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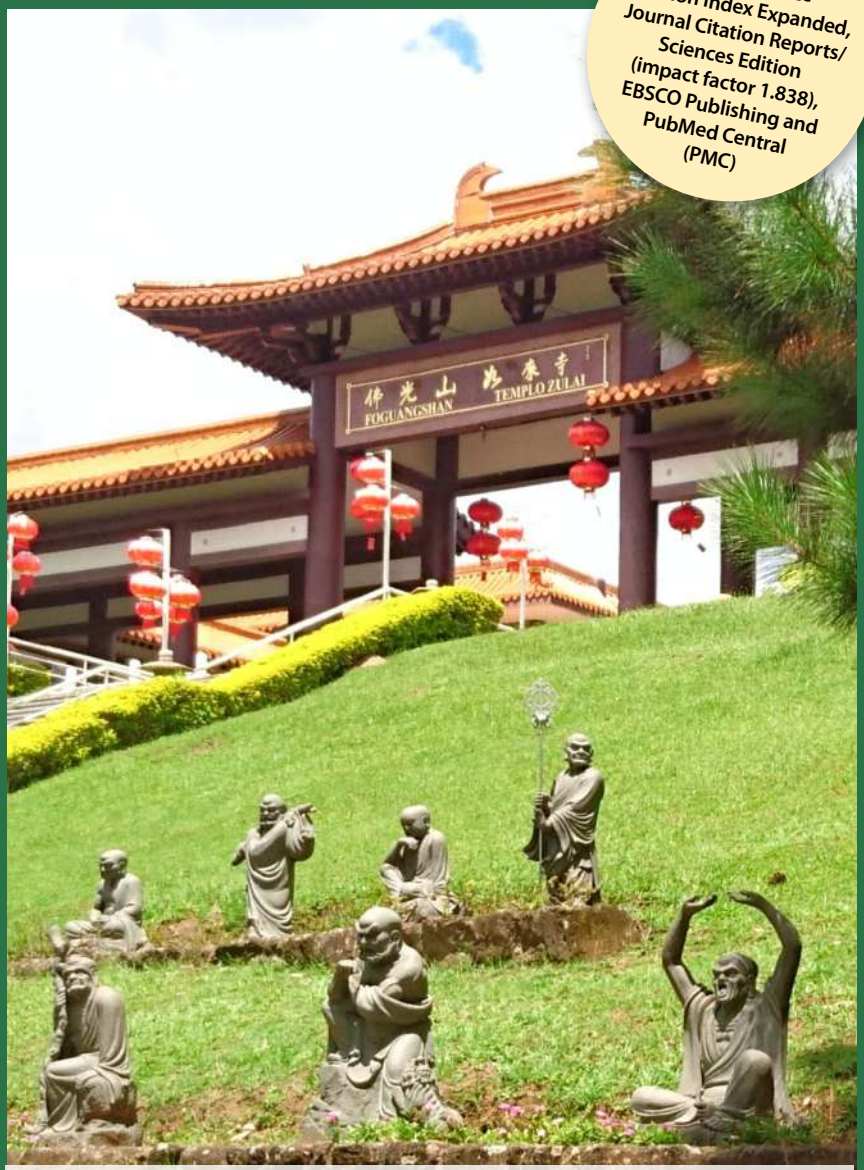

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31 de maio a 3 de junho

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Three-dimensional computed tomography reconstruction in the era of digital personalized medicine

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The radiological evaluation of anatomical structures is a fundamental part of the diagnostic and therapeutic workup in modern medicine. Since the discovery of X-rays by Wilhelm Conrad Roentgen in 1895, the medical community has added to its arsenal of instruments capable of evaluating the interior of the human body non-invasively.[1] Each development being safer and more efficient radiological exams became capable of identifying, isolating, and analyzing—with high realism—the anatomy and functionality of organs, gaining popularity at almost the same rate at which they evolved.[2]

Computational imaging tests, most notably computed tomography (CT), have contributed significantly to the spread of image-based medicine. Since its invention in 1972 by Cormack and Hounsfield, the quality of tomographic images has progressed exponentially, driven by advances in informatics and computing science.[3] The final product of a CT scan depends less on human influence in the image acquisition, and well-established protocols can be executed by professionals with a technical level to obtain adequate results. Unlike ultrasound examinations, which require a trained medical professional to perform an evaluation in real-time, tomographic images can be stored and evaluated by multiple professionals without limitations in terms of time or physical access to the patient. This quality facilitated its dissemination and allowed physicians from different areas and without previous in-depth radiology training, through repeated contact, to perform evaluations efficiently. However, its detailed analysis still lacks specialized workstations that allow the visualization of two-dimensional images in multiple planes, advanced contrast manipulation, image suppression techniques, and specific training in the field of medical radiology.

To address the difficulties in the analysis of bidimensional and monochromatic tomographic images, the technological evolution of graphic manipulation methods is being increasingly applied to the medical field.[4]

The study of three-dimensional (3D) rendering techniques for CT scans began in the 1970s, driven by the development of computer hardware and software. The dissemination of examinations performed on multislice helical CT scanners resulted in the generation of high-quality images with sufficient data for more complex and detailed renderings for a larger number of users. In this manner, techniques such as maximum intensity projection and surface shaded visualization were developed. However, limited by the technological development of data processing, these techniques use only 10% of the data available in the exams, using only part of the images to perform a low-quality 3D reconstruction; thus, this limits their applicability to certain circumstances.[4]

With the evolution of data processing capacity of modern computers, techniques such as volumetric rendering (VTR) could flourish to provide the medical community 3D images of CT scans with satisfactory quality.[5] Despite high resolution images, VTRs cannot efficiently isolate anatomical structures. The final product works like a sculpture with parts that can, in some cases, be cut or erased, but without natural segmentation and individualization of the human body. Although it does not interfere with the evaluation of superficial and bony structures, it is an important limitation for the evaluation of deep structures and those that are proximal to other parts with similar densities.

To overcome this deficiency, the segmentation of anatomical structures (organs and tissues) can be performed using software and techniques specialized in extracting these data from CT scan.

This technique uses computational power to differentiate countless shades of gray within the monochromatic spectrum of tomography and, based on Hounsfield units and structure contour, separates organs and tissues individually with high precision.[6] Thus, personalized 3D graphic representations can be obtained, considering the unique anatomy of each patient. These virtual models can be manipulated in different ways at different angles, bringing the results obtained from the examinations to the actual spatial reality. This led to the development of a software industry specialized in the segmentation and post-processing of medical images, enabling integration with new technologies and opening the doors of the era of digital and personalized medicine.

With more consolidated applicability in areas such as orthopedics, facial surgery, and neurosurgery, the use of 3D reconstruction and CT segmentation has been evolving at great strides in surgical aid techniques.[7-9] Solid organs, with little anatomical variations and simple vascularization, have benefited quickly because their rendering and segmentation require less complex software and algorithms. However, semi-automatic segmentation techniques are already available, allowing physicians with basic training to perform complex reconstructions such as vascular, hepatic, or pulmonary with just a few clicks. This automates and simplifies the acquisition of 3D reconstructions, which is essential for the dissemination of this technique. A simplified facility allows better multi-professional communication between surgeons, radiologists, and clinicians.[9,10] The interdisciplinarity optimizes the results obtained by adding different points of view from the surgical technical vision to the anatomical radiological evaluation and its clinical implications.

In thoracic surgery, the evolution of lung resection techniques through the spread of sublobar resections for the treatment of benign diseases and lung cancer has boosted the use of 3D reconstruction in this field. Approximately more than half of the lung resections are performed in a minimally invasive manner, that is, through small incisions with the aid of optics and video material to visualize the intrathoracic structures. This type of surgery minimizes the chance of extensive handling of anatomical structures by the surgeon, limiting the ability to identify them by touch.[11] In this context, the preoperative study regarding the vascular and bronchial structures to be treated becomes essential. The use of 3D reconstruction of chest CT scans facilitates this process and has shown positive results in reducing surgical time and intraoperative blood loss.[12,13] Moreover, with the dissemination of robotic platforms in different specialties, the integration of these technologies has become increasingly feasible. The presence of a digital machine between the surgeon and the patient allows the application of technologies such as intraoperative augmented reality, which is capable of interposing 3D images to the surgical field, thus facilitating decision-making and increasing surgical precision.[14,15] This integration allows us to envision AI-based functionalities capable of recognizing inaccurate and even dangerous surgical movements, thus reducing the rate of intraoperative accidents.

Extended reality, including virtual reality and augmented reality, is a technique capable of bringing 3D models even more into the real world. To provide a unique immersion sensation with binocular vision and ultra-realistic depth and visual texture sensations, they can be precisely employed in surgical planning and teaching for surgeons in the initial learning curve. It is no longer necessary to imagine the spatial distribution of the structures visualized in CT, allowing an easier understanding of the anatomy. Extended reality techniques are widely used in the field of endoscopic diagnosis. Virtual bronchoscopy, with the reconstruction of the tracheobronchial tree, identification of tumors and stenosis, and optimization of navigation techniques for performing biopsies of pulmonary nodules, are constantly expanding techniques.[15] These 3D reconstructions can be used in virtual reality environments for realistic simulations, allowing the surgical team to perform simulated training like those employed in aviation.[16] For example, surgeons and technicians can use 3D models and their customized features to simulate the best surgical approach and identify the best prosthesis or position for it to be used.

In addition, rendered images can be used for 3D printing. Because of the popularization and falling prices of printers and printing supplies, the construction of physical models helps surgeons from various specialties realistically experience what will be found in the surgery. Its use goes beyond preoperative planning and is also useful for patient counseling, teaching, and the development of bioimplantable materials. For example, in thoracic surgery, the construction of customized prostheses for chest wall and airway reconstructions is actively expanding.[17] Still limited by manufacturing costs, 3D printing of customized prostheses in biocompatible materials such as polymethylmethacrylate and laser cutting of titanium structures reduce complications and optimize esthetic results.[18] These techniques are in line with the growing concept of personalized medicine, considering the uniqueness of each individual pathology in the particular physiology of each human being.

Thus, 3D reconstruction technology based on CT scans shows promise in several fields. In the era of personalized medicine and the digitalization of medical care processes, its applicability will be broad, improving care results and academic performance. As discussed in this article, it is not an ultimate technology but a technological device that will serve as a basis for the development of several applications involving robotic platforms, artificial intelligence, extended reality, and 3D printing. The implementation of this technology in all institutional departments is essential in laying the groundwork for these future technologies and the benefits they can bring to patients and the scientific community.

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Domestic burns that occurred during the COVID-19 pandemic in Brazil: a descriptive cross-sectional study

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ABSTRACT

BACKGROUND: Due to "stay at home" restrictions during the coronavirus disease 2019 (COVID-19) pandemic, people spent more time at home leading to an increase in home accidents, including burns.

OBJECTIVE: To investigate the epidemiology of burns that occurred within homes during the COVID-19 pandemic in Brazil.

DESIGN AND SETTINGS: This was a quantitative, descriptive, and cross-sectional study with a non-probabilistic sample.

METHODS: Data were collected through the distribution of survey links on social networking sites and websites, and through email between December 2020 and February 2021. Participants were over 18 years of age, living in Brazil. Data analysis was performed using descriptive and dispersion statistics.

RESULTS: A total of 939 adults (aged > 18 years) participated in this study. The mean age was 37.2 years (standard deviation [SD] = 12.5), 75.6% were female, 70.0% self-reported white skin color, 74% had completed higher education, and 28.1% had an income of 3 to 6 times the monthly minimum wage. A total of 21.6% suffered burns during the pandemic, 44.3% from a hot object. Approximately 49.3% never had access to a burn prevention campaign.

CONCLUSION: It is necessary to develop burn prevention strategies that reach a wider population and to strengthen public policies to reduce the prevalence of domestic burns, especially during the pandemic.

INTRODUCTION

Burns injuries are a universal health hazard, which carry high morbidity and mortality, especially in low- and middle-income countries.[1] The etiology, time of exposure to the thermal agent, and depth of the burn wounds influence the severity of the injury.[2] In addition to physical injuries, burns have psychological, economic, and social implications of great impact and are considered a global public health problem. Among the causes of burns, the most frequent are exposure to flames, scalding, and electrical and chemical burns.[3]

It is estimated that burns are responsible for about 180,000 deaths annually, with the highest incidence in low- and middle-income countries, with approximately two-thirds occurring on the African and Asian continents.[1] In the United States of America, there were more than 410,000 cases of burns in 2008 and around 40,000 incidents required care at the hospital level.[1] In Brazil, the annual estimates of burn injuries can be as high as 1,000,000 incidents.[4] Several factors influence the occurrence of burns, such as socioeconomic level, geographic distribution, age, and gender.[5]

To reduce the burden on healthcare during the coronavirus disease 2019 (COVID-19) pandemic, "stay at home" orders and "lockdowns" were implemented at different stages worldwide with varying lengths of time and severity. This raised the concern that domestic accidents, mainly burns, might increase during this period.[6] The need to adopt social distancing and lockdowns affected family routines and had a negative impact on individuals from a social and psychological point of view.[7]

To adhere to the World Health Organization (WHO) measures related to COVID-19, in March 2020, the over-the-counter sale of hand sanitizers with 70% alcohol in liquid or gel form was approved in Brazil.[8] This public health measure was necessary to prevent the spread of disease in cases where it would be impossible to sanitize hands with soap and water. However, its sale and use were not accompanied by educational campaigns on safety for the use of products

with such high alcohol content. The improper use of alcohol-based sanitizers has put families at risk for burns and caused an increase in the number of hospitalizations.[9] Between March 19 and August 12, 2020, there were 497 hospital admissions related to hand sanitizers with 70% alcohol, in 36 Burn Treatment Centers (BTC) and general hospitals across the country.[10] The concerns were related to the inappropriate use of alcohol in liquid and gel form for sanitizing purposes, and the various situations that triggered accidental burn injuries at home, such as contact with hot liquids, fire, and hot objects.

The Brazilian Society of Burns reported that before the pandemic, a majority of burn accidents already occurred in homes (70%), with children comprising 40% of cases.[11] The lockdowns and social distancing measures affected the family environment and their habits. For example, people had to cook more frequently at home, and in families with children, parents had to work from home while supervising their children during the day. Hence, it should be expected to find an increase in preventable burn injuries taking place at home as a result of the COVID-19 pandemic restrictions in Brazil.

OBJECTIVE

The aim of this study was to investigate burns that occurred within homes during the COVID-19 pandemic in Brazil.

METHODS

Study design

This study adopts a quantitative, descriptive, and cross-sectional design with a non-probabilistic sampling method that aims to survey patterns of burn injuries occurring at home throughout Brazil. Data were collected using the questionnaire-based survey method.[12]

This paper was written in accordance with the guidelines for reporting observational epidemiological studies (STrengthening the Reporting of OBservational studies in Epidemiology, STROBE).

Procedure for data collection

In the first phase of the study, a 25-item questionnaire (entitled Investigation of burn injuries that occurred during the COVID-19 pandemic) was designed. The instrument was divided into two sections: *General sociodemographic items*, including 11 questions about sex, date of birth, skin color, education, profession, city and state of residence, number of people living in the same house with the participant, number of people under 18 years of age living with the participant, email and salary per month (R$ 1.100 was the Brazilian minimum wage in 2021.[13] As a point of comparison, the US dollar was valued at 5.19 Real in August 30, 2021[14]); and *Specific questions regarding domestic burns that occurred during the COVID-19 pandemic*, the first two questions were about the occurrence of domestic burns – if the participant had not suffered burns, he/she was sent to the last question about burn prevention campaigns – the following 11 items were about the location and date of occurrence, if there were multiple episodes of burns, cause of the burn, social distancing, first aid, hospitalization, length of stay, skin graft, burn prevention campaign.

In the second phase, an expert committee was constituted of four healthcare professionals (two physical therapists, one doctor, and one nurse; a fifth was invited but did not respond) with expertise in the area of burn injuries, to validate the instrument. An email invitation was sent to each member of the expert committee with the study objectives, study protocol, their role, and the link to evaluate the instrument built using the SurveyMonkey software (San Mateo, California, United States). The committee assessed the questions for content and apparent validation. The evaluation was based on the theory of elaboration of psychological scales.[15] The total instrument Content Validity Index (CVI) value was 0.98 and only one item had a value of 0.75 ("If you were hospitalized more than once due to burns, please specify"). In some questions, changes suggested by the experts were incorporated, such as living in urban or rural areas, type of housing, parts of the body that were burnt, difference between barbecue area and leisure area, treatment performed at home, and in the health service. The authors reviewed the new version and included marital status as an item to be analyzed. Thus, a new version of the instrument (33 items) was developed and submitted for reevaluation to three members of the expert committee. The modified version of the instrument had a CVI value of 0.99 and all items, a value above 0.80. No further changes were suggested and the burn investigation instrument was considered validated by the committee of experts.

In the third phase, the survey link was sent through social networking sites, websites, and email, with the aim of reaching the largest possible number of participants in the national territory. A database was created containing the emails of federal and private institutions, including hospitals, found using Google search tools. A designated email account for the research study was created, and invitations to participate were sent from this address. To expand the sample size, the first guests to participate in the survey were invited to forward the link to their personal contacts, generating a snowball sample. The survey was available online for the period of December 2, 2020, to February 15, 2021.

Inclusion and exclusion criteria

The study selected participants who were aged 18 years and older, residing in Brazil during the period under study, spoke Portuguese, had Internet access, and were Internet literate.

Instruments answered by participants under the age of 18, duplicates, or responses with a coherence error that invalidated the instrument were excluded from the study.

Data analysis

For the analysis of the apparent and content validation data of the instrument, the CVI was calculated.[16,17] To calculate the CVI, a Likert-type scale with scores from one to four was used, which assessed the relevance/representativeness of the responses identified as follows: 1 = not relevant or not representative (strongly disagree), 2 = item needs major review to be representative (disagree), 3 = item needs minor revision to be representative (agree), and 4 = relevant or representative item (strongly agree). The answer "I don't know" was assigned a value of 0. The following formula was used: the number of responses with scores of 3 or 4 divided by the total number of responses in the script. Items that received a score of "1" or "2" were revised and responses marked as "I don't know" were eliminated.[16,17] To calculate the instrument's total CVI, the average of the values of the items calculated separately was considered, that is, the sum of all the CVI calculated separately and the division by the number of items considered in the evaluation.[18] A CVI value above 0.80 was considered the minimum.[19,20]

Data collected in the third phase of the study through SurveyMonkey were exported to IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, New York, United States). Descriptive and dispersion analyses were performed for all variables.

Ethical considerations

The research protocol was registered and approved by the Human Research Ethics Committee on November 1, 2021[21] (number 34396320.4.0000.5154).

The participants had access to the Informed Consent Form (ICF) on the first page of the instrument and could only view the questionnaire after agreeing to the ICF conditions. Electronic signatures on the ICF were collected from all individuals involved in the study.

RESULTS

Over the study period (2 and a half months), 939 participants completed the survey. The sociodemographic profile showed that 710 were female (75.6%), and there was a predominance of respondents who declared themselves as having white skin color (70.0%). The mean age of the participants was 37.2 years (standard deviation, SD = 12.5). Regarding the level of education among the participants, 74% declared that they had completed higher education, and 28.1% had an income of 3 to 6 times the minimum wage. A total of 42.6% were married and 97.2% lived in an urban area (**Table 1**).

Two hundred and one participants (21.6%) sustained burn injuries, of whom 173 (76.1%) were female and 156 (77.6%) identified themselves as having brown skin color. In terms of occupation, the majority comprised 93 (46.3%) teachers, and 65 (32.3%) persons engaged in public service. The mean age was 37.2 years (SD = 12.87), 159 (79.1%) had an incomplete higher education level, 144 (71.6%) were single, 161 had an income of at least 9 times the minimum wage or higher, and all lived in urban areas (**Table 2**).

The survey identified that other family members had also sustained burn injuries (117 responses, 58.2%) during the pandemic period (**Table 3**). The following body areas were identified as being involved: right hand, 82 (40.2%); left hand, 42 (20.6%); and right arm, 33 (16.1%). The agents causing the burns were

Table 1. Distribution of sociodemographic variables of participants in the study on burns in the pandemic carried out in Brazil (n = 939)

Variables	Categories	n	%
Gender	Female	710	75.6
	Male	225	24.0
	Other	4	0.40
Skin color	White	657	70.0
	Brown	207	22.0
	Black	55	5.8
	Yellow	18	1.9
	Indigenous	2	0.2
Age, mean (SD)[a]		939	37.2 (12.5)
Education	Complete primary education	7	0.7
	Incomplete elementary school	5	0.5
	Complete high school	58	6.2
	Incomplete high school	6	0.6
	Complete higher education	695	74.0
	Incomplete higher education	168	17.9
Marital status	Married	400	42.6
	Divorced/Separated	70	7.5
	Single	387	41.2
	Stable union	73	7.8
	Widower/Widow	9	1.0
Income	Less than 1 minimum wage[b]	113	12.0
	From 1 to 3 times the minimum wage	261	27.8
	From 3 to 6 times the minimum wage	264	28.1
	From 6 to 9 times the minimum wage	129	13.7
	From 9 to 12 times the minimum wage	82	8.7
	Greater than 13 times the minimum wage	90	9.6
Residence	Urban area	913	97.2
	Countryside	21	2.2
	Other	5	0.5

SD = standard deviation.
[a]standard deviation; [b]R$ 1.100 – value of the Brazilian minimum wage paid monthly in 2021 (1 United States Dollar = 5,19 Real).

most frequently hot objects (44.3%) and hot liquids (29.9%) and the kitchen was the area of the house where most injuries occurred (77.1%).

The month with the highest incidence of burn-related accidents was November, followed by December and May 2020. Among the participants, 23 (11.4%) had more than one burn during the pandemic period, with a minimum interval of 7 days and maximum interval of 10 months between injuries.

Regarding the management of burn injuries, 168 participants (83.6%) did not seek care after the accident, and 171 (85.1%) did not require hospitalization (**Table 4**). The use of two products in the treatment of burns stands out: medicinal plants (9, 4.4%) and running water (9, 4.4%).

Of the participants who had sustained a burn injury, 99 (49.3%) reported that they were unaware of any burn prevention campaigns. Regarding the means of accessing information on burn prevention, 19 (26.4%) reported being healthcare professionals themselves and thus knowing how to prevent burn accidents, while articles in the media (TV programs and radio) represented the other substantial source of awareness (**Table 5**).

In relation to other means used to obtain information about burns, the word "prevention" appeared 16 times in phrases such as the following: normal preventive measures linked to attention and care, equipment installed by trained professionals; prevention strategies given by older family members, and previous knowledge about preventive measures.

Table 2. Distribution of sociodemographic variables of study participants who suffered burns in the pandemic in Brazil (n = 201)

Variables	Categories	n	%
Gender	Female	153	76.1
	Male	46	22.9
	Other	2	1
Skin color	Brown	156	77.6
	Black	45	22.4
Age, mean (SD)[a]			37.22 (12.87)
Education	Complete higher education	42	20.9
	Incomplete higher education	159	79.1
Marital status	Single	144	71.6
	Stable union	57	28.4
Income	From 6 to 9 times minimum wage[b]	40	19.9
	From 9 to 12 times minimum wage[b]	81	40.3
	Greater than 13 times minimum wage[b]	80	39.8
Residence	Urban area	201	100
Occupation	Teacher	93	46.3
	Psychologist	13	6.5
	Chemical	3	1.5
	Secretary	8	4.0
	Public server	65	32.3
	Sociologist	2	1.0
	Nursing technician	17	8.5

SD = standard deviation.

[a]standard deviation; [b]R$ 1.100 - value of the Brazilian minimum wage paid monthly in 2021 (1 United States Dollar = 5,19 Real).

Table 3. Distribution of clinical and environmental characteristics of study participants who suffered burns during the pandemic in Brazil (n = 201)

Variables	Categories	n	%
Family member burns	No	84	41.8
	Yes	117	58.2
Part of the body affected	Right hand	82	40.2
	Left hand	42	20.6
	Right arm	33	16.1
	Left arm	18	8.8
	Left leg	11	5.4
	Face	10	4.9
	Abdomen	8	3.9
	Right foot	5	2.5
	Right leg	4	1.9
	Neck	4	1.9
	Thorax	4	1.9
	Scalp	1	0.5
	Back	2	1.0
	Left foot	2	1.0
	Genital organs	0	0
Agent causing the burn	Hot object	89	44.3
	Hot liquid	60	29.9
	Vapor	11	5.5
	Direct flame	10	5.0
	Liquid alcohol	1	0.5
	Chemicals	1	0.5
	Did not answer	29	14.4
Location in the house where the burn occurred	Kitchen	155	77.1
	Bedroom	5	2.5
	Bathroom	1	0.5
	Barbecue grill	3	1.5
	Recreation Area	1	0.5
	Did not answer	36	17.9

Regarding measures of social distancing during the pandemic, 52 (25.9%) participants remained in total isolation for the entire period, in contact exclusively with people who stayed in the same house as them, while 33 (16.4%) remained in complete isolation for the first three months of the pandemic; 13 participants (6.5%) remained in partial isolation for the first three months of the pandemic, meeting a few people other than those who lived in the same house as them; 58 (28.9%) remained in partial isolation throughout the pandemic; 8 (4.0%) did not practice social distancing at any time; 3 (1.5%) did not want to answer, and 34 (16.4%) did not answer.

Table 4. Management of participants after the occurrence of burns during the pandemic in Brazil (n = 201)

Variables	Categories	n	%
Seek medical attention	No	168	83.6
	Yes	4	2.0
	Did not answer	29	14.4
Hospital internment	No	171	85.1
	Yes	1	0.5
	Did not answer	29	14.4
Specific product for burns in the healthcare unit	Yes	47	23.4
	No	65	32.3
	Did not answer	89	44.3
Used some product at home in the burn	Yes	86	42.8
	No	24	11.9
	Did not answer	91	45.3
Products used on burns at home	Medicinal plant	9	4.4
	Running water	9	4.4
	Oil	3	1.5
	Toothpaste	3	1.5
	Saline	2	1.0
	Ice bag	2	1.0
	Egg white	1	0.5
	Ozonized oil	1	0.5
	Laser therapy	1	0.5

DISCUSSION

Due to the measures imposed during the COVID-19 pandemic, the risks of the population experiencing traumatic burn injuries while in isolation are considerably higher.[22] In Brazil, burn injuries resulted in around 26,173 hospital admissions in 2020, a majority being in the Southeast area with 9,298 cases and 745 deaths.[23] A previous study evaluating the number of hospitalizations and deaths caused by burn injuries in pre-pandemic Brazil, identified the South and Midwest regions as having higher hospital admission rates.[24] During the COVID-19 pandemic in 2020, Brazil had a high number of deaths due to burns when compared to other countries.[24]

According to data from the Brazilian Institute of Statistics and Geography,[25] women constitute 51.03% of the country's population and 84.4% of the total population live in urban areas. The representation of ethnic-racial background identified in this study is similar to the frequency in the Brazilian population, in which white skin color accounts for 47.7% and brown, 43.1%.[26]

The average age of the participants who sustained burn injuries was 37.22 years. In a study comparing burn cases between March 16 and September 30, 2019, with the same period in 2020, it was shown that the average age of patients who suffered burns increased from 38.2, before the pandemic, to 55.7 in 2020. This indicates that adults are the most affected by burns, even during the pandemic.[22]

In this study, 40.3% of the participants who suffered from burns during the pandemic were of a high socioeconomic status. This differs from another survey conducted over a 10-year period at the Burn Care

Table 5. Profile of preventive measures adopted by participants on burn prevention in Brazil (n = 201)

Variables	Categories	n	%
Have you seen any burn prevention campaigns?	No	99	49.3
	Yes, before the pandemic	64	31.8
	Did not answer	38	18.9
Means of communication used to prevent burns	You are a health professional	19	26.4
	Articles in media such as TV or radio programs	18	25.0
	Guidelines from health professionals	10	13.9
	Other	8	11.1
	Scientific article readings	6	8.3
	You have already suffered burns in the past and from this, you follow strategies to prevent further burns	6	8.3
	Someone you know suffered burns and from there you follow burn prevention strategies	3	4.2
	Profiles on social networks such as Facebook, Instagram, and Twitter	2	2.3

Center of the Institute of Medical Sciences in Pakistan, where a total of 94,664 people were assessed and the majority of patients who suffered burn injuries were of low socioeconomic status.[27] It is believed that low-income people are more vulnerable to burns because of the lack of guidance on care and prevention of burns and low access to sources of media. Thus, this study suggests a need for reflection on the prevention strategies against burns and the means of dissemination, as even though the participants in this research belonged to the highest socioeconomic status, this did not prevent them from having burn accidents.

The hands were the most affected body part, followed by the arms. In a previous study, it was highlighted that the upper limbs and trunk were the most affected in the profile of burn victims.[28] Another study conducted an analysis of medical records of patients in the Burns Care Unit in the Northeast of the country from June 2015 to July 2016, in which of the 86 records reported the affected body area, the regions of the upper limbs were the most affected (51.2%) as an area of greater exposure during household chores.[29]

The most prevalent causal agents were burns caused by hot objects (44.3%) and liquids (29.9%). A study conducted with data from Uruguay[30] found direct fire (71%), followed by hot liquids (9%) and electricity (5%) to be the primary causes of burn injuries, and another study conducted at a regional adult burn center in the United Kingdom from March 23 to May 6, 2020, determined a prevalence of flame and scalding in burn accidents.[31] In a survey conducted in an emergency care hospital in the Northeast region of Brazil, the incidence of burns caused by hot liquids increased from January to September 2020 compared to the previous year, with other causes being flames and chemical substances.[32] These findings differ from the present study, as factors such as social distancing to reduce COVID-19 transmission caused a change in family routines, evidenced by the change in the profile of burns in Brazil.

The present study showed that burns occurred more often in kitchens. Other international studies involving 3,050 patients also identified that burns in domestic environments accounted for 57% of cases attended,[30] and 71.3% of all accidents causing burns.[27]

Prevention campaigns that increase population awareness about the risks and behaviors leading to burns are the best strategy to reduce such injuries, hospital admissions, and deaths. A study involving 776 people from the Southern region of Brazil demonstrated that, with respect to prevention, only 31.44% of patients claimed to have received information from public campaigns. [33] Similarly, our study identified that 99 (49.3%) participants had not seen information from public burn prevention campaigns and 64 (31.5%) had access to them before the pandemic. The findings from both studies suggest that there are opportunities to improve the dissemination of public burn prevention campaigns in Brazil.

This study had some limitations. First, the online survey distribution and data collection did not reach all population groups. Data from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, IBGE) in 2019 show that 82.7% of Brazilian households have internet access in urban areas while the rural distribution is only 55.6%.[34] Another survey conducted by the Regional Center for Studies on the Development of the Information Society (Cetic.br) published in 2020, identified that 99% of households of higher socioeconomic status have access to the internet, while 50% of households of lower socioeconomic status have this facility.[35] Based on existing evidence in the literature,[35] it was expected that the profile of people who suffered burn accidents during the pandemic would be from low-income settings. However, the profile of people in the current research project was different because the methods used to disseminate the survey were more likely to reach people of higher socioeconomic status. People who live in low-income settings may not have access to the Internet or lack technical knowledge about its use, and thus, may not have had the opportunity to participate in this survey. Nonetheless, the study highlighted that people of higher socioeconomic status also suffered from burn injuries. Second, the email sent may have been marked as spam mail and may not have been seen by the respondent. Assuming that keeping the questionnaire available for a longer period of time increases the likelihood that people who occasionally access the Internet will participate in the survey, this study may have compromised on a higher number of participants from regions of Brazil other than the southeast, since data collection took place over a short period of time, given the urgency of the theme.

CONCLUSION

This study identified that during the COVID-19 pandemic in Brazil, a majority of the people who sustained burn injuries were female, had brown skin color, and had incomplete higher education. Almost half of the participants suffered burns from hot objects or hot liquids, and most accidents occurred in the kitchen. Almost half of the participants reported that they had never accessed a burn prevention campaign. Thus, this study proposes improving the methods of disseminating educational campaigns and guidance on burn prevention, in addition to supporting public health policies to guide the population in an attempt to reduce the incidence of domestic burns. Future studies should identify risk factors associated with burns at home to inform future burn prevention initiatives.

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Isotemporal substitution of sleep or sedentary behavior with physical activity in the context of frailty among older adults: a cross-sectional study

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ABSTRACT

BACKGROUND: Frailty syndrome is associated with various physical, cognitive, social, economic, and environmental factors. Although frailty syndrome occurs progressively with age, prevention and treatment are possible. Reducing or eliminating risks and increasing protective factors may be potential strategies for reducing the prevalence of injuries related to frailty. One of the most effective actions is to decrease the time spent in sedentary behavior (SB) by increasing regular physical activity (PA).

OBJECTIVE: To examine the hypothetical effect of substitution of the time spent in sleep or SB with an equivalent time spent performing moderate or vigorous PA on frailty syndrome in the older population.

DESIGN AND SETTING: An analytical cross-sectional study conducted using exploratory methods of survey, carried out in Alcobaça city, Bahia, Brazil.

METHODS: A total of 456 older adults of both sexes, aged ≥ 60 years, participated in this study. Frailty syndrome was identified according to the criteria of the Study of Osteoporotic Fractures. PA and SB were assessed using the International Physical Activity Questionnaire, and sleep was assessed using the Pittsburgh Sleep Quality Index. The effects of time substitution on these behaviors were verified using Poisson regression.

RESULTS: The replacement of 60 min/day of SB (prevalence ratio, PR = 0.52; 95% confidence interval, CI: 0.28–0.96) or sleep (PR = 0.52; 95% CI: 0.27–0.98) with 60 min/day of moderate PA (MPA) was associated with a 48% reduction in the prevalence of frailty syndrome.

CONCLUSIONS: Replacing the time spent sitting or sleeping with the same amount of MPA time may reduce frailty; the longer the duration of time spent in the substitution of sleep or SB with MPA, the greater the benefits.

INTRODUCTION

Expansion of the older adult population is a global phenomenon. Data have shown that the number of older adults (aged ≥ 60 years) worldwide is expected to double from 841 million people in 2013 to over 2 billion in 2050.[1] In Brazil alone, it is estimated that by 2050, older adults will comprise almost a third of the total population (29.3%).[2]

Population aging is a multifaceted challenge because health problems such as frailty syndrome are common at this stage.[3] This impacts the individual and the society, as the associated problems directly affect the quality of life and functionality of the older person.[4]

Frailty syndrome is related to physiological alterations of the musculoskeletal, neuroendocrine, immunological, and cardiorespiratory systems[5] mainly causing muscle loss, appetite alteration, and a chronic inflammatory state,[3] as well as common chronic diseases such as cardiovascular diseases.[5] In addition, frailty syndrome is associated with various physical, cognitive, social, economic, and environmental factors.[6] It may be aggravated by the presence of one or more preexisting diseases,[7] thereby increasing the vulnerability to adverse outcomes such as impaired physical and functional capacity, high occurrence of falls, increased use of medication, hospitalization, institutionalization, and death.[8]

Although frailty syndrome occurs progressively with age, prevention and treatment are possible. Reducing or eliminating risks and increasing protective factors are probable strategies for reducing the prevalence of frailty and frailty-related injuries.[9] One of the most effective actions in this regard is to decrease the time spent in sedentary behavior (SB)[9] and increase regular physical activity (PA). This helps in the reduction of symptoms of the syndrome[10] and affects its associated

parameters such as improvement in physical performance,[10] muscular strength, mobility, body composition, and functionality and fall reduction.[11]

In the context of PA epidemiology, the isotemporal substitution model, developed by Mekary et al.,[12] is a simple and suitable method for the analysis of PA recommendations. This analysis estimates the relative effects of time spent on different behaviors. It is a well-established and validated model and holds great relevance for public health guidelines.[12] Previous researchers[13,14] have used the isotemporal model approach to estimate the effects of substituting the time spent in SB with an equal amount of time spent in PA on frailty in older adults, but none of the earlier studies have included the time spent in sleep in this model. This variable deserves attention, as there is evidence that both long and short sleep durations are associated with frailty.[15] Furthermore, the time spent in the substitution of SB with PA and the intensity of PA were important indicators of frailty in the current study. Prior information about these factors is crucial while imparting recommendations on PA to older adults, considering that they represent a population segment that shows low participation in PA. In particular, older adults from socioeconomically disadvantaged backgrounds maintain inadequate levels of PA.[16]

OBJECTIVE

The aim of this study was to examine the hypothetical effects of substituting the time spent in sleep or SB with the same amount of time spent in performing moderate or vigorous PA on frailty syndrome in an older adult population.

