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Correlates of Weight Bias in Adults From the NutriNet-Santé Study

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1 **Title**

2 Correlates of weight bias in adults from the NutriNet-Santé study

3

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33

34 **Abstract**

35 **Introduction:** Explicit weight bias (EWB) is an underlying cause of weight stigma but its
36 associations with individual characteristics are not well known. This study aimed to assess EWB
37 in French adults and to explore associations with weight status and sociodemographic
38 characteristics.

39 **Methods:** Adults from the NutriNet-Santé cross-sectional study (France, 2020, n=33948, 52%
40 women after weighting procedures) completed the Anti-Fat Attitudes Questionnaire assessing
41 three dimensions: *Dislike* (antipathy towards people with obesity), *Fear of fat* (concerns about
42 body weight) and *Willpower* (belief in weight controllability). Associations with weight status
43 and sociodemographic characteristics were examined using multi-variable ANCOVA models in
44 2022.

45 **Results:** *Fear of fat* and *Willpower* scores were higher than *Dislike* scores (mean [SD]: 4.0 [2.0],
46 3.3 [1.7] and 1.9 [1.3], respectively). *Fear of fat* was higher among women, whereas *Dislike* and
47 *Willpower* were higher among men (all P<0.0001). Obesity was associated with greater *Fear of*
48 *fat* scores (P<0.0001, mean difference vs. normal-weight participants [95% CI]: 0.35 [0.24;0.46]
49 in women, 0.36 [0.17;0.56] in men), lower *Dislike* scores (-0.38 [-0.45;-0.32] in women, -0.43 [-
50 0.56;-0.30] in men) and lower *Willpower* scores (-1.00 [-0.18;-0.90] in women, -0.40 [-0.57;-
51 0.23] in men). In both genders, lower income was associated with lower *Dislike*, *Fear of fat* and
52 *Willpower* scores (all P<0.0001), and lower education with greater *Fear of fat* and *Willpower*
53 scores (all P<0.0001).

54 **Conclusions:** EWB was driven by the fear of gaining weight and the belief in weight
55 controllability. This study provides new insights into which population subgroups should be
56 targeted by interventions aimed at reducing EWB.

57

58 **Introduction**

59

60 People living with obesity experience weight stigma in many life domains, especially women.¹
61 Weight stigma, defined as “social devaluation and denigration of individuals because of their
62 excess body weight”,¹ negatively affects social interactions, reduces professional opportunities,
63 favors eating disorders, depression, anxiety, weight gain or avoidance of physical activity, and
64 decreases the use of preventive services.¹⁻³ Because it reinforces social and health inequities and
65 hinders obesity management efforts, weight stigma has been targeted by several public health
66 institutions as a public health priority.^{1,4,5}

67

68 Negative attitudes towards others because of their weight, namely weight bias, are thought to be
69 the underlying cause of weight stigma.¹ Explicit weight bias (EWB) refers to intentional and
70 conscious negative attitudes towards people living with obesity,⁶ including antipathy, the
71 assumption that people with obesity lack self-discipline and willpower, as well as the excessive
72 fear of gaining weight.⁷ Weight bias is supported by popular narratives around obesity, which
73 oversimplify the causes of obesity and emphasize individual responsibility without considering
74 important biological, social and environmental factors.¹

75

76 In the literature on weight stigma, there is research focusing on the experiences of people living
77 with obesity, and research focusing on individuals' attitudes towards people with obesity.¹ For the
78 latter purpose, studies have been conducted in North America,⁸⁻¹¹ in northern^{8,12,13} or western
79 parts of Europe,¹⁴⁻¹⁶ or globally,¹⁷ and suggest that EWB is common in adults. Women^{8,13,16} and
80 people with obesity^{9,14,16,17} report lower scores of antipathy and belief in weight controllability. In

81 contrast, there have been mixed findings regarding the associations with age and socioeconomic
82 position.^{8,13-16} The fear of gaining weight has received less attention, but appears to be greater in
83 women and in those with obesity.¹⁶ The generalizability of these studies is limited either by small
84 sample sizes⁸⁻¹² or by the assessment of one unique dimension of EWB.^{11,13,17} In addition, despite
85 scientific literature documenting gender differences in both the prevalence of weight stigma¹ and
86 the level of EWB^{8,13,16}, to the best of the author's knowledge, no population-based study
87 examined the associations between the different dimensions of EWB and characteristics (weight
88 status or socio-demographics) according to gender. Thus, available data point out the need to
89 implement prevention programs and education campaigns to reduce EWB in the adult population.
90 However, they are insufficient to inform public health stakeholders on the population subgroups
91 that are most likely to report EWB in its different dimensions. Additional data improving
92 knowledge on the associations between weight status, sociodemographic characteristics and each
93 dimension of EWB in both men and women are therefore needed to consider and design tailored
94 public health interventions.

95

96 In this context, this study aimed to assess different dimensions of EWB in a large sample of
97 French adults, and to examine whether weight status and various indicators of socioeconomic
98 position and sociodemographic characteristics were associated with EWB in gender-stratified
99 analyses.

100

101 **Methods**

102

103 **Study population**

104 NutriNet-Santé is a web-based cohort launched in 2009. Participants are Internet-using adult
105 volunteers recruited among the general French population.¹⁸ At inclusion and each year
106 thereafter, participants complete a set of self-administered questionnaires regarding
107 sociodemographic and lifestyle characteristics, and anthropometry.^{19,20} They are also regularly
108 invited to fill in complementary questionnaires on nutrition-related behaviors. All questionnaires
109 are completed using a dedicated secure website (<https://etude-nutrinet-sante.fr/>). NutriNet-Santé
110 study is registered on ClinicalTrials.gov and is conducted according to the Declaration of
111 Helsinki guidelines and approved by the Institutional Review Board of the French Institute for
112 Health and Medical Research (IRB Inserm) and the “Commission Nationale de l’Informatique et
113 des Libertés” (CNIL n°908450/n°909216).

