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Prevalence of childhood obesity: is there a cause for concern?

Prevalência de obesidade infantil: há motivo de preocupação?

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ABSTRACT

This study aimed to determine the prevalence of overweight/obesity in preschoolers and to investigate the relationship between the body mass index (BMI) of the children and of their parents. Therefore, a cross-sectional study was conducted with 968 children aging 3-5 years old from public preschools. The children's nutritional status was defined by the BMI, after measuring their weight and height at the preschool, considering sex and age in months. According to the World Health Organization (WHO) criteria, the children were classified as eutrophic, thin, at risk of being overweight, overweight or obese. The parents' BMI was calculated using weight and height data obtained through a questionnaire. One percent of children were thin, 62% eutrophic, 17% at risk of overweight, 12% were overweight and 8% obese. Children's BMI was positively correlated with maternal and paternal BMI ($p < 0.05$). It was concluded that the prevalence of obesity and overweight in the population studied is alarming, and the child's BMI was correlated to their parents' BMI. Such findings should be of concern for the authorities, reinforcing the need for health care strategies covering the entire family.

Keywords: Body mass index. Child. Pediatric obesity. Preschool. Prevalence.

RESUMO

O objetivo deste estudo foi determinar a prevalência de sobrepeso/obesidade em pré-escolares e investigar a relação entre o índice de massa corporal (IMC) das crianças e o de seus pais. Para tanto, conduziu-se uma pesquisa transversal com 968 crianças, de 3-5 anos, regularmente matriculadas em pré-escolas públicas. O estado nutricional infantil foi definido pelo IMC após aferição do peso e estatura no próprio ambiente escolar, considerando-se o sexo e a idade em meses. De acordo com os critérios da Organização Mundial da Saúde (OMS), as crianças foram classificadas em eutróficas, baixo peso, risco de sobrepeso, sobrepeso ou obesas. O IMC dos pais foi calculado com os dados de peso e estatura obtidos por meio de questionário. Observou-se que 1% de crianças tinham baixo peso, 62% eram eutróficas, 17% apresentavam risco de sobrepeso, 12% sobrepeso e 8% obesidade. O IMC infantil mostrou-se positivamente correlacionado com o IMC materno e paterno ($p < 0,05$). Concluiu-se que a prevalência de obesidade e sobrepeso infantil na população estudada é alarmante e que o IMC da criança foi correlacionado ao dos pais. Tais achados devem ser motivo de preocupação das autoridades, reforçando a necessidade de estratégias de atenção à saúde abrangendo todo o núcleo familiar.

Palavras-chave: Criança. Índice de massa corporal. Obesidade pediátrica. Pré-escolar. Prevalência.

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INTRODUCTION

Regarding nutritional and metabolic disorders, obesity is identified as one of the most frequent health problems in Brazil.[1] The World Health Organization (WHO) already considers this disorder as a global epidemic since 1995.[2,3] In Brazil, in the last decades, there has been a great increase in the prevalence of overweight/obesity in the pediatric population.[4] The number of obese children aged 5 to 9 years increased by more than 300% between 1989 and 2009.[2] A study carried out in São Paulo, involving 809 preschoolers, showed obesity rates ranging from 6.6 to 11.1% .[5] Changes in lifestyle, such as a greater consumption of high-energy-dense foods, sedentary lifestyle and the "virtual era" are factors that could justify this increase in the prevalence of obesity.[2]

The most concerning issue is that the child with a high body mass index (BMI) has a significant risk of gaining weight quickly and continuously[6], in addition to having very high chances of continuing in this condition during adulthood.[2] Additionally, the alarming increase in weight in the Brazilian children population in recent years demonstrates the real and emphatic need for monitoring from early childhood, through periodic assessments enabling early diagnosis.[6] This monitoring would also include guidance on improving habits and the practice of physical activity.[7]

