Dietary patterns and their socioeconomic and behavioral determinants in 6-8 year old Portuguese children

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Running head: Determinants of diet in Portuguese children

What is already known on this topic?

1. The adoption of an unhealthy diet, rich in fat and sugar, is a worldwide problem with major health consequences

2. Analysis all over the world has shown an increase in the consumption of unhealthy foods

3. Poor eating patterns established during childhood can have long-term consequences

What this paper adds?

1. A multivariate analysis of a number of variables influencing dietary patterns among Portuguese children

2. Description of dietary patterns and their determinants among children in the face of the current economic crisis

3. Poorer diets are associated with other unhealthy lifestyle elements

4. Socioeconomic factors are stronger determinants of the dietary choices among participating children, which should be of special interest in the current difficult economic situation of Portugal

ABSTRACT

Background: Adherence to a healthier diet is reportedly declining in recent decades, with children favoring consumption of foods with more saturated fats and more simple carbohydrates.

Objective: It is important to understand the factors – demographic and environmental - that influence dietary choices among children.

Methods: A cross-sectional study was conducted in schools, among 6-8 year old children living in Coimbra. Environmental and family factors as well as the dietary habits of children were obtained from the parents using a questionnaire. Dietary patterns were identified by applying exploratory factor analysis and their relationship with socioeconomic and behavioural determinants was estimated by adjusted linear regression models.

Results: In total, 1063 questionnaires were returned. Three clusters were identified: Mediterranean Diet, Saturated fats diet and Base of Portuguese diet. We found that children who were of lower socioeconomic status (SES) ($p<0.01$), who had a higher number of siblings ($p=0.03$) and who spent more time watching TV ($p=0.01$) tended to adopt a more SFatDiet. Boys were more likely to adopt a BPDiet than girls ($p=0.047$). We found that SES was the greatest predictor of dietary patterns, with children from lower SES backgrounds adopting the SFatDiet diet more often and those from higher SES backgrounds choosing BPDiet foods more often.

Conclusions: Children's unhealthy behaviours tend to cluster with poorer diet and lower SES is the strong determinants of their dietary choices. To promote healthier diet parental education should be encouraged, particularly in the face of the economic crisis and the high levels of childhood obesity present in Portugal.

KEYWORDS: children, dietary habits, SES, Mediterranean Diet, Saturated Fatty Acids, parenting

INTRODUCTION

For children, healthy diet has important short- and long-term health effects (Kaikkonen, Mikkilä, and Raitakari 2014; Koletzko et al. 2012). Studies of dietary behaviors employ a multidimensional approach because they involve a variety of individual choices starting from the selection of the food to the conditions that surround each meal. Human choices are shaped by individual, societal, and cultural factors. When it comes to children's diet, the home environment is a huge contributor to the adoption of healthy or unhealthy behaviors by mediating access to unhealthy foods, the availability of fruits and vegetables and parental role modeling and attitudes (Østbye et al. 2013; Pearson, Ball, and Crawford 2012; Ranjit et al. 2015; Rodenburg et al. 2012).

A home environment is a complex social system involving a number of factors. Observations on childhood nutrition related to westernized lifestyle, adopted widely by high- and middle-income countries, point to an increase in consumption of foods prepared away from home, an increase in the total calorie intake and from snacks, and an increase in the consumption of fried and nutrient-poor foods (Chan and Sobal 2011; Gidding et al. 2006; Lachat et al. 2012; Popkin, Adair, and Wen 2012; Ranjit et al. 2015). High-fat foods are typically very palatable and less satiating, which leads to overconsumption (Drewnowski and Almiron-Roig 2010). At the same time, a general decline in fruit and vegetable consumption – other than fried potatoes – has been observed (Hall et al. 2009).

The Mediterranean diet is a traditional food pattern present in the areas of the Mediterranean basin, Portugal included. The primary components of this diet include an abundance of vegetables, fruits, olive oil and a moderate intake of fish and meat, little consumption of sugars and a low amount of animal and trans fats (Widmer et al.

2015). Although, studies have revealed the highly beneficial health effects of the Mediterranean diet, recent research suggest that people are abandoning this diet and associated healthy lifestyles – with higher daily ready-made meal consumption o eating away from home – and replacing it with unhealthy food patterns (Bonaccio et al. 2012; Martínez-Gonzalez et al. 2011; Sanchez-Benito, Sanchez-Soriano, and Ginart Suarez 2009; Trichopoulou, Bamia, and Trichopoulos 2009; Trichopoulou and Lagiou 1997). There seems to be a recent tendency toward the replacement of traditional cuisine with highly processed foods, animal fat, and fast foods, usually quicker to cook and cheaper (Farajian et al. 2011; San Juan 2006; Serra-Majem et al. 2004). The westernization of Mediterranean countries food observed in the last years (Rodrigues et al. 2008) can be reinforced within the current Economic crisis. Recent studies showed that food insecurity in Portugal is highly prevalent affecting mainly houses with low income and low education (Álvares and Amaral 2014).

