How socioeconomic status affect weight status through health-related lifestyles: a latent class analysis

Authors: Jesús García-Mayor[1], Antonio Moreno-Llamas[1], Ernesto De la Cruz-Sánchez[1*]

[1] Public Health and Epidemiology Research Group, San Javier Campus, University of Murcia, Murcia, Spain.

* Corresponding author: Ernesto De la Cruz-Sánchez

Address: Campus de San Javier, Universidad de Murcia, C/ Santa Alicia s/n, 30720 Santiago de la Ribera - Murcia – España

Email: erneslacruz@um.es **Tel.:** +34 868 884 589

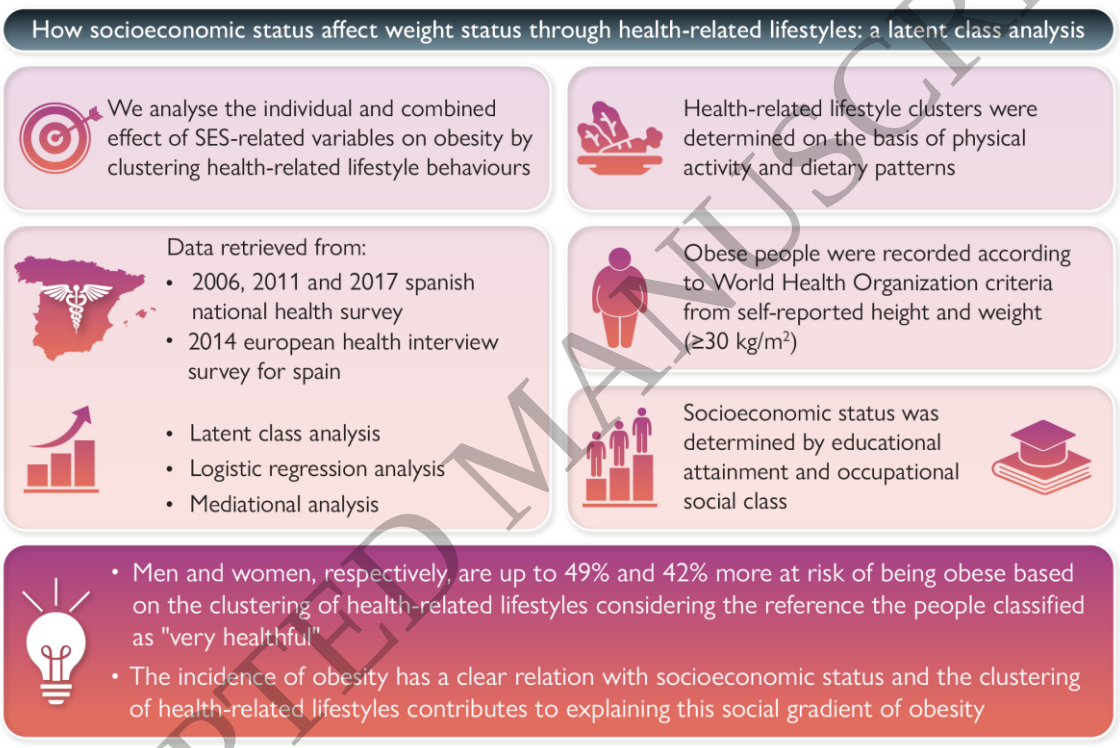
ABSTRACT

Aims Obesity levels have increased worldwide with serious public health concerns. However, weight status is related to socioeconomic status (SES), which may also influence health-related lifestyles. Here we study the association between SES and obesity mediated by diet and physical activity.

Method and results Using cross-sectional data from 2006, 2011, 2014 and 2017 Spanish health surveys (final sample consisted of 61,768 adults aged between 18 and 64), we conducted a latent class analysis to estimate health-related lifestyle clusters (based on dietary patterns and physical activity) and mediation analyses to evaluate the association of SES and obesity through the clustering of health-related lifestyles. In both men and women, SES was inversely related to obesity ($p < 0.001$) and positively related to healthier lifestyle classes ($p < 0.001$). Obesity was inversely related to healthier lifestyle classes ($p < 0.001$). A small –although significant– proportion mediated by the clustering of lifestyles was found: 4.9%, 95% CI (6.6%, 3.2%) in men and 2.3%, 95% CI (3.4%, 1.3%) in women for educational attainment, 5.3%, 95% CI (7.2%, 3.6%) in men and 2.0%, 95% CI (2.9%, 1.1%) in women for occupational social class, and 4.9%,

95% CI (6.5%, 3.1%) and 1.9%, 95% CI (2.9%, 1.1%) combining the above two SES indicators.

Conclusions SES is related to obesity through the clustering of health-related lifestyles, with greater emphasis on men. However, the complex relationship between SES and weight status also suggests other indicators that contribute to the social gradient of obesity.



Graphical abstract

Introduction

Obesity remains to be a serious health-related problem for public health, which has continued to increase worldwide during the last thirty-five years, nonetheless, with social inequalities [1]. Across the socioeconomic spectrum, the most disadvantaged – having few household assets, poorer education, income insecurity or having insecure employment or living in poorer housing and/or deprived communities – are most at risk

of obesity [2,3]. This poverty–obesity–health gradual relationship, known as the social gradient of health, is capable not only to determine our weight status but also another major health-related lifestyle (HRL) behaviours, attitudes and preferences for dietary patterns and physical activity practice [4,5].

There are physical, social and environmental characteristics that determine both dietary and physical activity patterns, influencing as a result, the weight status [6–8]. Specifically, weight status may be affected by structural determinants (i.e., macroeconomic policies, culture and social values and public and social policies) and socioeconomic position, affecting biological and behavioural factors, material and psychosocial circumstances (i.e., psychosocial stress, stressful life circumstances, social support, employment characteristics and working conditions, housing, domestic work and care or availability of food), as well as the health system (considering geographical barriers to accessing health care and the organisation of service provision) [9]. Among these determinants, the comprehensive amount of research highlights a gradient relate to the socioeconomic position, established by our living and material conditions, in weight status that determines the risk of being overweight or obese –such as income, occupational social class or educational attainment– in which each determinant might influence the population's weight status with subtle but meaningful differences according to their nature [10,11].

Occupational social class or income are inversely related to weight status, affecting healthy foods accessibility, leisure time for physical activity or living in less obesogenic environments, but the relationship is complex because is influenced by other factors such as education and demographic and depends to a large extent on the country's development [12–14]. Education attainment is also another social determinant, but more stable than occupational social class and income [15,16]. Education is closely

related to better job opportunities and material resources during the whole life but also provides better health-related knowledge, improving critical thinking and compliance with nutritional counselling and medical advice [17,18]. Thus, people with higher educational attainment show higher health literacy proficiency [19], are generally associated with less household activity and indicate lower levels of work-family conflict and insecurity due to competing demands on their time [20–22]. Therefore, it is crucial to know which socioeconomic status (SES) indicator holds the most promise for reducing inequalities related to obesity [23], and it is exceptional for studies to include more than one indicator [24].

The relationship between SES and obesity could be related to HRLs. A lower SES is related to a lower level of leisure-time physical activity [25–27] and energy-dense diets, with added fats and low in fresh foods such as fruit, vegetables or fish [28]. In addition, people with lower SES are also more frequent in lifestyle clusters associated with higher cardiovascular risk which show that different HRL behaviours do not occur in isolation, but are linked to [29].

So far, studies attributing the social gradient of weight status to physical activity and diet have found a contribution of between 4% and 50%, showing even inconsistency about certain HRL habits [30–35], and other studies also indicate unconfirmed mediation [36]. Because HRLs do not act in isolation from one another, physical activity and diet clusters could provide further evidence of the clustering of HRLs that determine the social gradient of obesity. Also, considering the particular complexities of each social determinant, the research on different social determinants could provide insights into causal pathways for possible public health intervention related to HRLs to reduce obesity. Here we analyse the individual and combined effect

of SES-related variables on obesity by clustering HRLs related to diet and physical activity.

Method

Data Collection

We retrieved cross-sectional data from four Spanish health surveys: the 2006 (n = 29,478), 2011 (n = 21,007) and 2017 (n = 23,089) Spanish National Health Surveys (SNHS) and the 2014 (n = 22,842) European Health Interview Survey (EHIS) for Spain.

SNHS and EHIS apply a multistage stratified cluster sampling divided into 50 subnational subsamples to obtain a representative sample of the Spanish population according to firstly, census sections; secondly, households; and finally, one individual per household. To minimise seasonal biases in terms of morbidity and lifestyle, the data collection period is conducted during the entire corresponding year. Response rates of the surveys were: 96.0% in 2006, 89.6% in 2011, 74.6% in 2014 and 74.0% in 2017. Additional information on these surveys has been described elsewhere [37].

This study excluded the population aged 65 years and older due to the inaccuracy of body mass index (BMI) as a variable to assess body fatness in older adults [38]. People who indicated "no response/don't know" to any of the variables analysed were also excluded due to the low percentage of missingness across all variables (<5.0%) [39,40]. The final sample consisted of 61,768 individuals (51.4% women) (valid percentage: 92.0%). The characteristics of the population are described in Table 1.

Measures

BMI was recorded according to World Health Organization criteria [41] for obese (≥ 30 kg/m^2) and non-obese (< 30 kg/m^2) from self-reported height and weight.

