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Inequalities in obesity in Portugal: regional and gender differences

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Background: Obesity levels vary considerably according to geographical region and socio-economic status. We evaluated the prevalence of obesity by education and occupational position across seven Portuguese regions. Relative and absolute inequalities in obesity were also assessed. **Methods:** Data was drawn from the Portuguese Health Survey 2005/6 (26 674 adults, 46.6% women). Education was categorized as ≤4, 5–11 and ≥12 complete years of education. Occupational position was grouped as upper white collar, lower white collar and blue collar. The Relative Index of Inequality (RII) and the Slope Index of Inequality (SII) were used to quantify relative and absolute inequalities in obesity, respectively. **Results:** In women, prevalence of obesity ranged between 10.0% (Algarve) and 20.3% (Azores); in men, it ranged between 13.3% (Algarve) and 16.4% (Lisbon). In women, the educational RII (95% confidence interval) ranged between 2.4 (1.1 to 5.1) in the Centre and 6.6 (3.0 to 14.2) in Alentejo, and the SII (95% CI) between 9.7 (−1.3 to 20.7) and 33.0 (26.0 to 40.0), respectively. In men, the RII ranged between 0.8 (0.4 to 1.5) in Madeira and 1.9 (1.0 to 4.5) in the Centre, and the SII between −8.3 (−19.0 to 2.5) and 9.5 (−0.1 to 19.1), respectively. Occupational RIIs were similar to those for education, although somewhat lower. **Conclusion:** In Portugal, large educational and occupational inequalities in obesity are observed, but they vary considerably by region and are larger among women than men.

Introduction

Obesity is an important public health issue[1] with serious health, social and economic consequences. This led the World Health Organization to develop a global strategy on diet, physical activity and health.[2] In 2005, the prevalence of obesity in the adult Portuguese population was 16.0% among women and 14.3% among men.[3–5] However, the increase in the age-standardized prevalence of obesity differed across geographical regions of the country. Between 1999 and 2005, the largest absolute increases occurred in the North (+4.7%) and Lisbon regions (+4.6%), whereas smaller variations were found in the Centre (+2.2%) and Alentejo regions (+2.6%).[6]

Obesity is also unevenly distributed across societal groups. In high-income countries, obesity is more prevalent among people of lower socioeconomic position (SEP).[7]Although many studies assessed inequalities in obesity using regional or national population samples,[8–11]fewer addressed regional variations in inequalities within the same country.[12] If regional heterogeneity in inequalities is found, the study of its determinants could provide additional information on the mechanisms underlying these inequalities. Further, gathering information on inequalities at the local level may support and facilitate the planning and implementation of local policies to decrease health disparities.

Thus, this study aimed to estimate and compare the socioeconomic differences in the prevalence of obesity across the seven level II Nomenclature of Territorial Units for Statistics (NUTS) regions in Portugal. We used data from the 2005/6 National Health Survey and we selected education and occupational position as indicators of SEP.[13] Additionally, we examined regional variations in relative and absolute inequalities in obesity using the Relative and Slope Indexes of Inequality.

Methods

Study sample

Data from the 4th Portuguese Health Survey was provided by Statistics Portugal upon request. The 4th National Health Survey was a cross-sectional, multistage cluster sampling, nationwide population-based survey conducted between February 2005 and January 2006; its methodology has been described previously.[6] Briefly, the target population was the people living in family households, subjects living in collective housings (i.e. monasteries) being excluded. Trained interviewers collected data according to a standardized protocol in computer-assisted face-to-face interviews. Participation rate (percentage of households who responded) was 76%. The final number of interviews was 41 193.

For the current analyses, participants aged ≥20 years that reported a principal occupation not related to the army, and whose employment status over the previous two weeks was active worker, unemployed or retired were considered eligible ($n = 27\,212$). We excluded subjects with missing information on education, occupation and self-reported height/weight ($n = 538$, corresponding to 2.0% of the eligible sample), leaving a final sample size of 26 674 (46.6% women). For 18 819 cases (70.5%) the information was provided directly by the interviewee, and for 7,855 (29.5%) by a proxy (Supplementary figure S1).

