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Nutritional status and food security of socially vulnerable families in the municipality of Contagem, Minas Gerais, 2014

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Abstract

This is a cross-sectional study evaluating nutritional status and food insecurity in a vulnerable community in Contagem, in the metropolitan region of Belo Horizonte. A total of 273 individuals from 67 families were evaluated. For the anthropometric assessment, weight, height, body mass index, waist circumference, and waist-to-height ratio were determined. Food insecurity was analyzed using the Brazilian Food Insecurity Scale. Total cholesterol, triglycerides, glucose, and serum albumin concentrations were also determined. Of the 67 families evaluated, 51% (n = 34) had food insecurity, of which 79.4% were mild, 17.7% were moderate, and 2.9% were severe. In children and adolescents, overweight and obesity were diagnosed in 9.3% (n = 4) and 19.5% (n = 16), respectively. Among adults, 34.1% (n = 42) were classified as overweight, 27.6% (n = 34) had grade I obesity, and 59.3% (n = 73) had an increased risk of cardiovascular disease. In the elderly, overweight was diagnosed in 44.0% (n = 11), and 80.0% (n = 20) had an increased risk for cardiovascular diseases. Hyperglycemia, hypercholesterolemia, and hypertriglyceridemia were diagnosed in 17, 45, and 72% of the population, respectively. There was a positive correlation between anthropometric and biochemical parameters, with the exception of albumin and glucose, which showed a negative correlation in children and adults. Our study confirms the impact of social vulnerability on the occurrence of high proportions of food insecurity, leading to a high prevalence of overweight and obesity and an increased risk for cardiovascular disorders. Furthermore, our findings support the use of serum albumin concentrations as an indicator of changes in glucose metabolism.

Keywords: Nutritional status. Food and nutrition security. Anthropometry.

INTRODUCTION

Food insecurity is a worldwide problem that commonly occurs in developed and underdeveloped countries whenever there is a limited or uncertain condition for the availability of nutritionally adequate and safe food[1,2]. The most severe form of food insecurity occurs when family members do not have any type of food, causing hunger and starvation, or when they need to reduce food intake and/or food diversity[3]. Reduced nutrient intake causes nu-

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tritional deficits; consequently, these individuals are more susceptible to opportunistic infections, which can lead to hospitalization[4].

In addition to hunger and malnutrition being the most serious manifestations of food insecurity and the inability to access food being its main cause, other aspects must be taken into account, such as obesity and diseases associated with poor diet[5].

The poor nutritional habits of the population highlighted obesity among the public health problems in Brazil and in the world. Obesity affects people's quality of life in different dimensions and in different age groups. The earlier its emergence, the greater the impact is on the life and health of the population due to the greater susceptibility to the development of associated diseases[6] (Frontzek, Bernardes, Modena (2017). The nutritional status of a population is important for assessing living conditions and, therefore, for the planning and promotion of health strategies.

A trend observed in socially vulnerable populations is the risk of overweight and obesity, which may possibly reflect an inadequate nutritional status or even food insecurity[7,8]. In this context, the present study aimed to assess the nutritional status and food insecurity of families residing in a vulnerable community in Contagem, in the metropolitan region of Belo Horizonte, Minas Gerais. As specific objectives, several anthropometric and biochemical measurements were evaluated to confirm the hypothesis that food insecure individuals living in this community have an inadequate nutritional status.

METHODOLOGY

This is an observational, cross-sectional study carried out in 2014 in Vargem das Flores, in the municipality of Contagem, located in the metropolitan region of Belo Horizonte, one of the Brazilian megacities. The focus on this community is derived from the fact of its poor living conditions and the general situation of vulnerability, classified as low and very low municipal development index (HDIM) (http://portalpmc.contagem.mg.gov.br/observatorio/visao-municipal-general/).

The eligibility criteria for the study were individuals of both sexes, aged over one year old and who consented to participate in the study, signing the informed consent or assent form. Participants were recruited by posting flyers in public areas of the community. The consultations were carried out from a convenience sample of people who presented themselves at the readily available health center in a non-random manner.

The study was carried out at the Primary Care Center - Vargem das Flores and all participants provided written informed consent before starting the study. The study protocol was approved by the Ethics Committee of the Federal University of Minas Gerais (Protocol no. CAAE 30510414.4.0000.5149).

