

Assessment of the nutritional issues contained in high school biology textbooks

Avaliação dos conteúdos relacionados à nutrição contidos nos livros didáticos de biologia do ensino médio

Evaluación de los contenidos relacionados a la nutrición contenidos en los libros didáticos de biología de la secundaria

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ABSTRACT

Objective: To analyze the nutrition-related issues of high school Biology textbooks by comparing the available information with the current knowledge.

Methods: A cross-sectional descriptive study was undertaken to evaluate all the Biology textbooks recommended by the Ministry of Education for high school classes. The data collection was performed by a structured assessment tool to evaluate the content of each book. The content was classified as “sufficient”, when all the variables analyzed were presented in the textbooks and in consonance with the current scientific literature; “insufficient”, when they were partially presented in the textbooks and in consonance with current scientific literature; “absent”, when the content was not available in the textbook. Variables available but outdated or incorrect were individually and descriptively assessed. The content analysis technique was employed in the present study.

Results: All the textbooks had nutrition-related information. However, most of them were insufficient to promote awareness of food choices and/or change of lifestyle. The following information was not available in the books: vitamin A and folate deficiency (100%), anemia due to iron deficiency (89%), obesity, iodine deficiency and food pyramid (78%).

Conclusions: The insertion of nutritional education in the academic curriculum and the periodical review of nutrition-related issues presented in the textbooks may

help the prevention of health problems among children and youth.

Key-words: adolescent nutrition; books; teaching.

RESUMO

Objetivo: Analisar os temas de nutrição contidos nos livros didáticos de Biologia do ensino médio, comparando a qualidade das informações com os conhecimentos atuais.

Métodos: Estudo transversal descritivo no qual foram avaliados, de forma estruturada, todos os livros de Biologia recomendados para o ensino médio pelo Ministério da Educação. A análise de cada livro foi realizada segundo o seu conteúdo de nutrição a partir de uma ficha de avaliação. As variáveis avaliadas foram selecionadas por meio de revisão de literatura, sendo classificadas em: “suficiente”, quando estiveram totalmente presentes nos livros didáticos e em concordância com os conhecimentos atuais; “insuficiente”, quando as variáveis analisadas estiveram parcialmente presentes nos livros didáticos, em concordância com os conhecimentos atuais; “ausente”, quando o conteúdo não foi abordado no livro didático. Variáveis presentes, porém desatualizadas ou incorretas, foram analisadas individualmente e de forma descritiva. A técnica de “análise de conteúdo” norteou este trabalho.

Resultados: Todos os livros didáticos continham informações sobre nutrição; porém, em sua maioria, apresentaram-se insuficientes para promover escolhas alimentares conscientes e/ou mudança de hábitos. Algumas informações estavam

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ausentes em alguns livros, como hipovitaminose A e deficiência de folato (100%), anemia ferropriva (89%), obesidade, deficiência de iodo e pirâmide dos alimentos (78%).

Conclusões: A inserção da educação nutricional no currículo escolar e a revisão periódica para adequação dos conteúdos sobre nutrição nos livros didáticos são medidas coadjuvantes à prevenção de agravos à saúde dos futuros adultos.

Palavras-chave: nutrição do adolescente; livros; ensino.

RESUMEN

Objetivo: Analizar los temas de nutrición contenidos en los libros didácticos de biología de la secundaria, comparando la calidad de las informaciones frente a los conocimientos actuales.

Métodos: Estudio transversal descriptivo en el que se evaluaron, de modo estructurado, todos los libros de biología recomendados para la secundaria por el Ministerio de la Educación. El análisis de cada libro se realizó según su contenido de nutrición a partir de una ficha de evaluación. Las variables evaluadas fueron seleccionadas mediante revisión de literatura, y se pudo clasificarlas en: Suficiente: cuando las variables analizadas estuvieran totalmente presentes en los libros didácticos y en concordancia con los conocimientos actuales; Insuficiente: cuando las variables analizadas estuvieran parcialmente presentes en los libros didácticos, en concordancia con los conocimientos actuales; Ausente: cuando el contenido no fuera abordado en el libro didáctico. Variables presentes, pero desactualizadas o incorrectas, fueron analizadas individualmente y de modo descriptivo. La técnica de «análisis de contenido» guió a ese trabajo.

Resultados: Todos los libros didácticos contenían informaciones sobre nutrición, pero, en su mayoría, se presentaban insuficientes para promover elecciones alimentarias conscientes y/o cambios de hábitos. Algunas informaciones estaban ausentes en algunos libros, como: hipovitaminose A y deficiencia de folato (100%), anemia ferropénica (89%), obesidad, deficiencia de iodo y pirámide de los alimentos (78%).

