


Obesity as an aggravating factor of COVID-19 in hospitalized adults: an integrative review

Obesidade como fator agravante da COVID-19 em adultos hospitalizados: revisão integrativa
Obesidad como factor agravante de COVID-19 en adultos hospitalizados: revisión integradora

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Descriptores

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Abstract

Objective: To identify, in scientific literature, the relationship of obesity as an aggravating risk factor for morbidity by COVID-19.

Methods: This is a bibliographic and integrative literature review study, in Brazilian Portuguese, English and Spanish languages, through PICO strategy, in the PubMed, Scopus, Web of Science, Embase and VHL databases, held from May to June 2020. Primary articles conducted with adults, available in full, published during the period 2019 to 2020, in Brazilian Portuguese, English and Spanish were included. Case reports, clinical cases, dissertations, theses, the already selected in the search in another database and that did not answer the question of the search were excluded.

Results: The selection resulted in nine studies. Four studies - 44.4% (E3, E5, E6 and E7) - presented the prevalence of obesity in adults hospitalized by COVID-19. Two studies - 22.2% (E6, E9) - associated obesity with the development of severe COVID-19. Three studies - 33.3% (E1, E4 and E7) - associated obesity with the need for mechanical ventilation. Three studies - 33.3% (E2, E4 and E8) - associated obesity with mortality due to COVID-19.

Conclusion: Obesity is a chronic non-communicable disease, being a risk factor considered important for the worsening of COVID-19 disease, however, it is preventable, because healthy lifestyle habits can reduce the severe picture of COVID-19 infection.

Resumo

Objetivo: Identificar, na literatura científica, a relação da obesidade como fator de risco agravante para a morbidade por COVID-19.

Métodos: Trata-se de um estudo bibliográfico, tipo revisão integrativa de literatura, nos idiomas português, inglês e espanhol, por meio da estratégia PICO, em cinco bases de dados, PubMed, Scopus, Web of Science, Embase e BVS, realizada de maio a junho de 2020. Os critérios de inclusão adotados foram: artigos primários realizados com adultos; disponíveis na íntegra; publicados durante o período de 2019 a 2020; nos idiomas português, inglês e espanhol. Os critérios de exclusão foram: relato de casos; casos clínicos; dissertações; teses; os já selecionados na busca em outra base de dados e que não respondessem à questão da pesquisa.

Resultados: A seleção resultou em nove estudos, sendo que quatro estudos - 44,4% (E3, E5, E6 e E7) - apresentaram a prevalência de obesidade em adultos hospitalizados por COVID-19, dois estudos - 22,2% (E6, E9) - associaram a obesidade ao desenvolvimento da COVID-19 grave, três estudos - 33,3% (E1, E4 e E7) - associaram a obesidade à necessidade de ventilação mecânica e três estudos - 33,3% (E2, E4 e E8) - associaram a obesidade à mortalidade por COVID-19.

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Conflicts of interest: nothing to declare.

Conclusão: A obesidade trata-se de uma doença crônica não transmissível, sendo um fator de risco considerado importante para o agravamento da doença COVID-19, no entanto, é passível de prevenção, pois hábitos saudáveis de vida podem reduzir o quadro grave de infecção por COVID-19.

Resumen

Objetivo: Identificar en la literatura científica la relación de la obesidad como factor de riesgo agravante para la morbilidad por COVID-19.

Métodos: Se trata de un estudio bibliográfico, tipo revisión integradora de literatura, en idioma portugués, inglés y español, por medio de la estrategia PICO, en cinco bases de datos: PubMed, Scopus, *Web of Science*, Embase y BVS, realizada de mayo a junio de 2020. Los criterios de inclusión adoptados fueron: artículos primarios realizados con adultos, con texto completo disponible, publicados durante el período de 2019 a 2020, en idioma portugués, inglés y español. Los criterios de exclusión fueron: relato de casos, casos clínicos, tesis de maestría y doctorado, los artículos ya seleccionados en la búsqueda en otra base de datos y los que no respondieran la pregunta de investigación.

Resultados: La selección tuvo como resultado nueve estudios, de los cuales cuatro — 44,4 % (E3, E5, E6 y E7) — presentaron prevalencia de obesidad en adultos hospitalizados por COVID-19; en dos estudios — 22,2 % (E6, E9) — se relacionó la obesidad con el desarrollo de COVID-19 grave; en tres estudios — 33,3 % (E1, E4 y E7) — se relacionó la obesidad con la necesidad de ventilación mecánica; y en tres estudios — 33,3 % (E2, E4 y E8) — se relacionó la obesidad con la mortalidad por COVID-19.

