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Artículo de investigación

Effects of a Multi-professional Intervention on Quality of Life of Women with Overweight or Obesity Post-Covid-19: A Pragmatic Trial

Efectos de una Intervención Multiprofesional sobre la Calidad de Vida de Mujeres con Sobrepeso u Obesidad post-Covid-19: Un Ensayo Pragmático

Efeitos de uma Intervenção Multiprofissional na Qualidade de Vida de Mulheres com Sobrepeso ou Obesidade pós-Covid-19: Um Ensaio Pragmático

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ABSTRACT

Obesity is a global Non-Communicable Chronic Disease (NCD) associated with various comorbidities and a high mortality rate. This scenario has increasingly affected the female population, leading to a rise in prevalence and related health issues. Therefore, the present study aimed to assess the health-related quality of life of women with overweight or obesity and symptoms of COVID-19 using a multi-professional intervention model. This research was conducted as a parallel group and repeated measures pragmatic trial, in which 28 participants aged between 25 and 65 were allocated into two groups: experimental (intervention group) and control (non-intervention participants). The Body Mass Index (BMI) was (30.5 ± 5.45 kg/m²) in the Experimental Group, and the Control Group was (31 ± 8.2 kg/m²). The 12-Item Health Survey (SF-12) questionnaire was applied to assess the quality of life in the physical and mental domains of COVID-19 survivors with different symptom severities (mild, moderate, severe) compared to the control group. At the end of the program, 28 participants finished the study (15 from the experimental group and 13 from the control group). The results indicated a significant improvement in the mental health domain only in the experimental group after the intervention period ($p < 0.05$). However, no significant differences in physical health were observed between the experimental and control groups ($p > 0.05$). Considering these findings, multi-professional actions emerge as a crucial component for enhancing the quality of life, particularly within mental health, during the 16-week intervention period.

Keywords: Pandemic; Public Health; Health Promotion; Overweight.

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RESUMEN

La obesidad es una Enfermedad Crónica No Transmisible (ECNT) global asociada a diversas comorbilidades y una alta tasa de mortalidad. Este escenario ha afectado cada vez más a la población femenina, lo que ha llevado a un aumento en la prevalencia y problemas de salud relacionados. El presente estudio tiene como objetivo evaluar la calidad de vida relacionada con la salud de mujeres con sobrepeso u obesidad y síntomas de COVID-19 mediante un modelo de intervención multiprofesional. Esta investigación se llevó a cabo como un ensayo pragmático de grupos paralelos y medidas repetidas, en el que 48 participantes con edades comprendidas entre 25 y 65 años fueron alocadas en dos grupos: experimental (participantes de la intervención) y control (participantes de la no intervención). En el grupo experimental el Índice de Masa Corporal (IMC) fue de $(30,5 \pm 5,45 \text{ kg/m}^2)$. En el grupo control, el IMC fue $(31 \pm 8,2 \text{ kg/m}^2)$. Se utilizó el cuestionario de **12-Item Health Survey** (SF-12) para evaluar la calidad de vida en los dominios físico y mental de las sobrevivientes de COVID-19 con diferentes grados de gravedad de síntomas (leves, moderados, graves) en comparación con el grupo de control (participantes que no recibieron intervenciones). Al final del programa, 28 participantes terminaron el estudio (15 participantes de la intervención y 13 sin intervención). Los resultados indicaron una mejora significativa en el dominio de la salud mental solo en el grupo experimental después del período de intervención ($p < 0.05$). Sin embargo, no se observaron diferencias significativas en la salud física entre el grupo experimental y el grupo de control ($p > 0.05$). A la luz de estos hallazgos, la rehabilitación multiprofesional emerge como un componente crucial para mejorar la calidad de vida, especialmente en el ámbito de la salud mental durante el período de intervención de 16 semanas.

Palabras clave: Pandemia; Promoción de la salud; Salud Pública; Sobrepeso.

