Effectiveness of a multidisciplinary obesity treatment program during the COVID-19 pandemic: Application of Remote Nursing Monitoring

Efectividad de un programa multidisciplinario de tratamiento de la obesidad durante la pandemia de COVID-19: Aplicación de Monitoreo Remoto de Enfermería

Efetividade de um programa multiprofissional de tratamento da obesidade durante a pandemia de COVID-19: Aplicação do Monitoramento Remoto da Enfermagem

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ABSTRACT

Objective: To verify the effectiveness of remote nursing monitoring associated with a multi-professional obesity treatment program to improve cardiometabolic biomarkers and health-related physical fitness indicators in obese adults followed during the COVID-19 pandemic. Methods: The study was characterized as a Pragmatic Clinical Trial, carried out in a municipality in the south of Brazil. It involved 22 women aged between 18 and 50 years, who had cell phones with access to the WhatsApp® application for 16 weeks. Pre- and post-intervention evaluations were carried out through laboratory tests capable of determining cardiometabolic biomarkers: HDL, triglycerides, LDL, total cholesterol, glycemia, glycated hemoglobin, insulinemia, Homa-IR, Homa-β, hs-CRP. As well as tests capable of assessing the levels of physical fitness related to health: body composition, cardiorespiratory fitness, muscle strength and flexibility. The data obtained were analyzed using the t-test for paired samples and correlated from the absolute delta value of each variable using Pearson's correlation. Results were considered significant when the p value was <0.05. This study received a favorable opinion from the National Research Ethics Committee. Results: The study observed significant improvements in blood glucose, insulin, Homa-IR and HDL levels, as well as in indicators of cardiorespiratory fitness and muscle strength. Conclusion: Remote nursing monitoring associated with a multidisciplinary obesity treatment program is an effective intervention for improving cardiometabolic biomarkers and HRPF indicators.

Key words: Obesity, Remote Nursing Monitoring, Health-Related Physical Fitness, Biomarkers, COVID-19.

RESUMEN

Objetivo: Evaluar la efectividad del monitoreo remoto de enfermería, en asociación con un programa multiprofesional de tratamiento de la obesidad, para mejorar los biomarcadores cardiometabólicos y los indicadores de aptitud física relacionados con la salud en adultos obesos durante la pandemia de COVID-19.Métodos: Se llevó a cabo un Ensayo Clínico Pragmático en un municipio del sur de Brasil, con la participación de 22 mujeres de edades comprendidas entre los 18 y 50 años, que contaban con teléfonos móviles con acceso a la aplicación WhatsApp® durante un período de 16 semanas. Se realizaron evaluaciones pre y postintervención mediante exámenes de laboratorio, que permitieron determinar los biomarcadores cardiometabólicos: HDL, triglicéridos, LDL, colesterol total, glucemia, hemoglobina glucosilada, insulinemia, Homa-IR, Homa-β, hs-CRP; y pruebas para evaluar los niveles de aptitud física relacionados con la salud: composición corporal, aptitud cardiorrespiratoria, fuerza muscular y flexibilidad. Los datos obtenidos se analizaron utilizando la prueba t para muestras pareadas y se correlacionaron mediante la correlación de Pearson, a partir del valor delta absoluto de cada variable. Se consideraron resultados significativos cuando el valor de p fue < 0,05. Este estudio recibió la aprobación del Comité Nacional de Ética en Investigación.Resultados: Se observaron mejoras significativas en los niveles de glucosa en sangre, insulina, Homa-IR y HDL, así como en los indicadores de aptitud cardiorrespiratoria y fuerza muscular.

Conclusión: El monitoreo remoto de enfermería, en asociación con un programa multidisciplinario de tratamiento de la obesidad, resulta en una intervención eficaz para mejorar los biomarcadores cardiometabólicos y los indicadores de aptitud física relacionados con la salud.

Palabras clave: Obesidad, Monitoreo Remoto de Enfermería, Aptitud Física Relacionada con la Salud, Biomarcadores, COVID-19.