It should be emphasized that the control of excess weight in childhood is very important, since obesity is a risk factor for the development of significant chronic diseases[8], such as: diabetes, dyslipidemia, cardiovascular diseases and more aggressive pathologies such as pancreatic cancer. A study has already shown that the higher the BMI in childhood, the greater the risk of this cancer to be present in adulthood.[9] Thus, the presence of obesity/overweight in children, may be associated in the future with non-communicable diseases, which are responsible for about 68% of deaths worldwide.[10]

Given this scenario, monitoring of BMI in the pediatric age group is extremely important, and there is little information in preschoolers. Health promotion actions should be planned based on scientific evidence and this research may provide some support for the adaptation of obesity prevention programs in the first years of life. Thus, this study aimed to determine the prevalence of overweight/obesity in preschoolers and to investigate the relation between the BMI of children and their parents.

METHODOLOGY

This cross-sectional study was approved by the Research Ethics Committee (CAAE: 46107015.2.0000.5514) and carried out in the public school system in 2016. Among the 46 municipal preschools in Bragança Paulista-SP, nine were selected for the research, considering the geographical location and the largest number of children enrolled in the age group of 3-5 years. In total, 968 preschoolers were included in the study, 30% more than the minimum number obtained through the sample calculation, considering 50% prevalence of obesity (percentage that generates the largest "n" possible), adopting 95% confidence interval and 5% margin of error.

For the measurement of weight and height, a calibrated digital scale (100g precision) and an inextensible measuring tape affixed to a wooden board perpendicular to the ground were used, respectively. When measuring height, the children were positioned in an upright posture (Camper's plane parallel to the ground) with their feet and heels together, and the measurement was obtained with the help of a square, which slid over the wooden board. Preschoolers were weighed wearing only light school uniforms and without shoes, standing upright, with their arms stretched out at their sides and with their feet in the center of the scale. Although the children were weighed in very light uniforms and without shoes, 100g was subtracted from the total weight, referring to the weight of that uniform.

For the classification of the nutritional condition, the BMI (weight[kg]/ height[m2]) was used

according to the WHO standards/2006-2007.[11,12] The BMI and the child's age in months, according to sex, were used for classification. Children aged 3 to 5 years were distributed into: underweight (≥ z-Score- 3 and <z-Score -2), eutrophic (≥ z-Score -2 and ≤ z-Score +1), risk of becoming overweight (≥ z-Score +1 and ≤ z-Score +2), overweight (≥ z-Score +2 and ≤ z-Score +3) and obese (> z-Score +3). Children aged 5 years and 1 month to 5 years and 11 months were classified in a very similar way in: underweight, (≥ z-Score -3 and <z-Score -2), eutrophic (≥ z-Score -2 and ≤ z-Score +1), overweight (≥ z-Score +1 and ≤ z-Score +2) and obese (≥ z-Score +2 and ≤ z-Score +3).

The measurements of weight and height of the child's mother and father were requested through a questionnaire, which included the following question: "What is the weight (kg) and height (m) of the child's father and mother?". Afterwards, BMI was calculated according to the response obtained and to WHO standards.[13]

For data analysis, descriptive statistics and Spearman's correlation were used, considering a significance level of 5%.

RESULTS

Among the 968 children assessed aged 3-5 years (mean age 4.4 years), 479 (49%) were male and 489 (51%) female. Figure 1 shows the nutritional status of the population studied according to the WHO classification.[2] The prevalence of overweight was 20% (n = 194), with 12% being overweight (n = 116) and 8% (n = 78) obesity. When considering the number of overweight children together with the risk of being overweight, a significant portion of 37% is reached (n = 358). This implies the fact that one in five children in the present study was at risk of becoming overweight or was already overweight. Only 1% (n = 10) of preschoolers were classified as underweight (thin). Most individuals were eutrophic, that is, ideal weight for age, representing 62% (n = 600) of the sample.