METHODS

Participants and study design

This observational, analytical, and cross-sectional study was conducted using exploratory survey methods on older adults of both sexes (aged ≥ 60 years) in the state of Bahia, Brazil, as part of the project Longitudinal Study of the Elderly Health of Alcobaça (Estudo Longitudinal de Saúde do Idoso de Alcobaça [ELSIA]). The study details, data collection procedures, and inclusion criteria have been described previously.[17]

Initially, the present study consisted of 743 older adults registered in the Family Health Strategy in Alcobaça City. The Family Health Strategy aims to reorganize primary health care in the country. It has been devised for the purpose of expansion and consolidation of primary care. Its objective is to reorient the work process using a cost-effective and multidisciplinary approach in order to develop the principles, guidelines, and fundamentals of primary care, so that it results in a resolute impact on the health situation of people and communities. During data collection, 54 older individuals refused to participate in the study, 58 were excluded for not meeting the inclusion criteria, and 158 older individuals were excluded after three failed attempts to contact them. Of the 473 participants aged ≥ 60 years included in the study, 17 did not fulfill at least one of the frailty criteria. Thus, the final sample consisted of 456 older adults (172 [37.7%] males and 284 [62.3%] females) with a mean age of 70.25 years (± 8.25 years).

The exclusion criteria were as follows: severe cognitive impairment (≤11 points) according to the Mini Mental State Examination (MMSE) guidelines adapted for the Brazilian population,[18] severely impaired visual and hearing acuity, use of wheelchairs, severe sequelae of stroke with localized loss of strength, or having a terminal illness.

For home visits, the researchers used data provided by the Municipal Health Department of Alcobaça as a reference. Contact was made with older adults through home visits, informing them of the objectives, and requesting their participation in the research on a voluntary basis.

The study protocol and procedures were in accordance with the Declaration of Helsinki and approved by the Human Research Ethics Committee of the Universidade Federal do Triângulo Mineiro (UFTM) on February 27, 2015 (ethics code: 966.983).

Frailty assessment

Frailty syndrome was identified on the basis of three criteria proposed by the Study of Osteoporotic Fractures (SOF): 1) self-reported unintentional weight loss of 4.5 kg or more in the past year; 2) self-reported fatigue, as assessed by questions on the Geriatric Depression Scale (GDS-15), e.g., "Did you stop performing many of your activities and interests?" and "Do you feel you are full of energy?". A positive answer to the first question and/or a negative answer to the second question were considered signs of lack of energy/low resistance; and 3) loss of strength, defined as the inability to sit down and stand up five times from a chair, without using the arms, according to the test guidelines. Older adults who satisfied two or three of these criteria were classified as frail, whereas the others were classified as non-frail.[19]

Behavioral variables

PA and SB were assessed using the International Physical Activity Questionnaire (IPAQ), which has been customized for the Brazilian older adult population.[20,21] The intensity of PA was determined based on moderate physical activity (MPA) and vigorous physical activity (VPA) performed for at least 10 continuous minutes during a typical weekday and in different domains such as work, transport, recreation/leisure, and housework. The population was dichotomized as sufficiently active (≥ 150 min/week of MPA, 75 min/week of VPA, or a combination of both) and insufficiently active.[22]

SB was assessed by asking questions regarding the time spent sitting on a usual day of the week ("How much time in total do you spend sitting during a weekday?") or on a typical day of the weekend ("How much time in total do you spend sitting during one day of the weekend?"). An SB score was considered high if it was greater than the cut-off (calculated to be equivalent to 527.50 minutes/day based on the 75th percentile of the SB score set). Previous research also suggests that individuals in the highest quartile of sitting time are at maximum risk of adverse health outcomes.[17,23]

The measurement of nocturnal sleep time was performed using the Pittsburgh Sleep Quality Index, modified for Brazilians (PSQI-BR),[24] by asking the question, "During the past month, how many hours did you sleep every night?". This measure was used to calculate the total time spent doing daily activities.

For the isotemporal adjustment models, the total durations of continuous MPA, VPA, SB, and sleep, expressed in minutes per day (minutes/day), were used.

Covariates

Data on sociodemographic variables such as sex (male and female), age group (60-79 years and 80 years or older), marital status (not married, married, widowed, and divorced), level of literacy (not literate and literate), and number of falls in the last 12 months (0 to 3 falls and 4 or more) were collected to characterize the sample.

Statistical analyses

The database was created using Epidata software, version 3.1b (EpiData, Odense, Denmark), and the analyses were performed using the statistical software SPSS 23.0 (IBM, Armonk, New York, United States).

Using descriptive statistics, absolute and relative frequencies and dispersion values for PA, SB, and frailty were calculated. For analyzing the association between frailty syndrome and its covariates, inferential statistics (chi-squared test) were used.

To verify the hypothetical effect of the reallocation of time spent in sleep and SB to performing PA on frailty syndrome, the isotemporal substitution approach was used.[12] For the isotemporal replacement analyses, Poisson regression with robust variance was used for estimating the adjusted prevalence ratios (PR) and calculating the respective 95% confidence intervals (CI) for statistical significance. The effects of reallocating 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, and 60 min spent on sleep and SB to MPA and VPA on the presence of frailty syndrome were verified. The models were adjusted for sex, age, number of falls, literacy level, and marital status. A significance level of $P < 0.05$ was adopted.

RESULTS

The study sample consisted of 456 adults of both sexes aged ≥ 60 years. The prevalence of frailty syndrome among the older adults was found to be 8.6% (n = 39). Frailty was associated with time of exposure to SB (P = 0.006) and PA (P = 0.014), as shown in **Table 1**.

The average time spent on the measured behavioral variables is shown in **Table 2**.

In the isotemporal substitution analysis (**Table 3**), for all the durations of time spent in SB or sleep, MPA, and VPA, it was observed that the replacement of MPA with sleep or SB resulted in a higher probability of frailty syndrome ($P < 0.05$). However, the replacement of SB or sleep time with MPA had a protective effect, and longer durations of replacement corresponded with greater protective effects.

Table 1. Sociodemographic, health-related, and behavioral characteristics associated with frailty syndrome

Variables	Total n (%)	Frailty syndrome		P
		Not frail n (%)	Frail n (%)	
Sex				
Male	172 (37.7)	158 (91.9)	14 (8.1)	0.476
Female	284 (62.3)	259 (91.2)	25 (8.8)	
Age range				
60 to 79 years old	388 (85.1)	358 (92.3)	30 (7.7)	0.107
80 years or older	68 (14.9)	59 (86.8)	9 (13.2)	
Marital status				
Not married	41 (9.0)	39 (95.1)	2 (4.9)	
Married	214 (46.9)	201 (93.9)	14 (6.1)	0.117
Widowed	121 (26.5)	108 (89.3)	13 (10.7)	
Divorced	80 (17.5)	69 (86.3)	11 (13.8)	
Number of falls				
0 to 3 falls	425 (93.2)	391 (92.0)	34 (8.0)	0.114
4 or more	31 (6.8)	26 (83.9)	5 (16.1)	
Literacy level				
Not literate	146 (32.2)	134 (91.8)	12 (8.2)	0.501
Literate	308 (67.8)	281 (91.2)	27 (8.8)	
Physical activity level				
Physically active	246 (53.9)	232 (94.3)	14 (5.7)	0.014
Insufficiently active	210 (46.1)	185 (88.1)	25 (11.9)	
Sedentary behavior P_{75}				
< 527.50 min/day	343 (75.2)	321 (77.0)	22 (6.4)	0.006
≥ 527.50 min/day	113 (24.8)	96 (85.0)	17 (15.0)	

min = minutes.

Table 2. Time spent in different behaviors adopted by the older adults throughout the day

	Average (SD)	Median (IQR)
Moderate physical activity (min/day)	45.05 (61.76)	22.86 (54.28)
Vigorous physical activity (min/day)	4.16 (24.41)	00.00 (00.00)
Sleep (min/day)	434.20 (104.07)	420.00 (138.75)
Sedentary behavior (min/day)	426.91 (157.02)	418.57 (205.18)

SD = standard deviation; IQR = interquartile range; min = minutes.

Table 3. Isotemporal substitution model of time spent in sleep, sedentary behavior, and physical activity along with the prevalence ratios of frailty syndrome

Replacement templates	Frailty syndrome			
	PR (95% CI)	PR (95% CI)	PR (95%CI)	PR (95% CI)
	MPA	VPA	Sleep	SB
5 minutes				
MPA replacement	-	1.03 (0.94-1.12)	1.05 (1.00-1.11)*	1.05 (1.00-1.11)*
VPA replacement	0.96 (0.88-1.05)	-	1.02 (0.95-1.08)	1.02 (0.95-1.08)
Sleep replacement	0.94 (0.89-0.99)*	0.98 (0.92-1.04)	-	1.00 (0.98-1.01)
SB replacement	0.94 (0.90-0.99)*	0.98 (0.92-1.04)	1.00 (0.98-1.01)	-
10 minutes				
MPA replacement	-	1.07 (0.89-1.27)	1.11 (1.00-1.23)*	1.11 (1.00-1.23)*
VPA replacement	0.93 (0.78-1.11)	-	1.04 (0.91-1.18)	1.04 (0.91-1.17)
Sleep replacement	0.89 (0.80-0.99)*	0.96 (0.84-1.09)	-	1.00 (0.97-1.02)
SB replacement	0.89 (0.81-0.99)*	0.96 (0.84-1.08)	1.00 (0.97-1.02)	-
15 minutes				
MPA replacement	-	1.10 (0.85-1.44)	1.17 (1.00-1.37)*	1.17 (1.00-1.37)*
VPA replacement	0.90 (0.65-1.17)	-	1.06 (0.87-1.27)	1.06 (0.88-1.27)
Sleep replacement	0.85 (0.72-0.99)*	0.94 (0.78-1.13)	-	1.00 (0.95-1.04)
SB replacement	0.85 (0.73-0.99)*	0.94 (0.78-1.13)	1.00 (0.96-1.04)	-
20 minutes				
MPA replacement	-	1.14 (0.80-1.62)	1.24 (1.00-1.52)*	1.24 (1.01-1.52)*
VPA replacement	0.87 (0.61-1.23)	-	1.08 (0.84-1.39)	1.08 (0.84-1.38)
Sleep replacement	0.80 (0.65-0.99)*	0.92 (0.71-1.18)	-	1.00 (0.94-1.05)
SB replacement	0.80 (0.65-0.98)*	0.92 (0.72-1.18)	1.00 (0.94-1.05)	-
25 minutes				
MPA replacement	-	1.18 (0.76-1.83)	1.31 (1.00-1.69)*	1.31 (1.01-1.69)*
VPA replacement	0.84 (0.54-1.30)	-	1.10 (0.80-1.51)	1.10 (0.80-1.51)
Sleep replacement	0.76 (0.58-0.99)*	0.90 (0.66-1.24)	-	1.00 (0.93-1.07)
SB replacement	0.76 (0.59-0.98)*	0.90 (0.66-1.23)	1.00 (0.93-1.07)	-
30 minutes				
MPA replacement	-	1.22 (0.72-2.07)	1.38 (1.00-1.89)*	1.38 (1.01-1.87)*
VPA replacement	0.81 (0.48-1.37)	-	1.12 (0.77-1.63)	1.12 (0.77-1.63)
Sleep replacement	0.72 (0.52-0.99)*	0.88 (0.60-1.29)	-	1.00 (0.92-1.08)
SB replacement	0.72 (0.53-0.98)*	0.88 (0.61-1.29)	1.00 (0.92-1.08)	-
35 minutes				
MPA replacement	-	1.27 (0.69-2.34)	1.46 (1.01-2.11)*	1.46 (1.02-2.08)*
VPA replacement	0.78 (0.42-1.46)	-	1.15 (0.73)	1.15 (0.74-1.78)
Sleep replacement	0.68 (0.47-0.99)*	0.87 (0.56-1.35)	-	1.00 (0.90-1.10)
SB replacement	0.68 (0.48-0.97)*	0.87 (0.56-1.34)	1.00 (0.90-1.10)	-
40 minutes				
MPA replacement	-	1.31 (0.65-2.64)	1.54 (1.01-2.35)*	1.54 (1.02-2.31)*
VPA replacement	0.76 (0.37-1.53)	-	1.17 (0.70-1.94)	1.17 (0.70-1.93)
Sleep replacement	0.64 (0.42-0.99)*	0.85 (0.51-1.41)	-	1.00 (0.89-1.11)
SB replacement	0.64 (0.43-0.97)*	0.85 (0.52-1.40)	1.00 (0.89-1.11)	-
45 minutes				
MPA replacement	-	1.35 (0.61-2.98)	1.62 (1.01-2.60)*	1.62 (1.02-2.56)*
VPA replacement	0.73 (0.33-1.59)	-	1.19 (0.68-2.08)	1.19 (0.68-2.08)
Sleep replacement	0.61 (0.38-0.99)*	0.83 (0.47-1.47)	-	1.00 (0.88-1.13)
SB replacement	0.61 (0.38-0.97)*	0.83 (0.47-1.46)	1.00 (0.88-1.13)	-
50 minutes				
MPA replacement	-	1.20 (0.58-3.36)	1.71 (1.01-2.90)*	1.71 (1.03-2.85)*
VPA replacement	0.70 (0.29-1.69)	-	1.21 (0.64-2.28)	1.21 (0.65-2.26)
Sleep replacement	0.58 (0.34-0.98)*	0.82 (0.43-1.54)	-	1.00 (0.87-1.14)
SB replacement	0.58 (0.35-0.97)*	0.82 (0.44-1.53)	1.00 (0.87-1.14)	-
55 minutes				
MPA replacement	-	1.46 (0.56-3.83)	1.81 (1.01-3.25)*	1.81 (1.03-3.19)*
VPA replacement	0.68 (0.26-1.78)	-	1.24 (0.62-2.50)	1.24 (0.62-2.48)
Sleep replacement	0.55 (0.30-0.98)*	0.80 (0.40-1.61)	-	1.00 (0.85-1.16)
SB replacement	0.55 (0.31-0.96)*	0.80 (0.40-1.59)	1.00 (0.85-1.16)	-
60 minutes				
MPA replacement	-	1.51 (0.53-4.31)	1.91 (1.01-3.61)*	1.91 (1.03-3.53)*
VPA replacement	0.66 (0.23-1.91)	-	1.27 (0.59-2.73)	1.27 (0.59-2.71)
Sleep replacement	0.52 (0.27-0.98)*	0.79 (0.37-1.68)	-	1.00 (0.84-1.18)
SB replacement	0.52 (0.28-0.96)*	0.79 (0.37-1.66)	1.00 (0.84-1.18)	-

CI = confidence interval; PR = prevalence ratio; MPA = moderate physical activity; VPA = vigorous physical activity; SB = sedentary behavior. PR adjusted for sex, age group, number of falls, literacy level, and marital status. *$P < 0.05$.

Replacing 60 min/day of SB or sleep with 60 min/day of MPA was associated with a 48% reduction in the likelihood of frailty.

The replacement of VPA with SB or sleep time, on the other hand, did not show association with frailty syndrome in the older adults, for all durations of time tested.

DISCUSSION

This study showed the hypothetical effect of reallocation of time between activities that require different intensities of movement (light or no movement to vigorous movement) on the prevalence of frailty among older adults. The results showed that replacing time spent on SB or sleep with MPA results in easing of symptoms of the frailty syndrome.

Worldwide, older adults are generally recommended to modify their lifestyle to include low levels of PA. In spite of this, it has been noticed that there are limited access to information and less opportunities in regions of low socioeconomic status, and the older adults from such backgrounds usually maintain low levels of PA. On the other hand, information is easily accessible in large urban centers, and the older adults are physically active as well.[25] The population studied in this investigation resides in the municipality of Alcobaça (Brazil), with an average Human Development Index of 0.608.[26] It is a regional population, and its characteristics differentiate it from the populations residing in more developed and/or populous cities, which were included in other national studies.[27,28]

The prevalence of frailty found in this research (8.6%) is similar to the worldwide prevalence of frailty in the population aged 65 and above, which is equal to 10.7% (95% CI = 10.5–10.9).[29] It is important to note that the prevalence of frailty varies widely (from 4.0 to 59.1%), depending on the population and the operationalization of frailty according to the method of analysis.[29] In the Lafaiete Coutinho region, also located in the state of Bahia (Brazil), a prevalence of frailty of 23.8% was identified.[30] This discrepancy between prevalence of frailty in Alcobaça and Lafaiete Coutinho can be explained by the fact that the former is a coastal region, where people are comparatively more active than people living in non-coastal cities.[31,32] Another reason might be that frailty was assessed using different criteria (SOF for the Alcobaça population and Fried Phenotype for the Lafaiete Coutinho population).

Sleep time was a differential variable in this study, and it has not been included in analysis using the isotemporal replacement model by any previous study.[13,14,33] In analyses of sleep-related mortality, a long duration of sleep (≥ 9 h) was shown to be a confounding factor and may be indicative of frailty among older adults. Excessive sleep time reduces the time available for active behavior, and prolonged sleep time can lead to several health risks.[34] On the other hand, short sleep time (≤ 6 hours) is also associated with frailty among older adults, as it is related to a decrease in gait speed and symptoms of exhaustion,[15] both of which are components of frailty.

The relationship between sleep disorders and frailty syndrome can be explained by several physiological mechanisms. Inadequate sleep results in oxidative stress, imbalance between the levels of anabolic and catabolic hormones, and acceleration of processes such as sarcopenia.[35] Short sleep durations and related disturbances are associated with the proliferation of inflammatory cells and an increase in the concentration of adipokines,[35] both of which are determinant factors in the physiopathologic development of frailty syndrome.[36] Besides this, sleep deprivation also modifies the levels of stress response markers such as cortisol and norepinephrine.[37] On the other hand, excess of sleep also impairs cognitive functions and leads to reduction of PA.[15] Consequently, the decrease in energy expenditure contributes to the elevation of the degree of adiposity and insulin resistance and increase in the concentrations of interleukin 6 (IL-6) and C-reactive protein (CRP) in blood plasma.[38]

In practice, it is necessary to be cautious while reallocating time between different variables. Older adults who usually sleep for very short durations would not be enthusiastic about substituting sleep for PA, because this would further limit the sleep time available to them, which in turn might cause many health-related complications.[15,35,37] Therefore, the recommendation of substitution of sleep for PA should be directed only towards older adults with a high average sleep time.

The combination of insufficient level of PA and longer duration of time spent in SB leads to caloric overload and accumulation of central adipocytes, which downregulate the production of anti-inflammatory adipokines.[39] In addition, SB negatively affects lipid and glucose metabolism and deregulates hemodynamic balance of the lower extremities.[40] Impairment of all these functions leads to an inflammatory state, which contributes to the development of frailty syndrome.[41] However, regular PA reduces systemic inflammation.[42] This highlights the importance of discontinuing SB and incorporating regular PA in the lifestyle in order to reduce the symptoms of frailty.

Song et al.[43] investigated a US cohort in which the participants were free of physical frailty at the baseline level. The participants spent an average of 9.9 hours/day in SB and less than 20 min in MPA, and it was found that those who spent more time in SB had a higher risk of developing frailty syndrome. A higher percentage of SB was strongly associated with a higher risk of frailty (risk relative, RR = 1.55 for a 10% increase; 95% CI = 1.04-2.32), regardless of participation in MPA and other controlled risk factors.[43] However, Mañas et al.[44] reported that moderate and vigorous PA (MVPA) had a moderating effect on the relationship between SB and frailty. The authors showed that spending 27 min/day on MVPA eliminated the increased risk of SB-associated frailty among older adults, affirming the importance of engaging in activities like MVPA, especially for insufficiently active individuals.

A previous research revealed that isotemporal replacement of 30 min of SB with light physical activity (LPA) decreased the

risk of frailty among older adults.[13] These findings indicated that increasing PA of lower intensity is feasible for the target population. Along similar lines, another study showed that replacement of at least 113 minutes of SB with LPA or 41 minutes of SB with MVPA per day resulted in a decrease in the frailty index.[33] However, it is known that reaching the daily PA recommendation is still a challenge for most older adults.[45] Health benefits are primarily obtained on increasing the level of PA above the baseline.[46] Overall, these reports corroborate our results in the current study, which showed that the risk of frailty is reduced only when sleep time or SB is replaced by MPA (not VPA). Even small modifications (5 min/day of MPA) in the lifestyle are beneficial for older adults.

Earlier studies have also shown that performing LPA and MPA rather than VPA contributes to better physical and mental health in older adults.[47] Generally, older adults show very limited participation in VPA because of multiple factors such as orthopedic problems, arthritis, and cardiovascular diseases. In particular, older adults refrain from VPA when it has to be performed for a long period of time. The participants in our study also indulged in a very limited amount of VPA, apparently because data on at least 10 continuous minutes of activity were used for the evaluation of PA.

This study has some limitations and implications that should be taken into consideration. These results have been obtained by statistical analysis of the data available from a cross-sectional study considering multiple variables simultaneously. However, these results should not be used to predict the cause and effect or values of the behavior variables for the long term. Moreover, these findings may not be comparable with the results obtained from studies that have used non-identical methods of data collection and calculation because the underlying variables might be different. In addition, since the subjective measures of PA and SB levels were self-reported by the participants, they tended to be overestimated and underestimated, respectively.

The main highlights of this study are as follows: the inclusion of sleep time in the estimation of the hypothetical isotemporal substitution effect, which could be more effective in explaining the behavior substitution for the measured hours in a day than the inclusion of time spent on SB alone. Further analysis on a larger sample size is required for better understanding of the outcome of frailty, and the different durations and intensities of PA in the isotemporal substitution model offer a broader scope for the verification of their effects in the context of frailty.

CONCLUSION

Replacing sitting or sleeping time with the same amount of MPA time can reduce the risk of frailty syndrome; the longer the reallocation time, the greater the benefits, which may equate to almost 91% risk reduction.

By understanding the necessities and specificities of health behavior in older adults, health care professionals can make appropriate decisions about the most suitable recommendations and interventions needed for the promotion and maintenance of health of the older adult population.

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Lumbar puncture for neurosyphilis investigation in asymptomatic patients with HIV-syphilis coinfection: a cross-sectional study among infectious disease specialists

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ABSTRACT

BACKGROUND: Syphilis is a major public health issue worldwide. In people living with human immunodeficiency virus (PLHIV), there are higher incidences of both syphilis and neurosyphilis. The criteria for referring PLHIV with syphilis for lumbar puncture is controversial, and the diagnosis of neurosyphilis is challenging.

OBJECTIVE: To describe the knowledge, attitudes, and practices of infectious disease specialists and residents in the context of care for asymptomatic HIV-syphilis coinfection using close-ended questions and case vignettes.

DESIGN AND SETTING: Cross-sectional study conducted in three public health institutions in São Paulo (SP), Brazil.

METHODS: In this cross-sectional study, we invited infectious disease specialists and residents at three academic healthcare institutions to answer a self-completion questionnaire available online or in paper form.

RESULTS: Of 98 participants, only 23.5% provided answers that were in line with the current Brazilian recommendation. Most participants believed that the criteria for lumbar puncture should be extended for people living with HIV with low CD4$^+$ cell counts (52.0%); in addition, participants also believed that late latent syphilis (29.6%) and Venereal Disease Research Laboratory (VDRL) titers ≥ 1:32 (22.4%) should be conditions for lumbar puncture in PLHIV with no neurologic symptoms.

CONCLUSION: This study highlights heterogeneities in the clinical management of HIV-syphilis coinfection. Most infectious disease specialists still consider syphilis stage, VDRL titers and CD4$^+$ cell counts as important parameters when deciding which patients need lumbar puncture for investigating neurosyphilis.

INTRODUCTION

Syphilis is a major public health problem with increasing occurrence in several countries. In Brazil, data from the Ministry of Health show a three-fold increase in syphilis detection between 2014 and 2018, with incidence rates escalating from 25.1 to 75.8 cases per 100,000 person-years.[1] Similar trends have also been reported in the United States, with a two-fold increase between 2014 and 2018,[2] and in Europe, with greater risk among men who have sex with men.[3]

The prevalence of syphilis among people living with human immunodeficiency virus (PLHIV) is higher than in the general population. Studies performed in Brazil suggest that the prevalence of syphilis ranges from 2.7 to 20.5% among PLHIV;[4-6] similarly, syphilis coinfection has been reported in 1%-21% of PLHIV in North America and 2%-43% in Europe.[7]

Besides its local manifestations, *Treponema pallidum* has systemic effects, notably, in the central nervous system. Conclusive diagnostic investigation of neurosyphilis may be challenging in the context of HIV coinfection, since serological and chemocytological abnormalities of the cerebrospinal fluid (CSF) may occur in PLHIV even without neurosyphilis. Moreover, given the high incidence of re-exposure to syphilis, the interpretation of the serological response after treatment may be challenging in this population.[8-10]

One of the most debated topics in the management of syphilis is the need and timing of CSF examination in HIV-syphilis coinfected patients with no neurologic symptoms. Guidelines and recommendations have been changing regarding this topic. Prior studies recommended a more aggressive approach with lumbar puncture based on CD4$^+$ cell count, Venereal Disease Research Laboratory (VDRL) titers[11-13] or syphilis stage.[14,15] However, a less invasive approach suggests performing lumbar puncture based on criteria that are similar to those applied to HIV-uninfected individuals.[16,17]

As guidelines have been evolving and may present inconsistent recommendations, the clinical practice regarding investigation of asymptomatic neurosyphilis in PLHIV remains heterogenous. Cabana et al. argue that contradictory recommendations are an obstacle to effective adherence to guidelines.[18] Other potential barriers include physicians' lack of familiarity, agreement, or motivation for specific guidelines, favoring the persistence of previous practices. External factors including the inability to reconcile patient preferences, lack of time, lack of resources and organizational constraints also play a role in heterogenous practices.[18,19]

Based on our routine observation, we hypothesized that some providers may tailor decisions regarding lumbar puncture based on barriers faced to perform the exam (i.e., long waiting time, lack of trained practitioners, lack of an appropriate procedure room) or difficulties to implement neurosyphilis treatment after the diagnosis (i.e., absence of hospital service and long waiting time for hospitalization).

Few studies have investigated the knowledge and attitudes of healthcare providers regarding the management of syphilis-HIV coinfection,[20-24] and studies exploring attitudes on the investigation of asymptomatic neurosyphilis in PLHIV are even more scarce.[25]

OBJECTIVE

Our aim was to describe the knowledge, attitudes, and practices of infectious disease specialists in the context of asymptomatic HIV-syphilis coinfection using close-ended questions and case vignettes. We also explored if attitudes and practices of providers who report difficulties for lumbar puncture procedure and/or neurosyphilis in-hospital treatment varied among participants.

METHODS

In this cross-sectional study, we invited infectious disease specialists and residents from three public and academic healthcare institutions in São Paulo, Brazil, to answer a self-completion questionnaire. The institutions were selected based on the anticipated number of potential participants. Responses could be collected either in person (paper form) or online via a form sent to an institutional mailing list or through WhatsApp. The electronic form option was added due to the restrictions imposed by the coronavirus disease pandemic.

The questionnaire included demographic information, case vignettes of PLHIV with syphilis coinfection and no neurologic symptoms, and questions addressing knowledge about the clinical management of neurosyphilis in patients with HIV/syphilis coinfections based on the Ministry of Health recommendations in Brazil. We also investigated participants' perceptions on barriers to refer patients to lumbar puncture or to neurosyphilis in-hospital treatment to explore if these aspects had any impact on questionnaire responses.

Demographics, training, and practice characteristics were collected in the first section of the questionnaire. Ten case vignettes with hypothetical situations addressing neurosyphilis investigation with lumbar punctures and interpretation of CSF laboratory reports were presented in the second part of the questionnaire. The final section explored the knowledge about the indications for lumbar puncture for neurosyphilis investigation in PLHIV according to recommendations in Brazil; criteria for lumbar puncture according to the participant's own opinion; and interpretation of CSF results.

Barriers for lumbar punctures and in-hospital neurosyphilis treatment were explored using ordinal close-ended responses. Participants were asked about the level of difficulty for a lumbar puncture in routine practice (not at all difficult; somewhat difficult; very difficult; cannot inform); and the level of difficulty in hospitalizing a patient with neurosyphilis for intravenous treatment with crystalline penicillin (not at all difficult; somewhat difficult; very difficult; cannot inform). To explore if participants' perceptions on barriers to refer patients to lumbar puncture or to in-hospital treatment had any impact on questionnaire responses, we categorized study participants as: (i) Group 1: participants reporting no difficulties for lumbar puncture or patient hospitalization; and (ii) Group 2: participants reporting at least some difficulties for lumbar puncture and/or those who perceived patient hospitalization as very difficult.

The characteristics of the study participants were presented using frequencies and percentages for categorical variables and medians and interquartile ranges (IQR) for numeric variables. Comparisons between individual participants' answers to case vignettes were performed using chi-squared tests or Fisher's exact tests, as appropriate. Two-tailed $P < 0.05$ were considered statistically significant for all the comparisons.

The data were inserted into the REDCap platform and analyzed using Stata 15.1 (StataCorp; StataCorp LP, College Station, Texas). Written informed consent was obtained from all participants, and no identifiable information was collected during the study.

Ethical aspects

The study was approved by the Ethics Committee at the coordinating institution (Comissão de Ética para Análise de Projetos de Pesquisa – CAPPesq, Faculdade de Medicina da Universidade de São Paulo, CAAE: 19926919.1.0000.0068, July 20, 2020) and by the ethics committees at the collaborating institutions (Comitê de Ética, Instituto de Infectologia Emílio Ribas, CAAE: 19926919.1.3001.0061, July 22, 2020 and Comitê de Ética em Pesquisa, Centro de Referência DST/AIDS, CAAE: 19926919.1.3003.5375, September 10, 2020). All participants provided written or electronic informed consent. All individual identifiable information was maintained in secured cabinets and electronic files.

RESULTS

Participant characteristics

Between December 2019 and September 2020, 98 infectious disease specialists or residents responded to the survey. The demographics, training, and practice characteristics are described in **Table 1**. Ages ranged from 25 to 68 years (median 35.5 years old). Most participants (65.3%) were female, most (72.4%) had completed the Infectious Disease Residency Program, and 43 (43.9%) had a postgraduate degree. The vast majority (92.9%) reported providing medical care to PLHIV. Regarding professional activities, 76 participants (77.6%) declared working in a public hospital, 48 (49.0%) in a private hospital, 15 (15.3%) in a research project, 9 (9.2%) in intensive care units, and 8 (8.2%) in-hospital infection control programs (**Table 1**).

Regarding barriers for lumbar puncture and hospitalization, 27 (27.5%) of the study participants declared the perception that access to lumbar punctures is somewhat difficult, and 3 (3.1%) perceived access to lumbar punctures as very difficult; 56 (57.6%) perceived access to in-hospital treatment as somewhat difficult, while 14 (14.7%) declared that patient hospitalization for neurosyphilis treatment was very difficult. Group 2 included 37 participants who considered access to lumbar puncture somewhat difficult or very difficult and/or hospitalization very difficult.

Comparisons of the demographics, training, and practice characteristics according to group categorization are presented in **Table 1**.

Responses to case vignettes

In the second section of the questionnaire, case vignettes with hypothetical situations addressing neurosyphilis investigation with lumbar punctures and interpretation of CSF laboratory reports were presented to participants, as described in **Tables 2** and **3**.

The first two vignettes described a PLHIV with early latent-stage syphilis and a VDRL titer of 1:128. When the $CD4^+$ cell count was above 350 cells/mm^3, 21.3% of respondents referred the patient for lumbar puncture; this percentage rose to 65.3% when the $CD4^+$ cell count was below 350 cells/mm^3.

The third vignette described a patient with early latent syphilis with a $CD4^+$ cell count above 350 cell/mm^3 and a VDRL titer of 1:128 with a four-fold (two dilution) decrease in the titer within 12 months after adequate treatment. According to 67.7% of the respondents, this patient should be referred for lumbar puncture.

The fourth and fifth vignettes presented a patient recently diagnosed with HIV infection, with latent syphilis of unknown duration. When the vignette described a patient with a $CD4^+$ cell count of 110 cells/mm^3 and a VDRL titer of 1:4, 51.6% of participants referred the patient for lumbar puncture. When the case presented a patient with a $CD4^+$ cell count above 350 cells/mm^3 and VDRL titer of 1:32, the 40.8% of respondents referred the patient to lumbar puncture. We found no statistically significant differences between Groups 1 and 2 in the answers to case vignettes 1-5 (**Table 2**).

In the five vignettes addressing the interpretation of CSF laboratory reports, we presented hypothetical patients with different $CD4^+$ cell counts and chemocytological findings in CSF. For all situations, the treponemal serological test was reactive, while VDRL

Table 1. Demographics, training, and practice characteristics of study participants, overall and according to group category

Characteristics	All participants n = 98	Group 1** n = 61	Group 2*** n = 37	P value
Median age (IQR)	34.5 (30-44)	36.0 (31-48)	33.0 (30-41)	0.138
Female sex (%)	64 (65.3)	43 (70.5)	21 (56.8)	0.193
Time since graduation from medical school*				
< 5 years	18 (18.4)	12 (19.7)	6 (16.2)	
5-10 years	31 (31.6)	15 (25.6)	14 (37.8)	
11-20 years	22 (22.4)	13 (21.3)	9 (24.3)	0.477
20-30 years	18 (18.4)	12 (19.7)	6 (16.2)	
> 30 years	10 (10.2)	9 (14.7)	1 (2.7)	
Infectious disease residency completed (%)	71 (72.4)	45 (73.7)	26 (70.3)	0.816
Master´s/PhD ongoing or completed (%)	43 (43.9)	28 (45.9)	15 (40.5)	0.677
Provides medical care for PLHIV (%)	91 (92.9)	56 (91.8)	35 (94.6)	0.707
Professional activity (%)				
Public hospital	76 (77.6)	48 (78.7)	28 (75.7)	0.805
Private hospital	48 (49.0)	29 (47.5)	19 (51.3)	0.835
Clinical research	15 (15.3)	6 (9.8)	9 (24.3)	0.081
Intensive care unit	9 (9.2)	5 (8.2)	4 (10.8)	0.726
Hospital infant control program	8 (8.2)	4 (6.6)	4 (10.8)	0.471

*Missing for one participant; IQR, interquartile range; **Group 1: Participants reporting no difficulties for lumbar puncture or patient hospitalization; ***Group 2: Participants reporting at least some difficulties for lumbar puncture and/or those who perceived patient hospitalization as very difficult.