RESUMO

Objetivo: Verificar a efetividade do monitoramento remoto da enfermagem associada a um programa multi-profissional de tratamento de obesidade na melhora dos biomarcadores cardiometabólicos e indicadores da aptidão física relacionada à saúde de adultos com obesidade acompanhados durante a pandemia da COVID-19. Métodos: Estudo caracterizado como um Ensaio Clínico Pragmático, realizado em um município do Sul do Brasil, com 22 mulheres, com idade entre 18 e 50 anos, portadores de telefone celular com acesso ao aplicativo WhatsApp® durante 16 semanas. Foram realizadas avaliações pré e pós intervenção por meio de exames labo-ratoriais, capazes de determinar os biomarcadores cardiometabólicos: HDL, triglicerídeos, LDL, colesterol total, glicemia, hemoglobina glicada, insulina, Homa-IR, Homa-β, PCR-us; e de testes capazes de avaliar os níveis da aptidão física relacionada à saúde: composição corporal, aptidão cardiorrespiratória, força muscular e flexibili-

dade. Os dados obtidos foram analisados através do teste t para amostras pareadas e correlacionados a partir do valor de delta absoluto de cada variável por meio da correlação de Pearson. Os resultados foram considerados significantes quando o valor de p foi < 0,05. Este estudo possui parecer favorável do Comitê Nacional de Ética em Pesquisas. Resultados: Foram observadas melhoras significativas nos níveis de glicemia, insulina, Homa-IR e HDL, bem como nos indicadores de aptidão cardiorrespiratória e força muscular. Conclusão: O monitoramento remoto da enfermagem associado a um programa multiprofissional de tratamento de obesidade é uma inter-venção efetiva na melhoria dos biomarcadores cardiometabólicos e dos indicadores da HRPF.

Palavras chave: Obesidade, Monitoramento Remoto da Enfermagem, Aptidão Física Relacionada à Saúde, Biomarcadores, COVID-19.

INTRODUCTION

Obesity, which has reached epidemic levels in Brazil and in most of the Westernized world (Ministry of Health, 2019; World Health Organization [WHO], 2023), is now emerging as a significant risk factor for COVID-19, representing one of the most important conditions that exponentially increase the risk of worsening and mortality of SARS-CoV-2 patients (Huang et al., 2020).

To contain the spread of the novel coronavirus, countries have implemented social distancing (Clemmensen et al., 2020). Despite the benefits of this measure (Matrajt & Leung, 2020), preliminary results from studies show that home confinement favored an obesogenic environment (Di Renzo et al., 2020), caused by reduced levels of physical activity (Andrades-Suárez et al., 2022; Zheng et al., 2020), and increased consumption of foods with high energy value and low nutritional quality (Batlle-Bayer et al., 2020), perpetuating underlying chronic diseases and making individuals affected by obesity even more exposed to the risks of COVID-19 (Chandrasekaran & Ganesan, 2021).

On the other hand, healthy habits are indicated as protective factors against the worsening of COVID-19, highlighting the need to maintain monitoring of individuals with obesity at a distance during the pandemic (Silva et al., 2021).

Therefore, nurses, the professionals responsible for care and the main link between patients and healthcare teams, must use tools capable of reaching individuals with obesity in order to provide health education (Di Renzo et al., 2020). Remote nursing monitoring stands out as a tool that enables this connection and has already demonstrated positive results in combating obesity (Utrila et al., 2021).

In this context, we conducted an extensive literature search and found no studies that tested the effectiveness of remote nursing monitoring associated with a Multidisciplinary Obesity Treatment Program (MOTP) in the context of the pandemic. Therefore, this study aimed to verify the effectiveness of a multidisciplinary obesity treatment program during the COVID-19 pandemic as an application of remote nursing monitoring.