114

115 **Measures**

116

117 EWB was assessed on one occasion between July 2019 and January 2020 using the validated
118 Crandall’s 13-item Anti-Fat Attitudes Questionnaire (AFAQ).^{7,21} This questionnaire, presented in
119 detail in **Appendix Table 1**, includes 3 subscales: *Dislike* (7 items assessing antipathy towards
120 people with obesity), *Fear of fat* (3 items reflecting personal concerns with body weight) and
121 *Willpower* (3 items assessing the belief in weight controllability). The AFAQ was cross-culturally
122 adapted from English into French (Appendix Table 1).²² All scores and subscale scores showed
123 good internal consistency (Cronbach’s $\alpha = 0.87, 0.87, 0.81$ and 0.85 for the total AFAQ score, the
124 *Dislike*, *Fear of fat* and *Willpower* subscales, respectively). The *Dislike*, *Fear of fat* and
125 *Willpower* scores were calculated as the mean values of items 1 to 7, 8 to 10, and 11 to 13,
126 respectively. A total score was also calculated (mean value of the 13 items). Responses were
127 rated on a 9-point Likert scale, a higher score indicating a greater level of EWB.

128
129 Body mass index (BMI, kg/m^2 , ratio of self-reported weight (kg) to squared self-reported height
130 (m^2)), was classified into five categories: underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal weight (18.5
131 $\leq \text{BMI} < 25.0 \text{ kg/m}^2$), overweight ($25.0 \leq \text{BMI} < 30.0 \text{ kg/m}^2$), moderate obesity ($30.0 \leq \text{BMI} <$
132 35.0 kg/m^2), severe obesity ($\geq 35.0 \text{ kg/m}^2$). Participants also reported their family history of
133 obesity (among parents and siblings). Sociodemographics included gender, age, and type of
134 residential area (i.e. rural community or urban unit with < 20000 , 20000 to 200000 or 200000
135 inhabitants)²³. Socio-economic position included highest educational attainment, occupational
136 category and monthly income. Monthly household income included net salary, social benefits,
137 family allowance, rental income and was calculated by household units. One household unit was
138 attributed for the first adult in the household, 0.5 for other persons aged 14 years or older and 0.3
139 for children under 14 years. Categories used for monthly income were as follows: $<1200 \text{ €}$
140 ($<1310 \text{ USD}$), $1200\text{-}1800 \text{ €}$ ($1310\text{-}1965 \text{ USD}$), $1800\text{-}2700 \text{ €}$ ($1965\text{-}2948 \text{ USD}$), and $>2700 \text{ €}$
141 ($>2948 \text{ USD}$) per household unit, plus a category for individuals unwilling to answer. Body
142 weight was collected on the day of completion of the AFAQ. Sociodemographic characteristics
143 were extracted from the questionnaire completed on the date closest to the date of completion of
144 the AFAQ (mean [min-max] time period: 0.8 [0-10.8] y).

145

146 **Statistical analysis**

147 Analyses were conducted in 2022 and were restricted to participants without missing data on
148 covariates and living in mainland France to permit the computation of the weighting procedure
149 described below. Characteristics of the included and not included participants were compared
150 using χ^2 tests for categorical variables and Wilcoxon tests for continuous variables.

151 In order to improve the representativeness of the sample compared to the French population,²⁴
152 and thus to improve the estimation of EWB in French adults, weighting was calculated using the
153 iterative proportional fitting procedure according to a national census report²³ on age, gender,
154 occupational category, educational level, and residential area for each gender. Descriptive
155 characteristics of the weighted study sample were compared between men and women using χ^2
156 and t-tests, as appropriate.

157 All AFAQ scores were analyzed as continuous variables to identify associations with weight
158 status and sociodemographic characteristics. Graphical methods (Q–Q plots and histograms) and
159 numerical methods (skewness and kurtosis) were used to estimate whether the residuals were
160 normally distributed for all models conducted. Continuous variables (BMI, age) were categorized
161 since restricted cubic spline analyses suggested evidence for non-linear associations with AFAQ
162 scores. Analyses of covariance (ANCOVA) models were performed to obtain adjusted means
163 (95% CI), using observed margins. When significant associations were found, pairwise post-hoc
164 testing corrected for multiple comparisons was performed, using Bonferroni test. Mean
165 differences between each group and the reference group were also provided, along with their 95%
166 CI. Models were stratified by gender ($P_{\text{interaction}} < 0.0001$ between gender and weight status or
167 sociodemographic characteristics for all subscale scores) and adjusted for age and BMI
168 (continuous), family history of obesity, educational level, occupational status, monthly income
169 per household unit, residential area; all of which were significantly associated ($P_{\text{value}} < 0.0001$)
170 with the AFAQ score in univariate analyses. All tests were two-sided and $P < 0.05$ was considered
171 statistically significant. SAS® software version 9.4 was used for analyses and R software version
172 4.0.3 ([http:// www.r- project. org](http://www.r-project.org)) for figures.

173

174 **Results**

175

176 From the 36232 participants who completed the AFAQ, 33948 participants with no missing
177 covariates and who were living in mainland France were retained (**Appendix Figure 1**).

