



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

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### ► To cite this version:

Olivia Branche, Camille Buscail, Sandrine Péneau, Julia Baudry, Christine Poitou, et al.. Correlates of Weight Bias in Adults From the NutriNet-Santé Study. *American Journal of Preventive Medicine*, 2023, 65 (2), pp.201-212. 10.1016/j.amepre.2023.02.012 . hal-04397429

**HAL Id: hal-04397429**

**<https://hal.science/hal-04397429>**

Submitted on 16 Jan 2024

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**Title**

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

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32 **Word count:** 3016 words, 11 pages (text only), 3 tables, 1 figure  
33

## **Abstract**

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

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

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

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

## Introduction

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

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

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

contrast, there have been mixed findings regarding the associations with age and socioeconomic position.<sup>8,13–16</sup> The fear of gaining weight has received less attention, but appears to be greater in women and in those with obesity.<sup>16</sup> The generalizability of these studies is limited either by small sample sizes<sup>8–12</sup> or by the assessment of one unique dimension of EWB.<sup>11,13,17</sup> In addition, despite scientific literature documenting gender differences in both the prevalence of weight stigma<sup>1</sup> and the level of EWB<sup>8,13,16</sup>, to the best of the author's knowledge, no population-based study examined the associations between the different dimensions of EWB and characteristics (weight status or socio-demographics) according to gender. Thus, available data point out the need to implement prevention programs and education campaigns to reduce EWB in the adult population. However, they are insufficient to inform public health stakeholders on the population subgroups that are most likely to report EWB in its different dimensions. Additional data improving knowledge on the associations between weight status, sociodemographic characteristics and each dimension of EWB in both men and women are therefore needed to consider and design tailored public health interventions.

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

## **Methods**

### **Study population**

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

## Measures

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

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

## Statistical analysis

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



In order to improve the representativeness of the sample compared to the French population,<sup>24</sup> and thus to improve the estimation of EWB in French adults, weighting was calculated using the iterative proportional fitting procedure according to a national census report<sup>23</sup> on age, gender, occupational category, educational level, and residential area for each gender. Descriptive characteristics of the weighted study sample were compared between men and women using  $\chi^2$  and t-tests, as appropriate.

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

## Results

From the 36232 participants who completed the AFAQ, 33948 participants with no missing covariates and who were living in mainland France were retained (**Appendix Figure 1**). Participants excluded from the analyses differed in terms of gender, age, BMI and all sociodemographic characteristics (**Appendix Table 2**). Descriptive characteristics of the weighted sample are presented in **Table 1**. In the weighted sample, 6%, 62% and 38% of women and 12%, 47% and 54% of men presented a score  $\geq 4$  for *Dislike*, *Fear of fat* and *Willpower*, respectively. *Dislike* and *Willpower* were higher in men, while *Fear of fat* was higher in women.

Compared with normal-weight participants, those with overweight, moderate and severe obesity reported lower *Dislike* scores, with a mean difference (MD) (95% CI) of -0.29 (-0.34;-0.25), -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 (-0.56;-0.30) and -0.65 (-0.87;-0.43) in men (**Figure 1A**). In both genders, lower income and living in a rural community or small urban unit were associated with lower *Dislike* scores (**Table 2 and 3**). In women, a lower age, a family history of obesity, a lower educational level and being an employee or a manual worker were associated with lower *Dislike* scores. In men, a family history of obesity and being  $< 30$  y were associated with greater *Dislike* scores whereas being middle-aged was associated with lower scores.