Conclusión: La obesidad se trata de una enfermedad crónica no transmisible y es considerada un factor de riesgo importante para el agravamiento de la enfermedad COVID-19. Sin embargo, la prevención es posible, ya que los hábitos de vida saludables pueden reducir el cuadro grave de infección por COVID-19.

Introduction

At the end of 2019, China reported cases of a type of pneumonia of unknown cause, identified in Wuhan Province, which was later named Severe Acute Respiratory Syndrome – Coronavirus 2 (SARS-CoV-2), also called COVID-19.⁽¹⁾

With its rapid spread and unstable behavior, COVID-19 has become a pandemic and a major public health emergency,⁽²⁾ with more than four million contaminated worldwide that resulted in more than 298,000 deaths.⁽³⁾ The continents most affected so far were the Americas, with 1,781,564 cases, and Europe, with 1,780,316 cases.⁽³⁾

The clinical manifestations of COVID-19 range from asymptomatic or mild infection to severe forms of life-threatening disease.⁽⁴⁾ Among the individuals who presented symptoms, fever, cough and dyspnea were observed between two and fourteen days after exposure to it.⁽¹⁾ In addition to the repercussions on the respiratory system, there is evidence that the pathogen affects several systems, such as cardiovascular.⁽⁵⁾

At first, making the diagnosis of this new pathology was very complex due to the diversity of symptoms, the findings in imaging tests and the severity of the disease at the time of presentation.⁽⁶⁾

Studies also warn that some conditions, such as obesity, hypertension and Diabetes Mellitus, are defined as risk factors for the worsening of COVID-19.⁽⁵⁾ In the case of obesity, some studies indicate that it is associated with severe outcomes of COVID-19.⁽⁴⁾

Obesity is defined as excessive accumulation of body fat, which can compromise the state of health in many ways. Physiologically, obese individuals are prone to decreased airways due to limited expansion, hindering airflow. Thus, oxygen consumption decreases and, consequently, respiratory potential can be seriously affected.⁽⁷⁾ Therefore, these subjects represent a serious challenge for intubation, given that the additional adipose tissue in the larynx makes intubation more laborious.⁽⁷⁾

The assessment of adults' nutritional status can be performed by measuring Body Mass Index (BMI), together with the assessment of individuals' percentage of body fat and abdominal circumference.⁽⁸⁾ The World Health Organization (WHO), since 1997, has been using BMI as a reference for indication of obesity, defined then as a range above 30.0 kg/m², ranging from grade I obesity (BMI > 30.0 and ≤ 34.9 kg/m²), grade II obesity (BMI > 35.0 and ≤ 39.9 kg/m²) and grade III obesity (BMI > 40.0 kg/m²).⁽⁹⁾

Another problem about obese individuals is insufficient physical exercise. Sedentary lifestyle implies insulin resistance, which can impair the immune response against microbial agents at some stages of the immune response and also contribute to the development of Diabetes Mellitus.⁽¹⁰⁾

In this sense, this integrative literature review was proposed with the objective of identifying, in scientific literature, the relationship of obesity as an aggravating risk factor for morbidity by COVID-19, seeking to expand knowledge and scientific basis for

the practice of care for obese individuals infected with coronavirus.

Methods

This is a bibliographic and integrative literature review study, a method that allows survey and analysis of subsidies in literature in a broad and systematized way.⁽¹¹⁾ The integrative review was based on six stages for its elaboration.

The first stage was composed by identifying the theme and selecting the hypothesis or research question. The second step comprises defining the criteria for inclusion and exclusion from the study: use of databases and selection of studies based on criteria. The third stage was performed by identifying pre-selected studies: reading abstracts, keywords and titles of publications and organizing the studies. The fourth stage covered the categorization of the selected studies. The fifth stage involved analysis and interpretation of results. The sixth stage corresponds to presentation of review and synthesis of knowledge.⁽¹²⁾

The research question was elaborated according to PICO strategy - Population, Interest, Context.^(12,13) The following structure was considered: P - adults hospitalized due to COVID-19; I - obesity as an aggravating factor; Co - obese patients diagnosed with COVID-19. Thus, the following question was elaborated: what scientific evidence does obesity contribute to the worsening of the clinical picture of COVID-19 in hospitalized adults?

