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Body Composition and Level of Physical Activity in Post-COVID-19 Patients

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Authors' contributions

This work was carried out in collaboration among all authors. Author WCB designed the study, performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Authors AMeS and LGB wrote the first draft of the manuscript and the protocol, participated in data collection and managed literature searches. Author RC wrote the protocol and participated in data collection. Authors CGC, JVVS, JRSC, ACCC, PCdA, RLRN, JAL and ESdS contributed to wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The coronavirus disease 2019 (COVID-19) pandemic has created a public health crisis. Body composition is an important nutritional indicator, knowledge of which allows the subdivision of body weight into some components, mainly lean mass or fat-free mass and body fat mass of individuals.

Aim: To evaluate lean mass and body fat in post-COVID-19 patients, correlating them with length of stay, pre-hospitalization and post-hospitalization and patients' level of physical activity, specifying relative segmental fat.

Methodology: Observational, cross-sectional study, with quantitative analysis, with a convenience sample, approved by the Research Ethics Committee of the State University of Minas Gerais. Patients undergoing care/rehabilitation in the physiotherapy/outpatient sector at a Regional Rehabilitation Center, with a history of diagnosis of COVID-19, aged 20 years or over, of both sexes, were invited to participate in the research. Lean body mass (LBM) and body fat (BF) were obtained by evaluating horizontal tetrapolar electrical bioimpedance (BIA). Body fat segmentation was collected by measuring skinfold thickness. Physical activity level (PAL) was obtained using the International Physical Activity Questionnaire (IPAQ). The hospitalization history was obtained by filling out the registration form.

Results: Data from 20 patients were analyzed. The average LBM found was 69.7% and 30.3% of BF. There was no correlation between sedentary lifestyle and LBM. 50% of patients had previous comorbidities and 50% had a mild form of COVID-19 infection. 10% required hospitalization and ventilator support. 85% were physically active or very active. There was a greater presence of body fat in the abdominal and suprailiac region.

Conclusion: LBM proved to be superior to other studies carried out and no statistically significant correlation was found between LBM and history of hospitalization, time elapsed since illness and PAL. The regions with the greatest share of body fat were abdominal and suprailiac, important for inflammatory reasons and risk factors for various diseases, especially cardiovascular diseases.

Keywords: Covid-19 pandemic; obesity; sarcopenia; nutrition.

1. INTRODUCTION

Several cases of pneumonia for an initially unknown reason were reported in Wuhan, in Hubei province, China, in 2019. Preliminary genomic analysis of the microorganism that triggered this outbreak of respiratory infection found a new type of coronavirus called Severe Acute Respiratory Syndrome - Coronavirus 2 (SARS-CoV2). The growing number of infected people, deaths, and the rapid spread of the virus across countries led the World Health Organization to declare a COVID-19 pandemic on March 12, 2020 [1].

In the COVID-19 pandemic, people in general changed their behaviors, including the restrictions resulting from isolation, which in many cases led individuals to a sedentary lifestyle, poor eating habits and irregular sleep. These behavioral factors, together with prolonged hospitalization in patients who were affected by the disease, promoted a deterioration and loss of muscle mass and an increase in body fat, the clinical picture of which contributes to the appearance of diseases such as osteoporosis, obesity, dyslipidemia, diabetes mellitus, arterial hypertension, cognitive changes, depression and sarcopenia. Sarcopenia is characterized by reduced muscle strength and mass, which can result in worse quality of life and death, and is currently related to complications and mortality in patients with COVID-19 and associated with longer hospital stays [2].

COVID-19 has raised several questions about human health, especially related to special groups, whether the elderly, those with chronic non-communicable diseases, such as high blood pressure, diabetes mellitus, obesity, among others [3].

It is known that nutritional demands can be compromised in patients infected by COVID-19, thus contributing to the decrease in muscle mass and malnutrition, which in turn, negatively influence the recovery of patients and increase the risk of morbidity and mortality, including resulting in sarcopenia itself, which is one of the relevant causes of mortality in Intensive Care Unit patients. Many studies demonstrate that both the loss of lean mass in adults can determine the appearance of sarcopenia throughout life, combined with the practice of physical exercise and intake of protein nutrients, are essential in the prevention and regression of this process [4].