Table 2. Attitudes in case vignettes regarding neurosyphilis investigation with lumbar puncture among patients with HIV-syphilis coinfection with no neurologic symptoms

Case 1: PLHIV diagnosed five years ago, under regular use of HAART, CD4⁺ cell count = 510 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128 (FTA-Abs was negative in the previous test)[1]				
	Total n = 78	**Group 1[**] n = 48**	**Group 2[***] n = 30**	**P value**
Expectant management and repeat VDRL in 3-6 months (%)	0 (0)	0 (0)	0 (0)	
Treat with Penicillin G Benzathine and repeat VDRL in 3-6 months (%)[#]	60 (85.3)	35 (72.9)	25 (83.3)	0.638
Refer to LP for neurosyphilis investigation (%)	17 (21.3)	12 (25.0)	5 (16.6)	
Another option (%)	1 (1.3)	1 (2.0)	0 (0)	
Case 2: PLHIV diagnosed five years ago under regular use of HAART, CD4⁺ cell count = 110 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128 (FTA-Abs was negative in the previous test)				
	Total n = 98	**Group 1 n = 61**	**Group 2 n = 37**	**P value**
Expectant management and repeat VDRL in 3-6 months (%)	1 (1.1)	1 (1.6)	0 (0)	
Treat with Penicillin G Benzathine and repeat VDRL in 3-6 months (%)[#]	33 (33.7)	18 (29.6)	15 (40.6)	0.485
Refer to LP for neurosyphilis investigation (%)	64 (65.3)	42 (68.9)	22 (59.4)	
Another option (%)	0 (0)	0 (0)	0 (0)	
Case 3: PLHIV diagnosed five years ago under regular use of HAART, CD4⁺ cell count = 510 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128 (FTA-Abs was negative in the previous test). 12 months after treatment with Penicillin G Benzathine persists with VDRL = 1/32. Reports no reexposure[2]				
	Total n = 96	**Group 1 n = 59**	**Group 2 n = 37**	**P value**
Expectant management and repeat VDRL in 3-6 months (%)	28 (29.2)	16 (27.1)	12 (32.4)	
Treat with Penicillin G Benzathine and repeat VDRL in 3-6 months (%)	2 (2.1)	0 (0)	2 (5.4)	0.221
Refer to LP for neurosyphilis investigation (%)[#]	65 (67.7)	42 (71.2)	23 (62.2)	
Another option (%)	1 (1.0)	1 (1.7)	0 (0)	
Case 4: PLHIV diagnosed recently without HAART, CD4⁺ cell count = 110 cells/mm³ and viral load 112.900. FTA-Abs reagent and VDRL 1:4. Reports no previous treatment for syphilis[3]				
	Total n = 97	**Group 1 n = 61**	**Group 2 n = 36**	**P value**
Expectant management and repeat VDRL in 3-6 months (%)	3 (3.1)	2 (3.3)	1 (2.8)	
Treat with Penicillin G Benzathine and repeat VDRL in 3-6 months (%)[#]	43 (44.3)	25 (41.0)	18 (50.0)	0.866
Refer to LP for neurosyphilis investigation (%)	50 (51.6)	33 (54.1)	17 (47.2)	
Another option (%)	1 (1.0)	1 (1.6)	0 (0)	
Case 5: PLHIV diagnosed recently without HAART, CD4⁺ cell count = 430 cells/mm³ and viral load 112.900. FTA-Abs reagent and VDRL 1:32. Reports no previous treatment for syphilis[3]				
	Total n = 97	**Group 1 n = 61**	**Group 2 n = 36**	**P value**
Expectant management and repeat VDRL in 3-6 months (%)	1 (1)	0 (0)	1 (2.8)	
Treat with Penicillin G Benzathine and repeat VDRL in 3-6 months (%)[#]	54 (55)	30 (49.2)	24 (66.7)	0.104
Refer to LP for neurosyphilis investigation (%)	40 (40.8)	29 (47.5)	11 (30.6)	
Another option (%)	2 (2)	2 (3.3)	0 (0)	

[1]Missing for 20 participants (20.4%); [2]missing for two participants (2.1%); [3]missing for one participant (1.0%); [#]Brazilian Guideline-recommended management; HAART, highly active antiretroviral treatment. PLHIV = people living with human immunodeficiency virus; HAART = Highly Active Antiretroviral Therapy; FTA-Abs = fluorescent treponemal antibody absorption; VDRL = Venereal Disease Research Laboratory; LP = lumbar puncture.

[**]Group 1: Participants reporting no difficulties for lumbar puncture or patient hospitalization; [***]Group 2: Participants reporting at least some difficulties for lumbar puncture and/or those who perceived patient hospitalization as very difficult.

Table 3. Attitudes in case vignettes regarding treatment of syphilis in patients with HIV-syphilis coinfection with no neurologic symptoms after lumbar puncture

Case 1: PLHIV diagnosed five years ago under regular use of HAART, CD4⁺ cell count = 510 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128. CSF: VDRL non-reagent, FTA-Abs reagent, 25 cells/mm³, protein 40 mg/dl[1]				
	Total n = 95	**Group 1** n = 59**	**Group 2*** n = 36**	**P value**
Neurosyphilis treatment: Intravenous Penicillin G/Ceftriaxone (%)	72 (75.8)	41 (69.5)	31 (86.1)	0.161
Syphilis treatment: Penicillin G Benzathine (%)	22 (23.3)	17 (28.8)	5 (13.9)	
Another option (%)	1 (1.1)	1 (1.7)	0 (0)	
Case 2: PLHIV diagnosed five years ago under regular use of HAART, CD4⁺ cell count = 110 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128. CSF: VDRL non-reagent, FTA-Abs reagent, 25 cells/mm³, protein 40mg/dl[1]				
	Total n = 95	**Group 1 n = 59**	**Group 2 n = 36**	**P value**
Neurosyphilis treatment: Intravenous Penicillin G/Ceftriaxone (%)	84 (88.4)	50 (84.7)	34 (94.4)	0.378
Syphilis treatment: Penicillin G Benzathine (%)	10 (10.5)	8 (13.6)	2 (5.6)	
Another option (%)	1 (1.1)	1 (1.7)	0 (0)	
Case 3: PLHIV diagnosed five years ago under regular use of HAART, CD4⁺ cell count = 510 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128. CSF: VDRL non-reagent, FTA-Abs reagent, 8 cells/mm³, protein 55 mg/dl[2]				
	Total n = 97	**Group 1 n = 60**	**Group 2 n = 37**	**P value**
Neurosyphilis treatment: Intravenous Penicillin G/Ceftriaxone (%)	56 (57.7)	33 (55.0)	23 (62.2)	0.384
Syphilis treatment: Penicillin G Benzathine (%)	37 (38.1)	23 (38.3)	14 (37.8)	
Another option (%)	4 (4.1)	4 (6.7)	0 (0)	
Case 4: PLHIV diagnosed five years ago under regular use of HAART, CD4⁺ cell count = 110 cells/mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128. CSF: VDRL non-reagent, FTA-Abs reagent, 8 cells/mm³, protein 55 mg/dl[1]				
	Total n = 95	**Group 1 n = 59**	**Group 2 n = 36**	**P value**
Neurosyphilis treatment: Intravenous Penicillin G/Ceftriaxone (%)	72 (75.8)	45 (76.3)	27 (75.0)	0.659
Syphilis treatment: Penicillin G Benzathine (%)	21 (22.1)	12 (20.3)	9 (25.0)	
Another option (%)	2 (2.1)	2 (3.4)	0 (0)	
Case 5: PLHIV diagnosed recently not under HAART, CD4⁺ cell count = 510 cells / mm³ and undetectable viral load. FTA-Abs reagent and VDRL 1:128. CSF: VDRL non-reagent, FTA-Abs reagent, 22 cells/mm³, protein 55 mg/dl[3]				
	Total n = 96	**Group 1 n = 60**	**Group 2 n = 36**	**P value**
Neurosyphilis treatment: Intravenous Penicillin G/Ceftriaxone (%)	88 (91.7)	54 (91.5)	34 (94.4)	0.706
Syphilis treatment: Penicillin G Benzathine (%)	8 (8.3)	6 (10.2)	2 (5.6)	
Another option (%)	0 (0)	0 (0)	0 (0)	

[1]Missing/do not know for three participants (3.1%); [2]missing/do not know for one participant (1.0%); [3]missing/do not know for two participants (2,0%); HAART, highly active antiretroviral treatment. PLHIV = people living with human immunodeficiency virus; HAART = Highly Active Antiretroviral Therapy; FTA-Abs = fluorescent treponemal antibody absorption; VDRL = Venereal Disease Research Laboratory; CSF = cerebrospinal fluid.

**Group 1: Participants reporting no difficulties for lumbar puncture or patient hospitalization; ***Group 2: Participants reporting at least some difficulties for lumbar puncture and/or those who perceived patient hospitalization as very difficult.

was non-reactive in CSF. Current Ministry of Health recommendations in Brazil do not define specific criteria for neurosyphilis treatment in PLHIV with a non-reactive VDRL in CSF, but underline pleocytosis as a common finding. [17]

The first two vignettes in this section presented PLHIVs with syphilis, VDRL titer of 1:128, elevated cell count in CSF and normal protein levels. For the case vignette with a $CD4^+$ cell count above 350 cells/mm^3, 75.8% of respondents indicated neurosyphilis treatment; when $CD4^+$ cell count was below 350 cells/mm^3, this percentage was 88.4%.

The third and fourth case vignettes presented a similar patient profile as previous cases with normal CSF cell counts and high protein levels; neurosyphilis treatment was indicated by 57.7% and 75.8% of the respondents for the vignettes with higher and lower $CD4^+$ cell counts, respectively. The last case vignette addressed a PLHIV not on antiretroviral treatment with syphilis coinfection, who had elevated cell and protein counts in CSF. For this hypothetical patient, 91.7% of the respondents indicated neurosyphilis treatment, with similar percentages in Groups 1 and 2 (**Table 3**). Again, we found no statistically significant differences between Groups 1 and 2 in responses to case vignettes in this section.

Knowledge and attitudes regarding lumbar puncture criteria and syphilis clinical management

The 2018 Ministry of Health recommendations in Brazil suggest the use of lumbar puncture for neurosyphilis investigation in PLHIV with syphilis coinfection in the following situations: presence of neurological or ophthalmic symptoms, evidence of active tertiary syphilis, and after antibiotic treatment failure, independently of presumed sexual re-exposure.[17] Only 23.5% (95% confidence interval, CI 14.9-32%) of the study participants provided correct answers according to the current recommendations. We found no statistically significant differences between participants who completed or were still in-course for infectious disease residency (21.3% versus 29.6%; P = 0.427) and physicians responding in paper or online forms (22.7% versus 26.1%; P = 0.781). The vast majority of professionals agree that PLHIV who present with syphilis treatment failure should be investigated for neurosyphilis, according to the current recommendations in Brazil.[17] However, many respondents mistakenly indicated that $CD4^+$ cell count, VDRL titers, and syphilis stage were part of the current guidelines criteria for lumbar puncture in this population (**Table 4**).

Among the 23 participants with correct answers according to the current recommendations for asymptomatic neurosyphilis investigation in PVHIV, 5 (21.7%) expressed the opinion that indications for lumbar puncture should be more comprehensive, distributed as follows:

- Individuals with late/unknown duration latent syphilis, n = 1
- Individuals with $CD4^+$ cell count $\leq$ 350 mm^3, n = 5
- Individuals with VDRL titer $\geq$ 1:32, n = 2

Participants' perceptions about lumbar puncture criteria and syphilis clinical management

Participants' opinions on criteria for referring asymptomatic PLHIV to lumbar puncture show that most believe lumbar puncture should be performed more often than currently recommended; 52.0% believe that $CD4^+ \leq 350$ cells/mm^3 should be a criterion for lumbar puncture; 29.6% believe that patients with late latent/unknown duration stage should be referred to lumbar puncture, and 22.4% that VDRL $\geq$ 1:32 should be considered for lumbar puncture.

Concerning CSF interpretation for neurosyphilis diagnosis, 88.8% consider that a reactive VDRL in CSF, regardless of cell or protein content, is a sufficient criterion. For CSF results showing a non-reactive VDRL and a reactive FTA-Abs (Fluorescent treponemal antibody absorption), most participants consider elevated CSF cell count (59.2%) and elevated protein count (50.0%) as criteria for neurosyphilis diagnosis.

Regarding treatment, all respondents considered penicillin crystalline as an adequate option. Ceftriaxone was also reported as an adequate treatment option by 43.9% (95% CI 34.2-54.0%). We did not explore whether the responders considered ceftriaxone a reliable first-line treatment.

DISCUSSION

The results of this cross-sectional study highlight heterogeneities in the knowledge and practices of 98 infectious disease specialists and infectious disease residents from São Paulo, Brazil, regarding the clinical management of neurosyphilis investigation in asymptomatic PLHIV. Most participants believe that the criteria for lumbar puncture should be extended; almost 60% believe that low $CD4^+$ cell counts should be an indication, and around a third favor late latent syphilis as a criterion to proceed with lumbar puncture even in asymptomatic patients. It is interesting to note that only 23.5% provided answers in accordance with the Guideline recommendations in Brazil, Ministry of Health. This percentage did not significantly differ among those in the residency program and graduated infectious disease specialists.

Our survey pooled infectious disease consultants from three reference centers in São Paulo. In our sample population, 44% had postgraduate degrees, and more than 90% reported providing medical care to PLHIV. This sample is not representative of all clinicians taking care of patients with HIV/syphilis coinfection in Brazil. Respondents may be better updated with current guidelines and interested in the topic. In our survey, less than a quarter of the respondents provided correct answers for lumbar puncture indications in PLHIV with syphilis. Thus, it is reasonable to assume that this percentage would be even lower among non-infectious disease clinicians or among medical practitioners in rural areas.

Table 4. Responses to questions on management of syphilis in PLHIV with no neurologic symptoms

According to current national recommendations, which asymptomatic individuals with syphilis-HIV coinfection should be referred for lumbar puncture for neurosyphilis investigation?		
	n (%)	**95% CI**
All patients (%)	10 (10.2)	4.1-16.3
Patients with late/indeterminate latent syphilis (%)	26 (26.5)	17.6-35.4
Patients with reduction of VDRL < 2 dilutions 3 months after adequate treatment, or < 4 dilutions 6 months after adequate treatment (%)	78 (79.6)	71.5-87.7
Patients with $CD4^+$ cell count ≤ 350 mm^3 (%)	55 (56.1)	46.1-66.1
Patients with VDRL titers ≥ 1:16 (%)	7 (7.1)	2.0-12.3
Patients with VDRL titers ≥ 1:32 (%)	24 (24.5)	15.8-33.2
In your opinion, which asymptomatic individuals with syphilis-HIV coinfection should be referred for CSF puncture for neurosyphilis investigation?		
	n (%)	**95% CI**
All patients (%)	10 (10.2)	4.1-16.3
Patients with late/indeterminate latent syphilis (%)	29 (29.6)	20.4-38.8
Patients with reduction of VDRL < 2 dilutions 12 months after adequate treatment (%)	82 (83.7)	76.2-91.2
Individuals with $CD4^+$ cell count ≤ 350mm^3 (%)	51 (52.0)	42.0-62.1
Individuals with VDRL ≥ 1:16 (%)	10 (10.2)	4.1-16.3
Individuals with VDRL ≥ 1:32 (%)	22 (22.4)	14.0-30.8
Which diagnostic criteria you consider for neurosyphilis in asymptomatic PLHIV?		
	n (%)	**95% CI**
VDRL reagent in CSF, regardless of CSF cell/protein count (%)	87 (88.8)	82.4-95.1
Elevated CSF cell count with reagent FTA-Abs (%)	58 (59.2)	49.3-69.0
Elevated CSF cell count with reagent or non-reagent FTA-Abs (%)	36 (36.7)	27.7-46.4
Elevated CSF protein count with reagent FTA-Abs (%)	49 (50.0)	39.9-60.0
Elevated CSF protein count with reagent or non-reagent FTA-Abs (%)	37 (37.8)	28.0-47.5

PLHIV = people living with human immunodeficiency virus; HIV = human immunodeficiency virus; CI = confidence interval; VDRL = Venereal Disease Research Laboratory; CSF = cerebrospinal fluid; FTA-Abs = fluorescent treponemal antibody absorption.

Cabana et al. described a lack of familiarity as a reason for not following a guideline for up to 89% of physicians.[18] We believe that heterogeneities and recent modifications regarding recommendations for lumbar puncture among PLHIV across local and international guidelines are also likely to contribute to this low percentage of correct answers. Adherence to guideline recommendations could also be influenced by environmental-related barriers.[18,27] We hypothesized that physicians' perceived barriers to refer patients to lumbar puncture or to in-hospital treatment could influence questionnaire responses. Almost 40% of study participants considered access to lumbar puncture somewhat difficult or very difficult and/or hospitalization very difficult. However, we failed to find statistically significant differences in the responses to case vignettes, knowledge, and attitudes when comparing Groups 1 and 2. It is plausible to assume that significant differences could emerge among infectious disease specialists in non-referent health services, where barriers for lumbar puncture and hospitalization are higher.

There are controversies about the management of PLHIV with syphilis coinfection and no neurologic symptoms. Regarding lumbar puncture indications, some recommendations consider similar lumbar puncture criteria as those used for HIV-uninfected individuals. In Brazil, the recommendations for the management of HIV (PCDT para Manejo da Infecção pelo HIV em Adultos, 2018), the management of sexually transmitted diseases (PCDT para Atenção Integral às Pessoas com Infecções Sexualmente Transmissíveis, 2020), and The Guidelines for the Prevention and Treatment of Opportunistic Infections in Adults and Adolescents with HIV from the Centers for Disease Control and Prevention all recommend lumbar puncture for neurosyphilis investigation in PLHIV when there are neurologic symptoms, tertiary syphilis, or treatment failure. All three guideline recommendations disregard VDRL titers or $CD4^+$ cell counts as criteria for neurosyphilis investigation with lumbar puncture.[16,17,28] The 2020 European guideline on the management of syphilis highlights that robust evidence is lacking, but reiterate that some experts recommend CSF assessment in asymptomatic

PLHIV with late syphilis and $CD4^+$ cells $\leq 350/mm^3$ and/or a serum VDRL/RPR titer > 1:32.[29] The 2020 German guidelines on the diagnosis and treatment of neurosyphilis consider $CD4^+$ cell counts, HIV treatment status, and VDRL titers in the decision for lumbar puncture among PLHIV with no neurologic symptoms.[30]

The incidence of neurosyphilis is demonstrably higher among PLHIV compared to that in the general population.[31,32] Additionally, higher VDRL titers and lower $CD4^+$ cell counts have been associated with the development of neurosyphilis in this population.[33] In a study published in 2009, Ghanem et al. showed that using VDRL titers and $CD4^+$ cell counts as criteria for lumbar puncture was associated with very high sensitivity, 100% [95% CI, 70%–100%]; however, it would have demanded the investigation with lumbar puncture for 88% of patients,[34] representing a considerable burden to the health system. Moreover, a more frequent indication for lumbar puncture in PLHIV with syphilis coinfection with no neurologic symptoms may also encounter low acceptability by patients.

The effectiveness in implementing recommendations varies considerably, with continuous debate regarding the adequate management of HIV-syphilis coinfection and great heterogeneity among physicians. This survey reflects the dilemma in clinical practice; more than 50% of study participants believe that $CD4^+$ cell counts below 350 cells/mm^3 should still be a criterion for lumbar puncture; almost 30% would indicate lumbar puncture for patients with latent syphilis of unknown duration; and approximately 20% would refer PLHIV for lumbar puncture when VDRL titers are $\geq$ 1:32.

Besides the controversy on lumbar puncture indication, the interpretation of CSF laboratory reports is another point of debate, as there is no gold standard for neurosyphilis diagnosis. The Ministry of Health recommendations in Brazil to refer a patient for neurosyphilis treatment do not define specific thresholds for cell or protein levels in CSF when VDRL is negative. A positive VDRL in CSF in the absence of blood contamination is highly specific but lacks diagnostic sensitivity.[35] For PLHIV, elevated CSF cell and protein levels can occur because of HIV infection, especially when $CD4^+$ cell counts are higher. Some authors suggest interpretation based on CSF cell count along with CSF treponemal test results with different cutoffs, depending on the patient's immune status.[36] The CSF protein level is neither specific nor sensitive,[37] but it is nevertheless considered for defining neurosyphilis in many published papers [33,34,38] since higher levels can be associated with neurosyphilis with cutoffs that vary from 45 to 50 mg/dL.[13] In our study, elevated cell and protein levels were considered as criteria for neurosyphilis by 59% and 50% of participants, respectively, when CSF VDRL was negative and CSF treponemal was positive.

Neurosyphilis treatment was addressed in one multicenter clinical trial including 36 PLHIV with syphilis coinfection. The authors randomized participants to receive either ceftriaxone 2 g/day or Penicillin G 24 million units/day for 10 days. Only 30 patients were included in the final analysis and the study failed to find differences between groups in the proportions of subjects with improvements in CSF cell count or protein levels.[39] Due to scarcity of data and study limitations, the evidence is insufficient to allow the adoption of ceftriaxone as a first-line treatment for neurosyphilis.[40] In our survey, all respondents accepted penicillin G as the antibiotic of choice and only 44% indicated ceftriaxone as a reliable option.

Our study had some limitations. Only 32.7% of all eligible infectious disease clinicians working in the participating sites responded to the questionnaire, which might have resulted in selection bias. The study instrument, a self-completion survey with close-ended questions, may have facilitated participants to provide the correct answers by chance. For the online questionnaire, professionals may have consulted guidelines and other technical manuals, leading to answers that do not necessarily reflect their attitudes and knowledge. Finally, we were limited by a small sample, which included participants from referral centers in the largest city of Brazil. The inclusion of participants from other regions could have highlighted wider gaps in knowledge and potentially identified a significant impact of barriers to refer patients to lumbar puncture or to in-hospital treatment on attitudes toward lumbar puncture.

CONCLUSIONS

This study highlights heterogeneities in the clinical management of patients with HIV-syphilis coinfection and no neurologic symptoms, despite the existence of national guidelines. Further, our results suggest that non-adherence with guideline recommendations may result from both a lack of agreement and lack of awareness. Most infectious disease specialists consider syphilis stage, VDRL titers, and $CD4^+$ cell counts as important parameters when deciding which patients need a lumbar puncture for the investigation of neurosyphilis. We failed to find statistically significant differences in attitudes and practices comparing participants who reported barriers for referring patients for lumbar puncture and/or hospitalization with participants who perceived no such difficulties. Prospective studies with long-term follow-up of clinical outcomes after several lumbar puncture criteria are needed among PLHIV with syphilis.

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Cross-cultural adaptation and validation of Sarcopenia and Quality of Life (SarQoL) in Brazil

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ABSTRACT

BACKGROUND: Sarcopenia is defined as a slow, progressive, and apparently inevitable process of involuntary loss of muscle mass, strength, and quality, which occurs with advancing age. It is widely accepted that sarcopenia can directly affect quality of life.

OBJECTIVE: Translate, adapt and validate the "Sarcopenia and Quality of Life" instrument (SarQoL) to the Brazilian context.

DESIGN AND SETTINGS: Translation, cross-cultural adaptation, and validation study carried out at the Federal University of São Carlos, São Carlos, São Paulo, Brazil.

METHODS: The population consisted of 221 older adult participants. The steps recommended by the guidelines from the authors of the original instrument were followed sequentially: initial translation, synthesis of translations, backward translation, evaluation by a panel of judges, pre-test, and analysis of psychometric properties. The translation and adaptation process was conducted as recommended.

RESULTS: Two hundred and twenty-one participants took part in the step analysis of the psychometric properties of SarQoL, in which 55 presented sarcopenia. Cronbach's alpha coefficient of the total SarQoL questionnaire was 0.976, indicating excellent internal consistency. Excellent agreements between the test and retest with an Interclass Correlation Coefficient (ICC) of 0.983 (95% confidence interval: 0.901–0.996) were observed in the SarQoL domains. The domains of Short-Form 36 and EuroQoL 5-dimension showed significant correlation, from moderate to strong magnitude, with SarQoL total score, indicating convergent validity.

CONCLUSION: The Brazilian version of SarQoL presented evidence of reliability and validity.

INTRODUCTION

The elderly population in Brazil is rapidly increasing and is currently ranked sixth largest in the world, with more than 23 million citizens over 60 years of age, accounting for 12.6% of the Brazilian population.[1] Due to this accelerated growth, there is a considerable increase in chronic conditions related to age, such as sarcopenia, attracting the attention of many researchers in this field.[2]

Sarcopenia is defined as a slow, progressive, and seemingly inevitable process of involuntary loss of muscle mass, strength, and quality, which occurs with advanced age.[3,4] To diagnose sarcopenia, according to the 2nd European Working Group on Sarcopenia in Older People (EWGSOP2), if low muscle strength is detected, confirm sarcopenia through the amount of muscle mass and to classify it as severe sarcopenia, check physical performance.[5]

Skeletal muscle dysfunction is a debilitating condition that leads to daily limitations.[6] Muscle mass, strength, and physical performance are particularly determinant of independent function in human life.[6-8]

In a meta-analysis, sarcopenia was found to be an independent risk factor for several adverse outcomes, including dependence for instrumental and basic activities of daily living, osteoporosis, hospitalization, and death.[8] It is therefore widely accepted that sarcopenia can directly impair quality of life.[6-9]

To evaluate the quality of life, specifically of people with sarcopenia, Sarcopenia and Quality of Life (SarQoL) was developed and validated in Belgium.[9,10] It consists of seven domains: physical and mental health, locomotion, body composition, functionality, activities of daily living, leisure activities, and fears.[9] Currently, SarQoL has been translated into 26 other languages including

Dutch, German, Spanish, Italian, Greek, Hungarian, Romanian, Ukrainian, Polish, Persian, and Czech. It should be mentioned that the French, English, Polish, Romanian, Dutch, Greek, and Lithuanian versions have already been validated.[11]

A systematic review and meta-analysis on the prevalence of sarcopenia in Brazilian older adults returned 31 completed studies with more than nine thousand older adult patients. Results showed that 17% of older adult patients present sarcopenia,[2] meaning that instruments for assessing the specific quality of life of this group are necessary.

OBJECTIVE

To translate, culturally adapt and validate the "SarQoL" instrument in the Brazilian context.

METHODS

Ethical considerations

This study was approved by the Research Ethics Committee of the Universidade Federal de São Carlos (UFSCar), under opinion number 637.779 / 2016 on July 14, 2016.

Procedures

Translation, adaptation, and validity

SarQoL has 55 items in 22 questions and includes seven domains. Its score ranges from 0 to 100, and the higher the score, the better the quality of life.[9] SarQoL is a simple, easy-to-use instrument and takes an average time of 10 minutes to complete. It can also be self-applied.[9-11]

It should be noted that prior to initiating the SarQoL translation, adaptation, and validation process, the authors´ permission was obtained by e-mail (Charlotte Beaudart and Olivier Bruyère - www.sarqol.org).

The following recommended steps were followed according to the protocol provided by the authors who designed the original instrument:

a. Initial translation: This was conducted by two qualified and independent translators. One had a medical background and the other did not have any specialized knowledge on the subject of the questionnaire. The translation by two qualified and independent translators allows for the detection of errors resulting from divergent interpretations of ambiguous terms in the original language. Both translators provided a written report with commentary in order to highlight phrases or uncertainties and the reasons for the specific language choices made.
b. Synthesis of the translations: Translators and researchers met to conduct a synthesis of the results of the translations and to establish a consensus in the face of the divergences found or ambiguous interpretations of the SarQoL.
c. Back-translation: The translation into the original language was conducted by two other translators fluent in both languages and whose mother tongue is English. The translators were unaware of the study objectives. In addition, each translation was independently reverse engineered, allowing for error detection.
d. Review Committee: A committee of judges reviewed and compared all translations conducted with the aim of producing a final version, modified and adapted to guarantee a replica of the instrument for use in Brazil. The committee comprised two methodologists, two health professionals, a Portuguese-speaking professional, and the four translators involved in the process. After the evaluation of this committee, the pre-final version of the SarQoL was obtained.
e. Pre-final version test: The pre-final version in Portuguese of the SarQoL was performed with 20 older adults of different educational and socioeconomic levels, diagnosed with sarcopenia. Participants were asked about difficulties in completing the questionnaire or understanding the purpose or meaning of the questions. Following the interview process, the expert committee discussed the results and proposed the final version.
f. Validation of psychometric properties: At this stage, 221 older adults from the community who accessed primary health care in the city of São Carlos, São Paulo, Brazil, were evaluated.

This was a cross-sectional study. The older adults were individually invited, through telephone contact, in which the objective and stages of the study were explained. After acceptance, a visit was scheduled at the older adult participant's residence, where the researchers collected data. Post signing the consent form, they answered the participant characterization questionnaire, SarQoL, EuroQoL-5D and Short Form Health Survey (SF-36), Geriatric Depression Scale, and mini nutritional assessment (MAN). After answering the aforementioned instruments, it was necessary to verify who among the older adult respondents were and were not sarcopenic.

To diagnose sarcopenia, the criteria recommended by the EWGSOP24 were adopted, in which muscle strength is assessed, sarcopenia is confirmed by muscle mass and severity determined by physical performance.[4]

As evidence of sarcopenia, the measurement of handgrip strength was used, in which the criterion established by the Health, Well-being and Aging (SABE) study was adopted, which uses the cut-off score of < 30 kg for men and < 20 kg for women.[13,14] If participants had scores lower than those mentioned above, they qualified for the test of the first criterion (low strength).

To confirm sarcopenia by detecting low muscle quantity and quality, dual-energy x-ray absorptiometry (DXA) was used. After answering the aforementioned instruments, a day and time were scheduled for the participant to perform the DXA at the

Physiotherapy Department of the UFSCar, where they were picked up at their own residence and taken back after taking the test. For the cut-off values, those recommended by the SABE study were used, that is, 6.37 m^2/kg for women and 8.90 m^2/kg for men.[15,13]

To determine the severity of sarcopenia, a gait speed test with a cut-off score of less than 0.8 m/s was used for both sexes.[3,5] The speed test was conducted at the Physiotherapy Department of the UFSCar, in which the participant did the DXA and then performed the walk test in a prepared and controlled environment.

Statistical analysis

The Kolmogorov-Smirnov test was first performed, to verify the absence of data normality. From this result, non-parametric statistical tests were adopted. In the descriptive analysis, the median values of the sociodemographic and health variables, as well as the frequency of the qualitative variables were determined. To analyze the reliability of SarQoL, the Cronbach's alpha coefficients, both for the total and the individual domains, were verified. Satisfactory internal consistency was considered for values equal to or greater than 0.7. To verify the test-retest reliability, the interclass correlation coefficient (ICC) was calculated for the total and individual SarQoL domains, with values equal to or greater than 0.7 indicating a satisfactory stability of the instrument.

For the SarQoL discriminant validity analysis between the group of the older adults with and without sarcopenia, the Mann-Whitney test was performed. To verify the discriminative power of SarQoL, a logistic regression analysis was conducted. The model was adjusted according to age and body mass index (BMI), which were the variables that presented a statistically significant difference between the groups (older adults with and without sarcopenia).

RESULTS

This study satisfactorily implemented all the steps recommended by the original authors for the SarQol translation and adaptation process. A general agreement average of 95.5% was obtained in the analysis conducted by the expert committee and there was no semantic change in the pre-test phase.

Out of the 221 older adults evaluated in the study validation process, 55 (24.8%) participants had sarcopenia and 166 (75.1%) did not fulfill the criteria to diagnose sarcopenia. Female participants predominated the sample (n = 151, 68.3%), which had an average of four years of schooling, two daily medications, and four associated diseases.

In addition, only 31 older adults consumed alcoholic beverages (14.0%) and 19 were smokers (8.6%). Respondents with sarcopenia were older, average age of 73.2 years, compared to those without, who were on average 68.0 years old ($P \leq 0.001$). Regarding the BMI, the older adults with sarcopenia had lower mean values than those without, with a BMI of 25.3 kg/m^2 and 29.6 kg/m^2, respectively ($P \leq 0.001$). There was no difference in gender, schooling, number of associated diseases, number of medications in use, or consumption of alcoholic beverages and cigarettes between sarcopenic and non-sarcopenic participants.

Reliability

Cronbach's alpha coefficient of the total SarQoL questionnaire was 0.976, indicating excellent internal consistency. Regarding the homogeneity of the domains of the SarQoL questionnaire, it can be observed that the values ranged from 0.622 to 0.976, also showing satisfactory internal consistency (**Table 1**).

Table 1 shows that all domains correlated positively and significantly with the total SarQoL score. Excellent stability of the SarQoL verified through the ICC was also observed, using the test and retest of the questionnaire, in which the ICC of 0.983 (95% confidence interval, CI: 0.901–0.996) was observed in the SarQoL total and in all its domains as well.

Discriminant validity

Table 2 shows that SarQoL was able to discriminate between the older adults with and without sarcopenia, in all domains of QoL, as well as the total SarQoL.

The older adults with sarcopenia had an average total score of 55.5 (± 18.67), compared to a score of 74.4 (± 18.06) in the older adults without sarcopenia. In the logistic regression model for the total SarQoL score between the groups, adjusted for age and BMI,

Table 1. Results of the correlation between each domain and the total score of the SarQoL and of the test-retest reliability of the SarQoL total score and individual domain scores. n = 221

SarQoL	Correlation		Cronbach´s Alpha	Test-Retest	
	r	P value		ICC	CI 95%
Total score			0.976	0.983	0.901–0.996
Physical and mental health	0.795	< 0.001	0.813	0.963	0.883–0.989
Locomotion	0.907	< 0.001	0.958	0.982	0.938–0.995
Body composition	0.647	< 0.001	0.845	0.990	0.966–0.997
Functionality	0.919	< 0.001	0.914	0.974	0.914–0.993
Activities of daily living	0.918	< 0.001	0.823	0.978	0.664–0.995
Leisure activities	0.540	< 0.001	0.615	0.930	0.774–0.979
Fears	0.599	< 0.001	0.735	1.000	1.000–1.000

SarQoL = sarcopenia and quality of life; ICC = interclass correlation coefficient; CI = confidence interval.

the odds ratio (OR) of 0.963 (95% CI: 0.945–0.982) was obtained, indicating a low total score in participants with sarcopenia compared to those without. In addition, in the SarQoL domain regression analyses, participants with sarcopenia also had lower scores compared to the older adults without sarcopenia (**Table 3**). The discriminant power of the SarQoL questionnaire was confirmed.

Convergent construct validity

Considering the validity of the convergent, it can be observed in **Table 4** that all domains of the SF-36 and the visual analog scale present in the EQ-5D correlated positively and significantly with the total SarQoL score. Given these results, the convergent construct validity of the SarQoL is confirmed.

Table 2. Discriminative power of the SarQoL. n = 221

	Sarcopenia (n = 55)	Without Sarcopenia (n = 166)	P value*
Physical and mental health	62.85	75.44	**< 0.001**
Locomotion	50.94	70.82	**< 0.001**
Body composition	61.64	74.70	**< 0.001**
Functionality	61.81	76.52	**< 0.001**
Activities of daily living	46.05	73.71	**< 0.001**
Leisure activities	37.64	47.47	**0.001**
Fears	84.83	91.72	**0.001**
Total score	55.57	73.94	**< 0.001**

*Mann-Whitney Test. SarQoL = sarcopenia and quality of life.

Table 3. Regression analysis between participants with and without sarcopenia

	OR	CI 95%
Physical and mental health	0.964	0.948–0.981
Locomotion	0.966	0.953–0.979
Body composition	0.960	0.943–0.977
Functionality	0.949	0.931–0.968
Activities of daily living	0.951	0.935–0.967
Leisure activities	0.968	0.947–0.988
Fears	0.959	0.940–0.979
Total score	0.942	0.922–0.961

OR = odds ratio; CI = confidence interval.

