Obesity Facts

Obes Facts 2020;13:322–332
DOI: 10.1159/000508111
Received: November 28, 2019
Accepted: April 21, 2020
Published online: July 14, 2020

Research Article

Factors Accounting for Obesity and Its Perception among the Adult Spanish Population: Data from 1,000 Computer-Assisted Telephone Interviews

Albert Lecube[a, b] Enric Sánchez[a] Susana Monereo[c] Gema Medina-Gómez[d] Diego Bellido[e] José Manuel García-Almeida[f, g] Purificación Martínez de Icaya[h] Maria Mar Malagón[i, j] Albert Goday[j, k] Francisco José Tinahones[f, j] on behalf of the Spanish Society of Obesity

[a]Endocrinology and Nutrition Department, University Hospital Arnau de Vilanova, Obesity, Diabetes and Metabolism Research Group (ODIM), IRBLleida, University of Lleida, Lleida, Spain; [b]Centro de Investigación Biomédica en Red de Diabetes y Enfermedades Metabólicas Asociadas (CIBERDEM), Instituto de Salud Carlos III (ISCIII), Madrid, Spain; [c]Endocrinology and Nutrition Department, Gregorio Marañón University General Hospital, Madrid, Spain; [d]Department of Basic Sciences of Health, Area of Biochemistry and Molecular Biology, Universidad Rey Juan Carlos, Alcorcon, Spain; [e]Endocrinology and Nutrition Department, Ferrol University Hospital Complex (CHUF), A Coruña, Spain; [f]Endocrinology and Nutrition Department, Virgen de la Victoria University Hospital, Institute of Biomedical Research of Malaga (IBIMA), University of Malaga, Málaga, Spain; [g]Quirón Salud Málaga Hospital, Málaga, Spain; [h]Sección de Endocrinología y Nurición, Hospital Universitario Severo Ochoa de Leganés, Madrid, Spain; [i]Department of Cell Biology, Physiology, and Immunology, Instituto Maimónides de Investigación Biomédica (IMIBIC)/University of Córdoba/Reina Sofia University Hospital, Córdoba, Spain; [j]Centro de Investigación Biomédica en Red de Fisiopatología Obesidad y Nutrición (CIBEROBN), Instituto de Salud Carlos III (ISCIII), Madrid, Spain; [k]Endocrinology and Nutrition Department, Parc de Salut Mar, Institut Hospital del Mar d'Investigacions Mèdiques (IMIM), Universitat Autònoma de Barcelona, Barcelona, Spain

Keywords
Obesity · Computer-assisted telephone interviewing · Lifestyle behaviors · Self-perception

Abstract
Objective: Our aim was to go deeper in the self-perception of weight and health status among the Spanish population, together with the connections of familiar relationships, physical activity practice, nutritional habits, and sleep patterns with the presence of obesity. ***Methods:***

Albert Lecube
Endocrinology and Nutrition Department, University Hospital Arnau de Vilanova
Obesity, Diabetes and Metabolism Research Group (ODIM), IRBLleida
Av. Rovira Roure 80, ES–25198 Lleida (Spain)
alecube@gmail.com

Obes Facts 2020;13:322–332
DOI: 10.1159/000508111

A total of 1,000 subjects were enrolled in April 2017 in a representative adult Spanish population sample. Computer-assisted telephone interviewing was used and self-reported anthropometric data was obtained. ***Results:*** The population was composed of 51.3% women, with a mean age of 48 (36–63) years and a BMI of 23.2 (20.3–26.6). Although only 17.7% of subjects with self-reported obesity exhibited the self-perception to suffer from obesity, they referred a bad (16%) or regular (47%) self-perceived health status. Subjects who considered themselves as people with overweight and obesity displayed a BMI of 30.5 (28.7–32.2) and 37.1 (34.8–41.5), respectively. The obesity group displayed the highest percentage (71.9%) of participants with some first-degree relative with overweight or obesity ($p < 0.001$) in comparison with the other groups. The main reason put forward of preventing healthy eating among subjects with obesity was that they dislike healthy food. The multivariable logistic regression model for presence of obesity showed that there was a significant association with older age, presence of a first-degree relative with weight excess, a positive snacking habit, and daily alcohol consumption ($p \leq 0.019$). ***Conclusion:*** The Spanish population has a low self-perception of obesity. Our data also reinforces the strong association between obesity and age, family interactions, usual snacking, and daily consumption of wine or beer.

Introduction

The increase in prevalence of obesity represents a worldwide phenomenon [1]. Obesity rises up to the top of the world's deadliest diseases as excess body weight has been related to more than 2.8 million annual deaths [2, 3]. Vast ethiopathogenic mechanisms leading to obesity have been defined, but they are still far from being well described [4, 5]. The roles of changes in contemporary lifestyle behaviors, with an increase in both sitting in front of a screen and caloric intake, would have a key role in this issue in the dramatic rise in obesity prevalence [6, 7].

