https://doi.org/10.1590/1678-9865202235e200323

ORIGINAL

Association between children and adolescents' body composition with family income

Associação entre a composição corporal de crianças e adolescentes e renda familiar

Lisiane Marçal PÉREZ[1] 0000-0002-6420-5916
Eduardo MUNDSTOCK[2] 0000-0002-1779-6696
Marina Azambuja AMARAL[2] 0000-0003-2645-3756
Fernanda Maria VENDRUSCULO[2] 0000-0001-8208-3476
Wilson CAÑON-MONTAÑEZ[3] 0000-0003-0729-5342
Rita MATTIELLO[1,2,4, 5] 0000-0002-0548-3342

ABSTRACT

Objective

To evaluate the association between children and adolescents' body composition with family income.

Methods

Cross-sectional study, participants between 5 and 19 years were included. A standardized questionnaire assessed socioeconomic variables. The outcome variables were z-score of Body Mass Index and bioimpedance parameters

[1] Pontifícia Universidade Católica do Rio Grande do Sul, Programa de Pós-Graduação em Pediatria e Saúde da Criança. Porto Alegre, RS, Brasil.
[2] Pontifícia Universidade Católica do Rio Grande do Sul, Programa de Pós-Graduação em Medicina e Ciências da Saúde. Porto Alegre, RS, Brasil.
[3] Universidad de Antioquia, Facultad de Enfermería. Medellín, Colombia.
[4] Pontifícia Universidade Católica do Rio Grande do Sul, Escola de Medicina, Departamento de Pediatria. Av. Ipiranga, 6690, Prédio 60, Partenon, 90610-001, Porto Alegre, RS, Brasil. Correspondence to: R MATTIELLO. E-mail: <rimattiello@hotmail.com>.
[5] Universidade Federal do Rio Grande do Sul, Escola de Medicina, Departamento de Medicina Social. Porto Alegre, RS, Brasil.

Support: *Fundação de Amparo à Pesquisa do Rio Grande do Sul* (FAPERGS), the National Research Council of Brazil (CNPq) and *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (Capes) Finance Code 001.

How to cite this article

Pérez LM, Mundstock E, Amaral MA, Vendrusculo FM, Cañon-Montañez W, Mattiello R. Association between children and adolescents' body composition with family income. Rev Nutr. 2022;35:e200323. https://doi.org/10.1590/1678-9865202235e200323

(skeletal muscle mass, fat-free mass, and fat percentage) and predictor variables (age, sex, race, place of residence, father's education, birth weight and breastfeeding) were analyzed using the quantile regression model and data from the 50th percentile are presented. The tests were bidirectional and the differences were considered significant with $p<0.05$.

Results

Among the 529 participants included, 284 (53.6%) were female and the mean age was 11.41±3.9 years. The Body Mass Index z-score was the only outcome that did not show differences between sexes ($p=0.158$). In the crude model, lower family income was associated with lower skeletal muscle mass (Difference=-7.70; 95% CI -9.32 to -5.89), $p<0.001$), lower fat-free mass (Difference= -13.40; 95% CI -16.40 to -10.39, $p<0.001$) and the lowest percentage of fat was associated with lower family income (Difference= -5.01, 95% CI -9.91 to -0.11, $p=0.027$). The z-score of BMI was not associated with family income.

Conclusion

Family income is directly associated with lower fat-free mass, fat percentage, and skeletal muscle mass in children and adolescents.

Keywords: Anthropometry. Body composition. Child. Income.

RESUMO

Objetivo

Avaliar a associação entre a composição corporal de crianças e adolescentes com a renda familiar.

Métodos

Estudo transversal, foram incluídos participantes entre 5 e 19 anos. As variáveis socioeconômicas foram avaliadas por meio de questionário padronizado. As variáveis de desfecho foram escore Z do índice de massa corporal e parâmetros de bioimpedância (massa muscular esquelética, massa livre de gordura e percentual de gordura) e variáveis preditoras (idade, sexo, raça, local de residência, escolaridade do pai, peso ao nascer e aleitamento materno) foram analisados pelo modelo de regressão quantílica e são apresentados os dados do percentil 50. Os testes foram bidirecionais, e as diferenças foram consideradas significativas com p<0,05.

