Nutrition in adolescence

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Abstract

Objective: to emphasize the importance of nutrition for healthy growth and development during adolescence.

Methods: 1 - National and international bibliographic review of the main anthropometric data to be used during puberty. 2 - Description of practical questions for the evaluation of the nutritional status of adolescents. 3 - Main interventions and prevention activities for nutritional and health risk situations to be planned by the pediatrician in his professional activities with the multidisciplinary team.

Results: adolescence is a life period between 10 and 20 years of age, marked by intense body changes resulting from puberty and psychosocial development that influence nutritional requirements. The routine follow-up of adolescents should include the evaluation of growth velocity and sexual maturation, and also the anthropometric measures for the evaluation of the nutritional status. During the pubertal growth spurt, there is an increase in the protein, calorie, and nutrient requirements, in addition to the extras recommended for growth and for several activities, according to different life styles.

Conclusions: dealing with adolescents consists of opening new opportunities for nutritional counseling and health education. The dissemination of healthy eating concepts is one of the basic recommendations concerning community and clinical intervention. It is also one of the pediatrician's obligations towards adolescents.


Introduction

Adolescence is the period of transition between childhood and adulthood, and it is characterized by intense body changes resulting from puberty and by impulses of emotional, mental, and social development. All these changes are part of a continuous and dynamic process that starts with the fetal life, changes during childhood, with favorable or unfavorable influences from the setting and from the social context, and end with the complete physical growth and sexual maturation, personality consolidation, economical independence, and integration of the individual within his/her social group.¹
The relationships between nutrition, growth, and development are essential in the lives of all children and adolescents, since eating, growing, and developing are different phenomena when we consider physiological conception, but they are totally interactive, interdependent, and inseparable, and they express the potentiality of the human being. For this reason, changes in growth, maturation, and differentiation concerning time, shape, and body size have also been marked by historical, political, socioeconomic, and cultural transitions, as well as by epidemics, multiple diseases, ecological problems caused by urbanization and industrialization, and also by technological and scientific advances that result from current globalization.

However, the core of so many polemic studies, which still cause perplexity to pediatricians, is the question about the improvement of quality of life, health, and well being, and also of the factors that determine the nutritional status and growth conditions of children, adolescents, and of more vulnerable social groups within their communities in their daily life. How to recover ideal patterns, reverse the intensity of adverse nutritional losses or gains, decide about the necessary low-cost interventions and efficient prevention measures, and stimulate maximum growth potential and the return to a normal, natural, and healthy development of the body?

It is always necessary to identify the individuals who fall outside acceptable limits and those who present increased nutritional risks through data obtained on anamnesis and on adequate anthropometric examination, or through inquiries, tracking, and population surveillance. In clinical practice, it is important to decrease damage and alterations caused by eating disorders of emotional cause, as in cases of anorexia, bulimia nervosa, or obesity, and also in other systemic statuses with nutritional involvement that frequently occur in adolescence. Asthmatic episodes or intestinal parasitoses are examples of primary causes that may interfere with the appetite and in the relation between intake, caloric expenditure, and absorption of nutrients. To sum up, pediatricians have the responsibility of promoting health education activities, as well as prevention activities and public clarification about healthy life habits. Themes about growth and nutrition remain in constant evidence in the media, and are always approached in meetings with adolescents and their relatives.

There is also another fundamental question in reports and official documents of international organizations2-4: What is the amount of foods that an individual, or a social or age group needs in order to live? Waterlow3 affirms that the controversy concerning protein and energy requirements is artificial and unreal, since no answer or “diet prescription” can be considered to be useful, practical, objective, inexpensive, with sources that are adequate and accessible to everybody, because life and human beings have a wide capacity of metabolic and neuroendocrine adaptation to changes in intakes and daily expenditures, according to the circumstances.6 For this reason, we do not have, up to the present moment, fully satisfactory answers about nutritional estimates that are representative of the optimal, medium, or minimum cut-off points, and that are adequate during adolescence in order to achieve a healthy life style, considering the stages of pubertal development and the variations in climate, sports, entertainment, and sleep.

