Dietary assessment of schoolchildren: is food record a valid method?

Avaliação do consumo alimentar de escolares: o recordatório é um método válido?

Evaluación dietética de los niños escolares: ¿es el registro de alimentos un método válido?

Laura Rangel Drummond de Menezes
ORCID: https://orcid.org/0000-0002-8422-9747
Federal University of Minas Gerais, Brazil
E-mail: lauramenezes17@gmail.com
Mariana Souza Lopes
ORCID: https://orcid.org/0000-0002-4624-6589
Federal University of Minas Gerais, Brazil
E-mail: marianalopes.ufmg@gmail.com
Aline Elizabeth da Silva Miranda
ORCID: https://orcid.org/0000-0001-9826-1409
Federal University of Minas Gerais, Brazil
E-mail: alineesnutri@hotmail.com
Márcia Christina Caetano Romano
ORCID: https://orcid.org/0000-0002-1819-4689
Federal University of São João del Rei, Brazil
E-mail: marciachristinacs@ufsj.edu.br
Luana Caroline dos Santos
ORCID: https://orcid.org/0000-0001-9836-3704
Federal University of Minas Gerais, Brazil
E-mail: luanacstos@gmail.com

Abstract
Objective: To verify the relative validity of 24-hour Dietary Recall (R24h) as an assessment tool of schoolchildren´s food intake. Methods: A cross-sectional study of 41 students of a big Brazilian urban center, with a mean age of 0.25–8.35 years and 22% had excess weight. The R24h was applied a day after direct observation of intake (reference method). Weight and height were measured and the participants were categorized according to nutritional status (excess weight or not). The median energy, macronutrients (carbohydrate, protein and lipid) and micronutrients intake (iron, calcium and vitamin A) was compared. The Mann-Whitney test was conducted. Also, Spearman and kappa correlation coefficients were calculated. Results: Median energy and nutrient intake irrespective of nutritional status was similar according to the test and reference methods. Higher correlations were found for protein (r= 0.87) and iron (r = 0.71) but the values were more accentuated among students with excess weight. Kappa coefficient was low for vitamin A, moderate for carbohydrate and lipid, good for iron and protein, and very good for energy. Conclusions: R24h is a valid method for the assessment of food intake among schoolchildren. It is a potential practical and economical food assessment method, which can find application in epidemiological studies focused on food intake in early life.
Keywords: Food consumption; Validation studies; Food Intake; School feeding; Students.

Resumo
Objetivo: Verificar a validade relativa do Recordatório Alimentar de 24 horas (R24h) como instrumento de avaliação do consumo alimentar de escolares. Métodos: Estudo transversal com 41 estudantes de um grande centro urbano brasileiro, com média de idade de 0,25 a 8,35 anos e 22% com excesso de peso. O R24h foi aplicado um dia após a observação direta da ingestão (método de referência). Peso e altura foram medidos e os participantes categorizados de acordo com o estado nutricional (excesso de peso ou não). Comparou-se a mediana da ingestão de energia, macronutrientes (carboidratos, proteínas e lipídios) e micronutrientes (ferro, cálcio e vitamina A). O teste de Mann-Whitney foi realizado. Além disso, foram calculados os coeficientes de correlação de Spearman e kappa. Resultados: A mediana da ingestão de energia e nutrientes, independentemente do estado nutricional, foi semelhante de acordo com os métodos de teste e referência. Correlações mais altas foram encontradas para proteína (r = 0,87) e ferro (r = 0,71), mas os valores foram mais acentuados entre os alunos com excesso de peso. O coeficiente Kappa foi baixo para vitamina A, moderado para carboidratos e lipídios, bom para ferro e proteína e muito bom para energia. Conclusões: o R24h é um método válido para avaliação do consumo alimentar de escolares. É um método potencialmente prático e econômico de avaliação de alimentos, que pode encontrar aplicação em estudos epidemiológicos voltados para a ingestão de alimentos na infância.
Palavras-chave: Consumo alimentar; Estudos de validação; Ingestão alimentar; Alimentação Escolar; Estudantes.