We also considered weekly physical activity, six factors related to dietary patterns, smoking status (smoker, ex-smoker and non-smoker) and alcohol use in the last 2 weeks (yes or no). Leisure-time physical activity was assessed from a valid and reliable approach included throughout the historical series of health surveys in Spain [42,43]. According to previously established criteria [27,44], the population was classified as active (i.e. they engage in leisure-time physical activity or sport on an occasional or a regular monthly or weekly basis) or inactive (i.e. they declare do not exercise. Leisure time is spent almost entirely sedentary: reading, watching TV, going to the cinema, etc.). Food frequency intake was employed to evaluate dietary behaviours during the last week, from never to one or more times a day [45]. The food group categorisation was then based on the non-regular intake of food groups associated with a higher risk of cardiovascular disease or cancer (meat processed or red meat, pastries or sweets and sugary soft drinks), and the regular use of healthy behaviours (fruit, vegetables and fish) [46–48]: daily vegetable intake, daily fruit intake, not daily pastries or sweets intake (biscuits, pastries, jams, cereals with sugar or candies, among others), not daily sugar soft drinks intake, fish (oily and/or non-oily) intake at least three times a week, and consumption of processed meat, red meat (beef, pork, lamb) or poultry three or fewer times a week.

We included sex, age (continuous variable), employment status (working, unemployed, pre-retired, homemaker and others), marital status (single, married and others) and SES. The latter was determined by educational attainment and occupational social class. Education was obtained from the last level of formal completed education according to the International Classification of Education [49]: levels 5-8 (High-H), levels 3-4 (Middle-M) and levels 0-2 (Primary or no education-P). Occupational social class was obtained from the proposal of the Working Group on Health Determinants of

the Spanish Society of Epidemiology and, subsequently, grouped into three groups considering the service, intermediate and working class [50]: 1) High social class (service: I-II): salaried directors and managers and professionals traditionally associated with university degrees, technical support professionals, sports people and artists; 2) Middle social class (intermediate: III): intermediate occupations and self-employed workers; and 3) Low social class (working class: IV-VI): supervisors and workers in skilled technical occupations, skilled workers in the primary sector and other semi-skilled and unskilled workers. From educational attainment and occupational social class, SES was determined in nine categories that combine the three categories of both variables (H/I-II, H/III, H/IV-VI, M/I-II, M/III, M/IV-VI, P/I-II, P/III, and P/IV-VI). We combined the two indicators because using several different indicators, rather than using them interchangeably, are more appropriate to reflect the social gradient of health [51].

Statistical analysis

A latent class analysis (LCA) was performed to cluster individuals with similar HRL patterns, analysing fruit, vegetables, pastries or sweets, sugary drinks, fish and meat intake and physical activity. From LCA, individuals were assigned to a group according to their probability of belonging to a specific class given their response in each HRL pattern, resulting in a more flexible and less arbitrary analysis [52]. We considered probabilities of 0.50 or less, 0.75 to 0.50, and 0.75 or more as low, moderate and high, respectively [53,54]. LCA was separately conducted for women and men as the clustering of health may differ by gender [55].

To select the best-fitting model, we tested LCA models with an increasing number of latent classes, from a two-cluster model up to the seven-cluster model. We used the seven-cluster model as a maximum because some clusters presented a proportion lower than 5% [56]. We used the Akaike Information Criterion (AIC) and

Bayesian Information Criterion (BIC) as measures of model fit and we also compared models with an adjacent number of classes with the Lo-Mendell-Rubin adjusted likelihood ratio test (LMR-LRT). However, we prioritised the BIC due to its best accuracy [57,58]. The analysis was run using Rstudio Version 3.6.1 (Rstudio, Inc., Boston, MA) with the "poLCA" package (Version 1.4.1) [59].

Logistic regression analysis was performed, estimating odds ratios (OR) and 95% confidence intervals (95% CI) to examine predictor variables for obesity. This analysis was performed by sex, and two models were run: 1) including age, SES, employment status, marital status, smoking status, alcohol use, the six variables related to dietary patterns, physical activity, and survey year, and 2) including the clustering of HRLs adjusted for age, SES, employment status, marital status, smoking status, alcohol use, and survey year. In this analysis, statistical significance was obtained from the Wald test and statistical significance was set at $P < 0.05$. This analysis was run with SPSS version 25.0.

Finally, we performed mediation analyses to estimate the effect of SES on obesity through the clustering of HRLs. To establish the mediation analysis, we used Hayes's PROCESS macro (version 4.0) for SPSS. The macro process proposed by Preacher and Hayes [60] is based on a bootstrapping method. This method is considered an accurate and powerful mediation method as it is complemented by the Sobel test to check the validity of the conclusions (it has higher power and better control over type I error) and due to its ability to test the significance of indirect (mediated) effects [61]. To consider the existence of mediation, the following steps were taken into account: 1) that the independent variable was correlated with the mediating variables, establishing the mediating variables as outcome variables; and 2) that the mediating variables and the

outcome variables were correlated, considering the causal variable as a control variable [62].

Bootstrapping with 10,000 resamples [63] was used to estimate the statistical significance of the association effects, computing the 95% CI. Thereby, effects are statistically significant when their 95% CI do not include zero ($P < 0.05$). Three sensitivity analyses were conducted, modifying the independent variable: 1) with education, 2) with occupational social class, 3) with the combined nine-group variable, obtained from education and occupational social class. The clustering of HRLs estimated from LCA (the mediator variable), was ordered from poorer (1) to healthier (6) class/cluster memberships. These analyses were conducted separately for men and women, according to the clusters estimated for each sex and were run adjusted for age, occupational status, marital status, smoking status, alcohol use, and survey year.

All analyses were weighted to account for survey designs and relative frequencies were presented as weighted percentages.

Results

Based on LCA, the best-fitting model was the six-class model for both women and men. It showed population cohorts above 5% in all clusters and had the lowest BIC and, therefore, the best fit in terms of this parameter (Table 2).

According to the 6-class model (Figure 1), in men, class 1 was denoted as *Regular healthful* (n = 2373, 7.7%), class 2 *Very unhealthful* (n = 3121, 10.2%), class 3 *Unhealthful* (n = 9,644, 31.5%), class 4 *Regular unhealthful* (n = 3785, 12.4%), class 5 *Healthful* (n = 13315, 37.1%), and class 6 *Very healthful* (n = 5632, 15.7%). In women, class 1 was called *Regular unhealthful* (n = 4614, 12.9%), class 2 *Healthful* (n = 18.176; 38.6%), class 3 *Very unhealthful* (n = 3460, 9.6%), class 4 *Unhealthful* (n = 6594,

18.4%), class 5 *Regular healthful* (n = 2289, 6.4%), and class 6 *Very healthful* (n = 8,469; 18.0%). This classification was based on the mean of the likelihood ratios of each of the behaviours in that cluster and the number of behaviours showing a low likelihood in each class (less than 0.5) (see footnote of Figure 1).

Obese people were older, had a lower prevalence of working employment status, were more often married and had a lower SES (22.1% of men and 31.7% of women belonged to P/IV-V) compared to the non-obese population (Table 3). Adjusted logistic regression values further showed that the prevalence of obesity increased by 3% in men and women for each year of age ($p < 0.001$). Also, compared to the reference, men and women with a P/IV-V SES ($p < 0.001$) and unemployed ($p < 0.001$), as well as married men ($p < 0.001$), were more likely to be obese (Table 4). The time trend of obesity indicated a lower probability of obesity among men and women in 2006 ($p = 0.024$ in men and $p = 0.014$ in women) compared to 2017.

According to HRLs, adjusted values (Table 4) also indicated that obese people were less likely to smoke ($p = 0.002$ in men and $p < 0.001$ in women) and consume alcohol ($p = 0.009$ in men and $p < 0.001$ in women). However, obese men were 35% more likely to be ex-smokers ($p < 0.001$). Obese people were more inactive ($p < 0.001$ in men and women) and were 13% (men) and 25% (women) more likely to consume meat at least 3 times per week ($p = 0.001$ in men and $p < 0.001$ in women). Obese men were also more likely to not consume fruit daily ($p = 0.035$) and obese men and women were also more likely to consume sugar soft drinks daily ($p = 0.048$ in men and $p = 0.002$ in women). However, obese women were less likely to not consume vegetables daily ($p < 0.001$) and, in both sexes, daily pastries or sweets intake was less likely among obese people ($p < 0.001$). According to LCA, men in the *Very unhealthful* class had the highest probability of obesity (49% more, $p < 0.001$) compared to the *Very*

healthful class, while in women it was observed in the *Unhealthful* class (42% more, $p <$ 0.001).

Mediational analysis

In both sex, we observed a significant total effect of educational attainment (b = –0.267, SE = 0.025, $p < 0.001$ in men; b = –0.555, SE = 0.027, $p < 0.001$ in women), occupational social class (b = –0.196, SE = 0.020, $p < 0.001$ in men; b = –0.492, SE = 0.024, $p < 0.001$) and SES (combination of educational attainment and social class) (b = –0.078, SE = 0.007, $p = < 0.001$ in men; b = –0.178, SE = 0.008, $p < 0.001$) on obesity adjusted for confounding variables.

Considering the clustering of HRLs, the direct effects were significant ($p <$ 0.001) for the three socioeconomic predictors on obesity among men (Figure 2) and women (Figure 3). However, the indirect effects of the educational attainment (b = –0.013, SE = 0.002, 95% CI (–0.018, –0.009) in men; b = –0.013, SE = 0.003, 95% CI (–0.019, –0.007) in women), occupational social class (b = –0.010, SE = 0.002, 95% CI –0.014, –0.007) in men; b = –0.010, SE = 0.002, 95% CI (–0.014, –0.005) in women) and SES (b = –0.004, SE = 0.001, 95% CI (–0.005, –0.002) in men; b = –0.003, SE = 0.001, 95% CI (–0.005, –0.002) in women) through the clustering of HRLs were significant because the 95% CIs did not include zero. Thus, the clustering of HRLs partially mediated the association between SES and obesity. The proportion mediated was equivalent to 4.9%, 95%CI (6.6%, 3.2%) and 2.3%, 95%CI (3.4%, 1.3%) in men and women, respectively, for educational attainment, 5.3%, 95% CI (7.2%, 3.6%) and 2.0%, 95% CI (2.9%, 1.1%) for occupational social class, and 4.9%, 95% CI (6.5%, 3.1%) and 1.9%, 95% CI (2.9%, 1.1%) for SES.

