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Original Research

Effects of Remote Versus In-Person Training on Metabolic Profiles and Body Composition of Physically Inactive Adults: Randomized Clinical Trial

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ABSTRACT

International Journal of Exercise Science 17(4): 1016-1025, 2024. The COVID-19 pandemic has pushed the population to adopt increasingly sedentary lifestyles. Faced with this problem, remote training appears as a practical and inexpensive strategy to promote physically active lifestyles. The aim of this research was to compare the effects of remote versus in-person training on metabolic profiles and body composition of physically inactive adults. This research was conducted through a randomized, single-blind clinical trial with balanced block randomization. The sample consisted of 30 physically inactive subjects of both sexes between 18 and 30 years of age. The sample was selected using a voluntary public call. The 30 subjects were randomized into three groups of 10 people each. One group trained for 36 sessions remotely, and the other did so in person. The control group did not have a training plan. The variables evaluated pre- and post-intervention were body composition by bioimpedance, grip strength through dynamometry, primary outcome, and metabolic profile assessed from a capillary sample using the CARDIOCHEK equipment. In the remote training group, significant gains were evident in the variables of weight (p = 0.042, d = 1.119), muscle percentage (p = 0.032, d = 0.499), and fat percentage (p = 0.001, d = 1.132), visceral fat (p = 0.032, d = 0.424), total cholesterol (p = 0.001, d = 1.213), HDL (p = 0.001, d = 0.534), LDL (p = 0.001, d = 0.973), triglycerides (p = 0.001, d = 0.583), and grip strength (p = 0.001, d = 1.201). When comparing the effects between the remote and in-person training groups, it is evident that the improvements were similar in all variables, except for glucose, in which the in-person group had a greater value reduction.

KEY WORDS: Physical exercise, resistance training, virtual training

INTRODUCTION

Physical activity is regarded as one of the most effective strategies to prevent the appearance of noncommunicable diseases (NCDs) (16), mainly due to the multiple physiological, morphological, biomechanical, and biochemical adaptations that occur in the body, resulting in better metabolic functioning that directly impacts people's health (9). A recent meta-analysis that included 305 randomized controlled trials with 339,274 participants determined that exercise has similar or even better effects than administering drugs when seeking to reduce mortality in patients with coronary disease (14). Therefore, from a public health perspective, healthcare systems in developing countries should focus their strategic plans on ensuring that their populations adopt physically active lifestyles.

As a result of the COVID-19 pandemic, the world population has transformed its daily routines, with a tendency to adopt unhealthy lifestyles due to the quarantine measures in which the spaces where physical activity was generally carried out have been closed (8). A recent study with 1,047 people between 18 and 50 years established that home lockdown has caused people to significantly decrease their levels of physical activity at all levels (vigorous, moderate, and mild) and increased sedentary behaviors from 5 to 8 hours a day (2).

Given this new reality, remote training has become an alternative for people to exercise from home. This brand-new workout method has some advantages, such as optimizing time and reducing economic investment (17). Conversely, some disadvantages are the trainer's impossibility to monitor the user's technique of each exercise, increasing the risk of injury. Additionally, the control of some training variables, such as intensity, volume, and density, becomes more complex, adversely affecting the fulfillment of the objectives set by the trainee.

It is essential to differentiate between virtual and remote training since the former has applications in which exercise programs are configured but lack individualized monitoring by a professional. On the other hand, remote training refers to training carried out at a distance, supported by some technological means (computers, tablets, cell phones), in which there is real-time feedback from an instructor (12, 19). Regarding this way of exercising, Kim et al. (10) conducted a study on 71 surviving patients of colorectal cancer, concluding that 12 weeks of remote training significantly improved the participants' quality of life and psychological health. Likewise, a meta-analysis that included ten randomized clinical trials determined that remote training improved cardiorespiratory fitness and anxiety levels in patients with lung cancer (21).

