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Original Article

EFEITO DE UMA INTERVENÇÃO REMOTA DE ATIVIDADE FÍSICA NO RISCO CARDIOVASCULAR E NA APTIDÃO FÍSICA

THE EFFECTS OF A REMOTE PHYSICAL ACTIVITY INTERVENTION ON CARDIOVASCULAR RISK AND PHYSICAL FITNESS

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RESUMO

Devido à pandemia da COVID-19, os projetos de orientação de atividade física (AF) tiveram que adaptar suas atuações para o formato remoto. O objetivo deste estudo foi avaliar os efeitos de uma intervenção remota de AF no risco cardiovascular e na aptidão física em participantes desses projetos. Para isso, 29 participantes do Projeto Exercício e Coração (66±5 anos) foram orientados a realizar, 2 caminhadas, 1 videoaula de exercícios aeróbicos e 2 videoaulas de exercícios de força muscular por semana, sendo cada atividade realizada por 30 min e em intensidade moderada. No início e após 8 semanas, foram medidos marcadores de risco cardiovascular e de aptidão física, que foram comparados por testes t-student ou Wilcoxon, considerando-se p≤0,05. Comparando-se as avaliações pré e pós-intervenção, houve redução da circunferência da cintura (95,9±11,3 vs. 94,7±11,3 cm, p=0,013) e aumento da capacidade cardiorrespiratória (117±21 vs. 123±23 passos, p=0,019), da força dos membros superiores (23±6 vs. 25±6 repetições, p=0,003), da resistência abdominal (20±9 vs. 22±10 repetições, p=0,002) e da aptidão física geral (-0,04±3,55 vs. 1,30±4,10, p=0,000). Em conclusão, a intervenção remota aumentou a aptidão física geral, aumentando a capacidade cardiorrespiratória, a força e a resistência muscular, além de reduzir a obesidade central.

Palavras-chave: Atividade física. Intervenção remota. Fatores de risco cardiovascular. Aptidão física.

ABSTRACT

Due to the COVID-19 pandemic, the projects that offer guidance for physical activity (PA) had to be adapted to the remote format. This study aimed at assessing the effects of a remote PA intervention on the cardiovascular risk and physical fitness of the individuals engaged in these projects. Thus, 29 participants of the Brazilian project known as *Projeto Exercício e Coração* (Exercise and Heart Project) (66±5 years) were instructed to perform 2 walking sessions, 1 aerobic exercise video class and 2 muscle strength video classes per week with each activity lasting 30 min and performed at moderate intensity. At baseline (pre) and after 8 weeks (post), markers of cardiovascular risk and physical fitness were evaluated and compared by using paired t-tests or Wilcoxon signed rank tests considering p≤0.05. When comparing pre- and post-intervention evaluations, there was a significant reduction in waist circumference (95.9±11.3 vs. 94.7±11.3 cm, p=0.013) and significant increases in cardiorespiratory fitness (117±21 vs. 123±23 steps, p=0.019), upper limb strength (23±6 vs. 25±6 repetitions, p=0.003), abdominal endurance (20±9 vs. 22±10 repetitions, p= 0.002) and overall physical fitness (-0.04±3.55 vs. 1.30±4.10, p=0.000). In conclusion, the remote intervention improved general physical fitness, increasing cardiorespiratory fitness, muscle strength and endurance, in addition to reducing central obesity.

Keywords: Physical activity. Remote intervention. Cardiovascular risk. Physical Fitness.

Introduction

Cardiovascular diseases (CVDs) represent the leading cause of death worldwide, accounting for at least 30% of deaths in 2016[1]. The highest prevalence of these deaths is concentrated in low and middle-income countries, which account for approximately three-quarters of the total[2]. The World Health Organization (WHO) defines the CVDs as a group of diseases that affect the heart and/or blood vessels, such as coronary disease, heart failure, cerebrovascular disease, among others[2]. The probability of developing CVDs is directly associated with the presence of cardiovascular risk factors that are characterized by innate or acquired conditions, such as genetic characteristics, chronological age, exposure to the environment and lifestyle[3].

