

Prevalence of inadequate nutrient intake in a group of adolescents using dietary reference intake-based methods

Prevalência de inadequação da ingestão de nutrientes em um grupo de adolescentes utilizando método proposto pelas Referências de Ingestão Dietética

ABSTRACT

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The aim of this study was to assess the prevalence of inadequate nutrient intakes in a group of adolescents from the city of Sao Bernardo do Campo. Food recalls from 89 adolescents were collected for analysis of energy, nutrient and dietary fiber intakes. The prevalence of inadequate intake was obtained using the EAR cut-point method, after adjustment for intrapersonal variability by using the Iowa State University method. The Dietary Reference Intakes were used as reference values. For those nutrients with no EAR established, the distribution of intakes was estimated and compared to the AI. The highest prevalence of inadequate intake for both male and female was observed for magnesium (99.3% for male and 81.8% for female), zinc (44.0% for male and 23.5% for female), vitamin C (57.2% for male and 59.9% for female) and folate (34.8% for female). Dietary fiber and calcium intakes were above AI values in a negligible proportion (0.0% to 2.0%) for both male and female.

Keywords: Adolescent. Nutrition assessment. Nutrients.

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RESUMEN

El objetivo del presente trabajo fue evaluar la prevalencia de ingestión inadecuada de nutrientes en un grupo de adolescentes de la ciudad São Bernardo do Campo-SP (BRASIL) Se utilizó el recordatorio de 24 horas de 89 adolescentes para análisis del consumo de energía, nutrientes y fibra dietética. Se obtuvo la prevalencia de inadecuación usando el método "EAR-cut-point" después del ajuste de la variabilidad intraindividual usando el método desarrollado por la Iowa State University. Como ingestión dietaria de referencia fue utilizada la Dietary Reference Intake. Para los nutrientes sin EAR establecida, la distribución del consumo fue comparada con la AI. El mayor desajuste para ambos sexos se observó para la ingestión de magnesio (99,3% para varones y 81,8% para mujeres), cinc (44,0% y 23,5%), vitamina C (57,2% y 59,9%) y folato (34,8 para mujeres). Las ingestiones de fibra dietética y de calcio fueron mayores que el AI en una proporción insignificativa (0,0% a 2,0%), en ambos sexos.

**Palabras clave: Adolescente.
Evaluación nutricional. Nutrientos.**

RESUMO

O objetivo do presente estudo foi avaliar a prevalência de ingestão inadequada de nutrientes em um grupo de adolescentes de São Bernardo do Campo-SP. Dados de consumo de energia e nutrientes foram obtidos por meio de recordatórios de 24 horas aplicados em 89 adolescentes. A prevalência de inadequação foi calculada utilizando o método EAR como ponto de corte, após ajuste pela variabilidade intrapessoal, utilizando o procedimento desenvolvido pela Iowa State University. As Referências de Ingestão Dietética (IDR) foram os valores de referência para ingestão. Para os nutrientes que não possuem EAR estabelecida, a distribuição do consumo foi comparada com a AI. As maiores prevalências de inadequação em ambos sexos foram observadas para o magnésio (99,3% para o sexo masculino e 81,8% para o feminino), zinco (44,0% para o sexo masculino e 23,5% para o feminino), vitamina C (57,2% para o sexo masculino e 59,9% para o feminino) e folato (34,8% para o sexo feminino). A proporção de indivíduos com ingestão superior à AI foi insignificante (menor que 2,0%) em ambos os sexos.

**Palavras-chave: Adolescente.
Avaliação nutricional. Nutrientes.**

INTRODUCTION

Adolescence is a time of rapid and intense physical growth. It is recognized to be a vulnerable phase with regard to nutritional status, both because of the high demand for energy and nutrients and because of changes in lifestyle that affect food consumption (WORLD HEALTH ORGANIZATION, 2005). The patterns of food intake by adolescents not only define their health, development and growth but also may influence the risk of developing chronic diseases such as cardiovascular disease, cancer and osteoporosis during adult life (WORLD HEALTH ORGANIZATION/FOOD AND AGRICULTURE ORGANIZATION, 2003). In this life stage, energy and nutrients are required not only for the maintenance of normal function and body stores, like in adults, but also for growth and development (PRENTICE, 2004). An inadequate dietary supply may result in reduced growth rate, which can have negative effects on both health and development (NUSSER; CARRIQUIRY; FULLER, 1996).

Studies on adolescents in several regions of the world have shown unhealthy dietary patterns which tend to linger throughout life. These patterns are especially characterized by frequent consumption of high energy-dense foods, usually rich in fat and with low nutrient content, and low consumption of vegetables (WORLD HEALTH ORGANIZATION, 2005). Thus, the aim of this study was to assess the prevalence of inadequate intakes of nutrients, including dietary fiber intake adequacy in a group of adolescents.