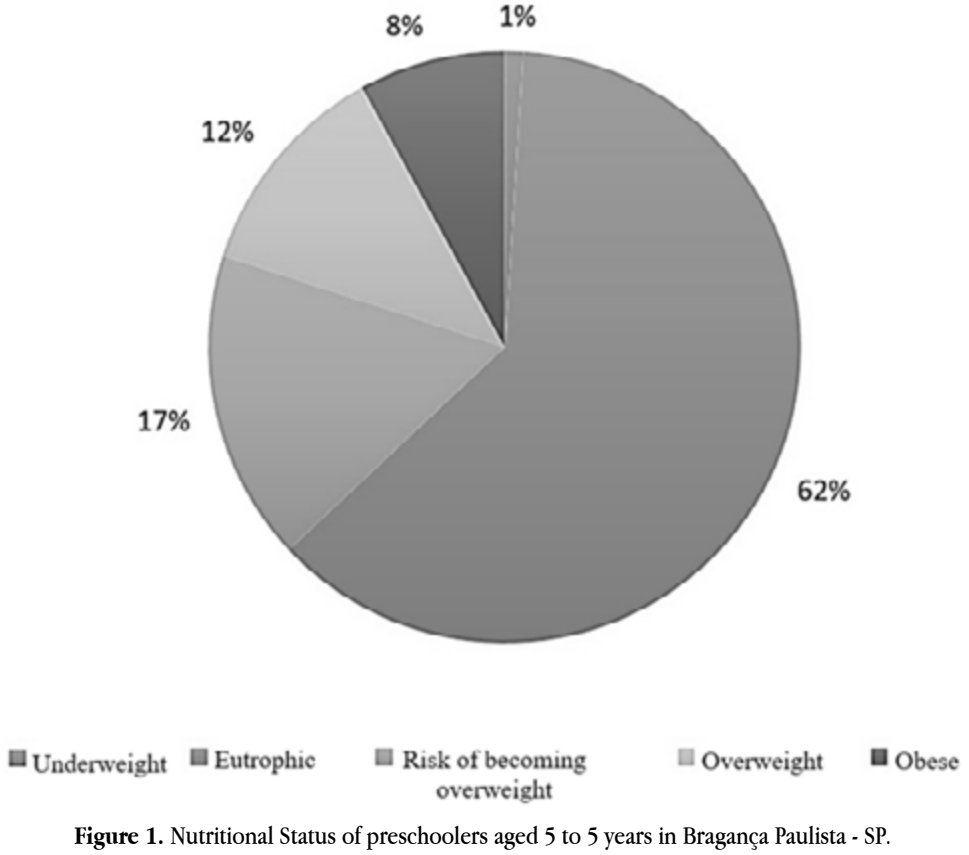

Figure 1. Nutritional Status of preschoolers aged 5 to 5 years in Bragança Paulista - SP.

Table 1 shows the medians of percentiles and BMI of preschoolers considering the nutritional status, sex, and age in months. In stratification by sex, the prevalence of obesity and overweight in girls was 9% (n = 43) and 11% (n = 53), respectively, while in boys the values of 7% (n = 35) and 13% (n = 63) were obtained. The median BMI was also very similar between boys and girls considering their age in months, ranging from 20.13 to 23.84 among obese people, from 17.86 to 18.90 among overweight children, from 15.47 to 15.70 among the eutrophic ones and from 12.35 to 14.29 among the thin people.

Considering the correlation between the BMI of preschoolers and the maternal (p=0.000 r=0.20) and paternal (p=0.007 r=0.15) BMI, there was statistical significance. However, this analysis can only be conducted with 40% of the sample, due to the absence of an answer to this question.

