dx.doi.org/10.5380/ce.v26i0.81396

Cogit. Enferm. 2021, v26:e81396

Cogitare Enfermagem

ORIGINAL ARTICLE

ASSOCIATION BETWEEN BODY MASS INDEX AND THE CLINICAL OUTCOMES OF COVID-19 CASES

Clarissa Bohrer da Silva[1]
Letícia de Lima Trindade[1]
Samuel Spiegelberg Zuge[2]
Lucimare Ferraz[1]
Marta Kolhs[1]
Marina Klein Heinz[1]

ABSTRACT

Objective: to analyze the association between Body Mass Index and the clinical outcomes of confirmed COVID-19 cases. Method: an epidemiological study conducted with secondary data from 618 confirmed COVID-19 cases, notified from March to December 2020 in a municipality from western Santa Catarina, Brazil. An inferential analysis was performed between Body Mass Index and several clinical and assistance-related aspects. Results: a significant association was found between Body Mass Index and the following symptoms: dyspnea (p=0.003), decreased appetite (p=0.004), runny nose (p=0.039) and diarrhea (p=0.029). There was also an association with previous comorbidities (p=0.000) and worse saturation mean values (p=0.00). Obese individuals presented more chances of: hospitalization in a ward (p=0.027); hospitalization in an Intensive Care Unit (p=0.002); and evolution to death (p=0.00). Conclusion: the need to implement effective educational actions for the prevention and treatment of obesity is evidenced, focusing on quality of life and mitigation of the clinical deterioration of this population in the face of pathologies such as COVID-19.

DESCRIPTORS: Infections by Coronavirus; Pandemics; Obesity; Overweight; Body Mass Index.

HOW TO REFERENCE THIS ARTICLE:

Silva CB da, Trindade L de L, Zuge SS, Ferraz L, Kolhs M, Heinz MK. Association between body mass index and the clinical outcomes of covid-19 cases. Cogit. Enferm. [Internet]. 2021 [accessed "insert day, monh and year"]; 26. Available from: http://dx.doi.org/10.5380/ce.v26i0.81396.

[1]Universidade do Estado de Santa Catarina. Chapecó, SC, Brasil.
[2]Universidade Comunitária da Região de Chapecó. Chapecó, SC, Brasil.

INTRODUCTION

In December 2019, there was a pneumonia outbreak in the city of Wuhan (China), which spread rapidly to other 24 countries. On January 30th, 2020, the World Health Organization (WHO) declared COVID-19, a disease caused by the coronavirus called SARS-CoV-2, as a public health emergency and, on March 11th of the same year, it declared the pandemic state[1].

The COVID-19 symptoms include from asymptomatic states to Severe Acute Respiratory Syndrome (SARS) and multiple organ dysfunction[2]. According to the WHO[3], 80% of the cases can be asymptomatic and nearly 20% may require hospital care for presenting respiratory distress and, of these, approximately 5% may need ventilatory support for the treatment of respiratory failure.

The most critical clinical conditions of the disease have been seen in older adults and in those individuals with underlying and chronic diseases such as cardiovascular diseases, including Systemic Arterial Hypertension (SAH), pulmonary diseases, and Diabetes Mellitus (DM). However, new data have shown severe symptoms, related to worse prognoses, for obese individuals[4-5]. In this pandemic context[6], this risk factor for the worsening of the COVID-19 condition becomes worrying, given the growth of obesity in the population during the recent decades.

According to the WHO[7], the global prevalence of obesity tripled since 1975 and, in 2016, more than 1.9 billion adults were overweight, with 650 million obese individuals among them. In addition, according to the latest report from the Organization for Economic Cooperation and Development (OECD), more than half of the population living in the countries that are part of the organization is overweight, and a quarter is obese. These data express an alarming panorama for public health, as obesity is correlated to a reduction in life expectancy[8].

Data from a Brazilian research study[9] corroborate the international findings since, since monitoring was initiated in 2006, the obesity rate increased from 11.8% to 20.3% in 2019. In addition to that, 55.4% of the Brazilian population presents excess weight. In relation to age, excess weight tends to increase, with 30.4% for young people aged between 18 and 24 years old and 59.8% among adults aged 65 years old or more.