Conclusiones: La inserción de la educación nutricional en el currículum escolar y la revisión periódica para adecuación de los contenidos sobre nutrición en los libros didácticos son medidas coadjuvantes a la prevención de agravio a la salud de los futuros adultos.

Palabras clave: nutrición del adolescente; libros; enseñanza.

Introduction

The rapid urbanization that is taking place in Brazil is completely changing the population's traditional way of life⁽¹⁾. Dietary habits have changed for the worse and are now typically unhealthy, with dietary intake that is especially rich in saturated fat and sugar and salt^(2,3). In combination with physical inactivity, this diet has contributed to the development of non-transmissible chronic diseases^(3,4). In parallel, diseases caused by deficiencies, such as vitamin A deficiency, iron deficiency anemia, folic acid deficiency and iodine deficiency, are still important causes of concern in public health. In this scenario, nutritional education has a fundamental role to play in correcting this situation and schools are the most appropriate places for health promotion⁽⁵⁾. Schools should be disseminating information about health as part of both primary and secondary education^(1,6).

Textbooks are still the educational materials most utilized by teachers and are very often the only source of scientific knowledge to which their students have access; as a result, their content is extremely important in any analysis of the state of teaching in Brazil^(7,8). It is against this background that this study was conducted with the objective of analyzing the way that the subject of nutrition is covered in the biology textbooks used in secondary education in Brazil, by comparing the quality of the information they contain with current knowledge.

Method

This was a descriptive cross-sectional study using the content analysis method, which is a series of techniques for analyzing communication, employing systematic, objective and even quantitative procedures for the description of the content of messages^(9,10).

In order to provide a basis for the study design, literature written in Portuguese, English and Spanish was reviewed if it had been published between November 2006 and December 2008 and dealt with the dietary habits, nutritional status and health of the Brazilian population, nutritional transition, healthy eating, health promotion or textbooks. The following databases were used to identify this literature: Medline, SciELO and LILACS.

The study sample comprised 100% of the biology textbooks recommended for Secondary Education by the Brazilian Ministry of Education, as listed in Directive 501 of 14/02/2006⁽¹¹⁾ and including all 9 recommended collections

(see Chart 1). The textbooks analyzed were donated by their publishers or purchased in bookshops.

A data collection instrument was constructed on the basis of the results of the literature review, covering 16 variables that are of fundamental importance to the acquisition of sufficient knowledge to promote healthy dietary habits. Each of these variables was classified into one of two groups:

- Group 1 – variables considered essential to understanding and acquiring healthy eating habits (carbohydrates, proteins, fat, vitamins, minerals, water, fibers, food pyramid and breastfeeding).
- Group 2 – variables that could motivate people to change their eating habits (cardiovascular diseases, diabetes, obesity, vitamin A deficiency, folic acid deficiency, iron deficiency anemia and iodine deficiency).

Each textbook was analyzed in terms of the nutritional information it contained, covering all material that mentioned the subject, including main texts, illustrations and supplementary texts. The analysis was conducted in a structured manner, using an assessment form based on the variables in groups 1 and 2, which are those subjects which bring together enough information to promote conscious eating choices. The textbook assessment form was based on studies by Rigodanzo and Unfer⁽¹²⁾, Campos⁽¹³⁾, and Silva, Gobbi and Simão⁽¹⁴⁾, which provide guidelines and examples of how to employ the content analysis method. Group 1 variables were analyzed for presence or absence of coverage of the subject and of information about chemistry/biochemistry, daily intakes, dietary sources and the functions of macronutrients and micronutrients, in addition to the relevance of the information provided. Group 2 variables were analyzed for the presence/absence of coverage, information about their etiology, dietary treatments and for the relevance of the information provided. The relevance of coverage of each variable in each group was classified as one of three possibilities,

Adequate, Inadequate or Absent, according to the following classifications: 1) Adequate: when the coverage of the variables analyzed was complete in the textbook in question and in line with current knowledge; 2) Inadequate : when the variables were only partially present in the textbooks, but in agreement with current knowledge; 3) Absent: when the subject was not covered in the textbook. When a variable was covered, but the information was out of date or incorrect, this was dealt with individually in a descriptive manner.