178 Participants excluded from the analyses differed in terms of gender, age, BMI and all
179 sociodemographic characteristics (**Appendix Table 2**). Descriptive characteristics of the
180 weighted sample are presented in **Table 1**. In the weighted sample, 6%, 62% and 38% of women
181 and 12%, 47% and 54% of men presented a score ≥ 4 for *Dislike*, *Fear of fat* and *Willpower*,
182 respectively. *Dislike* and *Willpower* were higher in men, while *Fear of fat* was higher in women.

183

184 Compared with normal-weight participants, those with overweight, moderate and severe obesity
185 reported lower *Dislike* scores, with a mean difference (MD) (95% CI) of -0.29 (-0.34;-0.25), -
186 0.38 (-0.45;-0.32) and -0.54 (-0.63;-0.46) in women, respectively, and -0.15 (-0.23;-0.07), -0.43
187 (-0.56;-0.30) and -0.65 (-0.87;-0.43) in men (**Figure 1A**). In both genders, lower income and
188 living in a rural community or small urban unit were associated with lower *Dislike* scores (**Table**
189 **2 and 3**). In women, a lower age, a family history of obesity, a lower educational level and being
190 an employee or a manual worker were associated with lower *Dislike* scores. In men, a family
191 history of obesity and being < 30 y were associated with greater *Dislike* scores whereas being
192 middle-aged was associated with lower scores.

193

194 Participants with overweight, moderate and severe obesity reported higher *Fear of fat* scores
195 (MD [95% CI] vs. normal-weight participants: 0.15 [0.07;0.23], 0.35 [0.24;0.46] and 0.56
196 [0.41;0.71] in women, respectively, and 0.28 [0.16;0.39], 0.36 [0.17;0.56] and 1.33 [1.01;1.66] in

197 men), whereas those with underweight reported lower scores (MD [95% CI]: -0.80 [-0.93;-0.68]
198 in women and -0.86 [-1.30;-0.42] in men) (**Figure 1B**). In both genders, having a family history
199 of obesity, a lower educational level and being a student were associated with greater *Fear of fat*
200 scores, whereas lower income was associated with lower *Fear of fat* scores. In women, a younger
201 age was also associated with greater *Fear of fat* scores. In men, living in a small urban unit was
202 associated with greater *Fear of fat* scores, and living in a rural community was associated with
203 lower scores.

204
205 In women, participants with overweight, moderate and severe obesity reported lower *Willpower*
206 scores than normal-weight participants (MD [95% CI]: -0.53 [-0.59;-0.46], -1.00 [-1.08;-0.90]
207 and -1.49 [-1.61;-1.37], respectively) (**Figure 1C**). In men, participants with underweight,
208 overweight and with moderate and severe obesity reported lower *Willpower* scores (MD [95%
209 CI]: -0.75 [-1.13;-0.38], -0.13 [-0.24;-0.03], -0.40 [-0.57;-0.23] and -0.79 [-1.07;-0.51],
210 respectively). In both genders, a lower educational level was associated with greater *Willpower*
211 scores whereas lower income was associated with lower *Willpower* scores. A family history of
212 obesity was associated with lower *Willpower* scores in women and greater scores in men. Only
213 among men, a younger age and living in a moderate to large urban unit were associated with
214 lower *Willpower* scores.

215

216 **Discussion**

217

218 This study assessed EWB in a large sample of French adults from the NutriNet-Santé study and
219 increases knowledge of EWB in western Europe, where little recent data is available.¹⁴⁻¹⁶

220 Consistent with existing literature,^{7,10,16,25} greater *Fear of fat* and *Willpower* scores than *Dislike*
221 scores were observed. Overall, this study reported lower scores than those usually observed when
222 using the same scale,^{8,10,16} with mean *Dislike*, *Fear of fat* and *Willpower* scores of 1.9, 4.0 and
223 3.3, respectively, vs. 2.4, 4.6 and 4.6 in a Canadian study.¹⁰ Higher *Willpower* scores of 6.4 have
224 even been documented in the US and in Northern Europe.⁸ Results of the present study were
225 however comparable to those observed in Spain,¹⁶ a country culturally close to France. In the
226 latter study,¹⁶ scores were obtained from a 1 to 9-point Likert scale and were higher of
227 approximately 0.5 to 1 point compared to the present one, obtained from a 0 to 8-point scale.
228 Cultural aspects may explain these differences between studies. Indeed, studies by Crandall et al.
229 found that political and societal views, i.e. conservative ideologies and the tendency to hold
230 people responsible for their health or socioeconomic status, were associated with greater
231 *Willpower* scores.^{7,26} In France, the universal healthcare system is based on the collectivistic
232 concept of providing an equal right to care for all, which may help explain why French adults
233 may be less likely to endorse the idea that individuals are entirely responsible for their own health
234 and, thus, their weight status.²⁷

235
236 A major and original aim of this study was to identify associations between weight status,
237 sociodemographics and EWB in gender-stratified analyses. A normal-weight status, a lower
238 educational level and higher income were positively associated with the *Willpower* score in both
239 genders. In agreement with previous literature,^{16,25} higher scores were found in men. In addition,
240 stratified analyses allowed more pronounced differences to be observed between groups in men,
241 suggesting higher variability of this score across the men's population. Since the belief in weight
242 controllability is thought to be the leading cause of weight stigma,¹ it is essential to identify
243 effective interventions to change beliefs in this area, especially in young men and with normal