METHODS

This study was characterized as a pragmatic clinical trial (Patsopoulos, 2011), carried out in a city in southern Brazil. The study was publicized on social media, print and spoken media during the months of September and October 2019. The study included obese people of both sexes, aged between 18 and 50 years, living in the city where the study was conducted, with access to the WhatsApp® application; those who had undergone previous bariatric surgery, reported eating disorders and reduced or impaired mobility were excluded; and those who discontinued/withdrew from the group activities for seven consecutive days.

Intervention: Remote nursing monitoring associated with a MOTP.

The intervention model of remote nursing monitoring associated with a Multidisciplinary Obesity Treatment Program (MOTP) was implemented remotely through the WhatsApp® application. Participants were included in two groups in the application: 1. Only health professionals had access to send messages; 2. Everyone could send messages, enabling interaction between participants.

The MOTP was formed by physical education, nutrition and psychology professionals, who worked based on cognitive-behavioral therapy (Bim et al., 2021, 2022; Castilho, Westphal, Thon et al., 2021). These professionals recorded videos with the interventions and sent them to group 1 on defined days and times.

The Physical Education Professional provided guidance three times a week (Mondays, Wednesdays and Fridays), at 6:30 pm, with guidelines and examples of moderate/intense aerobic physical activity, lasting one hour (Christinelli et al., 2022; Westphal et al., 2020).

The psychologist sent guidelines (second) that addressed body recognition, perception, goal setting, expectations, self-esteem, self-love, self-knowledge and self-assessment, the process of change, motivations, emotions and eating habits, anxiety, recognition of emotions, emotional eating, and the food industry.

The nutritionist's guidelines addressed goal setting and nutritional surveys, adequate and healthy eating, meal planning, hunger and satiety, mindful eating, food groups and nutrient functions, menu planning, food labels and fad diets, functional foods, comorbidities associated with excess weight and obesity, nutritional experience (by posting participants' meals in the WhatsApp® group) and everyday situations and how to continue healthy eating after the MOTP.

Remote nursing monitoring was associated with MOTP to link participants to healthcare team professionals and promote participants' health through guidance focused on health education with the following topics: Clarification of the proposal for remote nursing monitoring; concept and causes of obesity; healthy eating for health and weight control; complications of obesity; importance of physical activity and how to perform it; food preparation; hydration and water consumption; consumption of fruits and their properties; consumption of vegetables and greens; risk of certain diets and the importance of monitoring by a healthcare professional; importance of weight control; self-image; concept, causes and prevention of hypertension; concept, causes and prevention of dyslipidemia; control of diabetes, its symptoms and prevention; bariatric surgery, its risks, advantages and disadvantages; COVID-19 and its relationship with obesity; reinforcement of guidance on the importance of weight control and evaluation of participation in the group (Christinelli et al., 2021, 2022). The intervention took place between March and June 2020.

We made a cut from the multicenter project entitled "Effectiveness of a multidisciplinary program in the assessment of cardiometabolic risk factors and treatment of abdominal obesity in two municipalities in northwestern Paraná". It was designed to take place in person, however, the new coronavirus pandemic required changes to the remote format which, with the consent of the participants, led to the design presented. The evaluation of the participants before the intervention (carried out in February 2020) and after the intervention (July 2020) was carried out through laboratory tests, collected after an eight-hour fast, to determine the cardiometabolic biomarkers: blood glucose, insulinemia, glycated hemoglobin (HbA1c), total cholesterol, HDL-c, LDL-c, triglycerides and ultrasensitive C-reactive protein (us-CRP) and from the blood glucose and insulinemia values, the values of the homeostasis assessment model of insulin resistance (Homa-IR) and beta-pancreatic index (Homa-β) were calculated; and tests capable of assessing the levels of health-related physical fitness (HRPF): body composition, cardiorespiratory fitness (CRF), muscle strength and flexibility. Body bioelectrical impedance analysis (BBA) was performed using a multifrequency octapolar bioimpedance meter, model Inbody 520 from Biospace®, following the Heiward protocol (Heyward, 2001). Height was measured using a stadiometer attached to the wall with an accuracy of 0.1 cm. BMI classification was made according to the cutoff points established by the WHO. Neck, waist, and hip circumferences were measured using a 2 m inextensible anthropometric tape with an accuracy of 0.1 mm (WHO, 2008).