The data collected were analyzed using a quantitative-qualitative approach. The data recorded on the assessment forms were organized in contingency tables and descriptive statistics were compiled for frequency analysis, with simple frequency distributions and calculations of relative frequency. The relative frequency data are presented in four tables. This research project was submitted to and approved by the Research Ethics Committee at the *Universidade Federal de São Paulo*.

Results

All of the books analyzed (9 collections) covered some topics related to nutrition, but some of the information that is considered essential to the acquisition of knowledge about healthy eating appeared with less frequency.

Vitamins and minerals were dealt with in just 33% of the books analyzed. With regard to fiber, 89% of the books did not list food sources and 78% did not indicate daily water intakes. With relation to functions, 100% of the books listed the functions of fats, but only 22% listed the functions of dietary fiber (Table 1).

With regard to the relevance of the content, the information on water was only classified as adequate in 11% of the books analyzed. Information on carbohydrates, proteins, fats and vitamins were considered inadequate in 100% and, in 67% of the books, information on fiber was absent (Table 2). The variables

Chart 1 - Textbooks recommended by the Brazilian Ministry of Education

Titles	Authors	Publishers
"Biologia"	Lopes SGBC, Rosso S	Saraiva
"Biologia"	Frota-Pessoa O	Scipione
"Biologia: Coleção Vitória-Régia"	Crozetta MAS, Lago SR, Borba AA	IBEP
"Biologia"	Favaretto JA, Pifaia CML	Moderna
"Biologia"	Linhares SV, Gewandsznajder F	Ática
"Biologia"	Martho GR, Amabis JM	Moderna
"Biologia"	Sasson S, Silva Júnior C.	Saraiva
"Biologia"	Paulino WR	Ática
"Biologia"	Laurence J	Nova Geração

food pyramid and breastfeeding were absent in 78% and 56% of the textbooks respectively (Tables 1 and 2).

Group 2 variables are considered important to motivate people to change their dietary habits and the most often mentioned item in this group was cardiovascular diseases, followed by diabetes, obesity, iodine deficiency and iron deficiency anemia, while vitamin A deficiency and folic acid deficiency were not mentioned in any of the collections analyzed (Table 3). With regard to the relevance of the information provided about group 2 variables, 33% dealt with cardiovascular diseases adequately and 11% dealt with obesity, iron deficiency anemia and iodine deficiency adequately (Table 4).

Some of the variables analyzed were dealt with in some of the textbooks as "supplementary reading". These included breastfeeding in three collections, iron deficiency anemia and fiber in one collection, obesity, iodine deficiency and diabetes in two collections and cardiovascular diseases in five collections. One collection provided an incorrect definition of *diet* foods, stating that diet foods are designed for diabetics and do not contain sugar,

Discussion

When the Brazilian secondary education system was reformed in 1996 and regulated in 1998, it was proposed that the new curriculum should educate for life, creating a link between day-to-day experiences and the learning process⁽¹⁵⁾. Considering that eating is an integral part of the daily life of any individual and that nutritional errors lead to countless health problems, knowledge about nutrition should be considered of fundamental importance for promoting the development of conscious eating habits.

Minerals and fiber had the lowest percentage coverage in the textbooks analyzed here. Iron deficiency anemia is the most common deficiency disease in the world, currently affecting around 35% of the human population⁽¹⁶⁾. Vieira and Ferreira⁽¹⁷⁾ conducted a systematic review of the literature followed by a

Table 2 - Relevance of information provided on group 1 variables in the 9 collections analyzed

Group 1 variables	Adequate %	Inadequate %	Absent %
Carbohydrates	0	100	0
Proteins	0	100	0
Fats	0	100	0
Vitamins	0	100	0
Minerals	0	89	11
Water	11	89	0
Fibers	0	33	67
Food pyramid	0	22	78
Breastfeeding	0	33	56

Table 3 - Coverage of information related to group 2 variables in the 9 collections analyze

	Subject %C	Etiology %C	Dietary treatment %C
Cardiovascular diseases	56	56	33
Diabetes	33	33	22
Obesity	22	11	11
Vitamin A deficiency	0	0	0
Folic acid deficiency	0	0	0
Iron deficiency anemia	11	11	11
Iodine deficiency	22	11	22

%C: percentage of the 9 collections in which information is covered

Table 1 - Coverage of information related to group 1 variables in the 9 collections analyzed

