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The role of socio-economic factors in food consumption of Portuguese children and adolescents: results from the National Food, Nutrition and Physical Activity Survey 2015–2016

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Abstract

This study aimed to evaluate the association between socio-economic factors and the food consumption of a young population. Participants were from the Portuguese National Food, Nutrition and Physical Activity Survey (IAN-AF 2015–2016) aged from 3 to 17 years (*n* 1153). Food consumption was assessed using two non-consecutive days of food diaries in children and two 24-h recalls for adolescents. A latent class analysis (LCA) was used to classify children's socio-economic status (socio-economic composite classification (SCC)), categorised in low, middle or high. The associations between socio-economic variables and food consumption were evaluated through linear or logistic regression models, weighted for the Portuguese population distribution. A positive association was found between belonging to a higher level of SCC and consumption of fruits and vegetables (FV), by children ($\beta = 2{\cdot}4$, 95 % CI 1·1, 3·8) and by adolescents ($\beta = 52{\cdot}4$, 95 % CI 9·6, 95·3). A higher SCC, but particularly higher maternal education, was positively associated with consumption of 'white meat, fish and eggs'. Both higher SCC and parental education were positively associated with salty snack consumption in the adolescents' group. In conclusion, children and adolescents with higher educated parents and belonging to a high socio-economic level have a higher daily intake of FV and white meat, fish and eggs. Socio-economic factors play an important role in justifying differences in the food consumption of children and adolescents and must be considered in future interventions. The relationship between higher socio-economic position and salty snack consumption in adolescents needs to be further explored in other populations.

Key words: **Portugal: Socio-economic factors: Dietary intake: Children: National surveys**

Socio-economic status (SES) is commonly described by three main aspects: education, employment and income[1]. Socio-economic inequalities in health influence every phase of the life course, from birth to older ages[2]. A lower SES is associated with every major cause of premature mortality, whilst the higher the level of family income, education or occupational ranking, the lower the risk of morbidity and mortality[3].

Food consumption is determined by a wide range of factors, namely socio-economic factors including education, working conditions and family household composition[4–7]. Dietary habits of young population with better SES are associated with most favourable dietary habits, including greater consumption of fruits and vegetable (FV) and lower consumption of energy-dense foods and sugar-sweetened beverages (SSB), compared with those of a lower SES[4]. In particular, in paediatric ages, the more educated the parents, the more likely they will promote adequate dietary practices with their children[5]. Eating breakfast and consuming fewer energy-dense foods are a few examples of what children from more educated parents learn in their households[5].

The family context has a particularly important role in children's and adolescents' food choices[6] and habits[8]. Previous research has shown that the family environment is highly associated with the child's dietary habits[9]. Dietary habits acquired in early life can have a significant effect on short- and long-term health of individuals[10–12]. Eating habits are modelled

Abbreviations: FV, fruits and vegetables; IAN-AF, Portuguese National Food, Nutrition and Physical Activity Survey (Inquérito Alimentar Nacional e de Atividade Fisica); LCA, latent class analysis; SCC, socio-economic composite classification; SES, socio-economic status; SSB, sugar-sweetened beverages..

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by the family environment that includes not only food availability but also parents' eating behaviours and child feeding practices. High-SES families have a higher frequency of dialogues about healthy food consumption compared with low-SES families[13]. Moreover, the family's household composition is another aspect that can influence the quality and quantity of food consumption: having more than two children is associated with an increased intake of energy-dense foods[7,14].

Eating behaviours during adolescence are more independent of the family compared with those in childhood since adolescents seek more freedom of choice[15]. In the parents' perspective, they lose authority over their children when they become teenagers and can no longer control their food preferences, especially among low-SES families, while middle-SES parents tend to shape their adolescent's eating behaviours in a 'healthy direction'[16]. Besides the family context, socio-cultural environments and peers influence a teenager's lifestyle, including food consumption. Also, some studies have shown that adolescents with a higher SES level are keen to eat more FV, high-fibre foods, less meat and meat products and fewer fatty foods than lower SES families[17,18].

The younger Portuguese population is a particular risk group due to high prevalence of inadequate FV consumption, high consumption of sweetened beverages and high prevalence of inadequacy of saturated fat, fibre, sugar and salt intake[19]. Almost 60 % of the general Portuguese population are overweight, with the less educated individuals presenting the highest obesity prevalence. One-quarter of the children are already overweight[20]. Among 2-year-old Portuguese children, higher maternal age and education, higher household income and more specialised maternal occupation were significantly associated with a lower consumption of soft drinks and sweets[7]. In a multinational cross-sectional study[21], among 9- to 11-year-old children, including Portuguese children, lower annual household income and lower level of parental education were associated with unhealthy dietary patterns. Also among Portuguese adolescents, having highly educated parents was associated with lower consumption of energy-dense foods[10]. All these previous studies were performed with regional data, and the evaluation of the relationship between SES and food consumption at the national level is warranted. Moreover, scarce studies have evaluated the relations of aggregated socio-economic dimensions and food consumption in young populations. Knowing better these relations can improve the development of health interventions taking in mind the reduction of health inequalities. This study aims to investigate the independent contribution of socio-economic level aggregated in a single classification, on the food consumption among 3- to 9-year-old children and 10- to 17-year-old adolescents aged from a Portuguese representative sample.