Resumen
Objetivo: Verificar la validez relativa del Food Recall de 24 horas (24hR) como instrumento para evaluar el consumo de alimentos de los escolares. Métodos: estudio transversal con 41 estudiantes de un gran centro urbano brasileño, con una edad media de 0,25 a 8,35 años y un 22% de sobrepeso. La R24h se aplicó un día después de la observación directa de la ingestión (método de referencia). Se midieron el peso y la altura y se categorizó a los participantes según su estado nutricional (con o sin sobrepeso). Se comparó la ingesta media de energía, macronutrientes (carbohidratos, proteínas y lípidos) y micronutrientes (hierro, calcio y vitamina A). Se realizó la prueba de Mann-Whitney. Además, se calcularon los coeficientes de correlación de Spearman y kappa. Resultados: La ingesta media de energía y nutrientes, independientemente del estado nutricional, fue similar según los métodos de prueba y de referencia. Se encontraron correlaciones más altas para proteína (r = 0,87) y hierro (r = 0,71), pero los valores fueron más pronunciados entre los estudiantes con sobrepeso. El coeficiente Kappa fue bajo para la vitamina A, moderado para los carbohidratos y lípidos, bueno para el hierro y las proteínas y muy bueno para la energía. Conclusiones: el R24h es un método válido para evaluar el consumo de alimentos de los escolares. Es un método potencialmente práctico y económico de evaluación de alimentos, que puede encontrar aplicación en estudios epidemiológicos centrados en la ingesta de alimentos en la infancia.
Palabras clave: Ingestión de alimentos; Estudio de validación; Alimentación escolar; Estudiantes.

1. Introduction

Healthy and adequate food intake is indispensable for children growth and development. Impaired growth and development related to poor nutrition can affect a child´s learning capacity as well as increase his/her susceptibility to diseases (Conceição et al., 2010).

There is a growing trend of excess weight among school children. In the United States, the incidence of excess weight among schoolchildren increased from 4 to 16.4% among boys and 4.5 to 19.1% among girls between 1970 and 2012 (Fryar et al., 2014). A similar trend is observed in Brazil from 2.9 to 16.8% among boys aged 5 to 9 years and 1.8 to 11.8% among girls (Instituto Brasileiro de Geografia e Estatística, 2010). Knowledge on calorie intake alone is not efficient for the evaluation of nutritional status of children, especially because nutrient adequacy is neglected. Thus, there is the need to evaluate the nutritional status of children through food intake and the efficiency of public policies focused on children´s nutrition (Sichieri & Souza, 2008).

The selection of appropriate food assessment instruments for children is a challenge due to intrinsic age-specific errors. In early life, children are in the phase of cognitive development which can limit the consistent recall of food intake, time, food names and preparation methods and amount consumed (Livingstone & Robson, 2021). In addition, dependence on information relayed by parents about the child´s intake could limit the reliability of the assessment as many parents work outside the home (Rennie & Livingstone, 2007).

Food assessment instruments designed for children are few and their application depends on factors such as time and cost. In this context, the 24-hour Food Recall (R24h) emerges as a relatively inexpensive and quick alternative that does not influence information provided by the child. However, little is known about the validity of the assessment method among school-age children (Livingstone & Robson, 2021).

Thus, the present study verified the relative validity of R24h as an assessment instrument of schoolchildren´s food intake.

2. Methodology

Design and study population

The study is relative validity study of R24h for the assessment of food intake among second-grade schoolchildren in municipal school of a Brazilian metropolis. The schoolchildren are beneficiaries of the Integrated School Program characterized by a nine-hour school day. The program provides regular basic education and services associated with public policies (culture,

social assistance, environment, health, science and technology) in order to integrate the various dimensions of human development (Moll, 2008). The children of the program eat three meals a day at school.