Study search was carried out from May to June 2020 through the Journal Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES - *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*), with access through the Federated Academic Community (CAFe - *Comunidade Acadêmica Federada*).

In search and selection processes, the following databases were consulted: US National Library of Medicine Scopus, Web of Science, Embase, and Virtual Health Library (VHL).

Primary articles conducted with adults, available in full, published during the period 2019 to

2020, in Brazilian Portuguese, English and Spanish were included.

Case reports, clinical cases, dissertations, theses, the already selected in the search in another database and that did not answer the question of the search were excluded.

Study search and selection were performed by two researchers simultaneously. To perform the search, combinations were used with the following Health Sciences Descriptors (DeCS - *Descritores em Ciências da Saúde*): “Coronavirus”, “Coronavirus Infections” and “Obesity”; and the Medical Subject Heading (MeSH): “Coronavirus”, “COVID 19”, “S CoV2”, “Obesity”, “Adult” and “Hospitalization” combined through the operators Boolean “AND” and “OR”. Chart 1 demonstrates search strategies in databases.

Chart 1. Search strategy applied to the search question

Database	Search expression	Results
PubMed https://pubmed.ncbi.nlm.nih.gov/	Search (SARS virus OR SARS- Cov OR "SARS coronavirus" OR COVID-19 OR SARS-CoV-2 OR coronavirus OR "coronavirus infections" OR "coronavirus infection" OR coronaviridae) AND obesity AND adult AND hospitalization	10
Scopus http://www.periodicos.capes.gov.br/	TITLE-ABS- KEY:(coronavirus OR COVID 19 OR sars AND cov2 OR coronavirus AND infection AND obesity AND adult AND hospitalization)	9
Web of Science http://www.periodicos.capes.gov.br/	Basic Search- All fields: (SARS virus OR SARS- Cov OR "SARS coronavirus" OR COVID-19 OR SARS-CoV-2 OR coronavirus OR "coronavirus infections" OR "coronavirus infection" OR coronaviridae) AND obesity AND adult AND hospitalization	1
Embase http://www.periodicos.capes.gov.br/	Quick Search: (coronaviridae OR coronaviridae infection OR COVID 19 OR sars coronavirus) AND obesity AND adult AND hospitalization	24
VHL http://brasil.bvs.br/	Title, abstract, subject: (coronavirus OR "infecção por coronavirus") AND obesidade AND adulto AND hospitalização	1

In order to critically analyze eligible studies, the classification of the levels of scientific evidence of the Agency for Healthcare Research and Quality (AHRQ), which covers six levels, was used: (I) evidence resulting from meta-analysis and systematic review; (II) evidence obtained in randomized clinical trials; (III) evidence obtained in clinical trials without randomization; (IV) evidence from cohort and case-control studies; (V) evidence from a systematic review of descriptive and qualitative stud-

ies; (VI) evidence based on descriptive or qualitative study.

The studies were identified with letter “E” (E1 - article 1, E2 - article 2 and so on) and analyzed by three independent reviewers.

Results

The selection resulted in 45 references, from which three publications were removed by duplicity; 32 manuscripts were excluded for not dealing with the theme; one publication was excluded for not answering the research guide question. Thus, 17 studies were included in this review. The process of searching and selecting the studies was simplified through a flowchart recommended by the Preferred Reporting of Systematic Reviews and Meta-Analyses,⁽¹²⁾ being represented in figure 1.

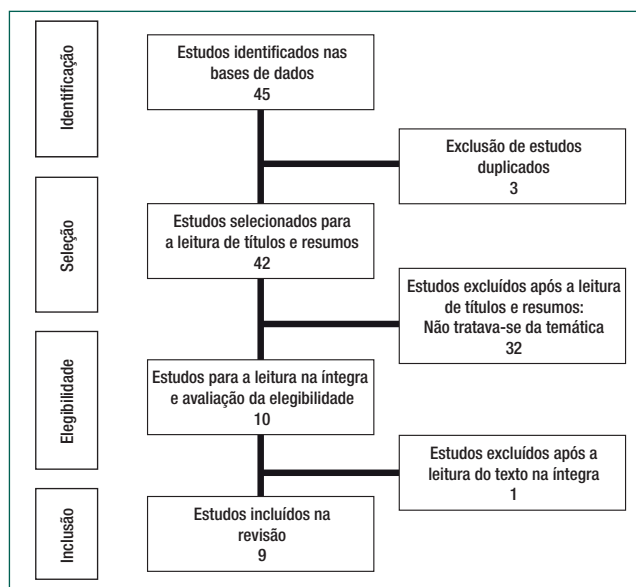


Figure 1. Flowchart of identification of the selection process of the studies included in the integrative review