The inflammatory reaction caused by Covid-19 triggers high metabolic stress and leads the patient to catabolism. This protein support, together with the practice of physical exercises, promoted successful cases in the reserve of muscle mass [5].

Among the strategies used in treatment, it is essential to establish auxiliary parameters and, especially, knowledge of the remaining muscle mass, the amount of fat and the level of physical activity of patients are important elements for conducting even more assertive therapies.

Often, body composition is used as a nutritional reference, allowing total body weight to be subdivided into some elements, including lean body mass (LBM) or fat-free mass-FFM (muscles, bones and water, and fat body mass-BF) [6].

In this scenario, one of the important methods for evaluating body composition is bioelectrical impedance (BIA), which is based on the conduction of a low-density electrical current (800mA) at a certain electrical frequency, through the body of the individual evaluated, being capable of to demonstrate the intensity of resistance offered by tissues, which in turn present differences depending on their water and electrolyte content. Another important and traditional method, considered easy to apply and non-invasive, is skin folds, four folds can be used (subscapular, tricipital, abdominal and supra iliac) [7].

The decrease in LBM contributes to the appearance of bodily pain, chronic non-communicable diseases, in addition to increasing the risk of dependence to carry out basic and instrumental activities of daily living, functional loss and physical disability [8].

Also, obesity is associated with the development of a series of serious medical complications and increased mortality in children and adults. The disease produces cardiovascular and metabolic changes[9], being a risk factor for the worsening of viral infections and other underlying diseases. This occurs mainly because adipocytes are often involved with the body's stress and defense mechanisms, where the very presence of fat can make it difficult for breathing to work properly[10]. The increase in adipose tissue is hypoxic, causing a decrease in available oxygen and thus contributing to inflammation [11].

In a recent study, it was observed that people with a certain degree of obesity and patients reported to have been admitted to an intensive care unit exhibited a greater risk of functional loss or malnutrition, six months after suffering a severe coronavirus infection[12]. Furthermore, COVID-19 affects patients of all ages, but has more serious clinical consequences for adult and elderly patients [5].

2. METODOLOGY

This is an observational, cross-sectional study, with quantitative analysis, with a convenience sample, approved by the Research Ethics Committee of the University of the State of Minas Gerais, following the standards for carrying out research with human beings, under opinion no. 5,725 .491, contained in National Health Council Resolutions No. 466/12 and No. 580/2018.

The participants were approached in person, whose invitation took place at the Regional Rehabilitation Center (CRER), in the city of Divinópolis, Minas Gerais, the same place where the study was carried out, on the same scheduled day scheduled for the physiotherapeutic rehabilitation of these patients. Scheduling occurred in accordance with the current practice of the health unit where the study was carried out.

All patients undergoing care/rehabilitation presenting orthopedic and cardiorespiratory complaints at the physiotherapy outpatient clinic with a post-COVID-19 condition, who were in a preserved cognitive state, were listed and invited to participate in the research. Post-COVID 19 patients referred to CRER were included, aged 20 years or over, of both sexes, who agreed to participate in the research by signing the Informed Consent Form. The criteria adopted for exclusion from the study were pathologies involving marked edema, ascites, abdominal distension or other pathology that prevented participation in the study, individuals restricted to their homes and/or using metal prostheses, in addition to not being able to answer the questions. Autonomously.

The collections took place between the months of November and December 2022. Patients were directed to their care following the practices routinely adopted by CRER, initially sent to a reserved room, with an approach carried out by the responsible researchers. At this time, there was an invitation to participate in the study, with due clarifications regarding the objectives. Participation was voluntary and only the project coordination and participating academics had access to the room at the time of data collection.

If there was no agreement to participate or interruption of future participation, this would not cause any harm to the way in which that service would be served, without the need for explanation or justification for this, and you could also withdraw from the research at any time.

In the second meeting, scheduled for the next day of care, the participant completed a registration form with identification information (such as age, sex, telephone number, date of illness, date of hospitalization - if any, previous and current comorbidities infection, severity of infection, hospitalization history, presence of respiratory symptoms, use of mechanical ventilation). Then, body measurements were taken. The evaluation took place in the local physiotherapy sector, which has a large installation and several rooms, an environment in which treatments are carried out, which contained the scale, stadiometer and BIA, with one patient being evaluated at a time.