RESUMO

A obesidade é uma Doença Crônica Não-Transmissível (DCNT) com alcance mundial, associada a diversas comorbidades e alta taxa de mortalidade. Esse quadro tem afetado cada vez mais o público feminino, com aumento da prevalência e doenças correlatas. O objetivo deste estudo foi avaliar a qualidade de vida relacionada à saúde de mulheres com sobrepeso ou obesidade com sintomas da COVID-19 utilizando um modelo de intervenção multiprofissional. Esta pesquisa foi conduzida como um ensaio pragmático de grupos paralelos e medidas repetidas, no qual 48 participantes de idade entre 25 a 65 anos foram distribuídas em dois grupos: experimental (participantes das intervenções) e controle (não participantes das intervenções). No grupo experimental o Índice de Massa Corporal (IMC) foi de $(30,5 \pm 5,45 \text{ kg/m}^2)$ e no grupo controle, IMC foi de $(31 \pm 8,2 \text{ kg/m}^2)$. Utilizou-se o questionário *12-Item Health Survey* (SF-12) para analisar a qualidade de vida nos domínios físico e mental das sobreviventes da COVID-19 nas diferentes sintomatologias (COVID leve, moderada e grave) em comparação com o grupo controle (não participantes das intervenções). Ao final do programa, 28 participantes finalizaram o estudo (15 do grupo experimental e 13 do grupo controle). Os resultados indicaram uma melhoria significativa no domínio de saúde mental apenas no grupo experimental após o período de intervenção ($p < 0,05$). Entretanto, não foram observadas diferenças significativas na saúde física entre o grupo experimental e controle ($p > 0,05$). Diante dos resultados a reabilitação multiprofissional emerge como componente importante para a melhoria da qualidade de vida, especialmente no âmbito da saúde mental durante as 16 semanas de intervenção.

Palavras chave: Pandemia; Promoção da Saúde; Saúde Pública; Sobrepeso.

INTRODUCTION

Obesity, a globally prevalent condition and one of the leading causes of morbidity and mortality is classified as a Non-Communicable Chronic Disease (NCD), affecting all social classes and age groups in both sexes (Abarca-Gómez et al., 2017; Abdelaal et al., 2017). However, it is essential to pay greater attention to the female population since, in Brazil, low-income women are more prone to develop obesity, which can lead to body image dissatisfaction and reduced self-esteem, negatively impacting both physical and mental health (Bolognese et al., 2020). Since 2013 in Brazil, there has been an observed increase in the prevalence of obesity among women above 20 years of age (Instituto Brasileiro de Geografia e Estatística [IBGE], 2020), and it is estimated that by 2025, the obesity rate among women will achieve 21%, compared to 18% in male (Manrique-Acevedo et al., 2020). These data underscore the importance of implementing preventive measures and targeted interventions to promote the health and well-being of Brazilian women (Bolognese et al., 2020).

Obesity is a multifactorial disease involving the interaction between genetic, environmental, social, economic, and lifestyle factors (Brasil, 2014; Silva et al., 2014). For instance, an inactive lifestyle combined with high-calorie and low-nutrient foods leads to an imbalance in energy intake and expenditure, resulting in weight gain (Goossens, 2017; Youngwanichsetha, 2018). The study conducted by Lemos et al. (2022) evaluated body composition and cardiorespiratory fitness in individuals with overweight or obesity after COVID-19 and found that excess fat deposition creates a chronic low-grade inflammatory environment. In turn, this environment can dysregulate the immune and endocrine systems (Manrique-Acevedo et al., 2020), contributing to various other comorbidities and affecting functional capacity and health-related quality of life (Sordi et al., 2023; Ryal et al., 2023; Perli et al., 2023).