Participants with overweight, moderate and severe obesity reported higher *Fear of fat* scores (MD [95% CI] vs. normal-weight participants: 0.15 [0.07;0.23], 0.35 [0.24;0.46] and 0.56 [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

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

In women, participants with overweight, moderate and severe obesity reported lower *Willpower* scores than normal-weight participants (MD [95% CI]: -0.53 [-0.59;-0.46], -1.00 [-1.08;-0.90] and -1.49 [-1.61;-1.37], respectively) (**Figure 1C**). In men, participants with underweight, overweight and with moderate and severe obesity reported lower *Willpower* scores (MD [95% 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], respectively). In both genders, a lower educational level was associated with greater *Willpower* scores whereas lower income was associated with lower *Willpower* scores. A family history of obesity was associated with lower *Willpower* scores in women and greater scores in men. Only among men, a younger age and living in a moderate to large urban unit were associated with lower *Willpower* scores.

## Discussion

This study assessed EWB in a large sample of French adults from the NutriNet-Santé study and increases knowledge of EWB in western Europe, where little recent data is available.<sup>14–16</sup>

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

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

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

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

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

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

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

## Conclusions

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

## Acknowledgments

We thank, Cédric Agaësse, Alexandre De-Sa and Rebecca Lutchia (dietitians), Younes Esseddik (IT manager), Nathalie Druesne-Pecollo (operational coordinator), Thi Hong Van Duong, Régis Gatibelza, Jagatjit Mohinder and Aladi Timera (computer scientists); Fabien Szabo de Edelenyi, PhD (manager), Julien Allegre, Nathalie Arnault, Laurent Bourhis, and Nicolas Dechamp (data-manager/statisticians); Paola Ivroud (health event validator), Maria Gomes and Mirette Foham (Nutrinaute support) and Sophia Marcus (intern) for their technical contribution to the NutriNet-Santé study. We warmly thank all the volunteers of the NutriNet-Santé cohort.

Funding sources: The NutriNet-Santé study was supported by the following public institutions: Ministère de la Santé, Santé Publique France, Institut National de la Santé et de la Recherche Médicale (INSERM), Institut national de recherche pour l’agriculture, l’alimentation et l’environnement (INRAE), Conservatoire National des Arts et Métiers (CNAM) and Université Sorbonne Paris Nord (Université Paris 13). Researchers were independent from funders. Funders had no role in the study design, the collection, analysis, and interpretation of data, the writing of the report, and the decision to submit the article for publication.

Conflicts of interest and financial disclosure: No financial disclosures were reported by the authors of this paper.

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## Figures titles and footnotes

### **Figure 1**

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

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

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

Error bars represent 95% CI.