Table 4. Correlations of the total score of the SarQoL questionnaire with individual domains of the SarQoL, the SF-36 and the EQ-5D

	Spearman correlation coefficients	P value
Convergent validity		
SF-36 Functional Capacity	0.852	< 0.001
SF-36 Physical Aspects	0.558	< 0.001
SF-36 Pain	0.607	< 0.001
SF-36 General Health Condition	0.523	< 0.001
SF-36 Vitality	0.572	< 0.001
EQ-5D Mobility	-0.696	< 0.001
EQ-5D Usual Activities	-0.719	< 0.001
EQ-5D Utility Score	0.510	< 0.001

SarQoL = sarcopenia and quality of life; SF-36 = short form health survey.

DISCUSSION

The present study satisfactorily implemented all the steps recommended by the original authors for the SarQoL translation, adaptation, and validation process in Brazil. SarQoL has been shown to be comprehensible, consistent, reliable, and valid, and therefore may be recommended for clinical and research purposes. The questionnaire is already available in 26 different languages, with more translations underway.[10,11]

Regarding internal consistency, it was observed that the SarQoL domains presented Cronbach's alpha coefficients between 0.62 and 0.97. In the SarQoL validation study in England, conducted with 235 older adults in the community-14 with sarcopenia and 221 without, Cronbach's alpha was found to be between 0.79 and 0.94,[12] in line with the results of the present research. In the psychometric properties of the Spanish Version of SarQoL[16] conducted with 252 older adults, 66 with sarcopenia and 186 without, Cronbach's alpha values were between 0.57 and 0.94, also compatible with the findings of the present investigation. Another study that corroborates these findings is the SarQoL validation study in Korean, carried out with 450 older adults in which 43.1% of the participants had sarcopenia, Cronbach's alpha was between 0.823 and 0.925.[17]

In the present study, excellent stability of SarQoL was observed, verified by the ICC, in which the ICC of 0.98 (95% CI: 0.90–0.99) was verified in the test-retest of the SarQoL total, as well as in all its domains. The data were corroborated with the validation study of the Dutch version of SarQoL, conducted with 92 older adults in the community, 30 of whom were sarcopenic, in which the ICC was 0.976 (95% CI: 0.947–0.989).[17] Another study that corroborates this finding is the psychometric properties of the Spanish Version of SarQoL by Fábrega-Cuadros et al.,[16] in which test-retest data showed excellent reliability for the total Spanish SarQoL score ICC = 0.99 (95% CI: 0.98–0.99).

The Brazilian version of SarQoL was able to discriminate between the older adults with and without sarcopenia, in all domains, as well as in their total score. Specifically, in the total quality of life score of the Brazilian version of SarQoL, the older adults with sarcopenia and without sarcopenia had a total average of 55.5 and 73.9, respectively.

In the validation study of the Romanian version of SarQoL, conducted with 100 older adults in the community, 87 without sarcopenia and 13 with, the older adults with sarcopenia also had lower scores in all domains and in the total score, in which the sarcopenia respondents had a mean score of 57.3 (34.4–70.7) and the older adults without sarcopenia scored 68.4 (55.7–85.2).[18] Data from the present study are also corroborated by results obtained from the validation of the SarQoL version in Dutch, in which the older adults with sarcopenia had a total average SarQoL score of 67.15 (54.75–81.52), lower than those without sarcopenia, who scored an average of 79.72 (70.10–86.88).[19]

Furthermore, in the SarQoL domain regression analysis, participants with sarcopenia displayed lower scores compared to the older adults without sarcopenia, corroborating the validation study in French: Physical and Mental Health (OR: 0.96; IC: 95%: 0.94–0.99), Locomotion (OR: 0.97, 95% CI: 0.95–0.98), Body Composition (OR: 0.95, 95% CI: 0.95–0 , 99), Functionality (OR: 0.95, 95% CI: 0.93–0.98), Activities of daily living (OR: 0.93, 95% CI: 0.91–0.96), Leisure activities (OR: 0.97; 95% CI: 0.95–0.99) and Fears (OR: 0.95, 95% CI: 0.91–0.98).[11]

Regarding the convergent construct validity, it was observed in this study that the SF-36 and EQ-5D dimensions evaluated were significantly correlated with the total SarQoL score, corroborating the validation study of the English version of SarQoL, where they obtained the following results: Functional Capacity ($r = 0.82$, $P < 0.001$), Physical Aspects ($r = 0.54$, $P < 0.001$) ($r = 0.55$, $P < 0.001$), General Health Condition ($r = 0.49$, $P < 0.001$), Vitality ($r = 0.74$, $P < 0.001$), Mobility ($r = -0.56$, $P < 0.001$), Usual Activities ($r = -0.55$, $P < 0.001$) and Utility score: ($r = 0.58$, $P < 0.001$).[12]

In the validation study of the Turkish version of SarQoL, the authors found strong/good correlations between the total SarQoL-TR score and some SF-36 domains that have similar dimensions, such as physical functioning ($r = 0.82$, $P < 0.001$), vitality ($r = 0.69$, $P < 0.001$), function limitations due to physical problems ($r = 0.69$, $P < 0.001$) and general health ($r = 0.60$, $P < 0.001$).[20] Strong/good correlations were also found between the total SarQoL-TR score and some domains of the EQ-5D that have similar dimensions, such as mobility ($r = -0.59$, $P < 0.001$), usual activities ($r = -0.63$, $P < 0.001$), self-care ($r = -0.59$, $P < 0.001$) and utility score ($r = 0.77$, $P < 0.001$).[20] These findings are in line with the results of the present study in which all domains of the SF-36 and the visual analogue scale present in the EQ-5D correlated positively and significantly with the total score of the SarQoL.

The convergent validity of SarQoL Dutch version was also confirmed, obtaining the following results in the correlations with the SarQoL total score: Functional Capacity ($r = 0.84$, $P < 0.001$), General Health Condition ($r = 0.62$, $P < 0.001$), vitality ($r = 0.65$, $P < 0.001$), usual activities ($r = -0.57$, $P < 0.001$), Utility score ($r = 0.47$, $P = 0.002$), in addition to the Mobility-test questionnaire ($r = 0.77$, $P < 0.001$).[21]

In a study correlating SarQoL with 4937 older adults in Korea through DXA and EQ-5D, they found that 6.6% of the evaluated older adults presented with sarcopenia and showed greater losses in all the domains of the EQ-5D, demonstrating that the condition directly influences the quality of life.[17]

A limitation of the study is the sensitivity to change of SarQoL, which will need to be evaluated in future longitudinal and clinical intervention studies.

CONCLUSION

Based on the proposed objective and results obtained, it can be concluded that the SarQoL shows evidence of reliability and validity. SarQoL is translated, adapted, and validated in the Brazilian context, and is available for use in Brazil (www.sarqol.org).

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Presenteeism and noise perception at work: a cross-sectional study using association analysis

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ABSTRACT

BACKGROUND: Presenteeism refers to the presence of a worker at work with reduced performance due to illness, and it is a common public health problem. Exposure to noise during production processes brings risk to workers' health.

OBJECTIVE: To analyze the health profile of workers in the automotive industry and identify the association between noise perception and presenteeism among workers in the Brazilian automotive industry.

DESIGN AND SETTING: This was a cross-sectional study utilizing a case study design analyzing the automotive industry in the interior of São Paulo state, Brazil.

METHODS: This study included 306 workers using the Presenteeism Work Limitations Questionnaire protocol. Multiple logistic regression was used for data analysis.

RESULTS: Male workers with reports of headache, tension, and limited well-being at work, having perceived that noise exposure interferes with productivity, showed a positive association with the occurrence of presenteeism. Physical demand had the highest score in terms of interfering with the presenteeism index.

CONCLUSION: Workers' perceptions of noise were associated with presenteeism.

INTRODUCTION

The quality of work performance and the health of a worker impact productivity, and they have been important subjects in the work world,[1] and they influence a company's costs, reputation, and competitiveness.

Traditionally, studies have analyzed the financial impact of absenteeism in production,[2-4] however, they point out that presenteeism today can become the absenteeism of tomorrow.[2] Some argue that the effects of presenteeism on an individual's future health are unknown, but it is recognized that it cannot be underestimated as a cause of potential health risks.[5,6] Furthermore, presenteeism can accentuate existing health problems and increase the risk of illness and absence from work, as well as negatively affect workability.[7]

Presenteeism can be defined as being present at work, but being limited with respect to some aspects of the development of work due to a health problem.[8-12] Presenteeism has been conceptualized as a measurable loss of worker performance due to health problems in the workplace, which contributes to the economic costs related to lost productivity,[13] and in some countries, represents the main occupational health problem.[6] A higher prevalence of presenteeism has been observed nationwide among young workers with higher education levels experiencing and reporting pain, impaired sleep, and stress, presenting an overall negative perspective on life.[14]

Treated as a public health concern, presenteeism can act as a risk to the health and safety of others, as the decision to go to work while being affected by an infectious disease, for example, represents a situation that entails possibilities of health disorders caused by exposure to viruses and bacteria, particularly when one interacts with more vulnerable people.[15] Presenteeism is therefore a poorly-studied phenomenon that has assumed greater magnitude in the field of health.[7]

A large-scale study in the United States, which included a four-year review of presenteeism data from a healthcare system, showed that chronic back pain, mental illness, general anxiety, severe migraines or headaches, neck pain, and depression were the causes of the greatest loss of estimated daily productivity and that allergies and headaches had the highest annual cost.[16]

With regard to well-being, workers exposed to occupational noise had more work-related illnesses and tended to continue carrying out the activity despite inadequate health conditions, thus signifying an association with the occurrence of presenteeism.[17]

Data from a recent survey conducted in Australia relating to hearing loss from noise exposure to productivity and quality of life showed that under current levels of occupational noise exposure in Australia, it is estimated that over 80,000 male and 31,000 female workers would develop occupational noise-induced hearing loss over 10 years of such exposure. Following this cohort to age 65, the estimated loss of productivity-adjusted life-years was 135,561, with a projected loss of 21.3 billion Australian dollars.

Studies on corporate health management have tended to study the impact of health on productivity and the financial impact of this relationship,[11,18-20] however, practically all the research that covers the subject of presenteeism was developed in capitalist countries.

From this perspective, the influence of self-reported noise exposure in the workplace on productivity, and its association with presenteeism have been under-investigated. This paper seeks to explore this gap by unveiling how certain health-related factors interfere with productivity, including addressing the workers' perception of exposure to occupational noise in an automotive components company.

OBJECTIVE

To analyze the health profile of workers in the automotive industry and investigate the association between presenteeism and noise in the work environment, as expressed by their own perceptions.

METHODS

Ethical considerations

The study was approved under No. 123854/2016 on (March 14, 2017) by the Research Ethics Committee São Paulo State University (Universidade Estadual Paulista, UNESP), Institute of Science and Technology, Campus São José dos Campos (SP), Brazil. All participants signed an informed consent form before participating in the study.

Procedures

This cross-sectional study was inspired by the research of Merrill et al.,[11] whose design is defined as a case study with a quantitative approach.

The studied company operates exclusively in the metallurgy sector, producing and marketing components for the automotive sector, located in the eastern region of the state of São Paulo, with 3,600 employees at the time of the field research carried out in June 2018.

Data collection instruments

To obtain data related to presenteeism, the Work Limitations Questionnaire (WLQ)[21] was used, validated for the language spoken in Brazil (Portuguese),[22] and developed by the researchers to collect sociodemographic and health data. The WLQ has four domains of work limitation, comprising 25 items: (1) time management (five items), (2) physical demand (six items), (3) mental-interpersonal demand (nine items), and (4) production demand (five items). After evaluating the four domains of work limitations, it was possible to set a WLQ index.

The sociodemographic and health questionnaire was divided into four sections to obtain data on noise exposure and hearing, and also on workers' health in the last 12 months from the date of application of the questionnaire.

Sampling

Based on the 20% prevalence of presenteeism observed in the study by LeCheminant and Merril[11] in which the highest quintile (20% worst) was considered, a sample size value of 320 workers was found, considering the 95% confidence interval and absolute precision of five percentage points.[23] We used the convenience sampling method, with the questionnaires being handed out to workers who moved through the company's leisure area.

The sample exclusion criteria were as follows: situations in which the worker answered all the questions as "not applicable" were excluded from the analysis, per the recommendation of the WLQ protocol—outsourced employees, employees who were at the company for less than one month of work, and questionnaires in which the subject failed to answer all the questions.

Data analysis

The collected data were organized using Microsoft Excel software version 2017 (Microsoft Office, Redmond, United States), and then analyzed using the statistical program Epi-info 3.5.2 (created by the Centers for Disease Control and Prevention (Atlanta, United States).

Association analysis controlling for confounding variables was performed using unconditional multiple logistic regression. The dependent variable was defined as "presenteeism," and categorized according to the WLQ index obtained as a cutoff point, wherein the value "1" signified greater or equal, and "0" for less than that defined by the cutoff. The explanatory variables (independent) used to build the model, based on the literature review, identified in association with the occurrence of presenteeism, were: factors related to noise and hearing (presence of tinnitus, complaints of difficulty in hearing, frequency of exposure to noise, perception of noise as an interference in work productivity), sociodemographic factors (age, sex, education, marital status), professional characteristics (position, work shift, work sector, working time), health issues

and "style" of life (classification of one's health in general, quality of life and sleep, alcohol consumption (more than twice a week), smoking, presence of high blood pressure, diabetes, stress, anxiety, depression, asthma, heart problems, allergy, back pain, headache, and body mass index (BMI), and aspects related to work (feeling of well-being at work, tension/stress at work).

Univariate analyses were conducted to build a multiple model, with the entry into the modeling process having a P-value < of 0.20 based on the likelihood ratio test. The stepwise forward methodology was used to define the most appropriate model, in which the variables were included in descending order of significance, and non-significant variables that could interfere with the adjustment of the model were excluded, analyzing the variations in the values of the odds ratio (OR) values, confidence interval (95% CI) and the significance levels of the models. The significant variables in the final model were also verified by the previous test, allowing for the permanence of variables with p being less than or equal to 0.05.[24]

RESULTS

Of the 320 questionnaires applied, 14 (4.4%) were discarded for the following reasons: some were incomplete, and others filled out the entire protocol with the option "not applicable." Exclusion from the analysis in this situation followed the stipulations of the protocol, resulting in 306 valid questionnaires, that is, 95.6% of the planned sample.

Sample characterization

The sociodemographic profile of the 306 workers who responded to the questionnaire, whose mean age was 33.6 ± 9.7 years, is shown in **Table 1**. Most of the sample consisted of male workers, married workers, and those who had completed high school.

Table 1. Distribution of sociodemographic data of a sample of workers in an automotive industry, 2018 (n = 306)

Variables		Mean ± SD
Age		33.6 ± 9.7 years
Seniority		9.4 ± 8.1 years
Variables		**n (%)**
Gender	Female	24 (7.8)
	Male	282 (92.2)
Marital status	Single	113 (36.9)
	Married	185 (60.5)
	Divorced	7 (2.3)
	Widower	1 (0.3)
Education	Incomplete Elementary School	2 (0.7)
	Complete Elementary School	11 (3.6)
	Incomplete High School	2 (0.7)
	Complete High School	199 (65.0)
	Incomplete Higher School	31 (10.1)
	Complete Higher School	61 (19.9)

SD = standard deviation.

Table 2 presents the data on the health conditions of the workers in the sample. In general, a high percentage of the workers in the sample declared their health and quality of life to be good, with good sleep patterns. Furthermore, they reported proportions that did not exceed 5% in terms of behaviors harmful to health, such as smoking and the use of alcoholic beverages more than twice a week. The distribution in relation to physical activity too was among the strata. The findings regarding hearing and other risk factors and their occurrence in the last 12 months are shown in **Table 3**.

WLQ protocol

From the perspective of the scope of the WLQ protocol, the demand results are as follows:

- Regarding the time management factor, there was no significant attribution of value to this item; that is, in relation to the last two weeks, the individual was limited to performing their tasks at work with regard to the time management limiter (7.46%).
- The physical demand factor had the highest score (16.09%), indicating that, across all demands, physical state had the greatest influence on the productivity of the analyzed sample.
- Regarding mental and interpersonal demands, interference in and subsequent loss of productivity was estimated at 8.43%.
- For production demand, a value of 9.33% of lost productivity was obtained.

Table 2. Distribution of basic data on health and lifestyle in a sample of workers, in an automotive industry, 2018 (n = 306)

Variables	Stratum	n (%)
BMI (kg/m²)	Underweight (0-18.5)	5 (1.7)
	Healthy (18.6-24.9)	133 (44.3)
	Excess weight (25-29.9)	121 (40.3)
	Obesity (level I, II, III) (≥ 30)	41 (13.7)
General health	Very bad/ bad	1 (0.3)
	Regular	30 (9.8)
	Good/very good	275 (89.9)
Quality of life	Very bad/bad	9 (2.9)
	Regular	51 (16.7)
	Good/very good	246 (80.4)
Sleep quality	Very bad/bad	34 (11.1)
	Regular	83 (27.1)
	Good/very good	189 (61.8)
Alcohol intake	Never	108 (35.3)
	Rarely	101 (33.0)
	Up to twice a week	87 (28.4)
	Three times or more in the week	10 (3.3)
Physical activity	Never	69 (22.8)
	Rarely	68 (22.4)
	Up to twice a week	76 (25.1)
	Three times or more in the week	90 (29.7)
Smoking	No	293 (95.7)
	Yes	13 (4.3)

BMI = body mass index.

According to the WLQ calculation protocol, a score above five indicates an estimated 4.9% decrease in productivity. Considering that the findings from the WLQ Index were equal to 2.74 in the sample studied, it can be said that the loss of productivity due to presenteeism is negligible or non-existent. It is noteworthy that the total presenteeism score of the WLQ measures the impact of chronic diseases and their treatment on the performance and productivity of workers. This finding corroborates the low prevalence observed in the sample in relation to chronic diseases.

Association between variables and WLQ Index

The univariate analysis, indicating the significant explanatory variables associated with presenteeism (WLQ Index), is shown in **Table 4**.

Thus, when analyzing **Table 4**, it is observed that workers who reported headaches had a 7.8 times chance of presenteeism than those who did not report any health problems. With regard to tension at work, the value index was 4.3 times the chance of presenteeism compared to those who did not declare it.

Analyzing the WLQ Index in the final model adjusted by multiple regression, there lay an association with significant explanatory variables: headache, noise interference at work, tension at work, well-being at work, and being a male (**Table 5**).

Table 3. Distribution of variables related to health and work conditions of the last 12 months (n = 306)

Variables	Stratum	n (%)
Allergy	Never	190 (62.1)
	Sometimes	64 (20.9)
	Frequent	33 (10.8)
	Very common	19 (6.2)
Back pain	Never	140 (45.9)
	Sometimes	118 (38.7)
	Frequent	30 (9.8)
	Very common	17 (5.6)
Headache	Never	138 (45.1)
	Sometimes	131 (42.8)
	Frequent	23 (7.5)
	Very common	14 (4.6)
Occupational noise exposure	Never	31 (10.1)
	Sometimes	28 (9.2)
	Frequent	63 (20.6)
	Very common	184 (60.1)
Noise interference in productivity	Does not interfere	150 (49.0)
	Interferes little	68 (22.2)
	Partially interferes	59 (19.3)
	Totally interferes	29 (9.5)
Well-being at work	Very bad/bad	4 (1.3)
	Regular	55 (18.0)
	Good/very good	247 (80.7)
Tension at work	Indifferent/not very tense	177 (57.8)
	Partially tense	68 (22.2)
	Tense/very tense	61 (20.0)

DISCUSSION

The study revealed a predominance of male workers, a characteristic found across research in the metal-mechanical sector, especially in terms of production,[25,26] and other studies[27,28] that limited the sample to male workers. The age of workers, represented by the average value, is consistent with other studies in the sector.[25-28] In terms of education, the findings are in line with those observed by Picoloto and Silveira.[29]

Table 4. Significant explanatory variables associated with the occurrence of presenteeism, through univariate analysis, with the respective values of OR and P-values in the automotive industry, 2018 (n = 306)

Variables		Total Score WLQ - means	
		OR	P value
Sociodemographic data			
Gender	2.97	0.012	
Education		0.6535	0.110
Work shift		0.53	0.0097
Health data			
General health		3.18	0.004
Quality of life		2.14	0.011
Sleep		1.71	0.034
Alcohol intake		0.6623	0.132
Stress		3.53	0.013
Anxiety		2.1645	0.111
Depression		3.1245	0.140
Asthma		2.9361	0.115
Smoker		0.4016	0.198
Noise and hearing data			
Bad hearing		2.49	0.030
Health and work conditions of the last 12 months			
Headache		7.84	< 0.001
Noise interferes in productivity	3.06	< 0.001	
Tension at work	4.33	< 0.001	
Well-being at work	3.00	< 0.001	
Allergy	2.38	0.006	
Back pain	2.32	0.010	
Occupational noise exposure	1.9207	0.052	

OR = odds ratio; WLQ = work limitations questionnaire.

Table 5. Final model adjusted for explanatory variables associated with the occurrence of presenteeism, with the respective values of OR, CI (95%), and P-values, in an automotive industry, 2018 (n = 306)

Variables	OR	CI (95%)		P value
		Lower	Upper	
Male	2.80	1.06	7.36	0.037
Headache	5.12	2.19	11.97	< 0.001
Noise interference in productivity	1.92	1.05	3.50	0.033
Tension at work	3.07	1.73	5.45	< 0.001
Feeling of well-being at work less than expected	1.96	1.00	3.82	0.047

OR = odds ratio; CI = confidence interval.

Regarding health data, alcohol consumption among workers was similar to that of national standards, according to the National Health Survey of the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, IBGE),[30] while physical activity was higher and smoking was much lower than that from the same source.

Because it was a relatively young sample, with regard to self-reported chronic degenerative diseases, the prevalence of hypertension and diabetes was lower than the national reference used, but similar when compared to the occurrence of cardiovascular diseases.

With respect to asthma as well as depression, in comparison with the country-level estimate, the prevalence values were also lower in the studied sample. Taking into account the values shown in **Table 3** and comparing it with data from IBGE,[30] the value of chronic back or back problems is close to the findings in this study.

In relation to the prevalence of frequent attacks of respiratory allergy among the workers in the sample, the study by Collins et al.[31] discusses that allergies, including respiratory allergy, are one of the most common factors among chronic diseases that impact presenteeism.

Also, as demonstrated in **Table 3**, it can be observed that 80.7% reported exposure to noise with a certain frequency in the work environment, and 28.8% reported this noise having some impact on their working capability. We expound that such findings are related to the fact that the researched company has a vast array of old machinery, thereby resulting in a noisier work environment.

Of the sample, 12.8% reported having tinnitus, and 8.5% reported not being able to hear well. Tinnitus is the perception of a sound that originates in the ears or head, without the presence of an external source, thus decreasing an individual's auditory sensitivity, with numerous possibilities of origin.[32] Another study demonstrated an association between the presence of tinnitus and hearing loss due to occupational noise.[33]

Exposure to intense noise for prolonged periods leads to auditory (hearing loss) and non-hearing effects, such as changes in the neurological system, circulatory system, digestive system, endocrine system, immune system, and psyche.[34] Thus, the effects of noise exposure can compromise several other organs, devices, and functions of the body, such as changes in the cardiovascular and gastrointestinal **s**ystems, endocrine system, and muscle and mood changes. It is also associated with the occurrence of stress, irritability, dizziness, and a greater probability of accidents at work.[35]

Association between variables and WLQ index

Pain with regard to presenteeism has been studied for a long time. Headaches appear to be a factor that interferes with presenteeism (5.12 times the chance compared to those without pain), thereby corroborating the findings of several studies.[16,31,36,37]

Regarding the demand for well-being, the study by Muckenhuber et al.[41] mentions well-being as a factor strongly associated with presenteeism. For such a variable, there is also an option to use the individual well-being index (IWB) protocol to explore this association.[39]

Corroborating the findings of this study, two studies involving workers in the health sector found a significant association between male workers and presenteeism.[40,41]

Regarding tension in the work environment, another significant variable, several studies have revealed the association between the occurrence of presenteeism and the presence of stress at work.[42-46]

With regard to noise exposure, a study conducted on railway workers focused on its association with well-being. The authors found that workers exposed to noise reported greater illness but were more likely to continue working anyway; that is, presenteeism.[17]

The association between noise perception and presenteeism was also identified in a study by Tavares et al.,[47] who evaluated workers in the mining sector.

It is well-established in the literature that excessive noise exposure can cause noise-induced hearing loss (NIHL). There is scientific evidence proving that workers with NIHL have a relative reduction of 1.9% in productivity at work (presenteeism) when compared to workers without hearing loss.[48] Published data from a survey conducted in Australia concluded that reducing noise exposure at work would substantially reduce the economic burden of occupational noise-induced hearing loss, also related to the loss of quality-adjusted life years (QALY) and productivity-adjusted life years (PALYs).[49]

It is noteworthy that the "body weight" factor, represented by the BMI, was not significant. This finding is in line with the study conducted by Bustillos, Vargas, and Gomero-Cuadra,[50] which examined work productivity among adults with varied BMI using Canadian Community Health Survey population-based data, between 2009 and 2010. The results reflected that, in relation to normal BMI, the chances of absenteeism were higher for those in obesity class III. Presenteeism was weakly associated with all obesity categories (Class I obesity).

The self-reported variable "asthma" did not present a significant association with presenteeism in this study, contrary to the findings of Sadatsafavi et al.,[51] who found that presenteeism was more responsive to asthma control than absenteeism.

The manifestation of presenteeism in organizations, such as working while sick, can be interpreted as organizational citizenship behavior and a sign of commitment and loyalty to the company, or even because labor relations are unequal and authoritarian. There also exists criticism against a few organizations discouraging employees from going to work when they are sick.[52]

This research founded physical demand as the most significant cause of presenteeism, in contrast to the findings of Merrill

et al.,[53] stating that demand related to the work environment was higher. In this study, we did not find a relationship between presenteeism and age, marital status, education, work area (sector), being overweight, or smoking, in contrast to the findings of the previous authors' research.

These research findings contribute to the improvement of the strategies used by companies for productivity and health management, that is, indicators that demonstrate the impact of the analyzed factors and, with this, allow for improvements in prospects regarding workers' quality of life, which fall in line with increased productivity. The novelty of this article lies in the fact that no other research has sought to analyze the relationship between presenteeism and the noise variable, while also using a research instrument validated internationally as well as in the Portuguese language. In a search conducted in the Web of Science database (2013–2021), using the keywords "presenteeism" and "noise," and without any search filter, four articles were identified, of which three mentioned the relationship between presenteeism and noise,[54-56] but did not aim to analyze or quantify this relationship.

As for the relationship between presenteeism and noise, there have been findings in which the factors most frequently listed as having adverse health effects among 53 educators from daycare centers in Frankfurt were noise and stress;[54] researchers investigated the environmental and health characteristics related to productivity in a complex of government buildings and highlighted that noise was one of the factors frequently reported by the participants, along with the prevalence of presenteeism in this sample.[55] In the research by Schell et al.,56 presenteeism and noise were listed, among other factors, to identify occupational health characteristics in a sample of 1961 workers with a wide variety of professional skills and occupational tasks. However, the studies demonstrate limitations as they do not measure the impact and/or relationship between presenteeism and the noise variable. This study contributes to this gap in knowledge by quantifying the impact of the perception of noise exposure and presenteeism score, thus meeting the indicated needs.

Data on presenteeism is scarce in the organizational environment, and consequently, strategies aimed at reducing presenteeism are minimal. The focus of corporate health programs remains limited to reducing absenteeism. Thus, there exist no efforts aimed at managing health as an active asset, reducing it to merely managing expenses and profits.

Studies that seek to investigate the impact of productivity related to chronic and occasional pain, levels of noise exposure by sector, sleep quality, job satisfaction, personal factors such as family-related factors, financial factors, organizational culture, and even promotion projects will add, synergistically, toward improvements in the effective management of workers in the long term promotion of corporate health, or even the sustainability of human capital.

This study encourages discussions in the field of worker and corporate health, involving issues of presenteeism and absenteeism in the organizational sphere, as well as encouraging researchers to discuss issues of this nature to promote improvements in this field and expand on the realm of extant knowledge. It is also necessary for future research to address the methodological importance of differentiating between the act and impact of presenteeism,[57] across different fields of work.

CONCLUSIONS

This study analyzed the association between the occurrence of presenteeism and exposure to occupational noise based on the perception of the workers of a company in the metallurgical (automotive) segment in Brazil.

It was concluded that perceived occupational noise is associated with presenteeism. Among other variables, in relation to health, the most relevant were headaches and the perception of well-being at work. Tension in the work environment and the perception of noise exposure were significant factors with regard to presenteeism.

Since the mean age in the sample consisted of younger workers, it is inferred that, for this reason, chronic diseases do not manifest themselves as important variables in the loss of productivity.

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Translation, adaptation, and reliability of a Social Frailty Scale for the Brazilian context: a methodological study

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ABSTRACT

BACKGROUND: Frailty comprises three dimensions: physical, psychological, and social. It is established that social frailty is correlated with several variables, such as quality of life, depression, and loneliness. These findings reinforce the need to investigate and define predictors of social frailty.

OBJECTIVE: To translate, culturally adapt, and assess the reliability of the HALFT scale for Brazil.

DESIGN AND SETTING: Methodological study conducted at Universidade Federal de São Carlos.

METHODS: This study aimed to translate and culturally adapt the HALFT scale from English to Brazilian Portuguese, for which the steps of translation, synthesis of translations, back translation, evaluation by an expert committee, pre-test, and test-retest were followed.

RESULTS: Two independent translators translated the HALFT. The consensual version was established by merging the translations, which were back translated into English by a third translator. The expert committee comprised seven health professionals working in frailty and/or social fields of study. Only one item on the scale had a content validity index of less than one (0.85). The instrument was pre-tested with 35 older adults who considered it clear and understandable, with no suggestion of changes. The reliability analysis (reproducibility) of the adapted version of the HALFT with test-retest of the scale with 23 participants showed a Kappa index of 0.62, showing good agreement.

CONCLUSION: The HALFT scale is translated and adapted for Brazil, and shows good reliability. However, it is necessary to conduct psychometric analysis of the instrument to provide normative data for this population.

INTRODUCTION

Frailty is increasingly standing out nationally and internationally, as a public health problem, is a predictor of multiple health complications, and tends to increase with aging populations.[1,2]

The definition of frailty has been constantly revised in the literature. However, at its core, the concept of frailty is guided by three pillars. The first is its multidimensionality, which involves both physical and psychosocial factors. The second pillar refers to advancing age; that is, frailty is related to the aging process. Finally, frailty is mutable; therefore, people with frailty can progress or regress according to the mechanisms involved in health care and attention.[2]

Frailty has been considered a one-dimensional syndrome for many years, the impairment thought to be only physical. However, gradual progress in research has made it clear that frailty comprises three dimensions: the physical, psychological, and social.[3] In this context, social frailty is yet to be defined, since there is no consensus on its criteria.[4] In addition, scholars indicate that social frailty is a little-explored concept and define it as a continuous risk and/or loss of resources that are important for the fulfillment of one or more basic social needs during life.[5]

Thus, the social environment and social activities developed, besides the physical aspects inherent to frailty, are important factors to be considered in preventing frailty and improving conditions among older adults in the community. Furthermore, a comprehensive understanding of social frailty is suggested, which includes domains of economic status, social networks, and social activities.[6] It is important to emphasize that frailty carries an individual burden for those who live with it, including impaired quality of life and loneliness.

In this context, Bessa analyzed the social components related to frailty, which showed the different social conditions along the course of life of an individual and the social aspects at each stage that were linked to frailty.[7] There is evidence in the literature that the accumulation of social deficits is correlated with health risks, which implies that social frailty, when properly assessed,

can predict mortality risk in the same way that aspects of physical frailty can.[7] Additionally, social frailty is correlated with several variables, such as poorer quality of life, depression, and loneliness. These findings reinforce the need to investigate and define the predictors of social frailty.[7,8]

Thus, scholars have developed a screening tool to measure social frailty called the "HALFT scale". The HALFT is an acronym for Help, Participation, Loneliness, Financial, and Talk, which respectively correspond to the following five items: the inability to help others, limited social participation, loneliness, financial difficulty, and not having anyone to talk to.[8]

There are few global studies on social frailty compared to the other dimensions, and a search for related measures shows that they are nonexistent in Brazil. Therefore, a Brazilian version of the HALFT scale for rapid screening of social frailty in older Brazilians is extremely relevant.

OBJECTIVE

Translate, culturally adapt and assess the reliability of the HALFT scale for Brazil.

METHODS

Study type

This is a methodological study[9] proposing the translation and cultural adaptation of the HALFT scale from English to Brazilian Portuguese. This methodology requires a prior design of all steps to be developed[10] **(Figure 1)**. This process of translation and cultural adaptation is conducted so that there is equivalence between the tool in its source language and target language.[11]

Sample

Individuals aged 60 years and above who have a minimum level of literacy that enables the reading and interpretation of the evaluation questions, participated in the present study. Persons who had severe vision impairment and did not have access to the internet or digital research platforms were not included. All participants signed a Free and Informed Consent Form, and the study was approved on December 19, 2020, by the Ethics Committee on Human Experimentation of the Universidade Federal de São Carlos (UFScar) (4.477.339).

Questionnaire structure

The HALFT scale comprises five items: the inability to help others, limited social participation, loneliness, financial difficulty, and not having anyone to talk to.[8]

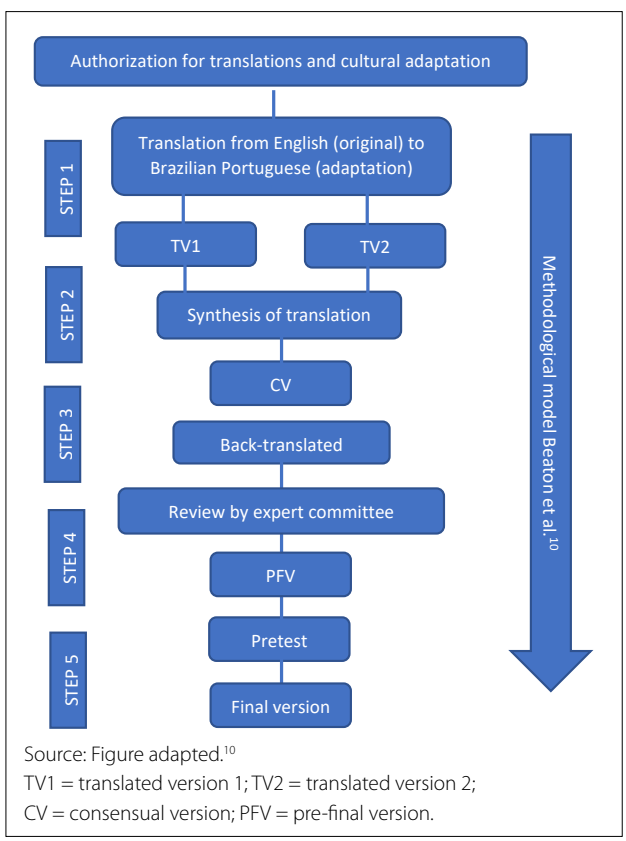
The item regarding the ability to help others was measured by asking participants if they had been able to help their friends or family in the past 12 months. Limited social participation was assessed by asking participants if they had engaged in any social or leisure activities in the previous 12 months. Loneliness was defined as feeling lonely during the last week. Financial difficulty was determined by asking participants if their income had been sufficient to live on for the past 12 months. The final item verified if the participants had someone they could talk to every day.