Table 1. Percentile medians and BMI of preschoolers in Bragança Paulista-SP

Nutricional Status	Age (months)	sex (nº of children)	Percentile (Median)	BMI (Median)	BMI (Minimum - Maximum)
Obesity	36 - 60	♂=12	P >99,9	22.67	(19,13-26,21)
		♀=16		23.84	(19,02-25,78)
	61 - 71	♂=23	P >99,9	20.25	(18,07-27,70)
		♀=27		20.13	(18,59-22,68)
Overweight	36 - 60	♂=39	P 99,99	18.65	(16,83-22,71)
		♀=33		18.90	(17,61-20,65)
	61 - 71	♂=24	P 99,99	17.86	(16,74-20,45)
		♀=20		17.93	(16,53-21,48)
Risk of becoming overweight*	36 - 60	♂=83	P 97	17.54	(15,84-19,48)
		♀=81		17.59	(15,48-18,94)
Eutrophy	36 - 60	♂=199	P 50	15.70	(13,12-17,00)
		♀=201		15.64	(13,47-17,04)
	61 - 71	♂=103	P 50	15.47	(13,16-16,80)
		♀=97		15.55	(16,93-13,47)
Underweight	36 - 60	♂=6	P 0,1	14.29	(12,83-15,54)
		♀=2		14.25	(14,00-14,50)
	61 - 71	♂ =0	P 0,1	-	-
		♀=2		12.35	(12,00-12,70)
All	36-60	♂=339	P50	16.37	(12,83-26,21)
		♀=146		16.28	(13,47-25,78)
	61-71	♂=150	P50	16.12	(13,16-27,70)
		♀=146		15.70	(12,70-16,93)
	36-71	♂+♀= 968	P50	16.29	(12,70-27,70)

* The "risk of becoming overweight" classification is only available for children up to 60 months

DISCUSSION

This study revealed that both obesity and overweight are already present even in very young Brazilian children (3-5 years old). Among the 100 preschoolers evaluated 20 were overweight (overweight + obesity) (Figure 1) and this percentage was practically the double of a similar study published in 2011, regarding the metropolitan area of São Paulo.[5] According to the National Survey on Demography and Health of Children and Women (PNDS) carried out in 2006, 7.3% of Brazilian children under 5 years of age were overweight.[14] This study found a percentage almost three times higher, ten years after the PNDS. Confirming the magnitude and severity of excess weight in the sample studied, when the risk of becoming overweight was included, the percentage reached started to represent more than a third of the children. Research involving schoolchildren, that is, individuals over 6 years of age, revealed comparable or even higher rates of overweight and obesity: 6% to 44.2% .[15-17]

Interestingly, it was found that the percentage of overweight boys and girls was very similar, 18% (n = 88) and 20% (n = 96) respectively (Table 1). Similar results were found among female (33%) and male (36%) children in the study by Bernardo et al. (2012)[16] with higher values than ours, since the individuals' age was older.[16] In addition, the study mentioned above was carried out in Florianópolis, which has a higher Human Development Index (HDI) than that of Bragança-Paulista, where this research was conducted. The higher the HDI of a city, the greater the purchasing power of treats is suggested, which are often eaten between meals, commonly in front of a television, tablet or computer. Certainly, this may have favored greater energy consumption than necessary for the body's metabolic functions. It is worth highlighting that weight control stands out among the main pillars for the treatment of dyslipidemia in children, which are risk factors for the development of cardiovascular problems.[18]

Regarding BMI, it was very similar for boys and girls, considering age in months and nutritional status (Table 1); the highest values were found in obese children. The median BMI value of 5-year-old boys in the studied sample (16.12) was slightly higher than the average BMI of boys in the state of Santa Catarina (15.81), in a study published in 2015.[19] As also observed in other countries[20,21] the BMI has been increasing over time, which is in line with higher rates of obesity and overweight in childhood and adolescence[4].

Although obesity depends on numerous other factors, including genetic predisposition, sedentarism, birth weight and breastfeeding conditions[22], the current lifestyle can also contribute to weight gain in childhood. The main factors associated with modern lifestyle that can affect children's diets are: lack of time to prepare food; frequent consumption of fast food; maternal need to work outside the home to supplement income, or even to provide it[23]. The research by Balem et al. [23] carried out in the state of Rio Grande do Sul, involving different age groups (children to adults) suggested that many human beings believe that part of the problem of lack of time in modern society could be solved through the consumption of readily available and fast prepared foods; and that less healthy industrialized products would be the most consumed. Still, the authors pointed out that although the dynamics involving work in the family nucleus has changed over time, the social roles have remained the same. Thus, the mother, a social actor responsible for cooking, no longer has the same time availability as before for the family, due to her insertion in work outside her home.