Fighting CVDs has been a major concern of public health systems in Brazil and around the world, and their main goal is to reduce cardiovascular risk by controlling the modifiable risk factors, i.e. those that can be changed by health interventions[4]. Among these factors, the components of the metabolic syndrome (diabetes, dyslipidemia, arterial hypertension, as well as total and main central obesity) are highlighted in the present study as they normally occur in an associated manner that increases the overall cardiovascular risk (defined by the association of the cardiovascular risk factors present in each individual)[5].

One of the main foundations of CVDs prevention strategies is encouraging and guiding the regular practice of physical activity (PA), recognized as an effective way to fight these diseases through the control of the cardiovascular risk factors, among other aspects[6]. In addition, this practice improves general physical fitness, and makes the execution of daily activities easier, thus, improving quality of life[7]. In view of so many benefits, several projects have been developed to encourage and guide the population in the sense of practicing PA[8]. Some of these projects have been carried out in public places, such as the ‘Exercise and Heart Project’ that, over the last 20 years, has promoted the improvement of the physical fitness and the reduction of the cardiovascular risk of its participants through an individualized prescription of PA practice with limited supervision of its execution[9-10].

However, since COVID-19 reached its pandemic stage, this disease has become a public health challenge that demanded health decisions to reduce its contagion. Thus, social distancing, quarantine and lockdown were actions implemented for several months. Despite being necessary in the fight against COVID-19, the application of these strategies made it difficult to maintain an active lifestyle[11]. In this sense, studies have shown a decrease in the number of steps taken by the population during the pandemic, with reductions ranging from 7 to 38% in different countries[12], in addition to a 30% reduction in the practice of leisure time PA by people who was used to practice such activities before the pandemic[13]. In Brazil, this reduction was also evident[14], even affecting the participants of projects that encourage PA practice[15].

To circumvent this impact of the pandemic, physical education professionals involved in projects that encouraged PA practice had to adapt their activities to the remote format. In this context, using recorded video lessons was the most applied strategy. The change to remote performance had positive points, such as greater flexibility of schedule and practicality for performing PA; however, it also had negative points, such as the difficulties in handling the technological tools, measuring overload, and monitoring the participants[16]. Despite these difficulties, this strategy allowed the guidance of PA practice during this period.

Therefore, similarly to other projects, the ‘Exercise and Heart Project’ also resorted to the remote format by using digital technologies to disseminate video lessons to guide the practice of different types of PA. However, the effectiveness of this format for maintaining cardiovascular health and physical fitness needed to be evaluated. Thus, the present study aimed at assessing the effects of a remote PA intervention on the cardiovascular risk and physical fitness of individuals engaged in PA guidance projects, based on the experience of the ‘Exercise and Heart Project’.

Methods

Participants

The sample consisted of individuals engaged in the ‘Exercise and Heart Project’, retrospectively selected among those who had been evaluated before the onset of the COVID-19 pandemic and who met the following criteria: 1) had signed the Free Informed Consent Form allowing the use of their data for researcher of the ‘Exercise and Heart Project’; 2) had cell phones with Internet access; 3) did not have heart disease and were not using beta-blockers; 4) did not have been either hospitalized or had a diagnosis or signs or symptoms of COVID; 5) did not have had contact with people with COVID-19 in the last 14 days; and 5) were interested in participating in this study. Data collection was carried out at two moments when the University allowed performing in-person research activities during the pandemic (from December, 2020 to February, 2021; and from June to August, 2021). At each moment, potential volunteers were contacted by telephone and informed about the research procedures. Those who volunteered to participate were invited to the next steps. This study was approved as an addendum to the main research of the 'Exercise and Heart Project' by the Committee on Ethical Research of the School of Physical Education and Sport of the Brazilian university known as *Universidade de São Paulo (USP).*

Procedures

The individuals who met the study criteria were evaluated before (pre) and after (post) 60 days of intervention. For each of these assessments, the individuals were invited to attend in person in the morning and after a 10-hour fast. All biosafety measures to prevent COVID-19 were taken to ensure the safety of those being evaluated and evaluators as well.