Variables definition

Seven regions, five in mainland Portugal (North, Centre, Lisbon, Alentejo and Algarve) and the two autonomous regions (Azores and Madeira) were considered (Supplementary figure S2).[14] A description of the characteristics of the regions for years 2005 and 2006 is provided in supplementary table S1. Gross domestic product was obtained from Eurostat[15]; urbanization rates from the Portuguese household budget survey;[16]unemployment rates for 2001 (not available for years 2005 and 2006) for each gender were obtained from PORDATA.[17]

Age was categorized as 20–39, 40–59 and 60 years or more. Education was assessed as the number of school years completed and categorized as less than 5 years, 5–11 years and 12 years or more. Occupation was assessed with the question 'What is (was) your main job?' and categorized in three groups: upper white collar (executive civil servants, industrial directors, scientists, middle management and technicians), lower white collar (administrative and related workers, service and sales workers) and blue collar (farmers, skilled and unskilled workers, craftsmen, machine operator and assembly workers).[13] Participants with no precise occupation such as students and women staying at home were excluded from the analyses. Height and weight were self-reported. Body mass index (BMI) was calculated as the ratio weight (kg)/height (m) squared. Obesity was defined by a BMI $\geq$30 kg/m^2.[18]

The relative index of inequality (RII) and the slope index of inequality (SII) were calculated for education and occupation. Both indexes are summary measures recommended when comparing populations.[19] Instead of comparing the two most extreme SEP groups, these measures take into account both the size and relative position of each group in the respective SEP hierarchy. In the present study, education was transformed into a summary measure ranging from zero (highest level of education) to one (lowest level of education). The population in each educational category was assigned a score corresponding to the midpoint of the relative position of their category in the cumulative population distribution.[20] For example, if the category with the highest level of education included 10% of the population, the range of the individuals in this category would be from 0 to 0.10, giving a mid-point of 0.05, which would be the value assigned to this category; if the next higher level of education category included 20% of the population, its range would be from 0.1–0.3, thus it would be assigned a value of 0.20 and so on.[21] The RII can be interpreted as the prevalence ratio and the SII can be interpreted as the prevalence difference between the extremes of the educational hierarchy.

Statistical analysis

Statistical analyses were performed using STATA version 14.1 for Windows® (Stata Corp, College Station, TX, USA). All analyses were stratified by gender. Frequency weights were used to obtain estimates representative of the Portuguese population of 2005.[6] The age, education and occupation distributions of respondents were compared across economic regions using Pearson chi-square tests.

For the whole country and for each region, the gender-specific weighted prevalence of obesity in each category of education and occupation was standardized using age categories 20–39, 40–59 and 60+ of the European standard population. Weighted logistic regression models were used to grade differences in the prevalence of obesity across educational and occupational groups within each region, using obesity as outcome and SEP as a continuous variable, adjusting for the same age categories.

The age-adjusted association between obesity prevalence and the RII or SII was assessed using log-binomial regression models, as logistic regression models may produce biased estimates when the prevalence of the outcome is relatively high.[22] Specifically, we used generalized linear models with a logarithmic link function to estimate RIIs and with an identity link function to estimate SIIs, each with the respective 95% confidence intervals (95% CI), as previously proposed.[23] In order to assess whether the magnitude of relative or absolute inequalities varied after taking into account other confounders such as urbanization and unemployment rate, we computed the RII and SII for Portugal adjusting for age and for the following regional characteristics: gross domestic product (model 2); percentage of the population living in an urban setting (model 3); unemployment rate (model 4) and the three variables together (model 5).

As proxies might provide biased information regarding individual characteristics such as height and weight and thus obesity status, analysis was performed on direct interview, and a further sensitivity analysis was conducted using all eligible interviews with data (Supplementary figure S1).