Study Sample

The study sample was estimated based on the Hulley correlation test criteria (Hulley et al., 2000). A correlation coefficient of 0.6 was determined which indicated satisfactory agreement between the methods (Willett & Lenart, 2013). A significance level of 5%, test power of 95%, 20% sample loss were utilized. Thus, the estimated sample size was 36 students.

The sample consisted of 41 students of a big Brazilian urban center, with a mean age of 0.25–8.35 years and 22% had excess weight.

Data collection

Face-to-face interviews and anthropometric measurements (weight and height) were conducted by trained interviewers from October and November 2018, with a questionnaire gathering assessment of food intake were collected. Demographic data (age, sex and name of guardians) were obtained from school documents.

Measures

Anthropometric data

The anthropometric was assessed according to recommended techniques (Ministério da Saúde, 2008). Weight was measured on a Marte® electronic scale, model LC 200 PS with a capacity of 200 kg and a precision of 50 g. Height was measured by a portable Height Exata® stadiometer with a capacity of 220 cm and an accuracy of 0.5 cm. Body mass index (BMI = weight / height^2) was calculated and classified according to the World Health Organization growth curves (Onis et al., 2007) with the aid of the WHO Anthro Plus version 3.2.2 software. The participants were classified according to the absence or presence of excess weight (overweight and obesity categories; Z score> +1).

Food intake

The assessment of food intake consisted of direct observation (reference method) of three school meals and the application of a R24h (test method) on a consecutive day.

The direct observation of breakfast, lunch and afternoon snack was conducted by trained collaborators and using a standardized protocol. And, for this purpose, each child was identified by name and color badge (each color corresponding to an observer). Each observer was responsible for five students. During mealtimes, the observer shared the same table with the students he/she was monitoring. The foods consumed were recorded in individual records in household measurments, number of repetitions and leftovers. In relation to reference method, we chose direct observation over approximation measurements due to its objectivity and good performance as shown by other validation studies (Edmunds & Ziebland, 2002; Kohlmeier & Bellach, 1995) in addition to being an independent method for the children's report.

A day after direct observation, a recall of the three observed meals was conducted via a R24h. The instrument was applied by a trained team. A kit composed of common household measures and utensils were presented to the children to facilitate accurate reporting and estimation of food quantities.

The application of the R24h followed the five-step multiple-pass method (United States Department of Agriculture, 2021), which stimulates respondent's memory and increases accuracy of reported information (Baxter et al., 2016).

The data obtained from each method, teste and reference, were transformed into weight (gram) and volume (mL) and subsequently, related to nutritional compositions according to the methodology proposed by the Brazilian Institute of Geography

and Statistics (IBGE) (Ministério do Planejamento, Orçamento e Gestão, 2011) for processing food data of the Family Budget Survey (Otten et al., 2006). The calories, macro and micronutrient from the three meals were estimated. Calcium, iron and vitamin A were evaluated because they are essential micronutrients for children and have considerable prevalence of deficiencies in the world.

Individual energy requirements were estimated according to age group, sex and nutritional status, using the Estimated Energy Requirement (EER) (IOM, 2006) (Otten et al., 2006) and a minimum and maximum variability (EER ± 2DP).

The prevalence of inadequate energy intake was calculated by comparing energy intake of each student with estimated energy needs. Inadequate intake of macro (protein, carbohydrate and lipid) and micronutrients (iron, calcium, vitamin A) was calculated using Acceptable Macronutrient Distribution Range (AMDR) (IOM, 2006) (Otten et al., 2006) and EAR (Estimated Average Requirement) values. (IOM, 2006; IOM, 2011), respectively (Institute of Medicine, 2011; Otten et al., 2006).

Since we evaluated three meals of the total daily meals eaten by the children, adequacy calculations were performed with a compliance of 70% recommended intake as proposed by the National School Feeding Program (Callegari-Jacques, 2009).

Statistical analysis

All the analyses were performed using the Stata Statistical Software version 14.2 and a significance level of 5%. The descriptive data were presented as median and interquartile range. Initially, a descriptive analysis of the quantitative variables was performed, the Shapiro Wilk test was applied.