The score of the HALFT scale ranges from 0 to 5 points, with a score of zero being considered not socially frail, 1 or 2 as pre-socially frail, and a score of ≥ 3 indicating socially frailty.[8]

Translation into Portuguese and cross-cultural adaptation

The instrument was formally authorized by the authors of the original scale for the creation of a Brazilian version. The researchers strictly followed scientific and ethical guidelines and the research was approved by the Human Research Ethics Committee of Universidade Federal de São Carlos and fully abided by the recommendations of Resolution 466/2012 of the Brazilian National Health Council (Conselho Nacional de Saúde, CNS) of the Ministry of Health.

As mentioned above, this type of study is conducted in steps. The first was the translation of the original English version into Brazilian Portuguese, which was conducted by two independent, qualified translators with fluency in Brazilian Portuguese. It is



Source: Figure adapted.[10]
TV1 = translated version 1; TV2 = translated version 2; CV = consensual version; PFV = pre-final version.

Figure 1. Scheme of the methodological model and phases adopted in the translation and cultural adaptation process of the HALFT scale.

noteworthy that both were experienced with this type of translation and familiar with health terminology. This translation step produced the translated version 1 (TV1) and translated version 2 (TV2).

The synthesis of the translations (TV1 and TV2) was conducted in the second step, thus constituting the consensual version. This process was conducted jointly by the researchers and translators. The subsequent step of back-translation utilized a third translator whose native language was English and who fulfilled the same requirements as the others but lacked prior knowledge of the instrument. Once the back-translated version (BTV) was ready, the instrument was sent to the authors for analysis and approved.

Cultural adaptation was performed as the fourth step, which included a content assessment and cultural equivalence analysis. A committee of experts comprising seven members was formed, all with PhDs, working in the field of research, with expertise in frailty and/or social aspects, and fluency in English. Upon agreeing to be part of the committee, they received an explanatory letter about the instrument clarifying the requested analysis. The committee members were asked to analyze the four versions of the instrument (original, translation 1, translation 2, and consensual version) to establish the content validity index, which aimed to verify the concordance of the judges. For this analysis, a four-point Likert scale was used, in which items with responses corresponding to a score of 1 and/or 2 were to be revised or excluded, and items with a score of 3 and/or 4 were to be calculated. Based on the sum of the responses of each judge on each item divided by the total number of responses, a concordance value was calculated, with a recommended result of 0.78 and over[12] to confirm the equivalence of the instrument after the entire process. The pre-final version (PFV) of the HALFT scale was obtained after a thorough evaluation by the experts.

In the fifth and last step, the instrument's PFV was pretested with an older adult sample, with characteristics as previously described. As this was a period of social distancing due to the pandemic, we decided to deliver the instrument to the participants and collect it 10 days later. Three instruments were delivered to the participants: a caregiver characterization questionnaire (sociodemographic information); the pre-final version of the HALFT with two extra columns that checked the clarity of the terms of each question and asked the participants for possible suggestions and adjustments to the questions; a general Disabkids questionnaire to assess the clarity of the instrument to be adapted. The HALFT scale was finalized at the end of this step.

Evaluation of the reliability of the HALFT scale

The HALFT scale was applied to 23 older adult participants twice with an interval of 15 days to assess its reliability (reproducibility). The research was conducted digitally, that is, with the scale typed in an online format. Upon contact, participants received instructions on how to proceed with the evaluation. Fifteen days later, the evaluator contacted them again to forward the instrument and request that they respond a second time.

Statistical analysis

Excel for Windows was used to tabulate the data, which were processed using the IBM SPSS statistics, version 20.0 (IBM Corporation, Armonk, New York, United States), in which a descriptive analysis of the sociodemographic characteristics of the participants was performed. The content validity index (CVI) of the HALFT scale items was calculated using the criteria proposed by Lynn in 1986, with an expected value greater than 0.78.[12] The Kappa statistic was used for reliability analysis. The criteria proposed by Landis and Koch[13] were followed. A 95% confidence interval (CI) was adopted.

RESULTS

After the initial translation process, the statistical analysis was conducted to reach the final version of the instrument and assess its reliability.

We began the analyses by checking the content validity of the scale approved by the expert committee. The CVI of the five questions of the instrument was calculated and only the first question had a value of 0.85 and the rest a value of 1, indicating satisfactory content validity (**Table 1**).

After the expert committee's analysis, a pre-test was conducted. For this step, 35 older adults participated, of whom 60% were female and 65.71% were married or had a common-law marriage (**Table 2**). Their average monthly income was R$ 3,014.28 (standard deviation, SD: 3,789.51) and the average amount of medication in terms of the number of pills taken per day was 3.80 (SD: 3.38).

When applying the PFV of the scale, all participants rated the five items of the instrument as clear and did not suggest any changes. The scale's relevance, as well as the clarity of the items in the PFV, was assessed using the general clarity questionnaire adapted from Disabkids, and showed that the participants considered the instrument to be very good (n = 35; 100%).

Even though the consensual version analyzed by the judges and participants obtained a good evaluation, they suggested adjusting the questions so that they all started with the time frame, thus facilitating the interpretation by the participants (**Table 3**).

Table 1. Content validity index of the HALFT Scale items as evaluated by the Expert Committee

Items	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6	Judge 7	Content validity index
1	4	3	3	4	2	4	4	0.85
2	4	3	4	4	4	4	4	1.00
3	3	3	4	4	4	4	4	1.00
4	4	4	4	4	4	4	4	1.00
5	4	3	4	4	4	4	4	1.00

To establish the reliability of the HALFT scale, we analyzed the responses of 23 older adult participants, of which 60.87% were female, and 47.83% had completed higher education. Their average monthly income was R$ 4,400.00 (SD: 4,443.89) and the average amount of medication taken daily in pill form was 5.39 (SD: 3.8) (**Table 4)**.

Reproducibility analysis was performed using weighted Kappa, with a value of 0.62, showing good concordance according to the reference adopted **(Table 5)**.[13]

DISCUSSION

Recently, much progress has been made in understanding frailty. However, there are still many gaps, from arriving at a consensus on the definition of frailty and associated variables to identifying the means of assessment. Scholars have emphasized the importance of conducting clinical trials for the development of preventive and management strategies for this syndrome.[2]

Frailty is a challenge for public health, as it is related to functional decline, depressive symptoms, and social isolation, in addition to being a predictor of mortality. It is believed that older adults can provide information on their experience that can help us design better health systems and social assistance to meet this demand for care, thus avoiding further harm to health.[14,15]

National and international studies have shown the need to provide the Brazilian population with an instrument for tracking social frailty, given the scarcity of studies and the need for acknowledgment of this syndrome, thus enabling the development of strategies and resources to prevent and address it. Bunt et al. emphasized in their scoping review on social frailty in older adults that it is the least explored variable when compared to physical and cognitive frailty.[5] The authors also reveal that older adults increasingly require assistance for social issues, whether through social relationships or even environments, which is why scholars stress the need for concrete conceptualization and effective assessments for this variable.

Faced with this need, Ma, Sun, and Tang[8] developed the HALFT Scale to screen for social frailty by applying it to 1,697 older adults living in the community in the city of Beijing. After evaluation, the authors reported that the HALFT scale was associated with adverse health, as well as social outcomes, indicating its usefulness. However, they also report the need to continue with psychometric evaluations through further studies in order to determine the efficacy of the scale.[8] Hence, the decision to conduct this process for the future availability of the scale in Brazil.

The availability of the HALFT scale in Brazil will enable research contributing to the advancement of scientific knowledge in the country on social frailty and the potential for comparisons with global findings. In addition, it will also allow health professionals who assist the aging population of Brazil in different health and social contexts to be equipped with a rapid social frailty screening scale, allowing them to identify individuals in the progression of social frailty, early. This will give them a chance to intervene and improve this domain

Table 2. Descriptive statistics of the sociodemographic characterization of pre-test participants

Variable	Category	Frequency	%
Gender	Female	21	60
	Male	14	40
Marital status	Single	1	2.81
	Married	23	65.71
	Widow/er	5	14.29
	Divorced	6	17.14
Education	Elementary school	7	20
	Middle school	8	22.86
	High school	9	25.71
	Higher education	11	31.43
Do you have any disease diagnosed?	Yes	27	77.14
	No	8	22.86

Table 4. Descriptive statistics of the sociodemographic characterization of test-retest participants

Variable	Category	Frequency	%
Gender	Female	14	60.87
	Male	9	39.13
Marital Status	Married	15	65.22
	Widow/er	7	30.43
	Divorced	1	4.35
Education	Elementary school	7	30.43
	Middle school	2	8.70
	High school	5	21.74
	Higher education	9	39.13
Do you have any disease diagnosed?	Yes	15	65.22
	No	8	34.78
Do you take medication on an ongoing basis?	Yes	21	91.3
	No	2	8.7

Table 3. Readjustment of items from the consensual version to the final version

Item	Consensual version	Final version
1	Have you helped a friend or family member in the past 12 months?	In the last 12 months, have you helped friends and/or family members in any kind of need?
2	Have you participated in any social or leisure activities in the last 12 months?	In the last 12 months, have you participated and/or been involved in any social or leisure activities?
3	Have you felt lonely in the last 12 months?	In the last week, have you felt lonely?
4	Was your income enough to live on for the last 12 months?	Do you think your income was enough to live on in the last 12 months?
5	Do you have someone to talk to daily?	Do you have someone you can talk to every day?

Table 5. Reproducibility of the HALFT scale (final version)

Item	Test		Retest		Weighted Kappa (95% CI)
	0	1	0	1	
1	19 (82.61%)	4 (17.39%)	20 (86.96%)	3 (13.04%)	
2	8 (34.78%)	15 (65.22%)	9 (39.13%)	14 (60.87%)	
3	20 (86.96%)	3 (13.04%)	20 (86.96%)	3 (13.04%)	0.62 (0.37–0.87)
4	16 (69.57%)	7 (30.43%)	18 (78.26%)	5 (21.74%)	
5	23 (100.00%)	0 (0.00%)	21 (91.30%)	2 (8.70%)	

CI = confidence interval.

of frailty, also impacting the physical and cognitive dimensions, as seen in the aforementioned international studies.

It is known that methodological studies have steps to be followed.[16] In Brazil, the number of studies of this type has increased because it is extremely important to have an instrument that is adapted and validated for local populations.[17]

The present study strictly followed all steps recommended by Beaton et al.[10] The initial step was conducted by two translators, both of English nationality and fluent in Brazilian Portuguese. According to the literature, it is recommended that the translation step be undertaken by fluent, independent translators with specialist qualifications to achieve efficiency in this process.[18]

The second step included the synthesis of the translations by the researchers and the formation of the consensual version. In this study, there was no discrepancy between the translations. A few differences in words but with the same meanings were present, in which case, the more commonly used word was chosen. To resolve differences and ambiguities, the translations were read, and a consensual version[18] was prepared. Subsequently, back-translation to the original language was performed to verify whether the instrument, after the translation and synthesis processes, remained faithful to the original, which was confirmed in the present study.

In the present study, an expert committee evaluated the instrument, as described in the Methods section. The five items of the scale were individually evaluated, in a process that ensured that the PFV was clear and understandable to the new culture. The purpose of IVC is to verify the committee's concordance on the scale's questions, that is, the equivalence of the questions in the different versions.[19]

Once the PFV was ready, a pre-test was conducted. Its objective was to apply the scale to a small sample and to verify whether the participants encountered any difficulties related to the understanding and clarity of the instrument's questions.[20] In the present study, participants did not report difficulties and did not suggest changes, so the final version of the HALFT scale was obtained.

The last step of the present study was to verify the reliability of the final version of the scale using the test-retest method, which involved the participants responding to the scale at two time points with a 15-day gap, as recommended in the literature.[21] Reliability, according to the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN), is the degree to which an instrument is free from measurement error.[22] The present study used the weighted Kappa and 95% CI were estimated[13] and observed with the analysis values of 0.62, which shows good reliability.

As a limitation, we can highlight the scarcity of studies on this subject, making it difficult to deepen the discussion. Another limitation of the present study is that data were collected through a digital platform which excluded people from participating because they did not have access to the digital environment or because they were unaware of the study. However, it is important to emphasize that this study stands out for being innovative and aiming to provide an instrument for assessing social frailty, serving as an addition to the limited supply of relevant and current studies required to remedy this gap regarding the construct of frailty.

CONCLUSION

Based on the objective of the study and the results obtained, it is concluded that the HALFT scale is properly translated and adapted to Brazil, and shows good reliability when it is self-applied to older Brazilian people in the community.

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Use of structural models to elucidate the occurrence of falls among older adults according to abdominal obesity: a cross-sectional study

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ABSTRACT

BACKGROUND: Obesity is a risk factor for falls in older adults, but the effects of body fat distribution and its interaction with other factors are not well established.

OBJECTIVES: To verify the occurrence of falls among older adults with and without abdominal obesity and the effects of sociodemographic, health, and behavioral variables on this outcome.

DESIGN AND SETTING: A cross-sectional study in an urban area of Alcobaça, Brazil.

METHODS: Men and women older than 60 years with (270) and without (184) abdominal obesity were included. Sociodemographic, health, and behavioral data were collected using validated questionnaires in Brazil. Descriptive and path analyses were performed ($P < 0.05$).

RESULTS: The occurrence of falls was high in participants with abdominal obesity (33.0%). In both groups, a higher number of morbidities ($\beta = 0.25$, $P < 0.001$; $\beta = 0.26$, $P = 0.002$) was directly associated with a higher occurrence of falls. Among participants without abdominal obesity, a lower number of medications ($\beta = -0.16$; $P = 0.04$), a higher number of depressive symptoms ($\beta = 0.15$; $P = 0.04$), worse performance on the agility and dynamic balance tests ($\beta = 0.37$; $P < 0.001$), and lower functional disability for basic activities of daily living ($\beta = -0.21$; $P = 0.006$) were directly associated with the occurrence of falls.

CONCLUSION: Adults older than 60 years with abdominal obesity have a higher prevalence of falls. Different factors were associated with the occurrence of falls in both groups.

INTRODUCTION

Falls are a public health problem at the global level due to the associated repercussions, such as a large number of years of disability, the need for long-term care, and high mortality rates.[1] In the Brazilian population there is a prevalence of 27% for falls among older adults, with advanced age among the risk factors with strong scientific evidence for falls.[2,3]

Falls have also been associated with the presence of morbidities,[4,5] depressive symptoms,[3,6] changes in balance and reduction in muscle strength,[7-9] use of medicines,[10,11] disabilities in basic activities (BADL) and instrumental activities (IADL) of daily living,[12,13] lower levels of physical activity,[14] prolonged sedentary behavior,[15] female sex[2,3] and obesity.[16-18]

Among these factors, obesity, which is also currently a public health problem, requires further investigation. However, the effects of body fat distribution on the occurrence of falls are not yet well established.[18] The scientific literature shows that excess fat in the central region contributes to the anterior displacement of the body's center of mass, making it difficult to stabilize in an upright posture, shifting the line of gravity that approaches the body's base of support.[19]

Based on studies in older adults, it appears that falls are associated with sociodemographic, health, and behavioral characteristics.[2-18] However, which of these factors act directly or indirectly to mediate the occurrence of falls in older adults with and without abdominal obesity remains unclear.

Obesity is a common condition in the elderly population and is associated with higher morbidity and mortality, risk of institutionalization, and poorer quality of life.[20] Additionally, advanced age is one of the main factors associated with falls.[1] Thus, it is necessary to expand on the understanding of the association between obesity and falls in this population, aiming to identify individuals at greater risk and propose preventive measures.[18]

For a better understanding of the event, analyses with structural equation models are necessary to allow for the simultaneous identification of the dependence and interrelation of multiple variables. Moreover, it is necessary to estimate the direct and mediated effects by other factors that may integrate into the causal network of the result of interest.[21]

This type of analysis has not been explored in this context. It can expand on the knowledge of falls in older adults with and without abdominal obesity, and provide support to the need for elaboration of actions aimed at improving the health care in this population.

OBJECTIVE

This study aimed to determine the occurrence of falls among older adults with and without abdominal obesity and the direct and indirect effects of sociodemographic, health, and behavioral variables on this outcome.

METHODS

Study design and setting

We used a quantitative approach with a cross-sectional design. It was conducted as part of the Brazilian project titled "Longitudinal Study of the Health of Older Adults in Alcobaça, Bahia" (ELSIA). The Program to Strengthen the Report of Observational Studies in Epidemiology (STROBE) guided the research report.

Data collection was carried out from July to October 2015 in the houses of adults aged greater than 60 years and consisted of the application of questionnaires, physical performance tests, and verification of anthropometric measurements. The selected interviewers underwent training, qualifications, and ethical research procedures.

The project was approved by the Ethics Committee for Research with Human Beings under protocol no. 966.983 on February 27, 2015. The interviewers contacted the participants at home and presented the research objectives and the free and informed consent form. The interviews started once participants signed the consent and terms forms.

Participants and eligibility criteria

Men and women aged 60 years or older registered in the Family Health Strategy and living in the urban area of the municipality of Alcobaça, state of Bahia participated in the study. In 2015, the municipality had a total of 21,319 inhabitants, of which 2,047 were aged 60 years or older and 1,024 lived in urban areas[22], with 743 registered in the Family Health Strategy. The municipality had all residences assisted by the Family Health Strategy in 2015;[23] however, in a survey conducted by community health agents, data from 743 older adults were made available.

The exclusion criteria for participants were: bedridden or hospitalized during the study period; residents' of long-term care institutions; severe visual and auditory acuity difficulties which could make communication with the interviewer difficult; wheelchair dependent; musculoskeletal or neurological diseases that prevented the performance of physical tests and anthropometric measurements; and cognitive decline (evaluated according to the Mini-Mental State Examination, in which a cutoff point of ≤ 12 points was used, regardless of education level, due to the high illiteracy rate among older adults in the municipality).[24]

Of the 743 eligible participants, six were wheelchair users, 10 were bedridden, 19 had diseases that made it impossible to carry out the interview, 14 had cognitive decline; eight had communication difficulties, and one had conditions that prevented communication during the interview. Moreover, 54 refused to participate, 158 were not at home in the interviewer's three attempts, and 19 did not complete the full interview. Thus, 454 older adults comprised the study sample, divided into two groups: those with abdominal obesity (270) and those without abdominal obesity (184).

Data collection

Waist circumference

With the participant in an orthostatic position and wearing as little clothing as possible, waist circumference was measured at the midpoint between the last rib and the iliac crest with a flexible and inelastic tape during normal expiration. Cutoff values of ≤ 102 cm for men and ≤ 88 cm for women were used to classify participants into the "without abdominal obesity" group and > 102 cm for men and > 88 cm for women into the "with abdominal obesity" group.[25]

Occurrence of falls (dependent variable)

The occurrence and number of falls in the last 12 months were determined with questions widely used in gerontological research:[5,17] (1) "Have you had any falls in the last 12 months?" (2) "If so, how many times?" The dependent variables in the present study were the report of falls (yes or no) and the average number of falls.

Independent variables

Sociodemographic and economic data, continuous use of medications, and the presence of morbidities were obtained through the application of a structured questionnaire constructed by the researchers.

Sociodemographic and economic data were: sex (female; male); age group (60–69; 70–79; 80 or more) and age in complete years (average), marital status (single; married; widowed; divorced), self-reported skin color/race (white; black; brown; indigenous), years of completed education (none; 1–4, 5 or more), housing arrangement (lives alone; lives with someone) and economic class

(A-B; C; D-E). Regarding the use of medications and the presence of morbidities, participants were asked if they used them continuously (yes or no) and if they had any of the diseases included in a list prepared by the researchers (yes; no). The average number of morbidities and continuous medications were used for calculations.

The presence of depressive symptoms was determined using the validated Brazilian version of the Abbreviated Geriatric Depression Scale, which provides a score ranging from 0 to 15 points.[26] The average number of depressive symptoms was considered.

Regarding functional capacity, BADL was evaluated using the Katz Index, which ranges from 0 to 6 points.[27] For IADL, the Lawton and Brody Scale was used, which ranges from 7 (highest level of dependence) to 21 points (complete independence).[28] Both instruments are adapted to reflect the Brazilian population and the scores in each of the scales were considered, with higher scores for BADL and lower scores for IADL indicating higher functional disability.

The level of physical activity was determined using the long version of the International Physical Activity Questionnaire (IPAQ), which has been adapted for older adults.[29] For the main analysis, participants were categorized, according to active time as insufficiently active (< 150 minutes/week) or sufficiently active (≥ 150 minutes/week).[30]

Sedentary behavior was obtained through two IPAQ questions, determined according to the total sitting time, in minutes per day, using the weighted average of time spent sitting on one day of the week and on one day of the weekend.[31]

Agility and dynamic balance were measured by the time spent performing the "Timed Up and Go" test, a modified version of the Fullerton test battery proposed by Rikli and Jones.[32] The variable was measured according to the time in seconds, in quantitative mode.

Handgrip strength was measured using a SAEHAN dynamometer (SH5001, Korea) with individual adjustment according to hand size and measurement performed according to Dias et al.[33] The variable was provided in kilogram-force (kgf), in quantitative mode.

Data analysis

Statistical analyses were performed using IBM Corp. Statistical Package for Social Sciences (SPSS, version 24.0; IBM Corp). Analysis of Moment Structures (AMOS), version 24.0 (Armonk, New York, United States). Data were subjected to descriptive analysis using absolute and relative frequencies for categorical variables and means and standard deviations for quantitative variables.

Following this, structural equation modeling was carried out through path analysis, which allowed the simultaneous verification of the dependence and interrelationship of multiple variables, in addition to estimating the direct and mediated effects of other factors that integrate into the causal network of the outcome of interest.[21] In building the model, it was considered that sociodemographic, health, and behavioral characteristics are associated with falls through direct and indirect trajectories. In this scenario, a hypothetical model was developed (**Figure 1**), tested through path analysis,[21] composed of observed variables, represented by rectangles, and classified as endogenous and exogenous. Endogenous variables receive directional arrows and measurement errors are attributed, as specified by the letter "e" in the models.[21]

From the specified hypothetical model (**Figure 1**), three steps for the analysis of structural equation modeling were carried out: data collection, model estimation, and assessment of the adequation of fit.[21] The parameters were estimated using the free asymptotic distribution method, and the fit qualities of the models were evaluated according to the Chi-square test (χ^2) $P > 0.05$; goodness of fit index (GFI) ≥ 0.95; comparative fit index (CFI) ≥ 0.95; Tucker-Lewis Index (TLI) ≥ 0.90; and root mean error of approximation (RMSEA) ≤ 0.05.[21] The hypothetical model was tested, and the adjustments were carried out later. For this purpose, non-significant pathways were eliminated ($P > 0.05$), and modification indices (≥ 11) were calculated.[21]

In the path analysis, the variables of age, morbidities, use of continuous medications, depressive symptoms, functional capacity for BADL and IADL, agility and balance, hand grip strength, sedentary behavior, and falls were used quantitatively, considering for completed years of life; number of morbidities, medications, and depressive symptoms; scores of activities of daily living (BADL/IADL); agility and balance; hand grip strength; sedentary behavior; and number of falls.

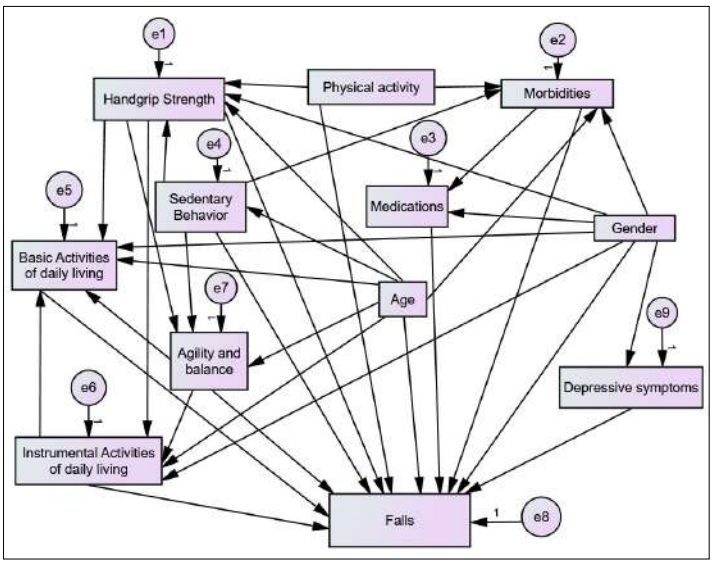

Figure 1. The initial model proposed for the analysis of association between sociodemographic, health, and behavioral variables and the occurrence of falls among older adults according to abdominal obesity, Alcobaça, Bahia, Brazil, 2021.

Direct associations were presented through estimates of standardized coefficients in the trajectories between sociodemographic, health, and behavioral variables and falls. Indirect effects (mediation effects) were determined from the intermediate trajectories of the aforementioned variables. In all tests, type I error was set at 5% (P value < 0.05).

RESULTS

The participants (n = 454) were divided into two groups: those with abdominal obesity (n = 270) and those without (n = 184). In both groups, those aged 60–69 years, married, black, with 1-4 years of education, who lived with someone, and who were sufficiently active (**Table 1**) predominated. Regarding sex and economic class, most participants in the group with abdominal obesity were women and economic class C, and most participants in the group without abdominal obesity were men and classes D-E (**Table 1**).

Table 1. Frequency distribution for sociodemographic and economic characteristics and the physical activity practices among older adults according to abdominal obesity, Alcobaça, Bahia, Brazil, 2021

Variables	Without abdominal obesity		With abdominal obesity	
	n	%	n	%
Gender				
Female	66	35.9	217	80.4
Male	118	64.1	53	19.6
Age group				
60–69	104	56.5	149	55.2
70–79	52	28.3	82	30.4
80 or over	28	15.2	39	14.4
Marital status				
Single	18	9.8	23	8.5
Married	107	58.2	106	39.3
Widowed	29	15.8	92	34.1
Divorced	30	16.3	49	18.1
Race/ethnicity				
White	53	28.8	92	34.1
Black	71	38.6	93	34.4
Brown	60	32.6	83	30.7
Indigenous	0	0	2	0.7
Years of study				
None	59	32.1	88	32.6
1–4	70	38.0	93	34.4
5 or over	55	29.9	89	33.0
Housing arrangement				
Alone	28	15.2	45	16.7
Accompanied	156	84.8	225	83.3
Economic class				
A-B	25	13.6	41	15.2
C	75	40.8	116	43.0
D-E	84	45.7	113	41.9
Physical activity				
Insufficiently active	104	56.5	139	51.5
Sufficiently active	80	43.5	131	48.5

Table 2 lists the means and standard deviations of the variables included in the tested model. Only sex and physical activity were considered dichotomous and inserted into the model according to the presence of abdominal obesity, as shown in **Table 1**.

The prevalence of falls in the study population was 28.6%. The percentage of falls in the last 12 months was 33.0% in the group with abdominal obesity, and 22.3% in the group without abdominal obesity. Further, participants with abdominal obesity were more likely to fall than those without obesity (odds ratio [OR] = 1.71, confidence interval, CI = 1.12–2.74; P = 0.013).

Figure 2 shows the association model of sociodemographic, health, and behavioral variables with the occurrence of falls in

Table 2. Means and standard deviations of sociodemographic, health and behavioral variables included in the model among older adults according to abdominal obesity, Alcobaça, Bahia, Brazil, 2021

Variables	Without abdominal obesity	With abdominal obesity
	Mean (±)	Mean (±)
Age (complete years)	70.26 (8.54)	69.96 (7.89)
Agility and dynamic balance (time in seconds)	6.28 (3.55)	7.14 (5.08)
Medications (number)	2.02 (2.03)	2.83 (2.30)
Sedentary behavior time (min/day)	415.4 (162.9)	436.3 (154.5)
BADL (0 to 12 scale)	0.32 (0.87)	0.28 (0.58)
IADL (7 to 14 scale)	11.52 (2.85)	11.41 (2.70)
Number of depressive symptoms (0 to 15 scale)	2.15 (2.12)	3.00 (2.81)
Handgrip strength (kgf)	26.35 (9.16)	21.86 (7.52)
Morbidities (number)	4.70 (3.93)	6.64 (4.79)
Falls in the last 12 months (number)	0.33 (0.76)	0.72 (1.52)

± = standard deviation; min = minutes; BADL = basic activities of daily living; IADL = instrumental activities of daily living; kgf = kilogram-force.

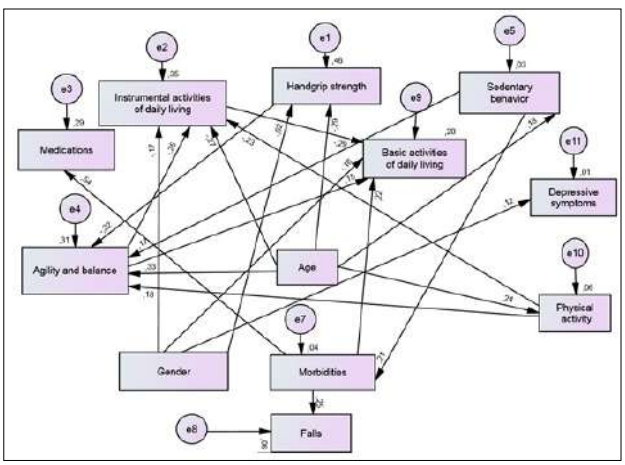

Figure 2. Model used for the analysis of association between sociodemographic, health, and behavioral variables and the occurrence of falls for older adults with abdominal obesity, Alcobaça, Bahia, Brazil, 2021.

the last 12 months in participants with abdominal obesity, with the following quality of adjustment indices: (χ^2 (df = 46) = 66.2, P = 0.03, CFI = 0.97, GFI = 0.96, TLI = 0.95, RMSEA = 0.04). For participants without abdominal obesity, (χ2 (df = 40) = 56.2, P = 0.05, CFI = 0.97, GFI = 0.95, TLI = 0.95, RMSEA = 0.05) was used, and the model is shown in **Figure 3**.

The direct estimators of the associations between the tested variables and the occurrence of falls according to the presence of abdominal obesity are shown in **Table 3**. The number of morbidities was directly associated with the incidence of falls in both groups (β = 0.25; P < 0.001 for abdominal obesity and β = 0.26; P = 0.002 without abdominal obesity), suggesting that the frequency of falls in participants increased with the number of morbidities, regardless of obese status (**Table 3**).

Furthermore, in the group of older adults without abdominal obesity, direct associations were also found between a higher incidence of falls and the lowest number of medications (β = -0.16; P = 0.04), the highest number of depressive symptoms (β = 0.15; P = 0.04), worse performance in the agility and dynamic balance tests (β = 0.37; P < 0.001), and lower functional disability for BADL (β = -0.21; P = 0.006) (**Table 3**).

Regarding indirect mediation of falls, among participants with abdominal obesity, greater exposure to sedentary behavior (β = 0.06), mediated by a greater number of morbidities, was indirectly associated with a greater occurrence of falls (**Figure 2**).

In participants without abdominal obesity, lower functional disability for BADL mediated an association between advanced age (β = 0.05), lower functional disability for IADL (β = 0.06), and a greater occurrence of falls (**Figure 3**). Lower handgrip strength (β = -0.07), advanced age (β = 0.11), and greater exposure to sedentary behavior (β = 0.11), mediated by worse performance in the agility and balance test dynamics, were also indirectly associated with a greater number of falls (**Figure 3**). Furthermore, a greater number of morbidities mediated an indirect association between a greater time spent in sedentary behavior (β = 0.06) and a greater occurrence of falls. A greater number of depressive symptoms also mediated the association between greater functional disability for IADL and the highest number of falls (β = -0.05) (**Figure 3**).

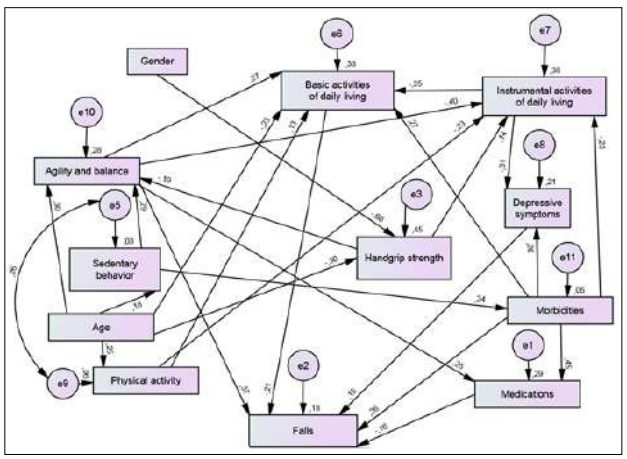

Figure 3. Model for the analysis of the association between sociodemographic, health, and behavioral variables and the occurrence of falls for older adults without abdominal obesity, Alcobaça, Bahia, Brazil, 2021.

Table 3. Direct standardized coefficients for the variables associated with the occurrence of falls among older adults, according to abdominal obesity, Alcobaça, Bahia, Brazil, 2021

Direct effects	With abdominal obesity		Without abdominal obesity	
	Estimator	P*	Estimator	P*
Morbidities	0.25	< 0.001	0.26	0.002
Agility and dynamic balance	-	-	0.37	< 0.001
Number of depressive symptoms	-	-	0.15	0.039
Number of medications	-	-	- 0.16	0.043
BADL	-	-	-0.21	0.006

*P < 0.05; BADL = basic daily living activities.

DISCUSSION

The prevalence of falls among the participants was 28.6%, similar to that found in previous surveys.[2,5,17] Regarding the groups, participants with abdominal obesity had a higher prevalence and chance of falling than those without abdominal obesity, in line with a study carried out in older Americans, who were more likely to suffer recurrent falls.[16] Moreover, a systematic review showed that older adults with obesity were also at higher risk for the occurrence of multiple events other than falls.[18]

Evidence shows that the relationship between obesity and falls can be explained by biomechanics.[18] The anterior position of the body's center of mass is assumed in relation to the ankle joint and the need to increase mass to stabilize it on the base of support.[19] The accumulation of fat in the abdominal region interferes with this postural control mechanism. Thus, the assessment of obesity in the context of preventing falls becomes useful, helping to identify potential risk groups requiring greater interventions.[18]

It should be noted that the use of body mass index (BMI) as the only parameter for the diagnosis of obesity may underestimate the population at risk for falls.[16] This issue highlights the need to adopt other assessment methods, such as waist circumference, which is easy to measure and use. Moreover, efforts should be made to control obesity and its associated diseases.[34]

Regarding the associations found, morbidities played a direct role in the relationship with falls in both groups. This result among older adults without obesity is similar to that found in other studies.[4,5] Chronic conditions are prevalent among older adults and are associated with negative outcomes such as years of life lived with disability and can mainly be attributed to low back pain, age-related

hearing loss, blindness, oral problems, and diabetes.[35] Some of these conditions, such as diabetes, cancer, and arterial hypertension, can intensify physical disability if they worsen,[36] which can predispose to the risk of falls.

In older adults with abdominal obesity, the association between morbidities and falls appears to intensify. Evidence indicates that, in addition to the physiological, physical, sensory, and cognitive changes that occur with the aging process,[1] the accumulation of adipose tissue in the abdominal region is a risk factor for the development of chronic diseases[34] and disability in older adults. [20] These two aspects are also involved in the occurrence of falls.[4,5,8,9,12] The fact that only the number morbidities was associated with falls in this group suggests that the effect of excess abdominal fat on the expression of morbidities seems to be a more important risk factor than other variables.

