International Journal of Nutrology
(Official Journal of the ABRAN - Brazilian Association of Nutrology)

ORIGINAL ARTICLE

DOI: 10.54448/ijn242023

The weight of obesity: a retrospective analysis of the direct costs of hospitalizations due to obesity between 2011 and 2020 for the unified health system in Brazil

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DOI: https://doi.org/10.54448/ijn24203
Received: 10-03-2023; Revised: 01-15-2024; Accepted: 02-15-2024; Published: 04-16-2024; IJN-id: e24203

Abstract

Aim: This study aimed to analyze the evolution of obesity-related costs over the past 10 years for Brazil's Unified Health System (SUS) and provide insights for guiding and expanding health management and promotion measures. **Methods**: An observational and retrospective study was conducted using secondary data from 2011 to 2020, extracted from DataSUS with the ICD-10 code for obesity. Statistical analysis was performed to assess trends in hospitalizations and costs related to obesity. **Results**: During the analyzed period, there was a substantial increase of 110% in hospitalizations and 167% in obesity-related costs for SUS. Female patients (86%) accounted for the majority of hospitalizations, while males (14%) had lower representation. Predominantly, white individuals (62%) were admitted, whereas indigenous individuals had the lowest representation (0,007%). The Southern region contributed to 46% of total cases, in contrast to the Northern region, which accounted for only 0,9%. **Conclusion**: The findings of this study indicate a significant rise in hospitalizations and associated costs related to obesity for Brazil's Unified Health System. These results underscore the urgency of implementing health promotion and prevention measures, both in the public and private sectors. There is a need for optimized allocation of human resources, including trained professionals for obesity treatment, to mitigate the burden of obesity-related morbidity and mortality and alleviate the strain on the healthcare system.

Keywords: Obesity. Nutrology. Hospitalization. Costs. Cost Analysis. Unified Health System.

Introduction

The prevalence of global obesity has seen a significant increase over the last four decades, being characterized as a global epidemic. In the context of Latin America and the Caribbean, it is evident that exponential urbanization and economic improvement, coupled with increased consumption of ultra-processed foods and sedentary lifestyles, have contributed to the rise in obesity rates. Among the highest prevalence countries are Chile, Mexico, Brazil, Argentina, and Paraguay, reaching levels comparable to developed nations, except for the USA **[1]**.

According to the Global Burden of Disease Study, in 2017, the number of individuals classified with high BMI (Body Mass Index) experienced a substantial increase since 1990, becoming one of the top 5 risk factors for attributable deaths and years of life lost due to morbidity **[2]**. As a result, BMI becomes one of the most important health parameters in the context of nutritional classification and population health.

BMI can be defined as weight in kilograms divided by height in meters squared. This index, although imperfect, is widely accepted for categorizing underweight, normal weight, overweight, obesity, and severe obesity. In this case, overweight can be defined as a BMI of 25 to 29,9 kg/m^2, obesity as a BMI > 30 kg/m^2, and severe obesity as a BMI > 40 kg/m^2, or ≥ 35 kg/m^2 if comorbidities are present **[3]**.

The predisposition to other comorbidities among obese patients includes more than 230 identified diseases, such as hypertension, hypercholesterolemia, diabetes mellitus, heart diseases, cancer, osteoarthritis, gallstones, among others. There are 5 major Non-Communicable Chronic Diseases (NCDs) that are predisposed by obesity:

heart diseases, stroke, cancer, chronic respiratory diseases, and diabetes. Furthermore, obesity is associated with increased susceptibility to infections [4]. In the context of COVID-19, a meta-analysis of 75 studies conducted by Popkin et al [5]. demonstrated that obese individuals had a 46% higher risk of developing severe forms of the disease, a 113% higher risk of hospitalization, a 74% higher risk of needing Intensive Care Unit (ICU) treatment, and a 48% higher risk of mortality.

Being fundamentally a metabolic disorder, obesity leads to increased insulin resistance and serum glucose levels, as well as altered adipokines in obese patients. This elevated level of serum glucose is responsible for the generation of oxidants and glycation products that impair immune cell function. Moreover, insulin and leptin hormonal dysregulation impairs the effector immune function of T cells, as these hormones contribute to the production of pro-inflammatory cytokines like IFN-y and TNF-a. Notably, a diet high in fatty acids also influences the inflammatory response by facilitating the spread of enveloped RNA viruses, such as Respiratory Syncytial Virus and Influenza, and by aiding the easy budding of viral particles through cellular receptors like ACE2 [5].