Obesity rates reach 34.9% of adults in the United States [8]. In Spain, 21.6% of adult people suffer from obesity, increasing with age and especially among women aged ≥50 years [9]. However, it has consistently been shown that a high proportion of people underestimate their own weight [10, 11]. In 2015, the European Association for the Study of Obesity showed similar results concerning people's perceptions among 7 different European countries with 14,043 survey respondents [12]. This fact might be another reason to explain obesity expansion, as a subject who has the self-perception to suffer from a disease is more likely to become active to counteract its consequences [13, 14]. Data about how the Spanish population perceive their own weight and how daily health behaviors are related with excess weight are not available. Discerning this data may support health strategies from National Health Services to reverse the actual lifestyle towards healthy habits such as a balanced diet and regular physical activity, which have been well exposed to decrease both body fat mass and obesity prevalence [15, 16].

Although the impact of daily attitudes regarding weight control are difficult to evaluate in big populations, computer-assisted telephone interviewing (CATI) is a validated method to obtain health information through a structured and digitally recorded questionnaire [17]. A CATI survey-based surveillance system has been used by the Australian government to evaluate food consumption habits [18]. Likewise, the Centers for Disease Control and Prevention, the leading national public health institute of the United States of America, consistently employs CATI for a broad range of health pathologies [19].

So, our aim was to go deeper in the self-perception to suffer from overweight and obesity in a Spanish representative population according to the conventional WHO classification of

body mass index (BMI). In addition, we also explored the self-reported health status in different BMI groups, as well as physical activity practice, nutritional habits, familiar relationships, and sleep patterns. The CATI method was used for this purpose.

Methods

Study Design and Characteristics of CATI

The execution and supervision of CATI was carried out according to ISO 20252/2006 standard of the Spanish Association for Standardization and Certification for market studies and opinion through the MyWord company. This study was conducted according to International Chamber of Commerce (ICC)/European Society for Opinion and Marketing Research (ESOMAR). The ICC/ESOMAR was developed jointly with the ICC, which sets out global standards for self-regulation for researchers and data analysts and is undersigned by all ESOMAR members [20].

The interview followed the quality and standards for survey research best practices and included 21 closed questions about health status, sedentary lifestyle, nutritional habits, familial relationships, and sleep pattern [21] (online supplementary Table 1, available at www.karger.com/doi/10.1159/000508111). All the questions were read directly on the computer screen by the interviewer and the answers were directly documented in the system. The interviews took an average of 5.5 (2.8 to 8.9) min to be completed, and no data transformation was made once the answers were recorded. The rate of telephone calls that allowed a complete interview was 7.8%.

Participants

Finally, a total of 1,000 subjects were enrolled in April 2017 in a representative adult Spanish population sample according sex, age, and region, ranging from 0.7% from La Rioja to 18.0% from Andalucía.

Information on BMI was obtained through self-reported data and subjects were classified following the WHO classification: (i) underweight when BMI <18.5, (ii) normal weight when BMI 18.5–25, (iii) overweight when BMI 25–30, and (iv) obesity when BMI ≥30. Finally, 67 patients were excluded owing to missing data for weight or height.

Statistical Analysis

A sample size of 1,000 individuals achieved 95.5% of statistical power and a 3.16% margin of error to detect a true difference in self-perception to suffer from overweight or obesity of at least a moderate effect size, with a false discovery rate of 0.001 using a Kruskal-Wallis test. With these 1,000 individuals, this study also had enough capacity to robustly estimate all coefficients required to develop logistic prediction models with 20 variables. The normal distribution of the variables was evaluated using the Shapiro-Wilk test. Given its skewed distribution, quantitative data are expressed as the median (interquartile range). Comparisons between groups were made using the Kruskal-Wallis test for quantitative variables and the Pearson's chi-squared test for categorical variables. A trend analysis was done to assess the percentage of participants with a misjudgment of the own weight situation between the categories of BMI. A multivariable logistic regression model for the presence of self-reported obesity was developed adjusting for the following confounding elements: age, sex, first-degree relative with overweight or obesity, sitting time, moderate and intense physical activity, sleeping time, snacking habit, and finally fish, red meat, and alcohol consumption. The calibration and discrimination of the model was evaluated using the test of chi-squared goodness of fit and the area under the receiver operating characteristic curve,

Table 1. Main sociodemographic characteristics according to the self-reported body mass index classification