Discussion

We found three main findings: 1) men were more likely to be in the poorest HRL clusters compared to women; 2) compared to the class with better HRLs, we observed the highest probability of obesity for the *Very unhealthful* class in men [49% higher] and *Unhealthful* class in women [42% higher]; 3) SES was inversely associated with obesity and the clustering of HRLs mediated the association of SES and obesity. This mediation effect was observed for all three SES-related predictors of obesity. However, this mediation was only partial and ranged from 4.9% to 5.3% in men and 1.9% to 2.3% in women.

In general terms, some studies indicate that men tend to report higher physical activity levels, while women have healthier eating habits [64–66]. However, these studies examine each of the HRL behaviours individually. According to the LCA analysis, sex differences are also described in the clustering of physical activity and dietary behaviours, with men being clustered to a greater extent in the less healthy lifestyle clusters. Also, it is not the first study that evaluates the relationship between the clustering of HRLs, related to physical activity and dietary patterns, and obesity. For example, a study conducted with 17,584 college students observed that a higher prevalence of obesity was observed among the clusters "Moderately Healthy Dietary Habits, Inactive" and "Moderately High Screen Time, Inactive" [67]. Furthermore, although we covered a sample of adults, in children and adolescents, it is supported that the clustering of HRLs characterized by low consumption of fruit and vegetable, higher discretionally food and low physical activity is positively associated with being obese [68].

We support previous studies reporting the impact of social determinants on weight status [6–8]. However, the explanation of the link between SES and obesity is

very complex: previous studies support the importance of SES for the maintenance of a healthy weight through better behavioural choices and preferences, as well as improved health-related information and critical analysis [69]. Educational attainment increases healthy eating awareness and could be related to a higher occupational social class and income, while occupational status is mainly related to income, which could lead to better conditions for accessing health-related resources [70]. We used different SES indicators because the consistency between SES and BMI depends on the SES indicator used, being education the best BMI predictor [71]. In this sense, there is a lack of articles assessing the simultaneous influence of SES indicators on BMI and specifying results for men and women separately. However, we have found that education and social class combined or individually, are strongly related to obesity.

Our results also complement previous studies that have observed the effect of SES on weight status through HRL behaviours, such as leisure-time physical activity [31,33], fruit and vegetables intake [31,72], takeaway food [73] or physical activity related to transport [31]. Other studies, for example, have focused on diet quality indices. Thus, the association between SES and obesity is attributed to adherence to the Mediterranean diet by only 4% and 8% [34,35], while other diet-related indices are attributed to between 22% and 35% [34]. We add that, among men, the clustering of HRLs mediates between SES and obesity more strongly than in women. However, the proportion mediated was less than 5.5% for both sexes, and therefore, other related factors need to attribute to understanding the impact of SES on obesity.

There are factors associated with weight status not included in this study that may mediate the social gradient of obesity. Thus, environmental factors (crime, the location of fast-food restaurants and the availability of parks) [74], factors related to mental health - stress, anxiety or depression –, social and family factors [75–77], sleep

duration and quality [78,79], reproductive history factors [80], and sedentary lifestyles and screen time [81,82] should be considered for its association with obesity. In addition, other diet-related factors that could not be taken into account, such as diet soft drinks, have been shown to strongly mediate between SES and weight gain [83].

There are several limitations to consider in our study. Firstly, it should be noted that the data come from four cross-sectional surveys and we cannot assume a cause-effect relationship between the variables. Therefore, the mediation model may generate uncertainties as it is assumed that the exposure leads to the mediator. However, we cannot determine whether lifestyle habits have been formed before, during or after exposure to SES. For example, in the case of people with university studies, life habits could be formed before or during completing the level (during adolescence or in early adulthood) or as a result of the resources and skills that education can provide in the middle and long term. Secondly, dietary and physical activity behaviours and obesity rates were self-reported. Therefore, we must consider the existence of a possible recall bias. Thirdly, this study only assesses the frequency and therefore does not consider the quantity and total intake of the food groups [84]. The cut-off points for dietary patterns and physical activity consider patterns that may be detrimental or beneficial to health. However, we had to limit ourselves to the use of variables common to the health surveys, and the use of more comprehensive measures, e.g. not based on frequency, could not be considered given the characteristics of the health surveys used. Fourthly, regarding SES, occupational social class does not assess job insecurity and other labour conditions that could be associated with health and HRL behaviours. Nevertheless, the employed social class classification is based on the proposal of the Spanish Society of Epidemiology, widely used in the literature. Finally, although LCA is a powerful tool for summarising a large number of categorical covariates to understand the meaningful

structures of the data, it should be noted that it involves uncertainty in the assignment of classes. Therefore, this uncertainty could affect the results of a regression using latent classes as predictors of obesity.

On the other hand, the strengths of this study should also be considered. There are a small number of articles examining mediational pathways linking SES and BMI [71], and we have analysed the simultaneous influence of two indicators (education and occupational social class) on obesity through means of clusters of dietary patterns and physical activity. We highlight the sample size of this study, which has been approached from four similarly designed and representative health surveys of the adult resident population in Spain. In addition, unlike previous studies, we have used the clustering of HRLs and thus defined similar patterns of behaviour inherent in the population studied.

Conclusions

In summary, the results indicate that SES plays an important role in the prevention of obesity and that the clustering of RHLs based on physical activity and dietary patterns partially explains the social gradient in obesity, with greater emphasis on men. However, the proportion mediated is less than 5.5% in both men and women, i.e. we have observed a small –although significant– proportion mediated. Based on mediation analysis, future studies should consider other factors related to SES and obesity to further understand the complex relationship between them and also determine this social gradient in obesity from non-frequency-based measures.

Acknowledgements

The authors are grateful to the Spanish Ministry of Health, Consumption and Social Welfare and the National Institute of Statistics for the availability of data from the Spanish National Health Survey and the European Health Survey for Spain. The analyses and content of this paper are the sole responsibility of the signing authors.

Conflicts of interest/Competing interests

The authors declare that there is no conflict of interest.

Consent to participate and Ethics approval

Because the data were extracted from secondary databases of the Ministry of Health, Consumption and Social Welfare and the National Institute of Statistics, neither informed consent from the subjects nor approval from the ethics committee was required.

Funding

No funding received.

Data availability

The SNHS and EHIS used in this study are freely accessible through the website of the Ministry of Health, Consumer Affairs and Social Welfare of Spain: https://www.sanidad.gob.es/estadEstudios/estadisticas/bancoDatos.htm

References

1. Bixby H, Bentham J, Zhou B *et al.* Rising rural body-mass index is the main driver of the global obesity epidemic in adults. *Nature* 2019;**569**:260–4.

2. Marmot M, Bell R. Social Determinants of Health and Obesity. In L. Dubé, A. Bechara, A. Dagher, A. Drewnowski, J. LeBel, P. James, & R. Yada (Eds.). *Obesity Prevention*. Elsevier: Academic Press, 2010, 701–11.

3. Tyndale N. The Marmot Review: implications for Spatial Planning. 2011.

4. Marmot M. The health gap: the challenge of an unequal world: the argument. *Int J Epidemiol* 2017;**46**:1312–8.

5. García-Mayor J, Moreno-Llamas A, De la Cruz-Sánchez E. High educational attainment redresses the effect of occupational social class on health-related lifestyle: findings from four Spanish national health surveys. *Ann Epidemiol* 2021;**58**:29–37.

6. McLaren L, Godley J, MacNairn IAS. Social class, gender, and time use: implications for the social determinants of body weight? *Heal reports* 2009;**20**:65.

7. Corsi DJ, Subramanian S V. Socioeconomic gradients and distribution of diabetes, hypertension, and obesity in India. *JAMA Netw open* 2019;**2**:e190411–e190411.

8. Cirera L, Huerta JM, Chirlaque MD *et al.* Life-course social position, obesity and diabetes risk in the EPIC-Spain Cohort. *Eur J Public Health* 2016;**26**:439–45.

9. Solar O, Irwin A. *A Conceptual Framework for Action on the Social Determinants of Health*. WHO Document Production Services, 2010.

10. Geyer S, Hemström O, Peter R *et al.* Education, income, and occupational class cannot be used interchangeably in social epidemiology. Empirical evidence against a common practice. *J Epidemiol Community Health* 2006;**60**:804–10.

11. Braveman PA, Cubbin C, Egerter S *et al.* Socioeconomic status in health research: one size does not fit all. *JAMA* 2005;**294**:2879–88.

12. Mathieu-Bolh N. The elusive link between income and obesity. *J Econ Surv* 2021:1–34.

13. Costa-Font J, Gil J. What lies behind socio-economic inequalities in obesity in Spain? A decomposition approach. *Food Policy* 2008;**33**:61–73.

14. Ameye H, Swinnen J. Obesity, income and gender: the changing global relationship. *Glob Food Sec* 2019;**23**:267–81.

15. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. *J Health Econ* 2010;**29**:1–28.

16. Cutler DM, Lleras-Muney A. *Education and Health: Evaluating Theories and Evidence*. National bureau of economic research Cambridge, Mass., USA, 2006.

17. Lawrence W, Skinner C, Haslam C *et al.* Why women of lower educational attainment struggle to make healthier food choices: the importance of psychological and social factors. *Psychol Heal* 2009;**24**:1003–20.

18. Barker M, Lawrence W, Woadden J *et al.* Women of lower educational attainment have lower food involvement and eat less fruit and vegetables. *Appetite* 2008;**50**:464–8.