Morbidities also mediated indirect associations between sedentary behavior and falls in older adults with and without abdominal obesity. Advanced age increases the propensity to spend more time in sedentary behavior, which in turn causes deleterious effects such as exposure to the risk of chronic diseases.[37] Abdominal obesity is also a threat to the emergence of these conditions,[34] which are associated with disability and years of life lost due to premature death.[35]

Although a meta-analysis showed that time spent in sedentary behavior did not increase the chances of being overweight or obese in older adults,[38] there are greater barriers for older people with these conditions to reducing time in sedentary behavior. These include pre-existing health conditions, feeling of pleasure in activities with lower energy expenditure, environments with adaptation problems, presence of fatigue, and difficulty understanding the differences between sedentary behavior and physical activity.[39]

The direct relationship between the longer time spent performing the agility and dynamic balance test and the occurrence of falls in older adults without abdominal obesity was confirmed by evidence from previous studies.[8,9] An indirect association also exists between advanced age and falls, mediated by a longer time spent performing the agility and dynamic balance tests. These relationships can be explained by the changes that occur with the aging process in the sensory system of older adults, which can affect balance control and gait pattern, resulting in difficulty adapting to the environment[40] and performing daily activities.

Still referring to this group, a worse performance in the agility and dynamic balance tests also mediated two other associations: lower handgrip strength and greater exposure to sedentary behavior with the occurrence of falls. Further to advanced age itself being recognized as a factor associated with falls,[2,3,7] it is known that over the years, changes in body composition occur which are related to a greater occurrence of falls,[7] including a reduction in muscle mass[20] and muscle strength[41]. Regarding sedentary behavior, a study carried out in Portuguese older adults showed that a longer time spent in sedentary behavior, regardless of the level of moderate to vigorous physical activity, negatively influences physical fitness components, such as agility and dynamic balance,[42] which are related to falls.[8,9]

A lower number of medications used in older adults without abdominal obesity was associated with a higher risk of falls in this study sample, which differs from other studies.[10,11] A study of Spanish older adults showed that 71% of the participants used medications considered to be at risk for falls, such as antidepressants, antipsychotics, sedatives, opioids, and diuretics, suggesting that the type of medication can also influence the risk of falls, in addition to the amount ingested.[10]

Among older adults without abdominal obesity, the highest number of depressive symptoms was positively associated with the occurrence of falls, which corroborates other studies.[3,6] Clinical symptoms related to depression, such as fear of falling, presence of fatigue, lack of concentration, changes in nutritional status, and gait and balance instability, may predispose to the risk of falls.[43] Thus, there is a need to integrate the assessment of the risk of falls when older people present with symptoms suggestive of depression.[6]

A higher number of depressive symptoms mediated the association between greater functional disability for IADL and falls. The literature confirms the relationship between functional disability for IADL and depressive symptoms[44,45] and falls.[12,13] IADL reflects the ability to socialize and live independently and healthy,[45] therefore, the inability to perform these activities can cause negative feelings, in addition to reducing the stimulation of physical and cognitive capacity.

The present study also found that the lower the functional disability for BADL, the greater the occurrence of falls in older adults without abdominal obesity. This finding differs from those described in the literature.[12] It is inferred that the self-perception that older adults have regarding their ability to perform self-care activities, with little or no help from third parties or adaptive equipment, can increase exposure to situations that predispose to falls.

In addition to the aforementioned finding, lower functional disability for BADL mediated the association between lower disability for IADL and older age with a higher occurrence of falls. Regarding the IADL, the relationship can be explained by the existing hierarchy between these activities and the BADL, since the commitment starts with the IADL, and then affects the BADL.[46] With the human aging process, there is a decline in the sensory system function, which can affect postural stability and displacement,[40] predisposing to the risk of falls and impairing the performance of ADL.

The strengths of this study include the population type and the path analysis approach, which allows the investigation of direct and indirect associations between variables and can help identify risk groups and target more specific interventions. Among the limitations of the study are the cross-sectional design, which did not

allow determination of a causal relationship; the use of subjective and self-reported measures such as BADL and IADL, sedentary behavior, and physical activity practice; and the limited population studied, which was composed only of older people registered in the municipality's Family Health Strategy.

CONCLUSION

A high number of morbidities was the only factor directly associated with falls in older adults with abdominal obesity. Conversely, in the group without abdominal obesity, besides the higher number of morbidities, an association was identified between falls and a higher number of medications, a higher number of depressive symptoms, a longer time to perform the agility and dynamic balance tests, and less functional disability for BADL. This set of findings can help to understand the complexity of factors associated with falls in older adults and allows the identification of individuals at greater risk for falls. In our study, this group was older adults with abdominal obesity.

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The impact of COVID-19 on kidney transplant activities in Brazil: a descriptive study

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ABSTRACT

BACKGROUND: The coronavirus 19 (COVID-19) pandemic has reached services, systems, and world society. Despite its certified efficiency, the Brazilian National Transplant System is not exempt from the side effects of COVID-19.

OBJECTIVE: To compare kidney transplantation activity registered in Brazil between the pandemic (2020) and pre-pandemic (2019) periods.

DESIGN AND SETTING: A descriptive study was conducted in March 2021. The annual reports of the Brazilian Transplantation Registry for 2019 and 2020 were included in this study.

METHODS: We conducted a descriptive study of kidney transplant activity in Brazil in 2019 and 2020.

RESULTS: A 23.9% decrease in kidney transplants per million population was observed during the pandemic period (22.9 in 2020 versus 30.1 in 2019). Kidney transplants with a living donor (-58.8%) and in the North Region (-79.5%) experienced the greatest declines. The pandemic waiting list increased by 6.8%, and deaths during the waiting period increased by 36.8%. The number of patients on the waiting list and transplant teams decreased by 31.3% and 9.5%, respectively.

CONCLUSION: The COVID-19 pandemic drastically affected Brazil and had a significant negative impact on KT activities in the country.

INTRODUCTION

After the outbreak in China, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection has rapidly spread to other countries and continents. The pandemic of coronavirus disease 19 (COVID-19) has reached services, systems, and global society. The first case of COVID-19 in Brazil was confirmed in mid-February 2020, and within days the number of cases increased dramatically.[1] The Brazilian epicenter of COVID-19 was in the southern region, in the city of São Paulo. However, several cities in the north and northeast of the country also experienced alarmingly high numbers of cases and deaths in the first months of the disease's registration.[1] the side effects of COVID-19 go beyond devastating damage to human health and undermine the structure, processes, and outcomes of a nation's services and systems. Despite its certified efficiency, the Brazilian National Transplant System was not exempt from the side effects of COVID-19, and the first negative impact of the pandemic on the organ donation-transplant process in Brazil was observed in the first quarter of 2020.[2]

Compared with the same period in 2019, there was a 9.5% decrease in heart transplants and a 30% and 22.2% decrease in the number of living kidney and liver donors, respectively, in the first quarter of 2020. Of the 27 Brazilian states, only six (22.2%) performed pancreas transplants, and one state in the Northeast saw a 27% decrease in liver transplants. Additionally, there was a significant decrease in the number of transplants for all solid organs in March 2020 compared with January and February [2] which corresponds to the period when records of COVID-19 infections began in the country, resulting in an exponential increase in the number of confirmed cases. Alternatively, we observed an increase in the rate of effective donors compared to the same period in 2019, especially due to the sharp decrease in the family rejection rate, which was below 40% for the first time.[2]

Analysis of pre-pandemic data showed that between 1995 and 2015, Brazil averaged 20 kidney transplants per million population per year. The absolute number of kidney

transplants during this period grew by 308%.[3] Between 2015 and 2019, the country continued to perform well in kidney and other solid organ transplantation, ranking prominently in the world. Therefore, the question underlying this study was: how has the COVID-19 pandemic affected kidney transplant activity in Brazil in 2020?

OBJECTIVE

To compare the kidney transplantation activities registered in Brazil between the pandemic (2020) and pre-pandemic (2019) periods.

METHODS

This is a descriptive study conducted in March 2021. The annual reports of the Brazilian Transplantation Registry for 2019 and 2020 were included in this study. Data from the Brazilian Transplantation Registry are compiled by the Brazilian Organ Transplantation Society,[4] which analyzes and publishes various information on national transplant activity in Brazil on a quarterly basis. The figures were reported to the Brazilian Organ Transplantation Society by the hospitals that performed the transplants. In this sense, the demand for kidney transplantation in the Brazilian Transplantation Registry is also presented as raw data calculated on the basis of the information provided by each service. Currently, there are approximately 160 kidney transplant centers in Brazil, distributed among the five geographic regions of the country. All data are presented in the Brazilian Transplant Registry as raw data based on information provided by individual facilities. Therefore, the number of facilities submitting data to the Brazilian Organ Transplantation Society may vary from year to year, justifying possible differences in the sum of data in each year.

Data collection

Numerical information was extracted from the following variables: annual kidney transplantation, the number of patients already enrolled, added and deceased on the kidney transplant waiting list; number of kidney transplant teams. Data on the incidence of COVID-19 in Brazil at the end of 2020 were obtained from the official epidemiological report released by the Ministry of Health.[5] Data were collected using a standardized form and subsequently tabulated in a Microsoft Excel spreadsheet.

Kidney transplant data were stratified considering donor type (living and deceased donors) and geographical region. The kidney transplant waiting list was stratified considering the general number and number of deaths on the waiting list. The number of kidney transplant teams includes all teams that performed at least one kidney transplant each year.

Statistical analysis

All statistical analyzes were performed in the Microsoft Excel, version 2010, and we present descriptive data for all variables of interest. Data from the pandemic (2020) and pre-pandemic (2019) periods were compared by calculating the percentage difference between the years of interest.

Ethical approval

We analyzed data from the Brazilian Transplantation Registry, which was made publicly available by the Brazilian Organ Transplantation Society. since we used publicly available data, it was not necessary to obtain formal consent for developing the study because the data were publicly available, patients were not identified, and sources were accurately cited.

RESULTS

Kidney transplantation activities

During the pandemic and pre-pandemic periods, 22.9 and 30.1 kidney transplants per million population were performed, respectively, a 23.9% decrease from the COVID-19 era. The largest decreases occurred in living donor kidney transplants (-58.8%) and in the Northern region (-79.5%) (**Table 1**). The percentage difference between kidney transplant volume and estimated demand was higher in the pandemic period (61.8%) than in the pre-pandemic period (49.8%) (**Table 2**). Analyzing data from each Brazilian state, we found that the decrease in kidney transplantation procedures was consonant with the increase in the incidence of COVID-19 (**Figure 1**).

Table 1. Kidney transplant* in the pandemic and pre-pandemic period, by donor type and region

Kidney transplant	Pandemic period (2020)	Pre-pandemic period (2019)	Percentual difference
Donor type			
Living	2.1	5.1	-58.8
Deceased	25.0	20.8	+20.2
Region			
South	34.7	46.6	-25.5
Southeast	30.9	38.1	-18.9
Midwest	18.7	20.3	-7.8
North	0.9	4.4	-79.5
Northeast	12.5	20.2	-38.1
Brazil	22.9	30.1	-23.9

*Expressed by 1 000 000 of population.

Source: Brazilian Transplantation Registry/Brazilian Organ Transplantation Society.

Waiting list and transplant teams

During the pandemic period (2020), there were 26,862 patients on the kidney transplant waiting list, compared with 25,163 during the pre-pandemic period, an increase of 6.8% (**Figure 2A**). The number of patients newly added to the waiting list decreased by 31.3% and was 9,064 in the pandemic period and 13,194 in the pre-pandemic period (**Figure 2B**). The number of patients who died on the waiting list before receiving a kidney transplant increased by 36.8% and to 1,780 in the pandemic period and 1,301 in the pre-pandemic period (**Figure 2C**). The number of transplant teams was 133 during the pandemic period and 147 in the pre-pandemic period, a decrease of 9.5% (**Figure 2D**).

Table 2. Kidney transplant volume and estimated demand, according to the period of report

Period	Kidney transplants	Estimated demand	Percentual difference
Pandemic (2020)	4,805	12,609	61.8
Pre-pandemic (2019)	6,283	12,510	49.8

Source: Brazilian Transplantation Registry/Brazilian Organ Transplantation Society.

DISCUSSION

Considering the growth curve of the number of COVID-19 cases in June 2020, it is likely that the pandemic in Brazil is far from over and could break out again with a heterogeneous geographic distribution, given that the country is the size of a continent. It is worth noting that despite the pandemic, there are still other diseases, such as chronic kidney disease, that maintain their natural course and tend to more severe stages. According to the Brazilian Dialysis Census, the number of patients requiring renal replacement therapy has increased significantly recently.[6] Kidney transplantation can improve life expectancy and quality of life for patients with chronic kidney disease, but the COVID-19 outbreak has had a significant impact on the kidney transplant activity in Brazil.

As shown in **Table 1**, the number of kidney transplants from living donors decreased significantly (-58%), the national rate decreased from 30.1 to 22.9 transplants per million population (-23.9%), and the North was the region the greatest negative impact (-79.5%). It is noteworthy that the North region already had low transplant activity in previous years due to the scarcity of available resources. With the outbreak of the COVID-19 pandemic, the numbers decreased even further as the region suffered from the severe impact of the pandemic on its population.

Alternatively, the South and Southeast regions already have a higher base volume and have more active services, including

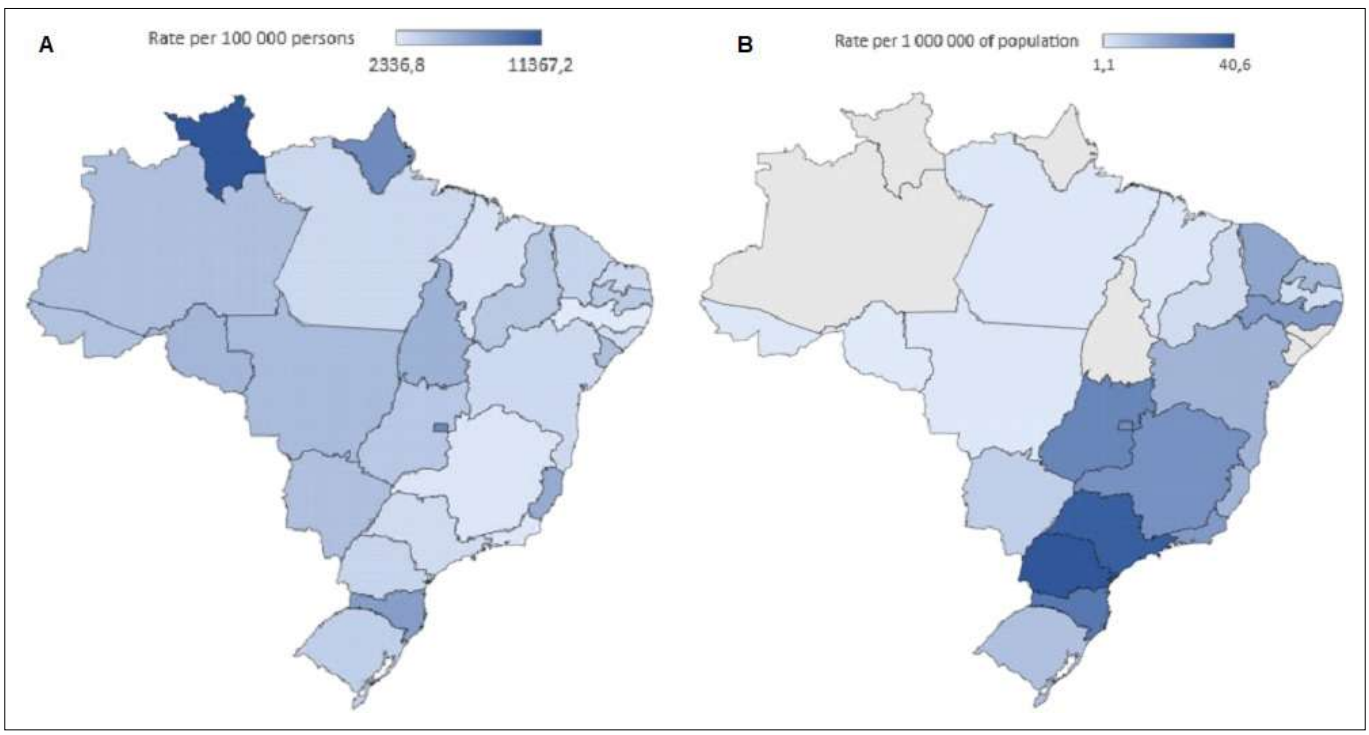

Figure 1. Regional rate in coronavirus disease 2019 (COVID-19) cases, (A) and kidney transplantation (KT) procedures; (B) during pandemic period (2020).

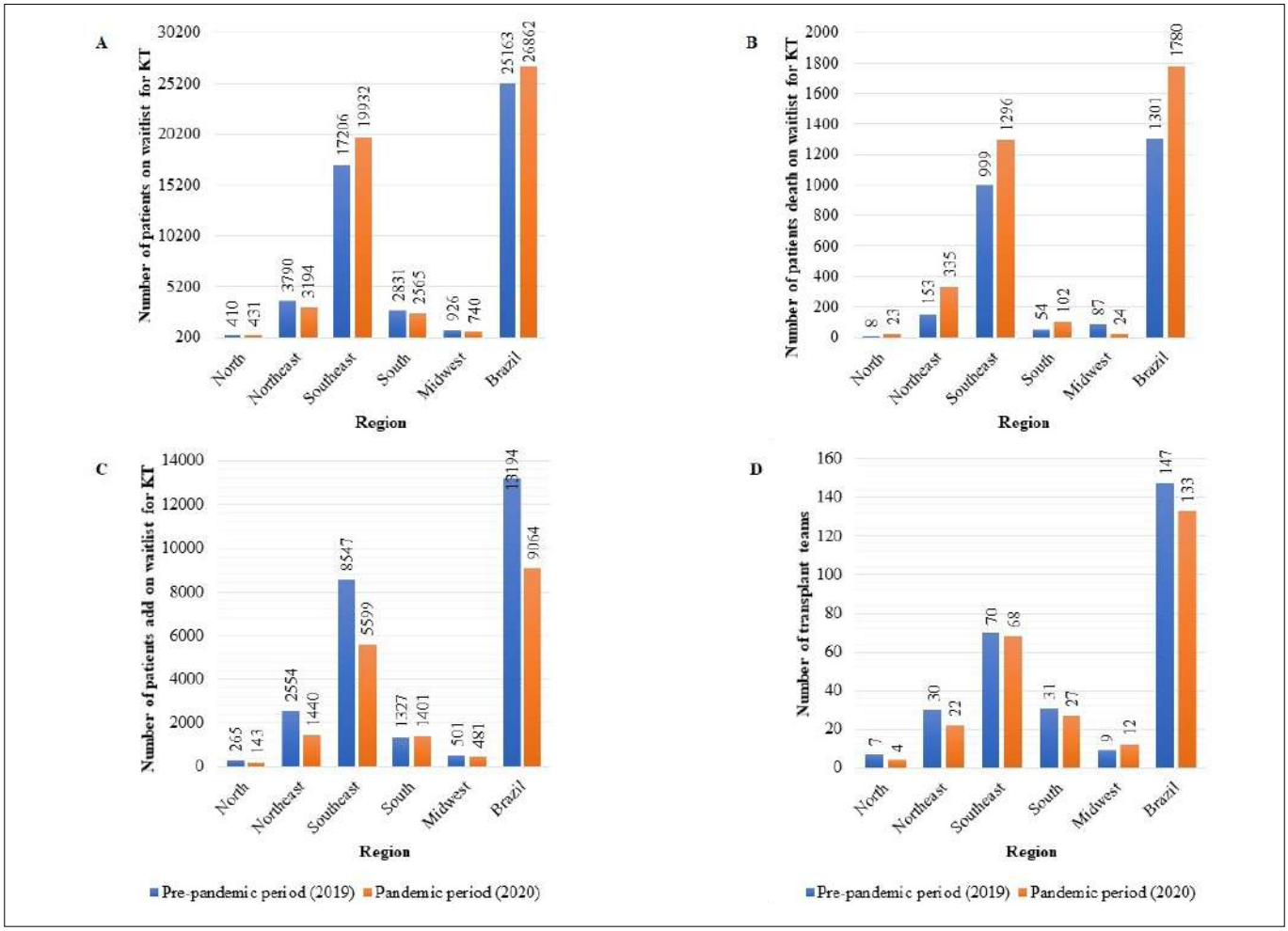

Figure 2. Number of patients on waitlist (A), that died on waitlist (B) and add (C) on kidney transplantation (KT) waitlist and number of transplant teams (D) in Brazil, according to the period of evaluation.

exclusive hospitals for transplantation, which have not become an open door for patients with COVID-19, as in the case of Hospital do Rim in São Paulo. In the Northeast region, there are few services, but they are very active. However , the transplant centers in the region are located in general hospitals, but due to the progression of the pandemic, these hospitals have become reference services for the care of patients with COVID-19.

This negative outlook has also been observed in other countries,[7] such as the United Kingdom, where the kidney transplant rate has decreased by 68%[8] and an estimated 1,670 kidney transplant opportunities have been lost, which will mean an increase in the number of patients in renal replacement therapy and on the waiting list.[9] In the United States, kidney transplantation by living and deceased donors has decreased to 24% and 87%, respectively.[10]

A study conducted in Italy found that the number of kidney transplants at the beginning of the outbreak COVID-19 remained stable compared with previous years.[11] In France, the decrease in deceased donor transplants was 90.6%.[12] In Spain, 49 (76.6%) of 64 kidney transplant centers suspended activities, and 9.4% imposed restrictions during COVID -19.[13] Kidney transplant rates also decreased significantly in Japan, Canada, Austria, the Netherlands, and Switzerland after the COVID-19 outbreak.[7] An international survey found that 75% of Latin American kidney transplant centers stopped seeking living donor candidates after the COVID-19 pandemic.[14] As the data show, the percentage decrease in the number of kidney transplants in Brazil (-23.9%) was acceptable compared with other developed countries, confirming the robustness of the Brazilian National Transplant Program.

Among the aspects that prevented the maintenance of kidney transplantation rates during the pandemic were the necessary distancing and social isolation, which made it difficult for patients to access health professionals and services; the lack of inpatient beds, especially in intensive care units; difficulties in the logistics of transporting organs from the collection facility to the kidney transplant center; the lack of human, material, and financial resources more focused on treating patients infected with COVID-19; and

the collapse of health services, particularly in low- and middle-income countries.

The number of deaths from traumatic causes decreased, which also contributed to the reduction in donor numbers. Hospitals were over-extended with COVID-19 patients and many professionals were directed to the front line, which impacted communication to potential donors. Many transplant hospitals have become health services dedicated to patients with COVID-19, reducing and even suspending transplant activities for prolonged periods, in the interest of patient protection.

As shown in **Table 2**, the COVID-19 pandemic increased the percentage difference between the demand and supply of kidneys for transplantation. However, being a country with a large geographic area, the decline in kidney transplantation in Brazil shows considerable variation among the different regions of the country (**Table 1**). The decline in kidney transplantation rates showed a geographic distribution related to the increase in COVID-19 contamination rates (**Figure 1**). The availability of resources in a region directly impacts kidney transplantation rates, as this is a factor that has contributed to the suspension or reduction in activity.[7,14] Additionally, the risk of contamination of recipients with COVID-19 virus is one of the most important clinical problems and a reason for the suspension of living donor transplants and the restriction of deceased donor transplants to be performed only after rigorous epidemiologic screening, according to the original recommendations of the American Society of Transplantation.[15]

For Brazilian kidney transplant programs, the recommendation of the Brazilian Organ Transplantation Society is that the donor-transplant process not be suspended as much as possible for the following reasons: 1) patients in need of a liver, heart, or lung will have their lives saved by a transplant, whose death is inevitable if the procedure is not performed within weeks or months; 2) in Brazil, an average of 6,000 kidney transplants are performed per year; for this reason, suspension of these procedures would lead to an increase in patients needing renal replacement therapy and an increase in the number of deaths of patients on the waiting list; 3) corneal and pancreatic transplants can be expanded, but not completely eliminated, as they are crucial in certain situations; 4) organ harvesting must be maintained in compliance with the rules of the Brazilian Organ Transplantation Society infection committee, with regard to the necessary care to avoid contamination by COVID-19; 5) if there are restrictions in performing transplants in a particular hospital, it is recommended to refer patients or even organs to the nearest service that can perform the procedure.[16]

The recommendations of the Brazilian Organ Transplantation Society for Brazilian programs to maintain kidney transplantation activity are plausible and defensible. During the pandemic period, the number of patients on the waiting list increased (**Figure 2A**), but the number of new patients added to the waiting list decreased (**Figure 2B**). These data are consistent with other studies conducted worldwide, and several countries have implemented strategies to minimize the impact of COVID-19 on kidney transplant program activity.[7,14]

The inactivity of the waiting list may have an impact on the congestion of Brazilian dialysis centers in the period after COVID-19, as is likely to be the case in other countries.[7] Despite global concern about infection of kidney transplant recipients with the SARS Cov-2 virus, a study conducted in the United States has shown that patients on the waiting list are at significantly higher risk of hospitalization and death compared with kidney transplant recipients.[17] In the United Kingdom, 10% of patients on the waiting list and with COVID-19 died.[18] In France, 42% of deaths of patients on the waiting list were attributable to COVID-19.[19] We cannot retrieve specific Brazilian data; however, we verified that the number of deaths on the waiting list increased during the pandemic period (**Figure 2C**). The most recent report from the Brazilian Organ Transplantation Society found that the deaths among patients on the kidney transplant waiting list increased by 40% in the first quarter of 2021 compared with the same period last year.[20]

Another negative finding was the decrease in the number of transplant teams (**Figure 2D**). One of the possible reasons for this may have been the need to redirect health professionals to the front line in treating patients infected with COVID-19. The delay in initiating containment measures, and especially the delay in vaccinating the population, had devastating consequences for the public health system in our country.[21] The fact that the Brazilian government considered SARS-Cov-2 infection as just another common infection at the beginning of the outbreak and delayed the national response to the pandemic may have contributed much to the inexorable increase in the number of deaths and cases of COVID-19 in the country.

Despite the political negligence, the Transplant Infections Committee of the Brazilian Organ Transplantation Society has presented several recommendations for Brazilian health services performing kidney transplants, including Donor management (with the epidemiological investigation of suspected or confirmed cases of SARS-CoV-2; clinical investigation of respiratory symptoms; laboratory investigation with reverse transcription-polymerase chain reaction test for SARS-CoV-2 of respiratory samples, depending on the availability of the test); Establishment of criteria for acceptance of organs (no recommendation to use organs from donors with active COVID-19); criteria for evaluation of kidney transplant candidates (perform only one emergency transplant in a candidate with active COVID-19, candidates with active COVID-19 are cleared for transplant 28 days after infection).[22] As in Brazil, the United States,[10] Canada,[23] Spain,[13] Italy,[11] the United Kingdom,[9] and the Netherlands[24] implemented good organ donation and transplantation practices during the COVID-19 pandemic.

Future perspectives

The Brazilian Transplant System is an international reference, mainly because of the financial subsidy of almost all transplants by the public health system.[25] However, looking to the post-COVID-19 era, we believe that Brazil will have a gradual, slow, and regionalized recovery, both in terms of the good kidney transplant rates that the country had in the pre-pandemic period and in several other areas. The inequality of income and resources among Brazilian regions was even greater during COVID-19, and integration among the system, health services, and society will be essential for the country's recovery.

CONCLUSION

The COVID-19 pandemic has drastically affected Brazil and had a significant negative impact on kidney transplant activity in the country. This is the first study to analyze national data on kidney transplant activity in the first year of the pandemic and compare it with the previous period. The results may help policymakers and transplant center managers implement strategies to help the Brazilian National Transplant System regain its world-leading position.

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Quality of life in older adults according to race/color: a cross-sectional study

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ABSTRACT

BACKGROUND: Increased longevity is accompanied by new social and health demands, such as the race/color social construct, indicating the need to identify the specific needs of older adults to maintain and improve their quality of life.

OBJECTIVE: We aimed to verify the direct and indirect associations of demographic, economic, and biopsychosocial characteristics with self-assessed quality of life in older adults according to race/color.

DESIGN AND SETTING: This cross-sectional study included 941 older adults living in the urban area of a health microregion in Minas Gerais, Brazil.

METHODS: Older adults were divided into three groups: white (n = 585), brown (n = 238), and black (n = 102) race/color. Descriptive and trajectory analyses were performed ($P < 0.05$).

RESULTS: Among the three groups, worse self-assessed quality of life was directly associated with lower social support scores and greater numbers of depressive symptoms. Worse self-assessed quality of life was also directly associated with a higher number of functional disabilities in basic activities of daily living and the absence of a partner among older adults of brown and black race/color. Lower monthly income and higher numbers of morbidities and compromised components of the frailty phenotype were observed among participants of white race/color, as well as lower levels of education in the brown race/color group.

CONCLUSION: Factors associated with poorer self-assessed quality of life among older adults in the study community differed according to race/color.

INTRODUCTION

Increased longevity is accompanied by new social and health demands, indicating a requirement to meet the specific needs of older populations in order to maintain and improve their quality of life (QoL).[1-4]

QoL is defined as "the individual's perception of their position in life in relation to the context and value systems in which they are inserted, as well as their goals, expectations, standards, and concerns."[5] This definition highlights the complexity of the relationships among components, such as physical and psychological health, level of functional independence, social support, and interaction with the environment.[6]

Several factors can negatively influence the QoL of older adults, including the presence of comorbidities and depressive symptoms,[1] decreased social support,[2,3] poor physical performance,[2] and frailty,[7] denoting the need to maintain health in these biopsychosocial aspects.[1,2] In an international survey of older adults, sociodemographic characteristics (female sex and low levels of education) were the main factors associated with worse QoL.[4] In addition, a national investigation showed better QoL in white older adults compared to brown and black older adults regarding sociodemographic indicators and health conditions.[8]

Race/color is a social construct,[9] expressed by self-reported skin color; this concept was adopted by the Brazilian Institute of Geography and Statistics when conducting the main demographic censuses.[10] The presence of racial inequalities among older adults suggests that race/color is a marker of social position,[9] which also reflects the distinct distribution of risk, protection, and health hazards that accumulate throughout life.[8]

The use of racial lines in epidemiological studies contributes to the analysis of the social implications of race/color on the health of different population groups.[8-9,11] However, despite investigations identifying the differences in health and social conditions among older adults according to

race/color,[4,8-9] it is questionable whether worse self-assessed QoL can be directly attributed to racial issues and demographic, economic, and biopsychosocial factors.

Furthermore, no previous studies have assessed the relationships among these variables in older adults considering race/color and have only used models previously tested in mediation analysis. Given the complexity of these relationships, analyses that consider direct and indirect effects, such as structural equation modeling, are required for simultaneous analysis of the dependence relationship and interrelation of multiple variables, as well as estimated the direct effects mediated by other factors integrated in the causal network of the outcomes of interest.[11-12]

OBJECTIVE

The objective of this study was to verify the direct and indirect associations of the demographic, economic, and biopsychosocial characteristics with self-assessed QoL in older adults according to race/color.

METHODS

Design

This cross-sectional and analytical study was guided by the Strengthening the Reporting of Observational Studies in Epidemiology[13] Statement and conducted in a developed urban area of a health microregion in Minas Gerais (MG), Brazil.

Sample

A multiple-stage cluster sampling technique was used for population selection. The sample size calculation considered the coefficient of determination as $R^2 = 0.02$ in a multiple linear regression model with 12 predictors, a significance level or type I error of $\alpha = 0.05$, and a type II error of beta (β) of 0.2, resulting in a priori statistical power of 80%. Using the Power Analysis and Sample Size application (version 13; NCSS, LLC, Kaysville, Utah, United States) introducing the values described above, a sample size of at least 798 older adults was obtained. Considering a sample loss of 20%, the final number of interview attempts was 958.

Older adults aged 60 years or older living in the urban area of a health microregion in Minas Gerais, Brazil were included in the study. We excluded institutionalized older adults and older adults with communication problems such as those associated with deafness not corrected by devices, severe speech disorders, and cognitive decline, as assessed by the Mini Mental State Exam.[14]

Nine hundred and fifty-six older adults were interviewed; 31 were excluded because they presented with cognitive decline. Thus, 925 older adults were ultimately included in this study.

Data collection

The interviews took place in the participants' homes from March 2017 to June 2018.

Explanatory and adjustment variables

Self-assessed QoL was measured using the question, "How would you rate your quality of life?" in accordance with the World Health Organization Quality of Life, Short Form (WHOQOL-BREF) questionnaire.[6]

Demographic data and morbidities were obtained using a structured questionnaire developed by the researchers of this study based on the literature.

Regarding functional capacity, the activities of daily living (ADL) were evaluated as follows: basic (basic ADL),[15] instrumental (IADL),[16] and advanced (AADL).[17] Basic ADL were measured using the Katz Index of Independence in Activities of Daily Living,[15] and the Lawton and Brody Instrumental Activities of Daily Living Scale[16] for IADL. AADL were verified using the Scale of Advanced Activities of Daily Living, which includes 13 questions of a social nature.[17] The activity performance in each of these scales was considered, with higher scores for basic ADL and lower scores for IADL and AADL indicating greater functional disability.

To verify depressive symptoms, we used the abbreviated Geriatric Depression Scale, which is comprised of 15 questions, with a total score ranging from 0–15 points.[18]

Frailty syndrome was identified through the five components of the frailty phenotype: 1) unintentional weight loss, 2) self-reported exhaustion or fatigue, 3) decreased muscle strength, 4) slow walking speed, and 5) low level of physical activity,[19] as described in a previous study.[20]

The Brazilian version of the Short Physical Performance Battery was used to measure physical performance,[21] with a higher score indicating better physical performance.

Social support was measured using the Social Support Scale, with the final score ranging from 20–100 points; the higher the score, the better the level of social support.[22]

Data analysis

We built an electronic database with double entries using Excel (Microsoft Corp., Redmond, Washington, United States). The analysis was performed using Statistical Package for Social Sciences (version 24; IBM Corp., Armonk, New York, United States), and Analysis of Moment Structures software (version 24; IBM Corp.).

The data were subjected to descriptive analysis. We considered that demographic, economic, and biopsychosocial characteristics were associated with self-assessed QoL through direct and indirect trajectories and developed a hypothetical model (**Figure 1**), which was tested through trajectory analysis[12] and composed of observed

variables, represented by rectangles and classified as endogenous and exogenous. Endogenous variables are indicated by directional arrows and measurement errors are specified by "e" in the models.[12]

The parameters were estimated using the asymptotic distribution-free method, and the adjustment qualities of the models were assessed according to the chi-square test (χ^2) with $P > 0.05$; goodness of fit index ≥ 0.95; comparative fit index ≥ 0.95; Tucker-Lewis index ≥ 0.90; and root mean error of approximation ≤ 0.05.[12] First, we tested the hypothetical model, and then re-specifications were conducted. For this purpose, non-significant pathways ($P \geq 0.05$) were eliminated and modification indices (≥ 11) were calculated.[12]

In the trajectory analyses, age, education level, morbidities, functional capacity, depressive symptoms, frailty, physical performance, and social support were used in quantitative forms, including complete years of life, years of completed studies, number of morbidities, basic ADL/IADL/AADL scores, number of depressive symptoms, number of compromised components of the frailty phenotype, and physical performance and total social support scores.

In the analyzed model, the direct effects were presented through estimates of the standardized coefficients of the trajectories among the demographic, economic, and biopsychosocial variables and the self-assessed QoL. Furthermore, indirect effects were determined from intermediate trajectories among the aforementioned variables. For all tests, the type I error was set at 5% (P value < 0.05).

Ethical considerations

This study was approved on May 9, 2017 by the Research Ethics Committee of Universidade Federal do Triângulo Mineiro (protocol number 2, 053, 520).