Resultados

Entre os 529 participantes incluídos, 284 (53,6%) eram do sexo feminino e a média de idade foi de 11,41±3,9 anos. O escore Z do índice de massa corporal foi o único desfecho que não apresentou diferenças entre os sexos (p=0,158). No modelo bruto, uma menor renda familiar foi associada a menor massa muscular esquelética (Diferença= -7,70; IC 95% -9,32 a -5,89), p<0,001), menor massa livre de gordura (Diferença= -13,40; IC 95% -16,40 a -10,39, p<0,001) e o menor percentual de gordura associou-se à menor renda familiar (Diferença= -5,01, IC 95% -9,91 a -0,11, p=0,027). O escore Z do IMC não foi associado à renda familiar.

Conclusão

A renda familiar está diretamente associada à menor massa magra, ao percentual de gordura e à massa muscular esquelética em crianças e adolescentes.

Palavras-chave: *Antropometria. Composição corporal. Criança. Renda.*

INTRODUCTION

The prevalence of obesity has been increasing significantly worldwide [1,2]. The global burden of diseases indicates that this prevalence doubled in more than 70 countries from 1980 to 2015. Although the prevalence of obesity in children is still lower than in adults, the rate of increase in childhood obesity in many countries has been higher than the rate of increase in obesity in other age groups [3] .

As obesity is becoming a global epidemic, there is a growing interest in measures that assess this outcome more specifically, such as the measurement of body composition. Body composition monitoring in recent years has expanded to other interests besides obesity. It is being also used as an important clinical marker and quality of life, mainly through the differentiation of fat and lean mass [4].

Body composition is known to be influenced by several determinants such as: weight, height, race and sex, among other objective measures. Still, the use of only these factors has been questioned [5,6]. The answer to this question is that body composition can also result from the interaction between sociodemographic factors, geographical and cultural differences [7]. Among these factors, the size of the importance of family income as a determinant of body composition is not known, considering that it is strongly associated with several indispensable criteria for the broad concept of health [8].

Considering the social inequalities and cultural diversity of our population, the study of the determinants for the body composition of children and adolescents, of different socioeconomic levels; can provide information for the development of public health policies and health education, in addition to lifestyle changes. Therefore, the objective of this article was to assess how much the body composition of children and adolescents is influenced by family income.

METHODS

This is a cross-sectional study that followed the recommendations of the STROBE Statement [9].

A sample of public healthy children and adolescents aged 5 to 19 years was included for convenience from public schools that agreed to participate in the study. The minimum number of individuals by sex and age group represented the participants better. Participants who had skin's diseases affected by electrical resistance, pregnancy, patients with cardiac pacemakers or cardio defibrillators and amputees or those using prostheses/orthoses, or chronic diseases were not included in the study. The age group and exclusion criteria were chosen due to the recommendations of the device used to perform the bio impedance. Data collection was carried out from November 2015 to August 2017, in the *Rio Grande do Sul*; considering different incomes, social classes and geographic locations.

The sociodemographic and clinical variables were answered by children's responsible with standardized interviews without a validated questionnaire. The sociodemographic variables considered were: age (5 to 19 years), sex (male and female), self-reported race (white, black and others), place of urban and rural (8), father's years of schooling (≤5 years, 6-11 years and ≥12 years) (7) and family income (total household income mean) classified as: <1,625, 1,625 -4,851 and ≥4,852 reais [10]. Data on birth weight (<2,500g and ≥2,500g) [11] and exclusive breastfeeding in the first six months of life (≤6 months and > 6 months) were considered clinical data. To assess the level of physical activity, children up to ten years old answered the physical activity questionnaire (DAFA) [12]. Young people in the 11 to 19 age group, young people answered the International Physical Activity Questionnaire (IPAQ) short version validated by Guedes *et al*. [13]. Regarding physical activity, children and adolescents were classified as active and inactive. Active children: those who do at least 300 minutes of moderate to vigorous physical activity per week [14]. All questions were closed and performed by trained interviewers.