Results

Education and occupation

The distribution of participants by age, educational and occupational groups according to gender and region is provided in supplementary table S2 and the corresponding weighted percentages are provided in table 1. Approximately half of Portuguese women and men were in the lowest educational groups. Five out of ten Portuguese women and six out of ten Portuguese men declared a blue collar occupation. Large regional differences in the proportion of women and men with a low educational or occupational level were found. Low educational level (weighted percentages) ranged from 32.0% (Azores) to 58.5% (Alentejo) in women and between 38.6% (Lisbon) and 58.0% (Alentejo) in men, table 1. Similarly, blue collar occupation ranged from 32.7% (Azores) to 59.3% (North) in women, and between 50.5% (Lisbon) and 67.7% (Alentejo) in men, table 1.

Overall prevalence of obesity was slightly higher in women than in men. When age-standardized, weighted data were used, lower educational and occupational levels had higher prevalence rates of obesity in women, while no such consistent association was found in men (table 2). Using non-standardized, non-weighted data, lower educational and occupational levels had higher prevalence rates of obesity in both genders, the difference being stronger in women than in men (supplementary table S3).

Obesity prevalence, overall and by educational or occupational group

The gender-specific, age-standardized, weighted prevalence of obesity according to educational or occupational group are summarized in table 2. Among women, there were large differences in the prevalence of obesity across regions, ranging from 11.6% (Algarve) to 20.6% (Alentejo). The prevalence of obesity increased with decreasing level of education and occupation in almost every region, Madeira excepted (table 2). In men, smaller differences in the prevalence of obesity were observed between regions, ranging from 14.7% (Algarve) to 18.1% (Alentejo). Contrary to women, no clear graded pattern was observed in men, although obesity was generally more common in lower educational and occupational groups.

Relative and absolute educational inequalities in obesity

The educational and occupational RII and SII regarding obesity for Portugal and the seven regions are summarized in table 3. Overall, Portuguese women with the lowest education were over three times more likely to be obese than their most educated counterparts. Large regional variations in RIIs were also found, ranging from 3.1 (Algarve) to 5.9 (Alentejo). Absolute differences in the prevalence of obesity also varied considerably between regions, ranging from 14.7 (Algarve) to 33.0 (Alentejo, table 3). Similar results were obtained for occupation,

Table 1 Weighted distribution of age, educational and occupational groups, stratified by gender and region, Portuguese health survey 2005–2006, only direct interviews

	North	Centre	Lisbon	Alentejo	Algarve	Azores	Madeira	Portugal
Women								
Age (years)								
20–39	37.9	31.8	33.8	25.3	32.9	50.7	37.1	34.8
40–59	35.7	32.6	35.2	31.9	34.6	34.4	34.7	34.7
60 or more	26.4	35.7	31.1	42.8	32.5	15.0	28.2	30.5
Education (completed years)								
Less than 5	51.5	54.4	42.1	58.5	46.7	32.0	47.3	48.5
5–11	38.8	32.5	44.5	31.6	42.5	51.8	39.4	39.7
12 or more	9.8	13.2	13.4	9.8	10.8	16.2	13.3	11.8
Occupation (NCO)								
Blue collar	59.3	58.7	39.6	57.2	41.6	32.7	49.1	51.1
Lower white collar	26.4	23.6	40.4	26.4	40.6	45.6	34.3	31.7
Upper white collar	14.3	17.7	20.0	16.4	17.8	21.7	16.6	17.2
Men								
Age (years)								
20–39	30.6	27.1	28.6	24.2	29.7	40.5	37.6	29.3
40–59	39.7	34.3	38.7	32.7	36.0	37.9	37.3	37.8
60 or more	29.7	38.6	32.7	43.2	34.3	21.6	25.1	32.9
Education (completed years)								
Less than 5	53.7	52.8	38.6	58.0	47.6	48.3	51.7	48.1
5–11	40.2	35.8	44.5	36.0	44.7	45.4	39.0	41.1
12 or more	6.1	11.5	16.9	6.0	7.7	6.3	9.3	10.9
Occupation (NCO)								
Blue collar	66.3	61.9	50.5	67.7	57.1	66.5	56.6	59.6
Lower white collar	13.0	16.0	17.8	17.4	20.1	17.8	24.0	16.0
Upper white collar	20.7	22.1	31.7	14.9	22.7	15.8	19.4	24.4

NCO: National Classification of Occupations (1994). Results are expressed as percentages calculated according to sampling weights. Statistical analysis comparing regions by Pearson chi-square test: all tests have $P < 0.0001$.