These findings emphasize the importance of addressing the topic with greater attention, aiming to understand the effects of obesity after COVID-19 infection and implementing interventions to improve the health and well-being of these patients. Among the comorbidities, previous studies have reported that obesity is one of the risk factors for the worsening of COVID-19 (Kang et al., 2020; Stefan et al., 2021; Lemos et al., 2022; Perli et al., 2023; Sordi et al., 2023; Ryal et al., 2023) and that individuals with obesity infected with COVID-19 had a higher mortality rate compared to non-obese individuals (Kang et al., 2020). Indeed, the quarantine period, adopted as a control measure during the pandemic, is a predictive factor for symptoms of acute stress disorder, anxiety, depression, insomnia, exhaustion, and post-traumatic stress disorder (Brooks et al., 2020).

In a study conducted by Ryal et al. (2023), which investigated the effects of a multi-professional intervention model on the mental health of middle-aged, overweight survivors after COVID-19, it was found that psychoeducation, combined with multi-professional activities, was effective in significantly improving psychological symptoms in different experimental groups, with varying degrees of emphasis depending on the severity of COVID-19. The multi-professional interventions effectively improved the mental health and sleep quality of the study participants, regardless of the experimental group (Ryal et al., 2023). The changes caused by COVID-19 that affect mental health, whether short- or long-term, impact individuals' health-related quality of life and present challenges for public health (Campos et al., 2020; Ryal et al., 2023).

These findings emphasize the importance of holistic approaches and appropriate interventions to support the mental health of the population affected by the pandemic and its psychological repercussions. Moreover, daily experiences of depression, anxiety, and stress can increase the likelihood of weight gain associated with overweight and obesity (Sheu et al., 2017). Therefore, it is crucial to implement interventions considering the various aspects associated with obesity, aiming to prevent and treat it during the pandemic (Brooks et al., 2020; Stefan et al., 2021; Sordi et al., 2023; Ryal et al., 2023).

Consequently, there have also been other social changes in this pandemic scenario, such as a significant reduction in physical activity and an increase in unhealthy habits, including dietary patterns (Campos et al., 2020). It is estimated that half of the population does not engage in regular physical exercise; however, during the pandemic, these figures may be even lower (Chagas et al., 2020). Nevertheless, despite the lockdown and quarantine measures of COVID-19, physical exercise remains a valuable strategy in preventing obesity and/or the progression of associated comorbidities. Additionally, it serves as a non-pharmacological tool to combat anxiety, stress, and depression (Bolognese et al., 2020; Silva-Filho et al., 2020). Thus, obesity is a public health issue associated with epidemiological, social, and political factors (Mitchell & Shaw, 2015). Furthermore, changes in dietary habits and reduced physical activity are connected to social, emotional, and financial aspects, especially during the pandemic (Campos et al., 2020; Stefan et al., 2021). Consequently, caring for patients after a COVID-19 infection requires considering these factors to provide comprehensive care promoting health-related quality of life and complete assistance (Christinelli et al., 2022; Perli et al., 2023).

Therefore, it is necessary to develop multi-professional rehabilitation strategies for overweight or obese women who are survivors of Coronavirus infection, as intervention practices assist in lifestyle changes, dietary practices, and physical exercise habits (Christinelli et al., 2022; Sordi et al., 2023; Westphal-Nardo et al., 2023). In this context, these interventions consequently prevent the progression of comorbidities and physical and mental health consequences resulting from the COVID-19 pandemic (Stefan et al., 2021; Ryal et al., 2023). However, studies on the benefits of multi-professional rehabilitation in the female population after recovering from COVID-19 are essential, using instruments that investigate health-related quality of life in both physical and mental aspects and developing an effective intervention model for women who survived COVID-19. Therefore, the present study aimed to assess the health-related quality of life of women with overweight or obesity and the symptoms of COVID-19 by a multi-professional intervention model. We hypothesized that these women's health-related quality of life may be impaired due to the sequelae of COVID-19. By investigating this specific aspect, we believe valuable information will be obtained for developing therapeutic approaches intending to improve the quality of life and well-being of these women facing challenges associated with obesity and potential complications from COVID-19 infection.

