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Parental education and frequency of food consumption in European children: the IDEFICS study

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Abstract

Objective: To assess the relationship between parental education level and the consumption frequency of obesity-related foods in European children.

Design: The analysis was based on data from the cross-sectional baseline survey of a prospective cohort study. The effects of parental education on food consumption were explored using analysis of covariance and logistic regression.

Setting: Primary schools and pre-schools of selected regions in Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany and Spain.

Subjects: Participants (n 14 426) of the IDEFICS baseline cohort study aged 2 to 9 years.

Results: Parental education level affected the intake of obesity-related foods in children. Children in the low and medium parental education level groups had lower odds of more frequently eating low-sugar and low-fat foods (vegetables, fruits, pasta/noodles/rice and wholemeal bread) and higher odds of more frequently eating high-sugar and high-fat foods (fried potatoes, fruits with sugar and nuts, snacks/desserts and sugared beverages; $P < 0{\cdot}001$). The largest odds ratio differences were found in the low category (reference category: high) for vegetables (OR = 0·56; 95 % CI 0·47, 0·65), fruits (OR = 0·56; 95 % CI 0·48, 0·65), fruits with sugar and nuts (OR = 2·23; 95 % CI 1·92, 2·59) and sugared beverages (OR = 2·01; 95 % CI 1·77, 2·37).

Conclusions: Low parental education level was associated with intakes of sugar-rich and fatty foods among children, while high parental education level was associated with intakes of low-sugar and low-fat foods. These findings should be taken into account in public health interventions, with more targeted policies aiming at an improvement of children's diet.

Keywords
Parental education
Children
IDEFICS study
Food consumption

Social inequalities in health determine the risk of morbidity and mortality from childhood through to adult life[1]. Consistent evidence indicates that people of low socio-economic status (SES) have a heavier burden of disease than their better-off counterparts[2]. SES refers to an individual's relative position in the social hierarchy and can be operationalized through diverse indicators including educational attainment, occupation and/or income. It is possible that such indicators affect food consumption in different ways due to different underlying social and psychological processes involving factors like nutritional knowledge, budget constraints or peer group behaviour[3,4]. Diet quality has been shown to follow a socio-economic gradient[5]. Studies examining the impact of SES on adolescents' and children's food intake have suggested high consumption of high-fat and high-sugar foods, and low consumption of fruits and vegetables, in individuals from disadvantaged groups[6–10].

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Family structure and support is one of the most influential aspects of the social environment of children. Parental influences on children's food choices and intake have an effect on individual and family practices, and operate among other mechanisms via availability and accessibility of foods or parental eating behaviour as food modelling[11,12]. Through this link, parental educational level is associated with children's food intake and frequency of consumption, and subsequently with childhood overweight and obesity[13–15]. However, the stability and repeatability of these relationships between countries have been scarcely investigated.

The present study aimed to assess the association between parental education levels and the consumption frequency of obesity-related food groups (e.g. foods that are shown by consistent evidence to be related, either positively or negatively, to overweight and obesity in children) among children aged 2 to 9 years from eight European countries.

Methods

The 'Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS' (IDEFICS) study is a population-based multicentre study of children aged 2 to 9 years from eight European countries. The two main aims were: (i) to investigate the aetiology of obesity and related disorders; and (ii) to implement a community-based intervention to prevent obesity and related diseases. For the present analysis, children recruited during the cross-sectional baseline survey were considered. Between September 2007 and May 2008, 31 543 children from primary schools and pre-schools of selected regions in Italy (Avellino), Estonia (Tartumaa, Harjumaa), Cyprus (Nicosia District, Paphos), Belgium (East-Flanders), Sweden (Västra Götaland), Hungary (Baranya, Zala), Germany (Lower Saxony) and Spain (Zaragoza, Huesca) were invited to participate in the baseline survey (T0) with a response rate of 53·4 % (*n* 16 864). The lowest response rates were reached in Spain (41 %) and Hungary (44 %), and the highest in Italy (60 %) and Sweden (66 %). In total 16 224 children (51·4 %) fulfilled the study's inclusion criteria (complete information on age, sex, height and weight). Sample size ranged from 1507 in Spain to 2567 in Hungary. An in-depth description of the complete IDEFICS study population is given by Ahrens *et al.*[16]. Of the total sample, 14 426 children (88·9 %) had valid data on SES and food intake, and were included in the current analysis. Further information on the study procedures is available in previous papers[17,18]. Each participating centre obtained ethical approval for the study from its respective responsible authority. All children provided oral consent and their parents provided written informed consent for all examinations and the collection, analysis and storage of personal data and collected samples.

Measurements

Data on personal, social, environmental and behavioural factors were collected by means of two standardized self-administered questionnaires that were filled in by the parents or guardians of the child. Education level of parents taken from the core parental questionnaire was used as a proxy indicator of SES, using categories according to the International Standard Classification of Education (ISCED)[19]. Three levels of education (low, medium, high) were created out of the six ISCED levels of the parental questionnaire: ISCED level 0, 1 or 2 adding up to low education; level 3 or 4 adding up to medium education; and level 5 or 6 adding up to high education. For the purposes of the present analysis, the highest education level of parents (either mother or father) was considered.

Dietary data were obtained by the food frequency section of the Children's Eating Habits Questionnaire–Food Frequency Questionnaire (CEHQ-FFQ)[20] in which the frequency of the child's consumption of selected food items during the preceding four weeks was reported. In order to assess meals under parental control, recall referred to meals outside the school canteen or childcare meal provision settings only[20,21]. The CEHQ-FFQ consisted of forty-three food items clustered into fourteen food groups. It was applied as a screening instrument to investigate the consumption of foods shown to be related, either positively or negatively, to overweight and obesity in children. The CEHQ-FFQ was not designed to provide an estimate of total energy intake or total food intake, but rather to investigate the consumption frequency of obesity-related foods. Those foods less likely to be associated with obesity were not included. Response options displayed were as follows: 'never/less than once a week', '1–3 times a week', '4–6 times a week', '1 time per day', '2 times per day', '3 times per day', '4 or more times per day' and 'I have no idea'. For the analysis, a conversion factor was used to transform the questionnaire answers into actual weekly consumption frequencies. When the proxy reported having 'no idea', consumption frequency could not be calculated and the data were not used in the analysis of the respective food item. No information on portion sizes was obtained.