Adolescents make up 21.8% of the Brazilian population, in a total of 35 million of inhabitants between 10 and 19 years, according to data from the Brazilian Institute of Geography and Statistics (IBGE), in 1991. In Brazil, there are few comparative, cross-sectional, or longitudinal epidemiological and anthropometric studies aiming at identifying nutritional risks for several subpopulations of adolescents, defined according to the five macro-regions, urban or rural situation of homes, parents’ income and education. Some age group data may be derived from the National Survey on Health and Nutrition, performed in 1989, even with the limitations of the sample concerning variability of pubertal spurt and sexual maturation within the studied adolescents. In this study, we verified that 54.7% of the adolescents presented adequate weight in relation to height, 26.3% presented weight deficit, and 19% had weight above the expected for the height, which revealed an important epidemiological transition of health conditions in the country. The care that should be taken while handling national and local information becomes indispensable, considering nutritional recommendations that will be applied in the daily practice of medical services and health units.7-18

Growth evaluation

Growth is the set of maturation changes that a living being experiences and the best effect resulting from the interaction of the genotype and all inherited characteristics with the environment and its continuous mutations and evolutions. Tanner19-21 affirms that growth is the most adequate sign of nutritional status during adolescence, and the basis for the clinical observation of the pubertal maturation process. Currently, growth is considered the best instrument for assessing health in individuals or populations, and the best socioeconomic indicator among nations.22

It is important to clarify some definitions and criteria used for the evaluation of growth and nutrition parameters, as well as the indicators most commonly used during adolescence. Chronological limits, for example, remain flexible and confused, according to local habits and cultures. For the World Health Organization, the chronological limits of adolescence are the ages 10 and 20, and for the United Nations Organization, the criterion used for statistical purposes includes the concept of youth and the ages between 15 and 24 years.4 In most countries (including Brazil), from...
the legal point of view, majority is achieved at 18 years of age. Law no. 8069, by the Child and Adolescent Statute, defines adolescence as the age group between 12 and 18 years.

It is also worthwhile to emphasize that due to the characteristics of variability and diversity of the beginning, duration, and progression time of pubertal changes, with their repercussions in the psychosocial development, denominated maturation asynchronies, the chronological age, even being the criterion most commonly used in population studies, usually is not the best descriptive criterion of individual clinical use in the examined adolescent. Some adolescents grow fast and have early sexual maturation, and others grow slowly, with late sexual maturation, which influences the stages of cognitive, emotional, and social development. Another important detail to be observed is the use of the decimal age system (the year is divided into 10 months in order to ease the computation and comparison of growth speeds, since the proportion of the year between two anthropometric examinations and the birth date can be more easily calculated) in the registration of growth tables and curves, according to the National Center of Health Statistics and Tanner, as well as the correlation between height and weight data, with the pubertal maturation of adolescents.

Puberty is the biological phenomenon that refers to changes in shape and function resulting from the reactivation of neurohormonal mechanisms of the hypothalamic-pituitary-gonadal axis. It starts with an increase in the gonadotropic, adrenal, and thyroid hormones, followed by the production of androgen by the testicles and estrogen/progesterone by the ovaries. These hormones stimulate the maturation of reproductive organs and of secondary sexual characteristics; they also act in the bone fusion of growth cartilages associated with the human growth hormone (HGH), with somatomedins (IGF-1) and their binding proteins, and with several cellular growth factors. Puberty ends with the total growth and fusion of the bone epiphyses, with sexual maturation and development of internal organs, mainly those of the circulatory and respiratory systems, and other body changes, including enzymatic and metabolic changes.

So, the follow-up of the adolescents’ growth should take into consideration height and weight in relation to the pubertal development in regular time intervals, with appointments every 3 or 4 months or at least 1 or 2 times a year. The record of these data, on each appointment, should be done with tables or growth curves. Adolescents are considered to present pubertal delay when the female adolescent does not present development of secondary sexual characteristics after 13 years, or menarche after 15 years, and when the male adolescent does not present development up to 14 years of age or does not reach the third stage up to 15 years of age (penis enlargement and increased testicular volume, above 4 cm³). Parents’ average height, familial development pattern, as well as dietary history and excessive gain or loss of weight within a small time interval should be analyzed in these cases.

Nutritional assessment

Anthropometry is defined as the body shape quantitative expression technique. During adolescence, it is the most accessible and universally applicable method, since it is of low cost, simple, and noninvasive, being liable to be used by any motivated and responsible professional. Its greatest disadvantage is not identifying the deficiency or excess of a more specific nutrient; so, the anthropometric indicators used in the nutritional assessment of adolescents are not specific and can be considered only as criteria that suggest increased nutritional risk.

The indexes or measure combinations more frequently used in adolescence are height/age, weight/age, and weight/height, expressed in percentiles or Z scores.

Currently, the weight/height index, also called Quetelet’s index, is recommended for adolescents and is very used in the assessment of emaciation, malnutrition, overweight, and obesity, although there is still considerable discussion about the validation of the reference used and about the cut-off points in relation of the functional results on clinical and community interventions.

Other indexes may also be used in order to compare data obtained with reference values and to calculate the percentage of body fat and lean body mass. These measures describe estimates of body composition and may be useful in the
nutritional follow-up and treatment of adolescents (Table 1)\textsuperscript{4,7,10,15,28}. Usually, the three most common and practical measures are the following:

1 - mid-upper-arm circumference (MUAC);
2 - triceps skinfold thickness (TRSKF);
3 - subscapular skinfold thickness (SSKF).