244 weight. Among potential interventions, educating the public about the multifactorial causes of
245 obesity appears to be particularly beneficial.⁸ Indeed, attending a curriculum program detailing
246 the genetic, social and environmental causes of obesity reduces the belief in weight
247 controllability to a greater extent than pursuing a program focusing on the benefits of diet and
248 physical activity for avoiding weight gain.²⁸ Educational programs and large scale
249 communication campaigns would be needed to not only rely on the popular narrative “Eat less,
250 move more”, which likely leads to overestimation of the role of personal responsibility in obesity
251 prevention and management.^{1,5}

252

253 In both genders, the highest *Fear of fat* scores were observed in people with obesity, even more
254 so in severe obesity, and in university students. Although this study did not assess whether the
255 fear of gaining weight was related to body acceptance issues or to health concerns, one can
256 hypothesize that the higher scores observed in women, in this study and others,^{16,25} may be
257 explained by the greater vulnerability of women to images of idealized bodies, who are therefore
258 more likely to internalize the thin-ideal beauty depicted by mass media.²⁹ This impact could be
259 amplified among younger women, who are increasingly exposed to weight-loss advertising and
260 weight-stigmatizing content on social media.³⁰ Although movements promoting body acceptance
261 and size diversity have gained popularity in recent years,³¹ more efforts are needed to make these
262 ideas more widely available to the public, especially to young women and university students
263 who appear to be particularly concerned by the fear of gaining weight. Social media platforms
264 may be seen as an opportunity to promote positive narratives around body acceptance,³⁰ while
265 acknowledging that maintaining a BMI within the normal range is a protective factor for many
266 chronic diseases.³²

267

268 Finally, *Dislike* scores were low and suggest that people disagree, on average, with statements
269 that reflect dislike for people living with obesity. Variability across weight status and
270 sociodemographic characteristics was also lower than for *Fear of fat* and *Willpower* scores.
271 Except for BMI, mean differences between categories were generally < 0.3 point, suggesting that
272 the level of *Dislike* is relatively stable across population subgroups. The clinical meaning of such
273 differences can be questioned and is difficult to estimate given the lack of standard threshold to
274 categorize EWB in the current literature.¹⁰ However, it is acknowledged that small effect sizes
275 may have an impact at the population level if changes occur in large samples.³³ Overall, the low
276 *Dislike* scores observed in this study contrast with the prevalence of weight discrimination, which
277 reaches up to 56% in France.³⁴ The very low scores observed in people with obesity also contrast
278 with previous studies documenting that a large proportion of people with obesity apply negative
279 weight stereotypes to themselves and thus tend to believe that they deserve to be stigmatized
280 because of their weight status.³⁵ Thus, although these results are encouraging and suggest overall
281 positive attitudes towards people with obesity, they should be interpreted with caution since
282 participants may be particularly prone to social desirability bias in this domain and may refrain
283 from explicit endorsements of negative attitudes.³⁶

284
285 Strengths of this observational study include its large sample size, the assessment of several
286 dimensions of EWB using a validated questionnaire,⁷ the gender-stratified analyses and the
287 consideration of confounding factors related to weight status, family history of obesity and socio
288 demographic characteristics. However, some limitations should be mentioned. First, participants
289 of the NutriNet-Santé cohort are volunteers broadly interested in dietary and health issues,
290 whereas participants of previous studies were most often recruited from survey panels,^{8,10-15}.
291 Although a weighting procedure was conducted on age, gender, occupational category,

292 educational level and residential area, this may have been insufficient to fully overcome selection
293 bias. In particular, the prevalence of obesity was lower than the estimated prevalence in the
294 French adult population.³⁷ Exclusion of participants with missing covariates may have further
295 increased selection bias. Second, participants of the NutriNet-Santé cohort may be particularly
296 prone to social desirability bias when completing the AFAQ, even though weight stigma remains
297 one of the most socially acceptable form of bias.¹ Finally, the AFAQ was not designed to assess
298 the reasons why participants fear gaining weight. In future studies, it would be important to better
299 understand which participants fear gaining weight because they are aware of the health risks
300 associated with obesity or because they have internalized the thin-ideal beauty and are concerned
301 with body weight and image.

302

303 **Conclusions**

304 In this large sample of French adults, EWB was largely driven by the fear of gaining weight and
305 the belief in weight controllability. Women were more likely to fear gaining weight (especially
306 younger women, students, or those with obesity) and men were more likely to believe in weight
307 controllability (especially younger men or those with normal weight, a low education level or
308 higher income). In contrast, antipathy towards people with obesity was low and varied little
309 between groups. This leads us to advocate for the development of educational initiatives and
310 education campaigns promoting not only the importance of dietary habits and physical activity in
311 obesity prevention, but also promoting positive narratives around body acceptance and
312 emphasizing the social and environmental causes of obesity. This study provides new insights
313 into which population subgroups should be targeted by future interventions.

314

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334

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444 **Figures titles and footnotes**

445

446 **Figure 1**

447 **Title:** Mean scores for *Dislike* (A), *Fear of Fat* (B) and *Willpower* (C) subscales for each BMI
448 status group

449 **Footnotes:** All P_{values} from ANCOVA models were adjusted for: age (continuous), family history
450 of obesity, educational level, occupational status, monthly income per household unit, and
451 residential area and were < 0.0001.

452 * P< 0.05; ** P< 0.0001 for P_{values} from pairwise post-hoc testing corrected for multiple
453 comparisons was performed (Tukey's test).