A recent editorial emphasized that individuals over 65 years old and with comorbidities, including obesity, are at a higher risk of developing a severe COVID-19 clinical condition[10]. This situation can be explained because excess weight is associated with deterioration of the immune response, loss of metabolic homeostasis, already evidenced as a precursor to SAH and Type 2 DM (comorbidities that worsen the clinical condition), and a poor prognosis for respiratory infections[11].

Physiological factors and metabolic disorders in obese people can reduce the immune function, making it impossible for macrophages and lymphocytes to perform their functions properly, which can make individuals more susceptible to complications of the disease[4]. A study[12] evidenced that the percentage of adults at risk of severe COVID-19 in Brazil varied between 34.0% (53 million) to 54.5% (86 million), with obesity being a risk factor estimated at 22.1%.

Obesity is a risk factor for the current pandemic due to its relationship with other factors that compromise organ and system functioning, increasing the risk of thromboembolism, reduced glomerular filtration, changes in the immune response, perpetuation of the chronic inflammatory response, and need for ventilatory assistance[13]. Thus, it becomes a common condition among hospitalized patients with greater clinical deterioration[6,14-18].

Therefore, it is considered relevant to better understand the factors that influence this process, in order to explore the relationship of this comorbidity with severity of the

disease in different ages and locations. From this perspective, the objective of this study is to analyze the association between Body Mass Index and the clinical outcomes of confirmed COVID-19 cases.

METHOD

This is a quantitative and epidemiological study, carried out with secondary data from 618 confirmed COVID-19 cases notified in a municipality from western Santa Catarina, Brazil.

The medical charts included in the study were those of individuals infected by COVID-19, notified in the period from March to December 2020. The diverse information referring to people living in other municipalities was excluded. For sample calculation, the number of cases notified in the municipality until September 2020 (total of 7,150), 4% error margin, 50% proportion, and 95% confidence interval were considered. The sample was estimated at 554; however, a total of 618 individuals were randomly included in the study.

Data collection was conducted in electronic medical records (accessed via a website) and in the case monitoring spreadsheets used by the Basic Health Units, both under control of the municipality. This strategy aimed at minimizing possible inconsistencies, prioritizing information quality and completeness.

Classification of the Body Mass Index (BMI) (overweight, obesity or normal weight) was considered according to the definition included in the medical chart, that is, no BMI calculations were performed.

Data collection and digitalization were performed in the EpiInfo software, version 7.2, and the analysis was conducted in the Statistical Package for the Social Sciences (SPSS) software, version 21.0. Analyses of absolute and relative frequencies were performed, relating the BMI categories and dichotomous correlations from Cramer's V2 test, where the closer to one, the stronger the association[19]. In addition, the mean values between the clinical and assistance-related aspects regarding BMI were compared. To such end, normality of the continuous variables was assessed by means of the Kolmorov-Smirnov test. Only the age variable was considered normal, with application of the ANOVA parametric test. The other variables (body temperature, saturation, number of previous comorbidities, number of the patient's contacts with the health services, days from onset of the symptoms to seeking the first health care appointment, days from onset of the symptoms to the test, days from onset of the symptoms to discharge from home isolation) did not pass the normality test ($p \leq 0.05$); thus, the non-parametric Kruskal-Wallis Test was performed[19].

Finally, the Prevalence Ratio was estimated between the following outcomes: hospital admission to a ward, admission to an intensive care unit and evolution to death, associated with BMI; to such end, not having presented the respective outcomes was used as the reference category. A significance level of $p<0.05$ was followed for all the analyses.

The ethical aspects established in Resolution No. 466/2012 of the National Health Council were preserved, with approval by the Research Ethics Committee: opinion No. 4,191,776/2020.

RESULTS

Based on the evaluation of the 618 individuals infected by COVID-19, it was possible to identify that 28 (4.5%) presented clinical overweight and that 72 (11.7%) were obese.