The pediatrician should consult tables and the national and international references already mentioned, and analyze the data found through statistical programs, such as Epi-Info 6.0, which is accessible to the public at large, especially in case of population group studies. These data are ideal criteria for research, prevention actions, and community interventions. For the routine individual follow-up of adolescents at health units, clinics with a great public or private clinics, simplified protocols may help in the nutritional assessment (Table 2 and 3, Figure 1).\textsuperscript{35-38}

Other data may serve to complement the nutritional assessment. For example:

- Body fat content: sum of the measurement of the tricipital, bicipital, subscapular, and suprailliac skinfolds.\textsuperscript{28}
- Basic laboratory examinations for the differential diagnosis and to detect the presence of anemia, helminthiasis, hyperlipidemia, diabetes, infections, etc.: complete hemogram, erythrocyte sedimentation rate, glucose, urea, creatinine, triglyceride and cholesterol dosage (HDL, LDL, VLDL), simple urine examination and 24 h urine for dosage of creatinine and determination of the creatinine/height index, as well as parasitological examination of feces. Hand and wrist radiographs should also be considered in order to determine bone age and, if necessary, laboratory diagnosis should be complemented with hormone dosages, mainly thyroidal and gonadal hormones in case of evident pubertal delay.

- Other examinations may also be performed, such as densitometry, bioimpedance, ergometry, muscle capacity testing, and cardiorespiratory capacity with determination of maximum VO\textsubscript{2} and specialized reports, according to the possibilities and cost-effectiveness.
- The quantitative and qualitative consumption of foods and the frequency of basic food group consumption may be estimated in a fast method of diet assessment, which requires little training from the pediatrician. The more detailed assessment of each nutrient intake through the use of questionnaires, or 24-h or 3 to 5-day recording methods, including weekends, or also the detailed diet frequency should be left to a nutritionist, which has the knowledge and food composition tables that are necessary to gather and assess information in a more effective and precise way\textsuperscript{2,15,35,36}, mainly in cases of chronic diseases or adolescents hospitalized with diabetes or anorexia nervosa, for example.

### Table 2 - Simplified classification of the nutritional status and of the body

<table>
<thead>
<tr>
<th>Nutritional Status</th>
<th>Current weight / ideal weight x 100</th>
<th>Weight / height\textsuperscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
<td>≥120%</td>
<td>≥30 kg/m\textsuperscript{2}</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥110-119%</td>
<td>≥25-29 kg/m\textsuperscript{2}</td>
</tr>
<tr>
<td>Ideal weight</td>
<td>≥90-109%</td>
<td>≥18.5-24.9 kg/m\textsuperscript{2}</td>
</tr>
<tr>
<td>Low weight</td>
<td>≥80-89%</td>
<td>≥16-18.4 kg/m\textsuperscript{2}</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>&lt;80%</td>
<td>&lt;16 kg/m\textsuperscript{2}</td>
</tr>
</tbody>
</table>

Source: World Health Organization, 1995\textsuperscript{4}

### Table 1 - Criteria for the nutritional assessment and cut-off points during adolescence

<table>
<thead>
<tr>
<th>Sign</th>
<th>Anthropometric variable</th>
<th>Cut-off points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanism or low stature for the age</td>
<td>Height/Age</td>
<td>&lt;3\textsuperscript{rd} percentile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;2 Z scores</td>
</tr>
<tr>
<td>Thinness or low body mass index/age</td>
<td>Body mass index/Age</td>
<td>&lt;5\textsuperscript{th} percentile</td>
</tr>
<tr>
<td>Risk for overweight</td>
<td>Body mass index/Age</td>
<td>≥ 85\textsuperscript{th} percentile</td>
</tr>
<tr>
<td>Obesity</td>
<td>Body mass index/Age</td>
<td>≥ 85\textsuperscript{th} percentile</td>
</tr>
<tr>
<td></td>
<td>Tricipital skinfold/Age</td>
<td>≥ 90\textsuperscript{th} percentile</td>
</tr>
<tr>
<td></td>
<td>Subscapular skinfold/Age</td>
<td>≥ 90\textsuperscript{th} percentile</td>
</tr>
</tbody>
</table>

Source: World Health Organization, 1995\textsuperscript{4}
Nutritional requirements

Nutritional recommendations during adolescence found in the medical literature are taken from researches carried out with adults, or from experimental data obtained with laboratory animals. So, the recommendations should always be adapted to the clinical use, considering interindividual pubertal growth variations, social reality, daily and monthly costs, and the lifestyle of most Brazilian adolescents.35-37,39