Table 2 Age-standardized, weighted prevalence of obesity according to educational and occupational groups, by gender and region, Portuguese health survey 2005–2006, only direct interviews

	North	Centre	Lisbon	Alentejo	Algarve	Azores	Madeira	Portugal
Women								
Overall prevalence	16.2	15.3	19.4	20.6	11.6	18.1	14.9	17.2
Education (completed years)								
Less than 5	21.6	20.3	28.7	25.5	15.8	31.6	20.6	23.6
5–11	11.7	9.3	12.4	15.3	9.0	12.3	10.7	11.7
12 or more	5.2	9.0	13.7	8.0	3.2	10.4	7.5	9.5
P value[a]	0.001	0.024	0.009	<0.001	0.02	0.001	0.06	<0.001
Occupation								
Blue collar	18.4	18.7	26.8	24.4	14.9	27.2	19.4	21.0
Lower white collar	14.9	10.8	16.7	16.6	10.5	14.6	12.7	15.0
Upper white collar	9.2	9.7	10.4	13.5	6.1	11.7	6.4	9.8
P value[a]	0.03	0.02	<0.001	0.003	0.03	0.001	0.05	<0.001
Men								
Overall prevalence	16.5	13.8	18.1	17.3	14.7	15.2	16.7	16.5
Education (completed years)								
Less than 5	18.3	16.7	24.3	19.3	17.7	17.4	16.5	19.7
5–11	13.5	10.9	14.3	13.9	12.2	13.8	18.9	13.5
12 or more	20.2	9.5	13.6	19.1	9.7	8.7	8.9	14.1
P value[a]	0.33	0.04	0.051	0.77	0.06	0.54	0.70	0.16
Occupation								
Blue collar	16.7	13.1	19.9	18.5	14.3	16.1	18.5	17.0
Lower white collar	18.3	17.5	16.6	15.7	17.1	15.2	17.3	17.2
Upper white collar	14.9	13.1	16.0	13.7	13.4	11.3	10.7	14.9
P value [a]	0.72	0.89	0.30	0.34	0.89	0.19	0.13	0.34

Results are expressed as percentages calculated according to sampling weights.
[a]*P* values for trend across socioeconomic categories, adjusting for age categories.

blue collar women being 2.2 times more likely to be obese than their white upper collar counterparts; again, large regional variations in RII and SII were found (table 3). Conversely, no consistent educational or occupational gradients were found for men, as the majority of RIIs included unity and the majority of SIIs included zero in their 95% confidence intervals (table 3).

The effect of regional gross domestic product, regional percentage of the population living in an urban setting, and regional unemployment rate on RII and SII for Portugal are provided in table 4. No particular effect was found for any of the three covariates, as the estimates for RII and SII were comparable to those obtained adjusting for age only (table 4).

Table 3 Relative and absolute educational and occupational inequalities across economic regions in Portugal, stratified by gender, Portuguese health survey 2005–2006, only direct interviews