Another factor associated with obesity, related to modern lifestyle, is the fact that grandmothers spend a significant part of their time with children, which favors a diet rich in treats, satisfying children's desires.[24] The recent study by An et al.[24] revealed that having grandparents as the main caregivers could increase the risk of childhood overweight/obesity by approximately 30%. Interestingly, some grandparents

have the perception that children with greater weight are better nourished[25] and many give unhealthy foods (such as sweets and fried foods) to children as a demonstration of love and kindness.[26]

Significant positive correlation was found between the BMI of preschoolers and the maternal ($p = 0.000$ $r = 0.20$) and paternal ($p = 0.007$ $r = 0.15$) ones. It is worth noting that the parents' weight and height are important information, as it has been proven that a child has 80% chance of being obese when the father and mother are obese and 40% when only one of them has such condition.[27] Although most studies focus on the mother as being largely responsible for the health of children, a recent review published in Jornal de Pediatria[28] suggested that paternal obesity could also be able to induce programmed phenotypes in offspring; and that in fact, there is an association between the father's body fat and the prevalence of obesity in children. In addition, a study involving infants and children showed that those individuals whose parents were obese were more likely to show specific developmental delays in the fine motor domain and in the personal/social domain when compared to individuals whose parents were eutrophic.[29]

The results of this research indicated a significant percentage of overweight preschoolers, emphasizing the real urgency to implement effective preventive health programs from early childhood and this is the strength of our study. Preventive programs must encompass the education of the population for a correct diet, for the practice of sports and reduction of virtual activities, so that future obesity is prevented, and consequently, related non-communicable diseases.[18] It is extremely important to emphasize that spending on obesity in Brazil corresponds to a substantial share of national health expenditure. The direct costs attributed to obesity total about $ 269 million, 1.86% of all spending on medium and high complexity health care.[30] According to the Brazilian association for the study of obesity and metabolic syndrome, the projection is that, in 2025, in the absence of timely interventions, the number of overweight and obese children will reach 75 million in the world.[31] Thus, working hard to prevent and control excess weight is crucial, and it is in childhood that healthy habits are established, which is why investment in education at this stage is so important.[32]

It is of prime importance to note that the present study also has limitations. Due to its transversal character, obesity was analyzed at a certain point in time and not at a certain period, which could have brought additional information regarding the behavior of this pathology in the studied population. Furthermore, risk indicators were not investigated, considering that the main objective was to estimate the prevalence of childhood obesity. Still, the correlation found between the children's and parents' BMI was weak, probably because it was carried out with only 40% of the sample (due to the absence of a response to this data in the questionnaire). This lack of response may have occurred due to the possible discomfort of parents in revealing their weight and height, therefore, future studies involving different methodologies should be encouraged.

Given the above, in future studies the need for continuous investigation of the nutritional condition of the child in Brazilian municipalities is explicit, guiding health promotion programs.

CONCLUSION

The results of this research indicated that the prevalence of childhood obesity in Brazilian children was alarming. When added to the prevalence of the risk of becoming overweight, an extremely high and worrying percentage was reached, mainly because they are children in early childhood. Furthermore, the child's BMI was closely correlated with the parents', reinforcing the need for health care strategies that include the entire family nucleus, being a challenge for public health.

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REFERÊNCIAS

1. Brasileiros atingem maior índice de obesidade nos últimos treze anos 2019. [acesso em 2020 Set 01]. Disponível em: https://www.saude.gov.br/noticias/agencia-saude/45612-brasileiros-atingem-maior-indice-de-obesidade-nos-ultimos-treze-anos.

2. Battaglini S, Zarzalejo Z, Alvarez ML. Obesity in childhood and adolescence, guidance manual. Sociedade Brasileira de Pediatria. Departamento de Nutrologia, Obesidade. Caracas: Caligraphy. 2a. edição revisada e ampliada. [Internet]. 2012 [cited 2018 Dez 02]. Available from: http://www.sbp.com.br/fileadmin/user_upload/publicacoes/14297c1-man_nutrologia_completo.pdf

3. World Health Organization. Physical status: the use and interpretation of anthropometry. Geneva: WHO. [Internet]. 1995 [cited 2018 Dez 02]. Available from: http://apps.who.int/iris/bitstream/handle/10665/37003/WHO_TRS_854.pdf;jsessionid=3DCDA11EE62A1A8822941BEFB7862759?sequence=1

4. Bergmann GG, Bergmann MLA, Pinheiro ES, Moreira RB, Marques AC, Garlipp DC, et al. Índice de massa corporal: tendência secular em crianças e adolescentes brasileiros. Rev Bras Cineantropom Desempenho Hum. 2009; 11(3):280-285.