The analysis of validation was stratified by nutritional status (with and without excess weight). The median intake obtained by the reference and test methods were compared using the Mann-Whitney test.

Therefore, the Spearman correlation was calculated to identify the relationship of the quantitative variables between the methods, adjusted and unadjusted according to the student's nutritional status. The classification proposed by Callegari-Jacques (Callegari-Jacques, 2009) was used.

The children were classified according to adequate energy, macro and micronutrients intake. The agreement between the classification of consumption (adequate and inadequate) between test and reference method was assessed using the Kappa statistics (Landis & Koch, 1977). Adequacy (percentage) was compared using Kappa coefficients stratified by nutritional status

Ethics

The guardians of the children signed an informed consent form to participate in the study as well as permitting the participation of their children. The study was approved by the Research Ethics Committee of the Federal University of Minas Gerais (CAAE 00734412.0.0000.5149).

3. Results and Discussion

Forty-one children participated in the study, 59% male, with a median age of 8.35 (8.17; 8.58) years old and 22% with excess weight.

Table 1 – Intake of energy, macro and micronutrients of students according to direct observation and 24-hour recall, Belo Horizonte-Minas Gerais, Brazil, 2018 (n 41).

	Reference Method Direct observation		Teste R24h		
	Median	p25-p75	Median	p25-p75	P value
Energy (Kcal)	592.97	445.21; 727.79	608.52	415.18; 717.08	0.64
Carbohydrate (%)	52.50	49.80; 63.34	54.71	49.62; 62.96	0.76
Protein (%)	19.83	12.70; 23.52	19.37	14.40; 25.16	0.53
Lipid (%)	25.27	22.00; 27.83	25.71	20.98; 28.18	0.84
Iron (mg)	3.45	2.34; 4.25	3.24	2.15; 3.79	0.30
Calcium (mg)	136.45	60.70; 267.40	143.19	56.50; 269.21	0.93
Vitamin A (ug)	186.41	96.13; 240.66	131.56	59.86; 165.04	**0.05**

Kcal = Kilocalories; mg = miligrans; ug=microgram; R24h = 24 hour dietary recall; P25, 25th percentile; P75, 75th percentile.
Source: Authors.

Median calorie intake was 592.97 (445.21;727.79) kcal and 608.52 (415.18; 717.08) according to the reference and test methods, respectively and did not present significant differences (Table 1). Macro and micronutrient intake was also similar for both methods irrespective of nutritional status (data not shown).

The correlations between the test and reference methods were moderate to strong. For energy, carbohydrates, protein and lipids intake, a strong correlation was found (0.70; 0.67; 0.87; 0.71 respectively, p <0.05). For micronutrients, a strong correlation was observed for iron (0.73) and calcium (0.60) and moderate for vitamin A (0.52).

Table 2 - Correlation between energy, macro and micronutrients of the two studied methods- 24h dietary recall and Direct Observation. Belo Horizonte-Minas Gerais, Brazil, 2018.

	Nutritional status		
	Total n=41	No excess weight n= 32	Excess weight n= 09
Energy (kcal)	0,70*	0,62*	0,91*
Carbohydrate (g)	0,67*	0,58*	0,93*
Protein (g)	0,87*	0,87*	0,73*
Lipid (g)	0,71*	0,65*	0,90*
Iron (mg)	0,73*	0,70*	0,93*
Vitamin A (ug)	0,52*	0,54*	0,35
Calcium (mg)	0,60*	0,61*	0,65*

Note: Kcal = Kilocalories; mg = miligrans; ug=microgram; R24h = 24 hour dietary recall. * Test of significance of Correlation, p value <0,05. r 0,00<ρ< 0,30, weak linear correlation; 0,30<r<0,60 moderate linear correlation; 0,60≤ r < 0,90, strong linear correlation; 0,90≤ r <1,00 very strong linear correlation [28]. Source: Authors.