Unhealthy behaviors tend to cluster and create an accumulated risk (Fernández-Alvira, De Bourdeaudhuij, and Singh 2013). A more complete and multivariate understanding of what may influence children's dietary behavior is needed. The aim of this study is to describe differences in dietary habits among Portuguese children, especially the adherence to a specific dietary pattern in association with a number of demographic, socioeconomic, and behavioural characteristics. This is especially relevant within the context of the economic crisis affecting many European countries, including Portugal.

MATERIALS AND METHODS

A cross-sectional study was done among 6-8 year old children attending elementary schools in the Coimbra district of Portugal, from September 2011 to June

2012. Children from public and private schools, located in urban, suburban, and rural areas of the district, were invited to participate in the study. Apart from the geographical location within the district, no pre-selection criteria were applied. A total of 1777 questionnaires were distributed between 28 public schools belonging to 7 school clusters, and 4 private schools. Questionnaires about environmental and family factors were distributed among the parents/legal guardians of children from the 1st and 2nd grades of primary school. Only children with the signed authorization were involved further in the process. The data for the present study was collected under the project "The association of childhood obesity with asthma and rhinitis symptoms in 6-8-year-old children living in the Coimbra district, Portugal: the role of environmental, family and socioeconomic factors". Environmental and family factors were verified using the ISAAC (The International Study of Asthma and Allergies in Childhood) environmental questionnaire for 6-7 year old children. The questionnaire is a tool designed by ISAAC study, validated in many countries, included Portugal and previously used to study food patterns in children this age (Ellwood et al. 2001; Nagel et al. 2010). In addition, it was approved for our study by *Direcção Geral de Inovação e Desenvolvimento Curricular* (DGIDC).

A food frequency questionnaire was administered and the parents/legal guardians of the child had to choose between three options when describing the number of times per week that the child ate each food type: never or occasionally, once or twice per week, and three or more times per week. We then performed a frequency analysis of the consumption of each food.

Further, we wanted to study the dietary patterns in our population. In order to do that, factorial analysis of diet was applied running the Principal Components Analysis (PCA). Both the Kaiser–Meyer–Olkin index (0.633) and Bartlett's test

($p<0.01$) indicated that the correlation between the variables was sufficiently strong for a factorial analysis. The Bartlett Test of Sphericity and the Kaiser–Meyer–Olkin measure of sampling adequacy were used to assess if the data were suitable for factor analysis. Cereals, milk and margarine were excluded from the model as they did not cluster well in the model (Cronbach's alpha measure of internal consistency). Retention of factors was based on the scree test (Cattel 1966). Food items were retained in the pattern if the factor loading value was equal to or above 0.30, and the least acceptable communality (the proportion of variance of each variable that could be explained by the factors) was 0.25 (Basilevsky 1994). The varimax rotation was chosen with Kaiser Normalization, and three components were pre-defined.

The clustering of the elements in a three-dimensional matrix and the exact values of scores for each element within the three components are presented in Table 1.

The Bartlett method was applied to generate the scores for the three components and continuous variables were used to determine the degree of adherence to each dietary pattern (the higher the score, the higher the adherence). One variable for each component was created, describing the representation of each type of diet in the nutritional habits of each child.

To evaluate the level of sedentary behaviour, we asked parents/legal guardians how many times per week the child practiced vigorous physical activity (PA) (by vigorous, we refereed to activities that would leave the child breathing heavily) and (2) how many hours per day, on an average week, the child watched television (TV).

Information about the current smoking habits of the mother, as well as the presence of any other smokers in each household, was obtained.

The postal code of child's residence was obtained. From this, we determined the residence parish (*freguesia*). The degree of urbanization was assessed using the new Urban Areas Typology released by the National Statistics Institute in 2009 (INE 2009). Three types were listed: Urban, Suburban, and Rural.

The survey contained questions about the socioeconomic situation of the child's family, such as the level of parental education and the occupation.

To create an indicator of the family's socioeconomic status we used the maternal and paternal level of education and their occupation, information we obtained through the questionnaire. The level of education was categorized based on the levels of the Portuguese educational system: Basic education (4 years), Basic education (6 years), Secondary education (9 years), Secondary education (12 years), and Higher education (at least a Bachelor's degree).

The occupation of the mother and father was determined by using an open question and the professions were further classified into a 10-point scale of large groups taken from the Portuguese Classification of Professions from 2010 (IEFP 2010).

Because of high correlation among the maternal and paternal levels of education and their occupation, a principal component analysis (PCA) was performed through exploratory factor analysis (EFA) to obtain a construct (i.e., factor or latent variable) for the global socioeconomic status (SES). The EFA aims to identify the latent structure of a group of interrelated variables from the understanding that if the variables are correlated, then they are correlated because the association results from a common but not directly observable characteristics (Chavance et al., 2010; Marôco, 2010). Thus, the principal component analysis developed using these indicators

revealed a construct representing 68.9% of the shared variance with Cronbach's alpha index equal to 0.89.

A question about the number of siblings of the child was included separately, as it did not cluster with the other SES elements (Cronbach's alpha measure of internal consistency).