19. van der Heide I, Wang J, Droomers M *et al.* The relationship between health, education, and health literacy: results from the Dutch Adult Literacy and Life Skills Survey. *J Health Commun* 2013;**18 Suppl 1**:172–84.

20. Stoilova R, Ilieva-Trichkova P, Bieri F. Work–life balance in Europe: institutional contexts and individual factors. *Int J Sociol Soc Policy* 2020.

21. Brough P, Timms C, Chan XW *et al.* Work–life balance: Definitions, causes, and consequences. *Handb Socioecon Determ Occup Heal From macro-level to micro-level Evid* 2020:473–87.

22. Montez JK, Sabbath E, Glymour MM *et al.* Trends in work–family context among US women by education level, 1976 to 2011. *Popul Res Policy Rev* 2014;**33**:629–48.

23. Lemmens VEPP, Oenema A, Klepp K-I *et al.* A systematic review of the evidence regarding efficacy of obesity prevention interventions among adults. *Obes Rev* 2008;**9**:446–55.

24. Faeh D, Braun J, Bopp M. Prevalence of obesity in Switzerland 1992–2007: the impact of education, income and occupational class. *Obes Rev* 2011;**12**:151–66.

25. Maestre-Miquel C, Regidor E, Cuthill F *et al.* [Educational Inequality in Physical Inactivity in Leisure Time in Spanish Adult Population: differences in Ten Years (2002-2012)]. *Rev Esp Salud Publica* 2015;**89**:259–69.

26. O'Donoghue G, Kennedy A, Puggina A *et al.* Socio-economic determinants of physical activity across the life course: A "DEterminants of DIet and Physical ACtivity" (DEDIPAC) umbrella literature review. *PLoS One* 2018;**13**:e0190737.

27. Maestre-Miquel C, Martínez D, Polonio B *et al.* Inequalities in physical inactivity according educational level in Spain, 1987 and 2007. *Aten primaria* 2014;**46**:565–72.

28. Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr* 2008;**87**:1107–17.

29. Meader N, King K, Moe-Byrne T *et al.* A systematic review on the clustering and co-occurrence of multiple risk behaviours. *BMC Public Health* 2016;**16**:657.

30. Borodulin K, Zimmer C, Sippola R *et al.* Health behaviours as mediating pathways between socioeconomic position and body mass index. *Int J Behav Med* 2012;**19**:14–22.

31. Compernolle S, Oppert J-M, Mackenbach JD *et al.* Mediating role of energy-balance related behaviors in the association of neighborhood socio-economic status and residential area density with BMI: The SPOTLIGHT study. *Prev Med (Baltim)* 2016;**86**:84–91.

32. Backholer K, Spencer E, Gearon E *et al.* The association between socio-economic position and diet quality in Australian adults. *Public Health Nutr* 2016;**19**:477–85.

33. Gearon E, Backholer K, Hodge A *et al.* The mediating role of dietary factors and leisure time physical activity on socioeconomic inequalities in body mass index among Australian adults. *BMC Public Health* 2013;**13**:1214.

34. de Mestral C, Chatelan A, Marques-Vidal P *et al.* The contribution of diet quality to socioeconomic inequalities in obesity: a population-based study of Swiss adults. *Nutrients* 2019;**11**:1573.

35. Seifu CN, Fahey PP, Atlantis E. Unhealthy Diet Pattern Mediates the Disproportionate Prevalence of Obesity among Adults with Socio-Economic Disadvantage: An Australian Representative Cross-Sectional Study. *Nutrients* 2021;**13**:1363.

36. Dollman J, Ridley K, Magarey A *et al.* Dietary intake, physical activity and TV viewing as mediators of the association of socioeconomic status with body composition: a cross-sectional analysis of Australian youth. *Int J Obes* 2007;**31**:45–52.

37. Ministerio de Sanidad Consumo y Bienestar Social. Encuesta Nacional de Salud de España.

38. Prentice AM, Jebb SA. Beyond body mass index. *Obes Rev an Off J Int Assoc Study Obes* 2001;**2**:141–7.

39. Barzi F, Woodward M. Imputations of missing values in practice: results from imputations of serum cholesterol in 28 cohort studies. *Am J Epidemiol* 2004;**160**:34–45.

40. Bell BA, Kromrey JD, Ferron JM. Missing data and complex samples: The impact of listwise deletion vs. subpopulation analysis on statistical bias and hypothesis test results when data are MCAR and MAR. *Proceedings of the Joint Statistical Meetings, Survey Research Methods Section*. Vol 26. 2009, 759–4770.

41. WHO. *WHO Technical Report Series 894: Obesity: Preventing and Managing the Global Epidemic*. Geneva, Switzerland: World Health Organization, 2000.

42. Martínez-Gómez D, Guallar-Castillón P, Higueras-Fresnillo S *et al.* Concurrent Validity of the Historical Leisure-time Physical Activity Question of the Spanish National Health Survey in Older Adults. *Rev Española Cardiol* 2016;**70**:669–70.

43. Moreno-Llamas A, García-Mayor J, De la Cruz-Sánchez E. Concurrent and Convergent Validity of a Single, Brief Question for Physical Activity Assessment. *Int J Environ Res Public Health* 2020;**17**:1989.

44. Higueras-Fresnillo S, Cabanas-Sánchez V, García-Esquinas E *et al.* Physical activity attenuates the impact of poor physical, mental, and social health on total and cardiovascular mortality in older adults: a population-based prospective cohort study. *Qual Life Res* 2018;**27**:3293–302.

45. Cade JE, Burley VJ, Warm DL *et al.* Food-frequency questionnaires: a review of their design, validation and utilisation. *Nutr Res Rev* 2004;**17**:5–22.

46. Alvarez-Alvarez I, Zazpe I, Pérez de Rojas J *et al.* Mediterranean diet, physical activity and their combined effect on all-cause mortality: The Seguimiento Universidad de Navarra (SUN) cohort. *Prev Med (Baltim)* 2018;**106**:45–52.

47. Watling CZ, Schmidt JA, Dunneram Y *et al.* Risk of cancer in regular and low meat-eaters, fish-eaters, and vegetarians: a prospective analysis of UK Biobank participants. *BMC Med* 2022;**20**:1–13.

48. Domingo JL, Nadal M. Carcinogenicity of consumption of red meat and processed meat: A review of scientific news since the IARC decision. *Food Chem Toxicol* 2017;**105**:256–61.

49. ISCED. *International Standard Classification of Education: ISCED 2011*. United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO Institute for Statistics., 2012.

50. Domingo-Salvany A, Bacigalupe A, Carrasco JM *et al.* Proposals for social class

classification based on the Spanish National Classification of Occupations 2011 using neo-Weberian and neo-Marxist approaches. *Gac Sanit* 2013;**27**:263–72.

51. Lewis MW, Khodneva Y, Redmond N *et al.* The impact of the combination of income and education on the incidence of coronary heart disease in the prospective Reasons for Geographic and Racial Differences in Stroke (REGARDS) cohort study. *BMC Public Health* 2015;**15**:1–10.

52. Vermunt JK, Magidson J. Latent class cluster analysis. In J, Hagenaars, & A. Mccutcheon, (Eds.). *Applied Latent Class Analysis*. Cambridge: Cambridge University Press., 2002, 89–106.

53. De Vries H, van't Riet J, Spigt M *et al.* Clusters of lifestyle behaviors: results from the Dutch SMILE study. *Prev Med (Baltim)* 2008;**46**:203–8.

54. Kino S, Bernabé E, Sabbah W. Socioeconomic inequality in clusters of health-related behaviours in Europe: latent class analysis of a cross-sectional European survey. *BMC Public Health* 2017;**17**:1–8.

55. Mawditt C, Sacker A, Britton A *et al.* The clustering of health-related behaviours in a British population sample: testing for cohort differences. *Prev Med (Baltim)* 2016;**88**:95–107.

56. Mooney SJ, Joshi S, Cerdá M *et al.* Patterns of physical activity among older adults in New York City: a latent class approach. *Am J Prev Med* 2015;**49**:e13–22.

57. Tein JY, Coxe S, Cham H. Statistical Power to Detect the Correct Number of Classes in Latent Profile Analysis. *Stat power to Detect correct number classes latent profile Anal Struct Equ Model* 2013;**20**:640–57.

58. Nylund KL, Asparouhov T, Muthén BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Struct Equ Model A Multidiscip J* 2007;**14**:535–69.

59. Linzer DA, Lewis JB. poLCA: An R package for polytomous variable latent class analysis. *J Stat Softw* 2011;**42**:1–29.

60. Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav Res methods, instruments, Comput* 2004;**36**:717–31.

61. Hayes AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Guilford publications, 2017.

62. Kenny D, Kashy D, Bolger N. Data analysis. *The Handbook of Social Psychology: Vols. 1 and 2,*. McGraw-Hill New York, 1998, 233–65.

63. Hayes AF, Rockwood NJ. Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and implementation. *Behav Res Ther* 2017;**98**:39–57.

64. Agudo A, Slimani N, Ocke MC *et al.* Consumption of vegetables, fruit and other plant foods in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohorts from 10 European countries. *Publlic Heal Nutr* 2002;**5**:1179–96.

65. Althoff T, Sosic R, Hicks JL *et al.* Large-scale physical activity data reveal worldwide activity inequality. *Nature* 2017;**547**:336–9.

66. Guthold R, Stevens GA, Riley LM *et al.* Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Glob Heal* 2018;**6**:E1077–86.

67. Mathur C, Stigler M, Lust K *et al.* A latent class analysis of weight-related health behaviors among 2-and 4-year college students and associated risk of obesity. *Heal Educ Behav* 2014;**41**:663–72.

68. Liberali R, Del Castanhel F, Kupek E *et al.* Latent class analysis of lifestyle risk factors and association with overweight and/or obesity in children and adolescents: Systematic review. *Child Obes* 2021;**17**:2–15.