Body composition variables, especially lean body mass, were obtained using horizontal tetrapolar electrical bioimpedance equipment (Bodystat, Quadscan 4000, Isle of Man, British Isles)[6]. The method uses four electrodes applied to the hand, wrist, foot and ankle. Following a standard procedure, measurements were performed on the right side of the volunteer's body, who should be lying in the supine position, with arms and legs comfortably separated by an angle of around 45 degrees from each other. In order not to compromise the result of the body composition analysis, in addition to removing metallic objects before carrying out the test, other precautions must be taken into consideration, in accordance with standardized techniques [13].

To understand body fat in a regionalized way, the skinfold technique was used, using measurements of the tricipital, subscapular, suprailiac and abdominal skinfolds [14]. A clinical adipometer (Avanutri, Brazil) with a scale from 0 to 80 mm and precision of ±1 mm was used, in addition to measuring body weight and height. All skinfold measurements were taken on the right side of the body, in triplicates, considering the arithmetic mean as a representative value for the region [6].

The level of physical activity was measured using the International Physical Activity Questionnaire (IPAQ), proposed by the International Group for Consensus on Physical Activity Measurements, created under the auspices of the World Health Organization. The IPAQ questionnaire in its short format It consists of eight open questions and its information allows estimating the time spent per week in different dimensions of physical activity (walking and physical efforts of moderate and vigorous intensity) and physical inactivity (sitting position). To this end, the product between the duration (minutes/day) and the frequency (days/week) reported in the answers to the questions presented is calculated, classifying individuals as “very active”, “active”, “irregularly active” and “sedentary”.

The data collected in the evaluations were typed and organized in the EpiData® spreadsheet model, in the public domain, with all participants and their respective results coded, which constituted the basis for data entry, composing the main database for the study. Subsequently, this database was introduced into the statistical program SPSS (Statistical Package for the Social Sciences) version 20, through the appropriate necessary coding and stratification. Descriptive and analytical statistical techniques were used, with a 95% confidence interval, that is, a significance level of 5% (α=0.05). The Shapiro-Wilk test provided by the statistical program was used to verify the normality of the distribution of values of continuous variables. Descriptive results were obtained through measures of central tendency (mean and median), dispersion (standard deviation and range) and categorization/dichotomization of variables.

3. RESULTS

20 individuals were evaluated, with a history of COVID-19 diagnosis, who attended the CRER rehabilitation sector, 14 females and 6 males. The means of % LBM and %BF showed normal data. The patients presented 20.8%BF and 35.1%BF, respectively for males and females. Descriptive statistics are presented in (Tables 1 and 2).

Table 1. Descriptive statistics of demographic, level of physical activity and dichotomous variables related to patients with a positive diagnosis of COVID-19. n=20, 2022

Variable	n	%
Gender		
Female	14	70.0
Male	6	30.0
Previous comorbities	10	50.0
Current comorbities	15	75.0
Severity or infection		
Mild	10	50.0
Moderate	4	20.0
Severe	5	25.0
Very severe	1	5.0
Hospitalization	2	10.0
Mechanical ventilation	2	10.0
LPA		
Sedentary	--	--
Irregularly active	3	15.0
Active	13	65.0
Very active	4	20.0

Legend: COVID-19, Coronavirus desease, of the year 2019; n, sample; LPA, Level of physical activity.

