Food consumption, physical activity level and sedentary behavior in schoolchildren

Consumo alimentar, nível de atividade física e comportamento sedentário em escolares

Alex Pinheiro Gordia[1]
 https://orcid.org/0000-0002-9064-9254
Jadiane Aparecida Tiago Dall'Agnol[2]
 https://orcid.org/0000-0002-1101-6927
Edmar Lacerda Mendes[3]
 https://orcid.org/0000-0001-8182-8296
Amanda Santos[4]
 http://orcid.org/0000-0003-2866-846X
Camilo Luis Monteiro Lourenço[5]
 https://orcid.org/0000-0003-0231-1702
Teresa Maria Bianchini de Quadros[1]
 https://orcid.org/0000-0002-7875-334X
Alynne Christian Ribeiro Andaki[3]
 https://orcid.org/0000-0002-6486-2326

Abstract – Dietary intake inquiry, physical activity (PA) and sedentary behavior (SB) surveys are practical tools for identifying habits among the pediatric population; however, the results of describing these behaviors appear to be restricted to large centers. The objective was to analyze dietary intake, PA and SB level in schoolchildren. Children from 6 to 10 years old, coming from public and private schools were evaluated for anthropometry, dietary pattern, PA and SB level. A total of 1408 children (48.1% male) with a mean age of 8.05 (± 1.53) years participated in the study. Only 4.6%, 4.9% and 17.2% of children met the recommendations for fruit, milk and dairy products, respectively. 40.4% and 59.5% of the children did not meet the recommendation for soft drinks and meat consumption, respectively. More than 75% of children met the recommendation for the consumption of packaged snacks, candies and beans. There was a difference between genders only for candy consumption (p=0.003), with a higher proportion of boys meeting the recommendations. Approximately half and one third of the children complied with the recommendations for moderate to vigorous PA and SB, respectively. Risk behaviors for cardiovascular disease were observed in children, characterized by low consumption of fruits and vegetables, low levels of PA and excessive time in SB.

Key words: Cross-sectional studies; Food consumption; Motor activity; Pediatric Obesity; Sedentary behavior.

Resumo – *Inquéritos de consumo alimentar, atividade física (AF) e comportamento sedentário (CS) constituem instrumentos práticos na identificação de hábitos entre a população pediátrica. No entanto, os resultados de descrição desses comportamentos parecem estar restritos a grandes centros. Objetivou-se analisar consumo alimentar, nível de AF e CS em escolares. Crianças de seis a 10 anos de idade, oriundas de escolas públicas e privadas foram avaliadas quanto à antropometria, padrão dietético, nível de AF e de CS. Um total de 1408 crianças (48,1% do sexo masculino) com média de idade de 8,05 (± 1,53) anos participou do estudo. Apenas 4,6%, 4,9% e 17,2% das crianças atenderam às recomendações de consumo de frutas, leite e derivados e verduras/legumes, respectivamente. Não atenderam a recomendação para consumo de refrigerante e carnes 40,4% e 59,5% das crianças, respectivamente. Mais de 75% das crianças atenderam a recomendação para o consumo de salgadinho de pacote, doces e feijão. Houve diferença entre os sexos somente para o consumo de doces (p=0,003), com maior proporção de meninos a atender as recomendações. Aproximadamente, metade e um terço das crianças atenderam as recomendações para prática de AF de moderada a vigorosa intensidade e de CS, respectivamente. Comportamentos de risco para doenças cardiovasculares foram observados nas crianças, caracterizado pelo baixo consumo de frutas e verduras/legumes, baixos níveis de AF e excessivo tempo em CS.*

Palavras-chave: *Atividade motora; Comportamento sedentário; Consumo de alimentos; Estudos transversais; Obesidade pediátrica.*

INTRODUCTION

Prevalence of overweight and obesity is on the rise not only in developed countries, but also among developing ones[1]. It is believed that modernization has contributed to the consumption of unhealthy food and sedentary lifestyles, observed by the increasing use of electronic devices and reduced practice of physical activity (PA), no matter how simple and fun these practices may be[2].

