Socioeconomic inequality in food intake and adult obesity in Portugal

Carlota Maria Miranda Quintal
University of Coimbra, Centre for Business and Economics Research, CeBER and Faculty of Economics

CeBER Working Papers
No. 1 / 2021

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University of Coimbra, Faculty of Economics & CeBER

Abstract:

Objective: To examine socioeconomic inequality in dietary habits and obesity in Portugal, looking at their evolution from 2005/06 to 2014.

Methods: Cross-sectional data collected by Statistics Portugal – National Health Survey. Samples used in this study include 18–64-year olds (*n*=23,049 in 2005/06 and *n*=10,312 in 2014). The analysis focusses on differences in the prevalence of intake (at main meals) of nine foods across income groups and over time. Multiple logistic regression analysis is adopted to analyse association between socioeconomic factors (income and education) and obesity, controlling for behavioural and demographic characteristics.

Results: Mean prevalence (%) in intake of food in 2005-06/2014 – soup (66/59: P<0.01), beans (22/28: P<0.01), meat (80/80), fish (48/46), carbohydrates (88/88), cakes (26/40: P<0.01). Intake increases with income in both periods for salad, fruit, fish and cakes; in 2014, intake decreases for soft drinks. The ratio between intake in highest income group and intake in lowest income group for fish, salad, cakes and soft drinks, changed from 1.24, 1.13, 1.6, 0.9, in 2005/06, to 1.71, 1.37, 1.2, 0.66, in 2014, respectively. Association between income and obesity is significant only in highest income group (OR about 0.78 in both periods). Risk of obesity is lower for secondary and superior education, compared to basic, in both years (OR=0.616 in 2005/06 and OR=0.820 in 2014, for secondary education; OR=0.525 in 2005/06 and OR=0.608 in 2014, for superior education).

Conclusions: Differences in dietary habits tended to increase in a decade, favouring the better-off. Socioeconomic inequality in obesity is clearer for education than income and persisted over time.

Keywords: Socioeconomic inequality, Food intake, Obesity, Multiple logistic analysis, Portugal

1. Introduction

Inequalities in health among groups of various socioeconomic status remain a major challenge for public health around the world[1]. In Europe, this issue has been and still is on the health policy agenda[2,3]. Inequalities in health stem from the unequal distribution of power, income, goods and services, which in turn affect aspects such as access to health care and education or working and living conditions[1]. Evidence has further shown that whichever indicator of socioeconomic status is considered (education, income, occupation-based social class or material deprivation) and whichever indicator of health is taken into account (life expectancy, self-assessed health or chronic diseases), poor outcomes are concentrated among the socioeconomically disadvantaged groups[2].

In this context, obesity is quite relevant because not only its prevalence is high (one in five adults is obese in OECD countries) and is expected to increase until at least 2030 but also social inequalities in obesity are strong[4]. Moreover, obesity is an important risk factor for a series of chronic diseases - cardiovascular and kidney diseases, diabetes, some cancers, and musculoskeletal disorders[5] and there is evidence of obesity causing a reduction in life expectancy[6].

Evidence on inequalities in obesity suggests the concentration of this condition among the worse-off[7]. Some gender differences have consistently been found, with the evidence pointing to a stronger inverse association between socioeconomic status and obesity among women compared with men[8-10]. In Europe, greater inequalities are seen in southern countries[11]. Given the central role of obesity for many diseases, socioeconomic differences in obesity are contributing to broader socioeconomic inequalities in health[12].

Concerning evolution over time, studies for the US[13], Ireland[9] and Canada[10] concluded that income-related inequality in obesity has declined. In Sweden[8], the reduced obesity inequality over time seems to have come at the cost of increased obesity prevalence. Differently, a study for Germany concluded that the obesity gap between the top and the bottom of the socioeconomic spectrum widened[14].

Regarding behavioural factors, dietary habits are associated with obesity, existing stronger evidence for the impact of energy consumption on weight gain, potentially leading to obesity[15]. The socioeconomic gradient in dietary intakes is also documented[16,17] with socioeconomically disadvantaged people presenting poorer diets[18], though, the evidence of the role of dietary intakes in socioeconomic inequalities in overweight/obesity has been inconclusive[15].

Other lifestyles associated with obesity include smoking[19], alcohol consumption[20] and physical activity[21,22]. In the current study we are particularly interested in socioeconomic inequality in dietary habits and, in particular, in its evolution in a decade. The other factors are used as controls in the regression analysis.

The prevalence of obesity in Portugal has followed the trend of OECD countries with increasing rates. In 2015, the rate was 16.6%, which compares to an OECD average of 19.4%[23]. Regarding inequalities in obesity in Portugal, the evidence is scant. A study, based on data for the period 1998-2001, concludes that obesity was concentrated among the poor, in the case of women, while it was concentrated among the rich, in the case of men, though coefficients were not statistically significant in the latter situation[24]. Another study found educational and occupational inequalities in obesity in Portugal (the data used were from 2005/06) [25]. The latest evidence on inequalities in obesity in Portugal is based on data from 2005/06. In the meantime, the country was hit by the 2008 economic crisis. Between 2010 and 2013, unemployment increased from 10.8% to 16.2%[26]. The effects of the economic recession were aggravated by the public debt crisis. Between 2012 and 2013, the country had the largest rate of increase in the at-risk-of-poverty or social exclusion rate in the EU-28[27] and, in 2015, 19.0% of the population was living below the poverty line[26]. People who experience periods of financial hardship are at increased risk of obesity, regardless of their income or wealth, and the increase is greater for more severe and recurrent hardship[28]. In terms of food intake, following the 2008 crisis, many families were forced to switch to lower-priced and less healthy foods; an increase in calorie intake was registered in the UK, during 2008-2009, while a decrease in expenditure on fruits and vegetables was observed in Greece, Ireland, Italy, Portugal, Spain and Slovenia, between 2008 and 2013[28]. In food-insecure conditions mothers may reduce their own dietary intake to buffer that of their children[29].