Blood was collected by a trained professional in heparinized tubes, transported to the laboratory at UFMG, where it was centrifuged to determine the concentrations of total cholesterol, triglycerides, and glucose. These parameters were determined by the colorimetric enzymatic method using Labtest® brand kits, with readings performed in a spectrophotometer model UV-1601PC (Shimadzu Corp, Kyoto, Japan).

Body weight (W) was measured to the nearest 0.1 kg with the participant wearing light clothing and no shoes using an electronic scale (Mallory, USA). Standing height

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was measured and recorded to the nearest 0.5 cm with a stadiometer (without shoes). The body mass index (BMI) was calculated from height and weight measurements. Children younger than two years old were held by their mothers and weight was obtained by subtracting the mother's weight from the result of the total weight. The height of these children was obtained in the horizontal position, using a child stadiometer. Nutritional status was assessed by comparing height and weight in the study cohort with the World Health Organization (WHO) growth reference for the same age and gender. Anthro software (1-5 years) and AnthroPlus software version 3.0.1 (5-19 years) were used[9]. WHO BMI cutoff points for adults were used to classify as underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), and obesity (BMI ≥ 30.0). kg/m^2)[10]. Waist circumference (WC) was measured in centimeters, with a flexible and inextensible measuring tape, halfway between the lower costal margin and the top of the iliac crest, to the nearest 0.1 cm. Waist circumference (WC) ≥80.0 cm was used to define central obesity[11]. The waist circumference/height ratio (WHR) was calculated using 0.5 as the cut-off point[10]. Total cholesterol, triglycerides, glycemia, and serum albumin were determined in 169 (57.1%) subjects initially enrolled in the study. These biochemical variables were chosen because alterations in the lipid profile, glycemia, and albuminemia may be associated with malnutrition.

Food insecurity was analyzed using the Brazilian Food Insecurity Scale (BFIS)[12,13], which directly measures the perception and experience of food insecurity and hunger at the household level. The evaluated families were classified into four categories, considering the quantification of the total number of affirmative responses as follows: Food security: only negative responses; mild food insecurity: one to five positive responses; moderate food insecurity: six to 10 positive responses; severe food insecurity: 11 to 15 positive responses.

All assessments were performed by properly trained personnel, following standardized procedures. The research team was composed of nutritionists, nurses, doctors, pharmacists, and university students.

Data were analyzed using the SPSS software package (version 24.0, Chicago, IL, USA). Continuous variables were tested for normality of distribution using the Kolmogorov Smirnov test. Descriptive statistical analyses and Pearson's correlation were applied for nutritional and biochemical variables. A significance level of 5% ($p \leq 0.05$) was adopted for all statistical analyses.

RESULTS

A total of 296 individuals agreed to participate in the study, of which 23 were excluded, leaving 273 individuals (from 5 to 88 years old), members of 67 families, who were stratified by age for a better visualization of the biochemical and anthropometric parameters. Thus, there were 43 children (5 to 9 years old), 82 adolescents (10 to 19 years old), 123 adults (≥20 years old), and 25 elderly individuals (>60 years old).

For parameters such as weight-for-age z-score (WA-Z), weight-for-height z-score; (WH-Z), height-for-age z-score (HA-Z) and BMI-for-age z-score (BMIA-Z), the majority (>70%) of children under 5 years of age were classified as eutrophic. Excess weight

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(overweight or obesity) was identified in 9.3% (n=4) of children aged 5 to 10 years old and in 19.5% (n=16) of adolescents. In the adult population, 34.1% (n=42) were classified as overweight, 27.6% (n=34) with type I obesity, and 59.3% (n=73) with cardiometabolic risk. Increased visceral fat was observed in 50% (n=43) of women and 32% (n=12) of men. In the elderly, 44% (n=11) were overweight and 80% (n=20) were at cardiometabolic risk. In addition, excess visceral fat was found in 89% (n=18) of the elderly women.

The results of the biochemical tests showed that in this population, 17% had hyperglycemia, 45% hypercholesterolemia, and 72% hypertriglyceridemia. Albumin values were normal. The results stratified by age groups for the biochemical results are presented in Table 1.

Table 1 – Biochemical parameters, stratified by age group, in the population of Vargem das Flores (Contagem, MG, 2014).