In relation to nutritional status, a stronger correlation was observed for energy intake (0.91), carbohydrates (0.93), lipids (0.90) and iron (0.93) in children with excess weight compared to children without excess weight. For children without excess weight, the same correlations ranged from moderate to strong (Table 2).

Table 3 - Kappa statistics of intake of energy, macro and micronutrient from the 24-hour dietary recall and direct observation. Belo Horizonte-Minas Gerais, Brazil, 2018 (n=41).

	Adequate Intake	Reference Method Direct observation n (%)	Test R24h n (%)	kappa
Energy (Kcal)	EER	1 (2.44)	1 (2.44)	1,00*
Carbohydrate (g)	AMDR	8 (19.51)	7 (17.07)	0,52*
Protein (g)	AMDR	15 (36.59)	3 (7.32)	0,63*
Lipids (g)	AMDR	6 (14.63)	3 (7.32)	0,49*
Iron (mg)	EAR	29 (70.73)	22 (53.66)	0,65*
Vitamin A (ug)	EAR	8 (19.51)	3 (7.32)	0,28*
Calcium (mg)	EAR	0 (0.00)	0 (0.00)	----

Note: Kcal = Kilocalories; mg = miligrans; ug=microgram; R24h = 24 hour dietary recall. EER: *Estimated Energy Requirement* [29] AMDR: *Acceptable Macronutrient Distribution Range* [29]. EAR: *Estimated Average Requirement* [29, 30]. *Kappa* – se, $\kappa < 0,2$ Very low; $0.2 < \kappa < 0.4$ below; $0.4 < \kappa < 0.6$ moderate; $0.6 < \kappa < 0.8$ good and $\kappa > 0.8$ Very good [29] * $p < 0.05$. --- value not calculated due to reported percentage of inappropriate consumption equal to 100. Source: Authors.

Regarding the classification of consumption (adequate and inadequate), both tests showed perfect agreement for adequate energy consumption. In addition, the Kappa coefficient ranged from low (vitamin A), moderate (carbohydrate and lipid), good (protein and iron) to very good (energy) (Table 3). For nutritional status, the kappa coefficients for carbohydrate (0.60 *vs* 0.38), iron (1.00 vs 0.56), vitamin A (0.60 *vs* 0,17; p>0,05) were higher in children with excess weight. The coefficients were similar when it came to protein consumption (0.58). We could not evaluate other nutrients due to the lack of minimum consumption data (percentage).

4. Discussion

The findings of this study demonstrate the relative validity of R24h for assessing the food intake of schoolchildren.

The medians estimated from the recalls were statistically similar to the reference method, indicating good correlation between the methods. Similarities in the medians of energy, macro, calcium and vitamin A intake were also observed by Preston et al. (2011) in a study conducted with 94 schoolchildren and Kobayashi et al. (2011) in a study of 103 children aged 3 to 11 years old. On the contrary, when Carter et al. (1981) used direct observation as a reference they found significant differences between mean macronutrients and energy intake among 28 children aged 10 to 12 years old. The discrepancy is justified by possible underreporting of R24h, particularity reported to accentuate differences between methods.

Furthermore, it should be noted that the correlations of energy and macronutrients were considerably higher compared to other validations of food assessment instruments for schoolchildren around the world. For FFQ validation studies, the coefficients ranged from 0.20 to 0.52 for energy and macronutrients (Fumagalli et al., 2008; Ortiz-Andrellucchi et al., 2009).

Smith et al. (2001) identified a correlation of 0.36 for lipids after the validation of a specific questionnaire to detect early risk of cardiovascular disease among 243 students using R24h as a reference. Ferguson et al. (2010) conducted a validation study of R24h, and found a correlation of 0.28 to 0.55 for micronutrients intake of 29 children.

The higher correlations and agreements observed in our study may be due to the familiarity of the students with the school menu, the regularity at which the preparations are offered and mainly because of the food and nutrition program in the school curriculum. Hunsberger et al. (2013) also observed very strong correlations (0.92) for the validity of R24h in schoolchildren aged 6 to 8 years using food weighing as a reference.