Table 2. Descriptive statistics of body composition variables using BIA, ST and post-diagnosis time of patients with COVID-19. n=20, 2022

Varable	Average (± sd)	Median (Amplitude)	Data normality (***P-VALUE***)
Age	47.65 ± 16.1	48.0 (16-81)	0.97
Weight	69.9 ± 16.4	65.2 (50.1-115.8)	0.04*
Height	1.63 ± 0.09	1.60 (1.43-1.80)	0.16
%BF	30.3 ± 11.3	32.0 (12.1-45.4)	0.08
BF (Kilograms)	21.6 ± 10.6	19.3 (7.7-39.0)	0.07
%LBM	69.7 ± 11.3	68.1 (54.6-87.9)	0.08
LBM (Kilograms)	48.3 ± 12.0	43.8 (32.1-76.8)	0.04*
% Segmental fat TRI	24.4 ± 5.1	24.7 (16.8-35.7)	0.56
% Segmental fat SE	23.1 ± 4.4	23.2 (15.5-30.2)	0.39
% Segmental fat SI	24.6 ± 6.6	23.5 (13.8-45.8)	0.02*
% Segmental fat AB	27.9 ± 5.0	29.2 (12.6-35.0)	0.03*
Post covid time (months)	20.2 ± 9.2	21.0 (5.0-35.0)	0.17

*Legend: COVID-19, Coronavirus deseas, of the year 2019; ST, skinfolds thickness; n, sample; sd, standard deviation; BF, Body fat; LBM Lean Body Mass; TRI, triceps; SE, subscapularis; SI, supra iliac; AB, abdomen; *, does not present data normality, according Shapiro-Wilk test, level de significance α=0.05*

Of the 20 participants evaluated, 50% reported having previous comorbidities (including high blood pressure, heart disease, embolism, diabetes, muscle fatigue, rheumatism and urinary infection). 70% had mild or moderate COVID-19 infection. The most prevalent comorbidity was high blood pressure, in 25% of the sample. Furthermore, only 10% were hospitalized and received ventilatory support (mechanical ventilation) and 15% of the sample were classified as irregularly active.

A statistically significant difference was observed between the mean and median values of tricipital, subscapular, supra iliac and abdominal segmented BF%. The regions with the highest share of body fat were the abdominal region, with 27.9% and the supra iliac region, with 24.6%. The analytical statistics are presented in (Table 3).

In the present study, only 15% of the sample was characterized as irregularly active. The analytical statistics of the correlation between % LBM and some explanatory variables are presented in (Table 4). There was no significant correlation between %lbm (and, therefore, %BF) with the explanatory variables.

Table 3. Difference between means/medians of segmented BF%, in the TRI, SE, SI and AB regions, measured using the skinfold technique, in patients with COVID-19. n=20, 2022

Variable	Average (± sd)	Median (Amplitude)	*P-Value*
% Segmental fat TRI	24.4 ± 5.1	24.7 (16.8-35.7)	<0,05*
% Segmental fat SE	23.1 ± 4.4	23.2 (15.5-30.2)	
% Segmental fat SI	24.6 ± 6.6	23.5 (13.8-45.8)	
% Segmental fat AB	27.9 ± 5.0	29.2 (12.6-35.0)	

*Legend: COVID-19, Coronavirus deseasE, of the year 2019; TRI, triceps; SE, subscapularis; SI, supra iliac; AB, abdomen; *, statistically significant difference, according to ANOVA, as well as the Kruskal Wallis Test, at the significance level α=0.05.*

Table 4. Correlation between %LBM measured through BIA, need for hospitalization, post-diagnosis time and Physical Activity Level of patients with a history of COVID-19. n= 20, 2022

Variable	Correlation coefficient	p-value
Need of hospitalization	0.109	0.646
Time since illness	-0.320	0.170
LPA	0.333	0.151

Legend: LBM, Lean Body Mass; BIA, electrical bioimpedance; COVID-19, Coronavirus desease, of the year 2019; n, sample; ; LPA, Level of physical activity.

4. DISCUSSION

The study by Luccas (2022), whose sample was composed of adults in the post-COVID-19 infection stage, with an average age of 49.1 years and characteristics of 48 hours of hospital discharge, found an average of 46.69 kg of LBM [15], a lower value than in the present study. The study conducted by Christinelli et al. evaluated 118 obese adult individuals and presented an average of 47.65 kg of lean body mass [16], a value also lower than that of the present study.

The reduction in the percentages of lean body mass impacts the quality of life and ability to perform activities of daily living, as it promotes a decline in neuromuscular function, affecting musculoskeletal integrity and resulting in reduced muscle strength and subsequent fatigue, due to the increase in energy expenditure even during light intensity activities and increased risk of overuse injury [17].