	North	Centre	Lisbon	Alentejo	Algarve	Azores	Madeira	Portugal
Women								
Education								
RII	3.7	3.3	3.3	5.9	3.1	4.5	3.3	3.3
(95% CI)	(1.9 to 7.4)	(1.4 to 7.6)	(1.6 to 6.7)	(2.7 to 12.9)	(1.2 to 8.3)	(2.1 to 9.6)	(1.0 to 10.9)	(2.3 to 5)
SII	21.8	15.5	19.4	33.0	14.7	21.2	17.0	18.8
(95% CI)	(9.2 to 34.4)	(4.1 to 26.8)	(8.2 to 30.6)	(24.0 to 42.0)	(5.6 to 23.8)	(9.4 to 33.1)	(3.8 to 30.3)	(12.7 to 24.8)
Occupation								
RII	1.9	2.5	2.7	2.5	2.2	3.2	2.7	2.2
(95% CI)	(1.0 to 3.5)	(1.1 to 5.4)	(1.5 to 4.8)	(1.3 to 4.9)	(1.0 to 5.0)	(1.6 to 6.3)	(1.0 to 7.2)	(1.6 to 3.0)
SII	11.1	11.6	22.9	18.7	10.3	17.6	15.6	14.3
(95% CI)	(1.6 to 20.6)	(1.8 to 21.5)	(13.9 to 31.8)	(7.8 to 29.7)	(1.7 to 18.8)	(6.7 to 28.5)	(2.6 to 28.6)	(9.3 to 19.4)
Men								
Education								
RII	0.8	2.6	2.4	0.9	2.3	1.4	1.0	1.5
(95% CI)	(0.4 to 1.7)	(1.1 to 6.1)	(1.3 to 4.6)	(0.4 to 2.2)	(1.0 to 5.2)	(0.7 to 2.8)	(0.4 to 2.6)	(1.0 to 2.2)
SII	−4.7	13.6	13.2	0.2	10.0	4.1	−1.1	6.0
(95% CI)	(−16.9 to 7.5)	(2.0 to 25.3)	(2.5 to 24.0)	(−14.1 to 14.6)	(−0.1 to 20.1)	(−8.2 to 16.3)	(−22.1 to 20.0)	(−0.4 to 12.4)
Occupation								
RII	1.1	0.8	1.4	1.4	1.0	1.6	2.0	1.1
(95% CI)	(0.6 to 2.1)	(0.4 to 1.7)	(0.8 to 2.6)	(0.7 to 3.0)	(0.5 to 1.9)	(0.8 to 3.3)	(0.7 to 5.2)	(0.8 to 1.6)
SII	2.7	−4.6	4.6	7.1	−2.1	6.6	8.4	2.1
(95% CI)	(−8.6 to 13.9)	(−16.1 to 6.9)	(−6.1 to 15.3)	(−4.8 to 19.0)	(−12.0 to 7.8)	(−4.0 to 17.2)	(−7.3 to 24.2)	(−3.7 to 7.9)

95% CI, 95% confidence interval; RII, relative index of inequality; SII, slope index of inequality. RIIs and SIIs can be interpreted as the prevalence ratio or difference in obesity between the extremes of the educational distribution, respectively.

Table 4 Relative and absolute educational and occupational inequalities in Portugal, stratified by gender, Portuguese health survey 2005–2006, only direct interviews

	Model 1	Model 2	Model 3	Model 4	Model 5
Women					
Education					
RII (95% CI)	3.3 (2.3 to 5.0)	3.6 (2.4 to 5.3)	3.5 (2.4 to 5.2)	3.5 (2.3 to 5.2)	3.6 (2.4 to 5.3)
SII (95% CI)	18.8 (12.7 to 24.8)	19.7 (13.8 to 25.6)	19.2 (13.4 to 25.0)	18.9 (13.1 to 24.6)	19.5 (13.6 to 25.3)
Occupation					
RII (95% CI)	2.2 (1.6 to 3)	2.4 (1.7 to 3.3)	2.3 (1.6 to 3.2)	2.3 (1.6 to 3.2)	2.4 (1.7 to 3.3)
SII (95% CI)	14.3 (9.3 to 19.4)	14.7 (9.8 to 19.6)	14.3 (9.4 to 19.1)	14.2 (9.3 to 19)	14.6 (9.7 to 19.5)
Men					
Education					
RII (95% CI)	1.5 (1.0 to 2.2)	1.6 (1.1 to 2.4)	1.6 (1.1 to 2.4)	1.6 (1.1 to 2.3)	1.6 (1.1 to 2.4)
SII (95% CI)	6.0 (−0.4 to 12.4)	6.6 (0.1 to 13.1)	6.7 (0.3 to 13.1)	6.5 (0.1 to 12.9)	6.7 (0.3 to 13.1)
Occupation					
RII (95% CI)	1.1 (0.8 to 1.6)	1.2 (0.8 to 1.7)	1.2 (0.8 to 1.7)	1.2 (0.8 to 1.7)	1.2 (0.8 to 1.7)
SII (95% CI)	2.1 (−3.7 to 7.9)	2.6 (−3.2 to 8.4)	2.5 (−3.2 to 8.2)	2.2 (−3.5 to 7.9)	2.4 (−3.3 to 8.1)