Anthropometric measurements were carried out by trained staff following a standardized procedure in all centres. Body height (cm) was measured without shoes and all braids undone using a portable stadiometer (SECA 225). Weight (kg) was measured by means of a child-adapted version of an electronic scale (TANITA BC 420 SMA) with the children in a fasting status and wearing only underwear[22]. BMI was calculated and categorized following cut-off points according to the criteria of the International Obesity Taskforce[23,24]. The sample was classified into thinness, normal weight, overweight and obese categories.

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Statistical analysis

Descriptive data are shown as proportions, means and standard deviations. Differences in frequency of food consumption (times/week) by classified parental education (low, medium and high) were assessed by analysis of covariance models. Logistic regression analysis was used to examine the effect of parental education on frequency of food consumption. For this purpose, frequencies of food consumption were divided into tertiles (lowest, middle and highest consumption), based on country-specific variable distributions and for each food item separately. Finally, dichotomous variables were created, comparing the highest consumption (high consumers) against the rest of the sample, namely the lowest and middle tertiles (average consumers). High parental education level was set as the reference category. Prevalence of high consumers by parental education was also calculated. Both analyses (analysis of covariance and logistic regression) were adjusted for the following covariates: sex, age, BMI category and country. Statistical significance was set at $P \leq 0{\cdot}05$. All analyses were conducted using the Predictive Analytic Software (PASW) version 18·0 (SPSS Inc., Chicago, IL, USA).

Table 1 Characteristics of the study sample: children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

	n	%	Mean	SD
Age (years)				
Total	14 426		5·99	1·8
Pre-school	6631	46·6	4·28	0·9
School	7795	54·0	7·44	0·8
Sex				
Girls	7338	50·9	–	–
Boys	7088	49·1	–	–
Parental education level				
Low	1258	8·7	–	–
Medium	7227	50·1	–	–
High	5941	41·2	–	–
BMI category				
Thinness	1592	11·0	–	–
Normal weight	10 068	69·8	–	–
Overweight	1790	12·4	–	–
Obese	976	6·8	–	–
Country				
Belgium	1765	12·2	–	–
Cyprus	1462	10·1	–	–
Estonia	1599	11·1	–	–
Germany	1922	13·3	–	–
Hungary	2480	17·2	–	–
Italy	2189	15·2	–	–
Spain	1272	8·8	–	–
Sweden	1737	12·0	–	–

Results

Study participants excluded from the present study did not differ from those included in terms of sex, age, BMI category or parental education level. Based on the statistically significant interaction between educational level and country (all $P < 0{\cdot}001$), results are provided for the whole sample and by country. Table 1 describes the sociodemographic and anthropometric characteristics of the participating children (*n* 14 426). Mean age was 6·0 (1·8) years, with 46·6 % being of pre-school age (<6 years old) and 50·9 % being girls. Of the children, 69·8 % had normal weight for their height and age, while 12·4 % were classified as overweight and 6·8 % as obese. Some 41·2 % of the participants' parents had a high education level, 50·1 % a medium education and 8·7 % a low education. Sample size as a proportion of the total population varied among countries from 8·8 % in Spain to 17·2 % in Hungary. The following results refer to meals consumed outside the school canteen or childcare meal provision settings. The percentage of meals under parental control differed between countries (Italy 88 %, Estonia 69 %, Cyprus 84 %, Belgium 77 %, Sweden 65 %, Germany 90 %, Hungary 69 % and Spain 84 %).

Table 2 shows the weekly consumption frequencies and odds ratios (95 % confidence intervals) for consumption of low-sugar and low-fat foods by parental education level for the total sample. Significant differences in mean frequency of consumption of the chosen foods between parental education groups were observed. The highest mean frequency of weekly consumption for vegetables, fruits, pasta/noodles/rice, wholemeal bread and water was observed in the highest education level category. The largest differences were found for water (21·6 (SE 0·1) times/week in the high category *v.* 19·5 (SE 0·3) times/week in the low category) and vegetables (9·0 (SE 0·1) times/week in the high category *v.* 7·7 (SE 0·2) times/week in the low category). No significant trend was found for plain unsweetened milk. Taking into account the odds ratio results, children with parents in the low and medium parental education level groups had lower odds of more frequently eating vegetables, fruits, pasta/noodles/rice and wholemeal bread ($P < 0{\cdot}001$). Children with parents from the low parental education level group had also lower odds of more frequently drinking water ($P < 0{\cdot}05$) and plain unsweetened milk ($P < 0{\cdot}001$). The largest odds ratio differences were found in the low category (reference category: high) for vegetables (OR = 0·56; 95 % CI 0·47, 0·65) and fruits (OR = 0·56; 95 % CI 0·48, 0·65).

Table 3 shows the weekly consumption frequencies and odds ratios (95 % confidence intervals) for consumption of high-sugar, refined and high-fat foods by parental education level for the total sample. Significant differences in mean frequency of consumption of the chosen foods between parental education groups were observed. The highest mean frequency of weekly consumption for fried potatoes, fruits with sugar and nuts, fried meat and fish, cold cuts, fast food, white bread, sugared beverages, snacks/desserts and chocolate/nut-based spread was observed in the low educational

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Table 2 Weekly consumption frequency (means and their standard errors), prevalence of high consumption, and odds ratios (95 % confidence intervals) for intake of low-sugar and low-fat foods by classified parental education level; children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