Participants and methods

Study design and participants

Participants were part of the National Food, Nutrition and Physical Activity Survey of the Portuguese population 2015–2016 (IAN-AF 2015–2016)[22,23]. In brief, this survey collected nationwide data from a representative sample of the Portuguese population aged between 3 months and 84 years by multistage sampling, according to the National Health Registry stratified by the seven Statistical Geographic Units of Portugal and weighted according to sex, age groups and region. The data collection process was carried out from October 2015 to September 2016 by trained field workers using an electronic platform specifically developed for the survey – 'You eAT&Move'[23]. The majority of the procedures of data collection were adapted from the European Food Safety Authority Guidance in view of the EU Menu methodology[24]. All procedures were approved by the Ethical Committee of the Institute of Public Health of the University of Porto and by the Ethical Commissions of each one of the Regional Administrations of Health. All participants were asked to provide their written informed consent according to the Declaration of Helsinki. Written agreements from the parents were required for children/adolescents. Adolescents were also asked to sign the consent form together with their legal representative.

From a total sample of 5811 individuals with complete information on the two dietary interviews, 1153 were children and adolescents (participation rate among eligible: 47 and 46 %, respectively). For the present analysis, the final sample included 521 children, from 3 to 9 years of age, and 632 adolescents, from 10 to 17 years of age, with complete information for all key variables.

Dietary data

For children under 10 years, two non-consecutive 1-d food diaries were used, followed by a face-to-face interview in the next day, so that the caregiver could give more details about food description and food quantification. Among adolescents, two non-consecutive 24-h dietary recalls were collected with the presence of one caregiver among subjects aged 10–14 years, and parents were not required among adolescents between 15 and 17 years of age.

The module eAT24 belonging to the software You eAT&Move was used for handling food data collected by the 24-h recall (or food diaries), which integrates food pictures[25] for portion size estimation. All foods and beverages consumed during 24 h were recorded per eating occasion and quantified and described as eaten. The grams of consumption were obtained by the average of the two reported days. The software allows subsequent conversion of foods into energy intake and nutrients, using by default the Portuguese food composition table[26]. Nine food groups were defined based on the food recommendations of the Portuguese Food Wheel Guide[27]: FV (fresh fruits, vegetables and legumes), cereals and potatoes (rice, pasta, potatoes, bread and other grains), dairy products (milk, yogurt and cheese), white meat, fish and eggs (eggs, chicken, turkey, rabbit, fresh, dry and canned fish), red meat and processed meat (e.g. pork, beef, ham, sausage, bacon), salty snacks (salty snacks, pizzas and chips), SSB (nectars and soft drinks), sugar and honey (added sugar, honey, molasses and syrup), sweets (cakes, candies, sweet pastry, chocolate, biscuits and ice cream, breakfast cereals and cereals bars).

A healthy eating index, previously used in Portuguese children[28,29] and based on the WHO's dietary recommendations[30], was developed in the present study to evaluate the

participants' adherence to a healthier eating pattern. The index included the nine food groups previously described. The main adaptation from the original study (based on FFQ data) was the inclusion of the 'sugar and honey' group. For the present study, based on food diaries, we felt the 'sugar and honey' group was an important group, especially for adolescents who were in the age group in Portugal with the highest consumption of added/free sugars[31]. The consumption of each food groups (g) was scored between 1 and 4 points according to the respective quartiles, separately by age groups. For food groups considered healthier, such as 'FV', 'dairy products', 'cereals and potatoes' and 'white meat, fish and eggs', lower consumption had lower scores and higher consumption scored higher. The remaining five food groups with less healthy foods were assigned inverse scores, that is, the lower consumption quartile was assigned the highest score. The scores assigned were summed up, resulting in an index with a final total score ranging from 11 to 28 in children and 12 to 29 in adolescents. Higher scores represented a higher adherence to a healthier eating pattern.

Socio-demographic data

Information about children's sex and age (calculated using birth date and the date of the first interview) and questions about the parental level of education and employment status (employed *v.* unemployed/other (retired, permanently disabled, student, domestic worker, compulsory military service or compulsory community service)) were accessed. Parental education was defined as 'low' (≤6 years of education), 'middle' (7–12 years of education) or 'high' (>12 years of education). Participants were also asked about the number of household members. Geographical regions were defined according to the Portuguese National Institute of Statistics' classification of urban areas[32], and participants' parish of residence was classified into three categories: predominantly urban areas, medium urban areas and predominantly rural areas. Based on the socio-demographic data, a 'socio-economic composite classification' (SCC) was developed to describe the SES of the participants. This classification considered the following six factors: mother's and father's employment status and education, household composition and geographical region type.