69. Devaux M, Sassi F, Church J *et al.* Exploring the relationship between education and obesity. *OECD J Econ Stud* 2011;**2011**:1–40.

70. Mathieu-Bolh N. Hand-to-mouth Consumption and Calorie Consciousness: Consequences for Junk-food Taxation. *Public Financ Rev* 2021;**49**:167–220.

71. Claassen MA, Klein O, Bratanova B *et al.* A systematic review of psychosocial explanations for the relationship between socioeconomic status and body mass index. *Appetite* 2019;**132**:208–21.

72. Ward H, Tarasuk V, Mendelson R *et al.* An exploration of socioeconomic variation in lifestyle factors and adiposity in the Ontario Food Survey through structural equation modeling. *Int J Behav Nutr Phys Act* 2007;**4**:8.

73. Miura K, Turrell G. Reported consumption of takeaway food and its contribution to socioeconomic inequalities in body mass index. *Appetite* 2014;**74**:116–24.

74. Zhao Z, Kaestner R, Xu X. Spatial mobility and environmental effects on obesity. *Econ Hum Biol* 2014;**14**:128–40.

75. Bremner JD, Moazzami K, Wittbrodt MT *et al.* Diet, Stress and Mental Health. *Nutrients* 2020;**12**, DOI: 10.3390/nu12082428.

76. Avila C, Holloway AC, Hahn MK *et al.* An Overview of Links Between Obesity and Mental Health. *Curr Obes Rep* 2015;**4**:303–10.

77. Talen MR, Mann MM. Obesity and mental health. *Prim Care* 2009;**36**:287–305.

78. Beccuti G, Pannain S. Sleep and obesity. *Curr Opin Clin Nutr Metab Care* 2011;**14**:402–12.

79. Zimberg IZ, Dâmaso A, Del Re M *et al.* Short sleep duration and obesity: mechanisms and future perspectives. *Cell Biochem Funct* 2012;**30**:524–9.

80. Wamala SP, Wolk A, Orth-Gomér K. Determinants of obesity in relation to socioeconomic status among middle-aged Swedish women. *Prev Med (Baltim)*

1997;**26**:734–44.

81. Biddle SJH, García Bengoechea E, Pedisic Z *et al.* Screen Time, Other Sedentary Behaviours, and Obesity Risk in Adults: A Review of Reviews. *Curr Obes Rep* 2017;**6**:134–47.

82. Fang K, Mu M, Liu K *et al.* Screen time and childhood overweight/obesity: A systematic review and meta-analysis. *Child Care Health Dev* 2019;**45**:744–53.

83. Gearon E, Peeters A, Ng W *et al.* Diet and physical activity as possible mediators of the association between educational attainment and body mass index gain among Australian adults. *Int J Public Health* 2018;**63**:883–93.

84. Qin P, Li Q, Zhao Y *et al.* Sugar and artificially sweetened beverages and risk of obesity, type 2 diabetes mellitus, hypertension, and all-cause mortality: a dose-response meta-analysis of prospective cohort studies. *Eur J Epidemiol* 2020;**35**:655–71.

Table 1. Characteristics of the study population (SNHS and EHIS, 2006–2017, Spain).

	Men (N = 29,018, 48.6%) Mean and SD or N and %	**Women** (N = 32,750, 51.4%) Mean±SD or N (%)	***p***
Age	41±12	42±12	0.003
Occupational social class			
Class IV-V (working class)	17016 (58.8)	18390 (57.3)	< 0.001
Class III (intermediate classes)	6053 (20.3)	7263 (21.3)	0.006
Class I-II (class of service)	5949 (21.0)	7097 (21.5)	0.278
Educational attainment			
Primary or low education	6211 (20.6)	7401 (21.8)	< 0.001
Middle education	17251 (59.8)	17700 (54.8)	< 0.001
High education	5556 (19.6)	7649 (23.4)	< 0.001
SES (education/social class)			
P/IV-V	5091 (17.0)	5779 (17.3)	0.999
P/III	842 (2.6)	1149 (3.1)	0.055
P/I-II	278 (0.9)	473 (1.4)	< 0.001
M/IV-V	11129 (39.0)	11102 (34.8)	< 0.001
M/III	3976 (13.2)	4337 (12.8)	0.982
M/I-II	2146 (7.7)	2261 (7.2)	0.674
H/IV-V	796 (2.8)	1509 (5.2)	< 0.001
H/III	1235 (4.5)	1777 (5.4)	0.001
H/I-II	3525 (12.3)	4363 (12.9)	0.857
Occupational status			
Working	19969 (67.8)	19171 (57.9)	< 0.001
Unemployed	3865 (13.7)	4467 (14.2)	0.576
Retired	3150 (10.7)	3311 (10.1)	0.304
Homemaker	530 (2.1)	4323 (12.8)	< 0.001
Other situation	1504 (5.7)	1478 (5.0)	0.006
Marital status			
Single	10091 (37.0)	8761 (28.9)	< 0.001
Married	16720 (57.7)	19624 (61.1)	< 0.001
Other	2207 (5.3)	4365 (10.1)	< 0.001
Smoking status			
Smoker	10559 (36.1)	9574 (28.7)	< 0.001
Ex-smoker	7873 (25.7)	6684 (19.7)	< 0.001
Non-smoker	10586 (38.2)	16492 (51.7)	< 0.001
Alcohol use			
Yes	19899 (67.5)	14259 (43.1)	< 0.001
No	9119 (32.5)	18491 (56.9)	
BMI			
Underweight	178 (0.8)	1053 (3.6)	< 0.001
Typical weight	10969 (40.1)	18391 (56.8)	< 0.001
Overweight	12952 (43.0)	8890 (26.1)	< 0.001
Obese	4919 (16.1)	4416 (13.4)	< 0.001
Survey year			
2006	7901 (25.9)	11087 (32.2)	< 0.001
2011	6515 (22.7)	6443 (20.5)	< 0.001
2014	7402 (25.8)	7624 (23.6)	< 0.001
2017	7200 (25.5)	7596 (23.7)	< 0.001

Population analysed aged 18-64 years (n = 61,768; valid percentage: 92.0%). By variables, the percentage of missing values was 4.4% in body mass index (BMI); 1.8% in occupational social class; 0.2% in educational attainment; 1.1% in employment status; 0.2% in marital status; 0.1% in smoking status and alcohol use, respectively; 0.5 in physical activity; 0.7% in sugary soft drink and pastries and sweet intake, respectively; 0.6% in fish, meat, fruit and vegetables intake, respectively. Percentages are weighted to account for survey designs. *P* value is presented from Chi-square test (Post-Hoc testing with Bonferroni correction).

1

Table 2. Model-fit indices for latent class analysis for health-related lifestyle behaviours (SNHS and EHIS, 2006–2017, Spain).

	Npar[a]	L^{2b}	df[c]	L^2 *p value*[d]	χ^{2d}	*LL*[f]	BIC[g]	AIC[h]	LMR-LRT[i]	LMR-LRT *p value*[j]	Absolute Entropy	Relative Entropy	Minimum % of a cluster
Women													
Two-cluster	15	2137,3	112	< 0.001	2259.503	-217694.1	435551.3	435418.3	-	< 0.001	4.149	0.421	35.22
Three-cluster	23	1151.049	104	< 0.001	1144.46	-217201	434652	434448	956.853	< 0.001	4.140	0.469	9.74
Four-cluster	31	498.8719	96	< 0.001	494.1038	-216874.9	434086.8	433811.9	632.792	< 0.001	4.135	0.561	7.82
Five-cluster	39	291.1616	88	< 0.001	291.5789	-216771.1	433966	433620.1	201.422	< 0.001	4.132	0.489	7.99
Six-cluster	47	157.118	80	< 0.001	155.8798	-216704.1	433918.9	433502.1	130.012	< 0.001	4.130	0.423	7.09
Seven-cluster	55	127.4586	72	< 0.001	126.025	-216689.2	433976.2	433488.4	28.913	< 0.001	4.130	0.527	4.06
Men													
Two-cluster	15	2102.355	112	< 0.001	2199.735	-170344.1	340847.4	340718.1	-	< 0.001	4.154	0.459	38.49
Three-cluster	23	1060.639	104	< 0.001	1052.624	-169823.2	339890.7	339692.4	1010.101	< 0.001	4.142	0.462	13.43
Four-cluster	31	494.7928	96	< 0.001	498.7475	-169540.3	339409.8	339142.6	548.584	< 0.001	4.136	0.548	11.27
Five-cluster	39	292.1911	88	< 0.001	295.5758	-169439	339292.2	338956	196.435	< 0.001	4.133	0.448	9.71
Six-cluster	47	140.7646	80	< 0.001	140.8972	-169363.3	339225.7	338820.5	146.793	< 0.001	4.130	0.428	7.96
Seven-cluster	55	97.70162	72	0.0236	96.25438	-169341.7	339267.7	338793.5	41.886	< 0.001	4.129	0.522	2.42

[a]Number of parameters in the model
[b]Model Fit Likelihood ratio chi-squared statistic
[c]Degrees of freedom in the model
[d]*p* value of L^2
[e]Pearson chi-square goodness of fit
[f]Log likelihood
[g]Bayesian Information criterion, based on the log likelihood
[h]Akaike's Information Criterion
[i]Lo-Mendell-Rubin adjusted likelihood ratio test
[j]*p* value of LMR-LRT

Table 3. Descriptive analysis of the study population according to sex and obesity status (SNHS and EHIS, 2006–2017, Spain).