Regarding micronutrients, similar moderate to strong correlation coefficients (> 0.50) were found for calcium and vitamin A in FFQ validation study where food record was used as a reference method among 151 Brazilian children aged 5 to 10 years (Fumagalli et al., 2008). Another FFQ validation study, with 24 Peruvian children aged 8 to 14 years, found moderate and weak correlation coefficients, 0.54 and 0.10, for calcium and iron, respectively (Rodriguez et al., 2017).

A systematic review of micronutrient evaluation in children and adolescents aged 8 to 14 years showed a wide variation of correlation coefficients, with values ranging from 0.20 to 0.60 (Ortiz-Andrellucchi et al., 2009), suggesting specific characteristics of this population with wide variability in food intake considering nutrition education and influence of guardians (Pearson et al., 2009).

The R24h may present a limitation in detecting daily differences in nutrient intake (Hunsberger et al., 2013), especially for nutrients whose sources are concentrated in few foods and those with variable habitual consumption. This may be one of the hypotheses for the lower agreement observed for vitamin A in the present study. The main food sources of vitamin A (e.g. carrots, sweet potatoes, whole milk and eggs) are mostly ingredients of main dishes thus, schoolchildren cannot identify them in dishes such as meat cooked with vegetables, recipes with egg and milk among others (Burrows et al., 2009). Bellù et al. (1995) also reported a weak coefficient (0.07) for this micronutrient among students. These data indicate the need for more recall days in order to promote the identification of the usual consumption of Vitamin A (Bellù et al., 1995).

The moderate kappa coefficient for lipid was higher compared to those of literature. Fumagalli et al. (2008) fu evaluated 188 children from 5 to 10 years of age in public schools validation of age-specific questionnaire and reference method and found a coefficient of 0.21. The major sources of this macronutrient were constituents of food, preparation methods (fried, sauteed) or components of preparations (butter in bread, cake ingredient, among others), commonly difficult to describe.

Regarding nutritional status, there were differences regarding the validity of the 24-dietary recall. Children with excess weight were more consistent in their recalls on energy, carbohydrate and iron intake. It is hypothesized that the greater awareness about food consumption through nutrition education and actions in different scenarios (including the family) are responsible for the reliable reports.

These findings are consistent with the literature (Block, 1982) although some publications report that obese individuals are more likely to omit information on food intake and underestimate energy consumption by about 30 to 47% regardless of assessment method compared to eutrophic individuals (Bertin et al., 2010; Michels et al., 2007). Efficient application of the food assessment tools without direct interference from the interviewer can minimize underreporting.

The present study has some limitations such as sample homogeneity, composed of participants from a single school and grade. However, we highlight that population is unique and underexplored in the literature. Another limitation refers to the non-assessment of total daily food intake since dinner was not considered. In contrast, breakfast, lunch and afternoon snack correspond to a greater portion of meals eaten throughout the day, and thus can reliably represent children's consumption.

Despite the limitations, the study was conducted in a real public service scenario and has the potential to be applied in similar environments as well as groups. Moreover, the study is one of the pioneer studies to reveal the potential pplication of R24h in school-age children.

5. Conclusions

The results of this study point to the relative validity of the 24-hour dietary recall as an assessment tool of schoolchildren's food intake. The instrument is practical and can be useful for characterizing and monitoring energy and nutrient consumption in early life cycle. The findings suggests that students can report their consumption appropriately, especially those with excess weight. Micronutrient assessment can be improved by increasing the repetitions of the R24h and improvement in the application of the instrument.

References

Baxter, S. D., Guinn, C. H., Smith, A. F., Hitchcock, D. B., Royer, J. A., Puryear, M. P., Collins, K. L., & Smith, A. L. (2016). Children's school-breakfast reports and school-lunch reports (in 24-h dietary recalls): conventional and reporting-error-sensitive measures show inconsistent accuracy results for retention interval and breakfast location. *British Journal of Nutrition*, *115*(7), 1301–1315.