During these assessments, the following cardiovascular risk factors were measured: body mass index (BMI), waist circumference (WC), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose (BG) and fasting total cholesterol (TC). Next, some tests were performed to measure the following physical fitness parameters: cardiorespiratory fitness, upper limb strength, lower limb strength, abdominal endurance, shoulder flexibility and lower back flexibility.

Between pre- and post- assessments, the individuals were instructed to perform at least 150 min of moderate PA per week. For that, they were instructed to perform 2 walking sessions of 30 min, 1 video class of aerobic exercises, and 2 video classes of strength/muscle endurance exercises per week. Such video classes also lasted approximately 30 min and were made available in specific playlists on a YouTube channel (https://www.youtube.com/channel/UC_Pz5_e2tZPgHRuS64SdBVg). During the execution of the activities, the individuals were instructed to maintain a moderate intensity (i.e. when doing the aerobic activities, they should feel increased breathing and sweating without becoming out of breath; and when performing strength activities, they should use overloads that allow them to complete the number of repetitions requested in the video lessons, usually about 10 repetitions). In addition, after performing each activity during the intervention period, the individuals were asked to complete an online form to record what activity they had done, for how long and at what intensity. The individuals were accompanied by monitors who were available in case of doubts and who contacted them after 1 and 4 weeks of the intervention.

Measurements

Body mass and height were measured on a digital scale and with a wall-mounted stadiometer (Welmy, model 110)[9-10]. BMI was calculated by the quotient between body mass and the squared height (kg/m^2). The WC was measured in duplicate with a measuring tape positioned at the level of the umbilicus, and the average of the values was considered. The individuals with a BMI equal to or greater than 30 kg/m^2 were classified as obese, while men with a WC > 102 cm and women with a WC > 88 cm were classified as with central obesity[17].

Blood pressure was measured by experienced evaluators using the auscultatory technique, an aneroid sphygmomanometer duly calibrated, and a cuff suitable for each individual's arm[18]. The measurement was performed with the individual seated at rest for at least 5 min by using phases I and V of Korotkoff sounds to respectively determine SBP and DBP. Three consecutive measurements with an interval of 1 min were performed, and the average of these values was calculated. The individuals with SBP equal to or greater than 140 mmHg and/or DBP equal to or greater than 90 mmHg were classified as hypertensives as well as those who were using antihypertensive drugs[18].

Blood samples were collected through digital puncture and were analyzed by automatic monitors for measuring fasting BG (Advantage® II, Roche) and fasting TC (Accutrend® GC – Roche). The individuals with fasting BG equal to or greater than 126 mg/dL as well as those using hypoglycemic agents were classified as diabetic, while the individuals with fasting TC equal to or greater than 240 mg/dL as well as those using cholesterol reducers were classified as dyslipidemic[19-20].

Global cardiovascular risk was calculated for each individual at each moment (pre and post) from the sum of the z scores of each risk factor. For that, the value of each cardiovascular risk factor was changed into a z-score, considering the mean and standard deviation of the values obtained in the pre-intervention assessment. Then, these values were added (i.e. Z = zBMI + zWC + zSBP + zDBP + zBG + zTC).

To assess physical fitness, cardiorespiratory fitness was measured by the 2-min step-test that accounts the total number of steps performed correctly during this period[21]. Upper limb strength was measured by the biceps curl test that evaluates the maximum number of repetitions performed in 30 s with women holding a weight of 2 kg and men of 4 kg[21]. Lower limb strength was measured by the vertical jump test without the use of the arms that remained raised[22], and the best result among three consecutive attempts was considered. Abdominal endurance was assessed by the number of abdominal crunches performed in 30 s, starting from the supine position with knees flexed, feet resting on the floor, arms extended at the side of the body, and raising the back at least 45° from the ground[22]. Shoulder flexibility was measured through the specific test suggested by Rikli & Jones[21], in which the distance in centimeters between the middle fingers of both hands positioned at the back is measured. For that, one arm is placed over one shoulder and the other hand under the other shoulder, bringing the hands together on the back. Negative values were considered when the fingers did not meet, and positive ones when they overlapped. Three attempts were made, and the best result was considered. Lower back flexibility was measured by the sit-and-reach test using Wells' bench[23]. Three attempts were made, and the greatest measure was considered. To classify the level of physical fitness in each of the tests, the tables generated by Albino et al.[24] were used.