METHODS

This study adopted a pragmatic trial (experimental group vs. control group) (Patsopoulos, 2011) conducted between February and June 2022, comprising 48 female volunteers. Following Jensen et al. (2014), 15 participants per group would be necessary to identify an $\alpha = 0.05$ and $\beta = 0.80\%$. The group allocation in the experimental or control group was determined by the preferences of the COVID-19

survivors, i.e., participants who wanted to participate in the interventions and participants who did not want to participate in the interventions. All the participants of the present study had COVID-19.

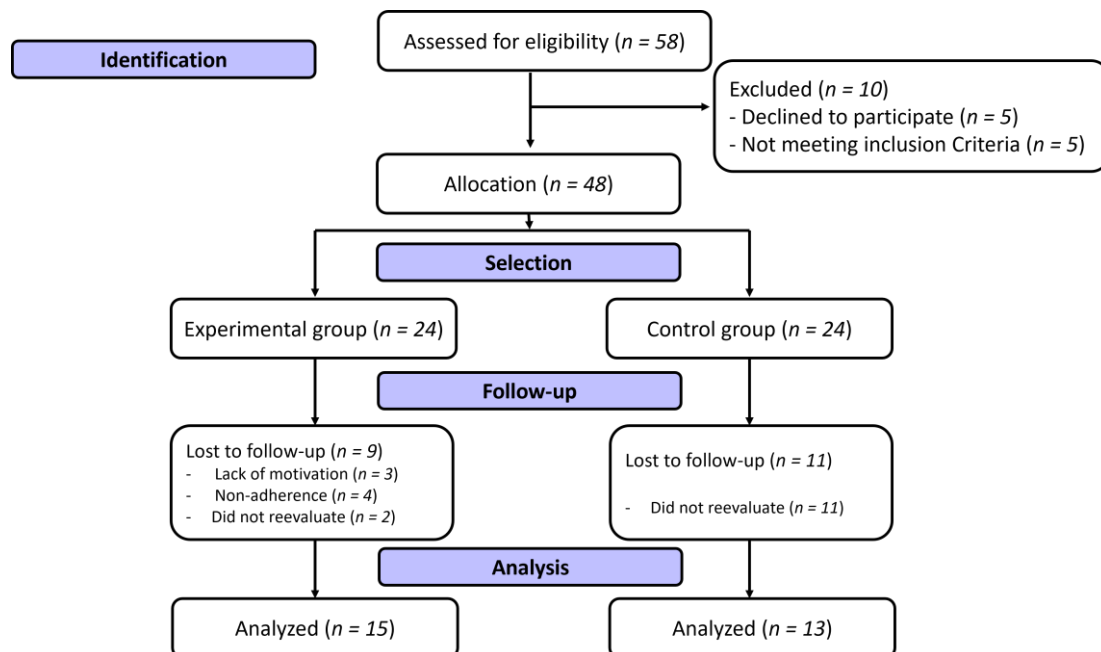
The participants underwent an evaluation of their health-related quality of life using the 12-item Short-Form Health Survey (SF-12) questionnaire. The study was approved by the Research Ethics Committee of Cesumar University and followed all the recommendations proposed by Resolution 466/12 of the Brazilian Government's Ministry of Health and the Declaration of Helsinki. The study was registered on the Brazilian Platform of Clinical Trials (REBEC) under RBR-4mxg57b. All subjects were informed about the study's objectives and signed an informed consent form.