	Underweight (*n* = 63)	Normal weight (*n* = 524)	Overweight (*n* = 211)	Obesity (*n* = 135)	*p*
Male	27 (42.9)	240 (45.8)	118 (55.9)	69 (51.1)	0.062
Age, years	35 [30–49]	44 [33–61]	54 [44–70]	51 [42–63]	<0.001
BMI	17.9 [17.3–18.2]	21.4 [20.1–23.0]	26.5 [25.7–27.9]	32.2 [31.1–34.5]	<0.001
Concordant BMI self-perception	50 (79.4)	275 (52.5)	53 (25.1)	24 (17.7)	<0.001
Social class*					<0.001
Upper middle	2 (3.2)	16 (3.1)	1 (0.5)	4 (3.0)	–
Middle	24 (38.1)	230 (44.2)	77 (37.9)	30 (23.1)	–
Working	34 (54.0)	247 (47.1)	107 (50.7)	73 (54.1)	–
Lower	3 (4.8)	27 (5.2)	18 (8.9)	23 (17.7)	–

Data are *n* (percentage) or median [interquartile range]. BMI, body mass index. * 17 patients did not respond to this question.

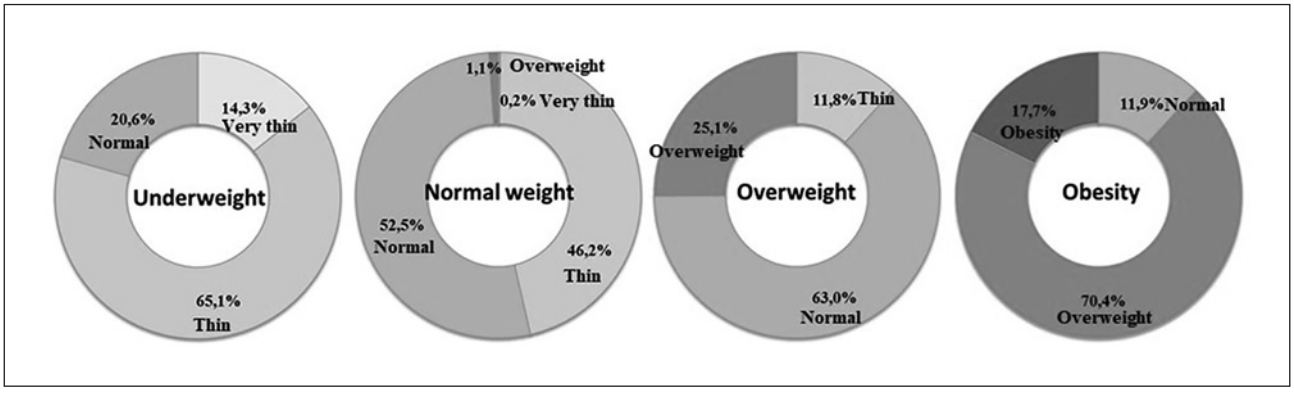

Fig. 1. Self-perception of obesity according to the body mass index classification.

correspondingly. All statistical tests were two-sided and set at $p \leq 0.05$. All statistical analyses were performed using SSPS statistical package (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA).

Results

The interviewed Spanish population had a median age and BMI of 48 (36–63) years and 23.2 (20.3–26.6), respectively, with a similar prevalence of both sexes (51.3% of women) (Table 1). According to the self-reported weight and height, 22.6% of participants were classified to suffer from overweight and 14.4% to suffer from obesity. Among subjects declared to be from lower social classes, the prevalence of self-reported obesity was more than three times higher than the prevalence of normal weight.

The misjudgment of the own weight situation was especially observed in individuals with overweight and obesity (*p* for trend <0.001). Only 25.1% of participants with self-reported overweight and 17.7% of participants with self-reported obesity exhibited the self-perception to suffer from overweight or obesity, respectively (Fig. 1). Median BMI values of people perceiving themselves as subjects with overweight and obesity were 30.5 (28.7–32.2) and 37.1 (34.8–41.5), respectively.