Although scientific evidence has determined that conventional and remote training are two fully validated methods to improve various health components of subjects of varying age ranges, there is no certainty about which is more effective. Thus, this research aims to compare the Effects of remote versus in-person training on metabolic profiles and body composition of physically inactive adults.

METHODS

Participants

The design implemented in this study was a single-blind clinical trial with balanced block randomization. A sample size of 39 participants was calculated and assigned into three balanced groups of 10. The inclusion criteria were people of both sexes, ages greater than or equal to 18 years and less than or equal to 30 years, and people who reported a weekly energy expenditure (METs) of less than 1,500 registered in the IPAQ questionnaire. People who reported suffering from a noncommunicable disease (NCD) or some physical injury in the last six months were excluded. Additionally, the PAR-Q questionnaire was administered; the people who answered "YES" to any question of this instrument were excluded. All the individuals who participated in this research voluntarily signed an informed consent form.

The Ethics Committee of the Andean Area University Foundation provided ethical approval through code 27042103. All the protocols developed followed the international ethical considerations proposed by Navalta for the International Journal of Exercise Science (15).

Protocol

First, a public call was made through social media, inviting the population to participate in the project and stating the possible benefits for their health. Secondly, they were presented with the research proposal, and we assessed the individuals who met the inclusion criteria. Subsequently, the subjects who decided to participate signed the informed consent and completed the following tests:

1) Self-report questionnaire: The PAR-Q questionnaire was administered to measure the participants' risk when undergoing demanding training protocols.

2) Height: The participant assumed an anatomical position, barefoot and leaning straight against a wall. The evaluator verified the position of the head concerning the Frankfurt plane. The subject was asked to inhale, and at that moment, height measurement was taken using the digital stadiometer (InLab, InBody Co., Seoul, South Korea).

3) Body composition: The measurement protocol for this variable consisted of making an appointment with the participant with an 8-hour fast, then the subject stood on top of the Tanita for three seconds with their arms fully extended and making permanent contact with the eight electrodes. This variable was measured using the Tanita Ironman BC-1500, which works through tetrapolar bioimpedance, where the body weight, fat and muscle percentage, and visceral fat data were obtained.

3) Grip strength: This variable was measured using the Takei TKK 5101 dynamometer (range 5–100 kg). The evaluation protocol consisted of two attempts for each of the extremities, with the arms fully extended and using the greatest strength possible for three seconds. The highest value reached in the four attempts was recorded. This equipment and protocol have already been validated for the Colombian population in different age ranges.

4) Metabolic profile: This variable was evaluated on a capillary blood sample (40 µL) taken by fingerprick. Total Cholesterol, HDL, LDL, and triglyceride values were estimated through the enzymatic analyses on the CardioChek PA equipment. The developed protocol followed the manufacturer's guidelines. All participants reported fasting for 8 hours before performing this test. All capillary samples were taken in the morning following the Ministry of Health's aseptic guidelines. This protocol and

equipment have already been validated for the Colombian population (5, 18). Once these procedures were completed, the participants were randomly assigned to the different arms of the study using the Research Randomizer program. Figure 1 shows the recruitment scheme and the losses generated in the sample.