Anthropometric data

Body weight and height were objectively measured by trained staff according to standard procedures[33]. Height was estimated to the closest cm, with participants in a standing position with light garments and shoeless, utilising a portable wall stadiometer (SECA 213). Body weight was estimated in similar conditions to the closest tenth of a kg utilising a digital scale (SECA 813)[20]. BMI was defined by three main categories – underweight/normal weight, pre-obese and obese – using BMI *z*-scores according to age and sex WHO standards[34]. Obesity was defined as a BMI-for-age *z*-score >2 SD (children older than 5 years of age) or >3 SD (children under 5 years of age) for participants of the same age and sex.

Statistical analysis

A socio-economic classification was obtained using LCA, which resulted in a categorical latent variable capable of distinct groups of individuals from the sample, homogeneous within the group. The LCA included the mother's and father's employment status and education, household composition and geographical region type (six variables). The number of latent classes was defined according to the Bayesian information criterion, and 1–5 latent classes were tested, starting from one single class and increasing the number of classes by one at each step. The final model considered corresponding to the minimum Bayesian information criterion achieved, which considers three latent classes. Several random starts were used to evaluate the convergence of the latent class model. The interpretation of the classification was based on the socio-economic items profiles in each latent class category, obtained from the probabilities of each item response category, conditional on class membership. The new variable 'SCC' included three distinct categories: low, middle and high. Socio-economic characteristics of the Portuguese population between 3 and 17 years of age were examined according to age groups. Normality of dietary data was checked by visually inspecting histograms of each variable, stratified by age group. Due to lower consumption of 'sugar and honey', we have decided to add it to the group of sweets. For each variable, homogeneity of variance was checked for the SCC using Levene's test, stratified by age group. For children, the variable FV presented heteroscedasticity; thus, a root square transformation was applied. The average daily intake of food groups and the respective 95 % CI were estimated according to the SCC variable, stratified by the age group. For each food group, comparisons between the average consumption in each socio-economic level were evaluated using ANOVA. SSB and salty snacks presented a higher prevalence of no consumers, so categorical variables were used to evaluate having any consumption of SSB or salty snacks in a random day *v.* having no consumption (for both age groups). The healthy eating index was also categorised using the median, 20 points for children and 21 points for adolescents. To evaluate the association between all food groups' consumption, except for salty snacks and SSB, and the socio-economic level, linear regressions were used obtaining crude and adjusted mean differences (β) and the respective 95 % CI. To evaluate the association between SSB, salty snack consumption and the healthy eating index and the SCC, logistic regressions were used obtaining OR and respective 95 % CI. Based on previous literature[35,36], the following potential confounders were tested: participants' sex and age, maternal age and, participants' practice of sports and screen time. Variables were included in the models based on the change-in-estimate criterion with a cut-off point of 10 % and/or the statistical significance of the variable for the model. An interaction effect for sex and age in the association between SSC and food consumption was tested by including an interaction term in the final models, but no interaction effects were found. Still, we decided to present the results by age group due to the very different consumption between the two groups. Three separated

models were fitted: crude model (model 0), a second model adjusted for participants' sex and mother's age as a continuous variable (model 1) and a third model additionally adjusted to the 2-d average energy intake (model 2). Similar analyses were also performed considering mother's and father's education as exposure factors instead of socio-economic classification. In these analyses, models were adjusted for mother's age when considering the mother's education and father's age when considering the father's education. All statistical analyses were weighted according to the complex sampling design used in IAN-AF, described in detail elsewhere[22]. A significance level of 5 % was assumed as well as independence between observations. Analyses were performed in the R software version 3.4.1 for windows and the library 'survey' for weighted analysis and the library 'poLCA' to perform LCA[37–39].

Results

The majority of children (50·7 %) and adolescents (51·3 %) were males, and <10 % of the participants were obese. Most of the parents had a middle or low level of education and most were employed. One-quarter of adolescents, comparing with only 13 % of the children, were classified as having a low socio-economic level (Table 1). Children and adolescents' characteristics were compared with participants who were not allowed to participate but whose caregiver has accepted to answer a short questionnaire by telephone. The percentage of males and the categories of parental education were similar among participants and non-participants. Non-participants were similar for the consumption of FV (≥5 portions/d: 31 *v.* 32 % for children and 14 *v.* 10 % for adolescents) and practice of regular structured physical activity (50 *v.* 51 % for children and 47 *v.* 56 % for adolescents); however, non-participant children had a slightly higher prevalence of self-reported obesity (5 *v.* 2 %), while non-participant adolescents had a lower prevalence of self-reported obesity (3 *v.* 6 %).

Table 2 presents the characteristics of the SCC categories for both children and adolescents. Overall, the first category 'low socio-economic level' includes individuals with lower educated parents and usually unemployed, families with household composition of five or more members (47 %) and families from a medium urban area (27 %). The 'high socio-demographic level' category included individuals with parents with higher levels of education and usually employed, families with a household composition up to four members and families more frequently living in the urban area.