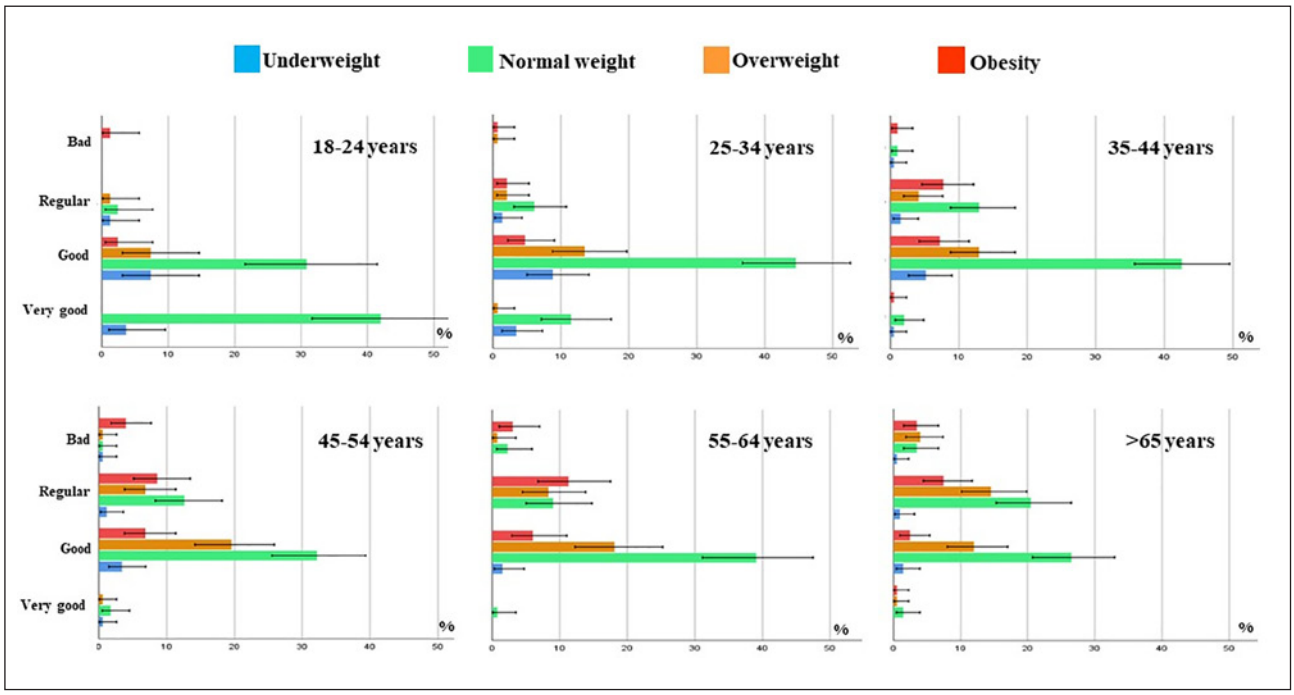

Fig. 2. Bar plot showing the percentage of subjects with a detailed self-perceived health status according to the body mass index classification and age.

In the entire population, the self-perceived health status progressively deteriorated as BMI (r = 0.287, p < 0.001) and age (r = 0.407, p < 0.001) increased. Irrespective of age, the self-perceived health status was better in subjects with normal weight in comparison to subjects suffering from obesity or overweight (Fig. 2).

The obesity group displayed the highest percentage (71.9%) of participants with some first-degree relative with overweight or obesity (p < 0.001) in comparison with the other groups: 31.7% in underweight, 34.9% in normal weight, and 32.7% in overweight. When the kind of kinship was assessed, no differences between grandparents, parents, uncles, or brothers were observed.

Data regarding physical activity and nutritional habits in the entire population and in each one of the four groups are displayed in Table 2. A tendency to sedentary lifestyle was observed in subjects with obesity in comparison with normal-weight subjects. In addition, the percentage of subjects who reported eating out or who declared never to consume fresh fruits and vegetables was significantly higher in those with obesity compared to subjects with normal weight. Similarly, the main reason given by subjects with obesity for not following a healthy diet was that they did not like healthy food.

Regarding the results about snacking habit (excluding snacks at mid-morning or mid-afternoon), a quarter of all population declared that they usually snack, and those subjects with obesity were the group who snack most (Fig. 3).

When the entire population was asked about the most consumed daily beverage, water was the elected choice. However, among participants with obesity, the quotidian preference of sugar-sweetened soft drinks increased to 18.5% in comparison with 2.3% of subjects with normal weight (p < 0.001). In addition, 22.5% of subjects declared a daily consumption of wine or beer, a percentage that ranged from 17.9% among subjects with normal weight to 40.7% in subjects with obesity (p < 0.001). Similar results were observed with the daily consumption of alcoholic beverages with high alcohol content.

Obes Facts 2020;13:322–332
DOI: 10.1159/000508111

Table 2. Main characteristics regarding physical activity and nutritional characteristics in the entire population and according to the self-reported body mass index classification