This research found 45 studies in databases distributed as follows: 2.2% in VHL; 2.2% on Web of Science; 22.2% in PubMed; 22.2% in Scopus; 51.1% in Embase. After detailed analysis and application of eligibility criteria, 36 (80%) publications were excluded, three (6.6%) due to duplicity, 32 (71.1%) because they do not deal with the theme after reading titles and abstracts, one (2.2%), after

reading its full text, for not dealing with the theme. Among the selected articles, nine, the observational study predominated in 44.4% of articles; 33.3% were characterized as a prospective cohort and 22.2% as a Cohort Retrospective, a strategy that is justified because it is a little known disease in which it is necessary to trace the epidemiological profile of those affected. Most of studies, six (66.6%), were produced by the USA, the others from England, the United Kingdom, and China (11.1%). All selected studies were available in English and were published in 2020. It is observed, based on the AHRQ categories, that 55.5% of articles were classified as evidence level IV (cohort study) and 44.4% as evidence level VI (descriptive study). Regarding the results found in the selected studies, four studies - 44.4% (E3, E5, E6 and E7) - presented the prevalence of obesity in adults hospitalized by COVID-19; two studies - 22.2% (E6, E9) - associated obesity with the development of severe COVID-19; three studies - 33.3% (E1, E4 and E7) - associated obesity with the need for mechanical ventilation and three studies - 33.3% (E2, E4 and E8) - associated obesity with mortality due to COVID-19. Chart 2 presents a summary of the selected studies named after the author(s), the year of publication, the basis from which the publication was retrieved, the study design and the level of evidence and the most relevant results of the respective study.

Discussion

The selected studies pointed to obesity as a risk factor for hospitalization by COVID-19, since patients who participated in the studies presented laboratory-confirmed infection by coronavirus (SARS-CoV-2) and required differentiated assistance because they presented worsening in their clinical picture.

It is important to highlight that, although studies found here address populations located in different geographic centers with differentiated BMI parameters for the classification of overweight and obesity, all of them highlighted obesity as a risk factor for the development of severe COVID-19.