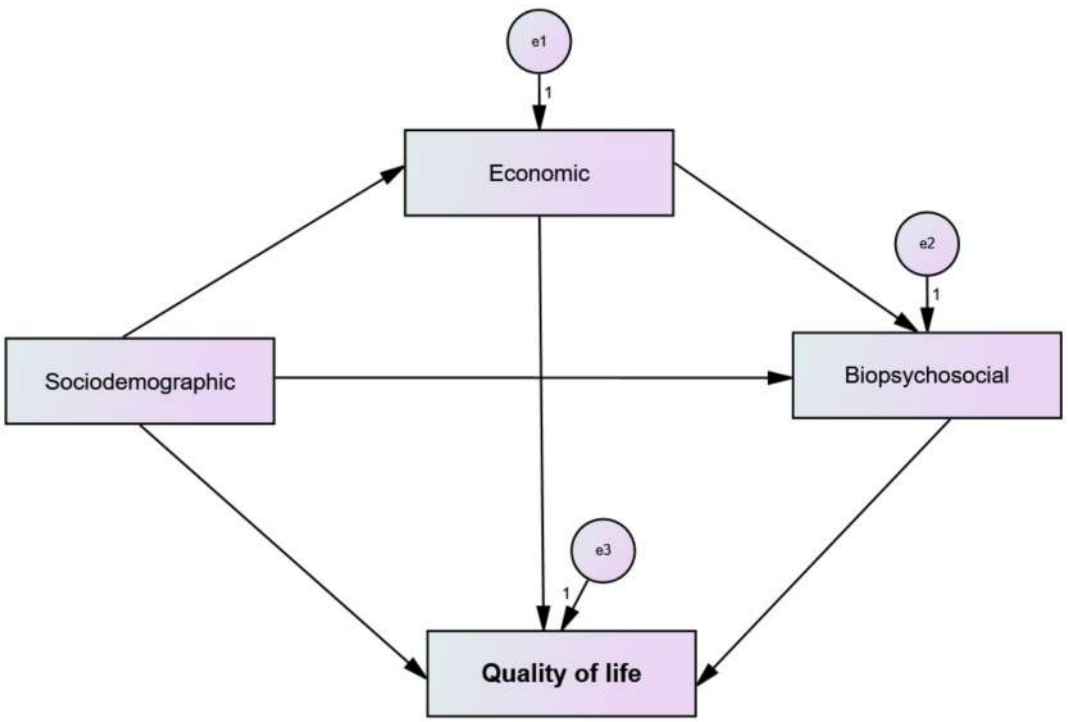
RESULTS

The majority of participants were self-declared white (63.2%, n = 585), followed by brown (25.7%, n = 238), and black (11.1%, n = 102) race/color. Among the three groups, the highest percentages were observed in older adult women, aged 70–80 years, with an individual monthly income of 1 minimum wage, unmarried, and a self-rated QoL of good (**Table 1**).

The means and standard deviations of the sociodemographic and biopsychosocial variables included in the model according to race/color in older adults in a health microregion of Brazil are shown in **Table 2**.

Figure 2 shows the associations of demographic, economic, and biopsychosocial variables with the self-assessed QoL according to race/color in older adults in a health microregion of Brazil: white, brown, and black race/color.

In the three race/color groups (white, brown, and black), we found that a lower level of social support and presence of depressive symptoms were directly associated with worse self-assessed QoL (**Table 3**).



1 = individual reliability; e1= measurement error 1; e2 = measurement error 2; e3 = measurement error 3.

Figure 1. Hypothetical model.

Among older adults of brown and black race/color, a higher number of functional disabilities in basic ADL and absence of a partner were directly associated with worse self-assessed QoL (**Table 3**).

In older adults of white race/color, lower individual monthly income, higher number of morbidities, and higher number of compromised components of the frailty phenotype were directly associated with worse self-assessed QoL (**Table 3**). Female sex, mediated by lower individual monthly income, lower social support score, and higher number of morbidities, presented an indirect association with worse self-assessed QoL among older adults of white race/color. In this group we also found that lower education level and older age, mediated by lower monthly individual income and frailty, was indirectly associated with worse self-assessed QoL.

Table 1. Distribution of demographic and economic characteristics and self-assessed quality of life according to race/color of older people in a health microregion of Minas Gerais, Brazil in 2018

Variables	Race/color					
	White		Brown		Black	
	n	%	n	%	n	%
Sex						
Female	403	68.9	157	66.0	61	59.8
Male	182	31.1	81	34.0	41	40.2
Age group						
60–70 years	209	35.7	96	40.3	39	38.2
70–80 years	239	40.9	98	41.2	49	48.0
80 years or older	137	23.4	44	18.5	14	13.8
Individual monthly income, in minimum wages						
No income	30	5.1	13	5.5	6	5.9
< 1	11	1.9	11	4.6	3	2.9
1	280	47.9	120	50.4	56	54.9
1–3	221	37.8	88	37.0	33	32.4
3–5	29	5.0	4	1.7	4	3.9
> 5	14	2.3	2	0.8	0	0.0
Marital status						
With partner	252	43.1	103	43.3	40	39.2
Without partner	333	56.9	135	56.7	62	60.8
Self-assessed quality of life						
Very bad	6	1.0	3	1.3	1	1.0
Bad	28	4.8	13	5.5	0	0.0
Neither bad nor good	134	22.9	55	23.1	18	17.7
Good	333	56.9	144	60.5	64	62.7
Very good	84	14.4	23	9.7	19	18.6

Table 2. Distribution of means and standard deviations of the demographic and biopsychosocial variables included in the model according to race/color of older people in a health microregion of Minas Gerais, Brazil in 2018

Variables	Race/color		
	White	Brown	Black
	Mean (±)*	Mean (±)*	Mean (±)*
Age (complete years of life)	73.9 (8.10)	72.4 (8.05)	71.6 (6.99)
Literacy (total years of study)	5.0 (4.20)	3.4 (3.13)	3.0 (3.01)
Morbidities	6.5 (3.38)	6.8 (3.46)	5.7 (3.30)
Basic activities of daily living (0–6 scale)	0.9 (0.34)	0.9 (0.35)	0.6 (0.23)
Instrumental activities of daily living (7–21 scale)	17.9 (3.16)	17.5 (3.38)	18.3 (2.81)
Advanced activities of daily living (0–13 scale)	5.5 (2.46)	5.0 (2.34)	5.14 (2.28)
Depressive symptoms (0–15 scale)	3.5 (3.33)	3.7 (3.42)	2.8 (2.60)
Frailty (0–5)	1.6 (1.37)	1.4 (1.23)	1.5 (1.50)
Physical performance (0–12 scale)	8.0 (3.24)	8.3 (3.05)	8.2 (3.27)
Social support (20–100 scale)	87.9 (16.87)	87.8 (17.3)	90.2 (14.68)

*± standard deviation.

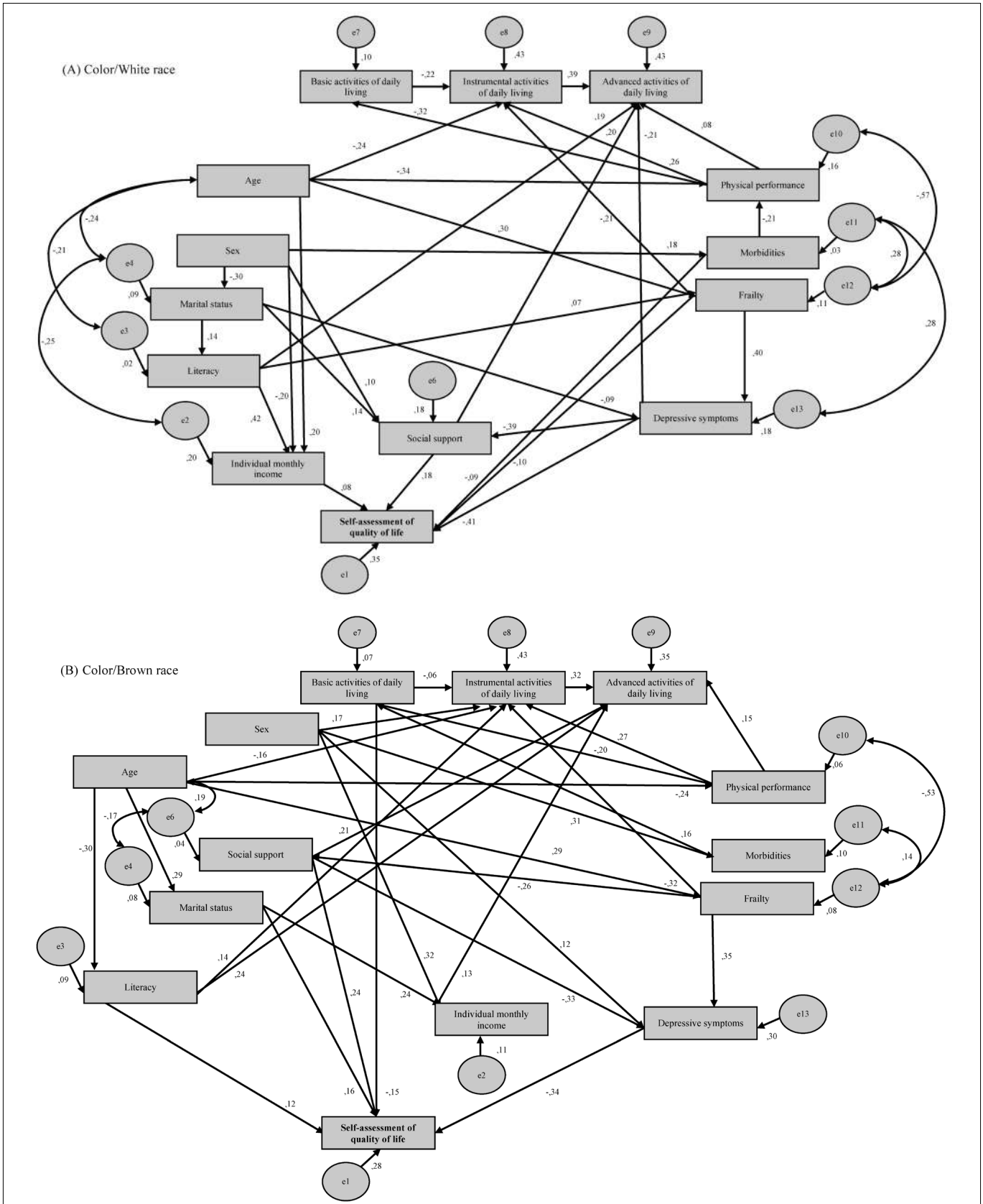


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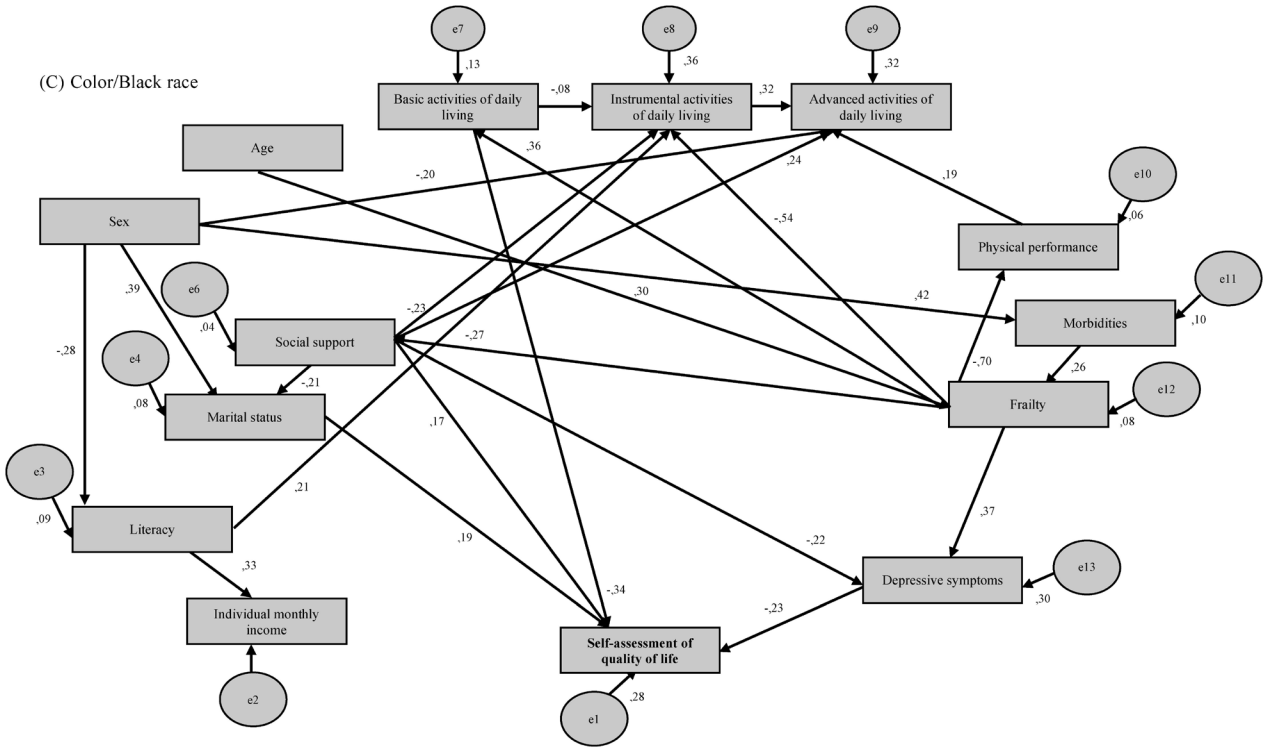
Figure 2. Models for analyzing the associations between demographic, economic, and biopsychosocial variables with self-assessed quality of life according to race/color of older people in a health microregion of Minas Gerais, Brazil.



(A) (χ2 (gl = 55) = 98.6; P < 0.000; comparative fit index = 0.98; goodness of fit index = 0.98; Tucker-Lewis index = 0.97; root mean error of approximation = 0.036); (B) χ2 (gl = 56) = 96.3; P = 0.001; goodness of fit index = 0.95; goodness of fit index = 0.95; Tucker-Lewis index = 0.91; root mean error of approximation = 0.050; (C) (χ2 (gl = 66) = 72.0; P = 0.286; comparative fit index = 0.98; goodness of fit index = 0.92; Tucker-Lewis index = 0.97; root mean error of approximation = 0.030).

Figure 2. Models for analyzing the associations between demographic, economic, and biopsychosocial variables with self-assessed quality of life according to race/color of older people in a health microregion of Minas Gerais, Brazil.

Table 3. Direct standardized coefficients for the variables associated with self-assessed quality of life according to race/color of older people in a health microregion of Minas Gerais, Brazil in 2018

Direct effects	Race/color					
	White		Brown		Black	
	Estimator	P*	Estimator	P*	Estimator	P*
Self-assessed quality of life						
Individual monthly income	0.08	0.013	-	-	-	-
Marital status	-	-	0.16	0.005	0.19	0.026
Age	-	-	-	-	-	-
Literacy	-	-	0.12	0.031	-	-
Morbidities	-0.09	0.017	-	-	-	-
Basic activities of daily living	-	-	-0.15	0.006	-0.34	P < 0.001
Instrumental activities of daily living	-	-	-	-	-	-
Advanced activities of daily living	-	-	-	-	-	-
Depressive symptoms	-0.41	P < 0.001	-0.34	P < 0.001	-0.23	0.013
Frailty	-0.10	0.009	-	-	-	-
Physical performance	-	-	-	-	-	-
Social support	0.18	P < 0.001	0.24	P < 0.001	0.17	0.050

*P < 0.05.

The absence of a partner, mediated by a lower score for social support and a higher number of depressive symptoms (β = 0.02 and β = 0.04, respectively), was indirectly associated with worse self-assessed QoL.

In the group of older adults of brown race/color, a lower education level was directly associated with worse self-assessed QoL (**Table 3**). Lower physical performance (β = 0.03) and higher number of morbidities (β = -0.02), mediated by functional disability in basic ADL, were indirectly associated with worse self-assessed QoL. Older age mediated by education level (β = -0.04), as well as younger age mediated by the absence of a partner (β = 0.05), was associated with worse self-assessed QoL. A higher number of depressive symptoms and lower social support score mediated the association between a higher number of compromised components of the frailty phenotype and worse self-assessed QoL (β = -0.12 and β = -0.06, respectively). Female sex, mediated by a higher number of depressive symptoms (β = 0.04), was indirectly associated with worse self-assessed QoL.

Among older adults of black race/color, a greater number of compromised components of the frailty phenotype, mediated by a greater number of depressive symptoms, functional incapacity in basic ADL, and lower social support scores (β = -0.08; β = -0.12; and β = -0.04, respectively), were indirectly associated with worse self-assessed QoL. Female sex, mediated by the absence of a partner (β = 0.07), was indirectly associated with worse self-assessed of QoL.

DISCUSSION

In this study, regardless of race/color, decreased social support was directly associated with worse self-assessed QoL and mediated by most indirect associations. In line with these results, a survey of Brazilian older adults revealed that the best self-assessed QoL was observed among older adults who met friends frequently and received social, material and emotional support from spouses, other relatives, and first-generation descendants.[2] An investigation of older adults in Turkey found that the greater the social support, the better the self-assessed QoL.[3] However, these surveys did not consider the effect of race/color on QoL. Older adults with less social support are more vulnerable to depressive symptoms, negative affect, and feelings of loneliness,[2-3,23-24] which are associated with increased morbidity and mortality and worsening of self-assessed QoL.[23-24]

In the current study, we found that less social support and a higher number of depressive symptoms were also associated with worse self-assessed QoL among the three groups, similar to previous studies[1,25-28] conducted in the same community; however, these studies did not consider race/color. These results emphasize the importance of monitoring older adults through screenings for depressive symptoms to prevent the development of the disease and adverse QoL outcomes. These findings also highlight the relevance of actions aimed at the mental health of this population, with the objective of preventing and minimizing depressive symptoms through therapeutic groups, psychological monitoring, and encouragement to practice physical exercise and participate in social activities.[29]

The association between the greater number of functional incapacities for basic ADL and worse self-assessed QoL among brown and black older adults observed in this study is partially consistent with that observed in a study conducted in the Northeast with a predominance of people of brown and black race/color.[30] The authors assessed QoL in older adults and found that older adults of black race/color had worse QoL values compared with whites and mixed race when assessing the physical domain of QoL.[31]

The absence of a partner was another factor that negatively affected the QoL of older adults of brown and black race/color in the current study, similar to the results of another survey.[8] The authors justified that single older people of black race/color had worse levels of social support in terms of frequency and diversity of contacts and daily instrumental support, as they essentially live alone and avoid inviting people to their homes or going out to public places[8], which favors a worse QoL.

Other surveys conducted of older adults, most of whom were white, found an association between comorbidity,[32] frailty,[33] and lower income and worse QoL,[34] which in part support the findings of the current study. Moreover, female sex was negatively related to self-assessed QoL, as also evidenced in research conducted in Uberaba (MG), with a sample of mostly white older adults.[34] This association was notably mediated by lower monthly individual income, lower social support score, and higher number of morbidities in the current investigation. A previous study conducted on more than 90% non-Hispanic white [35] and Japanese older adult women[36] verified a relationship between morbidity, social support, and monthly individual income with QoL. Considering that older adult women perceive old age more negatively than men,[7] it is possible that older adult women with morbidities, impaired social support, and socioeconomic disadvantages have greater difficulty accepting the changes that occur with the human aging process, thereby negatively impacting QoL.

Lower education level and older age, mediated by lower monthly individual income and frailty, were indirectly associated with worse self-assessed QoL among older white adults. In one study, age and education, mediated by health conditions and functional incapacity, were found to be related to QoL in older adults.[37] Another national survey found that age equal to or greater than 80 years and education level of 4–7 and 8 or more years were negatively associated with QoL.[2] However, these surveys were conducted in the general older population and did not assess the effect of race/color on QoL.

The absence of a partner was associated with lower QoL among older Chinese[38] and Korean adults;[39] which partially corroborates

the findings of the present study that identified this association among people of white race/color. Older people who live without a partner are at greater risk for depression and less social support[40] which is reflected in the self-assessed QoL, as observed in this study.

Among brown older adults, lower education levels were associated with worse self-assessed QoL, which is partially corroborated by international studies.[40-41] In a nationwide survey, sociodemographic variables, including low education level, better determined the health status of older adults than race/color.[11] Education level is considered a determinant factor in reducing racial differences in proactive health behaviors,[42] which is reflected positively in the QoL of this group.

In line with the results of this study, some researchers showed that black race/color (brown and black) is associated with higher risks for comorbidities and physical decline, which are related to lower QoL.[43] Notably, this association was mediated by functional incapacity in basic ADL, and reinforces the assumption that autonomy and independence during the human aging process are determining factors for physical, emotional, and mental health,[40] particularly among older women of brown race/color.

Several studies have also verified advanced age as a predictor of worse QoL in the physical and mental domains of older adult African Americans with breast cancer,[44] which may be related to higher levels of perceived discrimination throughout life.[41] Furthermore, brown older adults generally have lower levels of education than white older adults, which is considered a main aspect of health inequity in Brazil.[8] Therefore, the structural social inequalities present in Brazil, including disparities in access to education, can have a negative effect on the QoL of older adults, especially affecting adults with older age.

In contrast, younger older people assumably have a worse QoL due to a lack of coping skills or expectations that are typically acquired with old age.[45] In the current study, younger age mediated by the absence of a partner was associated with worse self-assessed QoL in brown older adults. During the human aging process, the instrumental support of a partner is considered a predictor of better QoL,[2] since living with a partner contributes to feelings of belonging and security, thereby reducing feelings of loneliness in older adults.[46] Thus, the absence of a partner possibly in brown older people can negatively affect QoL, especially among younger older people.

In Brazil, non-white older people were four times more likely to develop this frailty syndrome,[47] which supports the findings of the current study. These researchers highlighted that frailty is a topic of global public interest due to its impact on QoL in older adults, families, caregivers, and health and social assistance systems.[47] However, this association was mediated by a greater number of depressive symptoms and lower social support scores, which indicates the importance of evaluating other risk factors that mediate the relationships with QoL in brown older adults, contributing to the inequities among races in healthcare.

Some researchers have observed that the intersection between sex and race/color influences the QoL of older adults.[41,45] In line with the evidenced findings, a study with economically disadvantaged African Americans found that older adult women reported worse QoL in the physical component compared with men.[45] Notably, in the current study, the association of women with worse self-assessed QoL in brown older people was mediated by the greater number of depressive symptoms, which supports the hypothesis that the intersectionality of sex and race/color reflects the double marginalization of health problems in older adults, including depression.[45]

Frailty, mediated by a greater number of depressive symptoms, functional incapacity in basic ADL, and less social support was indirectly associated with worse self-assessed QoL in older adults of black race/color. One possibility that justifies these findings is that older adults of black race/color are typically single, live alone, and are more vulnerable in relation to social support, especially at older ages.[8] In another study, the authors found that older adults who live alone also tend to develop depression and lack social support.[41] In addition, functional incapacity can lead to dependence in performing ADL, resulting in frailty and consequent worsening of QoL.[48-50] Depressive symptoms may originate from different factors such as low income, living alone,[51] and functional dependence.[52] Thus, the presence of depressive symptoms, incapacity to perform one or more basic ADL, and decreased social support may negatively affect the frailty of older adults, thereby worsening their QoL.[50]

Female sex, mediated by the absence of a partner, was indirectly associated with worse self-assessed QoL in older adult women of black race/color. Low income and the absence of a partner may be related to the restriction of social protection and housing in these women,[53] regardless of age. However, the loss of a partner has a negative impact on the lives of older adult women, which may be associated with low income and worse QoL self-assessment.[39]

This study had some limitations, such as the exclusion of older adults with cognitive decline, which may have favored a healthier sample; however, the possibility of selection bias was minimized since all eligible older adults were interviewed. In addition, for the purposes of analysis, a question regarding self-assessed QoL was used; however, a broader measure including the domains/facets of QoL associated with self-reported race/color may be useful for a more in-depth analysis of the data.

CONCLUSION

Regardless of the race/color of older adults, a lower social support score and a higher number of depressive symptoms were directly associated with worse self-assessed QoL, as well as a higher number of functional disabilities in basic ADL and the absence of a

partner, among older adults of brown/black race/color. The other direct associations differed among groups; in older adults of white race/color, a lower individual income and higher number of morbidities and impaired components of the frailty phenotype were directly associated with worse self-assessed QoL, whereas in older adults of brown race/color, this association was observed with lower levels of education.

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Molecular aspects of COVID-19 and its relationship with obesity and physical activity: a narrative review

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ABSTRACT

BACKGROUND: Severe acute respiratory syndrome coronavirus 2 has several mechanisms of action related to inflammatory responses, especially in individuals diagnosed with obesity. This hyperinflammatory clinical profile resulting from the association between obesity and coronavirus disease 2019 (COVID-19) may be attenuated by regular physical activity.

OBJECTIVE: The aim of this study was to review the evidence on the consequences of physical inactivity and physical activity on COVID-19 in patients with obesity.

DESIGN AND SETTING: Narrative review at the Bahiana School of Medicine and Public Health in Salvador, Brazil.

METHODS: We searched evidence on the association of COVID-19 with physical activity and obesity using the following keywords: "covid-19," "physical activity," and "obesity". The databases used were MEDLINE (PubMed), ScienceDirect, and Virtual Health Library. Studies published from 2019 to 2021 and available in Portuguese, English, and Spanish were included. The final search was conducted on September 26, 2021.

RESULTS: We identified 661 studies in the database, among which 71 were considered for inclusion in the narrative review of the molecular aspects of COVID-19 and its relationship with physical activity and obesity.

CONCLUSION: This literature review enabled the perception of the relationship between the molecular mechanisms of COVID-19 and obesity. Regular physical activity had various benefits for the inflammatory condition of the studied population, highlighting moderate-intensity..

INTRODUCTION

December 2019 was marked by the first recorded case of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; coronavirus disease 2019, COVID-19), which affects the respiratory system with a high viral load and has the potential to cause hospitalization and death.[1] Since then, a global pandemic has been declared, affecting population health in two ways: directly, from contact with the virus and its pathological evolution in the infected individual, and indirectly, owing to the need to restrict human contact to reduce the risk of contagion, from social isolation.[2] Research has been conducted to uncover the causes of infection, methods of transmission, and effective measures of prevention, taking into account at-risk groups that need specific attention; this highlighted the high risk for individuals diagnosed with obesity.[3]

Lockdowns, to reduce human–human contact and prevent the spread of SARS-CoV-2, cause social isolation and reduce physical activity (PA), increasing the number of physically inactive individuals; this increases their body fat percentage, making them part of the high-risk group for COVID-19.[4] A recent cohort study with approximately 490 000 participants indicated that a body mass index above 30 kg/m² is associated with a higher risk of developing a severe viral infection, requiring hospitalization, with an odds ratio of 1.73.[5] This increased risk seems to be related to inflammatory mechanisms and is associated with a worse prognosis to COVID-19, highlighting the action of angiotensin-converting enzyme 2 (ACE2) and interleukin (IL)-6, which are expressed in adipose tissue and, respectively, allow the entry of SARS-CoV-2 and maintain the inflammatory state of individuals with obesity, especially those infected with the virus.[2,6]

Regular PA seems to attenuate weight gain and reduce the inflammation present in adults.[7] A recent systematic review reported strong evidence on the relationship between PA for more

than 150 min per week and the attenuation of weight gain in adults, corroborating the recent World Health Organization update on PA recommendations during the COVID-19 pandemic.[7,8] PA seems to reduce the inflammatory state of individuals with obesity through molecular changes in the adipose tissue, attenuating the action of inflammatory mechanisms, based on the expression of proteins, such as peroxisome proliferator-activated receptor γ co-activator 1α (PGC-1α), that favor mitochondrial biogenesis, and activation of molecular pathways, such as the AMP-activated protein kinase (AMPK) pathway, that, given increased enzymatic activity, act directly on lipid metabolism.[9,10]

There are gaps in the literature regarding COVID-19 and its molecular mechanisms, to the detriment of the population diagnosed with obesity, relating to effective methods to alleviate the exacerbated responses to which these individuals are exposed, given the inflammatory mechanism of these two pathologies.

OBJECTIVE

The aim of this study was to review the evidence regarding the consequences of physical inactivity and exercise on COVID-19 in patients with obesity.

METHODS

This study was an integrative literature review. The databases used to search for articles were MEDLINE (PubMed), ScienceDirect, and Virtual Health Library. Articles published from 2019 to 2021, available in Portuguese, English, and Spanish, were included, independent of the study design. The final search was performed on September 26, 2021.

The search strategy used in PubMed involved synonyms of COVID-19, obesity, and PA identified in Medical Subject Headings and Descriptors in Health Sciences: (((((Exercises) OR (Physical Activity)) OR (Exercise Training))) AND (((Obesity) OR (Obesity, Abdominal)) OR (Overweight))) AND ((((COVID 19) OR (SARS-CoV-2 Infection)) OR (COVID-19 Pandemic)) OR (Coronavirus Disease-19)).

The search was performed on the informed database. Duplicate articles were removed and filtered, based on the inclusion criteria, using the following order: reading of the titles, abstracts, and full text. In addition to the search strategy, some articles were accessed manually from reference lists.

RESULTS

The results of the search and selection strategy are shown in the flowchart (**Figure 1**).

Inflammatory mechanisms of obesity

Obesity, a chronic disease associated with inflammatory responses, can develop owing to multiple factors, including genetic predisposition, emotional disorders, hormonal changes, and energy imbalance between high caloric intake and low caloric expenditure, resulting in the proliferation of excess adipose tissue.[11–13] This highly pro-inflammation compromises several metabolic mechanisms, such as glycemic regulation and beta-oxidation, and causes endothelial and vascular dysfunctions.[14] In general, the levels of several proteins and cytokines related to inflammatory responses are above the standards in obese individuals. A recent literature review identified elevated C-reactive protein levels (≥ 3 mg/L) in 14.4% of individuals with normal body mass index and 36% of obese individuals.[15]

According to Zeyda and Stulnig,[16] the greater the amount of adipose tissue, the greater the secretion of interleukin (IL)-6, with visceral adipose tissue being the main factor responsible for the secretion of this cytokine, which has local and systemic mechanisms of action. In addition to visceral adipose tissue, IL-6 may originate in skeletal and smooth muscle tissue and endothelial, liver, and pancreatic cells.[14,17,18] Among various possible outcomes, the release of IL-6 from these structures results in the increased production of triacylglycerol by the liver, inhibition of lipase and hepatocyte insulin receptors, and, consequently, insulin resistance.[16,19] The positive correlation between IL-6 and C-reactive protein (CRP) levels results in an immunoregulatory function, as CRP is responsible for mediating the acute inflammatory response to aggressive agents and activating the complement system, which activates inflammatory processes and acts via the classical pathway, in which C proteins are linked to the target microorganism, exposing the activation sites of the system and subsequently generating the cleavage process of these components, ranging from C1 to C9, thereby allowing defense against aggressive agents, in parallel to antibodies.[20] Elevated CRP levels are also associated with cardiovascular and metabolic pathologies, such as type 2 diabetes mellitus.[15,21,22]

Dai et al.[23] have highlighted tumor necrosis factor-alpha (TNF-α) as a cytokine that also plays a crucial role in obesity. Although not primarily synthesized in adipocytes, the messenger ribonucleic acid for the production of TNF-α is present in adipose tissue, which is then used for TNF-α synthesis by macrophages. Thus, TNF-α plays an important role in adipose tissue, where the production of cytokines such as IL-6, cellular processes such as apoptosis, and vascular processes such as angiogenesis occur.[23] It has been suggested that a high body mass index is associated with higher levels of TNF-α in the systemic circulation.[24–26]

Other important inflammatory markers are adipokines, cytokines secreted by adipose tissue, which affect several metabolic pathways, as their secretion results in an immune system response to the aggressor agent, releasing leukocytes in response to systemic inflammation. Thus, obesity, at the molecular level, may have a systemic inflammation origin and not only be caused by adipose

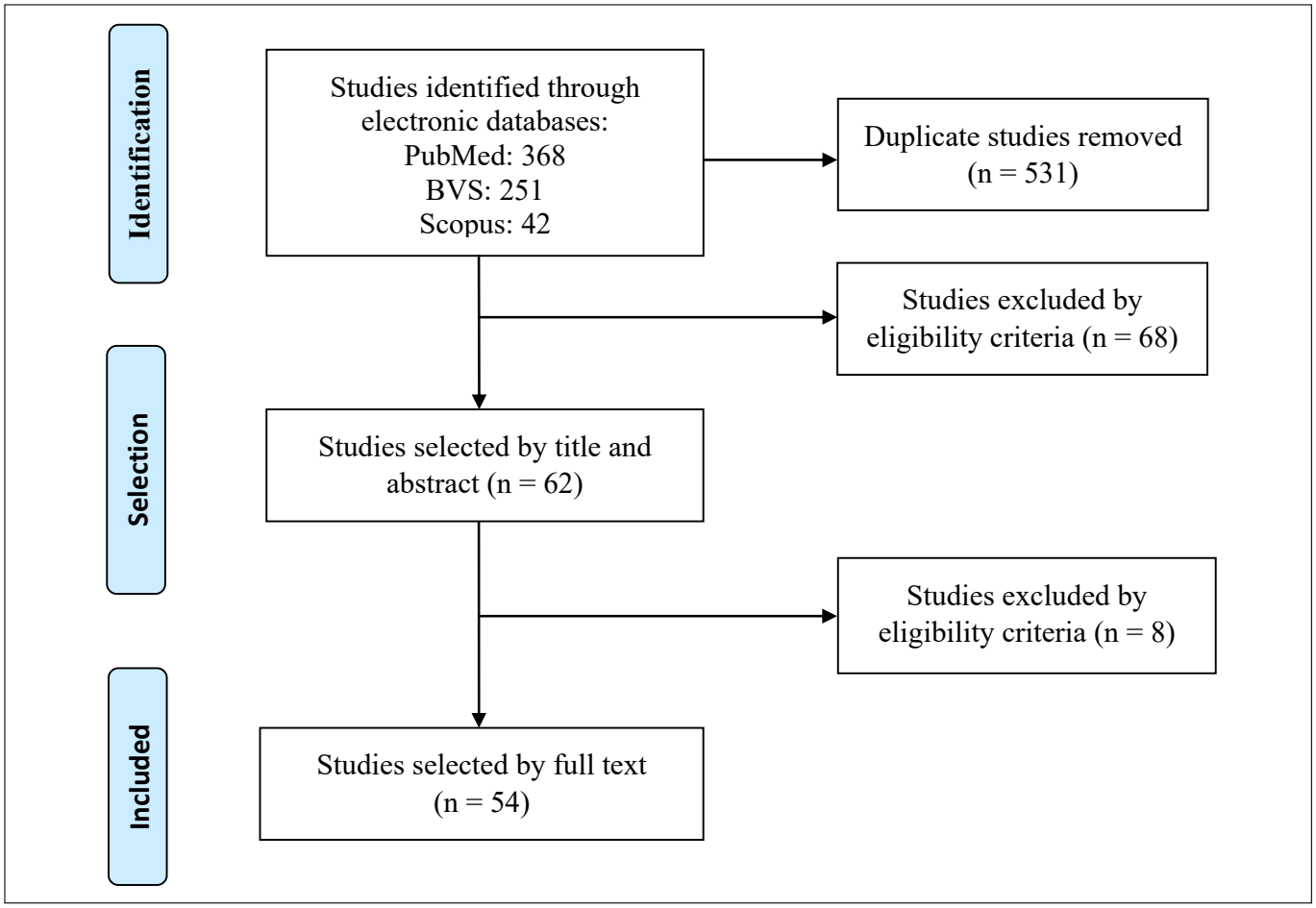


Figure 1. Flowchart of database searches and selection process.

tissue dysfunction.[27] Adipokines are also directly linked to vascular homeostasis; the microcirculation present in the adipose tissue can be compromised by the growth and increase in the number of adipocytes, resulting in deficient local and systemic circulation. This creates the need for angiogenesis to avoid severe impairments, such as adipocyte necrosis and worsening of adipose tissue inflammation, induced by hypoxia in obese individuals.[28–32]

Obesity and COVID-19

The mechanism of action of COVID-19 may be related to inflammatory immune responses caused by contact between the virus and pulmonary epithelium. Individuals with impaired immune responses, as well as those affected by chronic non-communicable diseases, have previous inflammatory conditions; thus, they are prone to complications caused by this infection, among whom individuals diagnosed with obesity are at greater risk.[33]

In a recent literature review, Stefan et al.[34] identified that the risk of this infection worsening is greater in obese patients, especially in those with high levels of visceral fat. This occurs because visceral adipose tissue is one of the major factors responsible for the expression of inflammatory mediators related to obesity.[34] Moreover, excess adipose tissue, especially visceral adipose tissue, is associated with the greater presence of T cells with reduced immune response owing to metabolic dysregulation caused by obesity. This reduced immune response is linked to the decreased functional activation of CD4 and CD8 T cells and the presence of ACE2.[34,35] ACE, which is also expressed in adipose tissue, acts as a receptor for SARS-CoV-2 in a way that favors the maintenance of the inflammatory state in obese individuals and, consequently, increases the risk of serious outcomes.[35-37] Dysregulated immune responses to the virus tend to compromise other systems that were not previously infected owing to the presence of infected macrophages in the systemic circulation and impaired generation of antibodies, which cause immune suppression in infected obese individuals.[38]

Immune dysregulation, which tends to occur in obese individuals affected by COVID-19, may be related to a phenomenon known as hypercytokinemia or "cytokine storm."[39] However, Brandão et al.[40] have indicated that the initial immune response is very weak considering the high SARS-CoV-2 viral load, which justifies the excessive recruitment of cytokines. This mechanism of

action is aggravated by viral overload in epithelial cells, especially in the lungs, causing the collapse of these structures. Thus, hypercytokinemia can occur in individuals infected with SARS-CoV-2 owing to high levels of cytokine expression, mediated by the high initial viral load.[41,42] Elevated levels of IL-1, IL-2, and IL-6 are detected in severely ill individuals, despite being present since the early stages of COVID-19.[43] Therefore, the high expression of these interleukins, associated with high concentrations of alpha interferons, beta interferons, and Th1 cells, promotes the constant maintenance of the inflammatory state, resulting in a "cytokine storm."[44] Overall, the dysfunctional visceral adipose tissue in obese individuals promotes an inflammatory state after SARS-CoV-2 infection, which impairs their pulmonary structures and, consequently, increases the probability of morbidity and mortality.[45,46]

Another concern with SARS-CoV-2 infection in the obese population is the occurrence of hypercoagulation in the pulmonary structures, which increases the risk of venous thrombosis and pulmonary embolism. Coagulopathies arise from the hyperinflammatory state, especially in lung structures, in obese patients infected with SARS-CoV-2; these are more evident in the more severe stages of COVID-19.[40] The levels of D-dimer, a blood marker of thrombin levels that is associated with cytokines during hypercytokinemia, are elevated in individuals affected by this coronavirus.[47] Hypercoagulation is responsible for the change in D-dimer levels, providing insight into the mechanism of COVID-19 worsening in obese individuals. D-dimer levels are further elevated in critically ill hospitalized patients and are associated with worse outcomes in obese individuals.[6,38] The French Society of Vascular Medicine suggests that obese individuals with COVID-19 are more susceptible to longer hospital stays and intubation times.[48] This scenario increases the risk of lung injuries and small blood vessel injuries. Thus, given the reduced mobility during hospitalization and hypercoagulability caused by multiple lesions, obese individuals should receive treatment for thromboembolism to avoid the worsening of this disease.[49]

Obstructive sleep apnea syndrome (OSAS) may be a risk factor for the worsening of COVID-19 in obese patients. Strausz et al.[50] have indicated that there is no difference in the risk of contracting COVID-19 between obese individuals with OSAS and those without the disorder; however, there is a greater risk of the worsening of the disease in obese individuals with OSAS.