5. Nascimento VG, Schoeps DO, Souza SB, Souza JMP, Leone C. Risk of overweight and obesity in preschoolers attending private and philanthropic schools. Revista da Associação Médica Brasileira. 2011; 57(6):657-661. doi: https://doi.org/10.1590/S0104-42302011000600012.

6. Mumena WA, Francis-Granderson I, Phillip LE, Gray-Donald K. Rapid increase of overweight and obesity among primary school-aged children in the Caribbean; high initial BMI is the most significant predictor. BMC obesity. 2018; 5(1):4. doi: https://doi.org/10.1186/s40608-018-0182-8.

7. Fisher A, Hammersley ML, Jones RA, Morgan PJ, Collins CE, Okely AN. Goal setting for weight-related behavior change in children: An exploratory study. Nutrition and Health. 2018; 24(2):67-74. doi: https://doi.org/10.1177/0260106018758519. ISSN 0260-1060.

8. Chung ST, Onuzuruike AU, Magge SN. Cardiometabolic risk in obese children. Annals of the New York Academy of Sciences. 2018; 1411:166-183. doi: https://doi.org/10.1111/nyas.13602

9. Nogueira L, Stolzenberg-Solomon R, Gamborg M, Sorensen TI, Baker JL. Childhood body mass index and risk of adult pancreatic cancer. Current Developments in Nutrition. 2017; 1(10):e001362. doi: 10.3945/cdn.117.001362.

10. World Health Statistics Monitoring Health for the SDGs, WHO. [Internet]. 2016 [cited 2018 Dez 02]. Available from: http://www.who.int/gho/publications/world_health_statistics/2016/en.

11. WHO reference for children aged 0-5 years is: WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: World Health Organization, [Internet]. 2006 [cited 2018 Dez 02]. Available from: http://www.who.int/childgrowth/standards/en/.

12. WHO reference for children aged 5-19 years is: de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bulletin of the World Health Organization. [Internet]. 2007 [cited 2018 Dez 02]. Available from: http://www.who.int/growthref/growthref_who_bull/en/.

13. World Health Organization (WHO). Obesity: preventing and managing the global epidemic. Report of a World Health Organization Consultation. Geneva: World Health Organization, WHO Obesity Technical Report Series. [Internet]. 2000 [cited 2018 Dez 02]. Available from: http://

www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/.

14. PNDS Brasil. Ministério da Saúde. National Survey of Demography and Health of Children and Women – PNDS 2006. Dimensions of the Reproductive Process and Child Health. Departamento de Ciência e Tecnologia. Centro Brasileiro de Análise e Planejamento (CEBRAP). Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher – PNDS 2006. Brasília: Ministério da Saúde. [Internet]. 2008 [cited 2018 Dez 02]. 307p. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/pnds_crianca_mulher.pdf.

15. Ricardo GD, Caldeira GV, Corso ACT. Brazil Prevalence of overweight and obesity and central adiposity indexes among school-aged children in Santa Catarina, Brazil. Revista Brasileira de Epidemiologia. 2009; 12(3): 424-35. ISSN 1415-790X. doi: http://dx.doi.org/10.1590/S1415-790X2009000300011.

16. Bernardo CO, Pudla KJ, Longo GZ, Vasconcelos FAG. Factors associated with nutritional status of 7-10 year-old schoolchildren: sociodemographic variables, dietary and parental nutritional status. Revista Brasileira de Epidemiologia. 2012; 15(3):651-61. Available from: https://www.scielosp.org/scielo.php?pid=S1415-90X2012000300018&script=sci_arttext&tlng=es.