Chart 2. Characteristics of selected studies and results

Study	Reference	Database	Source	Study type/ evidence level	Results
E1	Kalligeros, et al. (2020) ⁽⁴⁾	Embase	USA	Cohort Retrospective Level IV	- 103 patients hospitalized by COVID-19. - February 17 to April 5, 2020. -The prevalence of obesity was 47.5% (49 out of 103). -In a multivariate analysis, severe obesity (BMI \geq 35 kg/m ²) was associated with admission to the Intensive Care Unit (adjusted Odds Ratio [OR]: 5.39, 95% CI: 1.13-25.64). -Patients requiring invasive mechanical ventilation were more likely to be obese (BMI = 30-34.9 kg/m ² ; aOR: 6.85, 95% CI: 1.05- 44.82) or severe obesity (BMI \geq 35 kg/m ² ; aOR: 9.99, 95% CI: 1.39-71.69).
E2	Hur et al. (2020) ⁽¹⁴⁾	PubMed	Chicago - USA	Observational Level VI	- 564 patients hospitalized between March 1 and April 8, 2020 positive for COVID-19. -Age, males and history of diabetes were independent risk factors associated with intubation in patients hospitalized with COVID-19 in the Chicago metropolitan area. -The time for extubation was influenced only by age and obesity. Patients intubated with COVID-19 with BMI from 30 to 39.99 (HR, 0.53; 95%, 0.32-0.90) or \geq 40 (HR, 0.40; 95%, 0.19-0.82 CI) were associated with a lower chance of extubation compared to patients with a <30.
E3	Docherty AB, et al. (2020) ⁽¹⁵⁾	PubMed	United Kingdom	Prospective Cohort Level IV	-20,133 patients hospitalized with COVID-19 between February 6 and April 19. -The factors associated with hospital mortality were increased age, males, obesity (Risk Ratio 1.33; CI 95% 1.19 to 1.49; P<0, 001) and important comorbidities.
E4	Cummings, et al. (2020) ⁽¹⁶⁾	PubMed	New York - USA	Prospective Cohort Level IV	-257 adults in serious condition of COVID-19 between 2 March and 1 April 2020. - 119 (46%) patients were obese (BMI \geq 30 kg/m ² , including 39 (71%) of the 55 patients under 50 years old - Severe obesity (BMI \geq 40 kg/m ²) was not identified as an independent risk factor for mortality.
E5	Palaiodimos, et al. (2020) ⁽¹⁷⁾	Scopus	Bronx, New York- USA	Cohort Retrospective Level IV	-200 patients who attended the emergency room from March 9 to April 12, 2020. - 24% of the cohort died during hospitalization, with higher rates among individuals with severe obesity (BMI <25 kg/m ² : 31.6%, BMI 25-34 kg/m ² : 17.2%, BMI \geq 35 kg/m ² : 34.8%, $p=$ 0.030). - Patients with severe obesity were more likely to suffer intubation (BMI <25 kg/m ² : 18.4%, BMI 25-34 kg/m ² : 16.4%, BMI \geq 35 kg/m ² : 34.8%, $p=$ 0.032). - Severe obesity BMI \geq 35 kg/m ² (OR: 3.09; 95% CI: 1.43–6.69; $p=$ 0.004), increasing age, males and smoking were also independently associated with increased oxygen requirements during hospitalization.
E6	Richardson et al. (2020) ⁽¹⁸⁾	Scopus	New York - USA	Observational Level VI	- A total of 5,700 patients (median age 63 years) were included from March 1 to April 4, 2020. The most common comorbidities were hypertension (3026; 56.6%), obesity (1737; 41.7%), and diabetes (1808; 33.8%).
E7	Hamer, et al. (2020) ⁽¹⁹⁾	Scopus	England	Prospective Cohort Level IV	-387,109 people. Of these, 760 were hospitalized by COVID-19. -March 16 to April 26, 2020. - 23.5% were obese. - There was a dose-dependent association between the risk of COVID-19 and the worsening of lifestyle scores so that participants, in the most unfavorable category, had a four-fold higher risk (RR = 4.41; CI 95%, 2.52, 7.71). - After adjusting for age, sex and mutually for each lifestyle factor, sedentary lifestyle (RR 1.32, 95% CI, 1.10, 1.58), smoking (RR 1.42; 95% CI 1.12, 1.79) and obesity (RR 2.05; CI95% 1.68, 2.49) were associated with COVID-19. -Unhealthy behaviors in combination (smoking, inactivity, overweight and obesity) represented up to 51% of the fraction attributable to the severe COVID-19 population. - Overweight and obesity are risk factors for severe COVID-19 infection.
E8	Klang, et al. (2020) ⁽²⁰⁾	Embase	New York - USA	Observational Level VI	-3,406 patients were included; 572 were under 50. -March 1 and May 17, 2020. - For the younger population, BMI above 40 kg/m ² was independently associated with mortality (OR 5.1, 95% CI 2.3-11.1). -For the elderly population, BMI above 40 kg/m ² was also independently associated with mortality to a lesser degree (OR 1.6, 95%CI 1.2 - 2.3).
E9	Cai, et al. (2020) ⁽²¹⁾	Embase	China	Observational Level VI	- 383 patients with COVID-19 hospitalized from January 11 to February 16, 2020. - After adjustments for potential confounding factors, those who were overweight (BMI between 24-27.9 kg/m ²) had chances of 1.84 times of developing severe COVID-19 (OR 1.84, CI95% 0.99-3.43, $p=$ 0.05), while obese (BMI \geq 28 kg/m ²) had a 3.40-fold chance of developing severe disease (OR 3.40, 95% CI 1.40-2.86, $P=$ 0.007).

E - study

E5, conducted with 5,700 patients in the largest academic health system in New York, showed that obesity was present in 1737 (41.7%) hospitalized patients. E3, also conducted in two New York hospitals with 257 adults in severe COVID-19 condition, found that 119 (46%) patients had obesity BMI \geq 30kg/m² and, of these, 39 (71%) of 55 patients were under 50 years old.