	Age Group [Years]			
Biochemical parameters	**5-9 (N=22)**	**10-19 (N=25)**	**20-64 (N=98)**	**≥65 (N=19)**
Glucose (mg/dl)				
Mean ± SD	135 ± 96.60	122 ± 87.86	107 ± 63.41	85 – 24.07
Min - Max	66.00 -365.00	62.00 – 366.00	60 – 396.79	61 – 150.10
Albumin (g/dL)				
Mean ± SD	4.00 ± 0.18	3.97 ± 0.34	4.01 ± 0.19	4.03 ± 0.12
Min - Max	3.60 – 4.20	2.50 – 4.30	3.17 – 4.66	3.59 – 4.16
Cholesterol (mg/dL)				
Mean ± SD	154.22 ± 39.74	170.48 ± 37.69	223.67 ± 80.95	243.16 ± 68.17
Min - Max	92.00-273.00	122.00 – 272.00	51.26 – 537.28	147.91 – 383.51
Triglycerides (mg/dL)				
Mean ± SD	192.59 ± 33.83	155.28 ± 59.92	254.76 ± 118.32	313.79 ± 148.17
Min - Max	66.00- 637.00	77.00 – 382.00	90.00 – 658.90	139.52 – 725.90

SD = Standard Deviation; Min=minimum; Max=maximum; n = number of individuals evaluated in each age group.

Among children aged 5 to 9 years old, total serum cholesterol levels correlated with serum triglyceride levels and with the WA-Z parameter ($p \leq 0.05$) (Figure 1 A-B). Body weight was positively correlated with triglycerides, WC, WHR, and WH-Z ($p \leq 0.01$, both) (Figure 1 C-E). There was no correlation between biochemical parameters and anthropometry in the group of adolescents.

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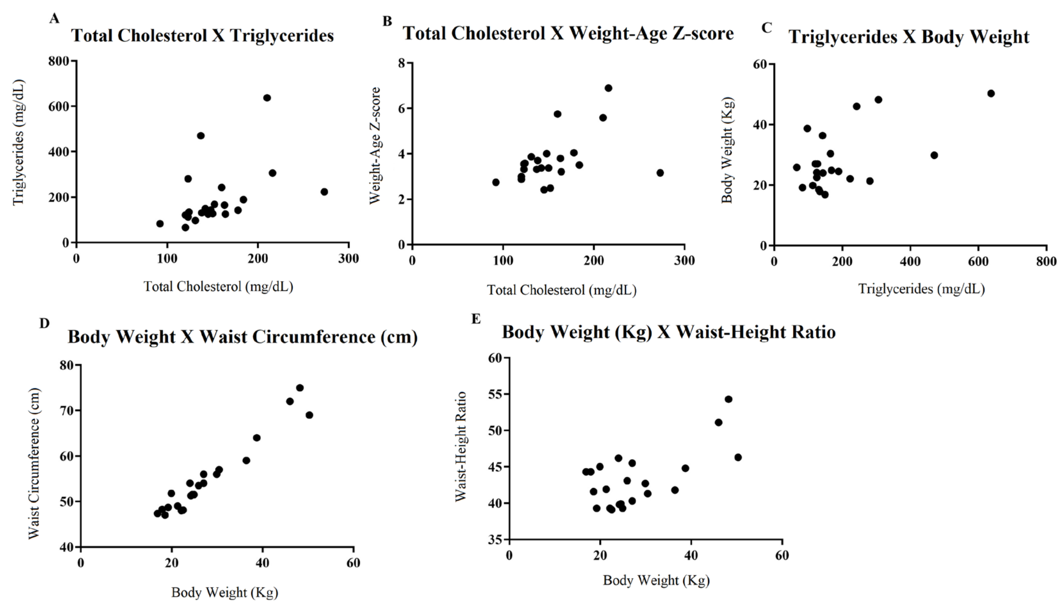
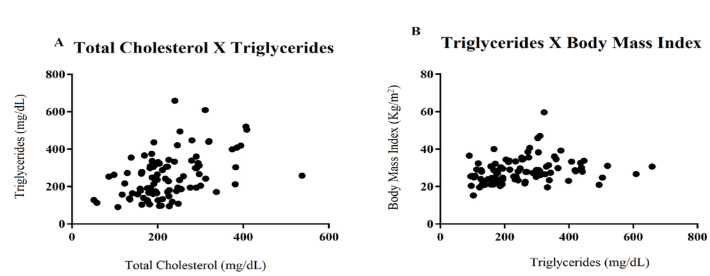


A) Correlation of Total Cholesterol X Triglycerides; **B)** Correlation of Total Cholesterol X Weight for age (z-score); **C)** Correlation of Triglycerides X Body Weight; **D)** Correlation of Body Weight X Waist Circumference; **E)** Correlation of Body Weight X Waist-Height Ratio. *Pearson's correlation and t-value were calculated at the significance level (P < 0.05).*

Figure 1 – Correlations between anthropometric and biochemical variables in children aged 5 to 9 years old in Vargem das Flores (Contagem, MG).