Fig. 1 presents the average daily intake of food consumption (in g/d) (or prevalence of consumption (in %)) according to

Table 1. Characteristics of the 3- to 9-year-old children and 10- to 17-year-old adolescents' groups, weighted for the Portuguese population distribution (Numbers; percentages and 95 % confidence intervals)

	Children (*n* 521)			Adolescents (*n* 632)		
	n	%	95 % CI	*n*	%	95 % CI
Sex						
Female	262	49·3	45·9, 52·7	319	48·7	45·7, 51·6
Male	259	50·7	47·3, 54·1	313	51·3	48·4, 54·3
BMI (*z*-score)						
Underweight/normal weight	375	69·2	63·0, 75·3	422	68·6	64·2, 73·1
Pre-obesity	96	21·6	15·9, 27·3	143	23·1	19·1, 27·1
Obesity	46	9·2	5·0, 13·5	66	8·3	5·1, 11·5
Education of mother						
Low	57	11·9	7·3, 16·4	163	24·3	18·9, 29·6
Middle	255	49·0	42·8, 55·1	305	48·0	43·0, 53·0
High	209	39·2	31·9, 46·5	164	27·7	22·0, 33·4
Education of father						
Low	116	20·0	14, 26·1	251	38·1	33·4, 42·9
Middle	285	54·6	47·6, 61·6	282	43·7	38·9, 48·5
High	120	25·4	18·4, 32·4	99	18·2	13·6, 22·7
Mother's working conditions						
Employed	424	82·1	77·3, 86·9	504	82·3	78·3, 86·3
Unemployed/other	96	17·9	13·1, 22·7	118	17·7	13·7, 21·7
Father's working conditions						
Employed	471	94·9	92·4, 97·3	510	87·1	83·2, 90·9
Unemployed/other	44	5·1	2·7, 7·6	84	12·9	9·1, 16·8
Household composition						
2 members	10	1·7	0·3, 3·1	41	7·3	3·6, 11·0
3–4 members	404	86·6	82·3, 90·8	450	76·3	71·5, 81·1
≥5 members	61	11·8	7·9, 15·7	87	16·4	12·2, 20·5
Region type						
Predominantly urban areas	384	78·3	70·6, 86·0	463	76·6	68·9, 84·3
Medium urban areas	88	14·5	7·1, 21·8	95	14·1	6·7, 21·4
Predominantly rural areas	49	7·2	3·0, 11·4	74	9·3	4·7, 13·9
SCC						
Low	55	12·9	8·4, 17·4	137	25·0	19·5, 30·5
Middle	230	47·5	40·6, 54·4	246	45·5	39·4, 51·5
High	185	39·6	31·6, 47·6	158	29·5	23·5, 35·6

SCC, socio-economic composite classification.

Table 2. Socio-economic composite classification (SCC)'s description

	SCC (%)		
	Low	Medium	High
Education of mother			
Low (≤6 years)	82·4	16·3	1·4
Middle (7–12 years)	10·5	81·9	7·6
High (>12 years)	1·6	11·2	87·3
Education of father			
Low (≤6 years)	92·3	18·5	0·0
Middle (7–12 years)	7·6	79·6	37·8
High (>12 years)	0·0	1·9	62·2
Mother's working conditions			
Employed	13·8	47·6	38·5
Unemployed	44·7	50·8	4·5
Other*	56·1	15·0	28·9
Father's working conditions			
Employed	15·5	48·7	35·8
Unemployed	53·1	26·3	20·7
Other*	81·2	17·4	1·4
Household composition			
2 members	13·3	45·3	41·5
3–4 members	15·3	49·3	35·4
≥5 members	47·1	29·6	23·3
Geographical region type			
Predominantly urban areas	18·5	42·7	38·8
Medium urban areas	27·5	47·9	24·6
Predominantly rural areas	16·8	77·4	5·8

* Retired, permanently disabled, student, domestic worker, compulsory military service or compulsory community service.