First, univariate analyses of the linear regressions was performed in order to study the association between each dietary pattern and gender, age, SES, number of siblings, urbanization of the residential area, TV watching and the PA level in children. The factors that were significantly associated with the diet pattern were included in the multivariate model, adjusting these factors for each other and testing therefore, which of the socioeconomic and environmental variables is associated with dietary intake, independently of other covariates. Results were presented as unstandardized B coefficient and a p value of <0.05 was considered significant.

RESULTS

The response rate was 59.8% with 1,063 questionnaires returned. There was no significant difference in response rate between private and public schools (p=0.88) or among urban, suburban and rural areas (p=0.42). Our sample consists of 531 girls (51%) and 510 (49%) boys; the mean age was 7.26 years old (SD=0.61).

The estimated number of all children in the 1st and 2nd grades in the Coimbra district is 8,200 (INE 2011). Compared to the census data for the corresponding proportion of the population, per degree of urbanization of the residential area, our sample showed a higher frequency of children from urban areas as compared to the distribution from the census (72% of children living in urban areas in our sample compared to 57% for the district) (Comissão de Coordenação e Desenvolvimento Regional e do Centro

2008). To correct for this difference, we applied the post-stratification weights correcting for the degree of urbanization of the residential area. Table 2 shows the socio-demographic characteristics of the sample.

In Figure 1 children's weekly intake of each food item is reported. Dietary elements consumed most frequently by children in our sample (3 or more times per week) were milk (96.2%), cereals (96.2%), fruits (96.0%), and meat (93.5%). Eggs (80.2%), potatoes (43.1%), and pasta (42.5%) were consumed, on average, 1 or 2 times per week. Margarine (77.3%), dried fruits (72.3%) and fast food (86.9%) were stated to be consumed never or occasionally by most children.

Both the Kaiser-Meyer-Olkin index (0.633) and Bartlett's test ($p<0.01$) indicated that the correlation between the variables was sufficiently strong for a factorial analysis. Scree test results allowed for the identification of three dietary patterns: base of the Portuguese Diet (BPDiet), with eigenvalue 2.04; Mediterranean Diet (MEDiet), with eigenvalue 1.55; and saturated fat diet (SFATdiet), with eigenvalue 1.23. The BPDiet pattern (loading heavily on meat, pasta, potatoes and rice) explained 18.53% of the data variation. The MedDiet pattern (consisting of fruits, vegetables, legumes and fish) explained 14.1% of the data variation. The SFatDiet pattern (consisting of fast food, butter and eggs) explained 11.2% of the total variation. Together, the three patterns explained 43.8% of the dietary intake variance (Table 2).

To study the association of the covariates (gender, , age, PA, TV watching, SES, number of siblings, residential area, current maternal smoking and smoking at home) with the three dietary pattern scores obtained from the PCA (Table 3), we used linear regression. We chose this test due to the continuous character of the dietary scores and mixed types (continuous and categorical) of the covariates included in the

model. Results were significant for the association of BPDiet with gender (p=0.04, B=0.13) and SES (p<0.01, B=0.016); MEDiet, with SES (p=0.01, B=0.09); and SFATDiet, with TV viewing (p<0.01, B=0.12), number of siblings (p=0.01, B=0.10), PA (p=0.02, B=-0.12) and SES (p<0.01, B=-0.17).

In the final model, we included all the covariates significantly associated with dietary patterns in univariate tests. In this model, children's gender (p=0.047, B=0.13) and SES (p<0.01, B=0.16) remained significantly associated with increased BPDiet; the TV viewing (p=0.01, B=0.11) and number of siblings (p=0.03, B=0.09 were associated with increased SFATDiet, and SES (p<0.01, B=-0.15) was associated with decreased SFATDiet adherence.

DISCUSSION

Clustering of unhealthy behaviours is a dangerous phenomenon, and has been observed worldwide. In our study, the adoption of healthy or unhealthy habits is determined at more than one level with less physical activity and more time spent watching TV being associated with higher intake of saturated fats diet by children.

Results of studies worldwide suggest that people from lower SES backgrounds consume more energy-dense and nutrient-poor diets, which are usually less expensive (Aggarwal et al. 2011; Coon et al. 2001; Moreira et al. 2010; Shahar, Shai, and Vardi et al. 2005). Indeed, we showed that children from higher-SES families consume more higher-quality foods, such as the Mediterranean diet, compared to children from lower SES families. More important, we revealed that the lower SES is the strongest predictor of unhealthy diet, independent of all the studied covariates. A national census reported that Portuguese families are spending less money in food and leisure and that those expenses have been declining during the last years (INE, 2011). This is

worrying because food insecure households have been correlated with less money to spend on food and being forced to buy cheaper food and consuming less fruit, vegetables and daily products (Mark et al. 2012; Monsivais and Drewnowski 2007; Sancho 2011). Portuguese children are indeed consuming unhealthier foods and this is especially true in boys from lower SES families.

We also found a correlation between sedentary behaviours and unhealthy diets, which is in line with other findings suggesting that watching TV during meals is associated with a higher consumption of pizza, salty snacks and soda which itself is related to family income, making children from lower-SES families more vulnerable to these obesity-related behaviours (Bibiloni et al. 2011, 2012; Darmon and Drewnowski 2008; Leech, McNaughton, and Timperio 2014a, 2014b, 2015; Lopez et al. 2009; Salmon, Campbell, and Crawford 2006).