In the adult population, positive correlations were found between total cholesterol and triglycerides ($p \leq 0.001$) and between triglycerides and BMI ($p \leq 0.05$) (Figure 2).



A) Correlation between Total Cholesterol X Triglycerides; **B)** Correlation between Triglycerides X Body Mass Index (BMI). *Pearson's correlation and t-value were calculated at the significance level (P < 0.05).*

Figure 2 – Correlation between anthropometric and biochemical variables in adults from Vargem das Flores (Contagem, MG).

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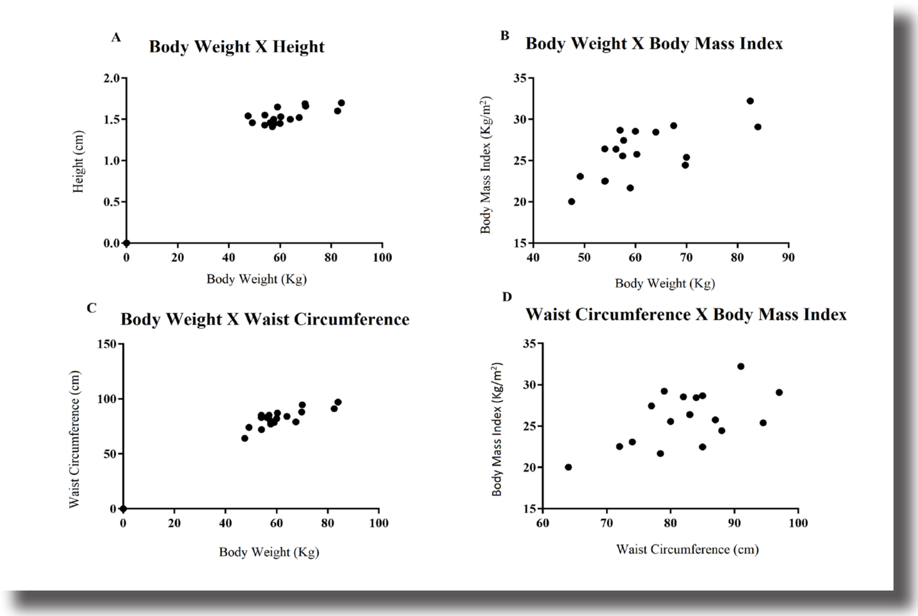
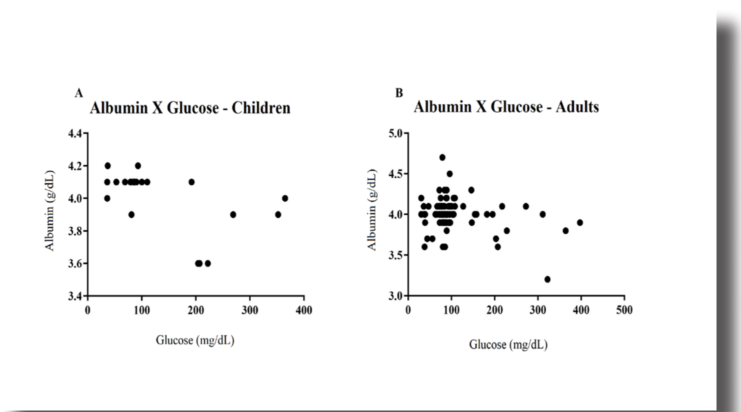
In the elderly, body weight correlated with height, WC, and BMI (p≤0.01, both). WC correlated positively with BMI (p≤0.05) (Figure 3).



A) Correlation of Body Weight X Height; **B)** Correlation of Body Weight X Body Mass Index (BMI); **C)** Correlation of Body Weight and Waist Circumference; **D)** Correlation of Waist Circumference X Body Mass Index (BMI). *Pearson's correlation and t-value were calculated at the significance level (P < 0.05).*

Figure 3 – Correlation between anthropometric variables in elderly people from Vargem das Flores (Contagem, MG).