454 Error bars represent 95% CI.

455 **Table 1.** Characteristics of participants, NutriNet-Santé study, 2020, France (weighted sample)

Characteristics	All N=33948	Women N=17778 (52.4%)	Men N=16170 (47.6%)
AFAQ score, mean (SD)	2.7 (1.2)	2.6 (0.9)	2.8 (1.7)
Dislike score, mean (SD)	1.9 (1.3)	1.7 (1.0)	2.2 (1.8)
Fear of fat score, mean (SD)	4.0 (2.0)	4.3 (1.7)	3.6 (2.7)
Willpower score, mean (SD)	3.3 (1.7)	3.0 (1.4)	3.7 (2.3)
Age, n (%)			
<30 y	6066 (17.9)	3022 (17.0)	3044 (18.8)
30-50 y	11175 (32.9)	5660 (31.8)	5515 (34.1)
50-65 y	8371 (24.7)	4316 (24.3)	4055 (25.1)
>65 y	8336 (24.6)	4781 (26.9)	3556 (22.0)
BMI, n (%)			
Underweight	1436 (4.2)	1206 (6.8)	230 (1.4)
Normal weight	19387 (57.1)	10229 (57.5)	9157 (56.6)
Overweight	8772 (25.8)	3780 (21.3)	4992 (30.9)
Moderate obesity	2954 (8.7)	1681 (9.5)	1274 (7.9)
Severe obesity	1399 (4.1)	883 (5.0)	516 (3.2)
Family history of obesity, n (%)			
Yes	6944 (20.5)	4184 (23.5)	2759 (17.1)
No	27004 (79.5)	13594 (74.5)	13411 (82.9)
Educational level, n (%)			
Less than high-school diploma	17476 (51.5)	8942 (50.3)	8533 (52.8)
High school diploma	6384 (18.8)	3400 (19.1)	2983 (18.5)
Undergraduate	4123 (12.1)	2393 (13.5)	1730 (10.7)
Postgraduate	5966 (17.6)	3043 (17.1)	2923 (18.1)
Occupational status, n (%)			
Unemployed	3266 (9.6)	2179 (12.3)	1087 (6.7)
Student	1696 (5.0)	893 (5.0)	803 (5.0)
Self-employed. Farmer	3860 (11.4)	1254 (7.1)	2606 (16.1)
Employee, manual worker	12832 (37.8)	6476 (36.4)	6356 (39.3)
Intermediate professionals	8501 (25.0)	5455 (30.7)	3046 (18.8)
Managerial staff	3793 (11.2)	1521 (8.6)	2272 (14.1)
Monthly income per unit, n (%)			
< € 1200	5911 (17.4)	3178 (17.9)	2733 (16.9)
€ 1200-1799	9238 (27.2)	4634 (26.1)	4604 (28.5)
€ 1800-2699	8637 (25.4)	4366 (24.6)	4271 (26.4)
> € 2700	5966 (17.6)	2751 (15.5)	3214 (19.9)
Unwilling to answer	4196 (12.4)	2848 (16.0)	1348 (8.3)
Residential area, n (%)			
Rural community	7582 (22.3)	3830 (21.5)	3752 (23.2)
Urban unit (< 20000 inhabitants)	6440 (19.0)	3233 (18.2)	3207 (19.8)
Urban unit (20000 to 200000)	6668 (19.6)	3613 (20.3)	3055 (18.9)

inhabitants)			
Urban unit (> 200000 inhabitants)	13259 (39.1)	7103 (40.0)	6156 (38.1)

456 AFAQ: Anti-Fat Attitude Questionnaire.

457 P_{values} from t-test for continuous variables and χ^2 for categorical variables were all < 0.0001.

Table 2. Associations between sociodemographic characteristics and explicit weight bias in women, NutriNet-Santé study, 2020, France

(weighted sample)