Despite the evidence on socioeconomic inequality in obesity, not many studies looked at the independent effect of a wide range of possible socioeconomic, demographic and behavioural determinants[30] and studies addressing socioeconomic inequality in dietary habits are mainly focussed on intakes of one food/nutrient at a time[15]. Studies covering large periods of time are even fewer[18]. Therefore, the objectives of this paper are to analyse socioeconomic inequalities in dietary habits and adult obesity risk in Portugal, a high income country which has witnessed a trend in obesity similar to other OECD countries. We are particularly interested in the analysis of changes in a decade, comparing results based on data from before the economic crisis that severely hit the country with results based on data posterior to the crisis.

2. Methods

2.1. Data and variables

Data come from the last two waves of the Portuguese National Health Survey, collected by Statistics Portugal in collaboration with the National Health Institute Doutor Ricardo Jorge, between February 2005 and February 2006 and between September and December 2014[31,32].

The survey contains information on food intake at main meals on the day prior to interview – we analyse the intake of soup, beans/chickpeas, meat, fish, potatoes/rice/pasta, salad, fruit, cakes/chocolates/dessert and soft drinks. There are a few exceptions, leading to differences between samples (see Table 1) – the intake of salad and fruit was measured, in 2014, as usual total daily servings (respondents were shown cards to homogenise the concept of servings) and the question about soft drinks refers to the intake between main meals, in 2005/06.

Our measure of obesity is derived from self-reported data on height and weight and from the calculation of the ‘‘body mass index” (BMI) indicator (weight in kilograms divided by height in meters squared). In accordance with the definition of the World Health Organisation, obesity corresponds to the situation where BMI >=30[30]. The current study includes individuals aged between 18 and 64 years old as BMI might not be adequate for use in older adult populations[33] and excludes pregnant women (to avoid misclassification of obesity). After dropping observations with missing values in the relevant variables for our study, the final samples used include 23,049 and 10,312 individuals for 2005/06 and 2014, respectively.

We use household income (as defined in Table 1) as our measure of socioeconomic status in the analysis of dietary habits and for obesity we further consider education. Based on previous studies[8,10,30,33], potential obesity risk factors are age and sex, marital status and behavioural variables (in addition to dietary habits), related with physical activity, smoking and drinking. The immigration status is also considered relevant as it might reflect cultural differences and adaptations and psychological strains that can influence lifestyle. Most studies include the area of residence as there might be differences in diets and lifestyles across regions within countries. In our case, we have a variable distinguishing the level of urbanisation and NUT II region. Table 1 presents the definition of all variables.

Table 1 Definition of the variables and descriptive statistics

Variables	**Definition**	**Mean**	
		2005/06 (N= 23,049)	2014 (N=10,312)
Outcome variable			
Obese	=1 if BMI ≥ 30, 0 otherwise	0.1535	0.1678
Demographic variables			
Sex and age (years)			
Male 18-24[†]	=1 if male aged 18–24, 0 otherwise	0.0542	0.0422
Male 25-34	= 1 if male aged 25–34, 0 otherwise	0.1000	0.0709
Male 35-44	= 1 if male aged 35–44, 0 otherwise	0.1145	0.1219
Male 45-54	= 1 if male aged 45–54, 0 otherwise	0.1177	0.1159
Male 55-64	= 1 if male aged 55–64, 0 otherwise	0.1004	0.1123
Female 18-24[a]	= 1 if female aged 18–24, 0 otherwise	0.0462	0.0446
Female 25-34	= 1 if female aged 25–34, 0 otherwise	0.0978	0.0832
Female 35-44	= 1 if female aged 35–44, 0 otherwise	0.1255	0.1337
Female 45-54	= 1 if female aged 45–54, 0 otherwise	0.1261	0.1350
Female 55-64	= 1 if female aged 55–64, 0 otherwise	0.1176	0.1403
Marital status			
Single	= 1 if single and not de facto married, 0 otherwise	0.2203	0.2404
Married	= 1 if married or de facto married, 0 otherwise	0.7194	0.6298
Divorced or widowed	= 1 if (divorced or widowed) and (not de facto married), 0 otherwise	0.0603	0.1298
Socioeconomic variables			
Household income			
Income_lower_500	=1 if household monthly income is 500 euros or lower, 0 otherwise	0.1599	--
Income_501_700	=1 if household monthly income is between 501 and 700 euros, 0 otherwise	0.1367	--
Income_701_900	=1 if household monthly income is between 701 and 900 euros, 0 otherwise	0.1625	--
Income_901_1200	=1 if household monthly income is between 901 and 1200 euros, 0 otherwise	0.1762	--
Income_1201_1500	=1 if household monthly income is between 1201 and 1500 euros, 0 otherwise	0.1371	--
Income_1500_more	=1 if household monthly income is 1500 euros or higher, 0 otherwise	0.2276	--
Quintile 1	= 1 if household equivalent monthly income belongs to 1st quintile (poorest), 0 otherwise	--	0.1985
Quintile 2	= 1 if household equivalent monthly income belongs to 2nd quintile, 0 otherwise	--	0.1745
Quintile 3	= 1 if household equivalent monthly income belongs to 3rd quintile, 0 otherwise	--	0.1963