The CRF was verified using the 6-minute walk test (6MWT) (American Thoracic Society [ATS], 2002; Castilho, Westphal, Pereira et al., 2021). The subjective perception of exertion (RPE) was recorded after the test using the adapted Borg scale (1982). The Wells bench was used to measure the flexibility of the back of the trunk and legs (Wells & Dillon, 1952).

The abdominal plank test was used to measure the static muscular endurance of the trunk region, which involves the muscles of the abdominal, lumbar and pelvic regions (Chase et al., 2014). To measure the dynamic muscular endurance of the lower limbs, the sit-to-stand test was performed (Rikli & Jones, 2013). And the handgrip test measured the maximum isometric handgrip strength using a dynamometer model: GRIP D - TKK 5410, Takei® (Caputo et al., 2014).

DATA PROCESSING AND ANALYSIS

The data obtained were entered into a Microsoft Excel 2010 spreadsheet and statistically analyzed using the Statistica Single User software, version 13.2, and the SPSS statistical package, version 22.0 (Field, 2009). Descriptive statistics parameters were presented, such as mean, standard deviation, minimum and maximum. The paired t-test was used to compare the two groups; and the absolute delta value was calculated and Pearson's correlation was used to associate the results of the variables. The significance level adopted was 5%.

ETHICAL ASPECTS

All participants signed the Informed Consent Form. The Clinical Trial of the umbrella project has approval by the Research Ethics Committee of the State University of Maringá under Protocol

No. 2,655,268, in accordance with Resolution 466/2012 and 510/2016, and approval by the Brazilian Registry of Clinical Trials, a platform of the Ministry of Health, under registration: RBR-2yzs76. The use of remote monitoring of nursing during the COVID-19 pandemic was approved by the National Commission on Ethics in Research with Human Beings under Opinion number: 4,018,114/2020. This is research funded by the Araucária Foundation through Call for Proposals CP 01/2016.

RESULTS

Based on the study criteria, the intervention began with 39 individuals, of whom 22 remained until the end of the 16 weeks and participated in the final evaluation. Thus, we analyzed the data of 22 women with a mean age of 40.4 ± 7.6 years (age range 18–50 years). Only two women (9.1%) were between 20 and 30 years old, seven (31.8%) were between 31 and 40 years old, and 13 (59.1%) were between 41 and 50 years old. The effectiveness of the intervention on HRPF indicators and biomarkers is demonstrated in Table 1. Significant improvements in CRF were observed in the variables of pre-test HR at rest (p=0.0001), HR measured 1 minute after the 6MWT (p=0.0069), and RPE (p=0.0001). There was also an improvement in the levels of dynamic MR LL (p = 0.0197), when compared to the initial results. Regarding biological markers, there was a significant improvement in the results of glycemia (0.014), insulin (0.001), Homa-IR (0.001) and HDL (0.000).

Table 1

Changes in HRPF indicators and cardiometabolic biomarkers after intervention by remote nursing monitoring associated with a multidisciplinary obesity treatment program in obese adults monitored during the COVID-19 pandemic.