Noncommunicable chronic diseases (NCDs) such as diabetes mellitus, hypertension, dyslipidemia, and heart disease are the leading causes of morbidity and mortality worldwide[3]. The high consumption of so-called "unhealthy" foods such as fast foods, soft drinks and candies associated with a sedentary lifestyle in childhood contribute to an increased likelihood of developing NCDs during adulthood[4]. On the other hand, the adoption of a healthy lifestyle, which includes eating fruits, vegetables, dairy products, foods with less fat and sugar content and regular practice of PA, has a positive impact on physical and mental development during childhood, contributing to the prevention and early management of NCDs and overweight[5].

Food consumption surveys are practical tools to identify eating habits and assist professionals in nutritional diagnosis. Among the methods used for school-age children, the illustrated QUADA-3[6] recall has advantages such as practicality, good cost/benefit ratio, and easy application in the school environment. The measurement of PA is a complex process, especially in children, because it involves many domains, namely, the leisure, domestic, transportation and occupational domain. Nevertheless, the List of Physical Activities (LPA)[7], whose Brazilian version has already been cross-culturally adapted and validated[8], is a powerful tool for this purpose.

There is a body of accumulated evidence regarding the impact of inappropriate eating habits and sedentary behavior (SB) on adverse health events among children[9]. However, information regarding the pediatric population on the prevalence of unhealthy behaviors is still insufficient[6,10–13], especially in large municipalities other than the Brazilian capitals. Thus, epidemiological surveys to support public intervention policies related to the control of overweight/obesity and its comorbidities are necessary. In this sense, the present study aimed to evaluate the dietary intake, PA and SB level in students from six to 10 years old.

METHODS

Study type and design

This is a population-based, epidemiological, cross-sectional study with a probabilistic sample of children aged 6 to 10 years, from public and private schools in the city of Uberaba, MG - located 481 kilometers from the state capital, Belo Horizonte, with a population of 295,988 inhabitants and Human Development Index of 0,772, thus classified as high. This study is

reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative[14].

Participants

The study included children of both sexes born between 2001 and 2005 who met the following inclusion criteria: non-use of medication, not being on a calorie restriction diet, and presentation of authorization from guardians. The chronological age of the children was determined by subtracting the data collection date from the date of birth.

Population and sample

The statistical software Epi Info™ (version 3.5.3) was used for calculation of a representative sample. The number of children enrolled in elementary school (1st to 9th grade) was considered for the population estimate; the prevalence of national overweight was 38/100 with estimated error of 3.0% and 95% confidence interval. A sample size of 979 children was obtained and after an increase of 10% to compensate for losses and refusals, the total sample size was 1076 children.

For sample selection, the schools were stratified according to the teaching segment: municipal, state and private. Within each stratum, schools were randomly selected with the help of a table of random numbers. The number of children in each stratum was determined proportionally to the number of enrollments, according to data provided by the State Department of Education. Of the 94 schools in the city of Uberaba, 15 were randomly selected, among seven municipal, six state and two private schools, respecting the criterion of proportionality. After consideration of the ethical aspects (see subsection below), the principals of the selected schools were contacted for authorization and scheduling of collections.

Collection instruments, variables and procedures

Once authorized by guardians, the assessment of anthropometric data and level of PA, and application of the Previous Day Food Questionnaire (QUADA-3) took place at the school, following specific protocols for measurements.

Body mass was obtained using a digital electronic scale (Plena, Lumina 02550) with a maximum capacity of 150 kg and 100 g accuracy, according to standard techniques[15]. Height was obtained using a portable meter for people (Welmy) with a length of 2 m and a scale of 0.1 cm, following standardized norms[15]. Body mass index (BMI) was calculated using the formula: BMI = body mass/height^2 (m). For the classification of overweight and obese children, the criteria developed by Cole et al.[16] were used.

Food intake was estimated using the QUADA-3[17]. This questionnaire was designed to assess the dietary intake of school-age children and was answered in the school environment[17]. The QUADA-3 is an illustrated tool, designed as a reminder to obtain data on food intake in the previous day from schoolchildren. Six chronologically ordered meals are illustrated:

breakfast, morning snack, lunch, afternoon snack, dinner, and evening snack. Each meal contains 21 different foods or food groups. This instrument was previously submitted to two validation studies among schoolchildren from 6 to 11 years old.