Variables	Definition	Mean	
		2005/06 (N= 23,049)	2014 (N=10,312)
Quintile 4	= 1 if household equivalent monthly income belongs to 4th quintile, 0 otherwise	--	0.2141
Quintile 5	= 1 if household equivalent monthly income belongs to 5th quintile, 0 otherwise	--	0.2166
Education level			
Basic	= 1 if individual has less than secondary education, 0 otherwise	0.7251	0.5897
Secondary_post	=1 if individual has secondary or some post-secondary education, 0 otherwise	0.1434	0.2182
Superior	= 1 if individual has superior education, 0 otherwise	0.1315	0.1921
Occupation status			
Employed	= 1 if individual has a job or work (includes family non-paid work and professional internship), 0 otherwise	0.7035	0.6360
Unemployed	= 1 if individual is unemployed, 0 otherwise	0.1188	0.1646
Student	= 1 if individual is a full time student, 0 otherwise	0.0648	0.0490
Retired[b]	= 1 if individual is retired, 0 otherwise	--	0.0723
Disabled_inactive	= 1 if individual is permanently unable to work or other situation of inactivity, 0 otherwise	0.0054	0.0241
Domestic worker[‡]	= 1 if individual is domestic worker or does civic or mandatory community service, 0 otherwise	0.1075	0.0540
Immigration status			
Born_always lived Portugal	= 1 if individual was born and always lived in Portugal, 0 otherwise	0.8434	0.8833
Lives Portugal less 10 years	= 1 if individual migrated to Portugal or is emigrant who returned to Portugal, within last 10 years, 0 otherwise	0.0471	0.0278
Lives Portugal more 10 years	= 1 if individual migrated to Portugal or is emigrant who returned to Portugal, more than 10 years ago, 0 otherwise	0.1095	0.0889
Lifestyles			
Physical activity[‡]			
Inactive	=1 if time spent on physical activities is < 10 minutes/day, 0 otherwise	0.7904	0.3626
Moderately active	=1 if time spent on physical activities is ≥ 10 minutes/day and < 30 minutes/day, 0 otherwise	0.0167	0.2976
Active	=1 if time spent on physical activities is ≥ 30 minutes/day, 0 otherwise	0.1929	0.3398
Drinking behaviour			
Abstainer[‖]	=1 if individual did not drink in last 12 months or drank just to taste or did not drink in last 12 months due to quitting before, 0 otherwise	0.3509	0.2787

Variables	Definition	Mean	
		2005/06 (N= 23,049)	2014 (N=10,312)
Rare_drinker	= 1 if individual drinks up to once a month, 0 otherwise	--	0.2410
Occasional_drinker¶	= 1 if individual drinks 1-2 days/week or 2-3 days/month, 0 otherwise	0.0153	0.2098
Regular_drinker††	= 1 if individual drinks every or almost every day, or 5-6 days/week, or 3-4 days/week	0.6338	0.2705
Smoking behaviour			
Never_smoker	= 1if individual never smoked, 0 otherwise	0.5886	0.5157
Former_smoker	= 1if individual is former smoker, 0 otherwise	0.1542	0.2169
Occasional_smoker	= 1 if individual smokes occasionally, 0 otherwise	0.0263	0.0386
Daily_smoker	= 1 if individual smokes every day, 0 otherwise	0.2309	0.2288
Dietary habits			
Soup	=1 if individual ate soup at main meals on day prior to interview, 0 otherwise	0.6588	0.5918
Beans	=1 if individual ate beans/chickpeas at main meals on day prior to interview, 0 otherwise	0.2230	0.2780
Meat	=1 if individual ate meat at main meals on day prior to interview, 0 otherwise	0.8026	0.7958
Fish	=1 if individual ate fish at main meals on day prior to interview, 0 otherwise	0.4831	0.4569
Carb	=1 if individual ate potatoes/rice/pasta at main meals on day prior to interview, 0 otherwise	0.8819	0.8811
Salad_bin	=1 if individual ate salad at main meals on day prior to interview, 0 otherwise	0.7068	--
Salad_num	Total daily servings of salad and vegetables	--	0.9729
Fruit_bin	=1 if individual consumed fruit at main meals on day prior to interview, 0 otherwise	0.8037	--.
Fruit_num	Total daily servings of fruit	--	1.5924
Cakes	=1if individual ate cakes/chocolates/dessert at main meals on day prior to interview, 0 otherwise	0.2578	0.4025
Soft_drinks	=1if individual had soft drinks between meals (2005/06) / at main meals (2014) meals on day prior to interview, 0 otherwise	0.0525	0.3578
Ecologic variables			
Geographical area			
Urban	= 1 if individual resides in densely or semi-densely populated area, 0 otherwise	--	0.6503
Rural	= 1 if individual resides in sparsely populated area, 0 otherwise	--	0.3497
NUT II Region			
North	= 1 if individual resides in Region North, 0 otherwise	0.1327	0.1635
Centre	= 1 if individual resides in Region Centre, 0 otherwise	0.1489	0.1898

Variables	Definition	Mean	
		2005/06 (N= 23,049)	2014 (N=10,312)
Lisbon and Tagus Valley	= 1 if individual resides in Lisbon and Tagus Valley, 0 otherwise	0.1548	0.1026
Alentejo	= 1 if individual resides in Region Alentejo, 0 otherwise	0.1392	0.1493
Algarve	= 1 if individual resides in Region Algarve, 0 otherwise	0.1470	0.1218
Azores	= 1 if individual resides in the archipelago of , 0 Azores otherwise	0.1455	0.1353
Madeira	= 1 if individual resides in the archipelago of Madeira, 0 otherwise	0.1319	0.1377

† For the 2005/06 sample, the first age band is 20-24 years.

‡ For the 2005/06 sample, the category 'Domestic worker' also includes retired individuals (only 20 in the whole sample).

‡ For the 2014 sample, physical activity includes walking, cycling and practising physical exercise; for the 2005/06 sample, physical activity also includes professional and general activity.

‖ For the 2005/06 sample, Abstainer =1 if individual did not drink in last 12 months.