Characteristics	<i>Dislike score</i>		<i>Fear of fat score</i>		<i>Willpower score</i>	
	Adjusted means (95% CI)	MD (95% CI)	Adjusted means (95% CI)	MD (95% CI)	Adjusted means (95% CI)	MD (95% CI)
Age						
<i>P</i> _{value} ¹		<0.0001		<0.0001		0.0005
<30 y	1.62 (1.58;1.66)	-0.33 (-0.40;-0.26)*	4.54 (4.48;4.61)	0.48 (0.36;0.59)*	3.04 (2.98;3.01)	0.07 (-0.02;0.17)
30-50 y	1.65 (1.63;1.68)	-0.30 (-0.35;-0.25)*	4.33 (4.29;4.38)	0.27 (0.18;0.36)*	3.04 (3.00;3.07)	0.07 (0.00;0.15)*
50-65 y	1.74 (1.71;1.77)	-0.21 (-0.26;-0.16)*	4.29 (4.24;4.34)	0.22 (0.13;0.30)*	2.96 (2.92;3.00)	-0.01 (-0.08;0.06)
> 65 y	1.95 (1.92;1.99)	Ref	4.07 (4.01;4.12)	Ref	2.96 (2.92;3.01)	Ref
Family history of obesity						
<i>P</i> _{value} ¹		<0.0001		<0.0001		<0.0001
Yes	1.72 (1.69;1.75)	-0.08 (-0.11;-0.05)*	4.42 (4.37;4.47)	0.23 (0.17;0.28)*	2.86 (2.81;2.90)	-0.17 (-0.22 ;-0.12)*
No	1.80 (1.79;1.82)	Ref	4.19 (4.17;4.22)	Ref	3.03 (3.00;3.05)	Ref
Educational level						
<i>P</i> _{value} ¹		<0.0001		<0.0001		<0.0001
Less than high-school diploma	1.71 (1.69;1.73)	-0.26 (-0.32;-0.20)*	4.27 (4.24;4.31)	0.11 (0.01;0.22)*	3.06 (3.03;3.08)	0.19 (0.11;0.28)*
High school diploma	1.81 (1.78;1.84)	-0.16 (-0.22;-0.09)*	4.34 (4.28;4.40)	0.18 (0.07;0.29)*	3.01 (3.0;3.3.05)	0.14 (0.06;0.23)*
Undergraduate	1.81 (1.77;1.85)	-0.16 (-0.22;-0.09)*	4.13 (4.06;4.20)	-0.03 (-0.14;0.08)	2.85 (2.79;2.91)	-0.01 (-0.10;0.08)
Postgraduate	1.97 (1.92;2.01)	Ref	4.16 (4.09;4.23)	Ref	2.86 (2.80;2.92)	Ref
Occupational status						
<i>P</i> _{value} ¹		<0.0001		<0.0001		0.01
Unemployed	1.86 (1.82;1.91)	0.04 (-0.05;0.12)	4.24 (4.17;4.31)	0.12 (-0.03;0.28)	2.99 (2.93;3.5)	0.0 (-0.1;0.2)
Student	1.89 (1.82;1.95)	0.06 (-0.04;0.17)	4.51 (4.40;4.63)	0.40 (0.22;0.58)*	3.02 (2.93;3.12)	0.1 (-0.1;0.2)
Self-employed or farmer	1.82 (1.76;1.87)	-0.01 (-0.10;0.09)	4.14 (4.05;4.24)	0.03 (-0.13;0.20)	2.99 (2.92;3.06)	0.0 (-0.1;0.1)
Employee, manual worker	1.73 (1.71;1.76)	-0.10 (-0.17;-0.02)*	4.30 (4.26;4.34)	0.19 (0.05;0.32)*	3.01 (2.98;3.05)	0.0 (-0.1;0.2)
Intermediate professionals	1.78 (1.76;1.81)	-0.04 (-0.12;0.03)	4.20 (4.16;4.25)	0.09 (-0.04;0.22)	2.95 (2.91;2.98)	-0.0 (-0.2;0.1)
Managerial staff	1.83 (1.77;1.88)	Ref	4.12 (4.02;4.21)	Ref	2.98 (2.90;3.01)	Ref
Monthly income per unit household unit						
<i>P</i> _{value} ¹		<0.0001		<0.0001		<0.0001

< 1200 €	1.80 (1.76;1.83)	-0.04 (-0.10;0.03)	4.15 (4.09;4.22)	-0.20 (-0.32;-0.09)*	2.88 (2.83;2.93)	-0.24 (-0.33;-0.15)*
1200-1799 €	1.73 (1.70;1.76)	-0.11 (-0.16;-0.05)*	4.17 (4.12;4.22)	-0.19 (-0.29;-0.09)*	2.89 (2.85;2.93)	-0.23 (-0.31;-0.15)*
1800-2699 €	1.82 (1.79;1.85)	-0.02 (-0.07;0.04)	4.21 (4.16;4.26)	-0.15 (-0.24;-0.05)*	3.04 (3.00;3.08)	-0.08 (-0.16;-0.00)*
> 2700 €	1.83 (1.80;1.87)	Ref	4.36 (4.29;4.42)	Ref	3.06 (3.01;3.11)	Ref
Unwilling to answer	1.77 (1.74;1.81)	-0.06 (-0.12;0.00)	4.42 (4.36;4.49)	0.06 (-0.04;0.18)	3.12 (3.07;3.17)	-0.06 (-0.15;0.03)
Residential area						
<i>P_{value}</i> ¹		<0.0001		0.17		0.04
Rural community	1.72 (1.69;1.75)	-0.11 (-0.15;-0.06)*	4.24 (4.18;4.29)	--	3.00 (2.95;3.04)	0.04 (-0.02;0.11)
Urban unit (< 20000 inhab.)	1.71 (1.68;1.75)	-0.12 (-0.16;-0.07)*	4.22 (4.17;4.28)	--	3.04 (2.99;3.08)	0.08 (0.01;0.15)*
Urban unit (20000-200000 inhab.)	1.84 (1.80;1.87)	0.01 (-0.04;0.05)	4.21 (4.16;4.27)	--	3.99 (2.94;3.03)	0.03 (-0.03;0.09)
Urban unit (> 200000 inhab.)	1.83 (1.81;1.85)	Ref	4.28 (4.24;4.32)	Ref	2.96 (2.92;2.99)	Ref

Abbreviations: Inhab., inhabitants; MD: mean differences compared to the reference category.

¹ *P*_{values} from ANCOVA models adjusted for: age (continuous), BMI (continuous), family history of obesity, educational level, occupational status, monthly income per household unit, and residential area.

² *P*_{values} from pairwise post-hoc testing corrected for multiple comparisons was performed (Bonferroni test): * *P* < 0.05.

Boldface indicates statistical significance (*P* < 0.05)

Table 3. Associations between sociodemographic characteristics and explicit weight bias in men NutriNet-Santé study, 2020, France (weighted sample)