In this regard, despite the global growth of obesity prevalence, preventive measures are still extremely rudimentary across countries, including Brazil, where there is an expansion of actions focused on the surgical treatment of morbid obesity but not on prevention [4,6]. Approximately 80% of strokes, heart diseases, Type 2 Diabetes Mellitus, and 40% of cancers could be prevented through low-cost yet highly effective preventive actions and interventions, targeting major modifiable risk factors like obesity [6].

For decision-making, it is important that health practices are evidence-based, considering the efficient allocation of resources to prevent overwhelming the public health system. Between January 2013 and January 2022, SUS (Unified Health System) expenditures solely on hospitalizations in Brazil amounted to approximately 88.045 billion [7]. Among these, how many could be reallocated through obesity prevention and its associated diseases?

Understanding the expenditures on obesity over the years and their influence on the economic burden of SUS can aid and support the enhancement and urgency of public policies for obesity prevention in the country. Thus, this study aimed to investigate the cost of hospitalizations due to obesity within the SUS (Unified Health System) in Brazil from January 2011 to December 2020.

Methods

Study Design

The study design was observational, cross-sectional, and retrospective, utilizing secondary data sourced from DATASUS, following the rules of STROBE (Strengthening the Reporting of Observational studies in Epidemiology). Available at: https://www.strobe-statement.org/checklists/. Accessed on: 02/15/2024.

Data Collection

Data collection occurred over the period of August to September 2022. Indices and costs associated with obesity-related hospitalizations were extracted from administrative records within the SUS Information System (SIH - Datasus). These records were organized according to variables such as age, race, sector (public/private), gender, annual and average hospitalization costs for obesity. The data were categorized using the 10th International Classification of Diseases (ICD-10) to identify obesity-related cases.

Categorical data were analyzed using basic descriptive measures, including frequency and proportion, with calculations provided by the SIH. Mortality rates were presented based on a scale of 100.000 inhabitants. Data tabulation and analysis were performed using spreadsheet software (Excel).

The research included individuals aged one year and older, encompassing both genders. Patients below the specified age range and those with unrecorded ages were excluded from the study. Ethical considerations were aligned with CNS Resolution 466/12, as the use of publicly available, anonymized secondary data from the Brazilian Ministry of Health obviated the need for Informed Consent Forms (ICFs). The study's primary focus was on the cost analysis of obesity-related hospitalizations within the SUS, excluding private costs or health insurance expenses. Additionally, the study did not account for calculations involving diseases linked to obesity.

In accordance with CNS Resolution 466/12, this research is exempt from the requirement for Informed Consent Form (ICF) due to its reliance on publicly accessible, secondary, and anonymized data sourced from the Brazilian Ministry of Health. This approach aligns with established ethical guidelines and ensures the protection of individuals' privacy and confidentiality.

Results

Between January 2011 and December 2020, a total of 108.951 hospitalizations for obesity (ICD-10) were recorded in DATASUS within the Brazilian SUS. The highest number occurred in the Southern region, accounting for 54.040 admissions, followed by the Southeast with 42.578 admissions, the Northeast with 8.611 cases, and the Northern region with 1.010 cases, as shown in Table 1. The majority of hospitalizations were among females, constituting 86% of the total, while the remaining 14% were males.

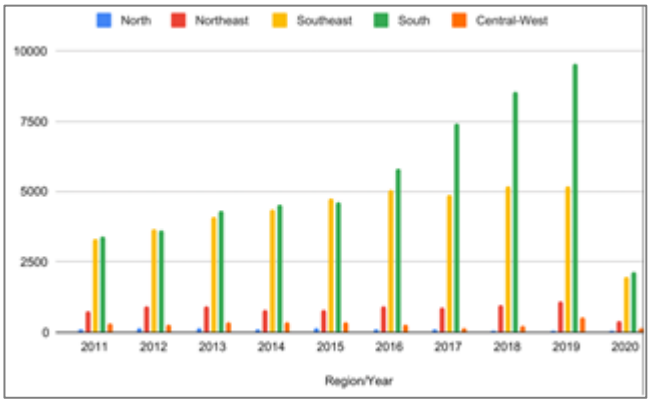
Table 1. Variables by regions of Brazil.