Participants

The participants were recruited through the Municipal Health Department of Maringa and the Municipal Hospital of Maringa. An anamnesis was performed (To identify the symptoms of COVID-19), and the health-related quality of life questionnaire (SF-12) was administered. Next, the volunteers were allocated into the mild ($n = 24$), moderate ($n = 14$), and severe ($n = 10$) symptoms. The participants in the experimental group (participants) had the following characteristics: 53% were between 45-64 years old, 26.6% between 25-44 years old, 6.6% between 19-24 years old, and 13.3% were over 65 years old, and the Body Mass Index (BMI) was $30.5 \pm 5.45 \text{ kg/m}^2$; in the control group, 76.9% were between 45-64 years old, 15% were between 25-44 years old, and 7.6% were between 19 and 24 years old, and the BMI was $31 \pm 8.2 \text{ kg/m}^2$. Throughout the rehabilitation program, 20 participants (experimental plus control groups) dropped out of the interventions, and 28 participated in the final analysis. Figure 1 shows the flowchart diagram of the present study.

Figure 1

Flowchart diagram of study participants.



The inclusion criteria were as follows: 1) being between 19 and 65 years old; 2) overweight or obese women; 3) having a positive diagnosis of COVID-19 through qualitative molecular tests (RT-PCR);

4) having contracted COVID-19 between January 3, 2021, and September 1, 2021; 5) having received the first dose of the COVID-19 vaccine; and 6) having received medical clearance for the practice of physical activities. As for exclusion criteria, the following participants were not accepted: 1) patients with debilitating neurological diseases; 2) individuals with limited mobility (use of cane or wheelchair); 3) individuals without medical authorization for physical exercise; and 4) missing more than 25% of the program and 3 consecutive interventions. Figure 2 shows the experimental design for 16 weeks.

Figure 2

Experimental design of the present study.

Study Activities for 16 Weeks in Women Post-COVID-19		
<u>Initial Assessment</u>	<u>Theoretical and Practical</u>	<u>Final Assessment</u>
Medical clearance	<u>Activities (twice a week)</u>	****
SF-12 Questionnaire	Nutrition, Psychology,	NSF-12 Questionnaire
Application	Physical Therapy and	Reapplication
	Physical Education	

Note: The control group was analyzed after and before 16 weeks of intervention, but this group did not participate in the activities.

Support for the multi-professional interventions was composed of nutritionists, psychologists, physiotherapists, and physical education professionals. The actions were carried out on Mondays, Wednesdays, and Fridays for 16 weeks of intervention. Before that, the health professionals collaborated to develop a schedule and plan encompassing all focus areas. On average, the program lasted one and a half hours, with 45 minutes of alternating psychological and nutritional interventions with physical activity practices.

The physical exercise and physical therapy practices (conducted together) were conducted twice a week to improve cardiorespiratory and neuromuscular capacity, emphasizing functional capacity, during sessions of about 60 minutes. The training program consisted of resistance exercises for large muscle groups and cardiovascular exercises, such as a treadmill, vertical/horizontal bicycle, or rowing ergometer. Each training session was individually tailored to the participant's needs and conducted in a group setting. The physical exercise practices occurred at the Cesumar Institute of Science, Technology, and Innovation's gym. All physical training was designed and structured after health-related fitness assessments to improve the participants' physical condition through functional independence and muscle hypertrophy, if necessary. The participants were monitored during the physical exercise sessions using heart rate and finger oximetry.

The nutritional intervention program followed the Brazilian Dietary Guidelines and was conducted in a group setting once a week (Brasil, 2014). The main objective was to instruct the participants about the benefits of a healthy diet for health-related quality of life and reducing risks associated with non-communicable chronic diseases. Each session lasted about 45 minutes and took place once a week. Several topics were addressed during the sessions, such as the food pyramid, the nutritional density of foods, macro, and micronutrients, the relationship between diet and health, nutritional composition of foods, differences between diet and light foods, techniques for preparing healthy meals, nutritional

education to improve health-related quality of life, differences between fresh, minimally processed, processed, and ultra-processed foods, as well as tips on foods that help combat sarcopenic obesity.