Characteristics	<i>Dislike score</i>		<i>Fear of fat score</i>		<i>Willpower score</i>	
	Adjusted means (95% CI)	MD (95% CI)	Adjusted means (95% CI)	MD (95% CI)	Adjusted means (95% CI)	MD (95% CI)
Age						
<i>P</i> _{value} ¹		<0.0001		<0.0001		0.0005
<30 y	2.41 (2.34;2.49)	0.14 (0.01;0.27)*	3.79 (3.68;3.90)	0.13 (-0.06;0.32)	4.22 (4.12;4.31)	0.68 (0.52;0.85)*
30-50 y	2.01 (1.96;2.06)	-0.27 (-0.37;-0.16)*	3.47 (3.40;3.54)	-0.19 (-0.34;-0.03)*	3.69 (3.63;3.75)	0.16 (0.02;0.29)*
50-65 y	2.00 (1.95;2.06)	-0.27 (-0.37;-0.17)*	3.53 (3.45;3.61)	-0.13 (-0.27;0.02)	3.40 (3.32;3.47)	-0.14 (-0.27;-0.01)*
> 65 y	2.28 (2.21;2.34)	Ref	3.66 (3.56;3.75)	Ref	3.53 (3.45;3.62)	Ref
Family history of obesity						
<i>P</i> _{value} ¹		<0.0001		<0.0001		<0.0001
Yes	2.26 (2.19;2.34)	0.12 (0.05;0.19)*	3.85 (3.74;3.95)	0.29 (0.18;0.40)*	3.72 (3.63;3.81)	0.21 (0.11;0.30)*
No	2.14 (2.11;2.18)	Ref	3.56 (3.50;3.61)	Ref	3.51 (3.46;3.56)	Ref
Educational level						
<i>P</i> _{value} ¹		0.02		<0.0001		<0.0001
Less than high-school diploma	2.13 (2.09;2.18)	-0.08 (-0.20;0.04)	3.55 (3.49;3.61)	0.07 (-0.11;0.25)	3.68 (3.62;3.73)	0.33 (.017;0.48)*
High school diploma	2.24 (2.16;2.31)	0.02 (-0.11;0.15)	3.93 (3.82;4.04)	0.45 (0.26;0.64)*	3.54 (3.44;3.63)	0.19 (0.02;0.35)*
Undergraduate	2.10 (2.12;2.31)	-0.11 (-0.25;0.03)	3.54 (3.40;3.68)	0.05 (-0.14;0.26)	3.26 (3.15;3.38)	-0.09 (-0.26;0.09)
Postgraduate	2.21 (2.12;2.31)	Ref	3.48 (3.35;3.61)	Ref	3.35 (3.24;3.57)	Ref
Occupational status						
<i>P</i> _{value} ¹		<0.0001		<0.0001		0.01
Unemployed	2.20 (2.09;2.31)	0.15 (-0.03;0.33)	3.38 (3.22;3.54)	-0.13 (-0.40;0.14)	3.26 (3.12;3.40)	-0.19 (-0.41;0.04)
Student	2.29 (2.17;2.42)	0.24 (0.04;0.44)*	3.94 (3.75;4.13)	0.43 (0.4;0.72)*	3.65 (3.49;3.81)	0.20 (-0.05;0.45)
Self-employed or farmer	2.19 (2.12;2.26)	0.14 (-0.01;0.28)	3.42 (3.32;3.53)	-0.09 (-0.30;0.13)	3.74 (3.66;3.83)	0.30 (0.11;0.48)*
Employee, manual worker	2.11 (2.23;2.37)	0.05 (-0.08;0.19)	3.59 (3.51;3.67)	0.07 (-0.13;0.27)	3.47 (3.40;3.54)	0.02 (-0.15;0.19)
Intermediate professionals	2.30 (2.23;2.37)	0.25 (0.11;0.39)*	3.88 (3.78;3.98)	0.67 (0.16;0.57)*	3.69 (3.61;3.78)	0.24 (0.07;0.42)*
Managerial staff	2.05 (1.96;2.14)	Ref	3.51 (3.38;3.64)	Ref	3.45 (3.34;3.56)	Ref
Monthly income per unit household unit						
<i>P</i> _{value} ¹		<0.0001		<0.0001		<0.0001

< 1200 €	1.85 (1.77;1.94)	-0.42 (-0.55;-0.29)*	2.98 (2.85;3.10)	-0.89 (-1.09;-0.70)*	3.30 (3.19;3.40)	-0.43 (-0.60;-0.27)*
1200-1799 €	2.25 (2.18;2.31)	-0.03 (-0.14;0.09)	3.71 (3.62;3.80)	-0.16 (-0.32;0.01)	3.62 (3.54;3.70)	-0.11 (-0.25;0.03)
1800-2699 €	2.19 (2.14;2.25)	-0.08 (-0.18;0.03)	3.69 (3.60;3.77)	-0.18 (-0.34;-0.02)*	3.53 (3.46;3.60)	-0.20 (-0.33;-0.06)*
> 2700 €	2.27 (2.21;2.34)	Ref	3.87 (3.77;3.97)	Ref	3.73 (3.65;3.81)	Ref
Unwilling to answer	2.18 (2.08;2.28)	-0.09 (-0.24;0.06)	3.65 (3.51;3.80)	-0.21 (-0.43;0.00)	3.42 (3.30;3.54)	-0.31 (-0.50;-0.12)*
Residential area						
<i>P_{value}</i> ¹		<i><0.0001</i>		<i>0.11</i>		<i>0.01</i>
Rural community	2.05 (1.99;2.11)	-0.21 (-0.30;-0.12)*	3.27 (3.18;3.36)	-0.28 (-0.41;-0.15)*	3.42 (3.35;3.50)	-0.21 (-0.33;-0.10)*
Urban unit (< 20000 inhab.)	2.14 (2.07;2.20)	-0.12 (-0.22;-0.02)*	4.00 (3.90;4.10)	0.45 (0.31;0.59)*	3.49 (3.40;3.57)	-0.15 (-0.27;-0.03)*
Urban unit (20000-200000 inhab.)	2.15 (2.08;2.22)	-0.11 (-0.20;-0.01)*	3.73 (3.63;3.82)	0.17 (0.03;0.31)*	3.59 (3.51;3.68)	-0.04 (-0.16;0.08)
Urban unit (> 200000 inhab.)	2.26 (2.20;2.31)	Ref	3.55 (3.47;3.63)	Ref	3.63 (3.47;3.70)	Ref

Abbreviations: Inhab., inhabitants; MD: mean differences compared to the reference category.