	Entire population	Under-weight	Normal weight	Over-weight	Obesity	*p*
Physical activity						
Sitting ≥3 h per day outside of their work or study schedules	50.5	49.2	50.9	42.6	62.2	<0.001
Going to work/school by cycling or walking	11.4	6.4	12.2	11.8	9.6	<0.001
Moderate physical activity (such as walking, gardening, dancing, or homework) <2 days per week	19.5	15.9	17.6	17.1	31.9	<0.001
Intense physical activity (such as swimming, basketball, or others) <2 days per week	75.3	66.6	73.9	72.5	89.5	<0.001
Nutritional habits						
Eat at home	68.2	42.9	63.0	78.2	84.4	<0.001
Never consume fresh fruits	7.7	6.3	7.8	4.8	12.7	0.002
Consumption of fish <1 time per week	18.8	27.0	17.4	14.3	27.4	0.047
Daily consumption of white meat	2.0	1.6	2.1	1.9	2.2	0.111
Daily consumption of red, fat, or processed meat	4.9	3.2	2.9	6.2	11.5	<0.001
The most consumed daily beverages						
Water	40.3	15.9	38.7	53.1	37.8	<0.001
Light soft drinks	20.4	38.1	26.1	7.1	10.4	<0.001
Coffee	14.9	17.5	16.2	12.8	11.9	0.470
Juices	11.8	20.6	11.1	12.8	8.9	0.100
Sugar-sweetened soft drinks	4.6	1.6	2.3	2.4	18.5	<0.001
Daily consumption of wine or beer	22.5	12.7	17.9	25.1	40.7	<0.001
Daily consumption of alcoholic beverages with high alcohol content	2.5	1.6	1.0	4.7	5.2	<0.001
Sleep pattern						
More than 8 h per day	19.2	23.8	19.7	17.1	18.5	0.432
Not established routine	11.0	7.9	10.3	10.0	17.0	0.383
Main difficulties to follow a healthy diet						
Economic reasons	23.7	20.0	27.6	14.3	19.4	0.001
Lack of knowledge about it	23.1	26.7	26.6	14.3	16.1	0.003
No time to buy or cooking	19.8	13.3	20.6	26.2	16.1	0.001
Dislike for healthy foods	18.3	13.3	11.1	31.0	35.5	0.003

Data are represented as percentage.

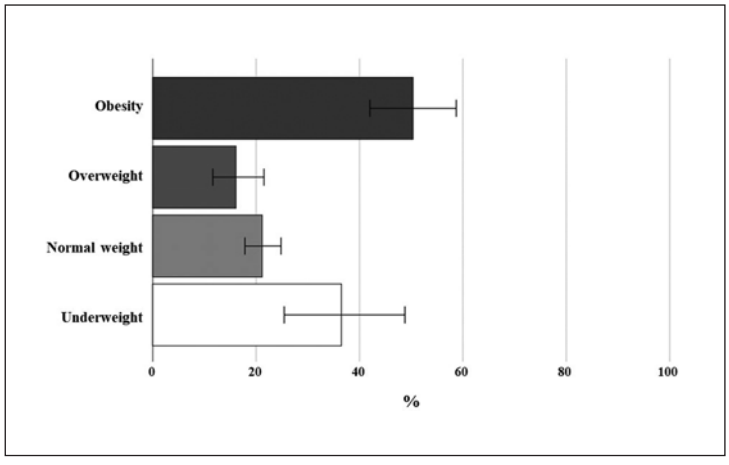

Fig. 3. Bar plot showing the percentage of subjects who declared usually snacking (excluding snacks at mid-morning or mid-afternoon) according to the body mass index classification.

Table 3. Multivariable logistic regression model with significant variables associated with the presence of obesity

Obesity	OR (95% CI)	*p*
Age (years)	1.0 (1.0–1.0)	0.012
Have some first-degree relative with overweight or obesity	6.2 (3.6–10.7)	<0.001
Snacking		
Almost never or never	Reference	
Occasionally	0.7 (0.4–1.3)	0.264
Usually	2.1 (1.1–3.9)	0.019
Wine or beer consumption		
<1 time per week	Reference	
1–3 times per week	0.7 (0.3–1.3)	0.236
4–6 times per week	0.5 (0.2–1.2)	0.123
At least once per day	2.0 (1.2–3.6)	0.016
Chi-squared goodness of fit		0.059
Area under the ROC curve	0.8 (0.8–0.9)	<0.001

The group with normal weight was used as reference. The model was adjusted for the following confounding elements: age, sex, first-degree relative with overweight or obesity, sitting time, moderate and intense physical activity, sleeping time, snacking habit, and fish, red meat, and alcohol consumption. OR, odds ratio; CI, confidence interval; ROC, receiver operating characteristic.

Finally, the multivariable logistic regression model for presence of obesity (Table 3) showed that there was a significant association with older age, the presence of a first-degree relative with weight excess, a positive snacking habit, and daily alcohol consumption ($p \leq 0.019$).

Discussion

Among the Spanish subjects with self-reported obesity who were interviewed in this study, there were four main independent variables that were related with this disease: to have some first-degree relative with overweight or obesity, usual snacking habit, daily consumption of wine or beer, and aging. Our data also confirm that not only health professionals underestimate obesity, but also that only 17.7% of Spanish subjects who self-reported a BMI ≥30 recognized themselves to suffer from obesity. This percentage slightly increased to 25.1% among those subjects with a BMI between 25 and 30, who considered themselves to suffer from overweight.