	Men				Women			
	Non-obese (BMI < 30 kg/m^2) (N = 24,099)	**Obese (BMI ≥ 30 kg/m^2) (N = 4,919)**	***p***	**OR (95% CI)[a]**	**Non-obese (BMI < 30 kg/m^2) (N = 28,334)**	**Obese (BMI ≥ 30 kg/m^2) (N = 4,416)**	***p***	**OR (95% CI)[a]**
Age	40±12	46±11	< 0.001	1.037 (1.034-1.040)	41±12	46±12	< 0.001	1.036 (1.033-1.039)
Occupational social class								
Class I-II (class of service)	5203 (22.0)	746 (15.6)		1	6624 (23.1)	473 (10.6)		1
Class III (intermediate classes)	5047 (20.3)	1006 (20.1)	< 0.001	1.389 (1.259-1.699)	6480 (22.0)	783 (16.5)	< 0.001	1.633 (1.450-1.839)
Class IV-V (working class)	13849 (57.7)	3167 (64.3)		1.565 (1.442-1.699)	15230 (54.8)	3160 (72.9)		2.906 (2.632-3.209)
Educational attainment								
High education	4921 (20.8)	635 (13.4)		1	7180 (25.3)	469 (11.1)		1
Middle education	14373 (59.8)	2878 (59.9)	< 0.001	1.557 (1.427-1.700)	15485 (55.3)	2215 (51.3)	< 0.001	2.120 (1.919-2.342)
Primary or low education	4805 (19.4)	1406 (26.8)		2.144 (1.943-2.365)	5669 (19.4)	1732 (37.7)		4.443 (4.001-4.933)
SES (education/social class)								
H/I-II	3129 (13.1)	396 (8.2)		1	4138 (14.1)	225 (5.0)		1
H/III	1107 (4.8)	128 (2.8)		0,948 (0,778-1,154)	1670 (5.8)	107 (2.3)		1,104 (0,870-1,400)
H/IV-V	685 (2.8)	111 (2,3)		1,289 (1,037-1,601)	1372 (5.4)	137 (3.8)		1,973 (1,606-2,422)
M/I-II	1860 (8.0)	286 (6.1)		1,214 (1,04-1,416)	2088 (7.7)	173 (3.1)		1,500 (1,229-1,831)
M/III	3295 (13.0)	681 (13.9)	< 0.001	1,702 (1,497-1,935)	3894 (13.3)	443 (9.7)	< 0.001	2,056 (1,743-2,424)
M/IV-V	9218 (38.8)	1911 (39.9)		1,645 (1,473-1,838)	9503 (34.4)	1599 (37.5)		3,072 (2,665-3,542)
P/I-II	214 (0.8)	64 (1.3)		2,56 (1,923-3,409)	398 (1.4)	75 (1.5)		3,070 (2,301-4,096)
P/III	645 (2.5)	197 (3.4)		2,159 (1,778-2,621)	916 (2.9)	233 (4.5)		4,313 (3,526-5,277)
P/IV-V	3946 (16.1)	1145 (22.1)		2,191 (1,944-2,469)	4355 (15.1)	1424 (31.7)		5,913 (5,113-6,838)
Occupational status								
Working	16873 (68.8)	3096 (62.5)		1	17204 (59.8)	1967 (45.8)		1
Unemployed	3136 (13.3)	729 (15.9)		1,318 (1,212-1,434)	3740 (13.8)	727 (16.9)		1,602 (1,465-1,751)
Retired	2431 (10.2)	719 (13.2)	< 0.001	1,437 (1,312-1,574)	2620 (9.4)	691 (14.8)	< 0.001	2,055 (1,869-2,261)
Homemaker	422 (2.1)	108 (2.4)		1,298 (1,066-1,579)	3481 (11.9)	842 (18.2)		1,996 (1,829-2,18)
Other situation	1237 (5.6)	267 (6.0)		1,167 (1,027-1,325)	1289 (5.2)	189 (4.2)		1,059 (0,906-1,239)
Marital status								
Single	8765 (39.2)	1326 (25.8)		1	7949 (30.3)	812 (19.9)		1
Married	13513 (55.6)	3207 (68.5)	< 0.001	1,872 (1,75-2,002)	16731 (59.9)	2893 (67.5)	< 0.001	1,714 (1,585-1,853)
Other	1821 (5.2)	386 (5.7)		1,657 (1,444-1,901)	3654 (9.8)	711 (12.6)		1,955 (1,748-2,188)
Smoking status								
Non-smoker	9049 (39.4)	1537 (32.1)		1	13982 (50.9)	2510 (56.7)		1
Ex-smoker	6096 (23.8)	1777 (35.4)	< 0.001	1,824 (1,695-1,962)	5800 (19.6)	884 (20.1)	< 0.001	0,917 (0,846-0,994)
Smoker	8954 (36.8)	1605 (32.5)		1,081 (1,005-1,163)	8552 (29.5)	1022 (23.2)		0,705 (0,654-0,761)
Alcohol use								
No	7477 (32.1)	1642 (34.3)	0.002	1	15434 (55.5)	3057 (69.3)	< 0.001	1
Yes	16622 (67.9)	3277 (65.7)		0.906 (0.851-0.964)	12900 (45.0)	1359 (30.7)		0.541 (0.506-0.578)

Population analysed aged 18-64 years (n = 61,768; valid percentage: 92.0%). By variables, the percentage of missing values was 4.4% in body mass index (BMI); 1.8% in occupational social class; 0.2% in educational attainment; 1.1% in employment status; 0.2% in marital status; 0.1% in smoking status and alcohol use, respectively; 0.5 in physical activity; 0.7% in sugary soft drink and pastries and sweet intake, respectively; 0.6% in fish, meat, fruit and vegetables intake, respectively. Socioeconomic status (SES): Obtained from the three initial categories of educational attainment and occupational social class. Percentages are weighted to account for survey designs. *P* value is presented from Chi-square test. [a]Crude OR (95% CI) from logistic regression analysis estimating the probability of obesity (BMI ≥ 30 kg/m^2).

Table 3. (Continued)

	Men				Women			
	Non-obese (BMI < 30 kg/m^2) (N = 24,099)	**Obese** (BMI ≥ 30 kg/m^2) (N = 4,919)	***p***	**OR (95% CI)**[a]	**Non-obese** (BMI < 30 kg/m^2) (N = 28,334)	**Obese** (BMI ≥ 30 kg/m^2) (N = 4,416)	***p***	**OR (95% CI)**[a]
Physical activity								
Active	16281 (67,6)	2666 (54,1)	< 0.001	1	17496 (60.7)	2229 (49.7)	< 0.001	1
Inactive	7818 (32,4)	2253 (45,9)		1.777 (1.673-1.887)	10838 (39.3)	2187 (50.3)		1.564 (1.469-1.664)
Fruit intake								
Daily	13768 (55.7)	2820 (56.6)	0.248	1	19161 (66.0)	3111 (68.5)	0.001	1
Non-daily	10331 (44.3)	2099 (43.4)		0.965 (0.909-1.025)	9173 (34.0)	1305 (31.5)		0.894 (0.837-0.956)
Vegetables intake								
Daily	8790 (36.5)	1837 (37.3)	0.279	1	14072 (49.6)	2281 (52.1)	0.002	1
Non-daily	15309 (63.5)	3082 (62.7)		0.968 (0.909-1.028)	14262 (50.4)	2135 (47.9)		0.905 (0.851-0.963)
Pastries or sweets intake								
Non-daily	16976 (71.7)	3658 (76.5)	< 0.001	1	19489 (70.3)	3217 (74.6)	< 0.001	1
Daily	7123 (28.3)	1261 (23.5)		0.779 (0.727-0.834)	8845 (29.7)	1199 (25.4)		0.808 (0.753-0.867)
Sugary soft drinks intake								
Non-daily	20386 (82.8)	4236 (84.5)	0.002	1	25350 (88.3)	3928 (87.7)	0.237	1
Daily	3713 (17.2)	683 (15.5)		0.880 (0.811-0.955)	2984 (11.7)	488 (12.3)		1.059 (0.963-1.164)
Fish intake								
≥ 3 times a week	8479 (34.5)	1713 (34.8)	0.629	1	11376 (39.0)	1781 (39.6)	0.425	1
< 3 times per week	15620 (65.5)	3206 (65.2)		0.985 (0.925-1.048)	16958 (61.0)	2635 (60.4)		0.974 (0.914-1.038)
Meat intake								
≤ 3 times per week	5878 (23.3)	1201 (23.7)	0.594	1	8743 (29.6)	1339 (27.7)	0.009	1
> 3 times per week	18221 (76.7)	3718 (76.3)		0.981 (0.915-1.052)	19591 (70.4)	3077 (72.3)		1.097 (1.024-1.176)
Clustering of health-related lifestyles								
Very healthful	3154 (12.3)	617 (12.0)	0.017	1	4510 (14.8)	652 (13.7)	< 0.001	1
Very unhealthful	2431 (11.1)	494 (10.9)		1,000 (0,883-1,131)	2767 (10.4)	345 (8.3)		0,858 (0,750-0,983)
Unhealthful	7573 (32.1)	1542 (31.8)		1,011 (0,915-1,118)	5116 (19.0)	818 (20.7)		1,180 (1.059-1,314)
Regular unhealthful	3009 (12.6)	573 (11.7)		0,941 (0,834-1,062)	3586 (12.6)	617 (13.5)		1,160 (1,029-1,306)
Regular healthful	1759 (7.0)	413 (8.2)		1,200 (1,049-1,374)	1710 (6.1)	294 (6.1)		1,071 (0.921-1,246)
Healthful	6173 (24.9)	1280 (25.4)		1,042 (0,940-1,156)	10645 (37.0)	1690 (37.7)		1,100 (0,998-1,213)
Survey year								
2017	5918 (25.2)	1282 (27.5)	< 0.001	1	6516 (23.6)	1080 (24.7)	0.029	1
2006	6662 (26.5)	1239 (22.8)		0,787 (0,724-0,856)	9638 (32.5)	1449 (30.4)		0,894 (0,821-0,972)
2011	5356 (22.5)	1159 (24.0)		0,979 (0,901-1,064)	5569 (20.6)	874 (20.4)		0,946 (0,862-1,039)
2014	6163 (25.8)	1239 (25.7)		0,912 (0,841-0.990)	6611 (23.4)	1013 (24.4)		0,993 (0,908-1,085)

Population analysed aged 18-64 years (n = 61,768; valid percentage: 92.0%). By variables, the percentage of missing values was 4.4% in body mass index (BMI); 1.8% in occupational social class; 0.2% in educational attainment; 1.1% in employment status; 0.2% in marital status; 0.1% in tobacco use; 0.1% in alcohol use; 0.5 in physical activity; 0.7% in sugary soft drink and pastries and sweet intake, respectively; 0.6% in fish, meat, fruit and vegetables intake, respectively. Socioeconomic status (SES): Obtained from the 3 initial categories of educational attainment and occupational social class. Percentages are weighted to account for survey designs. *P* value is presented from Chi-square test. [a]Crude OR (95% CI) from logistic regression analysis estimating the probability of obesity (BMI ≥ 30 kg/m^2).