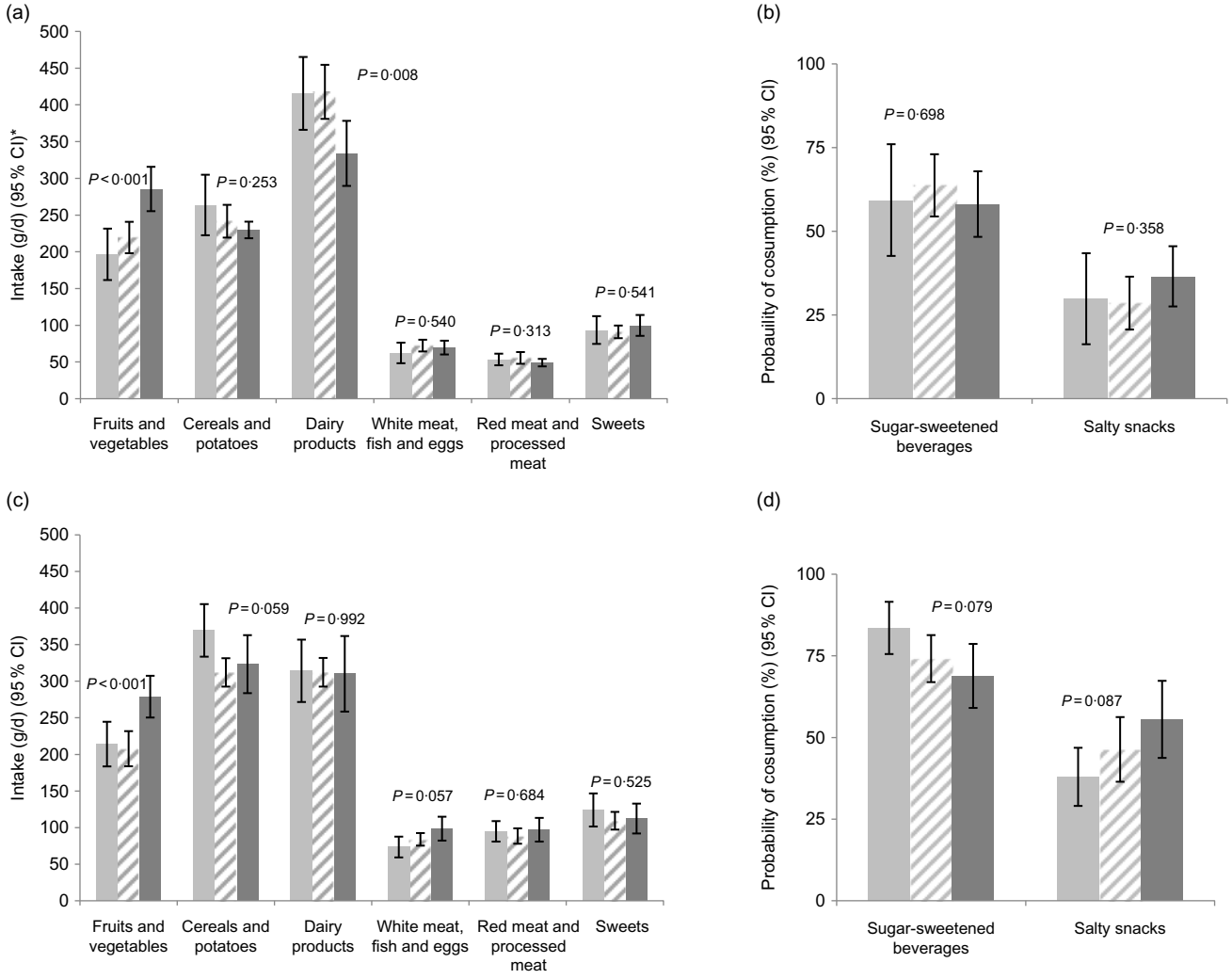

Fig. 1. Average daily intake of food consumption according to categories of the socio-economic composite classification (SCC), in Portuguese 3- to 9-year-old children (a) and 10- to 17-year-old adolescents (c); and the probability of having any consumption in a random day according to categories of the SCC, in Portuguese 3- to 9-year-old children (b) and 10- to 17-year-old adolescents (d). * For fruits and vegetables the means presented are quadratic means. ▒, Low; ▒, medium; ▒, high.

categories of SCC in children (Fig. 1(a) and (c)) and adolescents (Fig. 1(b) and (d)). Significantly higher levels of consumption of FV in children (mean 285·4, 95 % CI 256·6, 315·7) and adolescents (mean 278·7, 95 % CI 250·2, 307·1) were observed in the 'high' socio-economic category, compared with the lower socio-economic groups. Children belonging to a high socio-economic level had a lower daily intake of dairy products, compared with those in the lower SCC. Adolescents with a low socio-economic level had a higher daily intake of cereals and potatoes (mean 369·2, 95 % CI 333·3, 405·2) in comparison with adolescents from higher socio-economic context. Moreover, among adolescents, it was observed a decreasing trend in the consumption of SSB but an increasing trend in consumption of salty snacks and white meat, fish and eggs, by SCC categories, although not statistically significant. The score in the healthy eating index increases by increasing categories of the SCC in adolescents (high SCC, mean 21·5, 95 % CI 20·9, 22·2 *v.* low SCC, mean 20·3, 95 % CI 19·4, 21·2), although not achieving significance ($P = 0{\cdot}073$)

Tables 3 and 4 present the associations between the SCC categories and the food consumption (in g/d or categorised by the median or having any positive consumption in %) for children and adolescents, respectively. After adjusting for mother's age and children's sex (Table 3, model 1), and taking as the reference class the lowest SCC, a positive association between a higher SCC ($\beta = 2{\cdot}33$, 95 % CI 0·98, 3·674) and children's consumption of FV was found. Model 2 was further adjusted for children's energy intake, and a positive association was still described between a high SCC and children's FV consumption ($\beta = 2{\cdot}42$, 95 % CI 1·09, 76). Children in the higher levels of the SCC had a lower intake of dairy products (Table 3, model 0, crude analysis), although significance was lost after further adjustment for maternal age and children's sex (Table 3, model 1). No statistically significant associations were found between SCC neither with other food groups nor with adherence to the healthy eating index.