Psychoeducation was based on therapeutic interventions with the primary objective of establishing a model encompassing the treatment and prevention of mental illnesses permeated by an educational essence (Authier, 1977; Beck, 2013). These sessions were conducted weekly in groups, encouraging the active participation of the involved individuals. This approach was grounded in the incorporation of concepts and information from psychology and various related fields, aiming to provide a comprehensive understanding to the individual about their condition and other illnesses afflicting our contemporary society. The topics discussed were as follows: (i) the imperative of physical exercise for improving health-related quality of life and mental health; (ii) the daily impact of anxiety and strategies to effectively cope with it; (iii) a thorough examination of obesity in today's society, dispelling unfounded beliefs, prejudices, and stereotypes; (iv) understanding the role of food in social, psychological, and physical aspects; (v) enlightening information about post-traumatic stress disorder; (vi) promoting a healthy lifestyle, encouraging practices beneficial to well-being; (vii) reflections on stress and its implications; (viii) introspections about depressive symptoms; (ix) considerations about insomnia and relaxation techniques; (x) reflections on denial as a psychological mechanism; (xi) in-depth analysis of fear and its manifestations; (xii) reflections on binge eating and its implications; (xiii) considerations regarding a healthy lifestyle in its entirety; and (xiv) reflections on behavioral changes. Furthermore, at each meeting, informative pamphlets covering the respective topics were distributed, aiming to reinforce the interventions conducted and provide supporting material for both participants and the community. The psychological interventions also lasted 45 minutes once a week.

12-item health survey (SF-12)

The quantitative questionnaire was the SF-12, a short, rapidly applicable instrument with understandable language (Gandek et al., 1998). The SF-12 questionnaire has good psychometric properties for assessing overall health, encompassing physical and mental health components (Gandek et al., 1998; Jenkinson et al., 1997). The psychometric measurements approximate an accuracy of 90% (Gandek et al., 1998). The analysis of the SF-12 is done through scores of the physical and mental components, distributed using specific algorithms from the questionnaire (Gandek et al., 1998; Jenkinson et al., 1997). The instrument assesses eight situations intrinsic to health-related quality of life, considering the individual's perception of health and recent habits and activities (Gandek et al., 1998). The items have a set of distributed response options, and the scores can range from zero to one hundred, with higher scores indicating better health-related quality of life (Gandek et al., 1998; Jenkinson et al., 1997).

Statistical analysis:

The results of the SF-12 responses were expressed as mean and standard deviation and analyzed using Ottoboni et al.'s algorithmic mean (Ottoboni et al., 2017). The mixed-design analysis of variance (ANOVA) was used to identify possible differences between groups, time, and/or interactions. The Bonferroni post hoc test was used if a significant difference was detected. Data homogeneity was analyzed using the Levene test, and the distribution of residuals was assessed through visual inspection

of residual plots. A significance level of 5% was established for all analyses. The statistical analyses were conducted using Statistica 12.0 software (StatSoft, Tulsa, OK, USA).

RESULTS

Table 1 shows the means and standard deviations of physical and mental health for the participants and non-participants at the first and second assessments of the present study.

Table 1

Characteristics of Experimental and Control group for Physical Health and Mental Health in the 12-item health survey after and before 16 weeks of intervention.

	Experimental Group	Control Group
First assessment		
Physical Health	43.44 ± 8.03	42.93 ± 11.38
Mental Health	40.29 ± 9.95	44.31 ± 10.15
Second assessment		
Physical Health	45.58 ± 6.31	44.60 ± 9.07
Mental Health	50.38 ± 9.56*	39.69 ± 10.14

Note: The values are means ± standard deviation. Analyses were performed based on the Ottoboni et al. (2017) algorithmic mean; * = significant difference with higher values for mental health in the experimental group compared to itself in the first assessment.

The analyses just revealed a significant interaction between the mental health quality of the experimental group participants at the first and second assessments. For physical health, no group, no time, or interaction was observed ($p > 0.05$).