Body Mass Index (BMI): The BMI was calculated from the definition: weight (kilogram)/height^2 (meters) [15]. Body mass was checked with the subject in orthostatic position, with minimal clothing and barefoot, with a digital scale (Charder model MS6121) previously calibrated with 100 grams of precision. Height was measured with the subjects barefoot, feet in a parallel position, ankles together, arms along the body and head in the Frankfurt plane [16], with a portable wall stadiometer (Sanny model ES2040) with an accuracy of ± 1mm. The measurements were performed three times and the mean value between the measurements was considered. The BMI z-score value was calculated using the WHO AnthroPlus software.

https://doi.org/10.1590/1678-9865202235e200323

Evaluation of body composition through the analysis of electrical bioimpedance (BIE): The equipment used for the analysis of body composition was the InBodyS10 multi-frequency (100µA (1KHz), 500µA) through the system of tactile electrodes of eight points. The verification occurred with the individuals in the supine position, with the members away from the body and with as little clothing as possible. Following is the definition for the variables considered for assessing of body composition in the present study. The Fat-Free Mass (FFM) and the Skeletal Muscle Mass (SMM) are presented in absolute values (measured in kilogram). The Percentage of Body Fat (PBF) was calculated by subtracting the fat-free mass from the body weight.

Continuous variables were described by mean and standard deviation due to the symmetry of the variables. Categorical variables were presented using absolute and relative frequency. Sociodemographic and clinical variables were compared about sex using the t-test for independent samples and Chi-square.

The relationships between the outcome variables (BMI, FFM, SMM and PBF) and the predictor variables (family income, age, sex, race, place of residence, father's education, birth weight and breastfeeding) were analyzed using the regression model quantile and data referring to the 50th percentile are presented. The tests were bidirectional and the differences were considered significant with $p<0.05$. All analyzes were performed using the SAS 9.4 program (SAS Institute, Inc, Cary, North Carolina, United States).

The study was approved by the Research Ethics Committee of the Pontifical Catholic University of *Rio Grande do Sul* (CAEE nº 14338280431680). The guardians consented by signing the informed consent form and the children signed the consent form.

The sample size was estimated considering a Cohen's minimum effect size (f^2) of 0.15 in a fixed linear regression model, a power of 90%, an alpha of 1% and the minimum number of thirteen independent variables associated with the outcome, the minimum number required was 210 participants.

RESULTS

A total of 529 children and adolescents were included, with a mean age of 11.41±3.9 years, of which 284 (53.6%) were female. Table 1 shows the sociodemographic and clinical characteristics of sex. There were significant differences between gender in the body composition variables measured by electrical bioimpedance; that is, the BMI did not show any significant difference between gender. Male participants had the means of the variables FFM and SMM higher and PBF lower than the means of the female participants ($p<0.001$).

Table 2 shows the unadjusted and adjusted analysis for the association between family income and skeletal muscle mass. In this analysis, the lowest family income is associated with the lowest skeletal muscle mass in the unadjusted analysis model 1 (Difference = -7.70; 95% CI -9.32 to -5.89, $p<0.001$) and in model 2 (Difference = -8.65; 95% CI -11.18 to -6.11, $p<0.001$).

Table 3 presents the unadjusted and adjusted analysis for the association between family income and fat-free mass. The lowest family income was inversely associated with FFM in model 1 (Difference = -13.40; 95% CI -16.40 to -10.39) and in model 2 (Difference = -15.10; 95% CI -19.50 to -10.69, $p<0.001$).

Table 4 shows an unadjusted and adjusted analysis of the association between family income and body fat percentage. The lowest family income was inversely associated with fat percentage only in model 1 (Difference = -5.01; 95% CI -9.91 to -0.11, $p=0.027$).