When evaluating the sociodemographic characteristics and the relationship of the BMI parameters, a higher prevalence of overweight and obesity was identified in white-skinned individuals, with complete elementary school, and belonging to the age group between 50 and 59 years old. However, in relation to gender, the prevalence of overweight was higher among the women, and that of obesity was higher among the men (Table 1).

Table 1 – Sociodemographic characteristics of the confirmed COVID-19 cases according to the BMI. Chapecó, Santa Catarina, Brazil, 2020 (n=618)

Variables	**Normal BMI (n=518)**	**Overweight BMI (n=28)**	**Obesity BMI (n=72)**
	n(%)	n(%)	n(%)
Gender			
Male	266(51,4)	13(46,4)	42(58,3)
Female	252(48,6)	15(53,6)	30(41,7)
Skin color (n=611)			
White	440(85,8)	26(92,9)	62(88,6)
Brown	56(10,9)	2(7,1)	8(11,4)
Black	13(2,5)	-	-
Indigenous	2(0,4)	-	-
Not reported in the medical chart	2(0,4)	-	-
Age			
0-19 years old	14(2,7)	1(3,6)	1(1,4)
20-29 years old	98(18,9)	-	6(8,3)
30-39 years old	120(23,2)	5(17,9)	9(12,5)
40-49 years old	96(18,5)	4(14,3)	13(18,1)
50-59 years old	64(12,4)	9(32,1)	21(29,2)
60-69 years old	51(9,8)	4(14,3)	10(13,9)
70-79 years old	31(6,0)	4(14,3)	7(9,7)
80-89 years old	38(7,3)	1(3,6)	5(6,9)
>90 years old	6(1,2)	-	-
Schooling			
Elementary School	147(28,4)	16(57,1)	32(44,4)
High School		8(28,6)	21(29,1)
Higher Education	101(19,5)	3(10,7)	8(11,1)
Literate	46(8,9)	1(3,6)	4(5,6)
Cannot read/write	9(1,7)	-	2(2,8)
Not reported in the medical chart	78(15,1)	-	5(7,0)

Source: The authors (2020)

Among the symptomatological aspects of the people infected by COVID-19, a significant and low-strength correlation was identified between BMI and dyspnea, decreased appetite, runny nose and diarrhea (Table 2).

Table 2 – Symptomatological aspects of the people diagnosed with COVID-19 according to Body Mass Index. Chapecó, Santa Catarina, Brazil, 2020 (n=618)

Variables	Normal BMI (n=518)	Overweight BMI (n=28)	Obesity BMI (n=72)	p-value*	Cramer's V2
	n(%)	n(%)	n(%)		
Dyspnea				**0,003**	0,137
No	375(72,4)	20(71,4)	38(52,8)		
Yes	143(27,6)	8(28,6)	34(47,2)		
Decreased appetite				**0,004**	0,132
No	460(88,8)	19(67,9)	63(87,5)		
Yes	58(11,2)	9(32,1)	9(12,5)		
Fever				0,233	0,069
No	309(59,7)	13(46,4)	38(52,8)		
Yes		15(53,6)	34(47,2)		
Runny nose				**0,039**	0,103
No	343(66,2)	23(82,1)	56(77,8)		
Yes		5(17,9)	16(22,2)		
Diarrhea				**0,029**	0,107
No	395(76,3)	25(89,3)	47(65,3)		
Yes		3(10,7)	25(34,7)		

Key: *Chi-square test
Source: The authors (2020).

It was possible to identify a significant association between the BMI levels and the age and previous comorbidities mean values before COVID-19, with individuals categorized as overweight and obese presenting higher means in age and number of comorbidities. In addition to that, high BMI values (overweight and obesity) were significantly associated with the saturation mean values at the first appointment in the health services. In relation to the number of monitoring contacts, as well as days from onset of the symptoms to testing and discharge from monitoring, they did not present any association between the BMI groups (Table 3).