Variables/Region	North	Northeast	Southeast	South	Central-West	Total (n)
Gender						
Male	156	1276	5332	7200	291	14255
Female	854	7335	37246	46840	2791	94696
Total	1010	8611	42578	54040	3082	109321
Color/Race	**North**	**Northeast**	**Southeast**	**South**	**Central-West**	**Total (n)**
White	112	634	23776	42968	648	67768
Black	31	301	2194	1645	17	4188
Brown/mixed-race	678	4048	11013	4917	1389	22045
Yellow	33	362	123	212	27	757
Indigenous	-	1	5	2	-	8
Not informed	156	3265	5467	4296	1001	14185
Total	1010	8611	42578	54040	3082	108581
Age group	**North**	**Northeast**	**Southeast**	**South**	**Central-West**	**Total (n)**
1 a 4 years	-	2	2	-	-	4
5 a 9 years	-	3	6	1	-	10
10 a 14 years	-	4	21	1	-	26
15 a 19 years	9	53	300	652	13	1027
20 a 29 years	149	1257	5225	10367	387	17385
30 a 39 years	337	3199	14384	18429	1070	37049
40 a 49 years	328	2397	12735	14574	995	31029
50 a 59 years	154	1375	7628	8193	494	17844
60 a 69 years	29	299	2146	1756	118	4348
70 a 79 years	3	22	117	63	4	209
80 years and above	1	-	14	4	1	20
Total	1010	8611	42578	54040	3082	108581
Average values	**North**	**Northeast**	**Southeast**	**South**	**Central-West**	**Total (n)**
Average Hospitalization Cost	4105.82	4231.67	4383.42	5758.21	2852.63	5005.34
Average Length of Hospital Stay (days)	5.7	3.9	3.5	2.9	3.5	3.2
Mortality Rate per 100.000 Inhabitants	0.4	0.15	0.24	0.17	0.45	0.21
Hospitalizations by type of care	**North**	**Northeast**	**Southeast**	**South**	**Central-West**	**Total (n)**
Public	569	3199	7415	3208	711	15102
Private	5	914	11881	16470	947	30217
Unknown	436	4498	23282	34362	1424	63632
Total	1010	8611	42578	54040	3082	108581
Hospitalizations by year	**North**	**Northeast**	**Southeast**	**South**	**Central-West**	**Total (n)**
2011	94	755	3297	3388	306	7840
2012	130	916	3656	3613	297	8612
2013	141	918	4104	4300	353	9816
2014	88	818	4346	4513	357	10122
2015	152	796	4725	4622	376	10671
2016	95	942	5068	5825	281	12211
2017	88	896	4857	7442	166	13449
2018	79	992	5179	8552	248	15050
2019	84	1118	5199	9539	534	16474
2020	56	418	1960	2131	141	4706
Total	1007	8569	42391	53925	3059	108581

Source: Prepared by the author.

Another aspect of analysis was race, where 67.768 (62,3%) patients were white, 22.045 (20,1%) were mixed race, 14.185 (12,9%) lacked race information, 4.188 (3,8%) were Black, 757 (0,6%) were Asian, and 8 patients were Indigenous. Regarding age groups most affected by obesity, the 30-39 age range had the highest occurrence with 37.419 cases, followed by the 40-49 range with 31.029 cases, 50-59 range with 17.844 cases, and 20-29 range with 17.385 cases (Figure 1).

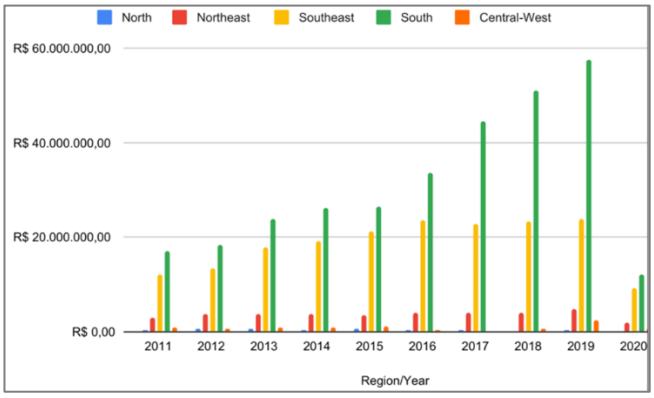
Figure 1. Annual evolution of hospitalization cases for obesity in each region.



Source: Own authorship.

Among these cases, 63.632 hospitalizations were classified as "unknown" sector, 30.217 occurred in the private sector, and 15.102 in the public sector. The state with the highest number of private sector hospitalizations was Paraná, while São Paulo had the highest in the public sector. The total cost during the period was R$ 156 million in the private sector, R$ 53 million in the public sector, and R$ 336 million in the "unknown" sector (Figure 2).