Food group/Parental education	*n*	Mean	SE	p†	OR	95 % CI
Vegetables (raw and cooked)						
Low	1049	7·7[a,b]	0·19	33	0·56***	0·47, 0·65
Medium	6685	8·1[a,c]	0·07	36	0·76***	0·70, 0·82
High	5696	9·0[b,c]	0·08	38		
Fruits						
Low	1021	7·0[a,b]	0·19	27	0·56***	0·48, 0·65
Medium	6598	7·6[a,c]	0·07	35	0·74***	0·69, 0·80
High	5660	8·2[b,c]	0·08	41		
Fresh meat and fish						
Low	1046	3·9[a,b]	0·10	41	1·02	0·88, 1·19
Medium	6685	3·6[a,c]	0·04	36	1·02	0·95, 1·11
High	5726	3·3[b,c]	0·04	35		
Pasta, noodles and rice						
Low	1021	2·8[a,b]	0·08	31	0·61***	0·52, 0·72
Medium	6606	3·0[a,c]	0·03	30	0·85***	0·77, 0·93
High	5669	3·2[b,c]	0·04	32		
Wholemeal bread						
Low	993	3·4[b]	0·15	28	0·76***	0·64, 0·90
Medium	6479	3·5[c]	0·06	32	0·79***	0·72, 0·86
High	5602	3·9[b,c]	0·06	36		
Water						
Low	1001	19·5[a,b]	0·32	60	0·83*	0·71, 0·99
Medium	6563	20·8[a,c]	0·12	51	0·97	0·89, 1·06
High	5637	21·6[b,c]	0·14	50		
Plain unsweetened milk						
Low	973	7·3	0·23	31	0·68***	0·59, 0·80
Medium	6394	7·5	0·09	36	0·92	0·85, 1·00
High	5511	7·4	0·10	33		

Reference group: high education.
Analysis of covariance model adjusted for gender, age and BMI category. Two-sided level of significance ($P < 0·05$): [a]significant difference between low and medium; [b]significant difference between low and high; [c]significant difference between medium and high.
OR and 95 % CI determined by logistic regression models. Variables included in the models were parental education, gender, age and BMI category. Two-sided level of significance: *$P < 0·05$, ***$P < 0·001$.
†p refers to the proportion of participants assigned to the highest consumption category.

level category. Marked differences were observed for sugared beverages (17·5 (SE 0·4) times/week in the low category *v.* 11·4 (SE 0·2) times/week in the high category), snacks/desserts (9·3 (SE 0·2) times/week in the low category *v.* 6·9 (SE 0·1) times/week in the high category) and fruits with sugar and nuts (4·7 (SE 0·2) times/week in the low category *v.* 2·5 (SE 0·1) times/week in the high category). Odds ratio results show that participants in the low and medium parental education level categories had higher odds of more frequently consuming fried potatoes, fruits with sugar and nuts, fried meat and fish, sugared beverages and snacks/desserts ($P < 0·001$). Participants in the low parental education category had also higher odds of more frequently consuming fast food and chocolate/nut-based spread ($P < 0·001$). The largest odds ratio differences were found in the low category (reference category: high) for fruits with sugar and nuts (OR = 2·23; 95 % CI 1·92, 2·59), fried potatoes (OR = 2·00; 95 % CI 1·72, 2·31) and sugared beverages (OR = 2·01; 95 % CI 1·77, 2·37).

Tables 4 and 5 show the weekly consumption frequencies and odds ratio (95 % confidence intervals) for consumption of low-sugar and low-fat foods and high-sugar, refined and high-fat foods, respectively, by parental education level and by participating country. The largest differences by parental education category were observed in Hungary for sugared beverages (22·5 (SE 2·4) times/week in the low category *v.* 14·1 (SE 0·4) times/week in the high category) and for white bread (13·9 (SE 1·4) times/week in the low category *v.* 8·0 (SE 0·2) times/week in the high category); in Belgium for water (9·7 (SE 1·9) times/week in the low category *v.* 17·2 (SE 0·3) times/week in the high category); and in Cyprus for snacks/desserts (11·0 (SE 4·0) times/week in the low category *v.* 6·1 (SE 0·2) times/week in the high category).

In the Hungarian sample, consumption frequencies for the pasta/noodles/rice and wholemeal bread categories followed the opposite trend to that in the whole sample, i.e. higher means in the low parental education level group. Similarly, in the Belgian sample, consumption of chocolate/nut-based spread followed an inverse direction compared with the whole group, i.e. higher frequency in the Belgian high parental education level group.

The largest odds ratio differences for intake of each food item among education level groups were observed in Germany (fruits, fried meat and fish, fast food), Belgium (vegetables, fresh meat and fish, white bread,

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Table 3 Weekly consumption frequency (means and their standard errors), prevalence of high consumption, and odds ratios (95 % confidence intervals) for intake of high-sugar, refined and high-fat foods by classified parental education level; children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

Food group/Parental education	*n*	Mean	SE	P†	OR	95 % CI
Fried potatoes						
Low	1035	1·6[a,b]	0·06	47	2·00***	1·72, 2·31
Medium	6618	1·2[a,c]	0·02	41	1·34***	1·24, 1·45
High	5674	0·9[b,c]	0·02	33		
Fruits with sugar and nuts						
Low	1045	4·7[a,b]	0·15	46	2·23***	1·92, 2·59
Medium	6691	3·2[a,c]	0·06	35	1·23***	1·14, 1·33
High	5742	2·5[b,c]	0·06	36		
Fried meat and fish						
Low	1048	3·9[a,b]	0·09	48	1·36***	1·17, 1·58
Medium	6683	3·4[a,c]	0·04	42	1·10*	1·01, 1·20
High	5717	3·0[b,c]	0·04	41		
Cold cuts						
Low	1025	4·4[a,b]	0·12	36	1·18*	1·00, 1·39
Medium	6574	4·0[a]	0·05	32	1·00	0·92, 1·08
High	5638	3·9[b]	0·05	36		
Fast food						
Low	1015	2·4[a,b]	0·09	30	1·55***	1·30, 1·85
Medium	6622	1·8[a]	0·03	25	0·99	0·89, 1·10
High	5700	1·8[b]	0·04	25		
White bread						
Low	1030	7·8[a,b]	0·19	40	1·14	0·99, 1·33
Medium	6609	7·1[a,c]	0·08	36	1·09*	1·01, 1·18
High	5662	6·6[b,c]	0·09	37		
Sugared beverages‡						
Low	1049	17·5[a,b]	0·35	47	2·01***	1·77, 2·37
Medium	6710	13·5[a,c]	0·14	37	1·27***	1·17, 1·38
High	5744	11·4[b,c]	0·15	33		
Snacks and desserts						
Low	1043	9·3[a,b]	0·21	43	1·61***	1·39, 1·87
Medium	6686	7·6[a,c]	0·08	37	1·22***	1·12, 1·32
High	5738	6·9[b,c]	0·09	39		
Chocolate- or nut-based spread						
Low	1017	2·5[a,b]	0·08	32	1·39***	1·17, 1·66
Medium	6551	1·9[a,c]	0·03	31	1·08	0·96, 1·20
High	5664	1·7[b,c]	0·04	27		