	Subject %C	Chemistry/Biochemist %C	Daily Intake %C	Food Sources %C	Functions %C
Carbohydrates	100	100	0	56	78
Proteins	100	100	0	56	89
Fats	100	89	0	56	100
Vitamins	100	33	0	100	78
Minerals	89	33	0	67	89
Water	100	89	22	-	67
Fibers	33	-	0	11	22
Food pyramid	22	-	0	22	22
Breastfeeding	44	22	-	-	11

%C: percentage of the 9 collections in which information is covered

Table 4 - Relevance of information related to group 2 variables in the 9 collections analyzed

	Adequate %	Inadequate %	Absent %
Cardiovascular diseases	33	22	44
Diabetes	22	11	67
Obesity	11	11	78
Vitamin A deficiency	0	0	100
Folic acid deficiency	0	0	100
Iron deficiency anemia	11	0	89
Iodine deficiency	11	11	78

meta-analysis and analyzed the prevalence of iron deficiency anemia in Brazilian children, observing prevalence rates of 35 to 68.8% in samples from schools or daycare, with a weighted average of 52%. It is therefore clear that iron deficiency anemia remains one of the most prevalent diseases among human populations⁽¹⁸⁾. Since adolescents have heightened nutritional iron requirements, they are known to be a group that is at greater risk of developing iron deficiency anemia, which underscores the need to relate students' daily lives to the knowledge they acquire at school.

The viscosity of soluble fiber means that it delays gastric emptying, increasing distension and the sensation of satiety, promoting reduced food intake and, as a result, preventing obesity⁽¹⁹⁾. It is important to remember that 2.6 million people die every year because they are overweight or obese⁽²⁰⁾. Furthermore, soluble fiber is important for diabetes control, because it slows down intestinal transport, which reduces glucose absorption and slows the rate of diffusion into absorbent mucosa. Fiber also appears to prevent enzyme-substrate interaction in the lumen, particularly with relation to pancreatic amylase⁽²¹⁾. In view of this, it is predicted that by 2030 11.3 million people in Brazil will have diabetes, raising it from 8th to 6th rank among the 10 countries with the highest rates of diabetes in the world⁽²²⁾.

It should also be remembered that fiber also reduces intestinal absorption of dietary cholesterol, increasing fecal excretion of biliary acids and reducing their resorption, meaning that the liver is forced to break down more cholesterol in order to replenish biliary acid levels⁽²³⁾. Elevated cholesterol levels are responsible for the deaths of around 4.4 million people every year. Reducing blood cholesterol levels has a substantial protective

effect against heart disease. A 10% reduction in cholesterol levels can reduce a 40-year-old man's risk of heart disease by 50% and for 70-year-olds the mean reduction is 20%⁽²⁰⁾.

These data on obesity, diabetes and dyslipidemia underscore the importance of knowledge about fiber, its functions in the human body, dietary sources and recommended intake.

Cardiovascular diseases, diabetes and obesity are all non-transmissible chronic diseases and were not mentioned in a large proportion of the books analyzed. The information provided was considered inadequate to motivate conscious dietary choices. It is estimated that 388 million people will die from chronic diseases in 2015 and, in contrast to what many people believe, one quarter of the deaths from chronic diseases are of people less than 60 years of age⁽²⁰⁾. This projection can be averted by acquisition of healthy lifestyle habits. The recommended daily intake of carbohydrates, lipids and proteins, which are energy nutrients, can be introduced using the food pyramid, which is an instrument that, if understood correctly, can be used to guide and inform the population, promoting healthy eating choices⁽²⁴⁾. However, this subject was absent from the majority of the textbooks.

People who eat correctly are less susceptible to diseases and are able to maintain a healthy weight without resorting to aggressive dieting⁽²⁴⁾. The food pyramid could be used as an instrument for appropriate food selection and to provide a basis for motivating a change in eating habits among adolescents in order to change the health profile of the population in the future.

Vitamin A deficiency was absent from all of the textbooks analyzed. Vitamin A deficiency is not only known to be harmful to sight, but also increases both infant and maternal mortality. Around 21% of the world's children suffer from vitamin A deficiency and approximately 800,000 deaths of children and women of reproductive age can be attributed to vitamin A deficiency⁽²⁵⁾. Iodine deficiency was dealt with by few of the textbooks.

Iodine deficiency was covered by just 22% of the books and, while it is under control, there are people who suffer from goiter because of this deficiency, probably because they use salt meant for animal consumption. In 2006 there were only 47 countries in which disorders related to iodine deficiency were a public health problem, which has decreased from 54 countries in 2004 and 126 in 1993⁽²⁶⁾.