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

<b>Characteristics</b>	<b>All N=33948</b>	<b>Women N=17778 (52.4%)</b>	<b>Men N=16170 (47.6%)</b>
<b>AFAQ score</b> , mean (SD)	2.7 (1.2)	2.6 (0.9)	2.8 (1.7)
<b>Dislike score</b> , mean (SD)	1.9 (1.3)	1.7 (1.0)	2.2 (1.8)
<b>Fear of fat score</b> , mean (SD)	4.0 (2.0)	4.3 (1.7)	3.6 (2.7)
<b>Willpower score</b> , mean (SD)	3.3 (1.7)	3.0 (1.4)	3.7 (2.3)
<b>Age, n (%)</b>			
<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)
<b>BMI, n (%)</b>			
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)
<b>Family history of obesity, n (%)</b>			
Yes	6944 (20.5)	4184 (23.5)	2759 (17.1)
No	27004 (79.5)	13594 (74.5)	13411 (82.9)
<b>Educational level, n (%)</b>			
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)
<b>Occupational status, n (%)</b>			
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)
<b>Monthly income per unit, n (%)</b>			
< € 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)
<b>Residential area, n (%)</b>			
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<sub>values</sub> from t-test for continuous variables and  $\chi^2$  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)
<b>Age</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		<0.0001		0.0005
<30 y	1.62 (1.58;1.66)	<b>-0.33 (-0.40;-0.26)*</b>	4.54 (4.48;4.61)	<b>0.48 (0.36;0.59)*</b>	3.04 (2.98;3.01)	0.07 (-0.02;0.17)
30-50 y	1.65 (1.63;1.68)	<b>-0.30 (-0.35;-0.25)*</b>	4.33 (4.29;4.38)	<b>0.27 (0.18;0.36)*</b>	3.04 (3.00;3.07)	<b>0.07 (0.00;0.15)*</b>
50-65 y	1.74 (1.71;1.77)	<b>-0.21 (-0.26;-0.16)*</b>	4.29 (4.24;4.34)	<b>0.22 (0.13;0.30)*</b>	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
<b>Family history of obesity</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		<0.0001		<0.0001
Yes	1.72 (1.69;1.75)	<b>-0.08 (-0.11;-0.05)*</b>	4.42 (4.37;4.47)	<b>0.23 (0.17;0.28)*</b>	2.86 (2.81;2.90)	<b>-0.17 (-0.22 ; -0.12)*</b>
No	1.80 (1.79;1.82)	Ref	4.19 (4.17;4.22)	Ref	3.03 (3.00;3.05)	Ref
<b>Educational level</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		<0.0001		<0.0001
Less than high-school diploma	1.71 (1.69;1.73)	<b>-0.26 (-0.32;-0.20)*</b>	4.27 (4.24;4.31)	<b>0.11 (0.01;0.22)*</b>	3.06 (3.03;3.08)	<b>0.19 (0.11;0.28)*</b>
High school diploma	1.81 (1.78;1.84)	<b>-0.16 (-0.22;-0.09)*</b>	4.34 (4.28;4.40)	<b>0.18 (0.07;0.29)*</b>	3.01 (3.0;3.3.05)	<b>0.14 (0.06;0.23)*</b>
Undergraduate	1.81 (1.77;1.85)	<b>-0.16 (-0.22;-0.09)*</b>	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
<b>Occupational status</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<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)	<b>0.40 (0.22;0.58)*</b>	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)	<b>-0.10 (-0.17;-0.02)*</b>	4.30 (4.26;4.34)	<b>0.19 (0.05;0.32)*</b>	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
<b>Monthly income per unit household unit</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<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)	<b>-0.20 (-0.32;-0.09)*</b>	2.88 (2.83;2.93)	<b>-0.24 (-0.33;-0.15)*</b>
1200-1799 €	1.73 (1.70;1.76)	<b>-0.11 (-0.16;-0.05)*</b>	4.17 (4.12;4.22)	<b>-0.19 (-0.29;-0.09)*</b>	2.89 (2.85;2.93)	<b>-0.23 (-0.31;-0.15)*</b>
1800-2699 €	1.82 (1.79;1.85)	-0.02 (-0.07;0.04)	4.21 (4.16;4.26)	<b>-0.15 (-0.24;-0.05)*</b>	3.04 (3.00;3.08)	<b>-0.08 (-0.16;-0.00)*</b>
> 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)
<b>Residential area</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		0.17		0.04
Rural community	1.72 (1.69;1.75)	<b>-0.11 (-0.15;-0.06)*</b>	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)	<b>-0.12 (-0.16;-0.07)*</b>	4.22 (4.17;4.28)	--	3.04 (2.99;3.08)	<b>0.08 (0.01;0.15)*</b>
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.

<sup>1</sup> *P*<sub>values</sub> 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.

