Nutrient and energy intake in adolescents from a public school

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Abstract

Objective: to assess the average intake of energy, protein, calcium, iron, vitamins A and C in adolescents.

Methods: cross-sectional study in a high school in São Paulo, Brazil, with 92 students, both males and females, aged between 11 and 17. The sample was chosen by a systematic statistical selection. The food intake was determined by 24-h diet recall and compared with the National Research Council recommendation (1989).

Results: the average intake of energy, proteins and vitamin C by both males and females was higher than the recommendation. The average iron intake by males was higher than the recommendation and more than 80% in females. The average calcium intake by males was less than 70% and less than 50% in females.

Conclusions: low average intake of calcium and high average intake of energy were observed.


Introduction

Adolescence is a developmental stage that consists of growth and maturation processes, both from a somatic and psychological standpoint. During this stage, there is an increased nutritional demand and, for that reason, nutrition plays a key role in adolescent development. In this case, an inadequate diet may hinder somatic growth.1

Changes in body composition are important in terms of nutritional recommendations and standards that influence adolescent health. Energy requirements increase with rapid growth, higher lean body mass concentration, less body fat content, more frequent physical activities, muscle development, and skeletal maturity.2

In addition, environmental factors such as family income, have a strong influence over adolescent nutrition. Housing and sanitation conditions may determine health conditions. Cultural aspects, traditions and taboos also influence food intake and contribute to the formation of eating habits at this age.3

In adolescence, the increased intake of calorie-rich food coincides with peak growth rate. There is enhanced appetite in relation to adequate energy supply. Significant variations exist between male and female adolescents: males tend to eat more calorie-rich foods than females.3
According to the National Research Council (1989), USA, recommended dietary allowances (RDA) up to the age of ten are not different for males and females. From this age on, however, the daily RDA is different due to age discrepancies at the beginning of puberty and because of different activity patterns. There is also a difference in how energy expenditure occurs at the growth stage. Dietary recommendations for this age group vary significantly; energy requirements may be adjusted individually, according to body weight, type of physical activity, and growth rate.4

Protein intake is determined according to the amount that is necessary to maintain normal body functions and to form new tissues that allow for adequate growth. During adolescence, these factors may account for a substantial portion of the total protein requirements.4

As far as mineral intake is concerned, skeletal development requires positive calcium balance until optimal peak bone is achieved. Bone mineralization continues for some years after the cessation of longitudinal growth. The total peak bone mass is related to calcium intake during the bone mineralization period. We do not know for sure at what age optimal peak bone is achieved, but this probably does not occur before the age of 25.

For both children and adolescents, iron is necessary to maintain hemoglobin concentration and increase total body iron stores during the growth stage. Since the required amount to increase total iron store is related to body growth, iron requirements for both children and adolescents are a bit higher if compared to those for male adults.

Vitamin A is important for proper vision, growth, cell differentiation and proliferation, reproduction, and integrity of the immune system. At and after the age of eleven, vitamin A is recommended according to sex, due to the different lean body mass composition present during the growth stage, and also because of different hormonal influence over the serum levels of vitamins regardless of vitamin A concentration.4

The effectiveness of the whole metabolic process is measured through the available amount of ascorbic acid. Another important aspect is the increased nonheme iron absorption in the presence of ascorbic acid.3

Food intake by adolescents should be further investigated in order that programs for the improvement of health, prevention of nutritional deficiencies, and adequate intervention measures can be developed and established.

The aim of this study is to assess the average intake of energy, protein, calcium, iron, vitamin A, and vitamin C by adolescents.

Materials and methods

Cross-sectional or prevalence study carried out at a public elementary school in the city of São Paulo, Brazil. The study population consisted of students who were attending the 5th, 6th, 7th, and 8th grades (elementary school), aged between 11 and 17 years, during the year of 1998.

The sample size was calculated considering the desired accuracy for estimating the weight/height for age and sex ratio, including a total of 125 students.

Students were selected by a systematic sampling procedure (interval 2), according to school grade and sex. The names of students were listed according to school grade and sex (all males from the 5th grade, all males from the 6th grade, all males from the 7th grade, and all males from the 8th grade). The same procedure was applied to female students.

The method used for data collection consisted of a 24-hour diet recall.

Visual aids, such as photographs, food replicas, and figures3 were used in the interviews in order to help the interviewed adolescents to estimate the amount of food they consumed. In this study, we used Zabotto’s image bank8 for the interviews. The foods and/or preparations indicated by adolescents were later converted into domestic weight measures (grams). For those foods and/or preparations not included in the image bank, the amounts reported by the interviewed adolescents had to be considered. The data on the consumed foods (in grams) were changed into nutrients by using food composition tables from software Virtual Nutri, version 1.0, designed by professors at the Department of Nutrition, Faculty of Public Health, Universidade de São Paulo.7

The information about nutrients and size of the consumed portions for those foods and/or preparations that were not available from Virtual Nutri database were obtained from Endef - IBGE food composition table (1977)8 from the domestic measure table as proposed by Pinheiro et al.,9 and also from product labels. If foods and/or preparations was presented in more than one form (for instance, different brand names), we chose those with a greater number of information about nutritional aspects.

Nutritional adequacy was assessed according to the National Research Council (NRC), 1989,4 which was used as a 100% standard adequacy criterion.

The relative intake of dietary macronutrients (proteins, carbohydrates, and lipids) was also evaluated in relation to the total energy intake (TEI), using the values recommended by the World Health Organization - WHO (1990)10 as reference: carbohydrates 55 to 75% of TEI, proteins 10 to 15% of TEI, and lipids 15 to 30% of TEI.