METHODS

A total of 154 adolescent members of a reading club in six public schools from Sao Bernardo, in the metropolitan region of São Paulo, Brazil, were invited to join the study and interviewed between August and November 2006. Adolescents aged 14 to 18 years (n=86) were included in this analysis. This age range was studied for being consistent with the established Dietary Reference Intake (DRI) values for this life stage. Seven adolescents with incorrect or inconsistent data were excluded, resulting in a sample of 79 adolescents (53 girls and 26 boys).

The data on food consumption were collected through the 24-hour recall method (24HR) which was randomly carried out on all days of the week, including weekends. In order to calculate the intrapersonal variability, a second 24HR was applied to 55% of the subjects. The method proposed by the Iowa State University – ISU (NUSSER; CARRIQUIRY; FULLER, 1996) was used to remove the intrapersonal variability of intake and to estimate the usual nutrient intake. PC SIDE (Software for Intake Distribution Estimation) was used for this calculation. For vitamin B6, calcium and fiber (among males) and vitamin C and sodium (among females), the intrapersonal variance was greater than the interpersonal variance. Therefore, an external intrapersonal variance obtained from data of the National Health and Nutrition Examination Survey (NHANES)

2001-2002 regarding adolescents was used (GOLDMAN, 2005). The DRIs (INSTITUTE OF MEDICINE, 2000) were used as reference values for nutrient intake. The prevalence of inadequate intake was obtained using the EAR cut-point method, which corresponds to the proportion of individuals with usual intake below the EAR established for each nutrient (BEATON, 1994). For nutrients with no EAR established, the distribution of intakes was estimated and compared to the Adequate Intake (AI). In this case, the proportion of individuals with consumption above the AI value was calculated (INSTITUTE OF MEDICINE, 2000).

Food recalls were analyzed for energy, copper, phosphorus, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, magnesium, vitamin C, zinc, calcium, sodium and dietary fiber using a software developed by the Federal University of Sao Paulo based on the food composition table of the United States Department of Agriculture (USDA). For regional foods and preparations, a national database and label information were searched for completeness. The food database was corrected to account for the fortification of wheat and maize flours with folic acid, which has been mandatory in Brazil since 2004. Folate intake was expressed as dietary folate equivalent (DFE), which accounts for differences in bioavailability between natural folate and synthetic folic acid (SUITOR; BAILEY, 2000).

This study was developed according to the ethic aspects in research involving humans. The participation was voluntary and a written informed consent was obtained from parents or legal guardians.

RESULTS

The mean age of the subjects was 15.9 (\pm 1.5) years for girls and 16.4 (\pm 1.4) years for boys. Their mean energy intake was respectively 2077.1 (\pm 696.9) kcal and 2289 (\pm 842.1) kcal.

The prevalence of inadequate nutrient intakes, which corresponds to the proportion of individuals with usual intake below the EAR established for each nutrient, is presented in table 1. The highest prevalence of inadequate intake among both male and female was observed for magnesium, zinc, vitamin C and folate.

Table 2 shows the estimated usual intake percentile distribution and the proportion of individuals whose consumption was greater than the AI. For these subjects, there is an acceptable but unknown probability that they present adequate intake of these nutrients. However, when the mean intake of this group is below the AI value, as is the case of calcium and dietary fiber, assumptions cannot be made about inadequacy of intake (INSTITUTE OF MEDICINE, 2000).

Table 1 – Means, standard deviations, reference intakes and estimated prevalence of inadequate intakes among adolescents. São Bernardo do Campo, SP, 2006

| Nutrient | Male | | | | Female | | | |
|----------------------|-------|-------|-------|-------------------------------------|--------|-------|-------|-------------------------------------|
| | EAR | Mean | SD | Prevalence of Inadequate Intake (%) | EAR | Mean | SD | Prevalence of Inadequate Intake (%) |
| Copper (mg) | 0.68 | 1.11 | 0.27 | <3.0 | 0.68 | 1.11 | 0.34 | 8.3 |
| Thiamine (B1) (mg) | 1.0 | 2.1 | 0.8 | 4.2 | 0.9 | 1.5 | 0.5 | 4.5 |
| Riboflavin (B2) (mg) | 1.1 | 1.9 | 0.5 | 3.8 | 0.9 | 1.7 | 0.6 | 7.3 |
| Niacin (B3) (mg) | 12.0 | 20.8 | 2.7 | <3.0 | 11.0 | 18.0 | 7.1 | 15 |
| Vitamin B6 (mg) | 1.1 | 1.3 | 0.3 | 24.4 | 1.0 | 1.4 | 0.4 | 16.4 |
| Folate (B9) (DFEa) | 330.0 | 501.4 | 198.5 | 19.5 | 330.0 | 387.7 | 124.5 | 34.8 |
| Vitamin B12 (µg) | 2.0 | 3.6 | 2.1 | 25.3 | 2.0 | 4.9 | 2.5 | 5.7 |
| Magnesium (mg) | 340.0 | 236.3 | 39.7 | 99.3 | 300 | 240.4 | 68.9 | 81.8 |
| Vitamin C (mg) | 63.0 | 68.4 | 49.0 | 57.2 | 56.0 | 54.7 | 26.8 | 59.9 |
| Zinc (mg) | 8.5 | 9.3 | 3.2 | 44.0 | 7.3 | 10.3 | 4.1 | 23.5 |

*Dietary Folate Equivalent.