In our cross-sectional study, having a first-degree relative with overweight or obesity increased the risk of being obese by more than six times. This was the main risk factor described in our study, reinforcing the role that both the genetic component and the presence of an obesogenic environment play in the development of the disease. In general, and leaving very particular groups aside, it is recognized that inheritance is responsible for 40–75% of the causes of obesity, which is modulable by epigenetic influences [22]. Our data also showed that 90.3% of subjects with obesity exceed 2 h a day sitting besides work, and 27.4% spent more than 5 h sitting. It is worth noting to highlight that not only unhealthy habits but also healthy lifestyle behaviors are transmissible. In this way, this "halo effect" of obesity might also be used to obtain positive changes in eating habits, activity levels, and healthy behaviors of the entire family, in a manner like that reported after bariatric surgery on patients with obesity class III [23].

The consumption of healthful snacks between meals affects satiety and has the potential to promote satiety and appetite control, which could suppress overconsumption at the subsequent meal and reduce obesity [24]. However, our data suggests that this may not be always the case, as subjects with obesity snacked more than twice the amount of people with normal weight. Among US adults, a significant increase of snacking habits from 1997 to 2012 has been reported, contributing to increased calorie intake in the American diet [25]. Specifically, these snacks were not the type of food recommended by the dietary guidelines, increasing energy intake from sugar-sweetened beverages and salty snacks [26]. Although we have no information about the type of snacks consumed by our population, subjects with obesity showed a higher prevalence for quotidian sugar-sweetened soft drink intake. Thus, as energy-dense snacks and snacks of low dietary quality are linked to weight gain, the fight against obesity needs to establish the factors contributing to snacking behaviors [27].

Although Spain is a country bordering the Mediterranean Sea, our data displayed a poor adherence to Mediterranean dietary pattern among our population, including a deficient weekly consumption of fresh fruits, vegetables, white meat, and fish, together with an increased uptake of red, fat, or processed meat [28]. In addition, there was an increased consumption of both light soft drinks and sugar-sweetened soft drinks, especially among self-reported obese subjects. For this reason, it seems mandatory to support the replacement of caloric drinks by diet soda beverages or water in patients with obesity [29]. In addition, a high daily consumption of wine or beer as well as alcoholic beverages with high alcohol content were observed. Although a Mediterranean diet includes a moderate intake of red wine with meals, these products increase the risk of obesity development and therefore, they should be contraindicated in subjects with excess weight [28, 30]. In this way, while 1 g of alcohol provides 7.1 kcal (29 kJ), recent prospective and longitudinal studies have shown that light to moderate alcohol intake is not associated with adiposity gain, while heavy drinking and binge eating are more consistently related to weight increase [31–33].

The misjudgment of the own weight situation, believing to be in a lower weight category than they really are, is in line with previous studies reported in different countries [10–12, 34, 35]. However, and although Spanish people with obesity were not aware of the disease, they showed the worst self-perceived health status in comparison with the other groups. Even at youngest ages, subjects with excess weight displayed a bad self-perceived health status. Finally, the top reasons in the entire population for not usually following a healthy diet did refer to economic reasons. In this scenario, tax scenarios on some products and especially on soft drinks might be recommended. A meta-analysis with nine studies from Mexico, Brazil, and France concluded that taxing sugar-sweetened soft drinks may reduce obesity [36]. More recently, it has been proposed that taxes alone on soft drinks are not going to solve the burden of diet-related ill health, but they will make a significant contribution to shifting both industry and consumer behavior in the right direction [37].

Some limitations need to be outlined from our study. First, it is a cross-sectional analysis that helps gain health information of a representative adult Spanish population sample. So, prospective studies are needed to confirm our findings. A second limitation is related to the CATI method. Medical interview with the patient is the most useful diagnostic and therapeutic instrument for physicians, whereas the CATI method is a rapid, cost-effective tool that provides relevant data of public health issues from a wide sample population [17, 38]. So, further improvements in methodological and practical issues are needed to build better public health surveillance that mimics the face-to-face interview [17]. Finally, classification of obesity was done through self-reported BMI. We underline that self-reported anthropometric measures should be interpreted with caution, as differences between objective BMI

and self-reported BMI have been identified [10]. It is well stablished that adult subjects systematically over-report their height and under-report their weight and BMI [39]. Consequently, the misjudgment of the own weight situation may be even higher than our results showed.

In conclusion, the Spanish population has a low self-perception of weight, looking thinner than they really are. Also, four independent risk factors were identified in a Spanish population to be associated with self-reported obesity, the strongest being to have a first-degree relative with overweight or obesity. Therefore, obesity-related medical care should inquire patients about family members with excess weight, snacking habit, and daily consumption of wine or beer. Our findings highlight some areas where improvement needs to be made by the Spanish population to reach the healthy lifestyle behavior goals set by the Mediterranean culture.