¶ For the 2005/06 sample, Occasional = 1 if individual drinks 1-2 days/week.

†† For the 2005/06 sample, Regular = 1 if individual drinks 3+ days/week.

2.2. Statistical analysis

We start by analysing mean values related to lifestyles and obesity in both samples, looking at changes over time. We also analyse dietary habits by income group as well as the ratio of the prevalence of the intake of each food in the highest income group relative to the lowest income group. In the case of 2014, this ratio corresponds to the S80/S20 ratio, as individuals are grouped by income quintile. In the 2005/06 sample, the highest income group corresponds to 23% of the sample while the lowest income group accounts for 16%. The Chi-Square and One-way ANOVA tests are used to analyse differences in the intake of food between the two samples and across income groups in each period.

Multiple logistic regression analysis is used to investigate the association between risk factors and obesity. The results of the regression analysis are reported as odds ratios; the ratio of the odds of an event (obesity) occurring in one group compared to the odds of that event occurring in another group (reference category). Results for 95% confidence intervals of the odds ratios intervals are shown – we are particularly interested in differences between the two samples. Our analyses are performed using SPSS (Version 25) and Excel (2013).

3. Results

Mean values for food intake in 2005/05 and in 2014 (Table 1) indicate that the prevalence of the intake of soup decreased about six percentage points (*P<0.01*), while the consumption of beans and chickpeas evolved in the opposite direction (*P<0.01*). The prevalence of the intake of meat and of carbohydrates are high (80% and above) and did not change in a decade. The mean prevalence of the intake of fish is much lower compared to meat, in both years, and although it decreased from 2005/06 to 2014, the difference is not statistically significant. The highest increase is observed for the intake of cakes/chocolates/dessert, where the prevalence increased from 25% to 40% (*P<0.01*). The remainder variables for food intake are not comparable across surveys. In 2005, there is a high percentage of individuals reporting the intake of salad and fruit at main meals. In 2014, the average daily servings is greater for fruit than for salad.

Concerning other lifestyles, the percentage of inactive individuals sharply decreased in a decade. Although the variables are not fully comparable (see Table 1), the definition of inactive is actually narrower in 2005/06 as professional/general activity also counts. Patterns of drinking behaviour also changed, with the extreme categories, regular drinker and abstainer, significantly shrinking (*P<0.01*), especially the former. Finally, in terms of smoking behaviour, changes are noticeable, and basically symmetrical, in the percentage of individuals who never smoked (decrease - *P<0.01*) and those who quit smoking (increase - *P<0.01*).

The rate of obesity increased from 2005/06 to 2014 (*P<0.01*). The increase is larger for women (from 16.35% to 18.19% - *P<0.01*) than for men (from 14.29% to 15.14% - not significant). Differences in obesity between sexes are statistically significant in both years (*P<0.01*).

Fig. 1 and Fig. 2 show few differences in the prevalence of the intake of foods across income groups for the cases of meat, carbohydrates and soup. The gradient is more visible in the cases of salad, fruit (in 2014) and cakes, with increasing prevalence, while in the cases of soft drinks and beans, in 2014, the prevalence decreases as income increases. The intake of fish also shows differences across income groups but this happens particularly in the extreme income categories. Except for carbohydrates, in 2014, the results of the Chi-Square and One-way ANOVA reject the hypothesis of equality.

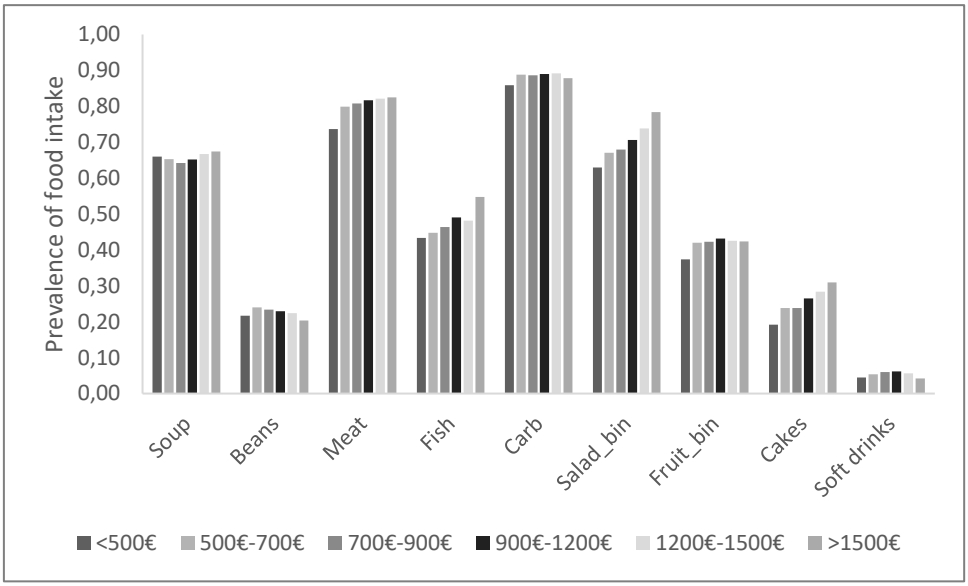


Fig. 1 Prevalence of food intake by type of food and household monthly income

Notes: Data from Portuguese National Health Survey 2005/06 (all variables are binary; all variables regard food intake at main meals on day prior to interview, except 'Soft dinks' which regards intake between meals; 'Beans' includes beans and chickpeas; 'Carb' includes potatoes, rice and pasta; 'Cakes' includes cakes/chocolates/dessert)