Table 5 shows the unadjusted and adjusted analysis for the association between family income and the z-score of BMI. The z-score of BMI was not associated with the lowest family income.

Table 1 – Sociodemographic and clinical characteristics of the sample by sex. *Rio Grande do Sul* (RS), Brazil.

Sex	Male (n=245)	Female (n=284)	*p*
Age (years), M±SD	11.38±3.77	11.41±3.91	0.916
Variables	n(%)	n(%)	*p*
Race,			0.796
Black	29(13.4)	38(15.0)	
White	146(67.3)	163(64.4)	
Others	42(19.4)	52(20.6)	
Family Income,			0.399
R$<1.625.00	60(35.7)	83(40.9)	
R$1.625.00 a 4.851.00	65(38.7)	79(38.9)	
R$≥4.852.00	43(25.6)	41(20.2)	
Place of Residency,			0.064
Urban	121(55.3)	116(45.7)	
Rural	76(34.7)	98(38.6)	
Periphery	22(10.0)	40(15.7)	
Parent Scholling,			0.401
≤5 years	34(26.8)	40(23.5)	
6-11 years	58(45.7)	91(53.5)	
≥12 years	35(27.6)	39(22.9)	
Physical activity,			0.787
Inactive	104(45.8)	121(44.3)	
Active	123(54.2)	152(55.7)	
Birth weight,			0.68
≤2.500g	10(6.7)	15(8.2)	
>2.500g	139(93.3)	169(91.8)	
Breast-feeding,			0.171
≤6 months	73(52.5)	73(44.2)	
>6 months	66(47.5)	92(55.8)	
Variables	M±SD	M±SD	*p*
Body Mass Index (z-score)	0.91±1.40	0.79±1.32	0.158
Skeletal Muscle Mass (Kg)	20.67±9.73	17.44±6.28	<0.001*
Fat-Free Mass (Kg)	37.95±16.12	32.66±10.55	<0.001*
Percentage of Body Fat (%)	19.72±10.55	25.94±9.89	<0.001*

Note: *$p<0.05$. Means compared using *t* test for independent samples. Proportions through the test based on Pearson's χ^2 statistic.

Table 2 – Association between family income and skeletal muscle mass. *Rio Grande do Sul* (RS), Brazil.

Family Income (R$)	Model 1			Model 2			Model 3			Model 4		
	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*
<1.625.00	-7.70	-9.32 to -5.89	<0.001*	-8.65	-11.18 to -6.11	<0.001*	0.30	-1.70 to 2.30	0.768	0.20	-1.65 to 2.05	0.831
1.625.00 to 4.851.00	-5.59	-7.83 to -3.41	*	-5.60	-8.43 to -2.76	<0.001*	0.50	-1.19 to 2.19	0.561	0.48	-1.26 to 2.22	0.588
≥4.852.00	Ref			Ref			Ref			Ref		

Note: *$p<0.05$. Model 1: not adjusted (family income); Model 2: model 1 + sex + birth weight + breast-feeding; Model 3: model 2 + age + race + urbanization + father's education; Model 4: model 3 + physical activity; Ref: Reference; D: Difference between the estimate of skeletal muscle mass distribution in relation to income category ≥4.852.00.

Table 3 – Association between family income and fat-free mass. *Rio Grande do Sul* (RS), Brazil.

Family Income (R$)	Model 1			Model 2			Model 3			Model 4		
	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*
<1.625.00	-13.40	-16.40 to -10.39	<0.001*	-15.10	-19.50 to -10.69	<0.001*	0.88	-2.45 to 4.23	0.602	0.87	-2.14 to 3.89	0.566
1.625.00 to 4.851.00	-9.96	-13.29 to -5.87	<0.001*	-9.30	-14.23 to -4.36	<0.001*	1.10	-1.84 to 4.04	0.461	1.27	-1.65 to 4.21	0.391
≥4.852.00	Ref			Ref			Ref			Ref		

Note: *p<0.05. Model 1: not adjusted (family income); Model 2: model 1 + sex + birth weight + breast-feeding; Model 3: model 2 + age + race + urbanization + father's education; Model 4: model 3 + physical activity; Ref: Reference; D: Difference between the estimate of fat-free mass distribution in relation to income category ≥4.852.00.