Acknowledgement

To the Spanish Society for the Study of Obesity (SEEDO) committee.

Statement of Ethics

This study was conducted following the ethical standards outlined by the International Chamber of Commerce (ICC)/European Society for Opinion and Marketing Research (ESOMAR) international code on market, opinion, and social research and data analytics.

Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

The Spanish Society for the Study of Obesity (SEEDO) supported this study. The funders had no role in study design, the collection, analysis, and interpretation of data, report writing, or the decision to submit the article for publication.

Author Contributions

A.L. and E.S. recruited patients, collected and analyzed data, and wrote the first draft of the manuscript; F.J.T. supervised the research, interpreted data, and critically reviewed the draft of the article; S.M., G.M.-G., D.B., J.M.G.-A., P.M.d.I., M.M.M., and A.G. designed the study, supervised the statistical analysis, interpreted data, critically revised the draft of the article, and contributed to the discussion; A.L. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript.

References

1 Inoue Y, Qin B, Poti J, Sokol R, Gordon-Larsen P. Epidemiology of Obesity in Adults: latest Trends. Curr Obes Rep. 2018 Dec;7(4):276–88.
2 World Health Organization (WHO). Global Health Observatory data repository. https://www.who.int/features/factfiles/obesity/en/.
3 Nyberg ST, Batty GD, Pentti J, Virtanen M, Alfredsson L, Fransson EI, et al. Obesity and loss of disease-free years owing to major non-communicable diseases: a multicohort study. Lancet Public Health. 2018 Oct;3(10):e490–7.
4 Lecube A, Monereo S, Rubio MÁ, Martínez-de-Icaya P, Martí A, Salvador J, et al. Prevention, diagnosis, and treatment of obesity. 2016 position statement of the Spanish Society for the Study of Obesity. Endocrinol Diabetes Nutr. 2017 Mar;64 Suppl 1:15–22.
5 Blüher M. Obesity: global epidemiology and pathogenesis. Nat Rev Endocrinol. 2019 May;15(5):288–98.
6 Biddle SJ, García Bengoechea E, Pedisic Z, Bennie J, Vergeer I, Wiesner G. Screen Time, Other Sedentary Behaviours, and Obesity Risk in Adults: A Review of Reviews. Curr Obes Rep. 2017 Jun;6(2):134–47.
7 Pearson N, Biddle SJ. Sedentary behavior and dietary intake in children, adolescents, and adults. A systematic review. Am J Prev Med. 2011 Aug;41(2):178–88.
8 Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA. 2014 Feb;311(8):806–14.
9 Aranceta-Bartrina J, Pérez-Rodrigo C, Alberdi-Aresti G, Ramos-Carrera N, Lázaro-Masedo S. Prevalence of general obesity and abdominal obesity in the Spanish adult population (aged 25–64 years) 2014–2015: the ENPE Study. Rev Esp Cardiol (Engl Ed). 2016 Jun;69(6):579–87.
10 Visscher TL, Viet AL, Kroesbergen IH, Seidell JC. Underreporting of BMI in adults and its effect on obesity prevalence estimations in the period 1998 to 2001. Obesity (Silver Spring). 2006 Nov;14(11):2054–63.
11 Cullum A, McCarthy A, Gunnell D, Davey Smith G, Sterne JA, Ben-Shlomo Y. Dietary restraint and the mis-reporting of anthropometric measures by middle-aged adults. Int J Obes Relat Metab Disord. 2004 Mar;28(3):426–33.
12 European Association for the Study of Obesity. Obesity an underestimated threat public perceptions of obesity in Europe (2015), https://www.seedo.es/images/site/Obesity_an_underestimated_threat.pdf.
13 Wee CC, Davis RB, Phillips RS. Stage of readiness to control weight and adopt weight control behaviors in primary care. J Gen Intern Med. 2005 May;20(5):410–5.
14 Lecube A, Sánchez E, Andrés A, Saldaña C, Morales MJ, Calañas A, et al.; Obesity Group of the Spanish Society of Endocrinology and Nutrition (GOSEEN). Assessing motivational stages and processes of change for weight management around bariatric surgery: a multicenter study. Obes Surg. 2019 Oct;29(10):3348–56.
15 Mohammadi HR, Khoshnam MS, Khoshnam E. Effects of Different Modes of Exercise Training on Body Composition and Risk Factors for Cardiovascular Disease in Middle-aged Men. Int J Prev Med. 2018 Jan;9(1):9.
16 Burrup R, Tucker LA, LE Cheminant JD, Bailey BW. Strength training and body composition in middle-age women. J Sports Med Phys Fitness. 2018 Jan-Feb;58(1-2):82–91.
17 Choi BC. Computer assisted telephone interviewing (CATI) for health surveys in public health surveillance: methodological issues and challenges ahead. Chronic Dis Can. 2004;25(2):21–7.
18 Daly AM, Parsons JE, Wood NA, Gill TK, Taylor AW. Food consumption habits in two states of Australia, as measured by a Food Frequency Questionnaire. BMC Res Notes. 2011; 23:4:507.
19 National Center for Health Statistics. State and Local Area Integrated Telephone Survey (SLAITS). https://www.cdc.gov/nchs/slaits/index.htm.
20 ICC/ESOMAR international code of market and social resesarch. https://www.esomar.org/uploads/public/knowledge-and-standards/codes-and-guidelines/ICCESOMAR_Code_English_.pdf. Accessed 2 Feb 2019.
21 Draugalis JR, Coons SJ, Plaza CM. Best practices for survey research reports: a synopsis for authors and reviewers. Am J Pharm Educ. 2008 Feb;72(1):11.
22 El-Sayed Moustafa JS, Froguel P; El-Sayed Moustafa. From obesity genetics to the future of personalized obesity therapy. Nat Rev Endocrinol. 2013 Jul;9(7):402–13.
23 Woodard GA, Encarnacion B, Peraza J, Hernandez-Boussard T, Morton J. Halo effect for bariatric surgery: collateral weight loss in patients' family members. Arch Surg. 2011 Oct;146(10):1185–90.
24 Njike VY, Smith TM, Shuval O, Shuval K, Edshteyn I, Kalantari V, et al. Snack Food, satiety, and weight. Adv Nutr. 2016 Sep;7(5):866–78.
25 Piernas C, Popkin BM. Snacking increased among U.S. adults between 1977 and 2006. J Nutr. 2010 Feb;140(2):325–32.
26 Dunford EK, Popkin BM. Disparities in snacking trends in US adults over a 35 year period from 1977 to 2012. Nutrients. 2017 Jul;9(8):E809.
27 Miller R, Benelam B, Stanner SA, Buttriss JL. Is snacking good or bad for health: an overview. Nutr Bull. 2013;38(3):302–22.
28 Davis C, Bryan J, Hodgson J, Murphy K. Definition of the Mediterranean Diet; a Literature Review. Nutrients. 2015 Nov;7(11):9139–53.
29 Pereira MA. Sugar-sweetened and artificially-sweetened beverages in relation to obesity risk. Adv Nutr. 2014 Nov;5(6):797–808.
30 Hernandez-Hernandez A, Gea A, Ruiz-Canela M, Toledo E, Beunza JJ, Bes-Rastrollo M, et al. Mediterranean Alcohol-Drinking Pattern and the Incidence of Cardiovascular Disease and Cardiovascular Mortality: the SUN Project. Nutrients. 2015 Nov;7(11):9116–26.