Figure 2. Annual evolution of obesity hospitalization costs by each region.



Source: Own authorship.

In terms of length of hospital stay, the national average was 3.2 days. The longest average stay was in the Northern region, at 5.7 days. The Northeast had an average of 3.9 days. The Central-West and Southeast regions had the same average of 3.5 days. The Southern region had the shortest average stay, at 2.9 days. Regarding mortality rates, the calculation was based on 100.000 inhabitants. The national average mortality rate solely for obesity-related cases was 0.21, with the Northern region having the highest rate at 0,4. The Northeast region had the lowest mortality rate among all analyzed regions, at 0.15.

Discussion

The results of this study indicated a progressive increase in hospitalizations for obesity between 2011 and 2019, despite a sharp decline in numbers in 2020, which is likely explained by the COVID-19 pandemic. This trend is in line with a prevalence study conducted between 2013 and 2019, which showed an increase in obesity numbers and its associated conditions during the same period.

A multicenter study conducted by the Global Burden of Disease in 2015 determined the prevalence of overweight and obesity in 1980 and 2015, with data from 176 countries, revealing that in 2015, there were 107 million children and 603 million adults with obesity, estimating a global prevalence of 5% and 12%, respectively. At that time, prevalence was typically higher among women aged 60 to 64.

In 13 of the 20 most populous countries, there was an increase of more than two times in obesity prevalence between 1980 and 2015 **[8]**, establishing itself as a significant risk factor for other serious morbidities. In this regard, the progressive number of hospitalizations found in the results of this study aligns with the global temporal evolution of these disease numbers.

There are several factors that can explain the gradual increase in obesity and its complications over the last three decades, including the progressive urbanization of developed and developing countries, contributing to sedentary lifestyles and lower population energy expenditure **[9]**. Additionally, changes in food systems and the food environment, providing greater availability and accessibility of energy-rich foods, along with intense marketing, may explain the excess energy contributing to obesity in different populations globally **[8,9]**.

Regarding non-environmental etiologies of obesity, genetics play a role in a portion of cases. According to Marques-Lopes:

> "The genes participate in maintaining stable weight and body fat over time by controlling effector pathways (leptin, nutrients, nerve signals, among others), central mechanisms (hypothalamic neurotransmitters), and afferent pathways (insulin, catecholamines, autonomic

> nervous system). Thus, energy balance, involving both energy intake and expenditure, appears to depend on genetic inheritance to about 40%, affecting both parts of the energy equation (appetite and expenditure). Scientific advancements indicate a transmissible genetic basis implicated in maintaining stable body weight through various mechanisms, such as appetite regulation, variations in basal metabolism, thermogenic effects of food, or spontaneous physical activity." **[10]**.

Therefore, genetic factors contribute to the energy balance equation, but they are not deterministic, and their influence varies among individuals. The obesogenic environment is largely responsible for the prevalence of obesity.

Our results showed that approximately 86% of these hospitalizations were in females. In 2008, morbid obesity was 2,6 times more common in females than in males in all regions of the country **[4]**. In this context, it was found that 45% of hospitalizations in females occurred between the ages of 40 and 59, which includes the menopausal period. This could be partially explained by hormonal changes during this period. With lower estrogen levels, physical changes such as genital atrophy, bone loss, and others are observed.

The ovaries produce less estradiol, but the production of androstenedione and testosterone remains at premenopausal levels, contributing to greater abdominal fat accumulation. Concurrently, there is a decrease in the levels of the carrier of androgens in the plasma, Sex Hormone-Binding Globulin (SHBG), leading to higher levels of free circulating androgens in the plasma. This central adiposity caused by hormonal changes is directly related to metabolic and cardiovascular diseases in the subsequent years **[11]**.

When broken down by region, the highest prevalence of hospitalizations for obesity was in the South Region (49.4%), followed by the Southeast (38.9%). This can be explained, in part, by social, cultural, and economic factors that create significant contrasts between regions in the country. Technological advancement has altered human lifestyles regarding diet and physical activity **[12]**. In this sense, nutritional and industrial transitions would directly contribute to the increased prevalence of obesity and, consequently, hospitalizations for this disease, explaining the high rates in the more industrialized regions of the country.