In difficult economic situation, additional siblings may decrease the availability of food for each child and can be related to the adoption of a nutrient-poor diet. Our finding suggests that a large number of siblings affect the quality of child's diet, which might be due to bigger general economic investment from parents, leading them to choose cheaper foods (Smithers, Brazionis, and Golley 2012).

Boys in our study seemed to adhere more to diet based on starchy foods and meat. This is in line with the results obtained by Moreira et al. studying Portuguese children who demonstrated that girls consumed significantly lower amounts of meat and higher amounts of vegetables while boys exhibited significantly higher consumption of dietary fiber, fast food and carbohydrates (Moreira et al. 2010). It is common that girls choose diets characterized by a higher intake of vegetables, fruits and fish, while meat (especially red meat) and large portion sizes are related with being a male (Arganini et al. 2012). Other researchers also agreed that the

Mediterranean diet is more often followed by girls, in particular the ones with higher parental SES (Bibiloni et al. 2012). These results show a disparity between genders in healthy food consumption. Indeed, it has been shown that parents are more concerned about a child's obesity if the child is a girl (Moore, Harris, and Bradlyn 2012). This points to the need for a gender specific approach when addressing nutritional issues in pediatric populations.

Our study has important strengths. Firstly, we used a combination of socioeconomic and environmental factors, in concert with the dietary patterns of the children. Multivariate analysis gave us the opportunity to study the effect of multiple variables and to recognize the most potent predictors of consumption. Our sample is representative of the population of children from central Portugal. Sufficient sample size and socio-demographic distribution, and application of post-stratification weights to account for the slight overrepresentation of urban children, improved the applicability of the study and the generalizability of the results. With regards to limitations, our results are based on cross-sectional observations; thus, cause-effect relationships cannot be established, and only hypotheses can be generated. Eating patterns and behaviors were self-reported which can introduce some bias. In addition, data relating to some important foods such as olive oil, which is commonly studied in research of Mediterranean diets, is lacking, as the questionnaire was predesigned by ISAAC.

The weather conditions in Portugal vary according to the season of the year and the geographical region. However, most of the year Portugal does not have extreme weather conditions, which can enable outdoor activities such as PA.

Summarizing, we found that the children's eating patterns are influenced by socio-demographic and lifestyle factors. Family socioeconomic status appears to be

the strongest predictor of food choices. Worse diet quality was shown to co-exist with other unhealthy behaviors such as more hours of watching TV, lower levels of physical activity, which added to the evidence that children with poorer diets have more probability of adopting other unhealthy lifestyle elements. These findings highlight the important modeling role that the family has when it comes to children's eating behavior, and as such, efforts to raise parental awareness should be made. Tailor-made, family focused interventions are necessary to target the variety of factors involved in unhealthy habits, especially in the face of the crisis affecting not only Portugal but also many parts of the world.

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REFERENCES

Aggarwal, A., P. Monsivais, A. J. Cook, and A. Drewnowski. 2011. Does diet cost mediate the relation between socioeconomic position and diet quality? *European Journal of Clinical Nutrition* 65:1059–66.

Álvares, L., and T. F. Amaral. 2014. Food insecurity and associated factors in the Portuguese population. *Food and Nutrition Bulletin* 35 (4):395–402.

Arganini, C., A. Saba, R. Comitato, F. Virgili, and A. Turrini. 2012. Gender differences in food choice and dietary intake in modern western societies. In *Public health - social and behavioral health*, ed. J. Maddock, 83–102. Rijeka, Croatia: InTech.

Basilevsky, A. T., ed. 1994. *Statistical factor analysis and related methods – Theory and application.* New York, NY: Wiley Interscience.

Bibiloni, M. M., E. Martínez, R. Llull, A. Pons, and J. A. Tur. 2011. Western and Mediterranean dietary patterns among Balearic Island's adolescents: Socio-economic and lifestyle determinants. *Publication Health Nutritional* 15:683–92.

Bibiloni, M. M., J. Pich, A. Córdova, A. Pons, and J. A. Tur. 2012. Association between sedentary behavior and socioeconomic factors, diet and lifestyle among the Balearic Islands adolescents. *BMC Public Health* 12:718–29.

Bonaccio, M., A. E. Bonanni, A. Castelnuovo, F. De Lucia, M. B. Donati, G. de Gaetano, and L. Iacoviello; Moli-sani Project Investigators. 2012. Low income is associated with poor adherence to a Mediterranean diet and a higher prevalence of obesity: Cross-sectional results from the Moli-sani study. *BMJ Open* 2:6. doi:10.1136/bmjopen-2012-001685.

Cattel, R. 1966. The screen test for the number of factors. *Multivar Behavioral Researcher* 1:245–76.

Chan, J. C., and J. Sobal. 2011. Family meals and body weight. Analysis of multiple family members in family units. *Appetite* 57 (2):517–24.