95% CI, 95% confidence interval; RII, relative index of inequality; SII, slope index of inequality. RIIs and SIIs can be interpreted as the prevalence ratio or difference in obesity between the extremes of the educational distribution, respectively. Model 1: Adjusted for age categories; Model 2: Adjusted for age categories and regional Gross Domestic Product; Model 3: Adjusted for age categories and regional percentage of the population living in an urban setting; Model 4: Adjusted for age categories and regional unemployment rate; Model 5: Adjusted for age categories, regional Gross Domestic Product, regional percentage of the population living in an urban setting and regional unemployment rate.

Sensitivity analyses

Sensitivity analyses were carried out by including all eligible interviews, i.e. direct and proxy. The results are provided in supplementary tables S4–9. Overall and regional prevalence of obesity was lower (supplementary table S7), but the associations with education and occupational status remained (supplementary tables S7–9).

Discussion

To our knowledge, this is the first description of regional variations in relative and absolute socioeconomic inequalities in obesity performed in Portugal. Our results show that among women, the prevalence of obesity is high and varies substantially across regions, with large social inequalities that also varied across regions. Conversely, in men, no significant variation in the prevalence of obesity was found, and no clear graded pattern was observed, although obesity was more common among men with a low educational or occupational level in all regions.

Associations between SEP and obesity

Prevalence of obesity was higher in the lower SEP groups, namely among women. The association between SEP and obesity might result from several relationships: (a) a causal relation; (b) a reverse relation indicating that obesity leads to lower SEP and (c) no causal effect, with the observed association being explained by unobserved factors related to both obesity and SEP.[24] For instance, Cutler and Lleras-Muney argue that a disadvantaged health status in childhood leads to lower levels of education which, in turn, lead to

disadvantaged health status in adulthood. Factors like family or genetic background are other plausible unobserved factors that might explain the relationship between education and obesity.[25] Still, although the causal relation between education and obesity has not been definitely proven, most of the effect of education on obesity seems to be direct.[26] The protective effect of education is likely related to a greater access and ability to manage health-related information, to a greater perception of the risks of certain lifestyle choices and improved self-control, consistency of preferences over time and self-esteem.[24]

Relative and absolute educational inequalities in obesity

Approximately one out of six Portuguese were obese, a prevalence rate which has been increasing regularly since 1995 (5), the increase being more prominent in women and in younger ages.[4] We observed larger relative and absolute educational and occupational inequalities in women than in men, a finding in agreement with previous reports.[11,27] The educational inequalities in women could partly be due to societal stereotypes, women of high SEP having more pressure to be thin and achieving a better weight control than their lesser educated peers.[28] Gender differences in physical activity patterns in the most disadvantaged socioeconomic groups may explain these differences as unskilled jobs, in which typically men engage more frequently, tend to be more physically demanding. Still, non-behavioural factors may also play a role: lower SEP women are more vulnerable than men to unfavourable psychosocial and material exposures over the life course,[29] which might influence adiposity through disturbances in physiological stress systems.[30] Further, within the same SEP, women tend to get lower wages than men, which could amplify these mechanisms.[31] Gender differences may also be partly explained by a reverse causation mechanism. Overweight during adolescence and early adulthood may lead to more severe socioeconomic consequences among women than among men. For instance, compared to men, overweight women complete fewer years of school, have lower wages and higher rates of household poverty.[32] The implications of the gender differences in socioeconomic gradients are considerable. As women belonging to disadvantaged socioeconomic groups are more likely to be obese, it is plausible that they are also more likely to give birth and raise children who will themselves become obese.[33] These children may perpetuate the socioeconomic gap in obesity as they will have fewer chances of upwards social mobility.[34] The intergenerational transmission of obesity is plausibly modifiable if we are able to decrease the prevalence of obesity among women. Furthermore, actions targeting the vulnerability to obesity of the low SEP groups will not only decrease inequalities *per se*, but will also potentially prevent part of the morbidity, mortality and economic burden associated with this condition.