General physical fitness was calculated for each individual at each moment (pre and post) from the sum of the z scores of each physical fitness parameter. Thus, the value of each parameter was transformed into z-score, considering the mean and standard deviation of the values obtained in the pre-intervention assessment. Then, these values were added (i.e. Z = zCardiorespiratory endurance + zStrength of upper limb + zStrength of lower limb + zAbdominal endurance + zShoulder mobility + zLow back flexibility).

Statistical analysis

Initially, normal distributions of data were assessed using the Shapiro Wilk tests applied to the differences between pre- and post-intervention values. Next, comparisons of the data obtained pre- and post-intervention were performed using paired t-tests or Wilcoxon tests depending respectively on the presence or absence of normal data distribution and considering $p < 0.05$ as significant. Then, the effect sizes were calculated by the Partial Eta Squared (η^2), considering $\eta^2<0.01$ as no effect; $0.01> \eta^2<0.06$ as a small effect, $0.06> \eta^2<0.14$ as a moderate effect and $\eta^2>0.14$ as a large effect[25]. Data are shown as mean±standard deviation and mean (95% confidence interval-CI).

Results

Thirty-two individuals agreed to participate in the study, however, 3 of them did not attend the post-intervention evaluations, and thus, the final sample consisted of 29 individuals.

This sample comprised elderly people between 60 and 78 years old, most of whom were women (79.3%). Several individuals had central obesity, dyslipidemia, and arterial hypertension. Most had physical fitness above or at the expected average for their sex and age (Table 1).

Table 1. Characteristics of the sample (n=29)

General characteristics	
Sex (men/women)	6/23
Age (years old)	66±5
Characteristics of Cardiovascular Risk	
Obesity, n (%)	6 (20.6)
Central obesity, n (%)	19 (65.5)
Diabetes, n (%)	1 (3.4)
Hypertension, n (%)	9 (31.0)
Dyslipidemia, n (%)	10 (34.4)
Characteristics of Physical Fitness	
Cardiorespiratory fitness	
Below the average, n (%)	2 (8.0)
On average, n (%)	7 (28.0)
Over the average, n (%)	16 (64.0)
Upper limb strength	
Below the average, n (%)	4 (15.4)
On average, n (%)	5 (19.2)
Over the average, n (%)	17 (65.4)
Lower limb strength	
Below the average, n (%)	8 (29.6)
On average, n (%)	5 (18.5)
Over the average, n (%)	14 (51.9)
Abdominal endurance	
Below the average, n (%)	11 (44.0)
Average, n (%)	3 (12.0)
Over the average n (%)	11 (44.0)
Shoulder flexibility	
Below the average, n (%)	5 (20.0)
On average, n (%)	7 (28.0)
Over the average, n (%)	13 (52.0)
Lower back flexibility	
Below the average, n (%)	10 (38.5)
On average, n (%)	5 (19.2)
Over the average, n (%)	11 (42.3)

Notes: Data: average±standard deviation or sample frequency.
Source: the authors

Effect on cardiovascular risk

The WC significantly decreased from pre- to post-intervention assessments. This reduction showed an effect size of η^2=0.215. The other cardiovascular risk factors (BMI, SBP, DBP, BG and TC) did not change significantly. Thus, the overall cardiovascular risk, assessed by the Z score, did not change from pre- to post-intervention (Table 2).

Table 2. Cardiovascular risk factors measured before (Pre) and after 60 days (Post) of a remote physical activity intervention guided for the participants of an extension project.