Reference group: high education.
Analysis of covariance model adjusted for gender, age and BMI category. Two-sided level of significance ($P < 0·05$): [a]significant difference between low and medium; [b]significant difference between low and high; [c]significant difference between medium and high.
OR and 95 % CI determined by logistic regression models. Variables included in the models were parental education, gender, age and BMI category. Two-sided level of significance: *$P < 0.05$, ***$P < 0.001$.
†p refers to the proportion of participants assigned to the highest consumption category.
‡Includes soft drinks, fruit juices and sugared milk.

wholemeal bread, water, plain unsweetened milk), Sweden (fried potatoes, chocolate/nut-based spread), Hungary (white bread, snacks/desserts), Spain (fruits with sugar and nuts) and Italy (sugared beverages, pasta/noodles/rice). As an exception, Hungarian and Swedish participants in the low parental education group had higher odds of more frequently consuming pasta/noodles/rice, wholemeal bread (Hungarian) and plain unsweetened milk (Swedish).

Discussion

The present study addressed the relationship between parental education level and the consumption frequency of obesity-related foods in their children. Our findings confirm such an association for a number of the investigated food groups. The intakes of vegetables, fruits, pasta/noodles/rice, wholemeal bread and water increased as education level increased; while intakes of fried potatoes, fruits with sugar and nuts, fried meat and fish, fast food, sugared beverages, snacks/desserts and chocolate/nut-based spread increased as educational level decreased. These trends were observed for the total sample and for most of the participating countries. It is noteworthy to mention that the magnitude of educational differences varied across the selected countries and that some of the observed country-specific differences might reflect cultural food specificities. Country-specific cultural norms on what is considered to be 'healthy eating' and gastronomic heritage may have a major impact on education-related disparities in food habits[25]. For instance, pasta frequency of consumption in Italy was higher in the high parental education group, possibly reflecting the paramount

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Table 4a Weekly consumption frequency (means and their standard errors), prevalence of high consumption, and odds ratios (95 % confidence intervals) for intake of low-sugar and low-fat foods by classified parental education level and country; children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

	Belgium					Estonia					Germany					Sweden				
Food group/Parental education	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI
Vegetables (raw and cooked)																				
Low	7·2	0·42	19	0·26***	0·11, 0·60	7·1	1·10	27	0·52	0·19, 1·41	8·4[a,b]	0·32	34	0·32***	0·23, 0·46	13·6	2·61	44	1·58	0·58, 4·34
Medium	7·7	0·16	41	0·82	0·66, 1·00	8·8	0·17	36	0·75	0·56, 1·00	10·4[a]	0·20	52	0·80	0·63, 1·02	11·6	0·35	31	0·93	0·73, 1·17
High	7·9	0·11	46			9·6	0·42	44			11·1[b]	0·33	57			12·0	0·19	33		
Fruits																				
Low	5·4	0·61	9	0·48	0·14, 1·61	7·0	1·44	46	0·85	0·31, 2·33	7·1[a,b]	0·36	20	0·42***	0·30, 0·59	11·6	2·11	50	1·89	0·69, 5·16
Medium	5·4[c]	0·18	10	0·55***	0·39, 0·76	7·6	0·17	52	0·72*	0·52, 0·99	8·4[a,c]	0·18	29	0·63***	0·49, 0·82	9·3	0·28	36	1·03	0·82, 1·29
High	7·0[c]	0·15	17			8·3	0·39	58			9·6[b,c]	0·31	39			9·3	0·17	36		
Fresh meat and fish																				
Low	3·1	0·61	38	2·03*	1·02, 4·05	3·8	0·81	33	1·10	0·41, 2·90	4·0[a,b]	0·23	46	1·94***	1·41, 2·66	3·0	0·44	31	0·65	0·22, 1·88
Medium	2·6[c]	0·12	34	1·60***	1·29, 2·03	4·2	0·09	37	1·09	0·81, 1·48	3·0[a,c]	0·09	35	1·25	0·96, 1·62	2·8	0·15	35	0·75*	0·60, 0·94
High	2·0[c]	0·08	24			4·2	0·19	35			2·4[b,c]	0·12	29			2·8	0·06	42		
Pasta, noodles and rice																				
Low	1·8	0·15	3	0·26	0·03, 1·99	3·0	0·51	27	0·64	0·24, 1·73	3·2	0·20	27	0·94	0·67, 1·32	3·5	0·48	6	0·57	0·07, 4·40
Medium	1·8[c]	0·05	5	0·62*	0·40, 0·97	2·8[c]	0·06	25	0·57***	0·42, 0·78	2·9	0·07	30	0·99	0·76, 1·29	4·1	0·12	10	0·90	0·63, 1·29
High	2·1[c]	0·04	8			3·2[c]	0·14	37			2·9	0·09	30			4·2	0·06	11		
Wholemeal bread																				
Low	1·6[a,b]	0·48	8	0·15*	0·05, 0·50	3·7	0·84	35	0·66	0·25, 1·76	4·6[b]	0·29	29	0·56***	0·40, 0·76	4·9	1·22	25	0·81	0·26, 2·56
Medium	3·7[a,c]	0·18	24	0·53***	0·42, 0·67	5·5	0·15	42	0·88	0·66, 1·18	5·2	0·15	37	0·79	0·62, 1·02	4·6	0·19	26	0·86	0·67, 1·10
High	5·4[b,c]	0·15	38			6·3	0·37	45			5·9[b]	0·27	43			4·8	0·12	29		
Water																				
Low	9·7[a,b]	1·87	19	0·14***	0·07, 0·29	21·3	2·36	59	1·18	0·43, 3·25	18·0	0·69	45	0·94	0·68, 1·31	21·1	2·81	56	1·28	0·40, 4·07
Medium	14·3[a,c]	0·45	24	0·46***	0·37, 0·58	18·3	0·29	34	1·08	0·79, 1·48	18·5	0·37	44	1·00	0·77, 1·30	18·4[c]	0·46	34	1·22	0·96, 1·56
High	17·2[b,c]	0·30	25			17·8	0·71	35			17·9	0·60	38			16·6[c]	0·28	24		
Plain unsweetened milk																				
Low	4·0[b]	0·58	5	0·16*	0·04, 0·67	13·2	1·97	50	1·29	0·53, 3·16	7·8	0·40	26	1·06	0·74, 1·50	14·7	2·16	38	3·20*	1·12, 9·10
Medium	5·3[c]	0·26	18	0·60***	0·46, 0·78	10·7	0·22	43	0·98	0·74, 1·33	8·2	0·20	30	1·25	0·95, 1·65	11·4	0·37	21	1·27	0·96, 1·67
High	6·7[b,c]	0·20	27			10·2	0·51	43			7·6	0·30	25			10·6	0·22	17		