Folic acid is essential for metabolic reactions, but the implications of this deficiency were not mentioned by any of the books analyzed. Pregnant women and women of reproductive age are classified as at-risk of folate deficiency and neural tube

defects such as anencephaly and spina bifida are the most serious birth defects that can result⁽²⁷⁾. It should be emphasized that nutritional deficiencies are still a cause for concern in Brazil and that very often their consequences are irreversible. Concern with unhealthy dietary habits in childhood and adolescence is not restricted to the problems caused at that age, but is also focused on their maintenance into adulthood⁽²⁸⁾.

Another subject of extreme importance – water – was covered by all of the textbooks, but the daily intake recommendation was only provided by 22% of them. Daily water intake is crucial to human health because it plays a fundamental role in regulating the body, including temperature control, nutrient transport and elimination of toxic substances or of substances that are not used by the body and it also plays a part in digestive, respiratory, cardiovascular and renal processes. It is recommended that adults consume 1ml of water for every Kcal of energy expended and for children the recommendation is 1.5ml/Kcal of energy expended per day⁽¹⁾.

The basic concepts of breastfeeding were absent from more than half of the books analyzed. While the prevalence of breastfeeding has been increasing in Brazil over recent years, 35% of children under the age of 6 months are still not being breastfed⁽²⁹⁾. Breastfeeding should be the first nutritional practice to be encouraged for health promotion, the formation of healthy dietary habits and the prevention of many different diseases⁽¹⁾, because the specific nutritional composition of breastmilk keeps in line with children's requirements as they grow, confers protection against infections and diarrhea, strengthens the musculature of the face and mouth, preventing future problems with speech and dental occlusion⁽²⁸⁾, improves growth velocity and appears to have a protective effect against childhood obesity, reducing its repercussions in adolescence and adulthood^(30,31). If this subject were dealt with more effectively in textbooks, it would act to prevent diseases.

The following question must be asked with regard to subjects that are treated as supplementary reading, "Are these subjects brought up and discussed in the classroom or are they only given as reading tasks to be done at home, with no follow-up in the classroom?" The answer to this question could completely change the extent to which the concepts are assimilated and habits modified, since tasks set for homework may or may not actually be done.

According to the Brazilian regulatory authority's directive number 29, which was published on 13th January of 1998⁽³²⁾ and has the force of law, the term "diet" may, optionally, be used in two situations; to describe foods with nutrient restrictions and for foods designed to be used when nutrient intake

is controlled, as in the case of weight control or diets with a controlled sugar level. This being so, the information provided in one of the collections analyzed is incorrect, since, in addition to *diet* foods not being exclusively related to restriction of sugar they are also not intended exclusively for diabetics.

The existence of a Brazilian national textbook program⁽³³⁾, means that textbooks are an important information vehicle for all students who attend public schools and so Biology textbooks in particular must cover concepts that are relevant to knowledge about, and probably acquisition of, healthy habits. It is in this context that textbooks are truly important to the process of nutritional education at school, since this environment is especially suited to adolescent health promotion. The goal of nutritional education is to develop systematic strategies that value nutrition, in addition to changing the beliefs, values, attitudes, modes of representation, practices and social relations that build up around nutrition^(5,34), Neumark-Sztainer *et al.*⁽³⁵⁾ explain how teachers can facilitate nutritional education and the development of healthy dietary habits by disseminating nutritional information through formal interaction and can serve as role models through informal interaction, but many teachers have no training in nutrition and may pass on incorrect information or unhealthy models of eating behavior. Individual people, as citizens, both need and have a right to information about health, which includes nutrition, in order to be able to play a positive role in the government's programs to combat nutritional deficiencies and public health diseases. In addition to the government's responsibility, individual people will exercise their citizenship if they are well-informed.

In the light of the facts presented and the results of the analysis conducted, it is concluded that the information on nutrition provided by the biology textbooks used in Brazilian secondary education is insufficient to have an influence on dietary habits, modifying them through knowledge acquisition. Paradoxically, textbooks, which are an important tool for the dissemination of knowledge about nutrition, within reach of millions adolescents, are being insufficiently exploited for the purposes of nutritional education and health promotion. The adolescents in our country still lack sufficient guidance to counter the tendency towards non-transmissible chronic diseases and increased nutritional deficiencies, potentiating harm to the health of the population in the future. Measures that will aid with prevention of harm to the health of future adults must be adopted, and urgently, by including nutritional education in the school curriculum and by reviewing the content of textbooks, since knowledge is a step towards exercise of citizenship and making government public health initiatives effective.

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