<sup>2</sup> *P*<sub>values</sub> 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)
<b>Age</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		<0.0001		0.0005
<30 y	2.41 (2.34;2.49)	<b>0.14 (0.01;0.27)*</b>	3.79 (3.68;3.90)	0.13 (-0.06;0.32)	4.22 (4.12;4.31)	<b>0.68 (0.52;0.85)*</b>
30-50 y	2.01 (1.96;2.06)	<b>-0.27 (-0.37;-0.16)*</b>	3.47 (3.40;3.54)	<b>-0.19 (-0.34;-0.03)*</b>	3.69 (3.63;3.75)	<b>0.16 (0.02;0.29)*</b>
50-65 y	2.00 (1.95;2.06)	<b>-0.27 (-0.37;-0.17)*</b>	3.53 (3.45;3.61)	-0.13 (-0.27;0.02)	3.40 (3.32;3.47)	<b>-0.14 (-0.27;-0.01)*</b>
> 65 y	2.28 (2.21;2.34)	Ref	3.66 (3.56;3.75)	Ref	3.53 (3.45;3.62)	Ref
<b>Family history of obesity</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		<0.0001		<0.0001
Yes	2.26 (2.19;2.34)	<b>0.12 (0.05;0.19)*</b>	3.85 (3.74;3.95)	<b>0.29 (0.18;0.40)*</b>	3.72 (3.63;3.81)	<b>0.21 (0.11;0.30)*</b>
No	2.14 (2.11;2.18)	Ref	3.56 (3.50;3.61)	Ref	3.51 (3.46;3.56)	Ref
<b>Educational level</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		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)	<b>0.33 (.017;0.48)*</b>
High school diploma	2.24 (2.16;2.31)	0.02 (-0.11;0.15)	3.93 (3.82;4.04)	<b>0.45 (0.26;0.64)*</b>	3.54 (3.44;3.63)	<b>0.19 (0.02;0.35)*</b>
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
<b>Occupational status</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<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)	<b>0.24 (0.04;0.44)*</b>	3.94 (3.75;4.13)	<b>0.43 (0.4;0.72)*</b>	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)	<b>0.30 (0.11;0.48)*</b>
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)	<b>0.25 (0.11;0.39)*</b>	3.88 (3.78;3.98)	<b>0.67 (0.16;0.57)*</b>	3.69 (3.61;3.78)	<b>0.24 (0.07;0.42)*</b>
Managerial staff	2.05 (1.96;2.14)	Ref	3.51 (3.38;3.64)	Ref	3.45 (3.34;3.56)	Ref
<b>Monthly income per unit household unit</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<0.0001		<0.0001		<0.0001

< 1200 €	1.85 (1.77;1.94)	<b>-0.42 (-0.55;-0.29)*</b>	2.98 (2.85;3.10)	<b>-0.89 (-1.09;-0.70)*</b>	3.30 (3.19;3.40)	<b>-0.43 (-0.60;-0.27)*</b>
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)	<b>-0.18 (-0.34;-0.02)*</b>	3.53 (3.46;3.60)	<b>-0.20 (-0.33;-0.06)*</b>
> 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)	<b>-0.31 (-0.50;-0.12)*</b>
<b>Residential area</b>						
<i>P<sub>value</sub></i> <sup>1</sup>		<i>&lt;0.0001</i>		<i>0.11</i>		<i>0.01</i>
Rural community	2.05 (1.99;2.11)	<b>-0.21 (-0.30;-0.12)*</b>	3.27 (3.18;3.36)	<b>-0.28 (-0.41;-0.15)*</b>	3.42 (3.35;3.50)	<b>-0.21 (-0.33;-0.10)*</b>
Urban unit (< 20000 inhab.)	2.14 (2.07;2.20)	<b>-0.12 (-0.22;-0.02)*</b>	4.00 (3.90;4.10)	<b>0.45 (0.31;0.59)*</b>	3.49 (3.40;3.57)	<b>-0.15 (-0.27;-0.03)*</b>
Urban unit (20000-200000 inhab.)	2.15 (2.08;2.22)	<b>-0.11 (-0.20;-0.01)*</b>	3.73 (3.63;3.82)	<b>0.17 (0.03;0.31)*</b>	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.

<sup>1</sup> *P*<sub>values</sub> 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.