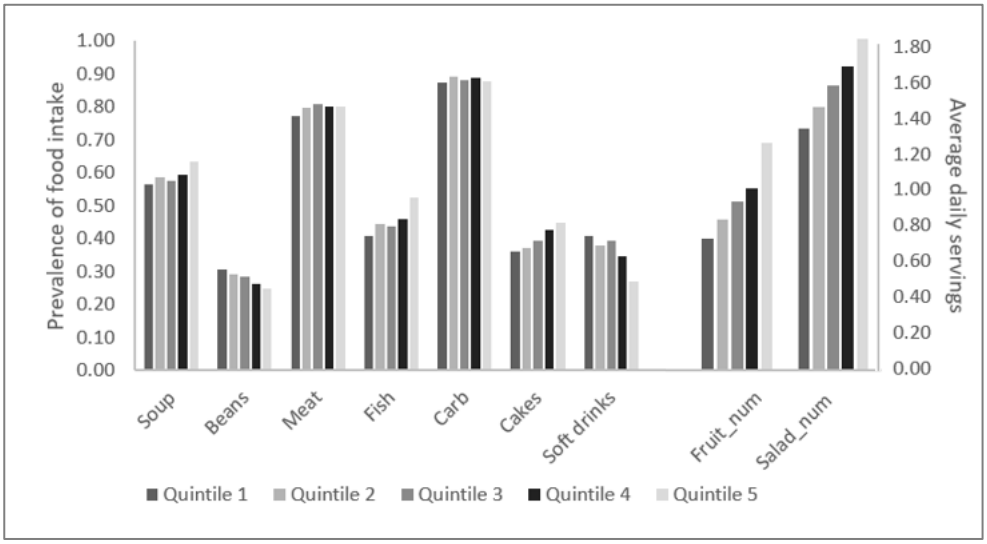


Fig. 2 Prevalence of food intake by type of food and quintile of equivalent income

Notes: Data from Portuguese National Health Survey 2014 (all variables are binary and regard food intake at main meals on day prior to interview, except 'Fruit_num' and 'Salad_num' which correspond to usual number of daily servings; 'Beans' includes beans and chickpeas; 'Carb' includes potatoes, rice and pasta; 'Cakes' includes cakes/chocolates/dessert; left/right Y-axis applies to binary/continuous variables)

The ratio comparing the intake in the highest income group with the intake in the lowest income group (Fig. 3) is greater than one for salad, fruit, fish, and cakes and the ratio is lower than one in the cases of soft drinks and beans. Ratios are close to one in the cases of meat, carbohydrates and soup. In terms of the evolution from 2005/06 to 2014, there were no sharp changes in the sense of ratios changing from being greater/lower than one to being lower/greater than one. The ratios for the (healthy) intake of salad and fruit further increased. The ratio for the (unhealthy) intake of cakes, still is greater than one in 2014, but it became closer to one. The ratio for the (unhealthy) intake of soft drinks is lower than on one in both periods and it further decreased in 2014. All these changes are in line with the aggravation of differences in dietary habits favouring the better-off.

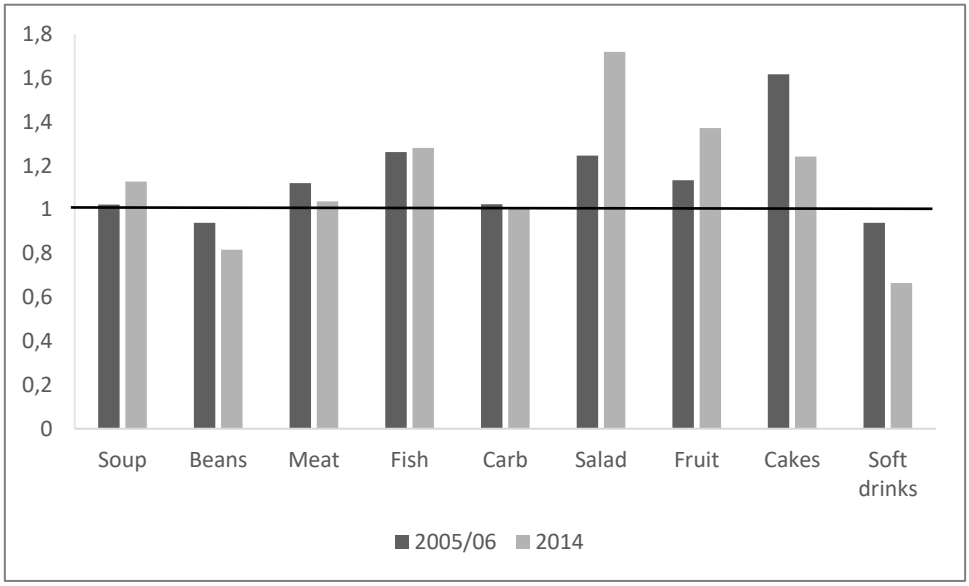
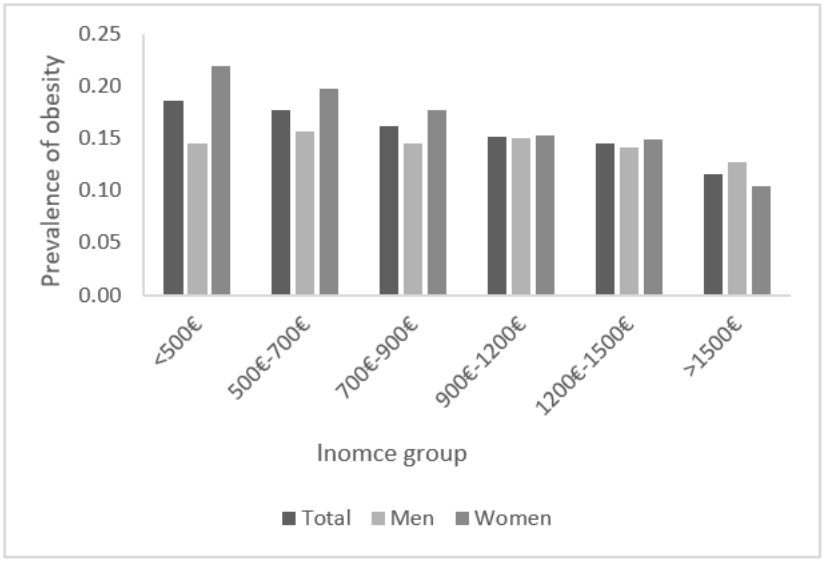