Among Portuguese adolescents (Table 4), after adjustment, a positive association was described between higher levels of the SCC and adolescents' daily consumption of FV ($\beta = 46{\cdot}6$, 95 % CI 4·2, 89·0) (Table 4, model 1). In crude analysis, adolescents belonging to the highest level of the socio-economic index had a lower odds of having SSB in a random day (OR 0·44, 95 % CI 0·20, 0·96), higher intake in 25 g of 'white meat, fish and eggs' and higher scores in the healthy eating index, compared with the adolescents from a more disadvantaged socio-economic environment. After adjustment for maternal age and children's sex (Table 4, model 1), all these associations, except for FV, were no longer statistically significant. After adjusting for adolescent's individual energy intake (Table 4, model 2), a high SCC was still significantly associated with FV. Still, in model 2, a positive association was found for belonging to the middle level of the SCC and consumption of 'white meat, fish and eggs'. Adolescents from a more advantage socio-economic environment had a significantly higher intake of salty snacks. No statistically significant associations were found between SCC and the other food groups.

When analysing the results separately by parents' level of education, a high level of mother's or father's education was

Table 3. Associations between the categories of the socio-economic composite classification (SCC) and food consumption, in a national representative sample of children aged 3–9 years of age, weighted for the Portuguese population distribution
(*β*-Coefficients and 95 % confidence intervals; odds ratios and 95 % confidence intervals)

	Fruits and vegetables (g/d)*		Cereals and potatoes (g/d)		Dairy products (g/d)		White meat, fish and eggs (g/d)		Red meat and processed meat (g/d)		Sweets (g/d)		Salty snacks (any consumption *v.* none)		Sugar-sweetened beverages (any consumption *v.* none)		Healthy eating index (≥20 points *v.* <20)	
	β	95 % CI	*β*	95 % CI	*β*	95 % CI	*β*	95 % CI	*β*	95 % CI	*β*	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
										Model 0†								
SCC																		
Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Middle	0·79	−0·62, 2·21	−22·1	−70·0, 25·9	2·1	−58·5, 62·6	10·0	−7, 2, 27·5	2·1	−8·6, 12·8	−2·5	−22·6, 17·5	0·94	0·43, 2·03	1·21	0·60, 2·90	1·02	0·45, 2·32
High	2·88‡	1·30, 4·46	−34·0	−75·5, 7·5	−81·8‡	−157·1, −6·4	7·2	−10·0, 24·5	−4·3	−14·4, 5·8	6·3	−17·5, 30·1	1·35	0·65, 2·82	0·95	0·43, 2·09	1·23	0·51, 2·97
						Model 1§								Model 1				
SCC																		
Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Middle	0·69	−0·63, 2·01	−24. 7	−73·4, 4·0	21·5	−44·3, 87·3	10·1	−8·8, 29·0	1·8	−9·2, 12·7	−0·3	−22·5, 21·9	0·74	0·32, 1·72	1·37	0·69, 2·75	1·00	0·45, 2·21
High	2·33‡	0·98, 3·67	−43·0	−89·8, 3·91	−47·8	−122·3, 26·6	5·8	−11·7, 23·4	−1·7	−14·2, 10·9	11·4	−13·0, 35·8	1·22	0·55, 2·71	1·08	0·47, 2·49	1·04	0·48, 2·25
						Model 2‖										Model 2		
SCC																		
Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Middle	0·69	−0·55, 1·94	−24·8	−71·5, 21·9	21·5	−44·0, 87·0	10·1	−8·9, 29·1	1·8	−8·9, 12·4	−0·3	−17·6, 16·9	0·72	0·31, 1·69	1·44	0·74, 2·80	0·99	0·45, 2·18
High	2·42‡	1·09, 3·76	−36·7	−80·3, 6·94	−49·0	−123·3, 25·4	6·4	−11·2, 24·1	0·3	−11·5, 12·1	15·4	−4·9, 35·8	1·29	0·56, 2·93	1·20	0·50, 2·86	1·00	0·46, 2·16

* The variable was transformed to guarantee normal distribution (root square).
† Model 0, unadjusted.
‡ Values denote statistical significance.
§ Model 1, adjusted for children's sex and mother's age.
‖ Model 2, model 1 plus children's average energy intake (kJ).

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Table 4. Associations between the level of the socio-economic composite classification (SCC) and food consumption, in a national representative sample of adolescents aged 10–17 years of age, weighted for the Portuguese population distribution
(β-Coefficients and 95 % confidence intervals; odds ratios and 95 % confidence intervals)