¹ *P*_{values} from ANCOVA models adjusted for: age (continuous), BMI (continuous), family history of obesity, educational level, occupational status, monthly income per household unit, and residential area.

² *P*_{values} from pairwise post-hoc testing corrected for multiple comparisons was performed (Bonferroni test): * *P* < 0.05.

Boldface indicates statistical significance (*p* < 0.05)

Titles and footnotes of appendix material

Appendix Figure 1

Title: Flowchart for the selection of the study sample

Appendix Table 1

Title: Crandall's 13-item Anti-Fat Attitudes Questionnaire (AFAQ) - English and French version

Footnotes: Responses were rated on a 9-point Likert scale (0 = very strongly disagree, 1= strongly disagree, 2= disagree, 3= disagree somewhat, 4= unsure, 5= agree somewhat, 6= agree, 7= strongly agree, 8 = very strongly agree).

Items 1 to 7 were used to calculate the *Dislike* score, 8 to 10 to calculate the *Fear of fat* score and 11 to 13 to calculate the *Willpower* score.

Appendix Table 2

Title: Characteristics of participants included and excluded from the analyses, NutriNet-Santé study, 2020, France (unweighted sample)

Footnotes: ¹ P value from Wilcoxon for continuous variables and χ^2 for categorical variables

Boldface indicates statistical significance (p<0.05)

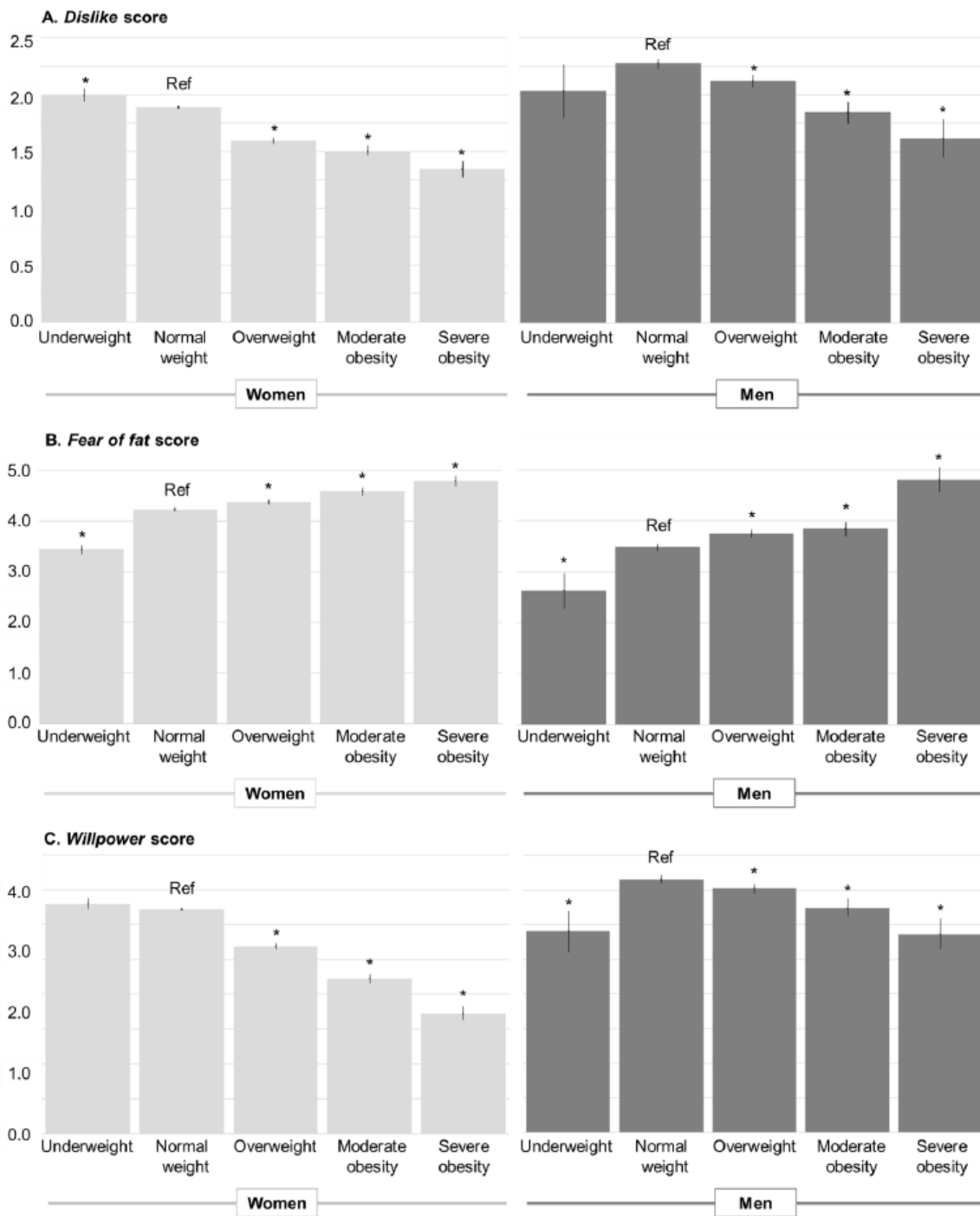


Figure 1