Table 4. Logistic regression analysis estimating the probability of obesity (BMI ≥ 30 kg/m^2) according to predictor variables (SNHS and EHIS, 2006–2017, Spain).

	Men		Women	
	OR (95% CI)	***p***	**OR (95% CI)**	***p***
Age[a]	1.030 (1.027-1.034)	< 0.001	1.030 (1.027-1.034)	< 0.001
SES[a]				
H/I-II	1		1	
H/III	1.011 (0.828-1.285)	0.911	1.143 (0.900-1.453)	0.273
H/IV-V	1.418 (1.137-1.769)	0.002	2.090 (1.696-2.575)	< 0.001
M/I-II	1.213 (1.036-1.420)	0.017	1.415 (1.157-1.732)	0.001
M/III	1.634 (1.434-1.863)	< 0.001	1.881 (1.591-2.225)	< 0.001
M/IV-V	1.566 (1.396-1.767)	< 0.001	2.782 (2.403-3.220)	< 0.001
L/I-II	2.012 (1.497-2.702)	< 0.001	2.210 (1.645-2.970)	< 0.001
L/III	1.895 (1.529-2.272)	< 0.001	2.966 (2.404-3.660)	< 0.001
L/IV-V	1.726 (1.514-1.967)	< 0.001	4.044 (3.468-4.715)	< 0.001
Occupational status[a]				
Worker	1		1	
Unemployed	1.265 (1.157-1.383)	< 0.001	1.317 (1.200-1.446)	< 0.001
Early retired	1.109 (1.001-1.229)	0.047	1.206 (1.082-1.345)	0.001
Homemaker	1.094 (0.891-1.345)	0.391	1.236 (1.119-1.365)	< 0.001
Other situation	1.372 (1.197-1.573)	< 0.001	1.062 (0.900-1.253)	0.477
Marital Status[a]				
Single	1		1	
Married	1.210 (1.115-1.313)	< 0.001	1.015 (0.926-1.113)	0.755
Other	0.997 (0.860-1.156)	0.972	1.018 (0.896-1.156)	0.789
Tobacco use[a]				
Non-smoker	1		1	
Smoker	0.885 (0.819-0.956)	0.002	0.751 (0.693-0.814)	< 0.001
Ex-smoker	1.347 (1.246-1.456)	< 0.001	1.037 (0.952-1.129)	0.404
Alcohol use[a]				
No	1		1	
Yes	0.915 (0.857-0.978)	0.009	0.673 (0.627-0.723)	< 0.001
Physical activity[a]				
Active	1		1	
Inactive	1.638 (1.537-1.746)	< 0.001	1.474 (1.379-1.575)	< 0.001

Population analysed aged 18-64 years (n = 61,768; valid percentage: 92.0%). By variables, the percentage of missing values was 4.4% in body mass index (BMI); 2.0% in socioeconomic status (SES); 1.8% in occupational social class; 0.2% in educational attainment; 1.1% in employment status; 0.2% in marital status; 0.1% in tobacco use; 0.1% in alcohol use; 0.5 in physical activity; 0.7% in sugary soft drink and pastries and sweet intake, respectively; 0.6% in fish, meat, fruit and vegetables intake, respectively. [a]Model 1: inclusion of all the variables indicated. [b]Model 2: Clustering of health-related lifestyles is adjusted by age, SES, occupational status, marital status, smoking status, alcohol use, and survey year.

Table 4. (Continued).

	Men		Women	
	OR (95% CI)	***p***	**OR (95% CI)**	***p***
Fruit intake[a]				
Daily	1		1	
Non daily	1.074 (1.005-1.147)	0.035	1.044 (0.969-1.125)	0.258
Vegetables intake[a]				
Daily	1		1	
Non daily	1.025 (0.960-1.095)	0.465	0.857 (0.801-0.917)	< 0.001
Pastries or sweets intake[a]				
Non daily	1		1	
Daily	0.798 (0.743-0.858)	< 0.001	0.788 (0.732-0.849)	< 0.001
Soft drink intake[a]				
Non daily	1		1	
Daily	1.092 (1.001-1.192)	0.048	1.170 (1.057-1.296)	0.002
Fish intake[a]				
≥ 3 times a week	1		1	
< 3 times per week	1.056 (0.990-1.127)	0.100	1.036 (0.968-1.108)	0.306
Meat intake[a]				
≤ 3 times per week	1		1	
> 3 times per week	1.127 (1.048-1.213)	0.001	1.253 (1.164-1.348)	< 0.001
Clustering of health-related lifestyles[b]				
Very healthful	1		1	
Very unhealthful	1.490 (1.306-1.698)	< 0.001	1.158 (1.003-1.337)	0.046
Unhealthful	1.274 (1.148-1.414)	< 0.001	1.419 (1.266-1.590)	< 0.001
Regular unhealthful	1.149 (1.013-1.302)	0.030	1.250 (1.104-1.416)	< 0.001
Regular healthful	1.303 (1.134-1.497)	< 0.001	1.079 (0.922-1.262)	0.346
Healthful	1.102 (0.991-1.225)	0.074	1.198 (1.083-1.326)	< 0.001
Survey year[a]				
2017	1		1	
2006	0.902 (0.824-0.986)	0.024	0.891 (0.812-0.977)	0.014
2011	1.021 (0.935-1.116)	0.637	0.943 (0.853-1.042)	0.251
2014	0.952 (0.875-1.037)	0.261	0.986 (0.896-1.084)	0.765

Population analysed aged 18-64 years (n = 61,768; valid percentage: 92.0%). By variables, the percentage of missing values was 4.4% in body mass index (BMI); 2.0% in socioeconomic status (SES); 1.8% in occupational social class; 0.2% in educational attainment; 1.1% in employment status; 0.2% in marital status; 0.1% in tobacco use; 0.1% in alcohol use; 0.5 in physical activity; 0.7% in sugary soft drink and pastries and sweet intake, respectively; 0.6% in fish, meat, fruit and vegetables intake, respectively. [a]Model 1: inclusion of all the variables indicated. [b]Model 2: Clustering of health-related lifestyles is adjusted by age, socioeconomic status (SES), occupational status, marital status, smoking status, alcohol use, and survey year.