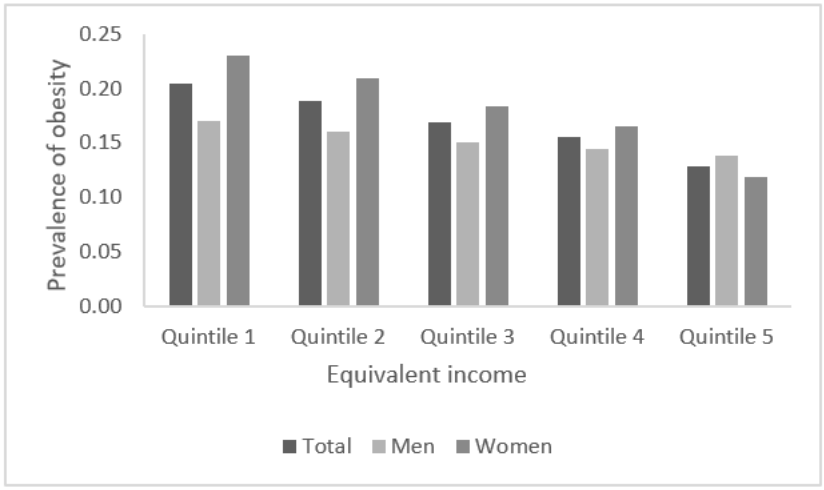
Fig. 3 Ratio between prevalence of intake in highest income group and prevalence of intake in lowest income group, for each type of food

Notes: Data from Portuguese National Health Survey 2005/06 and 2014;'Beans' includes beans and chickpeas; 'Carb' includes potatoes, rice and pasta; 'Cakes' includes cakes/chocolates/dessert.

As shown in Fig. 4, the rate of obesity decreases from the lowest to the highest income group, though, in 2005/06, differences seem to be small in middle income groups. This pattern of decreasing rates of obesity is more visible in the case of women than in the case of men, and it is more visible in 2014 than in 2005/06. In fact, obesity rates for men, in 2005/06, have ups and downs.



(a)



(b)

Fig. 4 Prevalence of adult obesity, total and by sex, by household monthly income in 2005/06 (panel a) and by quintile of equivalent income in 2014 (panel b); data from Portuguese National Health Survey

Table 2 presents the results for the analysis of the association between risk factors and adult obesity (after comparing models with the intake of various foods, we retained the model with the highest percentage of the cases correctly predicted –at the end of Table 2 there are the results of the tests of goodness of fit).

Regarding the effect of socioeconomic status, the main focus of the present work, both in 2005/06 and 2014, odds ratios are lower than one when comparing the various income groups with the reference category (lowest income group) but the effect is statistically significant only

in the highest income group. Moreover, the magnitude of the (average) effect is similar in both periods (the risk of obesity in the highest income group is about 22% lower than in the baseline). In terms of education, in the 2005/06 sample, the risk of obesity in the groups with secondary and superior education is 40% and 48% lower, respectively, compared to basic education. In the 2014 sample, the risk of obesity is 20% in the group with secondary education and 40% lower in the group with superior education. The impact of education seems to have lessened however differences are not statistically significant between the two periods.

Concerning dietary habits, in 2005/06, only the variable 'Carb' is statistically significant and the risk of obesity in the group consuming carbohydrates is lower. In 2014, the intake of carbohydrates and cakes is associated with a 25% reduction in the risk of obesity, in both cases. These results might reflect reverse causality as explained below in the discussion.

In terms of other lifestyles, physical activity is statistically significant in 2014 but not in 2005/06. The risk of obesity for active individuals is 40% lower compared to inactive individuals and even moderate activity is associated with a reduced risk of obesity by almost 30%. No statistically significant effect is found for drinking behaviour while in the case of smoking there is a strong negative association between obesity and being a daily smoker (in 2005/06, the effect is also detected, though to a lesser extent, for occasional smokers). Older individuals, females and married people have higher odds of being obese. The evidence suggests that the immigration status is not associated with obesity. Residents in the archipelago of Azores are more likely to be obese compared to residents in the North and the odds augmented from 2005/06 to 2014. In 2014, the country was still experiencing the effects of the recession coupled with the public debt crisis, the rate of unemployment increased substantially (as presented in Table 1), however, the positive association between obesity and unemployment is statistically significant only in 2005/06.

Table 2 Association between socioeconomic characteristics and other risk factors and adult obesity in Portugal: 2005/06 and 2014