Chavance, M., S. Escolano, M. Romon, A. Basdevant, B. de Lauzon-Guillain, and M. A. Charles. 2010. Latent variables and structural equation models for longitudinal relation- ships: An illustration in nutritional epidemiology. *BMC Medical Research Methodology* 10:37.

Comissão de Coordenacão e Desenvolvimento Regional, & do Centro. 2008. *Caracterização socioeconômica do distrito de Coimbra*,1–14. Coimbra, Portugal: CCDRC (Comissão de Coordenação e Desenvolvimento Regional do Centro)

Coon, K. A., J. Goldberg, B. L. Rogers, and K. L. Tucker. 2001. Relationships between use of television during meals and children's food consumption patterns. *Pediatrics* 107(1), e7–e7.

Darmon, N., and A. Drewnowski. 2008. Does social class predict diet quality? *The American Journal of Clinical Nutrition* 87:1107–17.

Drewnowski, A., and E. Almiron-Roig. 2010. Human perceptions and preferences for fat-rich foods. In *Fat detection. taste, texture, and post ingestive effects*, eds J. P. Montmayeur, and J. Le Coutre, 265–294. Boca Raton, FL: CRC Press.

Ellwood, P., M. I. Asher, B. Björkstén, M. Burr, N. Pearce, and C. F. Robertson. 2001. Diet and asthma, allergic rhinoconjunctivitis and atopic eczema symptom prevalence: An ecological analysis of the International Study of Asthma and

Allergies in Childhood (ISAAC) data. ISAAC phase one study group. *The European Respiratory Journal* 17 (3):436–43.

Farajian, P., G. Risvas, K. Karasouli, G. D. Pounis, C. M. Kastorini, D. B. Panagiotakos, and A. Zampelas. 2011. Very high childhood obesity prevalence and low adherence rates to the Mediterranean diet in Greek children: The GRECO study. *Atherosclerosis* 217 (2):525–30. doi:10.1016/j.atherosclerosis.2011.04.003.

Fernández-Alvira, J. M., I. de Bourdeaudhuij, and A. S. Singh. 2013. Clustering of energy balance-related behaviors and parental education in European children: The ENERGY- project. *The International Journal of Behavioral Nutrition and Physical Activity* 10:5–15.

Gidding, S. S., B. A. Dennison, L. L. Birch, S. R. Daniels, M. W. Gillman, A. H. Lichtenstein, K. T. Rattay, J. Steinberger, N. Stettler, and L. Van Horn; American Heart Association. 2006. Dietary recommendations for children and adolescents: A guide for practitioners. *Pediatrics* 117:544–59.

Hall, J. N., S. Moore, S. B. Harper, and J. W. Lynch. 2009. Global variability in fruit and vegetable consumption. *American Journal Prevention Medica* 36 (5):402–09. doi:10.1016/j. amepre.2009.01.029.

Instituto do Emprego e Formação Profissional (IEFP). 2010. *Classificação nacional das profissões*. Lisbon, Portugal: Author.

Instituto Nacional de Estatística (INE). 2009. *A aplicação da tipologia de áreas urbanas à região centro.* Coimbra, Portugal: Comissão de Coordenação e Desenvolvimento Regional do Centro.

Instituto Nacional de Estatística (INE). National Census - Portal do Instituto Nacional de Estatística. 2011.
http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_
publicacoes&PUBLICACOESpub_boui=73212469&PUBLICACOESmodo=2
accessed September 10, 2015.

Kaikkonen, J. E., V. Mikkilä, and O. T. Raitakari. 2014. Role of childhood food patterns on adult cardiovascular disease risk. *Current Atherosclerosis Reports* 16 (10):443. doi:10.1007/ s11883-014-0443-z.

Koletzko, B., B. Brands, L. Poston, K. Godfrey, and H. Demmelmair. 2012. Early nutrition programming of long-term health. *The Proceedings of the Nutrition Society* 71 (3):371–78. doi:10.1017/S0029665112000596.

Lachat, C., E. Nago, R. Verstraeten, D. Robertfroid, J. Van Camp, and P. Kolsteren. 2012. Eating out of home and its association with dietary intake: A systematic review of the evidence. *Obesity Reviews : An Official Journal of the International Association for the Study of Obesity* 13 (4):329–46.

Leech, R. M., S. A. McNaughton, and A. Timperio. 2014a. The clustering of diet, physical activity and sedentary behavior in children and adolescents: A review. *International Journal Behavioral Physical Act* 11:4. doi:10.1186/1479-5868-11-4.

Leech, R. M., S. A. McNaughton, and A. Timperio. 2014b. Clustering of children's obesity- related behaviours: Associations with sociodemographic indicators. *European Journal of Clinical Nutrition* 68:623–28. doi:10.1038/ejcn.2013.295.

Leech, R. M., S. A. McNaughton, and A. Timperio. 2015. Clustering of diet, physical activity and sedentary behaviour among Australian children: Cross-sectional and longitudinal associations with overweight and obesity. *International Journal of Obesity* 39 (7):1079– 85. doi:10.1038/ijo.2015.66.