Regarding race, it was observed that the highest rates of hospitalization were among whites (62%), followed by mixed-race individuals (20%). A study that associated race with obesity in Brazil found higher levels of abdominal circumference and Waist-to-Hip Ratio among white participants, followed by mixed-race individuals **[12]**. However, when reviewing international literature, it was noted that there was a disparity in the findings in the present study: there was a higher prevalence of obesity and its consequences in the black and Hispanic populations **[13,14]**. This is mainly due to differences in factors considered and variations in race classifications among countries **[12]**, in addition to other factors not considered in this study, such as education and income, which were not taken into account. In the results, an important variable is the age group most affected: 78,9% of hospitalized patients were between 30 and 59 years old.

A survey conducted by VIGITEL **[15]** in 2016 found that 40% of women aged 25 to 34 were overweight, while this number increased to 56% between the ages of 45 and 54. As for men, those aged 34 to 65 already had 63% overweight. Therefore, it is expected that the age group between 30 and 59 years is the most affected by hospitalizations for obesity. Surgical treatment for obesity is well established in cases with an indication, such as a BMI greater than or equal to 40 kg/m^2.

In this regard, a study **[13,16]** characterized hospitalizations related to Obesity - E66 - in the Brazilian Unified Health System (SUS) related to ICD-10, and it identified the procedures performed through this primary diagnosis at the time of hospitalization. Gastroplasty with intestinal bypass accounted for 95% of the costs, of which 85% of the patients were female, and among them, 84,5% were between 30 and 59 years old, results that are significantly close to our findings.

A progressive cost increase in hospitalizations related to obesity was observed during the study period, accumulating a total increase of 167% over these 10 years. However, it is worth noting that this study did not include the costs of diseases associated with obesity, as seen in other studies. In addition to being classified as a disease by the WHO, obesity is a risk factor for the development of metabolic and chronic diseases, including cardiovascular, renal, and various types of cancer.

A study conducted in 2018 **[14]** estimated the costs of obesity and its associated diseases, hypertension, and diabetes, for SUS in that year. It was estimated that only these three diseases accounted for 16% of total hospitalizations, with total costs of 3.45 billion reais, of which 59% were for managing hypertension, 30% for diabetes, and only 11% for obesity treatment and management. However, when considering obesity as a risk factor for hypertension and diabetes, it was concluded that obesity accounted for 41% of total healthcare costs that year (1.42 billion reais).

Therefore, it is evident that despite the isolated costs of obesity not being significant when compared to other diseases, the costs of diseases attributed to it are

extremely significant for SUS, daily burdening the financial management of the public healthcare system. Despite the increasing prevalence of obesity and its associated diseases, there is a significant lack of proactive actions, obesity prevention, and health promotion by governments worldwide **[8]**.

This is primarily due to resource limitations in countries with the highest increases in prevalence and dependence on external donors, as well as a focus on food security rather than dietary interventions. Several Latin American countries have obesity reduction policies, including taxing high-sugar beverages, regulating media advertising related to high-calorie foods, promoting physical activity, and implementing educational programs in schools. However, despite guiding global health measures, the impacts of these prevention strategies on obesity prevalence are still unknown, indicating that individual-level measures need to be aligned **[8,17]**.

In Brazil, the Health Care Networks within SUS allow for the establishment of different relationships between various health points, with Primary Health Care (PHC) at the center of these relationships and municipalities working locally through Overweight and Obesity Care Lines, promoting actions based on these guidelines **[16,18]**.

Studies addressing challenges in reducing prevalence in Brazil have a population predominantly composed of low-income women who are beneficiaries of the Bolsa Familia Program (BFP) **[16]**. Despite this program aiming to provide food and nutritional security through income distribution, it was observed that the increase in income and food consumption did not associate with a decrease in obesity prevalence in this group. It was noted that there is effectiveness in these food security policies when accompanied by nutritional counseling measures.

In this sense, GBD **[8]** argues that, in addition to macro-strategies, individual-level actions are essential: healthcare professionals need to actively engage in health promotion, weight loss, and obesity complication control, reducing the financial burden on global health systems and preventing morbidity and mortality from this disease. Therefore, the role of the nutritionist extends from health promotion by encouraging and teaching healthy eating habits and ways to achieve them, as well as treatment ranging from medication to lifestyle interventions. An approach from prenatal care to the elderly could be extremely effective in combating the increasing prevalence of obesity **[18]**.

Conclusion

Obesity isolated accounted for a progressive annual increase in both numbers and costs of hospitalizations between 2011 and 2020, predominantly affecting females, individuals of white ethnicity, and those aged 30 to 39 years. Obesity emerged as a significant risk factor for the predisposition to other diseases that impose a much greater burden on the public healthcare system. Therefore, its prevention and promotion are crucial on various levels, including macro-level initiatives, as well as individual and particularly educational efforts. Medical nutrition plays a pivotal role in the broader context of attempting to reduce the prevalence of this disease. Consequently, billions of Brazilian reais annually could be reallocated from the Brazilian Unified Health System (SUS) to other areas of healthcare.