<sup>2</sup> *P*<sub>values</sub> 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:** <sup>1</sup> P value from Wilcoxon for continuous variables and  $\chi^2$  for categorical variables

Boldface indicates statistical significance (p<0.05)

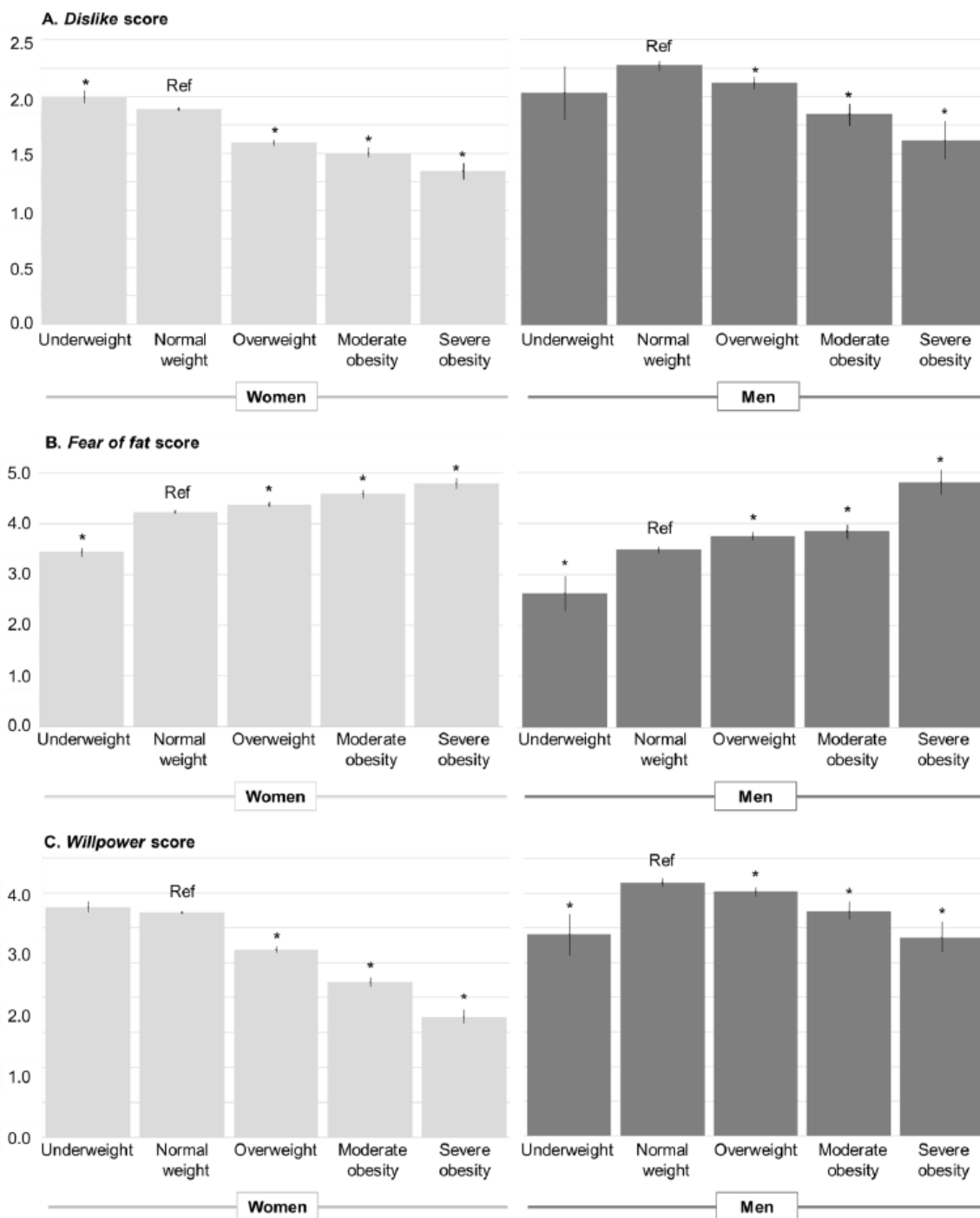


Figure 1