Importantly, differences in educational inequalities across regions were similar to those observed between countries. Specifically, in a previous study that compared educational inequalities in self-reported obesity across European countries, the RIIs among women varied from 1.5 in Latvia to 6.78 in Portugal.[35] In the current study, the RIIs varied from 3.1 in the Centre region to 5.9 in Alentejo. No important changes were found after adjusting for regional characteristics such as gross domestic product, percentage of the population living in an urban setting, or unemployment rate. These findings suggest that the regional heterogeneity of inequalities in obesity is not dependent on such socioeconomic characteristics. Interestingly, the previous study also showed no effect of socioeconomic development on obesity prevalence in women, but not in men.[35] Thus, it is likely that the regional heterogeneity of inequalities in obesity in Portugal is driven by other unmeasured factors that should be further assessed. This study shows that the direct evaluation of inequalities at the country level may hide important within-country variations. Thus, the implementation of national policies aimed to reduce inequalities in health outcomes should consider the regional specificities within each country.

Strengths and limitations

This study used a nationally representative sample of the Portuguese population. This allowed us to provide an updated picture of educational and occupational inequalities in obesity in Portugal. Also, this is one of the first studies to quantify regional variations in educational and occupational inequalities within a country.

However, some methodological limitations warrant discussion. First, the use of self-reported data leads to a likely underestimation of the prevalence of obesity.[36] Still, in a previous study of urban Portuguese adults, the magnitude of misreporting was smaller among women with the highest level of education.[37] If a similar reporting bias applies to the current study, the RIIs and SIIs among women might be underestimated and the real educational and occupational differences in obesity levels might be even larger than reported. Interestingly, using all eligible data showed that proxies tended to underestimate obesity levels (supplementary table S10) but this led to an increase (in women) and to a decrease (in men) of the estimated RIIs and SIIs; hence, underestimation of obesity does not have the same impact according to gender. Second, the cross-sectional nature of the current analysis limits our ability to address the issue of causality, which can only be assessed in a prospective study. Although limited in its geographical setting (city of Porto, North or Portugal), the ongoing EpiPorto prospective study[38] might provide more information in the near future. Third, the non-linear association between occupation and obesity among men in some regions might have limited the ability of RIIs/SIIs to summarize relative and absolute inequalities. Fourth, the data relate to the period 2005-2006 and it would be of interest to compare it to data collected during or after the financial crisis that raised unemployment rates from 7.6% in 2006–12.7% in 2011 (17) and led to considerable changes in health.[39] Finally, a sizable number of participants for whom no occupational data was available were excluded from the study, reducing sample size and thus statistical power.

Conclusion

In Portugal, prevalence of obesity varies considerably between educational groups, the differences being larger in women than in men. In women, the differences between educational groups also show considerable variation between regions, while no such variation was found in men.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Key points

- The prevalence of obesity varied substantially across regions among Portuguese women, but not among men.
- The prevalence of obesity increased with decreasing levels of education and occupation among Portuguese women, but not among men.
- Large regional variations in both absolute and relative educational inequalities in obesity were found among Portuguese women.
- In Portugal, regional variations in educational inequalities in obesity were similar in magnitude to those previously observed between countries.

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