The results showed a significant negative correlation between serum albumin and glucose in children (p≤0.01) and adults (p≤0.001) (Figure 4).



A) Correlation between albumin and glucose in children; **B)** Correlation between albumin and glucose in adults. *Pearson's correlation and t-value were calculated at the significance level (P < 0.05).*

Figure 4 – Correlation between albumin and glucose levels in children and adults from Vargem das Flores (Contagem, MG).

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Half of the families (50.8%, n = 34) were classified as having mild, moderate, or severe food insecurity, with proportions being 79.4, 17.7, and 2.9%, respectively. Among the families that presented food insecurity, 28 (82.4%) were worried about the lack of food, 21 (61.8%) feared lack of food for several days, 23 (67.6%) did not have financial resources to ensure a healthy diet, 15 (44.1%) reported consuming little variety of food, and 14 (41.2%) were unable to offer healthy and varied food to residents under 18 years of age.

DISCUSSION

Obesity is a complex and multifactorial condition, which involves biological and environmental factors and is considered one of the priorities on the backlog of world public health services[14,15]. We detected a high prevalence of overweight and obesity in children (9.3%), adolescents (19.5%), and in the adult population studied (61.7%). Our results follow those observed in Brazil in general for children and adolescents, since the findings in different Brazilian regions have their peculiarities, both for children and adolescents[16] and for adults[17].

For biochemical parameters, a direct association between total cholesterol levels and body weight was observed in children. This association was also verified in overweight children and adolescents in another region of Minas Gerais[18]. Together with data from the literature[19], our data pointed to obesity as a public health problem among children, adolescents, and adults.

Among adults, there was a positive association between triglycerides and BMI and between triglycerides and total cholesterol. Similar findings were reported in other studies, such as the one carried out with 139 physically active Brazilian women over 50 years old, with alterations in glycemia associated with high values of BMI, WC and WHR[20]. A cross-sectional study involving 30 randomly selected women aged 20 to 54 years in the state of São Paulo, Brazil, revealed higher levels of triglycerides, glycemia, and anthropometric parameters in patients with altered values of total cholesterol[21]. Our results showed increased values of lipids and WC in patients with altered BMI values. A positive association between increased blood glucose and body fat accumulation, especially in the abdominal region in adults, was also observed.

The use of a cutoff point of WHR > 0.5 as a criterion for abdominal obesity associated with the risk of cardiovascular disease was first proposed in adults and is a significantly better predictor than BMI or WC for cardiovascular outcomes such as diabetes or hypertension[22]. Some authors have stated the excellent performance of the waist-to-height ratio as a screening tool to identify cardiometabolic risk in children[22,23] and adolescents[24], suggesting the use of this assessment in the routine of primary health care. In the present study, it was possible to verify the positive association between data on body weight and WHR in children aged 5 to 9 years, suggesting the need for greater attention to the health of this population, since obese children are at a high risk of developing cardiovascular diseases (CVDs), hypertension, diabetes mellitus, among other pathologies.

For nutritional studies with the elderly, both at a clinical and population level, anthropometric assessment is one of the most used methods, and BMI is one of the most important variables[25]. The aging process is accompanied

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by body changes such as the successive increase in fat deposition with changes in body redistribution[20,25]. Here, we found hypercholesterolemia, hypertriglyceridemia, and hyperglycemia in 52.6, 78.9, and 15.8% of the elderly, respectively, but none of these variables were significantly associated with anthropometric data. These results corroborate the idea that traditional measures such as BMI would not be good markers of adiposity in the elderly[26].

Our results showed a negative association between albumin and glucose levels. A negative association between serum albumin concentrations and the risk of heart failure has been reported in the elderly[27]. A cohort of 546 individuals showed that the serum albumin level can serve as a prognostic factor in non-ischemic acute heart failure. Hypoalbuminemia was associated with an increased risk of hospital mortality, especially in elderly patients[28]. Currently, the measurement of circulating glycosylated albumin is encouraged to estimate glycemic control in diabetic patients and is considered a more accurate parameter than the measurement of glycosylated hemoglobin[29]. Therefore, our findings encourage further studies on the use of serum albumin concentrations as an indicator of changes in glucose metabolism.