Variables	Pre (initial) (n=22)	Post (16 weeks) (n=22)	p
	Mean (SD)	Mean (SD)	
HRPF			
Body Composition			
BMI	39,2 ± 7,3	38,3 ± 7,5	0,6176
Lean mass (%)	47,7 ± 8,6	47,5 ± 8,3	0,9555
Musculoskeletal mass (%)	27,8 ± 5,3	27,9 ± 5,2	0,9255
Fat free mass (%)	50,4 ± 8,9	50,4 ± 8,7	0,9673
Body fat percentage (%)	50,1 ± 4,9	48,5 ± 4,6	0,1988
Neck circumference (cm)	37,1 ± 3,2	36,7 ± 3,0	0,6700
Waist circumference (cm)	101,4 ± 12,3	97,8 ± 12,7	0,2729
Abdominal circumference (cm)	114,6 ± 15,5	110,8 ± 15,3	0,2536
Hip circumference (cm)	124,4 ± 13,2	122,8 ± 14,7	0,6038
ACR – 6MWT			
Pre-test resting HR (bpm)	102,7 ± 14,5	82,8 ± 14,8	0,0001*
Distance traveled (meters)	482,8 ± 49,0	486,3 ± 53,5	0,8527
Post-test HR (bpm)	127,5 ± 20,4	114,6 ± 26,2	0,0765
HR 1 minute post-test (bpm)	107,2 ± 17,3	92,5 ± 18,5	0,0069*
SpO2 (%)	96,6 ± 1,9	97,5 ± 0,7	0,1043
RPE	5,6 ± 1,1	2,2 ± 0,6	0,0001*
Flexibility			
Posterior flexibility trunk and legs (cm)	22,2 ± 7,2	24,8 ± 6,47	0,2729
Strength / MR			
Static abdominal MR (seconds)	30,3 ± 19,2	41,4 ± 27,4	0,1419
MR LL dynamics (number)	11,2 ± 2,5	13,0 ± 1,7	0,0197*
Biochemical Markers			
Blood glucose (mg/dL)	104±53	93±35	0,014*
Insulin (mU/L)	18,49±8,81	12,41±5,29	0,001*
Homa-IR	4,69±2,57	2,86±1,46	0,001*
Homa-β	201,49±104,07	217±134,57	0,556
PCR-us (mg/dL)	6,51±4,13	6,63±4,38	0,894
TC (mg/dL)	199±33	217±37	0,021*
HDL-c (mg/dL)	49±10	68±15	0,000*
LDL-c (mg/dL)	126±27	120±31	0,414
Triglycerides (mg/dL)	123±37	124±45	0,898
HbA1C (%)	5,54±0,84	5,53±0,78	0,826

HRPF: Health-Related Physical Fitness; BMI: Body Mass Index; ACR: Cardiorespiratory Fitness; 6MWT: 6-Minute Walk Test; HR: Heart Rate; bpm: Beats per minute; RPE: Perceived Exertion; MR: Muscular Endurance; LT: Lower Limbs. HOMA-IR: Insulin Resistance Index; HOMA-β: Beta-Pacreatic Index; CRP-us: High-Sensitivity C-Reactive Protein (mg/dL); TC: Total Cholesterol (mg/dL); HbA1C: Glycated Hemoglobin (%). Paired t-test.

The correlations between cardiometabolic biomarkers and body composition are presented in Table 2. A significant association was observed between CRP versus NC (r= 0.510 p=0.015) and BFP (r= 0.486 p= 0.022).

Table 2

Pearson correlation between biochemical markers and body composition. Maringá, Brazil, 2021.