Energy

Caloric requirements may be estimated in kcal/cm of height, varying according to age and sex and adding extra expenditures with daily activities. The maximum consumption of calories for females should be estimated around 2,500 kcal in the menarche period, on average between 12 and 12.6 years of age, decreasing progressively to 2,200 kcal after that. For males, the caloric intake requirements increase to up to 3,400 kcal around 15 to 16 years of age, due to the pubertal spurt, and decrease to 2,800 kcal until the end of the growth period. Energy requirements may also be calculated by using equations for the basal metabolic rate, adding the growth factor and the activity factor for each age group, according to data from the Food and Agriculture Organization (Table 4).2

Proteins

Protein requirements usually coincide with the maximum energy requirements during the pubertal spurt, and they may be estimated around 12 to 15% of the total calories for females and 15 to 20% for males (Table 5). It is important to consider an increase in this value for adolescents that work out or that live in “self-imposed restrictive diets”, as in cases of anorexia nervosa.

Fat

On a diet, fat serves as a concentrated source of energy (9 kcal/g), as well as a vehicle for fat-soluble vitamins and as a source for essential fatty acids, providing about 30% of the requirements. During the maximum growth rate, adolescents need so much energy that, without fats, the diet would become voluminous and unpalatable. On the other hand, fat-soluble vitamins and essential fatty acids are not stored during this period. Therefore, it is important to include fats in the diet of adolescents, especially during the pubertal spurt.

Table 3 - Limits of body mass index considered in the analysis of nutritional statuses of adolescents according to sex and age group, as proposed by Sichieri & Allam, 1996

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Male 10th percentile (kg/m²)</th>
<th>Male 90th percentile (kg/m²)</th>
<th>Female 10th percentile (kg/m²)</th>
<th>Female 90th percentile (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-11</td>
<td>15</td>
<td>20</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>11-12</td>
<td>15</td>
<td>20</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>12-13</td>
<td>16</td>
<td>21</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>13-14</td>
<td>16</td>
<td>22</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>14-15</td>
<td>16</td>
<td>22</td>
<td>17</td>
<td>24</td>
</tr>
<tr>
<td>15-16</td>
<td>17</td>
<td>23</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>16-17</td>
<td>18</td>
<td>23</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>17-18</td>
<td>18</td>
<td>23</td>
<td>18</td>
<td>25</td>
</tr>
</tbody>
</table>
Table 4 - Calculation of energy requirements according to FAO/WHO, 1985²

A - Calculate basal metabolic rate (BMR) from weight (kcal/day)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Total (kcal/day)</th>
<th>BMR/kg (kcal/day)</th>
<th>Recommendations (BMR x expenditures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-11</td>
<td>1215</td>
<td>37.7</td>
<td>1.76</td>
</tr>
<tr>
<td>11-12</td>
<td>1300</td>
<td>35.1</td>
<td>1.73</td>
</tr>
<tr>
<td>12-13</td>
<td>1370</td>
<td>33.4</td>
<td>1.69</td>
</tr>
<tr>
<td>13-14</td>
<td>1465</td>
<td>31.4</td>
<td>1.67</td>
</tr>
<tr>
<td>14-15</td>
<td>1570</td>
<td>29.9</td>
<td>1.65</td>
</tr>
<tr>
<td>15-16</td>
<td>1665</td>
<td>28.7</td>
<td>1.62</td>
</tr>
<tr>
<td>16-17</td>
<td>1750</td>
<td>27.9</td>
<td>1.60</td>
</tr>
<tr>
<td>17-18</td>
<td>1790</td>
<td>27.5</td>
<td>1.60</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-11</td>
<td>1160</td>
<td>34.3</td>
<td>1.65</td>
</tr>
<tr>
<td>11-12</td>
<td>1220</td>
<td>31.5</td>
<td>1.63</td>
</tr>
<tr>
<td>12-13</td>
<td>1280</td>
<td>29.1</td>
<td>1.60</td>
</tr>
<tr>
<td>13-14</td>
<td>1340</td>
<td>27.5</td>
<td>1.58</td>
</tr>
<tr>
<td>14-15</td>
<td>1375</td>
<td>26.7</td>
<td>1.57</td>
</tr>
<tr>
<td>15-16</td>
<td>1395</td>
<td>26.3</td>
<td>1.54</td>
</tr>
<tr>
<td>16-17</td>
<td>1405</td>
<td>26.0</td>
<td>1.53</td>
</tr>
<tr>
<td>17-18</td>
<td>1410</td>
<td>25.9</td>
<td>1.52</td>
</tr>
</tbody>
</table>

B - Or calculate BMR from weight (kcal/day) - Simplified method

<table>
<thead>
<tr>
<th>Age</th>
<th>Male Correlation</th>
<th>Female Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-18 years</td>
<td>17.5 x weight + 651 0.90</td>
<td>12.2 x weight + 746 0.75</td>
</tr>
</tbody>
</table>