Reference group: high education.
Analysis of covariance model adjusted for gender, age and BMI category. Two-sided level of significance ($P < 0·05$): [a]significant difference between low and medium; [b]significant difference between low and high; [c]significant difference between medium and high.
OR and 95 % CI determined by logistic regression models. Variables included in the models were parental education, gender, age and BMI category. Two-sided level of significance: *$P < 0·05$, ***$P < 0·001$.
†p refers to the proportion of participants assigned to the highest consumption category.

Table 4b Weekly consumption frequency (means and their standard errors), prevalence of high consumption, and odds ratios (95 % confidence intervals) for intake of low-sugar and low-fat foods by classified parental education level and country; children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

	Cyprus					Hungary					Italy					Spain				
Food group/Parental education	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI
Vegetables (raw and cooked)																				
Low	8·7	1·85	21	0·39*	0·15, 0·96	8·2	0·76	33	1·02	0·57, 1·82	5·5	0·25	33	0·91	0·68, 1·22	7·4	0·74	32	1·07	0·70, 1·63
Medium	7·3	0·30	30	0·62***	0·49, 0·78	7·9[c]	0·16	26	0·71***	0·59, 0·85	5·5	0·15	33	0·92	0·72, 1·17	7·1	0·29	31	1·06	0·81, 1·39
High	8·1	0·23	41			9·0[c]	0·19	34			5·4	0·24	35			7·3	0·21	31		
Fruits																				
Low	8·9	1·86	26	0·61	0·25, 1·47	5·7	0·81	15	0·71	0·32, 1·54	6·4	0·32	21	0·63*	0·46, 0·88	8·9	0·58	39	1·09	0·73, 1·65
Medium	9·0	0·33	33	0·85	0·67, 1·08	6·4	0·15	20	1·01	0·82, 1·24	6·9	0·16	26	0·84	0·65, 1·09	8·1	0·32	29	0·73	0·55, 0·95
High	9·5	0·24	37			6·7	0·15	20			7·4	0·30	29			9·0	0·23	36		
Fresh meat and fish																				
Low	3·1	0·61	14	0·56	0·19, 1·63	3·8	0·52	33	1·07	0·60, 1·90	4·7	0·18	35	0·89	0·67, 1·19	3·9	0·29	29	0·88	0·57, 1·36
Medium	2·6[c]	0·12	24	1·10	0·85, 1·43	3·0[c]	0·09	31	0·98	0·82, 1·18	4·8	0·09	36	0·91	0·72, 1·15	4·4	0·17	31	1·03	0·78, 1·35
High	2·0[c]	0·08	23			2·7[c]	0·07	32			4·6	0·13	38			4·2	0·12	31		
Pasta, noodles and rice																				
Low	3·8	1·27	30	1·20	0·51, 2·80	2·8[b]	0·32	20	2·70*	1·34, 5·45	3·5[a,b]	0·19	31	0·39***	0·29, 0·52	3·0	0·18	29	0·93	0·60, 1·43
Medium	2·7	0·14	24	0·80	0·61, 1·04	2·4[c]	0·06	16	1·91***	1·46, 2·49	4·3[a,c]	0·10	39	0·58***	0·46, 0·73	2·9	0·08	30	0·89	0·68, 1.17
High	2·9	0·10	28			2·0[b,c]	0·04	9			5·6[b,c]	0·19	53			3·0	0·07	32		
Wholemeal bread																				
Low	1·6[a,b]	0·48	53	1·87	0·75, 4·69	4·8[a,b]	0·98	44	1·82*	1·04, 3·19	2·1	0·21	31	0·87	0·64, 1·18	0·6	0·28	9	0·40*	0·21, 0·78
Medium	3·7[a,c]	0·18	31	0·78*	0·60, 0·99	3·2[a]	0·15	28	0·88	0·73, 1·06	1·8	0·11	31	0·91	0·71, 1·16	0·7	0·12	15	0·71*	0·51, 0·99
High	5·4[b,c]	0·15	37			3·1[b]	0·12	31			2·0	0·19	33			0·9	0·10	20		
Water																				
Low	9·7[a,b]	1·87	64	0·51	0·23, 1·13	19·0	1·72	49	0·72	0·40, 1·28	23·4[a,b]	0·49	67	0·49***	0·36, 0·68	27·2	0·64	84	1·07	0·63, 1·84
Medium	14·3[a,c]	0·45	75	0·84	0·64, 1·09	18·8[c]	0·33	44	0·65***	0·54, 0·78	26·1[a]	0·22	78	0·83	0·63, 1·10	27·7	0·31	85	1·26	0·89, 1·77
High	17·2[b,c]	0·30	78			21·5[c]	0·33	52			26·9[b]	0·34	80			27·5	0·22	82		
Plain unsweetened milk																				
Low	4·0[b]	0·58	23	1·66	0·64, 4·30	6·7	1·18	39	0·93	0·52, 1·65	3·8[b]	0·29	32	0·51***	0·37, 0·68	4·3	0·67	32	1·02	0·68, 1·60
Medium	5·3[c]	0·26	19	1·16	0·86, 1·57	5·3	0·18	39	0·99	0·83, 1·18	4·6	0·17	41	0·75*	0·59, 0·95	4·9	0·36	37	1·22	0·93, 1·60
High	6·7[b,c]	0·20	17			4·9	0·17	39			5·2[b]	0·33	48			4·0	0·23	33		

Reference group: high education.
Analysis of covariance model adjusted for gender, age and BMI category. Two-sided level of significance ($P < 0·05$): [a]significant difference between low and medium; [b]significant difference between low and high; [c]significant difference between medium and high.
OR and 95 % CI determined by logistic regression models. Variables included in the models were parental education, gender, age and BMI category. Two-sided level of significance: *$P < 0·05$, ***$P < 0·001$.
†p refers to the proportion of participants assigned to the highest consumption category.