Table 4 – Association enters family income with the percentage of body fat. *Rio Grande do Sul* (RS), Brazil.

Family Income (R$)	Model 1			Model 2			Model 3			Model 4		
	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*
<1.625.00	-5.01	-9.91 to -0.11	0.027*	-1.59	-5.43 to 2.23	0.412	5.15	-2.82 to 13.13	0.203	6.52	-0.78 to 13.84	0.080
1.625.00 to 4.851.00	-2.70	-7.29 to 1.89	0.248	1.10	-3.34 to 5.54	0.626	4.89	-1.70 to 11.67	0.143	6.29	-0.40 to 12.98	0.065
≥4.852.00	Ref			Ref			Ref			Ref		

Note: *p<0.05. Model 1: not adjusted (family income); Model 2: model 1 + sex + birth weight + breast-feeding; Model 3: model 2 + age + race + urbanization + father's education; Model 4: model 3 + physical activity; Ref: Reference; D: Difference between the estimate of percentage of body fat distribution in relation to income category ≥4.852.00.

Table 5 – Association between family income and body mass index (z-score). *Rio Grande do Sul* (RS), Brazil.

Family Income (R$)	Model 1			Model 2			Model 3			Model 4		
	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*	D (Kg/m²)	95%CI	*p*
<1.625.00	-0.07	-0.56 to 0.41	0.767	0.01	-0.45 to 0.47	0.966	0.85	-0.04 to 1.76	0.063	0.87	-0.04 to 1.79	0.061
1.625.00 to 4.851.00	-0.05	-0.42 to 0.31	0.788	0.15	-0.33 to 0.65	0.532	0.69	0.02 to 1.36	0.050	0.75	0.07 to 1.42	0.028*
≥4.852.00	Ref			Ref			Ref			Ref		

Note: *p<0.05. Model 1: not adjusted (family income); Model 2: model 1 + birth weight + breast-feeding; Model 3: model 2 + race + urbanization + father's education; Model 4: model 3 + physical activity; Ref: Reference; D = Difference between the estimate of body mass index (z-score) distribution in relation to income category ≥4.852.00.

DISCUSSION

Our study shows a significant association between family income and body composition, mainly through skeletal muscle mass, percentage of fat, and fat-free mass. Income-related differences raise questions about body composition and metabolic risk profile [17]. In epidemiological studies of childhood obesity and body composition, socioeconomic status in the family also includes education of parents and place of residence, among others [18].

Our results show that lower family income is associated with lower SMM, FFM, and BMI, when adjusted for birth weight and breastfeeding. Family income was inversely associated with the PBF when there were no adjustments, that is, without any relationship with the clinical variables. It is common to focus on fat mass percentages to express the body composition of children and adolescents, but focusing on fat mass can lead us to ignore FFM and SMM [19]. When comparing the PBF, among other parameters, of children with and without growth deficit, we observed that children with growth deficit have significantly higher body fat, after adjusting for birth weight, breastfeeding, age at the beginning of complementary feeding and income [20].

Our study found no significant differences between genders for the BMI outcome. This finding agrees with the literature where the BMI in children may involve some flaws, because it varies homogeneously for the sexes in the different phases of developing adipose tissue [21]. Although BMI is widely used to assess body fat, its main disadvantage is that it does not distinguish between the types of tissue analyzed. Thus, the increase in BMI can result in both an increase in fat mass and or an increase in lean mass. This can lead to the wrong classification of nutritional status [22].

As a predictor variable, lower family income was associated with lower values of SMM, fat percentage and FFM. Recent results that assessed body composition and socioeconomic status, among other variables, showed an association between increased adiposity and lower socioeconomic status, especially in females, meeting our findings [23]. Corroborating the results of this study, a research that sought to investigate the dependence on body composition parameters according to the participants' place of residence, showed that the walkable neighborhoods are associated with lower obesity prevalence [24].