Table 3 – Association of the clinical and assistance-related aspects in relation to the BMI of confirmed COVID-19 cases. Chapecó, Santa Catarina, Brazil, 2020 (n=618)

Variables	BMI			p-value
	Normal (n=518) Mean±SD	Overweight (n=28) Mean±SD	Obesity (n=72) Mean±SD	
Age	45,74±19,53	53,11±15,65	53,15±19,23	**0,002***
Body temperature at 1st appointment (n=431)	36,43±0,81	36,40±1,05	36,58±0,81	0,396ʃ
Saturation at 1st appointment (n=444)	96,22±4,24	95,34±4,41	92,68±13,12	**0,000**ʃ
Number of previous comorbidities	0,83±1,36	2,18±1,27	2,71±1,65	**0,000**ʃ
Number of the patient's in-person and/or telephone contacts with the health services	6,15±3,09	7,29±3,91	6,39±4,40	0,229ʃ
Days from onset of the symptoms to seeking the first health care appointment (n=602)	3,86±4,48	3,50±3,76	4,03±3,86	0,515ʃ
Days from onset of the symptoms to the test (n=599)	5,11±5,27	4,50±3,40	6,39±6,13	0,109ʃ
Days from onset of the symptoms to discharge from home isolation (n=444)	18,26±6,91	21,50±10,73	19,51±7,20	0,165ʃ

Key: *ANOVA test ʃKruskal-Wallis test
Source: The authors (2020).

The BMI levels presented a significant and weak correlation across the COVID-19 clinical outcomes: hospitalization in a ward; hospitalization in an Intensive Care Unit (ICU); and evolution to death (Table 4). When evaluating the prevalence ratio, taking BMI as exposure and hospitalization in a ward, hospitalization in an ICU and evolution to death as outcomes, the following can be identified: obese individuals were 2.1 times more likely to be hospitalized in a ward than individuals with normal BMI (95%CI: 1.21 – 3.72; p=0.008); obese individuals were 2.6 times more likely to be hospitalized in an ICU than those with normal BMI (95%CI: 1.45 – 4.49; p=0.001); and obese individuals were 3.7 times more likely to evolve to death than those with normal BMI (95%CI: 2.20 – 6.21; p=0.000).

Table 4 – Association between the clinical outcomes of COVID-19 and Body Mass Index. Chapecó, Santa Catarina, Brazil, 2020 (n=618) (continues)

Variables	BMI			p-value	Cramer's V2
	Normal (n=518) n(%)	Overweight (n=28) n(%)	Obesity (n=72) n(%)		
Hospitalization in a ward				**0,027**	0,108
Yes	84(16,2)	5(17,9)	21(29,2)		
No	434(83,8)	23(82,1)	51(70,8)		
Hospitalization in an Intensive Care Unit				**0,002**	0,142
Yes	72(13,9)	7(25,0)	21(29,2)		

No	446(86,1)	21(75,0)	51(70,8)		
Death				**0,000**	0,209
Yes	88(17,0)	5(17,9)	31(43,1)		
No	430(83,0)	23(82,1)	41(56,9)		

Source: The authors (2020).

DISCUSSION

The sociodemographic characteristics of the confirmed COVID-19 cases, in relation to BMI, are inconsistent with the profile of obesity among Brazilians, in which black-skinned individuals, women and lower schooling level (no education and with incomplete elementary school) are identified, with only age in consonance[20].

Obesity represents an important cause of arterial hypertension, Type 2 Diabetes Mellitus, heart disease, stroke and cancer[20]. In this sense, diverse evidence points to obesity as an independent risk factor for severe forms of COVID-19 and death due to the disease[21], since there is a mechanistic link between obesity and its endocrine or cardiometabolic associations.

A cohort study[22], conducted with 340 hospitalized individuals with confirmed COVID-19 diagnoses, evidenced that 44% of them were overweight and 34%, obese. Another study[23] conducted with 17.4 million individuals and 5,683 cases of death due to COVID-19, identified 29% with overweight and 33% with obesity. Both studies related excess weight to severity of the disease.