Variables	Blood glucose (mg/dL)	Insulin (mU/L)	Homa-IR	Homa-β	PCR-us (mg/dL)	TC (mg/dL)	HDL-c (mg/dL)	LDL-c (mg/dL)	TG (mg/dL)	HbA1C (%)
Weight (kg)	r= 0,134 p=0.552	r=0,276 p=0.213	r=0,309 p=0.162	r=-0,001 p=0.997	r=0,370 p=0.090	r=0,288 p=0.194	r=0,009 p=0.967	r= 0,075 p=0.741	r=0,241 p=0,280	r=0,277 p=0,212
BMI (kg/m2)	r= 0,132 p=0.558	r=0,282 p=0.204	r=0,313 p=0.156	r=-0,005 p=0.982	r= 0,369 p=0.091	r=0,283 p=0.203	r=0,005 p=0.982	r= 0,072 p=0.751	r=0,241 p=0,280	r=0,281 p=0,205
NC (cm)	r= 0,343 p=0.118	r=-0,031 p=0.890	r=0,113 p=0.617	r=-0,304 p=0.168	**r=0,510* p=0.015**	r=0,198 p=0.377	r=0,018 p=0.937	r=0,212 p=0.343	r=-0,125 p=0.580	r= 0,319 p=0.148
WC (cm)	r= 0,246 p=0.269	r=0,043 p=0.843	r=0,102 p=0.650	r=-0,147 p=0.514	r= 0,202 p=0.368	r=0,307 p=0.164	r=0,192 p=0.393	r=0,004 p=0.987	r=0,169 p=0.451	r= 0,283 p=0.202
AC (cm)	r= 0,154 p=0.493	r=0,196 p=0.382	r=0,247 p=0.268	r=-0,030 p=0.893	r= 0,266 p= 0.232	r=0,310 p=0.160	r=0,064 p=0.777	r=0,247 p=0.268	r=-0,084 p=0.709	r= 0,201 p= 0.369
HC (cm)	r= -0,042 p= 0.852	r=0,317 p=0.150	r=0,293 p=0.185	r= 0,086 p=0.702	r= 0,277 p= 0.212	r=0,161 p=0.474	r=-0,107 p=0.637	r=-0,046 p=0.838	r= 0,405 p=0.061	r= 0,294 p= 0.184
LM (kg)	r= 0,165 p= 0.464	r=0,171 p=0.447	r=0,240 p=0.283	r= -0,028 p=0.903	r= 0,144 p= 0.521	r= 0,086 p=0.702	r=0,027 p=0.904	r=-0,085 p=0.706	r=0,114 p=0.613	r= 0,405 p= 0.062
MSM (kg)	r= 0,136 p= 0.546	r=0,156 p=0.489	r=0,217 p=0.331	r=-0,034 p=0.881	r= 0,216 p= 0.334	r= 0,126 p=0.578	r=0,017 p=0.942	r=-0,041 p=0.857	r=0,149 p= 0.508	r= 0,405 p= 0.061
FFM (kg)	r= 0,158 p= 0.482	r=0,156 p=0.488	r=0,225 p=0.315	r=-0,030 p=0.893	r= 0,147 p= 0.515	r= 0,065 p=0.774	r=0,008 p=0.971	r=-0,110 p=0.627	r=0,120 p= 0.595	r= 0,418 p= 0.053
BFP (%)	r= 0,272 p= 0.221	r=0,171 p=0.447	r=0,255 p= 0.252	r=-0,035 p=0.879	**r=0,486* p= 0.022**	r=0,392 p=0.071	r=-0,026 p= 0.908	r= 0,179 p= 0.425	r= 0,320 p= 0.146	r= 0,195 p= 0.383

BMI: Body Mass Index (kg/m2); NC: Neck Circumference (cm); WC: Waist Circumference (cm); AC: Abdominal Circumference (cm); HC: Hip Circumference (cm); LM: Lean Mass (kg); MSM: Skeletal Muscle Mass (kg); FFM: Fat Free Mass (kg); PGC: Body Fat Percentage (%); HOMA-IR: Insulin Resistance Index; HOMA-**β**: Beta-Pacreatic Index; CRP-us: Ultra-sensitive C-Reactive Protein (mg/dL); TC: Total Cholesterol (mg/dL); HbA1C: Glycated Hemoglobin (%).

DISCUSSION

Based on the results found, it is clear that the Multidisciplinary Obesity Treatment Program (MOTP) promoted a significant improvement in ACR and HR; and in the significant reduction of blood glucose, insulin, Homa-IR, total cholesterol and HDL levels.

Satisfactory levels in HRPF indicators are related to better outcomes in the case of SARS-Cov-2 infection (Marçal et al., 2020). On the other hand, when the levels of these indicators are reduced, the chances of the individual developing severe cases of COVID-19 increase (Chen et al., 2020).

Obesity is associated with low levels of HRPF. During the intervention, the participants in this study were encouraged to perform physical activities at least three times a week. After this period, they were able to cover a greater distance in the 6MWT and the RPE was reduced. There were also significant improvements in resting HR and recovery HR measured 1 minute after the 6MWT, which was related to an improvement in SpO2.