	N	PRE $\bar{x}$±sd	POST $\bar{x}$±sd	*p*	POST-PRE $\bar{x}$ (95%IC)	ES η^2
BMI (kg/m^2)	27	26.2±3.8	26.2±3.9	0.542	0.06 (-0.15; 0.28)	0.014
WC (cm)	27	95.9±11.3	94.7±11.3*	0.013	-1.24 (-2.20; -0.29)	0.215
SBP (mmHg)	29	123.5±11.0	123.0±14.3	0.805	-0.52 (-4.76; 3.72)	0.002
DBP (mmHg)	26	78.0±7.9	78.8±7.7	0.468	0.81 (-1.45; 3.07)	0.021
BG (mg/dl)	29	99.8±10.7	99.0±8.0	0.626	-0.79 (-4.06; 2.49)	0.009
TC (mg/dl)	26	206.2±25.0	204.7±37.8	0.844	-1.58 (-17.92; 14.77)	0.002
GCR	21	-0.4±3.9	-0.3±4.0	0.785	0.14 (-0.92; 1.20)	0.004

Notes: BMI – body mass index; WC – waist circumference, SBP – systolic blood pressure, DBP – diastolic blood pressure, BG – blood glucose; TC – total cholesterol; GCR – global cardiovascular risk; ES – effect size. * Significantly different from the pre-intervention moment ($p \leq 0.05$)
Source: the authors

Effect on Physical Fitness

There was a significant increase in cardiorespiratory fitness (116.8±21.3 vs. 122.5±23.0 steps, p=0.019), upper limb strength (22.7±5.5 vs. 24.8± 5.6 repetitions, p=0.003) and abdominal endurance (19.8±8.5 vs. 22.3±10.0 repetitions, p=0.002) from pre- to post-intervention. These changes showed effect sizes greater than 0.20. Lower limb strength (18.2±7.5 vs. 18.8±7.1 cm, p=0.358), lower back flexibility (24.0±11.8 vs. 24.6±12.0 cm, p=0.267) and shoulder flexibility (0.7±8.4 vs. 0.6±8.6 cm, p=0.838) did not change significantly with the intervention. These changes showed effect sizes smaller than 0.05. Thus, a significant increase in general physical fitness, assessed by the Z score, was seen after the intervention (-0.04±3.55 vs. 1.30±4.10, p=0.000) with an effect size of η^2=0.598 (Figure 1).