31 Traversy G, Chaput JP. Alcohol consumption and obesity: an update. Curr Obes Rep. 2015 Mar;4(1):122–30.
32 Shelton NJ, Knott CS. Association between alcohol calorie intake and overweight and obesity in English adults. Am J Public Health. 2014 Apr;104(4):629–31.
33 Sayon-Orea C, Bes-Rastrollo M, Nuñez-Cordoba JM, Basterra-Gortari FJ, Beunza JJ, Martinez-Gonzalez MA. Type of alcoholic beverage and incidence of overweight/obesity in a Mediterranean cohort: the SUN project. Nutrition. 2011 Jul-Aug;27(7-8):802–8.
34 Mogre V, Abedandi R, Salifu ZS. Distorted self-perceived weight status and underestimation of weight status in diabetes mellitus type 2 patients. PLoS One. 2014 Apr;9(4):e95165.
35 Mogre V, Nsoh JA, Wanaba P, Apala P. Demographic factors, weight management behaviours, receipt of healthcare professional's counselling and having knowledge in basic anthropometric measurements associated with underassessment of weight status in overweight and obese type 2 diabetes patients. Obes Res Clin Pract. 2016 Jul-Aug;10(4):381–9.
36 Cabrera Escobar MA, Veerman JL, Tollman SM, Bertram MY, Hofman KJ. Evidence that a tax on sugar sweetened beverages reduces the obesity rate: a meta-analysis. BMC Public Health. 2013 Nov;13(1):1072.
37 Smith E, Scarborough P, Rayner M, Briggs AD. Should we tax unhealthy food and drink? Proc Nutr Soc. 2018 Aug;77(3):314–20.
38 Fowler FJ Jr, Brenner PS, Buskirk TD, Roman A. Telephone health survey estimates: effects of nonresponse and sample limitations. Health Serv Res. 2019 Jun;54(3):700–6.
39 Connor Gorber S, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. Obes Rev. 2007 Jul;8(4):307–26.