For presentation of the instrument to the students, four banners (1.20 x 90 cm) were printed, each with two meals. Each child received a sheet with the same banner images. At this point, the children were given explanations of the illustrated meals and foods and then circulated on their sheet what they had eaten at each meal the day before. To avoid memory bias, at each meal presented on the banner, the children were encouraged to remember the foods consumed the day before and the time they had that meal. If the student had not eaten a meal, he/she should leave it blank, without checking the food. All children involved in the study responded with the help of an evaluator trained to use the instrument. The foods were grouped and classified as sweets (stuffed biscuit, cake, ice cream, candy and lollipop), milk and dairy products (milk, cheese and yogurt) and meat (beef, chicken and fish). For the daily recommendations of the food groups, the proposal of the Brazilian Ministry of Health was adopted: soft drinks and snacks = 0; sweet foods = 1; meat = 2; milk and dairy products, vegetables and fruits = 3.

Overweight and obese children were instructed to fill out a three-day food record consisting of a pre-structured form to record all foods and beverages consumed and their quantities for two typical days and one atypical day (weekend)[18]. To avoid memory bias, the children were instructed, with the help of their guardians, immediately after meals to record the food and the amount ingested. The software Avanutri online version was used for the analysis of the data obtained by the Food Record. The assessment of energy consumption was made based on the comparison of the energy intake of each child with the recommended energy need for each gender and age group[19]. Dietary Reference Intakes (DRIs) were used to analyze macronutrient consumption, with recommendations ranging from 10% to 30% of the total energy value (TEV) in the case of proteins, 25 to 35% of the TEV in the case of lipids, and 45 to 65% of TEV % in the case of carbohydrates[19].

The time engaging in PA was obtained based on the List of Physical Activities (LPA) instrument, which is the Brazilian version of the Physical Activity Checklist Interview[7]. The PAL was proposed and validated by Sallis et al.[7] in American children and comprises PA practiced the day before the interview. Thus, the application is limited to school days, excluding Monday. The original study was developed with students of both genders of the 5th grade[7]. The LPA was submitted to cross-cultural adaptation, with conceptual equivalence of items and semantics, for the Brazilian Portuguese version, and validated to be used with children from 7 to 10 years old[8].

The LPA has general application guidelines, including instructions for the interview and a script of guiding questions. The instrument is divided

into sections A, B and C. In section A, child data such as code, name, age, gender, and grade are noted. Section B is designed to record moderate to vigorous PA (MVPA) (21 possibilities), engagement time and intensity, plus screen time (time spent on TV, playing video games, and using a computer) in the previous day. Section C is intended for the evaluator to rate the quality of the interview.

The LPA was applied by trained evaluators and in individual interviews. The interviewer encouraged the children to remember their previous day with questions such as: "What time did you wake up yesterday?"; "Did you play anything in the morning?"; "Did you watch any cartoons?"; "What time did you have lunch?"; "Did you go to school walking, by bike or by car?"; "Did you take Physical Education class yesterday?"; "What did you do during the interval?"; "After class, did you stay at home?; "Did you go outside to play?"; "Did you watch any soap opera or movie?"; "What time did you sleep?"

The reported time of engagement in PA was recorded in minutes, with the aid of images of a clock and geometric figures representing minutes to aid the children to estimate the time. Involvement in MVPA ≥ 60 min/day was considered satisfactory[20]. Screen time was considered the operational measure of SB among children, adopting the time < 2 h/day as the cutoff point for classification[21].

Ethical aspects

This study was approved by the Research Ethics Committee of the Federal University of Triângulo Mineiro (UFTM), protocol CEP/UFTM-2003/2011. Students received the Informed Consent Form for their parents to be aware of the study.

Statistics

Data were expressed as means (standard deviations), and absolute and relative frequencies. Data normality was checked by the Kolgomorov-Smirnov test. Comparisons between mean values of continuous anthropometric, health and behavioral variables were made using the Student's t-test and the Mann-Whitney test, in cases of parametric and nonparametric distribution, respectively. Comparisons of proportions between categorical variables were performed by the Chi-square test. The adopted significance level was 5%. The database was structured using Epidata version 3.1 and statistical analyses were made using SPSS 20.0 software.