C - Add caloric cost of activities according to sex

<table>
<thead>
<tr>
<th>Activities</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>School and mild activities</td>
<td>1.6 x BMR</td>
<td>1.5 x BMR</td>
</tr>
<tr>
<td>Moderate activities</td>
<td>2.5 x BMR</td>
<td>2.2 x BMR</td>
</tr>
<tr>
<td>Intensive activities</td>
<td>6.3 x BMR</td>
<td>6.0 x BMR</td>
</tr>
</tbody>
</table>

D - Add growth factor according to age or pubertal maturation²⁰

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Pubertal maturation (stages)</th>
<th>Growth factor (kcal/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-15</td>
<td>2-3</td>
<td>2</td>
</tr>
<tr>
<td>15-16</td>
<td>3-4</td>
<td>1</td>
</tr>
<tr>
<td>16-18</td>
<td>4-5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

hand, exaggeration of “high-fat snacks”, associated with sedentary life style, of the type “eat some snacks in front of the television”, which is a common behavior among adolescents of wealthier social groups, is responsible for the “epidemics” of obesity and arteriosclerosis. It is always important to decrease the percentage of total fats and saturated fats, thus influencing their beneficial effects on the lipid profile and body composition.

Carbohydrates

Carbohydrates are the main source of energy for adolescents, and usually contribute with 55% of the daily caloric intake. The monosaccharides glucose and fructose, which are present in fruit and vegetables, are agents of the “sweet” sugar. Their metabolic effects are different: although they release almost the same amount of energy, glucose releases more insulin and is metabolized in all tissues, while
The consumption of fructose, found in soft drink syrups, is responsible for the increased weight of many adolescents. Disaccharides, sucrose, lactose, and maltose are present in most balanced diets that include vegetables, cereals, and milk. The most common polysaccharide is the starch, which, along with fibers, forms complex carbohydrates. Carbohydrates act mainly in the center of hypothalamic satiety and affect the subsequent intake of other foods through its oxidation and transformation into calories; this process takes place in the liver.

**Minerals**

The requirements for most minerals duplicate during adolescence, mainly calcium, iron, and zinc. Restrictive diets and sports competitions influence bone mineralization, causing osteopenia, osteoporosis, amenorrhea, and pubertal delay. Out of the total body calcium, 97% are located in the bone mass, and this proportion also increases dramatically during the pubertal spurt, when the daily deposit of calcium is almost twice as high as the average amount during the whole growth period (also higher for boys). Calcium content depends on height; so, a tall adolescent that is on the 95th percentile may need 36% more calcium than a short adolescent on the 5th percentile. Among females, this difference is about 20% between tall and short women. About 20 to 30% of ingested calcium is absorbed; thus an average daily intake of 1,200 mg of calcium is recommended, depending on the needs of each adolescent.

In the same way, iron requirement increases with the growth of the muscle mass, blood volume, and respiratory capacity, besides menstrual losses and increase in exercises. The iron content in the foods also ranges from 4 to 6 mg/1,000 kcal. So, adolescents that menstruate, athletes, or adolescents that have deficient dietary habits will not receive the total amount of iron required, which is calculated to be about 15 to 18 mg per day during the pubertal spurt.

**Vitamins**

Vitamin requirements are all increased in puberty due to increased anabolism and energetic expenditure. Other factors also contribute to this increase, such as physical activities, pregnancy, oral contraception, and chronic diseases. Requirements for vitamins A, B, C, and D are progressively higher during the pubertal spurt, with cellular differentiation and bone mineralization. Folic acid supplementation, at 400 mcg/day, should be routinely prescribed for sexually active or pregnant adolescents, as well as to those of low socioeconomic level. Adolescents with vitamin deficiencies are more frequent when they do not have the habit of daily intake of fruit, vegetables, milk, and cereals. Nutritional recommendations for adolescents according to the age group are found in the article “Bases of nutritional support in pediatrics”, also published in this issue.

### Table 5 - Calorie and protein requirements for adolescents and young adults

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Total daily calories (kcal/cm height)</th>
<th>Total daily proteins (g/cm height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 - 14 years</td>
<td>17.2</td>
<td>0.29</td>
</tr>
<tr>
<td>15 - 18 years</td>
<td>15.9</td>
<td>0.34</td>
</tr>
<tr>
<td>19 - 24 years</td>
<td>16.4</td>
<td>0.32</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 - 14 years</td>
<td>14.0</td>
<td>0.29</td>
</tr>
<tr>
<td>15 - 18 years</td>
<td>12.9</td>
<td>0.28</td>
</tr>
<tr>
<td>19 - 24 years</td>
<td>12.9</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Zinc has been associated with delayed growth, hypogonadism, decreased taste sensation, and hair loss in adolescents with anorexia and also in athletes and pregnant women. The need for mineral supplementation will depend on the variety and quality of the diet, mainly during the pubertal spurt.