	2005/06			2014		
	Odds Ratio	**95% C.I.**	**P-Value**	**Odds Ratio**	**95% C.I.**	**P-Value**
Demographic variables						
Sex and age (years)						
Male 18-24 (Ref.)						
Male 25-34	1.879	1.367, 2.558	0.000	1.563	0.927, 2.637	0.094
Male 35-44	2.475	1.815, 3.374	0.000	2.164	1.313, 3.566	0.002
Male 45-54	3.430	2.521, 4.667	0.000	3.327	2.023, 5.471	0.000
Male 55-64	2.827	2.064, 3.870	0.000	2.740	1.648, 4.558	0.000
Female 18-24	0.817	0.540, 1.237	0.339	1.057	0.617, 1.811	0.839
Female 25-34	1.520	1.101, 2.097	0.011	1.389	0.829, 2.326	0.212
Female 35-44	2.271	1.665, 3.099	0.000	1.955	1.188, 3.215	0.008
Female 45-54	3.240	2.379, 4.411	0.000	2.861	1.747, 4.685	0.000
Female 55-64	3.465	2.536, 4.733	0.000	3.350	2.036, 5.509	0.000
Marital status						
Single (Ref.)						
Married	1.534	1.340, 1.757	0.000	1.217	1.028, 1.442	0.023
Divorced or widowed	1.216	0.999, 1.480	0.051	1.079	0.871, 1.336	0.487
Socioeconomic variables						
Household income						
Income_lower_500 (Ref.)						
Icome_501_700	1.011	0.889, 1.149	0.872			
Income_701_900	0.940	0.829, 1.066	0.336			
Income_901_1200	0.912	0.804, 1.036	0.157			
Income_1201_1500	0.895	0.780, 1.027	0.115			
Income_1501_more	0.775	0.677, 0.888	0.000			
Quintile 1 (Ref.)						
Quintile 2				0.917	0.774, 1.087	0.318
Quintile 3				0.870	0.731, 1.035	0.116
Quintile 4				0.843	0.704, 1.009	0.062
Quintile 5				0.785	0.638, 0.967	0.023
Education level						
Basic (Ref.)						
Secondary_post	0.616	0.536, 0.708	0.000	0.820	0.700, 0.962	0.015
Superior	0.525	0.447, 0.617	0.000	0.608	0.498, 0.743	0.000
Occupation status						
Employed (Ref.)						
Unemployed	1.265	1.127, 1.420	0.000	1.138	0.968, 1.338	0.119
Student	1.181	1.011, 1.380	0.036	0.949	0.592, 1.521	0.829
Retired				1.393	1.136, 1.709	0.001
Disabled_inactive	1.564	0.951, 2.574	0.078	1.419	1.040, 1.935	0.027

	2005/06			2014		
	Odds Ratio	**95% C.I.**	**P-Value**	**Odds Ratio**	**95% C.I.**	**P-Value**
Domestic worker	1.286	1.128, 1.466	0.000	1.404	1.125, 1.752	0.003
Immigration status						
Born_always lived Portugal (Ref.)						
Lives Portugal less 10 years	0.799	0.658, 0.972	0.025	0.993	0.715, 1.379	0.967
Lives Portugal more 10 years	0.989	0.879, 1.113	0.854	0.829	0.688, 0.998	0.048
Lifestyles						
Physical activity						
Inactive (Ref.)						
Moderately active	1.022	0.759, 1.376	0.885	0.729	0.640, 0.831	0.000
Active	0.991	0.902, 1.088	0.845	0.618	0.541, 0.705	0.000
Drinking behaviour						
Abstainer (Ref.)						
Rare_drinker				1.052	0.900, 1.229	0.532
Occasional_drinker	1.310	0.961, 1.787	0.088	0.910	0.772, 1.073	0.262
Regular_drinker	1.041	0.954, 1.135	0.367	0.917	0.781, 1.077	0.292
Smoking behaviour						
Never_smoker (Ref.)						
Former_smoker	1.059	0.948, 1.182	0.308	0.927	0.803, 1.070	0.300
Occasional_smoker	0.704	0.532, 0.932	0.014	0.790	0.575, 1.083	0.143
Daily_smoker	0.585	0.523, 0.655	0.000	0.497	0.422, 0.585	0.000
Dietary habits						
Beans	0.957	0.875, 1.046	0.331	0.941	0.834, 1.061	0.321
Carb	0.821	0.736, 0.917	0.000	0.759	0.650, 0.887	0.001
Salad_bin	1.035	0.952, 1.125	0.423			
Salad_num				0.965	0.919, 1.014	0.156
Cakes	0.987	0.903, 1.078	0.768	0.759	0.677, 0.851	0.000
Ecologic variables						
Geographical area						
Urban (Ref.)						
Rural				0.921	0.810, 1.047	0.207
NUT II Region						
North (Ref.)						
Centre	0.981	0.853, 1.128	0.787	1.024	0.851, 1.232	0.802
Lisbon and Tagus Valley	1.319	1.152, 1.512	0.000	1.137	0.906, 1.427	0.267
Alentejo	1.196	1.041, 1.375	0.012	1.085	0.880, 1.339	0.445
Algarve	0.941	0.816, 1.085	0.405	0.972	0.786, 1.202	0.794
Azores	1.397	1.221, 1.599	0.000	1.569	1.290, 1.909	0.000
Madeira	1.013	0.876, 1.171	0.865	1.016	0.831, 1.243	0.874

2005/06: Omnibus test (*P<0.001*); Pseudo-R^2= 0.091; 84.7% of the cases correctly predicted

2014: Omnibus test (*P<0.001*); Pseudo-R^2= 0.104; 83.3% of the cases correctly predicted

4. Discussion

The present study is one of the few analysing socioeconomic inequalities on the intake of various foods and it also looks at changes in a decade. This analysis is complemented by the study of the impact of sociodemographic and behavioural factors on adult obesity, addressing changes over time as well. The results confirm previous evidence[15,18] of strong socioeconomic differences in fruit and vegetable (with the exception of soup) intake. Importantly, our findings suggest that changes from 2005/06 to 2014 reinforced socioeconomic differences in favour of the better-off, in the intake of both healthy (salad and fruit) and unhealthy (sweets and soft drinks) foods. Regarding the intake of meat and carbohydrates, we obtained high and roughly homogenous rates of prevalence across income groups (again in line with previous evidence[15]) and no differences are observed in a decade. The intake of beans and chickpeas, usually associated with the Mediterranean diet and which are relatively cheap foods, actually increased overtime becoming more concentrated in lower income groups. On the contrary, the intake of soup, which is equally cheap, decreased over time. Although there are not marked differences across income groups, the ratio between the intake in the highest income group and the intake in the lowest income group increased from the 2005/06 to 2014.