Bellù, R., Ortisi, M. T., Riva, E., Banderali, G., Cucco, I., & Giovannini, M. (1995). Validity assessment of a food frequency questionnaire for school-age children in Northern Italy. *Nutrition Research*, *15*(8), 1121–1128.

Bertin, R. L., Malkowski, J., Zutter, L. C. I., & Ulbrich, A. Z. (2010). Estado nutricional, hábitos alimentares e conhecimentos de nutrição em escolares. *Revista Paulista de Pediatria*, *28*(3), 303–308.

Block, G. (1982). A review of validations of dietary assessment methods. *American Journal of Epidemiology*, *115*(4), 492–505.

Burrows, T. L., Warren, J. M., Colyvas, K., Garg, M. L., & Collins, C. E. (2009). Validation of Overweight Children's Fruit and Vegetable Intake Using Plasma Carotenoids. *Obesity*, *17*(1), 162–168.

Callegari-Jacques, S. (2009). *Bioestatística: Princípios e aplicações*. Artmed Editora.

Carter, R., Sharbaugh, C., & Stapell, C. (1981). Reliability and validity of the 24-hour recall. *Journal of the American Dietetic Association*, *79*(5), 542–547.

Conceição, S. I. O. da, Santos, C. de J. N. dos, Silva, A. A. M. da, Silva, J. S. e, & Oliveira, T. C. de. (2010). Consumo alimentar de escolares das redes pública e privada de ensino em São Luís, Maranhão. *Revista de Nutrição*, *23*(6), 993–1004.

Edmunds, L. D., & Ziebland, S. (2002). Development and validation of the Day in the Life Questionnaire (DILQ) as a measure of fruit and vegetable questionnaire for 7–9 year olds. *Health Education Research*, *17*(2), 211–220.

Ferguson, E. L., Gibson, R. S., Ounpuu, S., & Sabry, J. H. (2010). The validity of the 24 hour recall for estimating the energy and selected nutrient intakes of a group of rural Malawian preschool children. *Ecology of Food and Nutrition* , *23*(4), 273–285.

Fryar, C. D., Carroll, M. D., & Ogden, C. L. (2014). *Prevalence of Overweight and Obesity Among Children and Adolescents: United States, 1963–1965 Through 2011–2012*. Centers for Disease Control and Prevention.

Fumagalli, F., Monteiro, J. P., Sartorelli, D. S., Vieira, M. N. C. M., & Bianchi, M. de L. P. (2008). Validation of a food frequency questionnaire for assessing dietary nutrients in Brazilian children 5 to 10 years of age. *Nutrition*, *24*(5), 427–432.

Hulley, S., Cummings, S., Browner, W., Grody, D., Hearst, N., & Newman, T. (2000). *Designing Clinical Research: An Epidemiologic Approach* (2ª). Lippincott Williams & Wilkins.

Hunsberger, M., Pena, P., Lissner, L., Grafström, L., Vanaelst, B., Börnhorst, C., Pala, V., & Eiben, G. (2013). Validity of self-reported lunch recalls in Swedish school children aged 6–8 years. *Nutrition Journal*, *12*, 129.

Institute of Medicine. (2011). *Dietary Reference Intakes for Calcium and Vitamin D*. Institute of Medicine.

Instituto Brasileiro de Geografia e Estatística. (2010). *Pesquisa de Orçamentos Familiares: 2008-2009. Antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil*. Instituto Brasileiro de Geografia e Estatística.

Kobayashi, T., Kamimura, M., Imai, S., Toji, C., Okamoto, N., Fukui, M., & Date, C. (2011). Reproducibility and validity of the food frequency questionnaire for estimating habitual dietary intake in children and adolescents. *Nutrition Journal*, *10*, 27.

Kohlmeier, L., & Bellach, B. (1995). Exposure Assessment Error and its Handling in Nutritional Epidemiology. *Annual Review of Public Health*, *16*, 43–59.