Lopez, C. N., M. A. Martinez-Gonzalez, A. Sanchez-Villegas, A. Alonso, A. M. Pimenta, and M. Bes-Rastrollo. 2009. Costs of Mediterranean and western dietary patterns in a Spanish cohort and their relationship with prospective weight change. *Journal of Epidemiology and Community Health* 63:920–27.

Mark, S., M. Lambert, J. O'Loughlin, and K. Gray-Donald. 2012. Household income, food insecurity and nutrition in Canadian youth. *Canadian Journal of Public Health. Revue Canadienne De Sante Publique* 103 (2):94–99.

Marôco, J. 2010. Análise Fatorial. In *Análise estatística com o SPSS Statistics*, ed. J. Marôco, 172–234. Pêro Pinheiro, Portugal: ReportNumber, Lda.

Martínez-Gonzalez, M. A., M. García-Lopez, M. Bes-Rastrollo, E. Toledo, E. H. Martínez- Lapiscina, M. Delgado-Rodriguez, Z. Vazquez, S. Benito, and J. J. Beunza. 2011. Mediterranean diet and the incidence of cardiovascular disease: A Spanish cohort. *Nutrition, Metabolism, and Cardiovascular Diseases : NMCD* 21:237–44. Monsivais, P., and A. Drewnowski. 2007. The rising cost of low-energy-density foods. *Journal of the American Dietetic Association* 107 (12):2071–76.

Moore, L. C., C. V. Harris, and A. S. Bradlyn. 2012. Exploring the relationship between parental concern and the management of childhood obesity. *Maternal and Child Health Journal* 16 (4):902–08.

Moreira, P., S. Santos, P. Padrão, T. Cordeiro, M. Bessa, H. Valente, R. Barros, V. Teixeira, V. Mitchell, C. Lopes, and A. Moreira. 2010. Food patterns according to sociodemographics, physical activity, sleeping and obesity in Portuguese children. *International Journal of Environmental Research and Public Health* 7 (3):1121–38.

Nagel, G., G. Weinmayr, A. Kleiner, L. Garcia-Marcos, and D. P. Strachan. 2010. Effect of diet on asthma and allergic sensitisation in the International Study on Allergies and Asthma in Childhood (ISAAC) Phase Two. *Thorax* 65:516–22.

Østbye, T., R. Malhotra, M. Stroo, C. Lovelady, R. Brouwer, N. Zucker, and D. M. Hoelscher. 2013. The effect of the home environment on physical activity and dietary intake in preschool children. *International Journal of Obesity* 37 (10):1314–21.

Pearson, N., K. Ball, and D. Crawford. 2012. Parental influences on adolescent fruit con- sumption: The role of adolescent self-efficacy. *Health Education Research* 27 (1):14–23. doi:10.1093/her/cyr051.

Popkin, B. M., L. S. Adair, and N. S. Wen. 2012. Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews* 70 (1):3–21. doi:10.1111/j.1753- 4887.2011.00456.x.

Ranjit, N., A. V. Wilkinson, L. M. Lytle, A. E. Evans, D. Saxton, and D. M. Hoelscher. 2015. Socioeconomic inequalities in children's diet: The role of the home food environment. *The International Journal of Behavioral Nutrition and Physical Activity* 12 (1):S4. doi:10.1186/ 1479-5868-12-S1-S4.

Rodenburg, G., A. Oenema, S. P. J. Kremers, and D. Mheen. 2012. Parental and child fruit consumption in the context of general parenting, parental education and ethnic back- ground. *Appetite* 58 (1):364–72.

Rodrigues, S. S. P., M. Caraher, A. Trichopoulou, and M. D. V. Almeida. 2008. Portuguese households' diet quality (adherence to Mediterranean food patterns and compliance with WHO population dietary goals): Trends, regional disparities and socioeconomic determinants. *European Journal of Clinical Nutrition* 62:1263–72.

Salmon, J., K. J. Campbell, and D. A. Crawford. 2006. Television viewing habits associated with obesity risk factors: A survey of Melbourne schoolchildren. *The Medical Journal of Australia* 184 (2):64–67.

San Juan, P. M. F. 2006. Dietary habits and nutritional status of school aged children in Spain. *Nutricion Hospitalaria: Organo Oficial De La Sociedad Espanola De Nutricion Parenteral Y Enteral* 21:374–78.

Sanchez-Benito, J. L., E. Sanchez-Soriano, and J. Ginart Suarez. 2009. Assessment of the Mediterranean Diet Adequacy Index of a collective of young cyclists. *Nutricion Hospitalaria: Organo Oficial De La Sociedad Espanola De Nutricion Parenteral Y Enteral* 24:77–86.

Sancho, T. 2011. *Alimentação em tempos de crise. Gabinete de nutrição da administração regional de saúde do algarve.* Albufeira, Portugal: Administração Regional de Saúde do Algarve.

Serra-Majem, L., L. Ribas, J. Ngo, R. M. Ortega, A. García, C. Pérez-Rodrigo, and J. Aranceta. 2004. Food, youth and the Mediterranean Diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. *Public Health Nutrition* 7:931–35.