Table 5a Weekly consumption frequency (means and their standard errors), prevalence of high consumption, and odds ratios (95 % confidence intervals) for intake of high-sugar, refined and high-fat foods by classified parental education and country; children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

	Belgium					Estonia					Germany					Sweden				
Food group/Parental education	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI
Fried potatoes																				
Low	1·2	0·17	58	1·25	0·63, 2·47	1·4	0·42	50	0·94	0·38, 2·36	1·5[a,b]	0·15	48	2·23***	1·62, 3·06	1·0	0·26	50	3·45*	1·26, 9·39
Medium	1·3[c]	0·06	57	1·25*	1·01, 1·55	1·5	0·06	52	1·29	0·96, 1·72	0·9[a]	0·05	33	1·17	0·90, 1·53	0·5	0·05	21	0·99	0·76, 1·30
High	1·1[c]	0·04	51			1·2	0·11	46			0·6[b]	0·06	29			0·5	0·03	21		
Fruits with sugar and nuts																				
Low	1·7	0·45	38	0·78	0·39, 1·55	5·5	1·49	36	1·22	0·48, 3·12	4·2[a,b]	0·31	37	3·10***	2·20, 4·78	3·1	0·81	69	3·00*	1·02, 8·84
Medium	2·1[c]	0·13	51	1·36*	1·10, 1·67	5·0	0·15	33	1·10	0·80, 1·50	2·5[a]	0·14	22	1·47*	1·09, 1·97	2·1	0·15	47	1·14	0·92, 1·41
High	1·6[c]	0·09	44			4·5	0·36	31			2·1[b]	0·21	16			1·7	0·09	44		
Fried meat and fish																				
Low	5·2	0·39	43	1·44	0·73, 2·81	2·3	0·60	32	0·81	0·31, 2·12	3·9[b]	0·20	54	2·07***	1·43, 2·99	5·3	0·39	56	1·99	0·73, 5·45
Medium	4·5	0·12	33	0·97	0·78, 1·21	3·0[c]	0·09	42	1·46*	1·07, 1·99	3·5	0·08	52	1·58*	1·16, 2·16	4·4	0·13	37	0·96	0·77, 1·21
High	4·5	0·08	33			2·4[c]	0·15	33			3·2[b]	0·12	50			4·2	0·06	38		
Cold cuts																				
Low	5·3	0·63	36	1·32	0·66, 2·67	7·5[a,b]	1·51	38	1·94	0·74, 5·09	6·0	0·27	38	0·90	0·66, 1·23	3·6	0·92	38	1·84	0·65, 5·17
Medium	4·4	0·14	27	0·84	0·66, 1·05	4·3[a]	0·11	23	0·93	0·66, 1·32	6·6	0·13	43	1·11	0·87, 1·41	2·5	0·15	26	1·11	0·87, 1·43
High	4·5	0·10	30			4·1[b]	0·24	23			5·7	0·21	41			2·2	0·10	23		
Fast food																				
Low	0·5[b]	0·30	11	3·77*	1·24, 11·5	3·8	0·90	32	0·77	0·29, 2·04	1·0[a,b]	0·15	22	4·64***	2·77, 7·78	0·6	0·24	31	1·07	0·37, 3·13
Medium	0·2[c]	0·04	8	2·51***	1·56, 4·03	4·5	0·11	29	0·78	0·57, 1·07	0·3[a]	0·03	9	1·52	0·93, 2·47	0·6	0·05	29	0·73	0·73, 1·18
High	0·1[b,c]	0·02	3			5·0	0·28	35			0·2[b]	0·05	6			0·6	0·02	31		
White bread																				
Low	7·3[b]	0·78	56	3·01*	1·53, 5·92	9·4	1·67	36	2·08	0·79, 5·44	8·0[a,b]	0·35	53	1·92***	1·34, 2·76	3·8	0·87	31	0·79	0·27, 2·34
Medium	5·8[c]	0·21	43	1·80***	1·45, 2·24	6·8	0·17	23	1·24	0·86, 1·80	6·0[a]	0·16	42	0·96	0·70, 1·31	3·9[c]	0·20	42	1·25	0·99, 1·56
High	4·3[b,c]	0·14	29			6·5	0·40	19			6·2[b]	0·27	46			3·3[c]	0·09	37		
Sugared beverages‡																				
Low	15·3[b]	2·28	34	1·45	0·73, 2·90	12·1	2·11	18	0·47	0·15, 1·48	22·2[a,b]	0·93	46	2·10***	1·52, 2·90	7·2	1·26	44	1·51	0·55, 4·18
Medium	14·7[c]	0·50	38	1·77***	1·42, 2·20	12·8	0·27	34	1·20	0·82, 1·53	16·2[a]	0·44	34	1·14	0·87, 1·49	5·7	0·28	36	1·17	0·93, 1·47
High	10·9[b,c]	0·29	26			12·7	0·63	32			14·3[b]	0·65	31			5·1	0·14	32		
Snacks and desserts																				
Low	8·3	0·91	32	0·89	0·44, 1·80	9·6	1·74	48	1·96	0·78, 4·95	10·7[a,b]	0·49	41	1·34	0·98, 1·86	5·0	0·86	56	0·84	0·27, 2·65
Medium	8·7	0·28	31	0·87	0·70, 1·09	7·9	0·20	33	1·04	0·76, 1·42	9·6[a]	0·20	36	0·96	0·74, 1·24	5·0	0·16	51	0·88	0·69, 1·12
High	9·3	0·20	35			7·5	0·40	33			9·1[b]	0·27	36			5·3	0·08	56		
Chocolate- or nut-based spread																				
Low	3·0[b]	0·36	16	0·43	0·18, 1,06	2·1[a,b]	0·68	43	4·26*	1·56, 11·6	3·7[a,b]	0·26	41	1·46*	1·06, 2·00	0·3	0·17	12	6·94*	1·41, 34·2
Medium	3·9[c]	0·13	26	0·79*	0·62, 0·99	0·9[a,c]	0·05	25	2·41***	1·56, 3·71	2·8[a]	0·09	33	1·01	0·78, 1·30	0·1	0·02	4	1·32	0·73, 2·40
High	4·4[b,c]	0·10	29			0·3[b,c]	0·06	12			2·8[b]	0·17	33			0·1	0·02	3		