Similar results were found in E7, conducted in three hospitals in the USA with 103 patients hospitalized due to COVID-19 where the prevalence of obesity was 47.5% (49 out of 103). It is import-

ant to highlight that the prevalence of obesity in the U.S. population is 40%,⁽²²⁾ i.e., it is similar to the prevalence of obese patients hospitalized by COVID-19 in the USA.

In England, E6, conducted with 387,109 people, of whom 760 were hospitalized due to COVID-19, found that 178 (23.5%) were obese BMI \geq 30kg/m². After adjustments by age, gender and mutually for each lifestyle factor, it was found that physical inactivity (relative risk, 1.32, 95% confidence interval, 1.10, 1.58), smoking (1.42; 1.12, 1.79) and obesity (2.05; 1.68, 2.49) were related to

COVID-19. Unhealthy behaviors in combination represented up to 51% of the fraction attributable to the severe COVID-19 population. This result suggests that low-grade inflammation was a risk factor for worsening SARS-CoV-2 infection and partially explained the links between lifestyle behaviors and infection.

In E6, severe COVID-19 infection had as risk factors overweight and obesity, which may be associated with several mechanisms, such as immunological hyperreactivity, impaired metabolic responses and adverse effects of obesity on pulmonary function, decreasing forced expiratory volume, and forced vital capacity.⁽²³⁾

A study conducted in China (E9) with 383 patients hospitalized by COVID-19 corroborated the results found in a previous study, indicating that overweight and obesity are aggravating factors of the clinical picture of SARS-CoV-2 infection.

After adjustments for potential confounding factors, those who were overweight (BMI between 24-27.9 kg/m²) had a 1.84-fold chance of developing severe COVID-19 (OR 1.84, CI95% 0.99-3.43, *p* 0.05), while obese individuals (BMI ≥28 kg/m²) had a 3.40-fold chance of developing severe disease (OR 3.40, 95% CI 1.40-2.86, *P* 0.007) (E9).

In France, a cohort retrospective study conducted with 124 patients found that obesity is a risk factor for the severity of COVID-19. This study found that the prevalence of obesity in ICU patients was 47.6% and OR for the use of mechanical ventilation in patients with BMI > 35 kg/m² versus patients with BMI <25 kg/m² was 7.36 (1.63-33.14; *P* = 0.02).⁽²⁴⁾

Obesity was first identified as a risk factor for increased severity and mortality for respiratory disease in Influenza A H1N1 virus infection in 2009. Obesity causes a chronic state of meta-inflammation with systemic implications for immunity. Antiviral responses are delayed and insensitive to influenza virus infection. Moreover, decreased efficacy of antivirals and vaccines in obese individuals may also play a role in changing the viral life cycle, contributing to a weakened immune response and triggering worsening of the disease.⁽²⁵⁾

The need for oxygenation and the use of invasive mechanical ventilation in obese individuals has been evidenced in some studies. E4, conducted in the Bronx, New York, with 200 patients hospitalized by COVID-19, found that, in multivariate analysis, age, males, BMI ≥ 35 kg/m² and current or previous smoking were significant predictors for the increase in oxygenation need. Males, age and BMI ≥ 35 kg/m² were also significant predictors for intubation. These results indicate that obesity may predispose to negative results independently.

Obesity compromises pulmonary function because it is associated with decreased expiratory reserve volume, functional capacity and pulmonary compliance, resulting in increased respiratory work and airway resistance. Central obesity compromises ventilation by reducing diaphragmatic excursion in patients in supine position.⁽²⁶⁾

E1, conducted (E1) in ten hospitals of Chicago with 486 hospitalized patients, identified risk factors associated with intubation and time for extubation due to acute respiratory failure secondary to COVID-19 infection. Patients intubated with COVID-19 with BMI from 30 to 39.99 kg/m² (HR 0.53; IC95% 0.32-0.90) or ≥40 kg/m² (FC 0.40; 95% CI 0.19-0.82) were associated with a reduced chance of extubation in relation to patients with BMI <30 kg/m².

E7, conducted in the USA with 103 patients hospitalized by COVID-19, confirmed the results previously found. In this study, the prevalence of obesity was 47.5% in hospitalized patients; 56.8% of patients required hospitalization in Intensive Care Units (ICU) and 65.5% of patients required Invasive Mechanical Ventilation (IMV).