In relation to the association between the mean values of age and previous comorbidities, as well as worse mean oxygen saturation at the first visit to the health services among individuals with higher BMI values, the literature indicates an increase in the severity of COVID-19 among individuals aged over 50 years old, as well as obesity among the most associated comorbidities[4-5]. The saturation at first the first appointment variable indicates the rapid evolution of the disease in this group, with 5% of the affected individuals presenting severe forms of the disease, with clinical signs of pneumonia (fever, cough, dyspnea, tachypnea), in addition to at least one of the following findings: O_2 saturation in peripheral blood <90% in ambient air, respiratory frequency >30 bpm or severe respiratory disorder[3].

Regarding the symptomatological aspects of the people infected by COVID-19, the following were significant: dyspnea, decreased appetite, runny nose and diarrhea. A study conducted in the United States of America evidenced that obese people with COVID-19 were more likely to have fever, cough and dyspnea, in addition to significantly higher rates of hospitalization in the ICU or evolution to death[21]. Therefore, obesity has also been considered as an independent cooperating factor for worsening of the disease, as the patients are predisposed to severe lung infections and reduced blood oxygen saturation due to impaired lung ventilation, in addition to abnormal secretions of adipokines and cytokines, triggering a high risk of severe complications from COVID-19[24].

In this sense, it was evidenced that, when adding up the findings, the individuals categorized as overweight and obese presented higher mean age values, a higher number of comorbidities and lower saturation rates at the first appointment, indicating a group potentially at risk for developing the severe form of the disease. Thus, in addition to the clinical monitoring of these patients through Telemonitoring and face-to-face evaluation when necessary, other devices are important, such as electrocardiograms, oxygen saturation meters and breathing analysis. Therefore, the development of health startups targeted at

monitoring the cases, which allow recording cough and breathing (shortness of breath), enabling the collection of information that is analyzed through artificial intelligence and construct predictive models, assist in the qualification of the health care developed, added to the integrated analysis of the clinical data with laboratory results and imaging findings[25].

This study evidenced that obese individuals were 2.1 times more likely to be hospitalized in a ward than those with normal BMI. A study[14] conducted in Italy with patients hospitalized due to COVID-19, identified a 65.2% prevalence of overweight and obesity: 33.7% of the patients were overweight and 31.5% were obese. In addition to that, these patients were 10 years younger than those with normal weight admitted in the same locus and with the same diagnosis.

Another study[15], conducted with 210 inpatients infected by COVID-19, found that 18 (9%) died during hospitalization, 36 (17%) required mechanical ventilation, and 94 (45%) required hospital care, and these results were significantly associated with BMI > 30 (mortality OR=6.29, 95% confidence interval 1.76-22.46, p=0.0046; mechanical ventilation OR=6.01, 95% confidence interval, 2.5-14.48, p=0.0001; hospital admission OR=2.61, 95% confidence interval, 1.49-4.58, p=0.0008). In this study, obesity was linked to worse prognoses, even in young patients infected by COVID-19.

Among the most prevalent morbidities related to severe COVID-19, a study conducted in Brazil[16] pointed out that, among the individuals aged ≥50 years old, obesity was found in 39% of the cases, only behind cardiovascular diseases (56%), with a slight variation across the country's regions. When stratified by age, the most prevalent morbidities in all the age groups were also the cardiovascular diseases, followed by obesity.

In relation to the obese patients being more likely to be admitted to an ICU than individuals with normal BMI, another study corroborates this finding by presenting that at least 25% of the patients who die due to this disease were obese, so as to relate this morbidity as a risk factor for ICU admission[24].

A research study developed in the United States and France[17] related obesity with more severe COVID-19 cases, representing 47.6% of the cases and increasing in severity according to the patient's BMI. These findings are consistent with another study[26], developed in China, that analyzed 150 patients admitted to three hospitals and found that the presence of obesity was related to a three times higher risk of developing severe COVID-19.

The research findings were close to those identified in other countries in relation to the risk of death among obese individuals (3.7 times). In France[27], it reached a value of four times the probability. In Brazil, according to data from the Ministry of Health[18], obesity ranks as the sixth risk factor for deaths due to COVID-19 among people aged over 60 years old and as the third factor associated with deaths due to COVID-19 in individuals under 60 years of age.