The data were described using means and standard deviations. The Kruskal-Wallis test was used to check the existing relationship between sex and nutrient intake variables (energy, proteins, vitamins A and C, calcium and iron) and the differential double-ratio test was used to check the relationship between sex and macronutrient percentage variables (carbohydrates, proteins and lipids) in relation to the total energy intake.
The procedures used in this study complied with resolution 196/96 of the National Health Council/Ministry of Health, 1997, and with the statutes of the Faculty of Public Health, Universidade de São Paulo (USP), which regulate all research involving human beings. Our research project was approved by the Research Ethics Committee (COEP), Faculty of Public Health, USP.

Results
Among the 125 selected students, we obtained data from 92 (74.2%). The remaining 25.8% were not included for the following reasons: students refused to participate, parents did not allow their children to participate, written informed consent was not provided, or students forgot to ask their parents to sign the written informed consent.

Adolescents were characterized according to the following variables: age and sex.

The age of most male adolescents ranged between 13-14 years, while most female adolescents were in the 11-12-year-old and 13-14-year-old age groups. The mean age was 12.96 ± 1.24 years (Table 1).

The distribution of the mean calorie value of macronutrients in relation to the total energy intake (TEI) for male adolescents was: proteins 15.3%, carbohydrates 52.5%, and lipids 32.2%; the values for female adolescents were, respectively: 14.8%, 55.3% and 29.9%. These values are close to those recommended by WHO.10

According to the differential double ratio test, P values were: proteins (0.9468), carbohydrates (0.7887) and lipids (0.8124). Therefore, there was no statistically significant difference between sexes as to the mean calorie percentage of macronutrients in relation to TEI (P>0.05).

Table 2 presents information on nutrient intake according to sex, energy, protein, vitamin A, vitamin C, calcium, iron, and the relationship between the consumed foods and/or preparations and those recommended by the NRC (1989).4

In terms of protein intake, the mean values complied with an average of 223.96% of the recommendation for males, and 176.99% for females.

Other authors also found a high protein intake in adolescents.11,16,19,20

The mean iron intake in male adolescents amounted to 111.31% of NRC recommendations (1989), and 80.89% in female adolescents. We observed that adolescents consumed iron-rich foods, such as meat and beans. In addition, they consumed citrus fruit juices, rich in vitamin C, which helps with the bioavailability of nonheme iron. These data are similar to those obtained in other studies.11,12,17,19-21

Although the current rather than habitual intake was assessed, we can deduce that if energy greater than that recommended has been ingested for some time, adolescents may become overweight - a problem that is currently found and has been increasing among adolescents.

Discussion
The mean intake obtained from this study was similar to that found in the literature, despite the different methods used for data collection, and different reference standards used for the assessment of energy and nutrient intake adequacy.

By assessing macronutrient distribution, we found out that the values obtained from our study comply with WHO recommendations.10 Other studies14 also showed similar results.

Calorie intake revealed mean values that followed 136.34% and 123.2% of the recommendation for males and females, respectively.

The mean and median values found for energy are similar to those observed in other studies.11-14,16,18-20

Some studies, however, showed deficient energy intake not only in underdeveloped countries but also in industrialized ones.21,22

Although the current rather than habitual intake was assessed, we can deduce that if energy greater than that recommended has been ingested for some time, adolescents may become overweight - a problem that is currently found and has been increasing among adolescents.
The mean calcium intake in male adolescents reached 68.31% of the NRC recommendations (1989), and 48.32% in female adolescents. If the new recommendation of 1,300mg of calcium, implemented by the Food and Nutrition Board - National Academy of Sciences25 is considered, the values drop to 63.05% in males and to 44.6% in females. This deficiency is in large part explained through the low intake of calcium-rich foods - milk and its derivatives, and leafy green vegetables (kale, spinach, and broccoli) -, observed in our study. In this case, the replacement of milk with fruit juices for breakfast or with soda pop for morning and afternoon snacks was quite frequent.

According to the National Osteoporosis Foundation (1995), there are several risk factors for osteoporosis, including calcium intake lower than 1,200mg a day. Furthermore, the data suggest that low calcium intake may be a limiting factor for linear growth and bone mineralization in children and adolescents, given that bone mass formation occurs up to the age of 25.26

In a study conducted by Sichieri,20 the mean intake of calcium was higher than that obtained from our study. McBean et al.27 found out that the diet of North-American adolescents, especially girls, consists of food rich in fat, sodium, and sugar, with low calcium intake which, very often, does not meet the recommended dietary allowances.

According to some surveys into eating habits carried out in the USA, female adolescents consume large amounts of soft drinks, fruit juices, and other milk substitutes. On top of that, their intake of milk-based products is low, since most of them contain a high concentration of fat.28

The inadequate intake of calcium was observed in our study, and also in many other studies,12,17,29-34 warning us against this worrying problem among adolescents.

The mean intake of vitamin A corresponded to 94.81% in males and 94.18% in females in relation to the recommended allowances. These values were similar to those obtained through other studies.11,17

The mean intake of vitamin C amounted to 237.39% in males and 318.47% in females. The high consumption of this vitamin is due to the fact that adolescents consume large amounts of foods rich in vitamin C, especially juices and fruit. Values higher than those recommended were also found in other studies.11,12,16-18,20,21

Conclusions

We concluded that energy intake exceeded the limit values recommended for both sexes, and that calcium intake was much higher than the recommendations for both sexes.

Considering these findings, it is necessary that nationwide studies with Brazilian adolescents be carried out in order to check the extension of the problem and propose adequate intervention and control measures.

References

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