	Fruits and vegetables (g/d)		Cereals and potatoes (g/d)		Dairy products (g/d)		White meat, fish and eggs (g/d)		Red meat and processed meat (g/d)		Sweets (g/d)		Salty snacks (any consumption *v.* none)		Sugar-sweetened beverages (any consumption *v.* none)		Healthy eating index (≥20 points *v.* <20)	
	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI	β	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Model 0*																		
SCC																		
Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Middle	−6·3	−45·1, 32·5	−57·4†	−98·3, 16·6	−2·0	−53·3, 49·4	10·5	−6·7, 27·6	−6·4	−23·3, 10·5	−14·7	−41·2, 11·8	1·41	0·82, 2·42	0·56	0·28, 1·16	1·35	0·78, 2·35
High	64·9†	24·1, 105·5	−46·1	−102·8, 10·6	−4·1	−74·5, 66·2	25·1†	4·2, 46·0	2·2	−23·6, 27·9	−11·6	−38·6, 15·4	2·04†	1·13, 3·68	0·44†	0·20, 0·96	1·51	0·78, 2·92
Model 1‡																		
SCC																		
Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Middle	−29·6	−72·6, 13·4	−63·4†	−105·3, −21·4	−11·3	−66·9, 44·3	11·7	−4·9, 28·4	−10·9	−27·7, 5·9	−12·7	−42·6, 17·2	1·58	0·90, 2·79	0·65	0·30, 1·41	1·25	0·73, 2·16
High	46·6†	4·2, 89·0	−50·6	−105·4, 4·2	−11·0	−80·3, 58·3	16·1	−7·9, 40·1	10·9	−20·4, 42·3	−3·1	−30·4, 24·0	2·57†	1·40, 4·72	0·48	0·19, 1·22	1·19	0·58, 2·42
Model 2§																		
SCC																		
Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Middle	−13·2	−56·7, 30·2	−34·0	−70·9, 2·8	5·7	−48·1, 59·6	16·6†	0·2, 33·0	−1·8	−19·1, 15·5	2·5	−22·9, 27·9	1·97†	1·10, 3·53	0·73	0·32, 1·65	1·26	0·74, 2·15
High	52·4†	9·6, 95·3	−40·2	−85·0, 4·7	−4·9	−74·7, 64·9	17·8	−6·8, 42·4	14·2	−15·2, 43·6	2·2	−23·6, 28·0	2·92†	1·52, 5·63	0·49	0·19, 1·26	1·19	0·58, 2·43

* Model 0, unadjusted.
† Values denote statistical significance.
‡ Model 1, adjusted for adolescents' sex and mother's age.
§ Model 2, model 1 plus adolescents' average energy intake (kJ).

also associated with FV consumption, in both age groups (Appendices A and B in online Supplementary material). Moreover, a higher level of mother's education was inversely associated with the consumption of cereals and potatoes, in both children and adolescents (Appendices A and B in online Supplementary material). In fully adjusted models, higher consumption of salty snacks by adolescents was associated with a high level of both mother's and father's education (Appendix B in online Supplementary material). After adjusting for father's age, children's sex and energy intake (model 2), an inverse association was found between the higher level of fathers' education and adolescents' consumption of SSB (Appendix B in online Supplementary material). Moreover, the middle level of father education was negatively associated with dairy product consumption in children.

Discussion

In the present study, we have aggregated different socio-economic variables in a composite classification to have a better representation of the different dimensions. The results of this study show that children and adolescents with a high socio-economic level, and particularly with higher educated parents, had a greater daily intake of fresh FV and white meat, fish and eggs. Only in adolescents, a higher level of socio-economic environment was associated with higher intake of salty snacks and a lower intake of cereals and products. A higher educated father was also associated with lower intake of SSB by the adolescents.

Previous literature, using data from the British birth cohort ALSPAC, have described dietary patterns in childhood and their association with socio-demographic characteristics. Children aged 3 years of age with higher scores in a dietary pattern called 'junk' (characterised by greater consumption for energy-dense foods) had less educated mothers, with a lower income and with older siblings[40]. Furthermore, at 4 and 7 years old, the dietary pattern associated with higher intakes of salad, pulses, fruits and fish was more likely with increasing levels of maternal education[41]. In a previous study[7], among 2-year-old Portuguese children, having older siblings was a predictor of a higher intake of energy-dense foods. Comparing with our data, the highest level of socio-economic categorisation includes the smaller families and not having older siblings might be an additional explication for these children to engage in better food consumption (including the lower consumption of SSB).

A meta-analysis including US participants aged 2–19 years described that rural children have 26 % greater odds of obesity, compared with urban children[42]. These health disparities might be explained by different food consumption, as urban youth seem to consume FV more frequently, while rural children consumed more energy content than urban counterparts[43,44]. These results are in accordance with ours, as the highest socio-economic level includes the lower percentage of predominantly rural areas.

Mothers play an essential role in modelling children's nutrition intake. Studies have shown that there is a direct association between maternal and a child's food consumption[45].

Maternal lower SES at young age indirectly increases the chances of exposing their children to unhealthy eating habits later in life, and lower maternal education at birth directly increases those chances[35]. Usually, during meal times, mothers invest more time with their children than fathers do and they are more likely to be the family food supplier[15]. In the present study, the maternal middle level of education was associated with increased daily consumption of white meat, fish and eggs, in both children and adolescents. Mothers with a higher education level have a high influence on the lower consumption of red meat and processed meat among children, but not among adolescents, which shows that parents lose control of their diet, especially for less healthy foods once their children become teenagers.

A consistent result from SCC, and specifically paternal education, was the higher intake of salty snacks among Portuguese adolescents with a better socio-economic environment. Our present results are in concordance with the recent association between ultra-processed foods (in which salty snacks are included) and a high socio-economic position[46,47]. At least in Portugal, it seems to have occurred a shift in the last decade between the parental education and consumption of fast food, as adolescents born in 1990 with highly educated parents were less likely to follow a dietary pattern high in fast food and sweets[48].