DISCUSSION

The main objective of the present study was to investigate the health-related quality of life in obese women who had COVID-19 to identify mental and physical health parameters after a multi-professional intervention. Understanding the extent to which COVID-19 affects different sexes differently is a crucial advancement in comprehending the pathophysiology and characteristics of COVID-19 sequelae to prevent and promote actions tailored to the individuality of disease survivors. Within this context, it has been identified that the COVID-19 pandemic has had detrimental effects on the healthcare system, widening the gap in access to proper medical assistance globally, significantly impacting the health-related quality of life, and contributing to an increase in worldwide morbidity and mortality rates (Feletto et al., 2020). Additionally, there have been significant social changes, including reduced supervised and unsupervised physical exercise and decreased healthy eating habits (Campos et al., 2020).

Regular physical exercise is known to benefit the cardiovascular, metabolic, and immune systems and prevent more severe cases of coronavirus infection (Kang et al., 2020; Pitanga et al., 2020). Therefore, the reduction in physical activity during the COVID-19 pandemic has adversely affected the treatment and recovery of post-COVID-19 obese patients and contributed to the progression of comorbidities (Pitanga et al., 2020; Polero et al., 2020; Stefan et al., 2021). Even today, in a post-pandemic scenario, it is observed that these habits still prevail, strongly contributing to post-COVID-19

comorbidities and sequelae, which include hepatic, renal, and cardiac insufficiency, myocarditis, vascular inflammation, cardiac arrhythmias, gastrointestinal issues, and even cerebral complications (Armitage & Nellums, 2020; Campos et al., 2020). Among the most affected individuals, those with obesity experienced a more severe presentation and progression of the disease, affecting the body systematically, worsening physical and mental health, and having a higher mortality rate compared to those without obesity (Kang et al., 2020; Stefan et al., 2021). Additionally, women were significantly affected in the context of the pandemic and post-COVID compared to males (Iqbal et al., 2021; Munblit et al., 2021). In this regard, the female sex can be considered a risk factor for post-COVID-19 symptoms, particularly in the long term (Fernández-de-las-Peñas et al., 2022). During the pandemic period, many women experienced increased anxiety and impaired psychological well-being with advancing age (Akbas et al., 2021). While men and women presented similar symptoms of COVID-19 during hospitalization, it was evidenced that women developed more post-COVID symptoms eight months after hospital admission, as well as showing more significant depressive symptoms, signs of increased anxiety, and sleep disturbances when compared to men (Astin et al., 2023; Fernández-de-las-Peñas et al., 2022).

As described, anxiety was strongly associated with the pandemic period and may be related to post-COVID symptoms (Akbas et al., 2021; Fernández-de-las-Peñas et al., 2022; Ryal et al., 2023). During the lockdown, the focus of healthcare shifted, and the provision of primary and essential health services for women was impacted, leading to a further prevalence of anxiety, distress, and stress symptoms in women (Munblit et al., 2021). Additionally, post-COVID symptoms such as post-traumatic stress disorder, sleep disorders, and fatigue were identified among women (Bagheri et al., 2023; Fernández-de-las-Peñas et al., 2022). However, the male sex has 2.4 times higher levels of hospital mortality when the disease is still in its acute phase, and this percentage increases with advancing age and the presence of comorbidities among men. On the other hand, women represent up to 63% of patients with long COVID syndrome, which occurs after months of infection by the disease when the persistent signs and symptoms of patients extend beyond three months (Al-Aly et al., 2022). The most common symptoms identified were chest pain, shortness of breath, fatigue, chronic cough, and respiratory symptoms that compromise the individual's cardiopulmonary function (Astin et al., 2023; Bagheri et al., 2023). Moreover, it has been observed that COVID-19 survivors have a higher risk of long-term cardiovascular complications, including cerebrovascular changes, arrhythmia, inflammatory or ischemic heart disease, and thromboembolic disorders (Wang et al., 2022). Additionally, some studies explain through different mechanisms why women develop more post-Covid symptoms than men (Ortona et al., 2021).