Data from the Brazilian Institute of Geography and Statistics showed that 22.6% of the Brazilian population suffered from food insecurity, with 14.8% considered mild and 7.8% moderate or severe[30]. Our study revealed some type of food insecurity in 50.8% of the interviewed families, which is 2.25 times higher than the Brazilian average. This considerable difference can be explained by the fact that, in the nationwide study, the population survey was carried out in different socio-geographical situations[12,30]. The findings by Schott *et al.*[31] revealed that 63.4% of 596 families residing in the urban area of the State of Tocantins had food insecurity associated with low schooling of the head of household, low per capita income, receiving social assistance program benefits, and a lack of drinking water at home. Food insecurity and its determinants are unevenly distributed across Brazilian macro-regions, as demonstrated in the work by Santos *et al.* (2022)[32]. The authors evaluated a sample of 57,920 households in different regions of Brazil and found that the North had the worst proportions of all levels of food insecurity (57%), followed by the Northeast (50.4%), which were especially moderate/severe (25.2% and 20.6%, respectively). Another study using data from the National Household Sample Survey (2004, 2009, and 2013) and Altas Brasil (2010) revealed lower prevalence of food and nutrition insecurity in the Midwest, Southeast, and Southern regions, and in Minas Gerais a prevalence was found of 25.5%[33].

Another study carried out only in a northeastern region of Brazil had findings similar to our results. Food insecurity was found in 52.1% of the families[34]. These findings can be explained by the fact that these families were also from the outskirts of a Brazilian city and had a low economic standard. Even in developed countries, socially vulnerable communities have high rates of food insecurity, as demonstrated in our study[35].

CONCLUSIONS

In summary, our study revealed high rates of food insecurity, high prevalence of overweight and obesity, and increased risk for cardiovascular disease, which were associated with biochemical and metabolic changes in the examined community. Despite the

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vulnerability of this population, educational interventions related to the adoption of healthier eating habits, the development of health promotion strategies, and better access to healthy foods can lead to significant improvements in their nutritional profile. Furthermore, our findings may encourage further studies on the use of serum albumin concentrations as an indicator of changes in glucose metabolism.

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Contribution to study design and planning, data analysis and interpretation: Cruz, RE, Oliveira, DR, Geiger, SM, Santos, JFG; Gomes, MA. Data collection: Cruz, RE, Barros, RTV, Ribeiro, MRS, Oliveira, DR. Elaboration and revision of the manuscript: Oliveira, DR, Barros, RTV, Geiger, SM, Gomes, MA.

All authors read and agreed with the published version of the manuscript.

