

***Prevalence of nutrient inadequacy and their determinants in
Oporto adolescents***

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Abstract

Introduction: Adolescence is a period of potential nutritional risk given the nutritional requirements for growth and development. Additionally, the exposure to environmental factors early in life, primarily through the diet, will begin to condition adult susceptibility to diseases. Thus, evaluation of adolescents' nutrient intake is of particular interest for evaluating public health interventions and for research that seeks to elucidate the determinants of inadequate intake.

Objectives: To describe nutrient intake of Porto adolescents, estimate the prevalence of inadequate intakes of nutrients and identify their socioeconomic, behavioural and anthropometric determinants.

Methods: The present study was part of the EPITeen project. Were eligible adolescents born in 1990 and enrolled at public and private schools in Porto during the 2003/2004 school year. Anthropometric evaluation included weight and height measurements. Adolescents' body mass index (BMI) was calculated as weight (Kg) divided by squared height (m²). Overweight (BMI > 95th percentile) and at risk of overweight (BMI between 85th and 95th percentile) were defined using reference percentiles which are gender and age-specific and were developed by the United States Centers for Disease Control and Prevention. Data on sociodemographic and behavioural characteristics and individual and family history of disease was collected using two standardized questionnaires. One questionnaire was completed by adolescents at school and the other at home by the adolescents and their parents. Food intake was assessed using a food frequency questionnaire previously validated for the adult Portuguese population and adapted for use in adolescents. Nutrient intakes were estimated using Food Processor Plus[®] software of the United States Department of Agriculture.

After exclusion of participants with an ingestion of energy above three interquartile deviation, the prevalence and determinants of inadequacy were estimated for a final sample of 1542 adolescents (720 boys and 822 girls).

Macronutrients, expressed as percent of the total energy intake (TEI), were compared with the values established by the Institute of Medicine (between 10 and 30% of the TEI for proteins, 45 and 65% of the TEI for carbohydrates and 25 and 35% of the TEI for lipids). To assess the

prevalence of nutrient inadequacy two methods were used: the Estimated Average Requirement (EAR) cut-point method and the probability approach. The nutrients evaluated according to the established value of EAR were: proteins, carbohydrates, magnesium, phosphorus, vitamin A, vitamin E, thiamine, riboflavin, vitamin B₆, vitamin B₁₂, vitamin C, niacin and folate. The EAR cut-point method could not be used on iron, since iron requirements are not symmetric. Thus, we used tables that give approximate probabilities of inadequacy for various levels of intake. Adequate Intake (AI) was used to assess adolescents with inadequate intake of those nutrients without an established EAR: fiber, sodium, calcium, potassium and vitamin D.

Proportions were compared using the Chi Square test. In order to evaluate the associations between nutrient inadequacy and socioeconomic, behavioural and anthropometric variables and, odds ratios (OR) and 95% confidence intervals (95%CI) were calculated by unconditional logistic regression with adjustment for parents education.

Results: In this sample, 16.0% were at risk of overweight and 10.4% were overweight. In general, compared with girls, boys showed a proportion significantly higher of individuals that reported practicing sport (62.6% vs 41.4, $p < 0.001$), eating breakfast (96.2% vs 93.4%, $p = 0.019$) and not consuming light products (89.2% vs 81.9%, $p < 0.001$).

No statistical differences were found related to prevalence of inadequate intake of protein, carbohydrates and lipids between boys and girls. Prevalence of protein inadequacy in adolescents was 0.7% (0.6% below the reference range and 0.1% above it). For carbohydrates, 12.3% reported an inadequate intake (9.9% below and 2.4% above the reference range). Almost 23.6% of the adolescents presented levels of lipids intake above the reference range whereas 6.0% reported an intake below it.

Prevalence's of inadequate intake were similar when calculated by the EAR cut-point method or the probability approach, except for protein (0.8% when EAR was used and 1.5% using the probability approach). Considering only the EAR, the prevalence of inadequate intake in at least one of the 13 nutrients evaluated was 58.7% in girls and 59.2% in boys. Those nutrients with the highest prevalence of inadequate intake were vitamin E (57.7%), folate (19.8%) and magnesium (12.9%) with no statistical differences being found between boys and girls. Subjects with parents who received more education (> 12 years) were less likely to have inadequate intakes. After adjusting for parents education, the adolescents attending private schools presented an higher risk of vitamin E inadequate intake (OR: 1.39 [IC95%: 1.09-1.77]). We found a significantly and inversely association between inadequate intake of folate and physical activity (OR: 0.70 [IC95%: 0.54-0.91]) and breakfast consumption (OR: 0.41 [IC95%: 0.26-0.66]). The probability of vitamin C inadequacy was inversely associated with breakfast consumption. When AI was used the mean intake of fiber, calcium, potassium and vitamin D

was below the respective value of AI for both sexes. For sodium, the mean intake was above the respective value of AI. Although it is not possible to estimate the probability of inadequate intake for these nutrients, the prevalence of inadequate intake is assumed to be high.

Conclusion: This study showed that nutrients with the highest prevalence were vitamin E (58%), folate (20%) and magnesium (13%). For the remaining nutrients, adolescents presented a low prevalence of inadequate intakes. Low parents' education was the strongest determinant of inadequate intake, particularly of vitamin E and folate. Breakfast consumption and physical activity were associated with a decreased probability of inadequate intake of folate and vitamin C. So, interventions aimed at promoting healthy lifestyles among adolescents and their parents, could potentially result in significant reductions in the prevalence of nutrient inadequacy in this group and thus in gains in health.