RESULTS

A total of 1,408 children from 6 to 10 years old from the school system of Uberaba-MG (48.1% female) were evaluated. The mean age was 8.05 ± 1.53 years, body mass 30.5 ± 9.6 kg, height 130 ± 10 cm, and BMI 17.49 ± 3.54 kg/m². More than a quarter of the study sample was classified as eutrophic (75.9%), while 3.2%, 14.8% and 6.1% were classified as under-

weight, overweight and obese, respectively. Overweight was associated with sex, being more prevalent among girls (p = 0.021) (Table 1). Among the total number of children evaluated, 107 children were excluded from the questionnaire (QUADA-3) and 129 from the LPA due to incomplete forms or repeated answers in all items.

Table 1. Classification of nutritional status in schoolchildren from 6 to 10 years old, according to sex. Uberaba, MG, 2012.

Sex	n	Overweight n (%)	Obesity n (%)	p-value
Girls	730	127 (17.5)	44 (6.1)	0.021
Boys	678	82 (12.1)	41 (6.1)	

Apparent dietary intake was below the recommended for the milk and dairy products, vegetables and fruits. There was also a significant difference (p = 0.003) between the proportions for sweet food consumption among boys and girls, with higher values for males (Table 2). The consumption of soft drinks and packaged snacks was low, and for soft drinks, almost half of the children analyzed reported not consuming any portion/day, and more than half (76.8%) reported not having consumed packaged snacks on the previous day (Table 2).

Table 2. Distribution of compliance with the daily recommendations of food groups among schoolchildren from 6 to 10 years old, according to sex. Uberaba, MG, 2012.

Food groups	Recommended (nº of servings)	Total (%)	Boys n=602 n (%)	Girls n=699 n (%)	p-value
Sweet foods	1	82.7	518 (86.1)	557.8 (79.8)	0.003
Soft drinks	0	40.4	246 (40.3)	271 (40.3)	1.000
Packaged snacks	0	76.8	474 (77.7)	510 (75.9)	0.443
Milk and derivatives thereof	3	4.9	29 (4.9)	35 (5.1)	0.908
Vegetables and greens	3	17.2	105 (17.5)	115.3 (16.5)	0.626
Fruits	3	4.6	21 (3.6)	37 (5.4)	0.134
Meat	2	59.5	372 (61.8)	401 (57.4)	0.112
Bean	1	84.9	498 (82.8)	605 (86.6)	0.57

Dietary records of overweight and obese children were analyzed according to the energy recommendation for each age group. Of the analyzed records, 58.92% presented energy consumption above the recommended. Regarding macronutrient values, it was observed that 19.64%, 57.15% and 51.79% of the children consumed protein, carbohydrate and lipids above the recommended value, respectively.

According to Table 3, 51.2% and 56.4% of female and male children, respectively, complied with the recommendation to practice PA for at least 60 min/day, with no significant association between sexes (p = 0.063). As for SB, 32.8% of girls and 35.0% of boys met the recommendation, with no significant difference between sexes (p = 0.400).

Table 3. Classification of the practice of physical activity and sedentary behavior in schoolchildren from 6 to 10 years old, according to sex. Uberaba, MG, 2012.

Recommendations	Girls n=683 n (%)	Boys n=617 n (%)	p
MVPA ≥ 60 min	350 (51.2)	348 (56.4)	0.063
MVPA < 60 min	333 (48.8)	269 (43.6)	
ST < 2h	224 (32.8)	216 (35.0)	0.400
ST ≥ 2h	459 (67.2)	401 (65.0)	

Note. MVPA = moderate to vigorous physical activity; ST = screen time.

DISCUSSION

This study aimed to analyze the dietary intake, PA and level of SB in a representative sample of schoolchildren aged 6 to 10 years in a medium-sized municipality in the Southeast region of Brazil. The results showed a high prevalence of overweight and obesity, apparent inadequate dietary intake, as well as low level of PA and high level of SB among the students. This scenario suggests the need for measures that encourage and enable adherence to healthier behaviors among the children investigated, aiming at a positive impact on their current and future health.