Reference group: high education.
Analysis of covariance model adjusted for gender, age and BMI category. Two-sided level of significance ($P<0·05$): [a]significant difference between low and medium; [b]significant difference between low and high; [c]significant difference between medium and high.
OR and 95 % CI determined by logistic regression models. Variables included in the models were parental education, gender, age and BMI category. Two-sided level of significance: *$P<0.05$, ***$P<0.001$.
†p refers to the proportion of participants assigned to the highest consumption category.
‡Includes soft drinks, fruit juices and sugared milk.

Table 5b Weekly consumption frequency (means and their standard errors), prevalence of high consumption, and odds ratios (95 % confidence intervals) for intake of high-sugar, refined and high-fat foods by classified parental education and country; children (*n* 14 426) aged 2 to 9 years from eight European countries, baseline survey of IDEFICS study, September 2007 to May 2008

	Cyprus					Hungary					Italy					Spain				
Food group/Parental education	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI	Mean	SE	p†	OR	95 % CI
Fried potatoes																				
Low	3·6^{a,b}	1·12	24	3·21*	1·22, 8·49	1·8^{b}	0·29	62	2·85***	1·60, 5·05	1·2^{a,b}	0·10	42	1·39*	1·04, 1·84	1·5 ^{b}	0·15	60	1·69*	1·13, 2·53
Medium	2·1^{a,c}	0·13	14	1·69***	1·20, 2·39	1·4^{c}	0·05	54	1·99***	1·68, 2·37	0·8^{a}	0·04	33	0·94	0·74, 1·19	1·3	0·08	52	1·21	0·94, 1·55
High	1·5^{b,c}	0·08	9			0·8^{b,c}	0·04	37			0·7^{b}	0·06	34			1·1^{b}	0·05	47		
Fruits with sugar and nuts																				
Low	5·7	2·15	43	1·63	0·77, 3·43	6·3^{a,b}	1·07	46	2·72***	1·56, 4·74	4·7^{a,b}	0·28	45	3·14***	2·30, 4·29	4·4 ^{a,b}	0·44	46	3·24***	2·15, 4·89
Medium	4·5	0·27	36	1·23	0·97, 1·56	3·3^{a,c}	0·14	30	1·41***	1·17, 1·71	3·2^{a,c}	0·14	31	1·73***	1·32, 2·27	3·2 ^{a,c}	0·22	30	1·60***	1·20, 2·12
High	3·8	0·19	31			2·4^{b,c}	0·11	23			2·0^{b,c}	0·17	21			2·1 ^{b,c}	0·11	21		
Fried meat and fish																				
Low	3·2^{b}	1·98	13	1·46	0·70, 3·05	3·7^{b}	0·46	44	1·57	0·90, 2·72	2·8^{a,b}	0·15	36	1·58*	1·18, 2·13	5·3^{a,b}	0·42	39	1·43	0·95, 2·15
Medium	2·1^{c}	0·18	21	1·52***	1·21, 1·90	3·0	0·08	34	1·04	0·87, 1·24	2·4^{a,c}	0·07	34	1·40*	1·08, 1·80	4·0^{a}	0·15	32	1·05	0·81, 1·37
High	1·2^{b,c}	0·07	14			2·8^{b}	0·07	34			2·0^{b,c}	0·10	27			3·9^{b}	0·10	31		
Cold cuts																				
Low	3·5	0·72	48	1·49	0·69, 3·23	6·8^{a,b}	0·87	43	1·72	0·99, 3·02	2·9^{a,b}	0·15	28	1·75*	1·25, 2·46	3·9	0·40	19	0·90	0·55, 1·49
Medium	3·2	0·17	31	0·76*	0·60, 0·96	5·1^{a}	0·12	34	1·22*	1·02, 1·46	2·4^{a}	0·07	20	1·17	0·87, 1·58	3·8	0·15	20	0·91	0·67, 1.24
High	3·1	0·13	37			4·7^{b}	0·12	30			2·1^{b}	0·11	18			4·0	0·11	22		
Fast food																				
Low	5·3	1·15	44	1·53	0·70, 3·35	7·0^{a,b}	1·04	57	2·22*	1·26, 3·91	1·0^{a,b}	0·10	31	1·39*	1·01, 1·90	0·8	0·11	35	1·10	0·73, 1·68
Medium	4·1	0·19	29	0·78*	0·62, 0·99	3·6^{a}	0·11	36	0·95	0·80, 1·14	0·7^{a}	0·04	26	1·11	0·85, 1·45	0·8	0·07	29	0·90	0·68, 1·18
High	4·4	0·13	35			3·5^{b}	0·10	37			0·6^{b}	0·06	24			0·8	0·06	30		
White bread																				
Low	11·4	2·03	44	1·59	0·71, 3·56	13·9^{a,b}	1·36	59	2·89***	1·64, 5·10	6·8	0·30	23	0·88	0·64, 1·21	8·8	0·75	34	0·83	0·55, 1·27
Medium	8·9	0·34	34	1·01	0·80, 1·28	9·7^{a,c}	0·21	42	1·50***	1·26, 1·80	7·2	0·17	26	1·01	0·78, 1·32	7·2	0·36	34	0·81	0·62, 1·06
High	8·8	0·24	34			8·0^{b,c}	0·21	32			7·3	0·31	25			7·0	0·27	39		
Sugared beverages‡																				
Low	15·1	2·18	39	1·74	0·80, 3·77	22·5^{a,b}	2·38	44	2·07*	1·19, 3·60	16·0^{a,b}	0·59	45	2·74***	2·02, 3·71	18·2^{a,b}	1·26	55	2·38***	1·60, 3·54
Medium	13·8^{c}	0·54	34	1·20	0·94, 1·52	16·9^{a,c}	0·39	37	1·53***	1·28, 1·84	12·9^{a,c}	0·29	32	1·52*	1·16, 1·97	14·1^{a,c}	0·47	38	1·24	0·95, 1·60
High	11·8^{c}	0·35	29			14·1^{b,c}	0·37	28			11·2^{b,c}	0·48	23			12·2^{b,c}	0·27	33		
Snacks and desserts																				
Low	11·0^{a,b}	3·99	52	1·34	0·61, 2·95	9·2^{a,b}	0·84	56	3·45***	1·98, 6·03	11·5^{a,b}	0·51	43	2·28***	1·69, 3·08	6·3	0·48	34	1·26	0·83, 1·92
Medium	7·2^{a,c}	0·38	38	1·17	0·92, 1·50	6·4^{a,c}	0·18	38	1·65***	1·38, 1·98	9·3^{a}	0·25	33	1·44*	1·11, 1·85	5·9	0·28	37	1·44*	1·11, 1·88
High	6·1^{b,c}	0·18	38			4·6^{b,c}	0·13	27			8·1^{b}	0·38	25			5·2	0·17	29		
Chocolate- or nut-based spread																				
Low	1·6	0·41	55	3·92*	1·65, 9·32	3·2^{a,b}	0·48	78	4·88***	2·53, 9·42	3·0^{a,b}	0·20	26	1·39	0·99, 1·94	1·5	0·19	55	1·29	0·66, 2·52
Medium	1·2^{c}	0·13	34	1·62***	1·26, 2·09	1·8^{a,c}	0·08	53	1·52***	1·28, 1·81	2·3^{a}	0·08	23	1·20	0·90, 1·59	1·5	0·09	59	1·16	0·74, 1·79
High	0·7^{c}	0·06	24			1·3^{b,c}	0·06	43			1·9^{b}	0·13	20			1·5	0·06	59		