Still in E7, it was found that, after an adjusted multivariate analysis for age, gender and race to examine the association of obesity with ICU admission, severe obesity (≥35 kg/m²) was associated with increased risk of ICU admission (aOR: 6.16, 95% CI: 1.42-26.66). In a multivariate model that examines the association of different categories of BMI with IMV (after adjustment for age, gender and race), severe obesity (≥35 kg/m²) was associated with the need for IMV (aOR: 8.19, 95% CI: 1.36-49.13).

Although the exact mechanisms that associate obesity with worsening of the clinical picture in SARS-CoV-2 infection are not fully defined, it is believed that, among other factors, obesity contributes to the deficiency in surveillance and immune system response.⁽²⁷⁾ Another possible explanation, which still needs to be studied, concerns the levels of angiotensin--converter enzyme 2 (ECA 2) expression in adipose tissue, an enzyme by which SARS-CoV-2 shows high affinity.

Although this research was not the objective, the selected studies showed that obesity was also associated with mortality due to COVID-19. E2, conducted with 20,133 patients hospitalized in the United Kingdom, pointed out that the prevalence of obesity was 11%, and the increase in age, males and comorbidities, such as chronic heart disease, chronic non-asthmatic lung disease, chronic kidney disease, liver disease and obesity, were associated with higher hospital mortality.

E4, conducted in the USA with 200 patients, presented 24% mortality rate during hospitalization, with higher rates among individuals with severe obesity (BMI <25 kg/m²: 31.6%, BMI 25-34 kg/m²: 17.2%, BMI ≥ 35 kg/m²: 34.8%, *p*= 0.030).

E8, conducted in New York with 3,406 patients, in which 572 patients were under 50 years old and 2,834 were over 50 years old, concluded that BMI above 40 kg/m² in the population under 50 years old was independently associated with mortality (aOR 5.1, 95% CI 2.3-11.1). In the population over 50 years old, BMI above 40 kg/m² was also independently associated with mortality to a lesser degree (aOR 1.6, 95%CI 1.2 - 2.3).

Ryan and Caplice (2020)⁽²⁸⁾ described a possible theory in which adipose tissue in obese individuals would act as a reservoir for more extensive viral dispersion, with greater shedding, immune activation and cytokine amplification.

Obesity can be considered as a disease and as a risk factor for the development of other chronic non-communicable diseases such as diabetes and hypertension. In this research, obesity was associated with the severe form of COVID-19 and mortality, a fact that alerts health professionals about the importance of devising strategies to

approach obese patients; establishing therapeutic plans; carrying out interdisciplinary actions; instituting adequate indicators to measure the effectiveness of multidisciplinary assistance; promoting educational actions capable of making the population aware of the importance of self-care and healthy habits.

It is also important to highlight the need for health managers to raise awareness about public policies aimed at preventing and treating obesity, about the need to provide human and material resources necessary to work with this public and about the possibility of saving with health expenditures when prioritizing preventive actions.

In a society where the number of obese people is increasing and consequently the number of patients with chronic non-communicable diseases, working on obesity prevention is a challenge that needs to be overcome daily. It is expected that this research can direct health professionals' actions to care aimed at comprehensiveness and humanization in order to reduce the consequences that chronic non-communicable diseases can have on the population.

This study presented some limitations, since a pandemic is being experienced and scientific production on the subject has been encouraged. Therefore, new information and conducts are disseminated at all times and, to delimit this research, there was a need to restrict it to a period of time, which limited it to the studies produced until the deadline of the search.

Another limitation concerns studies conducted in specific populations with local characteristics, which does not prevent the use of the results found in another reality.

Conclusion

The findings of this study concluded that obesity is a risk factor for the worsening of COVID-19. Obesity was associated with the need for oxygen, intensive care, invasive mechanical ventilation, longer time for extubation and mortality. It was evidenced the need to deepen the studies on the

mechanisms associated with obesity that aggravate the clinical picture of the disease. As it is a disease that still needs to be unveiled, only a few theories were found that could explain the pathophysiology of the association between obesity and severe COVID-19. It is emphasized that obesity is a chronic non-transmissible disease that can be preventable and that healthy lifestyle habits can reduce the severe picture of COVID-19 infection. Special attention should be given to obese patients regarding early diagnosis and treatment, since the possibility of worsening of the disease is known.

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