It is noteworthy that abdominal obesity compromises the patients' pulmonary function, being associated with a decrease in expiratory reserve volume, functional capacity and respiratory system complications and, consequently, lower blood saturation[28]. Obesity or ectopic fat deposition reduces the protective cardiopulmonary reserve, which produces harmful mechanical effects on the pulmonary function[29]. Considering that obesity is a pro-inflammatory condition, COVID-19 can exacerbate inflammation in these individuals, exposing them to high levels of circulating inflammatory molecules that increase the risk of complications from the infection[30].

The late warning of the relationship between obesity and COVID-19 is to be noted, although morbidity is widely associated with other diseases[6]. Once again, the findings highlight the importance of facing the increased prevalence of obesity in the country, reinforcing the urgency of preventive actions aimed at health promotion, with a focus on maintaining healthy habits among Brazilians[20], making them less susceptible to the disease

caused by obesity and reducing their vulnerability to pathologies such as COVID-19.

A limitation of the study is the impossibility of longitudinal follow-up of the cases monitored, especially their clinical condition after discharge, including the sequelae of the pathology. Further prospective and longitudinal studies with this population are suggested to understand the late outcomes in the individuals who survived COVID-19, as well as investments in health education activities to fight against obesity and overweight in the Brazilian population.

CONCLUSION

The findings confirm the association between BMI and clinical deterioration among overweight and obese people, relating the latter condition to higher propensity to hospitalization and death among individuals affected by COVID-19. The potential outcome of hospitalization in a ward, ICU and evolution to death, warns against the need for increased monitoring and follow-up of the patients affected by SARS-CoV-2 with high BMI values, suggesting early care and longer follow-up of these individuals based on this risk factor.

Therefore, the study contributes to scientific knowledge in the Health and Nursing areas by highlighting the need for reflection about public policies aimed at the prevention and treatment of obesity. It is expected that this research may guide the health professionals' actions towards an assistance based on integrality and humanization, in order to promote educational actions capable of stimulating self-care and healthy habits, through the establishment of therapeutic plans and interprofessional actions, aiming at quality of life and at mitigating the clinical deterioration of this population in the face of pathologies such as COVID-19.

REFERENCES

1. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. Int J Oral Sci. [Internet]. 2020[accessed 03 Fev 2021]; 12(9): 1-6. Available from: https://doi.org/10.1038/s41368-020-0075-9.

2. Paudel S, Dangal G, Chalise A, Bhandari TR, Dangal O. The coronavirus pandemic: what does the evidence show? J Nepal Health Res Counc. [Internet]. 2020 [accessed 03 Fev 2021]; 18(1): 1-9. Available from: https://doi.org/10.33314/jnhrc.v18i1.2596.

3. World Health Organization. Coronavírus disease (COVID-19) [Internet]. Geneva: WHO; 2020 [citado 30 Jan 2021]. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-coronaviruses#:~:text=symptoms.

4. Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis. Int J Infect Dis. [Internet]. 2020[accessed 03 fev 2021]; 94: 91-5. Available from: https://doi.org/10.1016/j.ijid.2020.03.017.

5. Dietz W, Santos-Burgoa C. Obesity and its implications for COVID-19 mortality. Obesity (Silver Spring). [Internet]. 2020 [accessed 03 fev 2021]; 28(6): 1005. Available from: https://doi.org/10.1002/oby.22818.

6. Bolsoni-Lopes A, Furieri LB, Alonso-Vale MIC. Obesity and covid-19: a reflection on the relationship between pandemics. Rev Gaúcha Enferm. [Internet]. 2021[accessed 03 fev 2021]; 42(spe): e20200216. Available from: http://dx.doi.org/10.1590/1983-1447.2021.20200216.

7. World Health Organization. Obesity and overweight [Internet]. Geneva: WHO; 2020 [accessed 30 jan

2021]. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.

8. Organisation for Economic Co-operation and Development. The heavy burden of obesity: the economics of prevention, OECD health policy studies. Paris: OECD; https://doi.org/10.1787/67450d67-en.