REFERENCES

1. Papas, M.A., Trabulsi, J.C., Dahl, A., Dominick, G. Food insecurity increases the odds of obesity among young Hispanic children. J immigrant minority health. 2016; 18 (5): 1046-1052. https://dx.doi.org/10.1007/s10903-015-0275-0
2. Long, M.A., Gonçalves, L., Stretesky, P.B., Defeyter, M.A. Food insecurity in advanced capitalist nations: A review. Sustainability. 2020; 12 (9): 3654. https://dx.doi.org/DOI:10.3390/su12093654.
3. Stamoulis, K., Hemrich, G. Hunger food insecurity and malnutrition: new challenges for international organizations. Italian Rev Agricul Econom. 2016; 71(1): 13-18. http://dx.doi.org/10.13128/REA-18621
4. Perez-Escamilla, R., Bermudez, O., Buccini, G.S., Lutter, C.K., Victoria, C. Nutrition disparities and the global burden of malnutrition. BMJ. 2018; 361: k2252. https://dx.doi.org/10.1136/bmj.k2252
5. Dhurandhar, E.J. The food-insecurity obesity paradox: A resource scarcity hypothesis. Physiology & behavior. 2016; 162: 88-92. https://dx.doi.org/10.1016/j.physbeh.2016.04.025.
6. Frontzek, L.G.M.; Bernardes, L.R.; Modena, C.M. Obesidade Infantil: Compreender para Melhor Intervir. Revista da Abordagem Gestáltica, 2017, 23(2): 167-174.
7. Nettle, D., Andrews, C., Bateson, M. Food insecurity as a driver of obesity in humans: The insurance hypothesis. Behavioral Brain Sci. 2017; 40: 1-56. https://dx.doi.org/10.1017/S0140525X16000947.
8. Farrell, P., Thow, A.M., Abimbola, S., Faruqui, N., Negin, J. How food insecurity could lead to obesity in LMICs: When not enough is too much: a realist review of how food insecurity could lead to obesity in low-and middle-income countries. Health Promot Int. 2018; 33 (5): 812-826. https//dx.doi: 10.1093/heapro/dax026.
9. World Health Organization Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation, World Health Organization, Geneva (2000). WHO technical report series, 894. file:///C:/Users/ruthc/Downloads/WHO_TRS_894.pdf
10. World Health Organization Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation, Geneva. 8–13 December (2008).
11. McCarthy, H.D., Ashwell M.A. Study of central fatness using waist-to-height ratios in UK children and adolescents over two decades supports the simple message–keep your waist circumference to less than half your height'. Int J Obes. 2006; 30 (6): 988-992. https://dx.doi.org/10.1038/sj.ijo.0803226.
12. Segall-Corrêa, A.M., Pérez-Escamilla, R., Maranha, L.K., Sampaio, M.F.A., Yuyama, L., Alencar, F. Projeto: acompanhamento e avaliação da segurança alimentar de famílias brasileiras: validação de metodologia e de instrumento de coleta de informação: urbano/rural: relatório técnico. Campinas: Departamento de Medicina Preventiva e Social, Universidade Estadual de Campinas/Organização Pan-Americana da Saúde/ Ministério de Saúde. 2004. (Relatório Técnico). https://bvsms.saude.gov.br/bvs/publicacoes/vru_unic.pdf
13. Ministério do Desenvolvimento Social e Combate à Fome. Escala Brasileira de Insegurança Alimentar - EBIA: análise psicométrica de uma dimensão da Segurança Alimentar e Nutricional. Brasília: Ministério do Desenvolvimento Social e Combate à Fome. 2014 (Estudo Técnico 1). https://fpabramo.org.br/acervosocial/wp-content/uploads/sites/7/2017/08/328.pdf
14. Reilly, J.J., El-Hamdouchi, A., Diouf, A., Monyeki, A., Somda, S.A. Determining the worldwide prevalence of obesity. The Lancet. 2018; 391(10132): 1773-1774. https://dx.doi.org/10.1016/S0140-6736(18)30794-3.
15. Sarma, S., Sockalingam, S., Dash, S. Obesity as a multisystem disease: Trends in obesity rates and obesity-related complications. Diabetes, Obesity and Metabolism. 2021; 23: 3-16. https://dx.doi.org/DOI: 10.1111/dom.14290.
16. Guedes, D.P., Mello, E.R.B. Prevalência de sobrepeso e obesidade em crianças e adolescentes brasileiros: revisão sistemática e metanálise. ABCS Health Sci, 2021; 46, e021301. https://doi.org/10.7322/abcshs.2019133.1398.

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DOI: 10.15343/0104-7809.202347e13622022I