Regarding body fat, according to da Silva et al [18], there are several studies confirming the relationship of obesity as an aggravating risk factor for COVID-19 [18], associating them with severe COVID, the need for ventilation mechanics and mortality. In this regard, YU et al. (2021) also reported that an increasing number of reports have linked obesity to more severe illnesses and deaths from COVID-19 [19].

The study by Rocha et al. [20] found that the association between obesity and mortality from COVID-19 is important, and the older the age group, the greater the chances of complications, which makes it important to control and monitor the values of fat percentage also in post-COVID-19 patients [20].

In the present study, 10% of participants were hospitalized and received mechanical ventilation. The length of stay for patients with COVID-19 requiring mechanical ventilation can range from two to four weeks. Furthermore, complications, such as pneumonia associated with MV, pulmonary thromboembolism, asynchronies that are difficult to resolve, delirium, among others, contribute to increased morbidity and mortality [21].

The regions with the highest share of body fat were the abdominal region and the suprailiac region. In this sense, the study by Graziano et al. [22] indicates that although obesity and metabolic syndrome (MS) are not associated with greater intensive oxygen support, this association is significant in patients with excessive abdominal adiposity [22]. According to recent evidence, adequate control of metabolic disorders is important to reduce the risk of severe COVID-19 [23].

However, in a prospective study on the impact of obesity, metabolic syndrome and body composition on clinical outcomes and mortality of patients with COVID-19, an abdominal adipose tissue paradox was found, since waist circumference and visceral tissue metabolically active (VTM) were risk factors for more intensive oxygen support, but not for mortality [22]. Compared to the non-severe COVID-19 group, VTM accumulation levels were significantly higher in COVID-19 patients with a severe condition.

In the present study, 85% of the sample were classified as physically active or very active, which may have contributed to the low need for mechanical ventilation and the severity of the cases, that is, the vast majority of the sample presented a mild or moderate infection, which could be related to the fact that they are physically active, which would act as a protective effect. In this sense, Ribeiro (2022), in his study on the impact of the COVID-19 pandemic on sedentary behavior and physical inactivity in university students, observed that, in patients who had a predominance of sedentary behavior previously and during the COVID-19 pandemic, losses from such conduct were identified, creating favorable conditions of risk to physical and mental health [24].

A study carried out with 1,895 individuals indicated that social isolation resulting from the COVID-19 pandemic led to a reduction in physical activity levels and an increase in sedentary behavior among Brazilian adults. This factor, together with comorbidities, advanced age and excess weight before the COVID-19 pandemic, lead to an increased risk of impact on the level of physical activity. In this same study, more than 50% of men and women reported that the COVID-19 pandemic decreased their level of physical activity [25].

In the present study, there was no statistically significant correlation between %LBM and hospitalization history, as well as the time elapsed since illness and the level of physical activity of the participants. However, the study by Gualtieri et al. carried out with an adult population composed of 30 individuals revealed that the main result observed in that sample was the loss of lean mass related to obese individuals [26].

Furthermore, Cava and Carbone evaluated the impact of body composition on the severity of the disease and concluded that the loss of muscle mass affected up to 80% of elderly patients admitted to the intensive care unit. Weakness acquired in the intensive care unit is an important predictor of long-term mortality and morbidity, affecting nutritional status and body composition in the short and long term [27].

5. CONCLUSION

According to the sample and characteristics of the present study, it was found that lean mass was superior to other studies carried out. There was no correlation between lean body mass and factors such as hospitalization, length of illness and sedentary lifestyle with an average of 20 months after infection, although other studies have found the opposite. Furthermore, the regions with the highest share of body fat were the abdominal and suprailiac regions, known to be important for inflammatory issues and risk factors for metabolic and cardiovascular diseases. A small part of the sample required hospitalization and ventilatory support, and 70% were classified according to their level of physical activity as active or very active.

The study's sample size is limited, and further follow-up studies of post-COVID-19 patients are recommended in aspects related to symptoms and functionality.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

All authors declare that all experiments were examined and approved by the Research Ethics Committee of the University of the State of Minas Gerais, following the standards for carrying out research with human beings, under the opinion no 5.725.491.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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