9. Ministério da Saúde (BR). Vigitel Brasil 2018: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico [Internet]. Brasília: Ministério da Saúde; 2019 [accessed 30 Jan 2021]. Available from: https://portalarquivos2.saude.gov.br/images/pdf/2019/julho/25/vigitel-brasil-2018.pdf.

10. Vakil-Gilani K, O'Rourke K. Are patients with rheumatologic diseases on chronic immunosuppressive therapy at lower risk of developing severe symptoms when infected with COVID-19? Clin Rheumatol. [Internet]. 2020[accessed 03 Fev 2021]; 39(7): 2067-8. Available from: https://doi.org/10.1007/s10067-020-05184-3.

11. Gómez JC, Lorido JCA, Sánchez FJC. La obesidad y el coronavirus2019-nCoV: una relación de riesgo. Rev Clin Esp. [Internet]. 2020[accessed 03 Fev 2021]; 220(6): 387-8. Available from: https://dx.doi.org/10.1016%2Fj.rce.2020.04.008.

12. Rezende LFM, Thome B, Schveitzer MC, Souza-Júnior PRB de, Szwarcwald CL. Adults at high-risk of severe coronavirus disease-2019 (Covid-19) in Brazil. Rev Saúde Pública. [Internet]. 2020[accessed 03 Fev 2021]; 54: 50. Available from: https://doi.org/10.11606/s1518-8787.2020054002596.

13. Finer N, Garnett SP, Bruun JM. COVID-19 and obesity. Clin Obes. [Internet]. 2020[accessed 03 Fev 2021]; 10(3): e12365. Available from: https://doi.org/10.1111/cob.12365.

14. Busetto L, Bettini S, Fabris R, Serra R, Pra CD, Maffei P, et al. Obesity and COVID-19: an Italian snapshot. Obesity (Silver Spring). [Internet]. 2020 [accessed 03 fev 2021]; 28(9): 1600-5. Available from: https://doi.org/10.1002/oby.22918.

15. Steinberg E, Wright E, Kushner B. In young adults with COVID-19, obesity is associated with adverse outcomes. West J Emerg Med. [Internet]. 2020 [accessed 03 fev 2021]; 21(4): 752-5. Available from: https://dx.doi.org/10.5811%2Fwestjem.2020.5.47972.

16. Nunes BP, Souza ASS de, Nogueira J, Andrade FB de, Thumé E, Teixeira DS da C, et al. Multimorbilidad y población en riesgo para la COVID-19 grave en el Estudio Brasileño Longitudinal del Envejecimiento. Cad Saúde Pública. [Internet]. 2020[accessed 03 fev 2021]; 36(12): e00129620. Available from: https://doi.org/10.1590/0102-311X00129620.

17. Sociedade Brasileira de Cirurgia Bariátrica e Metabólica. SBCBM alerta: obesidade está presente em metade dos internamentos por COVID-19 nos EUA e na França [Internet]. São Paulo: SBCBM; 2020 [accessed 30 Jan 2021]. Available from: https://www.sbcbm.org.br/sbcbm-alerta-obesidade-esta-presente-em-metade-dos-internamentos-por-covid-19-nos-eua-e-na-franca/.

18. Ministério do Brasil (BR), Secretaria de Vigilância em Saúde. Boletim Epidemiológico Especial: doença pelo Coronavírus COVID-19 [Internet]. Brasília: Ministério da Saúde: 2021 [accessed 30 Jan 2021]. Available from: https://www.gov.br/saude/pt-br/media/pdf/2021/janeiro/22/boletim_epidemiologico_covid_46-final.pdf.

19. Pagano M, Gauvreau K. Princípios de Bioestatística. 2. ed. São Paulo: Thomson, 2006. 506 p.

20. Ferreira AP de S, Szwarcwald CL, Damacena GN. Prevalence of obesity and associated factors in the Brazilian population: a study of data from the 2013 National Health Survey. Rev Bras Epidemiol. [Internet]. 2019 [accessed 03 fev 2021]; 22: e190024. Available from: http://dx.doi.org/10.1590/1980-549720190024.