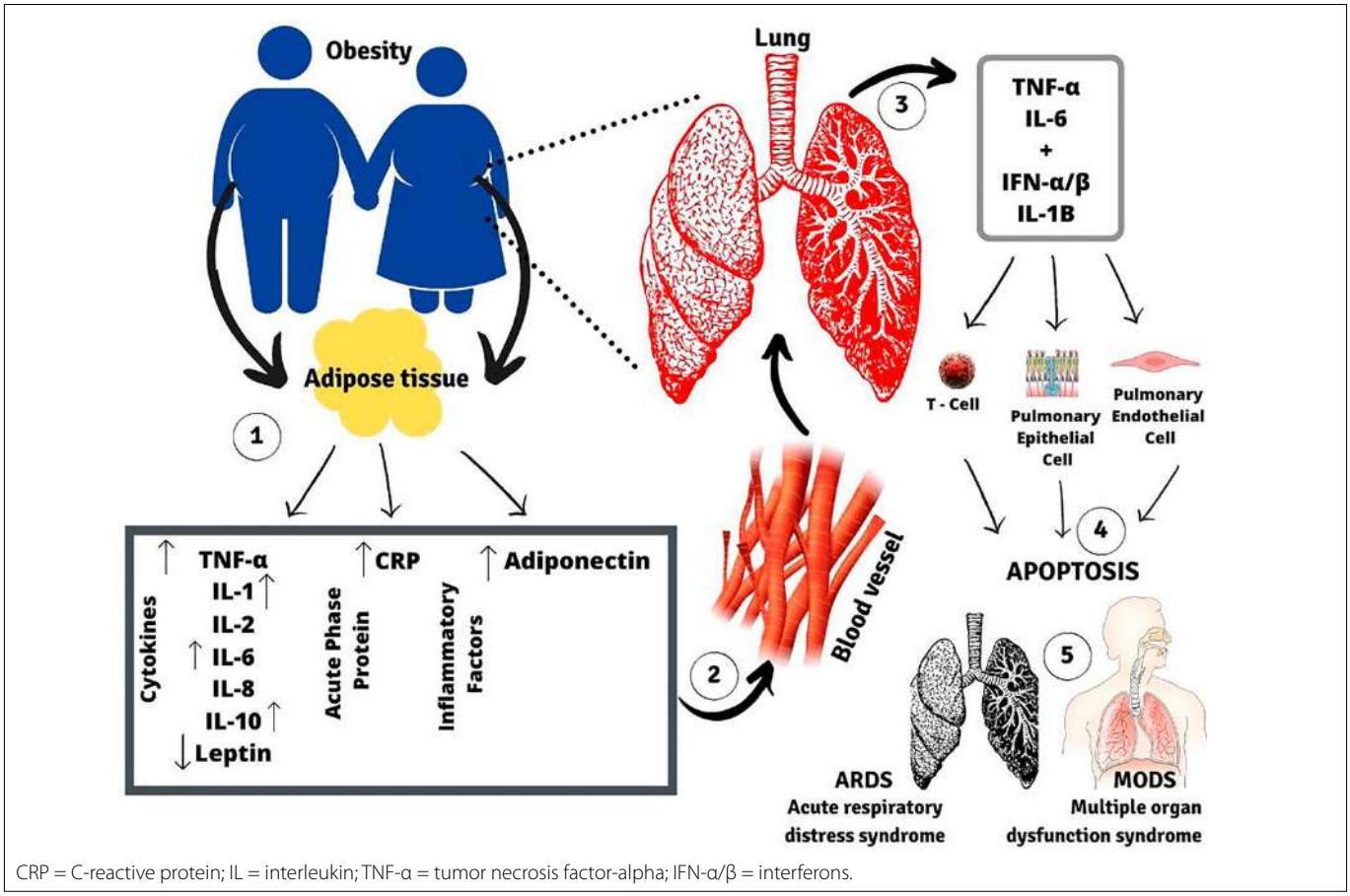
Individuals with OSAS have high levels of oxidative stress and are prone to acute respiratory distress syndrome; thus, OSAS is a risk factor for the worsening of COVID-19 in obese patients.[51] Some studies have shown that the onset of severe lung injuries, such as acute respiratory distress syndrome, after SARS-CoV-2 infection, is a stress coupling mechanism in gravity-dependent and active stress caused by nuclear factor-κB, which provokes an exacerbated pro-inflammatory response under stress.[52,53] Among the causes for this, repetitive episodes of apnea and the consequent reduction in oxygen saturation stand out. Thus, OSAS can contribute to hospitalization and the use of artificial mechanical ventilation.[54]

Cellular mechanisms contribute to the effects of OSAS in obese patients with coronaviruses. Sleep apnea episodes can cause hypoxemia and, consequently, an inflammatory state, as the low concentration of oxygen in the arterial blood stimulates the release of IL-6 and TNF-α. As a result, the immune response is dysregulated and the respiratory condition worsens, increasing the susceptibility of obese individuals with COVID-19 to acute respiratory distress syndrome.[41] This indicates the need for a differentiated approach to treatment in obese patients with OSAS affected by this coronavirus, as this population is more susceptible to respiratory failure and, consequently, more severe outcomes **(Figure 2).**[55,56]

Physical exercise and obesity: Health consequences associated with COVID-19

Physical exercise may be one of the key measures to improve the inflammation in obese individuals with COVID-19.[57] Regular physical exercise can reduce the number and size of adipocytes, as well as reduce the inflammatory response and associated with immune dysregulation mediated by excess adipose tissue .[58] A reduction in cytokine expression can be considered a benefit of physical exercise in this population because, among various mechanisms, TNF-α induces an increase in the levels of protein phosphatase 2C; this reduces the activity of AMPK, which is directly linked to the oxidation of fatty acids in muscle and liver tissue and, consequently, control of adiposity.[45] The entire process of lipid metabolism can benefit from regular physical exercise, which will reduce obesity and the occurrence of problems in individuals affected by this coronavirus.[57]

Physically inactive obese individuals with COVID-19 should participate in regular physical exercise to experience the positive effects of physical exercise on the immune system; the volume and intensity of exercise are crucial factors underlying the beneficial effects of physical exercise in this population.[59] High intensity (> 75% VO_2 max) and prolonged (> 60 min) physical exercise can result in an immunosuppressive effect, especially in those with systemic impairment, owing to several acute physiological responses, such as micro injuries in target muscles and the consequent increase in the production of ferritin and creatine kinase, which are important markers of muscle inflammation and injury.[60] Creatine kinase, in particular, is found at greater concentrations in environments with high energy demand, such as muscle tissue, during high-intensity physical exercise.[61] Mechanical stress caused by excessive muscle contractions, associated with metabolic stress, promotes, in addition to tissue microdamage, an increase in the production of prostaglandins and leukotrienes, accumulation of mitochondrial calcium accumulation, and levels of reactive oxygen species, which cause inflammation.[60,62] The latter results in the



CRP = C-reactive protein; IL = interleukin; TNF-α = tumor necrosis factor-alpha; IFN-α/β = interferons.

Figure 2. Adipose tissue secretes several pro-inflammatory cytokines, acute phase proteins, and adipokines (1) into the circulation (2), contributing to systemic low-grade chronic inflammation. Obesity-related inflammatory cytokines, in addition to pro-inflammatory molecules related to intrapulmonary (3) SARS-CoV-2, decrease the activation of effector cells in the immune system, which suppresses the immune function and host defenses; in addition, apoptosis of epithelial and pulmonary endothelial cells occurs (4), which can cause lung injuries (5).

production of receptors for cytokines, such as IL-6 and TNF-α, and exacerbated functional activation of immune system defense cells; for example, the levels of natural killer cells increase 3-fold compared with pre-exercise levels.[63]

Aerobic exercise of low (< 50% VO_2 max) and moderate (≥ 50% and ≤ 75% VO_2 max) intensities lasting up to 60 min does not result in exacerbated inflammatory responses in obese individuals; consequently, the risk of immunosuppression is low, demonstrating the beneficial potential of such exercise in the post-COVID-19 recovery period.[7,45,62] In obese individuals, regular physical exercise reduces body fat levels, regulates the immune system, and reduces the hyper-inflammatory state, resulting in improved outcomes in those with this coronavirus.[18] Several molecular factors related to the better prognosis of these individuals are mediated by regular physical exercise.[57]

Angiotensin-2 converting enzyme and adipose tissue

ACE2 is expressed in adipocytes and acts as a receptor for COVID-19 SARS-CoV-2. Its expression tends to decrease in response to regular physical exercise because the size of adipocytes decreases. Considering the high expression of this enzyme in dysfunctional adipose tissue,[37] the reduction of body and visceral adipose tissue, mediated by physical exercise, may enable a reduction in the risk of infection and degree of inflammation. Regular physical exercise, associated with reductions in lipid profile and dysfunctional adipose tissue as one of the major outcomes, may result in a reduction in the inflammatory condition of this population, considering that excessive visceral adipose tissue in individuals with obesity is related to the release of adipokines and other inflammatory cytokines, such as IL-1, IL-2, IL-6, and alpha and beta interferons.[43]

Nitric oxide and lung and vascular health

The inflammation of endothelial and vascular dysfunction in individuals with obesity and COVID-19 reduces circulating nitric oxide and increases free radical levels.[2,64] Free radicals, which are produced owing to oxidative stress in this population, contribute to a

worse prognosis in the inflammatory condition and, consequently, a worse clinical respiratory outcome.[64,65] Regular PA has positive hemodynamic effects, such as increased vasodilation and angiogenesis, mediated by the increased supply of nitric oxide; this is facilitated by the increase in nuclear factor κB levels and consequent increase in the expression of the nitric oxide synthase enzyme in endothelial and neuronal cells caused by physical effort and muscle contraction.[66] This cascade of events results in the activation of AMPK via the canonical pathway. The progressive increase in the adenosine diphosphate/adenosine triphosphate ratio in the cellular environment mediates the phosphorylation of the AMPK enzyme; this results in gene regulation and the increased expression of the PGC-1α protein, favoring mitochondrial biogenesis and, owing to the translocation of glucose transporter type 4 to the membrane, glycolytic metabolism and lipid oxidation, reducing the lipid and inflammatory profile in individuals with obesity.[67] Given this mechanism of action of nitric oxide on the vascular endothelium, the maintenance of homeostasis and local blood flow may be promoted.[62] Thus, regular moderate aerobic exercise may facilitate the recovery of obese individuals from COVID-19.[58]

PGC-1α and free fatty acids

PGC-1α is a transcriptional coactivator that is involved in the control of several biological mechanisms involved in energy metabolism. For example, a recent study showed the ability of the PGC-1α protein to inhibit the production of IL-6 in hepatocytes, highlighting the possible benefit of this mechanism in clinical conditions involving high levels of inflammation.[68] Regular moderate-intensity physical exercise tends to increase the expression of PGC-1α because, during physical exercise, the increase in muscle contractions increases the calcium concentration in the sarcoplasm; this results in the activation of calcium-dependent proteins, which alter the phosphorylation state of some transcription factors, such as nuclear factor of activated T cells, and transcription of genes associated with physical exercise, such as PGC-1α.[62,69] PGC-1α stimulates the production of irisin, a hormone involved in lipid metabolism, especially in adipose tissue, and the immune system, modulating the activity of macrophages.[70,71] This can reduce the inflammatory picture, increase the enzymatic capacity for free fatty acid oxidation, increase mitochondrial biogenesis, and improve respiratory function.[42,62]

CONCLUSION

Once exposed to SARS-CoV-2, a hyperinflammatory state and worse prognosis, with a greater risk of hospitalization, are observed in obese individuals. However, regular moderate-intensity PA seems to exert a protective effect against the worsening of health and mortality and is an important tool in the post-infection recovery phase in this population.

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INSTRUCTIONS FOR AUTHORS

Scope and indexing

São Paulo Medical Journal (formerly Revista Paulista de Medicina) was founded in 1932 and is published bimonthly by Associação Paulista de Medicina, a regional medical association in Brazil.

The Journal accepts articles in English in the fields of evidence-based health, including internal medicine, epidemiology and public health, specialized medicine (gynecology & obstetrics, mental health, surgery, pediatrics, urology, neurology and many others), and also physical therapy, speech therapy, psychology, nursing and healthcare management/administration.

São Paulo Medical Journal's articles are indexed in MEDLINE, LILACS, SciELO, Science Citation Index Expanded, Journal Citation Reports/Science Edition (ISI) and EBSCO Publishing.

Editorial policy

Papers with a commercial objective will not be accepted: please review the Journal's conflicts of interest policy below.

São Paulo Medical Journal accepts manuscripts previously deposited in a trusted preprint server.

São Paulo Medical Journal supports Open Science practices. It invites reviewers to join Open Peer Review practices through acceptance that their identities can be revealed to the authors of articles. However, this is purely an invitation: reviewers may also continue to provide their input anonymously.

São Paulo Medical Journal is an open-access publication. This means that it publishes full texts online with free access for readers.

São Paulo Medical Journal applies a publication fee in the form of an article processing charge (APC) for all studies conducted outside of Brazil. This rate will be charged to the corresponding author when the study has been accepted on the grounds of its scientific merit. This fee is US$ 500.00 and is independent of the length of the text. The corresponding author should wait to receive the journal's invoice before making the payment. The article will only be published after presentation of the proof of payment. Submission is free for all. Associação Paulista de Medicina provides financial support for the Journal.

Articles accepted for publication become the Journal's property for copyright purposes, in accordance with Creative Commons attribution type BY.

Transparency and integrity: guidelines for writing

The Journal recommends that all articles submitted should comply with the editorial quality standards established in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals,[1] as updated in the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. These standards were created and published by the International Committee of Medical Journal Editors (ICMJE) as a step towards integrity and transparency in science reporting and they were updated in December 2018.[1]

All studies published in *São Paulo Medical Journal* must be described in accordance with the specific guidelines for papers reporting on clinical trials (CONSORT),[2] systematic reviews and meta-analyses (PRISMA),[3,4] observational studies (STROBE),[5,6] case reports (CARE)[7] and accuracy studies on diagnostic tests (STARD).[8,9] These guidelines ensure that all methodological procedures have been described, and that no result has been omitted. If none of the above reporting guidelines are adequate for the study design, authors are encouraged to visit the EQUATOR Network website (http://www.equator-network.org/) to search for appropriate tools.

Conflicts of interest

Authors are required to describe any conflicts of interest that may exist regarding the research or the publication of the article. Failure to disclose any conflicts of interest is a form of misconduct.

Conflicts of interest may be financial or non-financial. The Journal recommends that the item "Conflicts of interest" at http://www.icmje.org should be read to obtain clarifications regarding what may or may not be considered to be a conflict of interest. The existence and declaration of conflicts of interest is not an impediment to publication at all.

Acknowledgements and funding

Grants, bursaries and any other financial support for studies must be mentioned separately, after the references, in a section named "Acknowledgements." Any financial support should be acknowledged, always with the funding agency name, and with the protocol number whenever possible. Donation of materials used in the research can and should be acknowledged too.

This section should also be used to acknowledge any other contributions from individuals or professionals who have helped in producing or reviewing the study, and whose contributions to the publication do not constitute authorship.

Authorship

The Journal supports the position taken by the ICMJE (http://www.icmje.org) regarding authorship. All authors should read ICMJE's recommendations to obtain clarifications regarding the criteria for authorship and to verify whether all of them have made enough contributions to be considered authors.[10]

All authors of articles published in *São Paulo Medical Journal* need to have contributed actively to the discussion of the study results and should review and approve the final version that is to be released. If one author has not contributed enough or has not approved the final version of the manuscript, he/she must be transferred to the Acknowledgement section.

The corresponding author is the primary guarantor of all ethical issues relating to the manuscript, before, during and after its

publication. However, *São Paulo Medical Journal* and ICMJE consider that all authors are held fully responsible for the study, regarding the accuracy or integrity of data and data interpretation in the text. Contributions such as data collection only do not constitute authorship.

The addition or deletion of authors' names in the manuscript byline is possible only if the corresponding author provides the reason for the rearrangement and a written signed agreement from all authors. Modifications to the order of the authors are possible, but also need to be justified. Authors whose names are removed or inserted must agree with this in writing. Publication of the article cannot proceed without a declaration of authorship contributions signed by all authors.

São Paulo Medical Journal supports the ORCID initiative. All authors should create an ORCID identification (ID) record (in www.orcid.org) before submitting their article and should link the submission to their existing ORCID ID in the electronic submission system. ORCID identifications help to distinguish researchers with similar names, give credit to contributors and link authors to their professional affiliations. In addition, this may increase the ability of search engines to retrieve articles.

São Paulo Medical Journal supports Open Science practices. Authors must therefore complete an open science compliance form, which is available from: https://wp.scielo.org/wp-content/uploads/Open-Science-Compliance-Form_en.docx.

Redundant or duplicate publication

São Paulo Medical Journal will avoid publishing redundant or duplicate articles. The Journal agrees with the ICMJE definition of redundant publication,[11] i.e. an attempt to report or publish the same results from a study twice. This includes but is not limited to publication of patient cohort data that has already been published, without clear reference to the previous publication. In situations in which authors are making a secondary analysis on data that has already published elsewhere, they must state this clearly. Moreover, the outcomes assessed in each analysis should be clearly differentiated.

The Journal's peer review policy and procedures

After receipt of the article through the electronic submission system, it will be read by the editorial team, who will check whether the text complies with the Journal's Instructions for Authors regarding format. The Journal has adopted the *CrossRef Similarity Check* system for identifying plagiarism and any text that has been plagiarized, in whole or in part, will be promptly rejected. Self-plagiarism will also be monitored.

When the general format of the manuscript is deemed acceptable and fully compliant with these Instructions for Authors, and only then, the editorial team will submit the article to the Editor-in-Chief, who will firstly evaluate its scope. If the editor finds that the topic is of interest for publication, he will assign at least two reviewers/referees with expertise in the theme, to evaluate the quality of the study. After a period varying from one to several weeks, the authors will then receive the reviewers' evaluations and will be required to provide all further information requested and the corrections that may be necessary for publication. These reviewers, as well as the Editorial Team and the Editor-in-Chief, may also deem the article to be unsuitable for publication by *São Paulo Medical Journal* at this point.

At the time of manuscript submission, the authors will be asked to indicate the names of three to five referees. All of them should be from outside the institution where the authors work and at least two should preferably be from outside Brazil. The Editor-in-Chief is free to choose them to review the paper or to rely on the *São Paulo Medical Journal's* Editorial Board alone.

Articles will be rejected without peer review if:

- they do not present Ethics Committee approval (or a justification for the absence of this);
- they fail to adhere to the format for text and figures described here.

After peer review

Peer reviewers, associated editors and the Editor-in-Chief may ask for clarifications or changes to be made to the manuscript. The authors should then send their article back to the Journal, with the modifications made as requested. Changes to the text should be highlighted (in a different color or using a text editor tool to track changes). Failure to show the changes clearly might result in the paper being returned to the authors.

The modified article must be accompanied by a letter answering the referees' comments, point by point. The modified article and the response letter are presented to the editorial team and reviewers, who will verify whether the problems have been resolved adequately. The text and the reviewers' final evaluations, along with the response letter, will then be sent to the Editor-in-Chief for a decision.

Manuscripts that are found to be suitable for publication through their scientific merit will be considered "provisionally accepted". However, all articles will subsequently be scrutinized to check for any problems regarding the reporting, i.e. sentence construction, spelling, grammar, numerical/statistical problems, bibliographical references and other matters that may arise, especially in the Methods section. The adherence to reporting guidelines will be checked at this point, and the staff will point out any information regarding methodology or results that the authors should provide. This is done in order to ensure transparency and integrity of publication, and to allow reproducibility.

The editorial team will then provide page proofs for the authors to review and approve. No article is published without this final author approval. All authors should review the proof, although the Journal asks the corresponding author to give final approval.

Submission

Articles should be submitted only after they have been formatted as described below. Texts must be submitted exclusively through the Internet, using the Journal's electronic submission system, which is available at http://mc04.manuscriptcentral.com/spmj-scielo. Submissions sent by e-mail or through the post will not be accepted.

The manuscript should be divided into two files. The first of these, the main document ("blinded"), should contain the article title, article type, keywords and abstract, article text, references and tables, but must omit all information about the authors. The second of these, the "title page", should contain all the information about the authors.

To format these documents, use Times New Roman font, font size 12, line spacing 1.5, justified text and numbered pages.

The corresponding author is responsible for the submission. However, all authors should approve the final version of the manuscript that is to be submitted and should be aware of and approve any changes that might be made after peer review.

Covering letter

All manuscripts must be submitted with a covering letter signed at least by the corresponding author. The letter must contain the following five essential items relating to the manuscript:

1. a declaration that the manuscript is original and that the text is not under consideration by any other journal;
2. a statement that the manuscript has been approved by all authors, who agree to cede the copyrights to the Journal, disclose all sources of funding and declare all potential conflicts of interest;
3. a statement that the study protocol was endorsed by an Internal Review Board (Ethics Committee), including the date and number of the approval (in the case of original articles). This is required for absolutely all studies involving human subjects or patient data (such as medical records), in accordance with the Committee on Publication Ethics (COPE) guidelines, and even for case reports. A copy of the approval document must be submitted to the Journal;
4. each author should indicate a valid, up-to-date email address for contact;
5. a list of a minimum of five potential referees outside of the authors' institutions, who could be invited, at the Editor-in-Chief's discretion, to evaluate the manuscript.

General guidelines for original articles

The following are considered to be full-text original articles: clinical trials; cohort, case-control, prevalence, incidence, accuracy and cost-effectiveness studies; case series (i.e. case reports on more than three patients analyzed together); and systematic reviews with or without meta-analysis. These types of article should be written with a maximum of 3,500 words (from the introduction to the end of the conclusion).

Typical main headings in the text include Introduction, Methods, Results, Discussion and Conclusion. The authors can and should use short subheadings too, especially those concerning the reporting guideline items.

Trial and systematic review registration policy

São Paulo Medical Journal supports the clinical trial registration policies of the World Health Organization (WHO) and the International Committee of Medical Journal Editors (ICMJE) and recognizes the importance of these initiatives for registration and international dissemination of information on randomized clinical trials, with open access. Thus, since 2008, manuscripts on clinical trials are accepted for publication if they have received an identification number from one of the public clinical trial registration database (such as ClinicalTrials.gov and/or REBEC and/or the World Health Organization; the options are stated at http://www.icmje.org). The identification number should be declared at the end of the abstract. Articles describing systematic reviews must provide the protocol registration number from a reliable database, such as PROSPERO, Open Science Framework, Cochrane, Joanna Briggs and others. Articles presenting clinical trials or systematic reviews without registration protocols will be promptly rejected without peer review.

Results from cases with DNA sequences must be deposited in appropriate public databases. The protocol number or URL can be requested at any time during the editorial review. Publication of other research data in public repositories is also recommended, since it contributes towards replicability of research, increases article visibility and possibly improves access to health information.

Sample size

All studies published in SPMJ must present a description of how the sample size was arrived at. If it was a convenience or purposive sample, the authors must declare so and explain the characteristics of this sample and recruitment method. For clinical trials, for instance, it is mandatory to inform each of the three main values used to calculate sample size:

- power (usually 80% or more);
- level of significance (usually 0.05 or lower);
- clinically meaningful difference (effect size targeted), according to the main outcome measurement.

Regardless of study results (if "positive" or "negative"), the journal will probably reject articles of trials using underpowered samples, when sample size has not been properly calculated or the calculation has not been fully described as indicated above.

Abbreviations, acronyms and products

Abbreviations and acronyms must not be used, even those in everyday use, unless they are defined when first used in the text. However, authors should avoid them for clarity whenever possible. Drugs or medications must be referred to using their generic names (without capital letters), with avoidance of casual mention of commercial or brand names.

Interventions

All drugs, including anesthetics, should be followed by the dosage and posology used.

Any product cited in the Methods section, such as diagnostic or therapeutic equipment, tests, reagents, instruments, utensils, prostheses, orthoses and intraoperative devices, must be described together with the manufacturer's name and place (city and country) of manufacture in parentheses. The version of the software used should be mentioned.

Any other interventions, such as exercises, psychological assessments or educational sessions, should be described in enough details to allow reproducibility. The Journal recommends that the TIDieR reporting guidelines should be used to describe interventions, both in clinical trials and in observational studies.[13]

Supplementary material

Because supplementary material comprises documents that do not form part of the text of the manuscript, São Paulo Medical Journal will not publish it. The authors should cite an access link that allows readers to view the supplementary material.

Short communications

Short communications are reports on the results from ongoing studies or studies that have recently been concluded for which urgent publication is important. They should be structured in the same way as original articles. The authors of this kind of communication should explain, in the covering letter, why they believe that publication is urgent. Short communications and case reports must be limited to 1,000 words (from the introduction to the end of the conclusion).

Case reports, case series, narrative reviews and letters to the editor

Starting in June 2018, only individual case reports dealing with situations of public health emergencies will be accepted by *São Paulo Medical Journal*. Case reports that had already been accepted for publication up to May 2018 will still be published in a timely manner.

After initial evaluation of scope by the editor-in-chief, case reports, case series and narrative reviews will be considered for peer-review evaluation only when accompanied by a systematic search of the literature, in which relevant studies found (based on their level of evidence) are presented and discussed.[12] The search strategy for each database and the number of articles obtained from each database should be shown in a table. This is mandatory for all case reports, case series and narrative reviews submitted for publication. Failure to provide the search description will lead to rejection before peer review.

The access route to the electronic databases used should be stated (for example, PubMed, OVID, Elsevier or Bireme). For the search strategies, MeSH terms must be used for Medline, LILACS, and Cochrane Library. DeCS terms must be used for LILACS. EMTREE terms must be used for Embase. Also, for LILACS, the search strategy must be conducted using English (MeSH), Spanish (DeCS) and Portuguese (DeCS) terms concomitantly. The search strategies must be presented exactly as they were used during the search, including parentheses, quotation marks and Boolean operators (AND, OR, and NOT). The search dates should be indicated in the text or in the table.

Patients have the right to privacy. Submission of case reports and case series must contain a declaration that all patients gave their consent to have their cases reported (even for patients cared for in public institutions), in text and images (photographs or imaging examination reproductions). The Journal will take care to cover any anatomical part or examination section that might allow patient identification. For deceased patients whose relatives cannot be contacted, the authors should consult the Editor-in-Chief. All case reports and case series must be evaluated and approved by an ethics committee.

Case reports should be reported in accordance with the CARE Statement,[7] including a timeline of interventions. They should be structured in the same way as original articles.

Case reports must not be submitted as letters. Letters to the editor address articles that have been published in the *São Paulo Medical Journal* or may deal with health issues of interest. In the category of letters to the editor, the text has a free format, but must not exceed 500 words and five references.

FORMAT: FOR ALL TYPES OF ARTICLES

Title page

The title page must contain the following items:

1. Type of paper (original article, review or updating article, short communication or letter to the editor);
2. Title of the paper in English, which should be brief but informative, and should mention the study design.[14] Clinical trial, cohort, cross-sectional or case-control study, and systematic review are the most common study designs. Note: the study design declared in the title should be the same in the methods and in the abstract;
3. Full name of each author. The editorial policy of the *São Paulo Medical Journal* is that abbreviations of authors' names must not be used; therefore, we ask that names be stated in full, without using abbreviations;
4. Place or institution where the work was developed, city and country;
5. Each author should indicate the way his/her name should be used in indexing. For example: for "João Costa Andrade", the indexed name could be "Costa-Andrade J." or "Andrade JC", as preferred;
6. The author's professional background (Physician, Pharmacist, Nurse, Dietitian or another professional description, or Undergraduate Student); and his/her position currently held (for example, Master's or Doctoral Student, Assistant Professor, Associate Professor or Professor), in the department and institution where he/she works, and the city and country (affiliations);

7. Each author should present his/her ORCID identification number (as obtained from HYPERLINK "http://www.orcid.org/" www.orcid.org);
8. Each author must inform his contribution, preferably following the CRediT system (see above in Authorship);
9. Date and venue of the event at which the paper was presented, if applicable, such as congresses, seminars or dissertation or thesis presentations.
10. Sources of financial support for the study, bursaries or funding for purchasing or donation of equipment or drugs. The protocol number for the funding must be presented with the name of the issuing institution. For Brazilian authors, all grants that can be considered to be related to production of the study must be declared, such as fellowships for undergraduate, master's and doctoral students; along with possible support for postgraduate programs (such as CAPES) and for the authors individually, such as awards for established investigators (productivity; CNPq), accompanied by the respective grant numbers.
11. Description of any conflicts of interest held by the authors (see above).
12. Complete postal address, e-mail address and telephone number of the author to be contacted about the publication process in the Journal (the "corresponding author"). This author should also indicate a postal address, e-mail address and telephone number that can be published together with the article. *São Paulo Medical Journal* recommends that an office address (rather than a residential address) should be informed for publication.

Second page: abstract and keywords

The second page must include the title and a structured abstract in English with a maximum of 250 words. References must not be cited in the abstract.

The following headings must be used in the structured abstract:

- Background – Describe the context and rationale for the study;
- Objectives - Describe the study aims. These aims need to be concordant with the study objectives in the main text of the article, and with the conclusions;
- Design and setting – Declare the study design correctly, and the setting (type of institution or center and geographical location);
- Methods – Describe the methods briefly. It is not necessary to give all the details on statistics in the abstract;
- Results – Report the primary results;
- Conclusions – Make a succinct statement about data interpretation, answering the research question presented previously. Check that this is concordant with the conclusions in the main text of the article;
- Clinical Trial or Systematic Review Registration – Mandatory for clinical trials and systematic reviews; optional for observational studies. List the URL, as well as the Unique Identifier, on the publicly accessible website on which the trial is registered.
- MeSH Terms - Three to five keywords in English must be chosen from the Medical Subject Headings (MeSH) list of Index Medicus, which is available at http://www.ncbi.nlm.nih.gov/sites/entrez?db=mesh.These terms will help librarians to quickly index the article.
- Author keywords - The authors should also add three to six "author keywords" that they think express the main article themes. These keywords should be different from the MeSH terms and preferably different from words already used in the title and abstract, so as to improve the discoverability of the article by readers doing a search in PubMed. They provide an additional chance for the article to be retrieved, read and cited. Combinations of words and variations (different wording or plurals, for example) are encouraged.

References

For any manuscript, all statements in the text that do not result from the study presented for publication in the *São Paulo Medical Journal* but from other studies must be accompanied by a quotation of the source of the data. All statements regarding health statistics and epidemiological data should generally be followed by references to the sources that generated this information, even if the data are only available electronically.

São Paulo Medical Journal uses the reference style known as the "Vancouver style," as recommended by the International Committee of Medical Journal Editors (ICMJE). Follow the instructions and examples at www.icmje.org, item "References", for the format.

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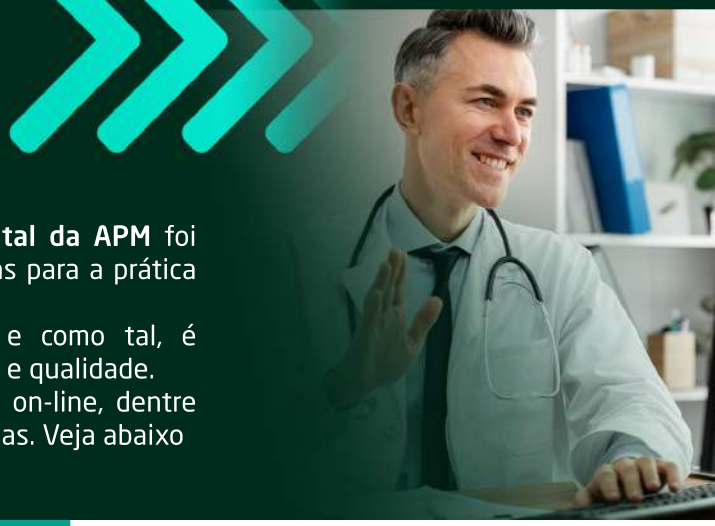

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