In summary, physical exercise is capable of significantly reducing symptoms of anxiety. The mechanisms through which exercise achieves these results are likely due to physical and mental conditions (Svensson et al., 2021). Therefore, interventions enabling physical exercise can promote effective treatment and prevention for anxiety and other psychological disorders due to exercise's broad benefits, thereby increasing life expectancy (Svensson et al., 2021). Among the various limitations of physical exercise for an anxious population, stress is considered a barrier to regular exercise participation; this is because when exercise becomes a regular part of one's routine, anxiety symptoms are reduced in the future, and it may also prevent other anxiety-related disorders (Schuch et al., 2019). It seems that there is an appropriate intensity for the exercise to have a reliable protective effect; thus,

moderate to high-intensity exercise is more strongly associated with reducing anxiety than low-intensity exercise; this occurs due to the neurological and hormonal stimuli that are related to anxiety and physical exercise (Singh et al., 2023).

Consequently, when exercise is practiced, endorphins are released, which are peptide opioids generated by the hypothalamus-pituitary system in response to exercise, thus improving mood (Mahindru et al., 2023). For effective treatment and management of obesity, it is necessary to consider the multifactorial influences that have contributed to the development of the condition and devise strategies and interventions that aim to modify behavioral patterns, promoting a healthy lifestyle through physical exercise, proper nutrition (Christinelli et al., 2022; Sordi et al., 2023; Westphal-Nardo et al., 2023), and psychoeducation (Ryal et al., 2023). Therefore, multi-professional actions are required to ensure comprehensive and complete care for the individual, promoting health and health-related quality of life (Bolognese et al., 2020; Sordi et al., 2023).

It is evident the need for access to healthcare services post-pandemic to minimize the long-term consequences of COVID-19, especially regarding the clinical condition of women (Bagheri et al., 2023). Rehabilitation is essential for improving systemic functions, particularly the cardiovascular and respiratory systems, which are more affected. Furthermore, considering the changes in daily habits during and after the pandemic that can worsen recovery and contribute to post-COVID-19 complications, multi-professional rehabilitation with physical exercise practices, nutritional education, and psychological interventions are of utmost importance (Lemos et al., 2022; Perli et al., 2023; Sordi et al., 2023; Ryal et al., 2023).

Finally, the main strengths of the present study were: (i) the utilization of a multi-professional model of intervention with non-pharmacological intervention to recover health aspects of women with overweight/obesity and (ii) a low-cost method of treatment may be applied in other health places. However, the limitations were: (i) a lack of follow-up of study participants in the middle and long term (ii) a lack of other physical and mental instruments to access other aspects of the health of these study participants, and (iii) a restricted sample size that could not possibility the data extrapolation.

CONCLUSION

There was limited adherence to daily intervention, which may have been motivated by factors such as distance and transportation and persistent discouragement among the participants. Although there was a significant improvement in the participants' mental health quality, anxiety was the most prominent factor subjectively identified by the multi-professional team during the rehabilitation program sessions, indicating a vital point to be analyzed and better understood in future research. Therefore, there is a need for more interventional studies that clarify the association between multi-professional interventions and factors that affect the participation of the participants. Additionally, there is a need for a better understanding of mental health and its intrinsic parameters, as well as a more profound comprehension of other impacts on the health-related quality of life regarding multi-professional rehabilitation in obese patients post-COVID-19.

The combination of multi-professional interventions allows for a more comprehensive and individualized approach to each patient's integral and specific recovery. Among the practical applications of multi-professional rehabilitation in post-COVID-19 patients, improvements in physical

capacity, health-related quality of life, mental health, and reductions in cardiovascular and metabolic risk factors stand out. Multi-professional rehabilitation can, therefore, be an effective therapeutic intervention for post-COVID-19 patients, contributing to a faster and more efficient recovery. In summary, cardiorespiratory and multi-professional rehabilitation plays an essential role in the recovery and improvement of the health-related quality of life of post-COVID-19 patients and should be considered an essential therapeutic intervention.

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