21. Hajifathalian K, Kumar S, Newberry C, Shah S, Fortune B, Krisko T, et al. Obesity is associated with worse outcomes in COVID-19: analysis of early data from New York City. Obesity (Silver Spring). [Internet]. 2020 [accessed 03 Fev 2021]; 28(9): 1606-12. Available from: http://dx.doi.org/10.1002/oby.22923.

22. Ho FK, Celis-Morales CA, Gray SR, Katikireddi SV, Niedzwiedz CL, Hastie C, et al. Modifiable and non-

modifiable risk factors for COVID-19, and comparison to risk factors for influenza and pneumonia: results from a UK Biobank prospective cohort study. BMJ Open. [Internet]. 2020[accessed 03 Fev 2021]; 10: e040402. Available from: https://doi.org/10.1101/2020.04.28.20083295.

23. Williamson E, Walker AJ, Bhaskaran K, Bacon S, Bates C, Morton CE, et al. Open SAFELY Collaborative. Open-SAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. medRxiv. [Internet]. 2020 [accessed 03 fev 2021]. Available from: https://doi.org/10.1101/2020.05.06.20092999.

24. Ryan PM, Caplice NM. Is adipose tissue a reservoir for viral spread, immune activation and cytokine amplification in COVID-19? Obesity. [Internet]. 2020 [accessed 03 fev 2021]; 28(7): 1191-4. Available from: https://doi.org/10.1002/oby.22843.

25. Meirelles G de SP. COVID-19: a brief update for radiologists. Radiol Bras. [Internet]. 2020[accessed 03 fev 2021]; 53(5): 320-8. Available from: http://dx.doi.org/10.1590/0100-3984.2020.0074.

26. Gao F, Zheng KI, Wang X-B, Sun Q-F, Pan K-H, Wang T-Y, et al. Obesity is a risk factor for greater COVID-19 severity. Diabetes Care. [Internet]. 2020[accessed 03 fev 2021]; 43(7): e72-e74. Available from: https://doi.org/10.2337/dc20-0682.

27. Simonnet A, Chetboun M, Poissy J, Raverdy V, Noulette J, Duhamel A, et al. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. Obesity (Silver Spring). [Internet]. 2020 [accessed 03 fev 2021]; 28(7): 1195-9. Available from: https://doi.org/10.1002/oby.22831.

28. Huang J-F, Wang X-B, Zheng KI, Liu W-Y, Chen J-J, George J, et al. Letter to the editor: Obesity hypoventilation syndrome and severe COVID-19. [Internet]. Metab. 2020 [accessed 03 fev 2021]; 108: 154249. Available from: https://doi.org/10.1016/j.metabol.2020.154249.

29. Malavazos AE, Romanelli MMC, Bandera F, Iacobellis G. Targeting the adipose tissue in COVID-19. Obesity (Silver Spring). [Internet]. 2020 [accessed 03 fev 2021]; 28(7): 1178-9. Available from: https://doi.org/10.1002/oby.22844.

30. Chiapetta S, Sharma AM, Bottino V, Stier C. COVID-19 and the role of chronic inflammation in patients with obesity. Int J Obes. [Internet]. 2020 [accessed 03 fev 2021]; 44(8): 1790-2. Available from: https://doi.org/10.1038/s41366-020-0597-4.

Received: 09/06/2021
Approved: 03/10/2021

Associate editor: Luciana Puchalski Kalinke

Corresponding author:
Clarissa Bohrer da Silva
Universidade do Estado de Santa Catarina – Chapecó, SC, Brasil
E-mail: clarissa.bohrer@udesc.br

Role of Authors:
Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - Silva CB da, Trindade L de L, Zuge SS, Ferraz L, Kolhs M, Heinz MK; Drafting the work or revising it critically for important intellectual content - Silva CB da, Trindade L de L, Zuge SS, Ferraz L, Kolhs M, Heinz MK. All authors approved the final version of the text.

ISSN 2176-9133