Shahar, D., I. Shari, H. Vardi, A. Shahar, and D. Fraser. 2005. Diet and eating habits in high and low socioeconomic groups. *Nutrition* 21:559–66.

Smithers, L. G., L. Brazionis, and R. K. Golley. 2012. Associations between dietary patterns at 6 and 15 months of age and sociodemographic factors. *European Journal of Clinical Nutrition* 66:658–66. doi:10.1038/ejcn.2011.219.

Trichopoulou, A., C. Bamia, and D. Trichopoulos. 2009. Anatomy of health effects of Mediterranean diet: Greek EPIC prospective cohort study. *Bmj* 338:b2337.
Trichopoulou, A., and P. Lagiou. 1997. Healthy traditional Mediterranean diet: An expression of culture, history, and lifestyle. *Nutrition Reviews* 55:383–89.

Widmer, R. J., A. J. Flammer, L. O. Lerman, and A. Lerman. 2015. The Mediterranean diet, its components, and cardiovascular disease. *The American Journal of Medicine* 128 (3):229–38. doi:10.1016/j.amjmed.2014.10.014.

Table 1. Rotated factorial matrix, factor loads and communalities (h_2) estimated for the three dietary patterns identified among children, Coimbra, Portugal, 2011-2012 (n = 1.063)

Food groups	**Patterns**			**h_2**
	Base of Portuguese diet	**Mediterranean diet**	**Saturated fats**	
Rice	0.79			0.63
Pasta	0.69			0.53
Meat	0.54			0.37
Potatoes	0.51			0.36
Vegetables		0.78		0.59
Legumes		0.59		0.42
Fruits		0.58		0.34
Fish		0.47		0.43
Fast food			0.67	0.46
Eggs			0.66	0.48
Butter			0.27	0.20
Eigenvalues	2.04	1.55	1.23	
% of explained variance	18.53	14.07	11.20	
% of accumulated explained variance	18.53	32.60	43.80	

Table 2. Distribution of children according to demographic, socioeconomic, and behavioral characteristics, Coimbra, Portugal, 2011-2012 (n = 1.063)

Characteristic	n	%
Gender		
Girls	531	51
Boys	510	49
Number of siblings		
0 (only child)	283	27.3
1	554	53.5
2	149	14.4
3 or more	50	4.8
Maternal education		
Basic (4 years)	30	2.9
Secondary (6 years)	65	6.3
Secondary (9 years)	127	12.4
Secondary (12 years	271	26.4
University	535	52
Paternal education		
Basic 4 years	39	3.9
Secondary 6 years	100	9.9
Secondary 9 years	192	19
Secondary 12 years	281	27.8
University	399	39.5
Residential area[1]		
Urban	687	72.2
Suburban	190	20
Rural	74	7.8

Vigorous Physical Activity		
Never or occasionally	143	14
1-2 times per week	611	59.7
3 or more times per week	269	26.3
TV hrs. /day		
≥5	69	6.7
3 to 5	136	13.2
1 to 3	548	53.2
<1hr	277	26.9
Current maternal smoking		
No	830	81.1
Yes	194	18.9
Anyone smoking at home		
Yes	366	35.8
No	656	64.2

Definitions source: [1]Based on the INE classification (INE, 2009)

