	0.63	367	1.14	1.27	0.90
Underweight–overweight	161	−0.08	0.46	−0.17	170	0.11	1.15	0.10
Underweight–obese	179	−0.16	0.47	−0.34	195	0.38	1.15	0.33

Each row shows the results for one of the five comparisons performed in the present study. All implicit and explicit scores were significantly different from 0 ($p < 0.01$). For every comparison (e.g. normal weight–obese), a positive score indicates a preference for the first weight category (i.e. normal weight), while a negative score indicates a preference for the second weight category (i.e. obese). Explicit and implicit scores for the normal–underweight comparison were computed by aggregating data collected in both the two versions of the self-items and Multi-category Implicit Association Test.

be underweight, including poverty and war. Indeed, poverty refers to the deprivation of basic human needs that commonly include food. Similarly, conflicts consistently disrupt food production and force people to flee their homes, leading to hunger emergencies as the displayed find themselves without the means to feed themselves. Such negative associations firmly established in our mind may thus lead us to implicitly prefer individuals with obesity over underweight individuals.

The present study also found that, for some comparisons among the investigated weight categories, implicit and explicit preferences were influenced by socio-demographical factors.

Overall, weight preferences were related to BMI, i.e. although people showed, on average, no clear preference for their own BMI category, they nonetheless exhibited less negativity towards it than people belonging to other BMI categories. These results are in accordance with previous studies (12,31) showing that people with obesity prefer thin people on average, but these preferences are weaker than those exhibited by normal weight and underweight people.

In addition, consistently with previous research (32–35), less negativity towards some weight categories was observed among women, less educated individuals, older people, Hispanic and African–American individuals. Minority groups are more subjected to social discrimination and negative judgments, and thus, they may be more sensitive to social biases and, for this reason, show less negativity towards stigmatized weight categories.

The present study provides several relevant insights concerning the weight-related stigma. However, some limitations should be noted. The sample might not represent a random selection of the general population. Indeed, several selection biases could have influenced the composition of the sample used in this study, such as people who voluntarily participated in the research because they are interested in assessing their own weight-related preferences. Although it is not possible to identify a plausible reason why variation in selection biases would explain the dissociation between implicit and explicit found here, replication with other samples will be very useful to increase the confidence of the present results.

Taken together, these results may have important implications at the behaviour level. Indeed, research showed that implicit attitudes predict prejudiced behaviours more effectively than explicit attitudes (13–15). For example, a recent study in the healthcare setting showed that implicit (but not explicit) measures predicted physicians' thrombolysis decisions for myocardial infarction (36). An explorative analysis of the data collected in the present study showed that healthcare professionals ($N = 391$) held the same weight-related bias as the general population (Table 3). Further studies that include assessment of behaviour and decision-making will be thus important to determine how the implicit weight-related attitudes found here might contribute to social disparities, especially in the healthcare setting (e.g. clinical behaviour and decisions and quality of care delivered to underweight and overweight/obese patients).

Conflict of Interest Statement

Authors declare no conflict of interest.