17. BRASIL. Vigitel Brasil (2017). Vigilância de fatores e risco e proteção para doenças crônicas por inquérito telefônico. Brasília: Ministério da Saúde, 2018. http://portalarquivos2.saude.gov.br/images/pdf/2019/julho/25/vigitel-brasil-2018
18. Ued FV, Souza MC, Maluf ARL., Weffort VRS. Alterações antropométricas, bioquímicas e de variáveis da síndrome metabólica entre crianças e adolescentes obesos com e sem doença hepática gordurosa não alcoólica. Rev Med Minas Gerais. 2015; 25(4):529-536. http://www.dx.doi.org/10.5935/2238-3182.20150118.
19. Biswas, T., Islam, A., Islam, M.S., Pervin, S., Rawal, L.B. Overweight and obesity among children and adolescents in Bangladesh: a systematic review and meta-analysis. Public Health. 2017; 142: 94–101. https://dx.doi.org/10.1016/j.puhe.2016.10.010
20. Petreça, D.R. et al. Medidas antropométricas podem discriminar a ocorrência de alterações bioquímicas em mulheres acima de 50 anos praticantes de atividade física. J Phys Educ, 2016; 27 (1), 2741. https://dx.doi.org/10.4025/jphyseduc.v27i1.2741
21. Rodrigues, A.S., Barbalho, S.M., Quesada, K., Oshiiwa, M., Bechara, M.D. Association of blood pressure and biochemical parameters with adiposity in women. Int J Health Sci Res. 2017; 7 (2): 146-152.
22. Muñoz-Hernando J, Escribano J, Ferré N, Closa-Monasterolo R, Grote V, Koletzko B, Gruszfeld D, ReDionigi A, Verduci E, Xhonneux A, Luque V. Usefulness of the waist-to-height ratio for predicting cardiometabolic risk in children and its suggested boundary values. Clin Nutr. 2022 Feb;41(2):508-516. doi: 10.1016/j.clnu.2021.12.008. Epub 2021 Dec 8. PMID: 35016145.
23. Jiang Y, Dou Y, Chen H, Zhang Y, Chen X, Wang Y, Rodrigues M, Yan W. Performance of waist-to-height ratio as a screening tool for identifying cardiometabolic risk in children: a meta-analysis. Diabetol Metab Syndr. 2021 Jun 14;13(1):66. doi: 10.1186/s13098-021-00688-7. PMID: 4127061; PMCID: PMC8201900.
24. Lee HJ, Shim YS, Yoon JS, Jeong HR, Kang MJ, Hwang IT. Distribution of waist-to-height ratio and cardiometabolic risk in children and adolescents: a population-based study. Sci Rep. 2021 May 4;11(1):9524. doi: 10.1038/s41598-021-88951-9. PMID: 33947900; PMCID: PMC8096959.
25. Silva, V.S., Souza, I., Silva, D.A.S., Barbosa, A.R., Fonseca, M.J.M. Trends and association of BMI between sociodemographic and living conditions variables in the Brazilian elderly: 2002/03-2008/09. Cienc & saúde coletiva, 2018; 23 (3): 891-901. http://dx.doi.org/10.1590/1413-81232018233.12532016
26. Lee, S.H. et al. Association between body mass index and mortality in the Korean elderly: A nationwide cohort study. PLoS One. 2018; 13 (11), e0207508. http://dx.doi: 10.1371/journal.pone.0207508. eCollection 2018.
27. Gopal, D.M. et al. Health, A.B.C. Study Serum albumin concentration and heart failure risk The Health, Aging, and Body Composition Study. Am Heart J. 2010; 160 (2): 279-85. doi: 10.1016/j.ahj.2010.05.022.
28. Ancion, A., Allepaerts, S., Oury, C., Gori, A.S., Piérard, L.A., Lancellotti, P. Serum albumin level and hospital mortality in acute non-ischemic heart failure. ESC Heart Fail. 2017; 4(2): 138-145. https://dx.doi: 10.1002/ehf2.12128
29. Lu, J.M. et al. Glycated albumin is superior to glycated hemoglobin for glycemic control assessment at an early stage of diabetes treatment: A multicenter, prospective study. J Diabetes Complications. 2016; 30(8): 1609-1613. https://dx.doi.org/10.1016/j.jdiacomp.2016.07.007.
30. Kepple, A.W., Segall-Corrêa, A.M., Santos, L.P.D., Del Grossi, M.E., Santos, J.R.S.S. Food and Agriculture Organization of the United Nations. O estado da segurança alimentar e nutricional no Brasil: agendas convergentes. FAO – Brasil, 2015. https://repositorio.unb.br/handle/10482/21925
31. Schott, E et al. Fatores associados à insegurança alimentar em domicílios da área urbana do estado do Tocantins, Região Norte do Brasil. Revista Brasileira de Epidemiologia 2020; 23 https://doi.org/10.1590/1980-549720200096
32. Santos, L. A. et al. Interseções de gênero e raça/cor em insegurança alimentar nos domicílios das diferentes regiões do Brasil. Cad. Saúde Pública 2022; 38(11):e00130422. https://doi.org/10.1590/0102-311XPT130422
33. Bezerra, M. S., Jacob, M. C. M., Ferreira, M. A. F., Vale, D., Mirabal, I. R. B., & Lyra, C. D. O. (2020). Insegurança alimentar e nutricional no Brasil e sua correlação com indicadores de vulnerabilidade. Ciência & saúde coletiva, 25, 3833-3846. https://doi.org/10.1590/1413-812320202510.35882018
34. Silva, E.K.P. et al. Food insecurity in rural communities in Northeast Brazil: does belonging to a slave-descendent community make a difference? Cad. Saúde Publica. 2017; 33 (4), e00005716-e00005716. https://dx.doi.org/10.1590/0102-311X00005716.
35. Murimi, M.W., Kanyi, M.G., Mupfudze, T., Mbogori, T.N., Amin, M.R. Prevalence of Food Insecurity in Low-Income Neighborhoods in West Texas. J Nutr Educ Behav. 2016; 48 (9): 625-630. https://dx.doi.org/10.1016/j.jneb.2016.07.003

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