Figures

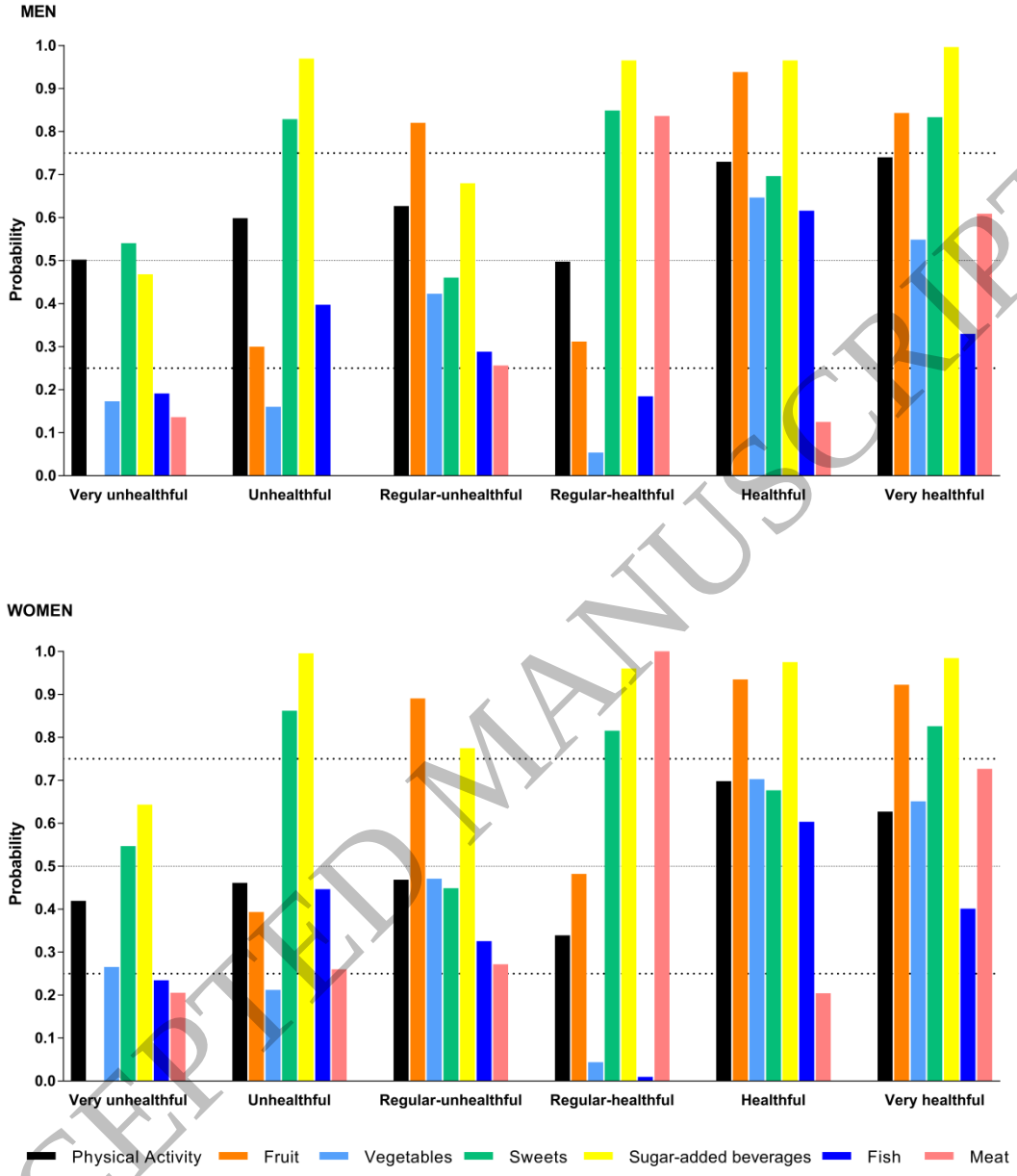


Fig. 1. Probabilities of health-related lifestyle behaviours for the six-cluster model among women and men (SNHS and EHIS, 2006–2017, Spain). For each of the seven behaviours, values closer to 1 indicate a higher probability of adherence to healthy habit. In women: *Very unhealthful* (mean = 0.33; values lower than 0.5 = 5); *Unhealthful* (mean = 0.51; values lower than 0.5 = 5); *Regular unhealthful* (mean = 0.52; values lower than 0.5 = 5); *Regular healthful* (mean = 0.52; values lower than 0.5 = 4); *Healthful* (mean = 0.68; values lower than 0.5 = 1); *Very healthful* (mean = 0.73; values lower than 0.5 = 1). In men: *Very unhealthful* (mean = 0.29; values lower than 0.5 = 5); *Unhealthful* (mean = 0.47; values lower than 0.5 = 5); *Regular unhealthful* (mean = 0.51; values lower than 0.5 = 5); *Regular healthful* (mean = 0.53; values lower than 0.5 = 4); *Healthful* (mean = 0.67; values lower than 0.5 = 1); *Very healthful* (mean = 0.70; values lower than 0.5 = 1).

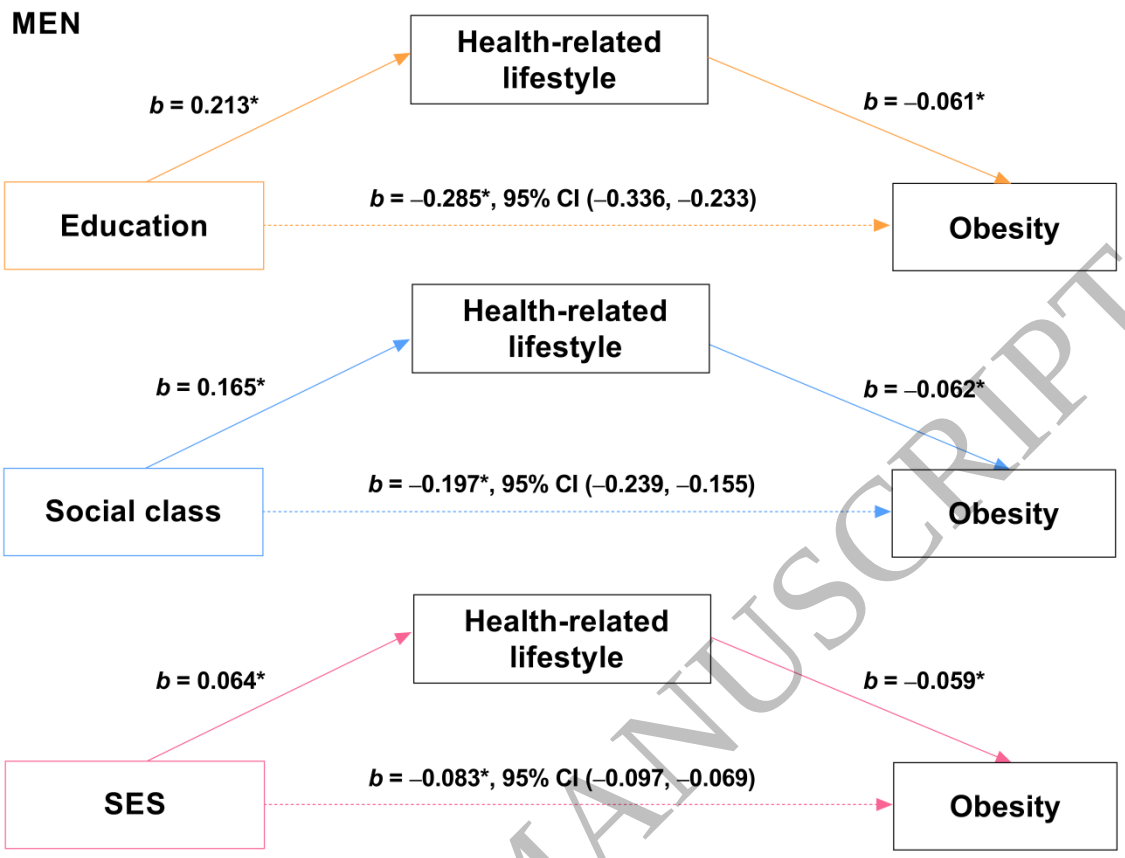


Figure 2. Educational attainment, occupational social class, and SES (combination of educational attainment and occupational social class) relate to obesity through the clustering of health-related lifestyle behaviours (from 1 *Very unhealthful* to 6 *Very healthful*) among men. We show unstandardized regression coefficients (b) and bootstrap confidence intervals (95% CI). The discontinuous line represents the direct effect. Analyses are adjusted by age, employment status, marital status, smoking status, alcohol use, and survey year. *p < 0.001.

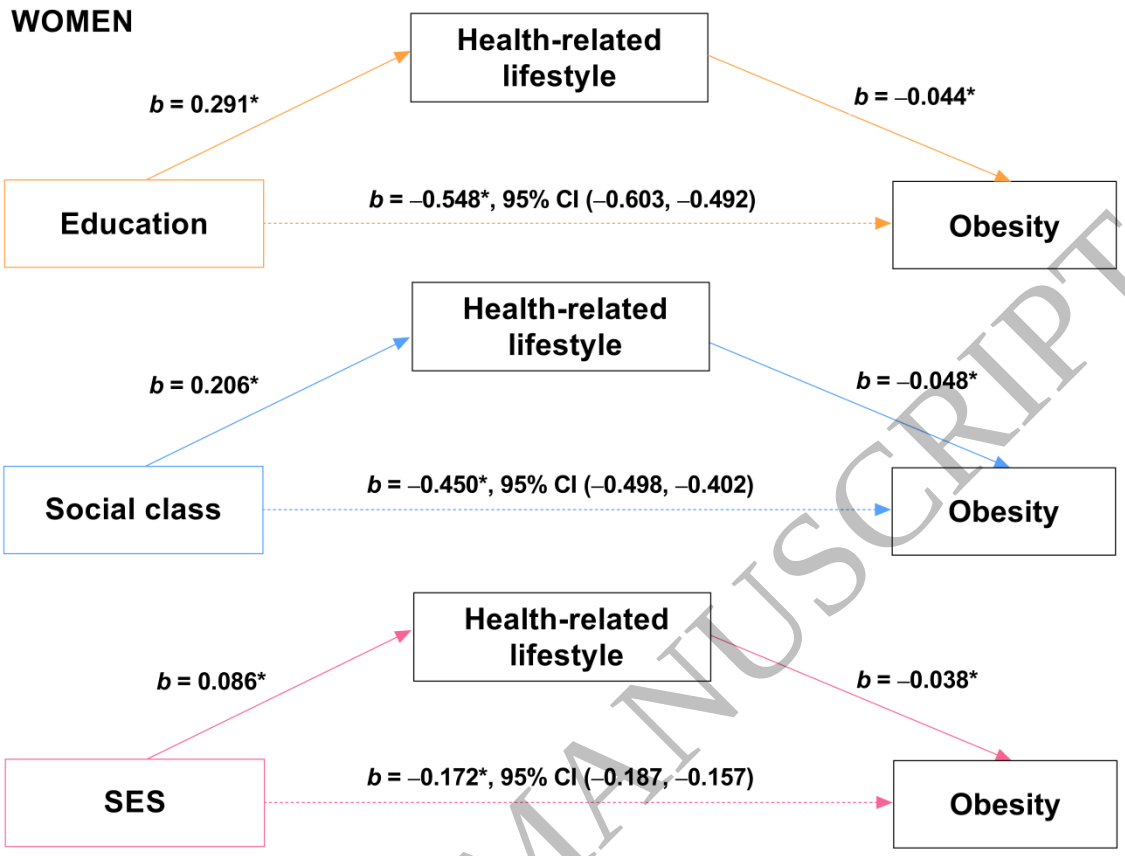


Figure 3. Educational attainment, occupational social class, and SES (combination of educational attainment and occupational social class) relate to obesity through the clustering of health-related lifestyle behaviours (from 1 *Very unhealthful* to 6 *Very healthful*) among women. We show unstandardized regression coefficients (b) and bootstrap confidence intervals (95% CI). The discontinuous line represents the direct effect. Analyses are adjusted by age, employment status, marital status, smoking status, alcohol use, and survey year. *p < 0.001.