Landis, J. R., & Koch, G. G. (1977). The Measurement of Observer Agreement for Categorical Data. *Biometrics*, *33*(1), 174.

Livingstone, M. B. E., & Robson, P. J. (2021). Measurement of dietary intake in children. *Proceedings of the Nutrition Society*, *59*, 279–293.

Michels, K. B., Willett, W. C., Graubard, B. I., Vaidya, R. L., Cantwell, M. M., Sansbury, L. B., & Forman, M. R. (2007). A longitudinal study of infant feeding and obesity throughout life course. *International Journal of Obesity*, *31*(7), 1078–1085.

Ministério da Saúde. (2008). *Protocolos do Sistema de Vigilância Alimentar e Nutricional-SISVAN na assistência à saúde*. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica.

Ministério do Planejamento, Orçamento e Gestão. (2011). *Pesquisa de orçamentos familiares 2008-2009: análise do consumo alimentar pessoal no Brasil*. Ministério do Planejamento, Orçamento e Gestão.

Moll, J. (2008). Conceitos e pressupostos: o que queremos dizer quando falamos de educação integral? In Ministério da Educação & TV Escola - Salto para o futuro (Eds.), *Educação Integral: Elementos para o debate necessárioto de 2008* (pp. 11–16). Ministério da Educação.

Onis, M. de, Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization*, *85*(9), 660–667.

Ortiz-Andrellucchi, A., Henríquez-Sánchez, P., Sánchez-Villegas, A., Peña-Quintana, L., Mendez, M., & Serra-Majem, L. (2009). Dietary assessment methods for micronutrient intake in infants, children and adolescents: a systematic review. *British Journal of Nutrition*, *102*(S1), 87–117.

Otten, J., Hellwig, J., & Meyers, L. (2006). *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*.

Pearson, N., Biddle, S. J., & Gorely, T. (2009). Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutrition*, *12*(2), 267–283.

Preston, A. M., Palacios, C., Rodríguez, C. A., & Vélez-Rodríguez, R. M. (2011). Validation and Reproducibility of a Semi-Quantitative Food Frequency Questionnaire for Use in Puerto Rican Children NIH Public Access. *Puerto Rico Health Sciences Journal*, *30*(2), 58–64.

Rennie, K. L., & Livingstone, M. B. E. (2007). Associations between dietary added sugar intake and micronutrient intake: a systematic review. *British Journal of Nutrition*, *97*(5), 832–841.

Rodriguez, C. A., Smith, E. R., Villamor, E., Zavaleta, N., Respicio-Torres, G., Contreras, C., Perea, S., Jimenez, J., Tintaya, K., Lecca, L., Murray, M. B., & Franke, M. F. (2017). Development and Validation of a Food Frequency Questionnaire to Estimate Intake among Children and Adolescents in Urban Peru. *Nutrients*, *9*(10), 1121.

Sichieri, R., & Souza, R. A. de. (2008). Estratégias para prevenção da obesidade em crianças e adolescentes. *Cadernos de Saúde Pública*, *24*(suppl. 2), s209–s223.

Smith, K. W., Hoelscher, D. M., Lytle, L. A., Dwyer, J. T., Nicklas, T. A., Zive, M. M., Clesi, A. L., Garceau, A. O., & Stone, E. J. (2001). Reliability and Validity of the Child and Adolescent Trial for Cardiovascular Health (CATCH) Food Checklist: A Self-report Instrument to Measure Fat and Sodium Intake by Middle School Students. *Journal of the American Dietetic Association*, *101*(6), 635–647.

United States Department of Agriculture. (2021). *AMPM - USDA Automated Multiple-Pass Method*. United States Department of Agriculture.

Willett, W., & Lenart, E. (2013). Reproducibility and Validity of Food Frequency Questionnaires. In W. Willett (Ed.), *Nutritional Epidemiology* (3rd ed., pp. 1001–1047). Oxford University Press.