Parents' education was considered in another study as an independent factor associated with the body composition of their children and adolescents, which may interact with parental obesity and socioeconomic status [25].

Studies reinforce that the beginning of life is a critical window for children's programming and that breastfeeding can influence the risk of late disease through the modulation of body composition [26].

This study also has limitations. Due to the study's cross-sectional design, a causal relationship between body composition and its determinants cannot be defined. Prospective studies with a large number of participants are essential to assess the impact of determinants of body composition on the clinical conditions and nutritional status of children and adolescents. Although confounding factors have occurred and multivariate analyzes adjusted for family income have been carried out, the possibility of unmeasured confounding factors playing a role in the observed associations cannot be ruled out.

CONCLUSION

Among the clinical applications of the results of this study, family income was directly associated with lower SMM, and FFM in children and adolescents is translated as a potential marker for the body composition of populations of social vulnerability. Several factors can explain the associations between income and body. Among them, people with lower incomes have greater difficulty in accessing leisure activities and healthy foods than people with high incomes.

Two other results bring interesting questions to clinical practice, the BMI which showed no difference between sex, making it reflect on its indiscriminate use in clinical practice and the PBF, the most frequently used body composition parameter, which showed no association in any adjusted model.

Family income is directly associated with lower fat-free mass, fat percentage, and skeletal muscle mass in children and adolescents. Future studies that evaluate, explore, and compare these and other likely determinants of body composition will be of paramount importance.

CONTRIBUTORS

LM PÉREZ contributed to the conceptualization, data curation, formal analysis, investigation, methodology, project administration, validation, visualization, writing-original draft (lead), writing-review and editing (lead). E MUNDSTOCK was responsible for the data curation, investigation, methodology, visualization, writing-original draft writing-review and editing. MA AMARAL was responsible for the investigation, writing-original draft, writing-review and editing. FM VENDRUSCULO contributed to the methodology supervision, writing-original draft, writing-review and editing. W CAÑON-MONTAÑEZ and R MATTIELLO collaborated with the supervision of conceptualization, data curation, formal analysis investigation, methodology, project administration (lead), supervision, validation, visualization, writing-original draft writing-review and editing.