Table 3. Factors associated with dietary pattern scores in children

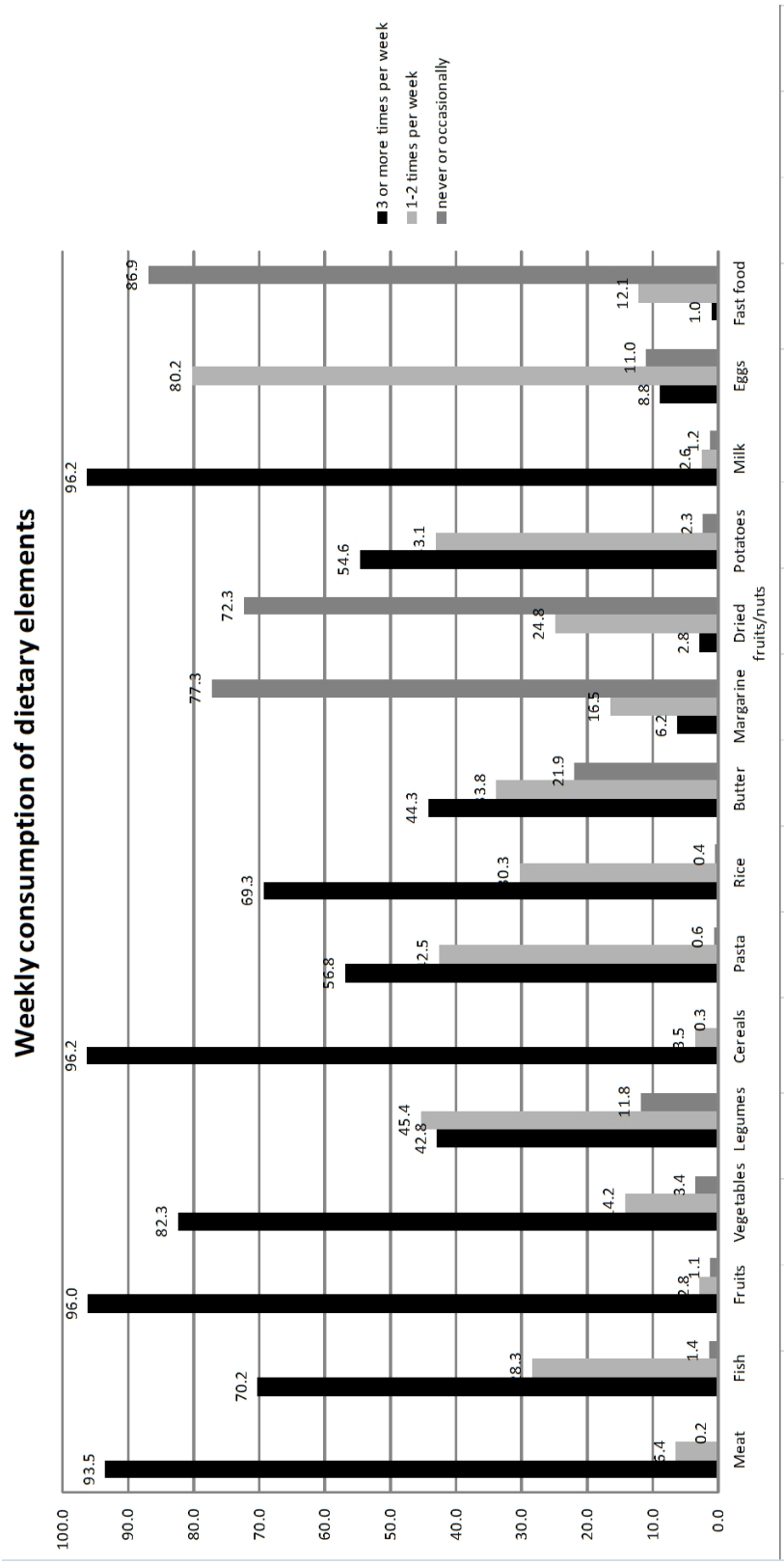
Variables	Base of Portuguese diet					
	Univariate (crude)			Multivariate (adjusted)		
	B	95% CI	p value	B	95% CI	p value
Gender	0.13	0.01; 0.25	**0.04**	0.13	0.00-0.25	**0.047**
Age	-0.04	-0.14; 0.07	0.49			
Physical Activity	0.09	-0.01; 0.19	0.07			
TV watching	0.01	-0.06; 0.09	0.74			
SES	0.16	0.10; 0.22	**<0.01**	0.16	0.10-0.16	**<0.01**
Number of siblings	0.06	-0.02; 0.13	0.17			
Residential area	-0.03	-0.16; 0.09	0.60			
Current maternal smoking	-0.08	-0.18; 0.03	0.15			
Smoking at home	0.01	-0.15; 0.17	0.88			
	Mediterranean diet					
Gender	0.01	-0.11-0.14	0.85			
Age	0.10	0.00-0.20	0.06			
Physical Activity	0.09	0.00-0.21	0.08			
TV watching	-0.06	0.00-0.22	0.12			
SES	0.09	0.00-0.23	**0.01**	NA		
Number of siblings	-0.04	0.00-0.24	0.28			
Residential area	0.03	0.00-0.25	0.57			
Current maternal smoking	-0.01	0.00-0.26	0.86			
Smoking at home	-0.05	0.00-0.27	0.48			
	Saturated fat diet					
Gender	-0.04	-0.16-0.09	0.56			
Age	0.10	0.00-0.20	0.06			

Physical Activity	-0.12	-0.22--0.02	**0.02**	-0.06	-0.16-0.04	0.26
TV watching	0.12	0.05-0.20	**<0.01**	0.11	0.03-0.18	**0.01**
SES	-0.17	-0.23--0.11	**<0.01**	-0.15	-0.21--0.08	**<0.01**
Number of siblings	0.10	0.02-0.18	**0.01**	0.09	0.01-0.17	**0.03**
Residential area	-0.02	-0.13-0.08	0.67			
Current maternal smoking	0.08	-0.08-0.24	0.31			
Smoking at home	0.09	-0.04-0.22	0.16			

Abbreviations: SES = Socioeconomic Status, CI= Confidence Interval, TV= Television

Results obtained using multiple linear regression, presented as B= unstandarized coefficient. Significant results ($p<0.05$) are marked in bold and underlined.

Figure 1. Frequency of the consumption of dietary elements among studied children. Results presented as percentage of children in each frequency group with n-values presented in the table below.



Dietary element (n)	Meat	Fish	Fruits	Vegetables	Legumes	Cereals	Pasta	Rice	Butter	Margarine	Dried fruits/nuts	Potatoes	Milk	Eggs	Fast food
3 or more times per week	962	723	988	847	441	991	585	713	452	63	29	558	984	90	10
1-2 times per week	66	292	29	146	467	36	438	312	345	166	252	440	27	819	124
never or occasionally	2	15	12	35	121	3	6	4	224	777	735	24	12	112	886