17. Schultz M, Petreça DR. Prevalence of body composition disorders in students of Rio Negro – PR. Saúde e Meio Ambiente. 2013; 2(2):84-97. doi: http://dx.doi.org/10.24302/sma.v2i2.514.

18. Mangili L. Alta Prevalência de Dislipidemias em Crianças e Adolescentes: Oportunidade para Prevenção. Arq Bras Cardiol. 2020; 114(1):57-58. doi: https://doi.org/10.36660/abc.20190761.

19. Souza WC, Grzelczak MT, Reiser FC, Lima VA, Souza WB, Alarcón-Meza EI, et al. Relação entre o IMC e o IAC em meninos pré-escolares. R. bras. Qual. Vida. 2015; 7(1):48-55.

20. Herpertz-Dahlmann B, Geller F, Böhle C, Khalil C, Trost-Brinkhues G, Ziegler A, et al. Secular trends in body mass index measurements in preschool children from the City of Aachen, Germany. Eur J Pediatr. 2003; 162(2):104–109.

21. Tremblay MS, Willms JD. Secular trends in the body mass index of Canadian children. Can Med Assoc J. 2000; 163(11):1429-1433.

22. Silveira JA, Taddei JA, Guerra PH, Nobre MR. Effectiveness of schoolbased nutrition education interventions to prevent and reduce excessive weight gain in children and adolescents: a systematic review. Jornal de Pediatria. 2011; 87(5):382-92. doi: http://dx.doi.org/10.2223/JPED.2123.

23. Balem TA, Alves EO, Coelho JC, Mello ALP. As transformações alimentares na sociedade moderna: a colonização do alimento natural pelo alimento industrial. Revista Espacios. 2017; 38(47):5-16.

24. An R, Xiang X, Xu N, Shen J. Influence of Grandparental Child Care on Childhood Obesity: A Systematic Review and Meta-Analysis. Child Obes. 2020; 16(3):141-153. doi:10.1089/chi.2019.0246

25. Jiang J, Rosenqvist U, Wang H. Influence of grandparents on eating behaviors of young children in Chinese three-generation families. Appetite. 2007; 48:377-383.

26. Li B, Adab P, Cheng KK. The role of grandparents in childhood obesity in China – evidence from a mixed methods study. Int J Behav Nutr Phys Act. 2015; 91(12). doi:10.1186/s12966-015-0251-z.

27. Keller C, Stevens KR. Assessment, etiology, and intervention in obesity in children. The Nurse Practitioner. [Internet]. 1996; 21(9):31-41. Available from: https://www.ncbi.nlm.nih.gov/pubmed/8884793/.

28. Ornellas F, Carapeto PV, Mandarim-de-Lacerda CA, Aguila MB. Obese fathers lead to an altered metabolism and obesity in their children in adulthood: review of experimental and human studies. Jornal de Pediatria. 2017; 93(6):551-559. doi: https://doi.org/10.1016/j.jpedp.2017.08.006.

29. Yeung EH, Sundaram R, Ghassabian A, Xie Y, Buck LG. Parental Obesity and Early Childhood Development. Pediatrics. 2017; 139(2). doi: 10.1542/peds.2016-1459.

30. Oliveira ML, Santos LM, Silva EN. Direct healthcare cost of obesity in Brazil: an application of the cost-of-illness method from the perspective of the public health system in 2011. PLoS One. 2015; 10(4):e0121160. doi: 10.1371/journal.pone.0121160.

31. Abeso. Mapa da obesidade. Website da Abeso. 2018. [acesso em: 2020 Set 01]. Disponível em: http://abeso.org.br/atitude-saudavel/mapa-obesidade.

32. Jester A, Kreider KE, Ochberg R, Meek J. Effectiveness of Implementing Initial Education Strategies to Promote Awareness and Healthy Habits in Childhood Obesity: A Quality Improvement Project. J Pediatr Health Care. 2018; 32(2):157-162. doi: 10.1016/j.pedhc.2017.09.006.