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References

1. Puhl RM, Brownell KD. Bias, discrimination, and obesity. *Obes Res* 2001; **9**: 788–805.
2. Puhl RM, Heuer CA. The stigma of obesity: a review and update. *Obesity* 2009; **17**: 941–964.
3. Puhl RM, Suh Y. Stigma and eating and weight disorders. *Curr Psychiatry Rep* 2015; **17**: 1–10.
4. Fleming J, Szmukler GI. Attitudes of medical professionals towards patients with eating disorders. *Aust N Z J Psychiatry* 1992; **26**: 436–443.
5. Roehrig JP, McLean CP. A comparison of stigma toward eating disorders versus depression. *Int J Eat Disord* 2010; **43**: 671–674.
6. Crisp A. Stigmatization of and discrimination against people with eating disorders including a report of two nationwide surverys. *Eur Eat Disord Rev* 2005; **13**: 147–152.
7. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision*. American Psychiatric Association: Washington, DC, 2000.
8. Ebneter DS, Latner JD. Stigmatizing attitudes differ across mental health disorders: a comparison of stigma across eating disorders, obesity, and major depressive disorder. *J Nerv Ment Dis* 2013; **201**: 281–285.
9. Zwickert K, Rieger E. Stigmatizing attitudes towards individuals with anorexia nervosa: an investigation of attribution theory. *J Eat Disord* 2013; **1**: 5.
10. Greenwald AG, Banaji MR. Implicit social cognition: attitudes, self-esteem, and stereotypes. *Psychol Rev* 1995; **102**: 4–27.
11. Teachman BA, Brownell KD. Implicit anti-fat bias among health professionals: is anyone immune? *Int J Obes Relat Metab Disord* 2001; **25**: 1525–1531.
12. Marini M, Sriram N, Schnabel K, et al. Overweight people have low levels of implicit weight bias, but overweight nations have high levels of implicit weight bias. Serino A (ed.). *PLoS One* 2013; **8**: e83543.
13. Dovidio JF, Kawakami K, Johnson C, Johnson B, Howard A. On the nature of prejudice: automatic and controlled processes. *J Exp Soc Psychol* 1997; **33**: 510–540.
14. Fazio RH, Jackson JR, Dunton BC, Williams CJ. Variability in automatic activation as an unobtrusive measure of racial attitudes: a bona fide pipeline? *J Pers Soc Psychol* 1995; **69**: 1013–1027.
15. Greenwald AG, Poehlman TA, Uhlmann EL, Banaji MR. Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity. *J Pers Soc Psychol* 2009; **97**: 17–41.
16. Bessenoff G, Sherman J. Automatic and controlled components of prejudice toward fat people: evaluation versus stereotype. *Soc Cogn* 2000; **18**: 329–353.
17. Nosek BA, Sriram N, Smith CT, Bar-Anan Y. The Multi-category Implicit Association Test. 2014.
18. Greenwald AG, McGhee DE, Schwartz JL. Measuring individual differences in implicit cognition: the Implicit Association Test. *J Pers Soc Psychol* 1998; **74**: 1464–1480.
19. Nosek BA, Bar-Anan Y, Sriram N, Axt J, Greenwald AG. Understanding and using the Brief Implicit Association Test: recommended scoring procedures. *PLoS One* 2014; **9**: e110938.
20. Axt JR, Ebersole CR, Nosek BA. The rules of implicit evaluation by race, religion, and age. *Psychol Sci* 2014; **25**: 1804–1815.
21. Heine SJ, Buchtel EE, Norenzayan A. What do cross-national comparisons of personality traits tell us? The case of conscientiousness. *Psychol Sci* 2008; **19**: 309–314.
22. Peng K, Nisbett RE, Wong NYC. Validity problems comparing values across cultures and possible solutions. *Psychol Methods* 1997; **2**: 329–344.
23. Wiseman CV, Gray JJ, Mosimann JE, Ahrens AH. Cultural expectations of thinness in women: an update. *Int J Eat Disord* 1992; **11**: 85–89.
24. Crandall CS. Prejudice against fat people: ideology and self-interest. *J Pers Soc Psychol* 1994; **66**: 882–894.
25. Branch CH, Eurman LJ. Social attitudes toward patients with anorexia nervosa. *Am J Psychiatry* 1980; **137**: 631–632.
26. Fairburn CG. *Cognitive Behavior Therapy and Eating Disorders*. Guilford Press: New York, 2008.
27. Espie J, Eisler I. Focus on anorexia nervosa: modern psychological treatment and guidelines for the adolescent patient. *Adolesc Health Med Ther* 2015; **6**: 9–16.
28. Arcelus J, Mitchell AJ, Wales J, Nielsen S. Mortality rates in patients with anorexia nervosa and other eating disorders. A meta-analysis of 36 studies. *Arch Gen Psychiatry Gen Psychiatry* 2011; **68**: 724–731.
29. Park JH, Faulkner J, Schaller M. Evolved disease-avoidance processes and contemporary anti-social behavior: prejudicial attitudes and avoidance of people with physical disabilities. *J Nonverbal Behav* 2003; **27**: 65–87.
30. Schaller M, Duncan LA. The behavioral immune system: its evolution and social psychological implications. In: Forgas JP, Haselton MG, von Hippel W (eds). *Evolution and the Social Mind: Evolutionary Psychology and Social Cognition*. Psychology Press: New York, 2007, pp. 293–307.
31. Schwartz MB, Vartanian LR, Nosek BA, Brownell KD. The influence of one's own body weight on implicit and explicit anti-fat bias. *Obesity* 2006; **14**: 440–447.
32. Falkner NH, French SA, Jeffery RW, Neumark-Sztainer D, Sherwood NE, Morton N. Mistreatment due to weight: prevalence and sources of perceived mistreatment in women and men. *Obes Res* 1999; **7**: 572–576.
33. Sabin JA, Marini M, Nosek BA. Implicit and explicit anti-fat bias among a large sample of medical doctors by gender, BMI and race/ethnicity. *PLoS One* 2012; **7**: e48448.
34. Puhl RM, Andreyeva T, Brownell KD. Perceptions of weight discrimination: prevalence and comparison to race and gender discrimination in America. *Int J Obes (Lond)* 2008; **32**: 992–1000.
35. Puhl RM, Latner JD, O'Brien K, Luedicke J, Danielsdottir S, Forhan M. A multinational examination of weight bias: predictors of anti-fat attitudes across four countries. *Int J Obes (Lond)* 2015; **39**: 1166–1173.
36. Green AR, Carney DR, Pallin DJ, et al. Implicit bias among physicians and its prediction of thrombolysis decisions for Black and White patients. *J Gen Intern Med* 2007; **22**: 1231–1238.