Reference group: high education.
Analysis of covariance model adjusted for gender, age and BMI category. Two-sided level of significance ($P < 0·05$): [a]significant difference between low and medium; [b]significant difference between low and high; [c]significant difference between medium and high.
OR and 95 % CI determined by logistic regression models. Variables included in the models were parental education, gender, age and BMI category. Two-sided level of significance: *$P < 0.05$, ***$P < 0.001$.
†p refers to the proportion of participants assigned to the highest consumption category.
‡Includes soft drinks, fruit juices and sugared milk.

importance of pasta in the traditional Italian gastronomy. The same applies to the case of chocolate in Belgium. Other examples, like bread consumption (e.g. wholemeal bread in the northern countries, white bread in the southern countries) and plain unsweetened milk (e.g. high consumption in Sweden and Estonia), seem also to be affected by traditional consumption.

Similarly to our findings, higher intakes of fruits and vegetables in children and adolescents with high SES have been reported in previous studies[26–30]. Some studies have observed that the impact of SES is particularly strong for healthy foods, such as vegetables and fruits[31]. These findings were reported in several countries with different cultural backgrounds, suggesting that fruit and vegetables are commonly considered as healthy. However, some other socio-economic differences in food intake have not been reported consistently (like for wholemeal bread, pasta, fish or fats), suggesting that these are more culturally dependent.

Previous studies have also focused on the socio-economic situation of parents, especially on maternal education, finding again positive associations between parental education and foods reducing the risk of obesity, like fruits and vegetables[29]. Education could provide an important socio-economic influence on health-related behaviour as it may increase the use of health-related information[32]. Although some other SES indicators, mainly occupational position and income, have been shown to have an impact on food intake[33–37], parental education level, especially maternal education level, has been strongly related to children's dietary habits[14,38,39] and to childhood overweight and obesity[13,40,41].

An important strength of the present study is its large sample size and international multicentric nature, which allowed us to investigate the research question in different cultural settings with a wider variety of food consumption patterns. Another important strength of the study is the strict standardized procedures followed during the data collection of the IDEFICS fieldwork[16,17] and the high quality control procedures carried out during the project, including plausibility checks implemented in the database and performed during data entry.

One of the major limitations of the study is the response rate. The whole survey programme involved complex logistics for participants and required the active involvement of parents, so that time constraints prevented some parents from participating. In addition, a selection bias cannot be ruled out as individuals without health problems or not having concerns about their children's health may be less motivated to take part in such a study. It is also known that participation is lower both in people with lower levels of education and in high-income groups[42]. As we have no systematic information about non-participants, the direction of a possible bias cannot be predicted.

A second limitation of the study design is the fact that the sample selected within the IDEFICS study was not necessarily representative for each specific country and the results obtained by the participating centres cannot be generalized to the whole countries.

Another limitation is related to the use of the frequency of consumption assessment tool, which is based on proxy reports. Proxy reporting might be strongly related to the number of meals under parental control. Subsequently, the accuracy of the consumption frequencies reported by parents could differ between countries, as the number of meals consumed at home did differ between the participating countries. Some previous studies suggest that over-reporting of foods reducing the risk of obesity mainly takes place among individuals with higher levels of education, due to their greater knowledge about healthy diet, and therefore might tend to overstate the actual consumption, the known social desirability bias[33,43]. Although FFQ are not designed to accurately capture intakes, results of food consumption frequencies derived from the food frequency section of the CEHQ-FFQ gave reproducible estimates of the consumption frequency in the IDEFICS children[21].

Conclusions

The present study showed a strong association of parental education level with the frequency of consumption of high-fat, high-sugar foods and products increasing the risk of obesity. These findings suggest that children of parents with a low educational level may be at higher risk of unhealthy eating. Therefore, the socio-economic determinants of food choice within families need to be addressed. It should be noted that the amount of differences, and not only the size of differences, in relation to disease outcome is of interest, and should be addressed in future research. The results of the present study should lead to more accurate targeting of intervention programmes for healthy eating promotion in childhood, in order to overcome social health inequalities. Special focus should be driven to undereducated parents and their children, in order to minimize this social health burden.

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