Acknowledgement

The authors would like to thank all data collectors engaged in data collection and study participants whose responses enabled the availability of data used in this study.

Ethical Approval

Not applicable, as data was obtained from DATASUS.

Informed consent

Not applicable, as data was obtained from DATASUS.

Funding

No external funding sources are used.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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References

1. Ferreira AP de S, Szwarcwald CL, Damacena GN, Souza Júnior PRB de. Increasing trends in obesity prevalence from 2013 to 2019 and associated factors in Brazil. Revista Brasileira de

Epidemiologia. 2021;24(suppl 2).
2. Jaacks LM, Vandevijvere S, Pan A, McGowan CJ, Wallace C, Imamura F, et al. The obesity transition: stages of the global epidemic. Lancet Diabetes Endocrinol. 2019 Mar;7(3):231–40.
3. Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, et al. 2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults. Circulation. 2014 Jun 24;129(25_suppl_2).
4. Oliveira ML. ESTIMATIVA DOS CUSTOS DA OBESIDADE PARA O SISTEMA ÚNICO DE SAÚDE DO BRASIL. **[Brasília]**: Universidade de Brasília; 2013.
5. Popkin BM, Du S, Green WD, Beck MA, Algaith T, Herbst CH, et al. Individuals with obesity and COVID-19: A global perspective on the epidemiology and biological relationships. Obesity Reviews. 2020 Nov 26;21(11).
6. World Health Organization. Preventing noncommunicable diseases in the workplace through diet and physical activity : WHO/World Economic Forum report of a joint event. . 2008.
7. Brasil M da Saúde. Banco de dados do Sistema Único de Saúde - DATASUS. 2022.
8. GBD 2015 Obesity Collaborators. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. New England Journal of Medicine. 2017 Jul 6;377(1):13–27.
9. Figueiredo BQ de, Souto BOV, Nogueira CFR, Silva IT da, Bernardes LBR, Peres MLA, et al. O enorme custo da obesidade para a saúde pública brasileira: Uma breve revisão de literatura. Research, Society and Development. 2021 Jul 28;10(9):e33610918276.
10. Marques-Lopes I, Marti A, Moreno-Aliaga MJ, Martínez A. Aspectos genéticos da obesidade. Revista de Nutrição. 2004 Sep;17(3):327–38.
11. Knight MG, Anekwe C, Washington K, Akam EY, Wang E, Stanford FC. Weight regulation in menopause. Menopause. 2021 Aug;28(8):960–5.
12. Moretto MC, Fontaine AM, Garcia C de AMS, Neri AL, Guariento ME. Associação entre cor/raça, obesidade e diabetes em idosos da comunidade: dados do Estudo FIBRA. Cad Saude Publica. 2016 Oct;32(10).
13. Carvalho A da S, Rosa R dos S. Cirurgias bariátricas realizadas pelo Sistema Único de Saúde em residentes da Região Metropolitana de Porto Alegre, Rio Grande do Sul, 2010-2016*. Epidemiologia e Serviços de Saúde. 2018 May;27(2).
14. Nilson EAF, Andrade R da CS, Brito DA de, Michele Lessa de O. Custos atribuíveis a obesidade, hipertensão e diabetes no Sistema Único de Saúde, Brasil, 2018. Revista Panamericana de Salud Pública. 2020 Apr 10;44:1.
15. MINISTÉRIO DA SAÚDE B. VIGILÂNCIA DE FATORES DE RISCO E PROTEÇÃO PARA DOENÇAS CRÔNICAS POR INQUÉRITO TELEFÔNICO. 2016.
16. Almeida LM de, Campos KFC, Randow R, Guerra VDA. Estratégias e desafios da gestão da Atenção Primária à Saúde no controle e prevenção da obesidade. Revista Eletronica Gestão & Saúde. 2017 Jan 31;8(1):114.
17. Cominato L, Di Biagio GF, Lellis D, Franco RR, Mancini MC, de Melo ME. Obesity Prevention: Strategies and Challenges in Latin America. Curr Obes Rep. 2018 Jun 8;7(2):97–104.
18. Sociedade Brasileira de Pediatria. Manual de Orientação - Obesidade na infância e adolescência. 3a ed. Weffort V, editor. 2019.

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