REFERENCES

1. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019;92:6-10.
2. Ferreira CM, Reis ND, Castro AO, Hofelmann DA, Kodaira K, Silva MT, *et al.* Prevalence of childhood obesity in Brazil: systematic review and meta-analysis. J Pediatr. 2021; 97(5):490-499.
3. The GBD 2015 Obesity Collaborators. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. N Engl J Med. 2017;377(1):13-27.
4. Andreoli A, Garaci F, Pio F, Guglielmi G. Body composition in clinical practice. Eur J Radiol. 2016;85(8):1461-8.
5. Pérez LM, Mattiello R. Determinantes da composição corporal em crianças e adolescentes. Rev Cuid. 2018;9(2):2093-104.
6. Matłosz P, Wyszy´nska J, Wyszy´nska W, Asif M, Szybisty A, Aslam M, et al. Clinical Medicine Prevalence of Overweight, Obesity, Abdominal Obesity, and Obesity-Related Risk Factors in Polish Preschool Children: a Cross-Sectional Study. J Clin Med. 2021;10:790.
7. Kondolot M, Poyrazoğlu S, Horoz D, Borlu A, Altunay C, Balcı E, *et al*. Risk factors for overweight and obesity in children aged 2-6 years. J Pediatr Endocrinol Metab. 2017;30(5):499-505.
8. Beghin L, Vanhelst J, Gonzales-gross M, Henauw D, Moreno LA, Gottrand F. Le statut l ' activité et la condition physique des adolescents sous influence. médecine/sciences. 2016;32:746-51.
9. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. Int J Surg. 2014;12(12):1495-9.
10. Ambrósio B, Wakaguri T, Ibope K. Critério Brasil 2015 e atualização da distribuição de classes para 2016. São Paulo: Associação Brasileira de Empresa e Pesquisa; 2016. p. 1-6.
11. Saleem S, Naqvi F, McClure EM, Nowak KJ, Tikmani SS, Garces AL, *et al.* Neonatal deaths in infants born weighing ≥ 2500 g in low and middle-income countries. Reprod Health. 2020;17(S2):158.
12. Adami F, Bergamaschi D, Hinnig P, Oliveira N. Validity study of the " Physical Activity Checklist " in children. Rev Saude Publica. 2013;47(3):1-9.
13. Guedes DP, Lopes CC, Guedes JERP. Reprodutibilidade e validade do Questionário Internacional de Atividade Física em adolescentes. Rev Bras Med do Esporte. 2005;11(2):151-8.
14. Chaput JP, Willumsen J, Bull F, Chou R, Ekelund U, Firth J, *et al.* 2020 WHO guidelines on physical activity and sedentary behaviour for children and adolescents aged 5–17 years: summary of the evidence. Int J Behav Nutr Phys Act. 2020;17(1):1-9.
15. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of Obesity and Severe Obesity Among Adults: United States, 2017-2018. NCHS Data Brief. 2020;(360):1-8.
16. International Standards for Anthropometric Assessment. Underdale, SA, Australia: The International Society for the advancement of Kinanthropometry. Melbourne: ISAK; 2006. 131 p.
17. Bramsved R, Regber S, Novak D, Mehlig K, Lissner L, Mårild S. Parental education and family income affect birthweight, early longitudinal growth and body mass index development differently. Acta Paediatr. 2018;107(11):1946-52.
18. Chung A, Backholer K, Wong E, Palermo C, Keating C, Peeters A. Trends in child and adolescent obesity prevalence in economically advanced countries according to socioeconomic position: a systematic review. Obes Rev. 2016;17(3):276-95.

19. Dahly DL, Li X, Smith HA, Khashan AS, Murray DM, Kiely ME, *et al*. Associations between maternal lifestyle factors and neonatal body composition in the Screening for Pregnancy Endpoints (Cork) cohort study. Int J Epidemiol. 2018;47(1):131-45.

20. Savanur MS, Ghugre PS. BMI, body fat and waist-to-height ratio of stunted non-stunted Indian children: a case-control study. Public Health Nutr. 2016;19(8):1389-96.

21. Roy SM, Chesi A, Mentch F, Xiao R, Chiavacci R, Mitchell JA, *et al.* Body Mass Index (BMI) Trajectories in Infancy Differ by Population Ancestry and May Presage Disparities in Early Childhood Obesity. J Clin Endocrinol Metab. 2015;100(4):1551-60.

22. Silva S, Baxter-jones A, Maia J. Fat Mass Centile Charts for Brazilian Children and Adolescents and the Identification of the Roles of Socioeconomic Status and Physical Fitness on Fat Mass Development. Int J Environ Res Public Heal. 2016;13:151.

23. Lizana PA, González S, Lera L, Leyton B. Association Between Body Comosition, Somatotype and Socioeconomic Status im Chilean Children and Adolescents at Different School Levels. J Biosoc Sci. 2018;50(1):53-69.

24. Kowaleski-Jones L, Zick C, Smith KR, Brown B, Hanson H, Fan J. Walkable neighborhoods and obesity: evaluating effects with a propensity score approach. Popul Heal. 2018;6:9-15.

25. Svensson V, Ek A, Forssén M, Ekbom K, Cao Y, Ebrahim M, *et al.* Infant growth is associated with parental education but not with parental adiposity: early Stockholm Obesity Prevention Project. Acta Paediatr. 2014;103(4):418-25.

26. Gridneva Z, Rea A, Hepworth AR, Ward LC, Lai CT, Hartmann PE, *et al.* Relationships between Breastfeeding Patterns and Maternal and Infant Body Composition over the First 12 Months of Lactation. Nutrients. 2018;10(1):45.

Received: March 16, 2021
Final version: May 16, 2022
Approved: May 30, 2022