The results confirm previous evidence of a negative association between socioeconomic status and obesity, though, this association is clearer for education than for income[8-10]. No significant progresses are observed over time. Not only the rate of obesity increased in Portugal in a decade but also socioeconomic differences persist. The stronger effect of education compared to income/wealth is also observed in other studies, with similar[36-37] and different contexts[30] compared to Portugal. 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[38]. Nonetheless, there is also evidence that educational attainment can be reversely influenced by overweight and obesity through negative stereotypes, discriminatory behaviours and reduced psychological resources[39]. The reverse causality between income and obesity is also an open question[40]. Obesity might lead to negative outcomes in the labour market outcomes (wage gaps, poorer job prospects compared to normal-weight people, lower probability of being employed and more difficulty re-entering the labour market) that, in turn, contribute to reinforcing existing social inequalities[4].

Results for dietary habits are not conclusive. These are in line with previous studies as well, where the effects of the intake of foods are not statistically significant or show a relatively low magnitude[8-10]. Due to the cross-sectional nature of the data used, it is not possible to establish the direction of causality. Thus, it cannot be excluded the possibility of people increasing the intake of healthy food and decreasing the intake of unhealthy food precisely because they are already obese.

Physical activity is, as expected, negatively associated with obesity, however, in the 2005/06 sample it is not statistically significant. This might occur because the variables include professional and general activity (as indicated in Table 1), hence not distinguishing well among individuals from different income groups. Socioeconomic status is positively correlated with sedentary behaviour in main activity but a higher status tends to be negatively associated with sedentarism in leisure time[37]. Thus, probably the two effects outweigh each other in the 2005/06, while in 2014 the socioeconomic gradient appears because the variables measuring physical activity are related with leisure time.

Findings regarding the remainder control variables basically agree with the results in the literature. By comparing the results based on the 2014 sample with the results based on the 2005/06 sample it is not clear the impact of the recession. Although unemployment increased, in 2014, it is no longer significantly associated with obesity. The comparison between the intake of salad/fruit in the highest income group and the intake of these foods in the lowest income group shows increasing inequality which might be related with the reported decrease in expenditure on fruits and vegetables due to the crisis [28].

Limitations

A main limitation, as already mentioned and developed, stems from the cross-sectional nature of the data which is able to inform only about associations and not about causations.

Another limitation is related with self-reported data namely regarding height and weight. BMI is likely to be biased because individuals have a tendency to over report their heights and under report their weights. Nonetheless, self-reported height and weight are considered valid information to construct a measure of obesity[30]. Additionally, some authors have argued that the underestimation is of modest magnitude[35] though in a study of urban Portuguese adults[42], the magnitude of misreporting was smaller among women with the highest level of education. If a similar reporting bias applied to the current study, income-related differences in obesity could be larger than shown by results. Biases might also occur in self-reported data for lifestyles

in general but they still are considered valid measures[30]. In our case, another limitation is that most questions regarding the intake of food consider the day prior to the interview. However, unless biases vary across income groups, they still are valid measures to analyse socioeconomic differences in dietary habits as well as to analyse changes over time. In the cases of fruit, salad and soft drinks, the questions changed from one survey to the other, so, comparisons over time are limited. Income groups are not defined in the same way in both samples as well, thus, in 2005/06 some of the small differences found in the middle income groups might stem from the fact that each represents a lower percentage of the sample, hence, differences in consecutive groups are attenuated. But differences between the extreme groups and consequently the ratios in Fig. 3 should be fairly comparable.

The data available might be limited to capture the effect of the recession. For example, there is evidence for Germany, Finland, United Kingdom and Australia that people experiencing financial stress have a higher risk of becoming obese[28]. There is not such information in the Portuguese National Health Survey. The data used in this study were collected six years ago but still are the most up-do-date data for Portugal.

Implications

Obesity remains a public health problem in OECD countries and various strategies have been implemented[4], including food labelling and the use of financial incentives linked with health and wellness objectives. Portuguese authorities have also introduced taxes on sugar sweetened beverages. However, campaigns and policy measures should consider not only the impact on the prevalence of obesity but also in terms of inequalities. Portugal has a national plan to tackle obesity since 2005[43], nonetheless, both objectives and target populations do not consider questions related to inequality. Our results show that, unlike in other countries, the socioeconomic gradient in obesity has not reduced over time. Attention should also be paid to changes in behaviour as they might come slowly and unnoticed, differently affecting socioeconomic groups and increasing health inequalities. Our findings do not support a significant association between dietary habits and obesity. However, apart from this link, there are beneficial health effects of heathy foods and the opposite applies to unhealthy foods. Therefore, our results should raise concerns given that overall changes in diet are in favour of the better-off. There is not much evidence on the effectiveness of interventions across different socioeconomic groups but interventions based on the delivery of information only, whether through counselling, mass media campaigns or curriculum-based interventions in schools, tend

to be ineffective in lower socioeconomic groups. They get information but they lack resources and capacity to understand and act upon delivered messages[44]. More structural measures are needed such as improved community access to physical activity[44] though when it comes to health equity an inter-sectoral approach is more likely to be successful involving stakeholders in the policy areas of housing, social protection, employment, education, transport, planning and the food system[45].

In future research it is of utmost relevance to keep monitoring changes in dietary habits and physical activity. It is indispensable to scrutinise the evolution of socioeconomic inequalities in these lifestyles. It would be interesting to compare our results regarding inequalities in dietary habits with results from other countries.

Acknowledgements: This work has been funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., Project UIDB/05037/2020"

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