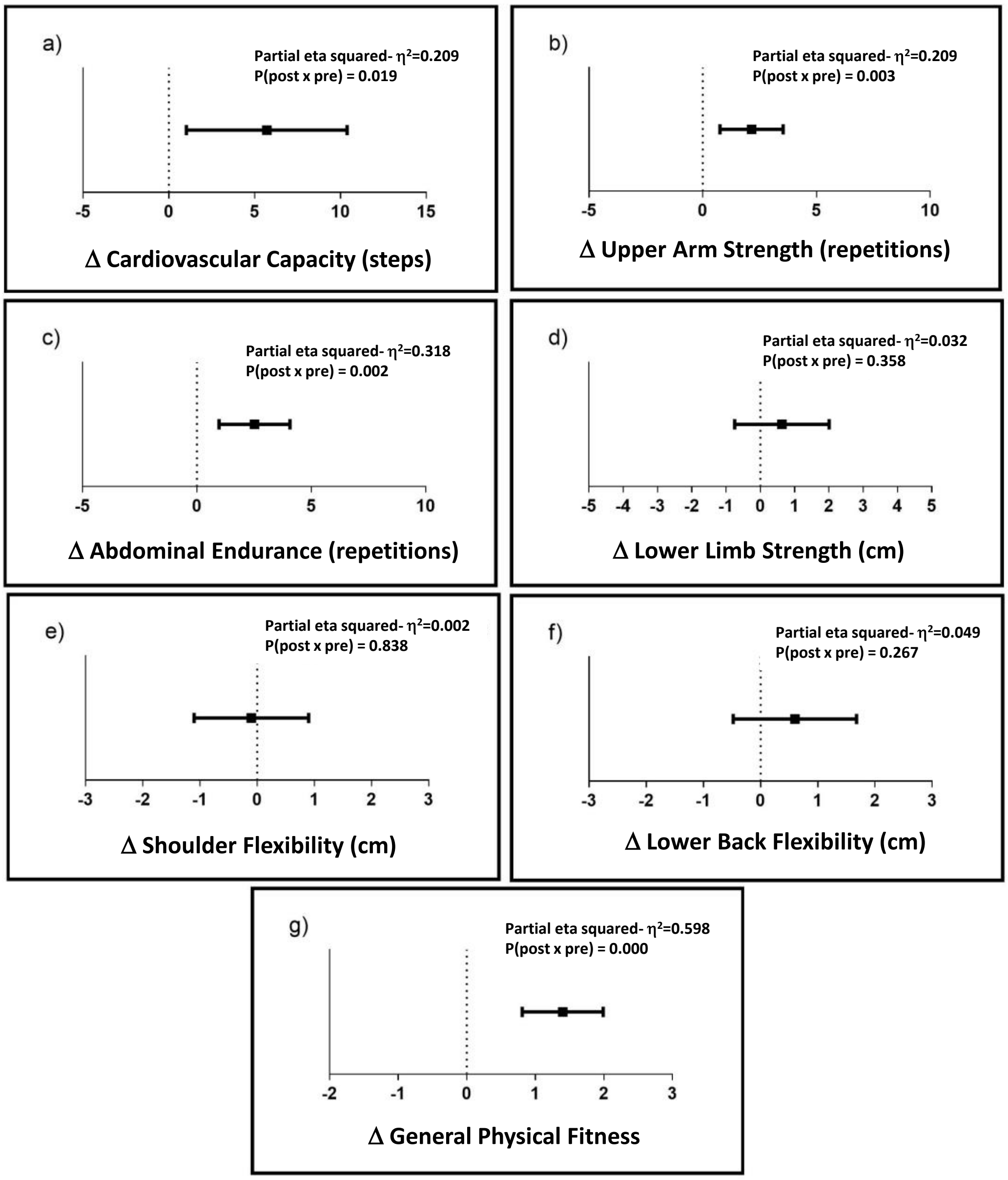

Figure 1 – Changes of the physical fitness parameters measured by the difference between the values obtained after 60 days (Post) and before (Pre) a remote physical activity intervention guided for the participants of an extension project

Notes: Data: mean (rectangle) and 95% confidence interval (horizontal lines)

Source: the authors

Discussion

The main findings showed that the PA remote intervention suggested by the present study decreased central obesity and increased cardiorespiratory fitness as well as upper limb strength and abdominal endurance. The overall cardiovascular risk was not changed, but an increase in general physical fitness was seen.

The remote intervention suggested had little influence on the cardiovascular risk factors herein evaluated. Only the WC was significantly reduced, whereas the other factors and the overall cardiovascular risk were maintained. In fact, considering most factors, except WC, the changes were not significant, and the effect sizes were representative of no effect or small effect.

On the other hand, the decrease in WC showed a large effect size, which suggests a clinical significance of this reduction[25]. Several studies reported an inverse relationship between practice of PA and cardiovascular risk[6,10]. In addition, PA interventions for the elderly populations have been shown to be effective in reducing cardiovascular risk[9,10]. Similarly, previous studies that assessed the effect of the face-to-face intervention of the 'Exercise and Heart Project' on global cardiovascular risk have shown a decrease of the BMI, WC, SBP and DBP[26,27]. The smaller effect found in the present study might be associated with the sample size, the sample characteristics or the protocol suggested. Regarding the number of individuals, it is noteworthy that, although smaller than in previous studies[26,27], it was sufficient to identify the effect of the intervention on WC and physical fitness. Considering the sample characteristics, the low percentage of individuals with altered initial values (i.e. only 4 individuals with SBP/DBP values > 140/90 mmHg; none with BG > 126 mg/dL and only 1 with TC > 240 mg/dL) may explain the lack of effect, since it is already well evidenced in the literature that the effect of PA on each of these risk factors is more evident when they are modified[28]. Corroborating this hypothesis, regarding central obesity, whose prevalence was high in the sample (65.5%) a relevant effect of the intervention was seen with a reduction in WC. Considering the protocol used, the indication for performing 150min/week of PA stands out, as recommended for improving health[29]; however, the lack of objective intensity control might have contributed to the smaller benefits observed in some risk factors[29]. Thus, further studies should consider interventions that control this important physical practice component. In addition, it should be highlighted that the intervention lasted only 8 weeks, whereas the previously studies mentioned[26,27] evaluated intervention periods between 3 and 6 months. Thus, a longer period might be necessary to show more expressive effects of the remote intervention proposed for reducing cardiovascular risk, which needs to be investigated in the future.