### Healthy nutrition

Since the first moments of life, feeding is narrowly linked with emotions, symbolism, socioeconomic and cultural influences. Growing and feeding result in establishing relations, making choices, getting identified or not with the family’s or other people’s models and values, adapting well or badly to the established standards and living together with habits, timings, and several life styles. In adolescence, the need for marking new positions or becoming unattached from the family may also be expressed by affective matters or conflicts concerning sexuality that are transferred to the dietary process. Eating too much or not eating may mean unconscious ways to satisfy needs, refuse external controls, or be fashionable. And eating outside home consists of a new opportunity to make friends, but also to create new dietary habits. To sum up, it is a matter of being different but at the same time being just like all the others - this immediatism is characteristic of adolescence.

Eating well is not the same as eating a lot or little. Taking care of the body that is growing consists of learning how to choose better the foods that maintain the balance between caloric gains and losses, with the necessary extras to guarantee increased growth speed. Hunger and satiety sensations, and the difference between appetite, gluttony, and voracity may serve to stimulate the adolescent’s own curiosity about the nutrient groups and about how to adequate his/her routine in order to achieve a diet that is healthy, balanced, and pleasant to the taste.


Proteins
They have plastic function, allowing growth and essential development of the organism, including tissue regeneration. The main animal and vegetal protein sources, such as meat, chicken, fish, milk, soy, grains and seeds, beans and cereals, supply 20 to 25% of the total calories and should be consumed 2 to 3 times a day.

Carbohydrates
They have energetic function, and guarantee metabolism and body temperature. They are gluclides, sugars, and starches found in cereals, rice, wheat, corn, oat, flours, breads, and pastas, vegetables and fruit; they constitute 50 to 55% of the total calories in 6 to 11 portions a day.

Lipids
They have an essential caloric function that is carried out by saturated and nonsaturated fats present in oils, soybean oil, butter, margarine, fat, lard, sausages, creams, sauces, fries, and mayonnaise. They may contribute with 20 to 30% of the total calories in one to two portions a day.

Vitamins and mineral salts
They have the function of regulating or maintaining the rhythm of cellular and enzymatic reactions. Main sources are vegetables, whole cereals, milk, seeds, meat, eggs, and grains. They should be part of 3 to 5 portions a day.

Water, juices, coconut milk, and other sources of liquids should be consumed on average at an amount of 4 to 6 glasses a day. On hot days, after beaches, pools, activities in the sun, and after exercises and sports, this amount should be increased to 6 to 8 glasses a day (2 liters). Alcoholic or energizing drinks, as well as anabolic steroids should always be contraindicated. In this growth phase, milk, which is an important source of calcium, proteins, and vitamins, should be part of the daily diet with two to three glasses a day, besides one to two portions of dairy products, such as cheese, yoghurt, ice cream, puddings, and desserts or sandwiches. When necessary for means of controlling weight, whole milk may be replaced with low-fat or fat-free milk.

There is no standard diet to all adolescents. It is important to adequate all the nutrient groups according to the different stages of pubertal spurt, to daily activities and different life styles. The nutrient groups should also be divided into three meals and two to three breaks a day, in order to balance daily intake and expenditure, without exaggerations on the weekends (Figure 2).

Main nutrional risks
Dealing with adolescents may be at the same time a challenge to face problems or a lever to promote health habits. It is important to take into consideration that, at every moment, the pediatrician and the multidisciplinary team may not only make a diagnosis of the current nutritional situation, but also modify behaviors and unfavorable conditions that deviate adolescents and their families from healthy growth and development. So, they will be contributing to stimulate new life styles and new patterns of prevention of the nutritional disorders most commonly found in the population in an almost unnoticeable way, through health education activities and through opportunities to nutritional orientation at each appointment or clinical visit.

Several situations may influence nutritional status. These situations are linked with a complex set of risks, such as socioeconomic factors and poverty, inadequate intake of commercialized foods due to the media, psychosocial and familial conflicts that are manifested during the meals, no schedule and lack of time for the preparation and adequate choice of foods, social disintegration, or even neglect and omission of parents and relatives, who are usually “busy” with other duties and with daily survival. So, it is important to consider the following conditions of nutritional risk during dialogues established directly with adolescents:

- Inadequate intake of nutrients due to frequent “magic” diets or “skipping meals” due to lack of time (mainly in the morning and at night, before sleeping).
- “Monotonous” diets (“every day the same thing”) or without a nutrient balance.
- Frequent use of “snacks”, fast food, with a high intake of products that present excessive fat, fries, chewing gums, candies, cookies, and chocolate, as the only and “cheapest” source of calories, or excessive salt and “snacks” to “deceive hunger”.
- Rejection of milk, fruit, vegetables, and cereals, or considerably spiced products.
- Excessive voracity to eat associated with the use of alcoholic drinks (beer, spirits, cocktails, etc.) or soft drinks (containing caffeine and colorants) in parties or on the weekends.
- Restricted daily consumption of water, coconut milk, juices (or after exercises and exposure to sun and heat in sports courts, beaches, pools).
- Lack of supervision by the parents, absence of adequate refrigeration and preparation of foods.
- Lack of “school snack”, or food supplementation in schools, which are progressively replaced with “snack bars” without any supervision, control, or nutritional and sanitary surveillance, with no fresh fruit, juices, milk, cereals, or more nutritive and healthier foods.
- Commercial advertisement of products such as “anabolic steroids”, “weight-reducing drugs”, “body modulators”, and vitamins, on television, newspapers, and magazines; posters on the streets and accessible illegal schemes of drug distribution in gyms and clubs, which influence adolescents in a negative and “unhealthy” way.
Reverting nutritional risk situations during adolescence requires a teamwork by the pediatrician and the nutritionist, as well as by the multidisciplinary team, in a construction process and establishment of a relationship marked by support, confidence, and respect, aiming at facilitating the counseling and follow-up of necessary changes in dietary habits.45

**Special situations**

Integrated prevention and treatment work is fundamental in cases of chronically ill or hospitalized adolescents, and also in cases of anorexia and bulimia nervosa,40,45 obesity,35,36,45 exercises and sports competitions, as described in other articles of this issue. It is important to emphasize prevention in cases of chronic malnutrition with pubertal delay,16,42 iron deficiency anemia,46 dyslipidemia and arteriosclerosis41,45,47 as well as teenage pregnancy.43

**Chronic malnutrition**

This is the most probable diagnosis in short adolescents presenting pubertal delay, deficient diet due to poverty, and increased risks for drug abuse, violence, or lack of familial or social links, as well as adolescents that have quit studying. On examination, patients present height/age and body mass/age index deficits below or equal to the 5th percentile, clinical or laboratory signs compatible with malnutrition, iron deficiency anemia, and verminoses, with bone age delay above 2 years. The role of nutritional recovery with
low-cost foods but of high nutritional value is as important as the care and the links the adolescent develops with the health team in order to allow homeorhesis or growth recovery speed associated with pubertal spurt. Primary chronic malnutrition is multifactorial, and in order to interrupt this vicious cycle between poverty, violence, hunger, and social abandonment, clinical and nutritional interventions aiming at improving the dietary pattern are necessary, as well as a setting that offers care and new affective and social connections, in community actions of prevention and health education. The reversion of a complex process of social inequalities requires from the pediatrician the ethical commitment of facing difficult situations and of maintaining his/her professional consciousness enlightened. Nutritional education is one of the basic factors needed to rehabilitate growth and development potential in adolescents, this way assuring their rights to health and citizenship.13,16,42,48

Iron deficiency anemia

This is a frequent diagnosis in malnourished adolescents, athletes, or female adolescents, since the beginning of menstruation increases iron nutritional requirements for blood reposition. Anemia may be defined as hemoglobin index below 11.6 g/dl or hematocrit below 35%, or, still, using diagnostic criteria44 according to age, sex, and race. Symptoms such as tiredness, sleepiness, dizziness, cephalgia, and declining school performance may remain unnoticeable until the worsening of anemia. Treatment consists of nutritional orientation with foods that contain iron, mainly the heme radical, drug supplementation or iron associated with vitamin C, aiming at better absorption.

Osteopenia

This is the generic term used to define generalized reduction in bone mass. Osteoporosis and osteomalacia are the main osteopenic syndromes, due to the quantitative decrease or the qualitative demineralization of bone mass, respectively. Rickets consists of the deficient mineralization of the epiphyseal growth plate cartilage. The relationship between calcium and phosphorus in the diet influences body calcium and phosphorus homeostasis, bone mineralization, and skeletal integrity, mainly during the pubertal spurt. Bone densitometry should be requested during nutritional assessment and follow-up. Currently there is a consensus that the prevention of osteoporosis in adults and of fractures in old people should start during adolescence, in the bone maturation phase. The extra intake of these nutrients at 1,500 mg/day is important, mainly in teenage athletes with amenorrhea or feeding disorders, such as anorexia nervosa.

Arteriosclerosis

This is the most common cardiovascular disease among adults and the most significant cause of death in the world. The risk becomes more significant when cholesterol and the LDL fraction increase. Individuals with low LDL fractions tend to present the highest rate of cardiovascular disease. The following risk factors are easily identifiable: family history of cardiac problems (infarct, cerebral vascular accident, or similar problems before the age of 55 years), or obesity, dyslipidemia, hypercholesterolemia, arterial hypertension, smoking, and sedentary life. In case of positive history of risks, two fasting lipid tests should be performed; average LDL-cholesterol will be determined by these results. If the values are within acceptable limits, as shown in Table 6, the recommendation is to repeat the test after 5 years.