The prevalence of obesity observed here was lower than that reported by the meta-analysis conducted by Aiello et al.[22], in which the overall prevalence of obesity was 14.1%; 16.1% among boys and 14.95 among girls. In the present study, the prevalence of overweight was higher among girls, a result that is similar to that presented by Ferrari et al.[23]. High prevalence of overweight/obesity among schoolchildren is mainly associated with modifiable behavioral factors such as insufficient practice of PA, excessive screen time, and unhealthy eating habits.

Food consumption of dairy products, vegetables and fruits below the recommended by the Ministry of Health[24] was observed for the age group described. Similar findings were found by Assis et al.[6], who reported only 15% of schoolchildren (7-10 years) met the recommendations for fruits and vegetables. Reduced consumption of fruits, vegetables and dairy products may be associated with unhealthy eating habits of those responsible, or even the direct contact of students with the media[25]. Moreover, according to Triches and Giugliani[26], the low consumption of milk and dairy products is associated with childhood obesity, as children replace healthy foods with high-calorie foods.

Consumption of simple carbohydrate-rich foods (sweets) did not exceed daily consumption recommendations in the case of most of the children evaluated, with a higher proportion of care among girls. Regarding the consumption of soft drinks and snacks, it was observed that half of the children analyzed reported not consuming any portion on the previous day. Assis et al.[8] observed similar results to those presented in this study; 51.8% and 27.7% of the children reported not having consumed snack foods and soft drinks on the previous day, respectively. It is speculated that the high proportion of children who met the recommendation for sweet foods and

soft drinks may be explained by the limitation found in the instrument itself. According to Assis et al.[17], children tend to omit the consumption of sweet foods and soft drinks because they know they are not recommended foods, or even because they ate some food items that are part of this food group but that are not illustrated in the same way in QUADA-3.

In the present study, a high percentage of children were observed to meet the recommendations for meat and bean consumption, as observed by Costa et al.[10]. High consumption of these food groups probably is a result of cultural issues related to the eating habits of Brazilians. Furthermore, it is worth mentioning that the National School Feeding Program provides for the routine provision of these foods in school meals[27].

Regarding the level of PA, approximately 50% of the children analyzed in the present study did not meet the recommendations of ≥ 60 min/day of moderate to vigorous PA. The replacement of motor activities by sedentary behaviors has been the focus of the latest scientific studies in the area, mainly due to the greater involvement of children in the early use of screen-based technologies. Our findings showed that approximately 75% of children had SB above the recommended two hours, similarly as observed in other studies[28,29]. Still, SB has been associated with unhealthy eating habits, high body mass and low levels of PA in Brazilian children and adolescents[11,12]. This scenario of decreased PA and increased time in sedentary behaviors is worrying, especially during childhood, as it considerably increases the likelihood of developing obesity and its comorbidities[30].

The instruments used to measure dietary intake and PA level are of the recall type and then subject to the respondents' memory bias. However, in order to circumvent this limitation of the method, the collection team was rigorously trained to guide to rescue in the memory of the children episodes of PA, SB and the dietary intake on the previous day in order to minimize possible forgetfulness.

CONCLUSION

Low consumption of fruits, vegetables, milk and derivatives was observed in most of the sample investigated, as well as a high proportion of students who did not follow the recommendations of PA and SB. The results support the indication of the development of public policies based on actions of food reeducation and promotion of PA aiming to provide culturally relevant behavioral changes for the investigated population. The school environment needs to be included in this process, as it represents a promising space for health actions during childhood.

COMPLIANCE WITH ETHICAL STANDARDS

Funding

Ethical approval

Ethical approval was obtained from the local Human Research Ethics Committee – University Federal do Triângulo Mineiro and the protocol (no. 2003/2011) was written in accordance with the standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed the experiments: APG; JAT and ELM. Performed the experiments: APG; JAT and ELM. Analyzed the data: JAT; AS; CLML; APG; TMBQ and ELM. Contributed reagents/materials/analysis tools: JAT; AS; CLML; APG; TMBQ and ELM. Wrote the paper: JAT; AS; CLML; APG; TMBQ and ELM.

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Corresponding author
Alex Pinheiro Gordia
Universidade Federal do Recôncavo da Bahia
Centro de Formação de Professores
Av. Nestor de Melo Pita, 535 - Centro, Amargosa.
Bahia, Brasil. CEP: 45300-000
E-mail: alexgordia@gmail.com