We also observed that the best performance during the 6MWT was related to a reduction in triglyceride levels. In other words, the participants significantly increased their HRPF levels. These findings reinforce the importance of health professionals promoting actions to encourage people with obesity to remain active during and after the COVID-19 pandemic (Bim et al., 2022; Herrera-Santelices et al., 2022).

Beyond the pandemic, good CRF results are considered the most important determinants of general health and predict a reduction in mortality risks (Al-Mallah et al., 2018), being even more important than weight loss in the obese population (Elagizi et al., 2020).

These results reinforce those indicated in a meta-analysis that attributed to MOTP the effectiveness in improving HRPF indicators (Pazzianotto-Forti et al., 2020). By demonstrating the effectiveness of improving these indicators, communication tools between professionals and patients are expanded, which may be very important in the context of social distancing during the COVID-19 pandemic.

Regarding cardiometabolic outcomes, we observed that participants significantly reduced their insulin, blood glucose, and HOMA-IR levels. The reduction in insulin resistance, demonstrated through HOMA-IR, is very important in reducing the amount of angiotensin-converting enzymes (ACE2), responsible for the entry of the coronavirus into cells (Sanchis-Gomar et al., 2020). Therefore, the decline in HOMA-IR may improve myocellular insulin sensitivity, which may be relevant in the context of ACE-2 by SARS-CoV-2 (Li et al., 2020).

Individuals with obesity infected with COVID-19 may experience significant changes in blood glucose levels during active infection (Bode et al., 2020). Vice versa, poorly controlled glucose metabolism increases severity and mortality in obese patients with COVID-19 (Li et al., 2020).

Our results are consistent with a meta-analysis that included 1,601,490 participants and associated higher levels of CRF and muscle strength with reduced insulin resistance. The same study estimated that 4% to 21% of new annual cases of type 2 diabetes among people aged 45 to 64 years could be prevented by changes in CRF and that even small improvements in CRF and muscle strength are associated with clinically significant reductions in the risk of developing type 2 diabetes (Bode et al., 2020).

Another important result found in our study was the association of hs-CRP levels with measures of NC and %BF. This protein is found in increased quantities during the inflammatory process of COVID-19 (Hamer et al., 2020; Westphal et al., 2021). This association may explain the results of a prospective cohort study conducted in Italy with adult patients hospitalized for COVID-19, which demonstrated that increased NC patterns in women (NC>37.5) significantly increased the need for invasive mechanical ventilation, with a stronger association in the subgroup with BMI≥30 kg/m2 (Di Bella et al., 2021).

We found no published studies on interventions that treated people with obesity remotely during the pandemic. However, a study that interviewed Brazilian people with chronic conditions during this period revealed the presence of weight gain related to unhealthy eating habits (p = 0.008) and sedentary lifestyle (p = 0.03) among participants (Pedroza et al., 2021), demonstrating that the interventions were of great importance in the context experienced.

This study has some limitations, particularly the context of the COVID-19 pandemic in which it was conducted, characterized as a period of sudden changes in the way people relate to each other, to which we attribute the difficulty in participating in the study. Other limitations of this study are related to the use of online questionnaires. These limitations may include the exclusion of participants with low digital literacy, difficulties in providing assistance when there is a lack of understanding of a question, and the impossibility of obtaining information about the circumstances in which the questionnaire was answered. However, it is important to highlight that solutions to these limitations are increasingly being studied and developed, as the benefits of collecting data through online surveys are recognized.

CONCLUSION

Remote nursing monitoring associated with MOTP is an effective tool for reducing cardiometabolic risks and improving HRPF indicators in adults with obesity monitored during the COVID-19 pandemic.

We recommend the integration of remote nursing monitoring with a multidisciplinary team as an effective tool for promoting the health of obese adults, expanding the tools for tackling this disease, especially in primary health care services.

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