Table 2 – Distribution of nutrient intakes with established AI values and proportion of individuals with intake above these values. São Bernardo do Campo, SP, 2006

| Male | AI | p5 | p10 | p25 | p50 | p75 | p90 | p95 | % cons > AI |
|---------|------|------|------|------|------|------|------|------|-------------|
| Calcium | 1300 | 482 | 522 | 595 | 683 | 781 | 878 | 939 | 0.0 |
| Sodium | 1500 | 2201 | 2464 | 2991 | 3736 | 4837 | 5816 | 6617 | 99.8 |
| Fiber | 38.0 | 12.6 | 13.7 | 15.5 | 17.7 | 20.1 | 22.5 | 24.0 | 0.0 |
| Female | | | | | | | | | |
| Calcium | 1300 | 417 | 464 | 549 | 657 | 777 | 899 | 977 | 0.1 |
| Sodium | 1500 | 1911 | 2113 | 2497 | 3003 | 3606 | 4247 | 4682 | 99.3 |
| Fiber | 26.0 | 11.2 | 12.3 | 14.4 | 16.9 | 19.6 | 22.3 | 24.4 | 2.0 |

DISCUSSION

This is one of few studies evaluating the adequacy of nutrient intakes among adolescents using the methods proposed by the DRI committee. In a recent publication, the Food and Agriculture Organization and the World Health Organization also recommended this methodology for this purpose (MURPHY; VORSTER, 2007). In the present study, adjustment for day-to-day variability of intake allowed to minimize errors in estimating the proportion of those individuals presenting an intake below a given criterion. The presence of intrapersonal variance can distort percentiles above or below the mean, resulting overestimates on the prevalence of both inadequate and excess intakes in the population (NUSSER; CARRIQUIRY; FULLER, 1996).

The present study agrees with published data on adolescents which also indicated a high prevalence of inadequate intake for magnesium, zinc, vitamin C and folate, and low proportions of individuals with adequate calcium and dietary fiber intakes (AFFENITO et al., 2007; MOSHFEGH; GOLDMAN; CLEVELAND, 2005; SUTOR; GLEASON, 2002). These papers used the same methodology to estimate the usual intake and prevalence of inadequate intake used here.

Considering the intense skeletal development during adolescence, the low intake of nutrients involved in this process, such as zinc, magnesium and calcium, becomes an important finding. Besides, there are evidences on the role of adequate calcium intake during adolescence in preventing bone mass losses in women during post menopause (TUCKER, 2003).

Dietary fiber acts as a protective factor against obesity, cardiovascular diseases, diabetes and some types of cancer (KEY et al., 2003) and a greater consumption of fiber should be encouraged among this population. Folate plays a crucial role in nucleic acid and protein synthesis, in concert with vitamin B₆ and B₁₂, and therefore deficiency or lack of folate alters many metabolic processes. Moreover, folate is required for conversion of homocysteine to methionine. An elevated plasma homocysteine level is considered a risk factor for atherosclerosis (BAUTISTA et al., 2002). Another finding in our study is the high sodium intake in this group. There is now a large body of evidence showing that the reduction of sodium intake lowers blood pressure, which is an etiologically relevant and modifiable cardiovascular risk factor (COOK et al., 2007).

Missing and replacing meals with fast food and junk food, frequent practices among individuals in this age group, may be one of the reasons for the results found in this study. These events are generally characterized by a reduced consumption of vegetables (FRENCH et al., 2001).

The limitations of this study include the self-report of dietary intake. Despite data collection has been accomplished by trained interviewers, recall errors and underreporting may have occurred.

The use of an external intrapersonal variance for some nutrients may have caused a bias in their estimated intake distribution. However, an analysis of inadequacy without adjustment of the intake distribution, even with data from an external population, gives rise to an estimate which is known to be less reliable (JAHNS et al., 2005).

Finally, early recognition of incorrect dietary practices may stimulate interest in implementing health and nutrition promotion programs.

CONCLUSIONS

This study shows an important prevalence of inadequate nutrient intake by both male and female, mainly concerning magnesium, zinc and vitamin C. Furthermore, calcium and dietary fiber intakes were below the AI values for almost all individuals. Considering the role of such nutrients and aiming to promote healthy habits in order to reduce the risk of developing chronic diseases, the adolescents in this study should be encouraged to eat foods rich in these nutrients, such as milk, green-leaf vegetables and fruits.

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