Previous studies, including European and Australian children and adolescents[42–45], have also described a positive relationship between parental education level and FV consumption. A cross-sectional study[49], performed on Dutch IMPACT Nutrition Physical Activity Child cohort, showed that children of mothers with a high educational level and high SES consumed more FV. Another cross-sectional study[50] conducted on children aged between 9 and 13 years old and their parents showed that mother's educational level was the most consistent and strongest SES predictor for children's food consumption, showing that children of mothers with a high level of education consumed more FV. Contradictory, in a Canadian study, parent's level of education was not significantly related to FV consumption among 10- to 12-year-olds[51]. Moreover, in a French study among children, adolescents and adults[52], the daily consumption of whole grains was higher in children of parents with higher educational level than of those with less educated parents. This is a contradictory result comparing to the present study; however, the group of cereals and potatoes included both whole and white cereal and in the Portuguese population, namely in children and adolescents, it represented mainly white cereals consumption since in these age groups the consumption of whole cereals is really low[19]. Another explanation, at least in the older group, might be that the adolescents from a higher socio-economic position are substituting bread at snacks events by salty snacks.

Adolescents' eating habits and meal patterns tend to be unhealthier and not so well organised. Skipping main meals (e.g. breakfast)[53] and consuming more SSB, fewer fruits[54], more fast food[55] and snacks[56] are very common habits amongst this age group[5]. Still, our results show a higher consumption of FV among adolescent from a better socio-economic environment. Moreover, the father's education was inversely related to adolescents' consumption of SSB. A previous European study has also described an inverse association between educational level and intake of SSB in 11-year-old adolescents[57].

No association was found for the mother's or father's education and children's consumption of SSB. In a recent study[58], among Dutch children, the authors also failed to show an association between parental education and children's consumption of SSB. The children's age, parenting practices and parental modelling were the most relevant factors[58], In our population, the mothers are highly educated (only 10 % of mothers of children have low education and 25 % of mothers of adolescents), so the lack of variability in our population might justify the lack of associations with maternal education. Moreover, children's consumption of SSB is lower than adolescents, which might also justify the lack of associations among children. Regarding the Portuguese fathers, they are overall less educated than the mothers (40 % of the fathers of adolescents have low education against only 25 % of mothers), so the variability might be higher and because of that the expected associations were shown only for father's education.

The healthy eating index used in the present study was adapted from a previous one using data from Portuguese children[28], in which maternal education was positively associated with 7-year-old children's diet quality. We aimed to further study this association in other age groups and also using a socio-economic aggregated variable. In our study, in the unadjusted model, a positive link was described between the adolescents' healthy eating index and a better socio-economic environment. However, after adjustment for maternal age and adolescent's sex, the significance was lost. This might indicate that the maternal age in this association is more important than maternal education.

Study limitations and strengths

Some limitations of the present study are acknowledged. A social desirability bias might have occurred, resulting in an over-reporting of healthier foods (e.g. FV) and/or under-reporting of less healthy foods (e.g. energy-dense foods). If this has occurred, our associations could be underestimated and might be even stronger. Using large food groups could have limited the estimation of other associations; for example, we did not distinguish the whole from non-refined cereals, and the category of 'Sweets' included a large range of products that contain ingredients from other categories as well, such as cakes, pastry, ice cream and cereals bars.

Strengths of this study include a national representative sample of Portuguese children and adolescents and results weighted for the Portuguese population distribution regarding sex, age and region, and following harmonised European methodology of dietary assessment. Differences described between participants and refusals were considered of small magnitude for variables representing the main areas of the survey. Moreover, several important factors besides food consumption were evaluated, such as socio-economic circumstances and collection of anthropometric measurements, allowing the adjustment for several potential confounding factors. The aggregation of several socio-economic dimensions in a composite variable is also a strength, once it allows understanding better the influence

of the socio-economic environment, beyond parental education, on children and adolescent's food consumption. Knowing better these relations can improve the development of health interventions taking in mind the reduction of health inequalities. However, when analysing the final models including as main exposure the socio-economic classification variable or the mother's and father's education, as a single variable, the trend of estimates were not so different, at least for the FV consumption. This supports that education, at least in this population, is still a good socio-economic indicator.

Conclusions

Portuguese children and adolescents with a higher socio-economic background, and in particular with parents with a high level of education, have a higher daily intake of FV and white meat, fish and eggs. High consumption of FV is still the dietary indicator that is most related to a better socio-economic position. The positive link between higher socio-economic position and salty snack consumption in adolescents needs to be validated in other populations. Socio-economic factors play an important role in justifying food consumption disparities in children and adolescents and should be considered in future public health interventions.

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The authors' contributions to the study were as follows: S. V. and I. M. contributed to the design of study, performed statistical analyses and interpretation of the data and wrote the first draft of the paper. D. C. and M. S. contributed with the statistical analysis and with the interpretation of data. C. L. contributed to the design of study, coordinated the design of data collection instruments and contributed to the discussion of results. All the authors critically reviewed the manuscript and approved the final version as submitted.

The authors declare that there are no conflicts of interest.

Supplementary material

For supplementary material referred to in this article, please visit https://doi.org/10.1017/S0007114520001373

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