Borderline values should result in two main objectives: decreasing the total amount of fats (on average, no more than 30% of the total calories) and of saturated fats (less than 10% of total calories), and decreasing cholesterol (less than 300 mg/day), besides controlling weight (body mass index close to the 50th percentile). Proteins should represent about 15 to 20% of the total calories, and carbohydrates, 55%. Nutritional interventions and prevention actions should be started early. Exercising should be stimulated. Pharmacological treatment is only indicated for adolescents with cholesterol and LDL levels above the 99th percentile for the age and with positive familiar history.31,45,47

<table>
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<tr>
<th>Classification of risks for arteriosclerosis</th>
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<tr>
<td><strong>Riscos</strong></td>
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<td>Limítrofes</td>
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<td>Altos</td>
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Pregnancy

The assessment of nutritional, clinical, and psychosocial risks during teenage pregnancy and lactation requires special care and support measures. Pregnancy evolution and fetal growth are altered by higher risks for malnutrition, anemia, vitamin deficiencies, intrauterine growth delay, drug abuse, and infections such as sexually transmitted diseases, human immunodeficiency virus, and acquired immunodeficiency syndrome, with increased indexes of prematurity, low birthweight, and postnatal malnutrition. The assessment of gynecological age (time interval between menarche and pregnancy), pre-pregnancy weight/height, and body mass index is important. Adolescents with low gynecological age (below 2 years) and still in the end of bone growth and maturation process present the double anabolism phenomenon, in which a lower proportion of nutrients and gestational weight gain is transferred to the fetus, even with maternal accumulation of body fat; this may compromise
the fetal growth pattern. Additional requirements for biologically valuable proteins are of 60 g/day during all gestation; these requirements are estimated according to risks, age, pre-pregnancy age, height, and gestation time, and extra requirements in order to sustain fetal growth range from 300 to 500 kcal/day. The complexity of factors that interact demands a strong commitment by the part of the health team, in order to effectively interfere with the main aspects of the health of this population group, which is reaching significant numbers in all Brazilian states. 34,43,49

**Hypoglycemia**

Faints due to dietary deficiency or prolonged spacing between meals are frequent causes of differential diagnosis of lipotrophism in adolescents in the beginning of the pubertal spurt who are admitted to healthcare or emergency services. They usually occur in periods of much stress, during tests in school, sports competitions, in the early mornings or late afternoons, and many times after exercises or physical education classes. The concomitant use of any medicine, such as appetite suppressants or stimulating drugs, should be carefully assessed, as well as vagal reactions and seizures, also common in this age group. Usually, a nutritional orientation with a better organization of meal and snack schedules in relation to activity schedule is enough as for treatment, but the follow-up of gain weight in relation to height is always necessary in the next visit.

**Final considerations and recommendations**

1. Follow adolescents’ growth and development evolution through anthropometric data concerning height, weight, body mass index, and sexual maturation at each clinical visit, in 4 to 6-month intervals.

2. Always and routinely assess adolescents’ nutritional and growth status, and adapt changes in dietary habits according to increased nutritional requirements during the pubertal spurt and to the life style of Brazilian adolescents.

3. Take into consideration the possibilities of primary chronic malnutrition, anorexia and bulimia, overweight, and obesity as common nutritional and psychosocial risks in this age group; this situations require early identification and interventions by the health team.

4. Facilitate the development of protocols aiming at the monitoring of growth speed and careful observation of weight gain/loss speed, associated with refeeding and recovery of nutritional balance.

5. Collaborate with participating and community strategies aiming at the orientation of basic and essential feeding, including dietary supplementation in schools and health units for more vulnerable social groups, adolescents that are growing, women that are pregnant or breastfeeding, as well as adolescents in risk situations.

6. Train health teams in multidisciplinary handling of adolescents and their families, promoting direct and interactive participation with adolescents and with the people that live with them, in the establishment of a support and social attention network.

7. Help the implementation of prevention and health education actions, including community interventions for the tracking and surveillance of growth and nutritional status.

8. Spread basic concepts about healthy feeding, as well as health and citizenship rights during all the growth phases in adolescence through mass media.

9. Establish and support growth, development, and dietary education programs, with the dissemination of innovating community projects of low cost through the networks already formed in all Brazilian municipalities.

10. Stimulate the development of multicentric research for the obtainment of anthropometric data concerning growth, pubertal maturation, and nutritional status, taking into consideration the characteristics and biopsychosocial influences of adolescents, as well as their association with the indicators of health conditions in the Brazilian population.

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**References**


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