Regarding the effects of the intervention on physical fitness, the results showed that even in a remote and unsupervised way, the intervention promoted an increase in some parameters (cardiorespiratory fitness, upper limb strength and abdominal endurance), which improved general physical fitness. It should be highlighted that the increases observed in these parameters showed large effect sizes, which means significant clinical improvements[25]. Considering these aspects, an increase in cardiorespiratory fitness was seen. This is the classic adaptation to supervised aerobic training[30] and had also been reported after non-supervised interventions that involve aerobic activities, such as showed by the study of Modesto et al.[27] in the population that participated of the face-to-face activities of the 'Exercise and Heart Project' before the COVID-19 pandemic. This improvement is probably due to the aerobic component of the proposed remote intervention that included two 30-min walking sessions per week and a remote aerobic exercise class. Interestingly and accordingly, the same outcome of increased cardiorespiratory fitness was seen in a study carried out by Kuldavletova et al.[31], in which face-to-face and video conference training were compared, and both promoted an increase in this physical fitness parameters.

The results of the present study also showed that the remote intervention herein suggested promoted an increase in upper limb strength and abdominal endurance. The improvement of these two parameters is likely to be related to the guidance for the execution of two video classes per week of muscle strength exercises, which is in accordance with the guidelines for the use of this modality of health training[29]. Additionally, this improvement has an important impact on health and quality of life, especially for the elderly[7].

Even though walking and muscle strength video classes included exercises for the legs, there was no significant increase in the lower limb strength with the intervention. In addition, the effect size on this variable was zero, which differs from other studies, such as that by Queiroz et al.[26], who showed an increase in lower limb strength with walking prescribed by qualified professionals and performed without supervision. The divergence of results is likely to be related to the fact that the individuals had already been participating in the 'Exercise and Heart Project' that already encouraged walking even before the pandemic, as well as to the fact that they already had lower limb strength above the average expected for their age. The lack of effect of the remote intervention on flexibility, both on the shoulders and lower back, with zero or small effect sizes, might be explained by the lack of a specific guidance for performing stretching exercises during the remote intervention, which should be included in a further intervention proposal.

The results of the present study have significant clinical implications, since they showed that the guidance for the execution of a structured remote intervention involving aerobic and strength activities, despite the difficulties already reported in the literature especially regarding overload dosage and monitoring the execution[16], can be effective to promote improvement in physical fitness and reduction of central obesity in individuals who were already participating in a PA guidance project. These results are strengthened by the fact that the analyses of hypothesis tests (significance) and effect sizes revealed concordant results. On the other hand, the present study also had limitations. In this sense, the main one was the absence of a control group, which would allow us to state that the results obtained were really due to the suggested remote intervention. However, the health restrictions imposed by pandemic limited the number of face-to-face assessments that could be carried out, so it was necessary to prioritize the assessment of the intervention group. It is noteworthy, however, that these same individuals had already been evaluated before the pandemic and that there were no significant changes in their cardiovascular risk and physical fitness during the period when they did not receive the specific intervention described in this study (unpublished data). This reinforces the possibility that the improvement actually resulted from the intervention proposed. The other limitations of the study are related to the sample, since it consisted only of individuals already participating in an extension project who had access to the Internet and cell phones. In addition, the sample mainly consisted of elderly individuals, without a diagnosis of heart problems or COVID-19. So, the results cannot be extrapolated to other populations.

Conclusions

In conclusion, the guided PA remote intervention proposed was effective in improving the general physical fitness of the individuals already participating in a PA guidance project, which was expressed by an increase in cardiorespiratory fitness, upper limb strength and abdominal endurance. In addition, the remote intervention was effective in reducing WC, helping to maintain the participants' global cardiovascular risk.

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