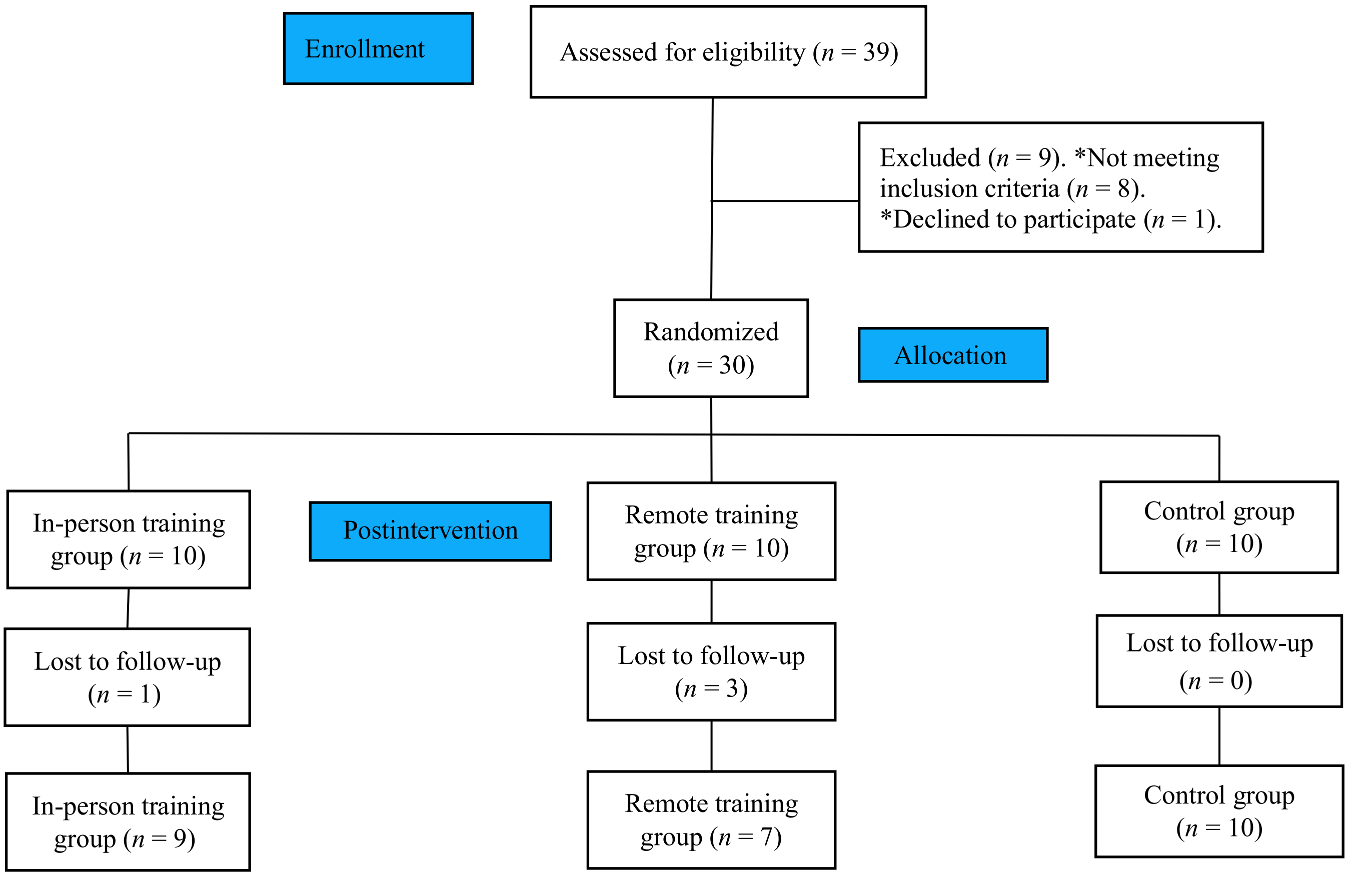

Figure 1. Recruitment process and randomization of the sample.

For the remote training group, the training plan had a frequency of three times a week for three months, totaling 36 sessions. Each session was held under the initial phase (15 min)-central phase (45 min)-final phase (15 min) structure. The initial phase focused on joint mobility and muscle activation exercises. The central phase included functional activities with only bodyweight exercises and no work with external weights; the modified Borg scale controlled intensity, keeping the user between 4 and 7 in the first 18 sessions and 7 and 9 in the remaining sessions. Between 6 to 10 exercises were performed in total, with 3–6 sets and 40–60 repetitions (adjusted based on the difficulty of the exercises). The final phase focused on stretching exercises. All sessions were held on the Teams or Meet platforms. Depending on the participants' schedules, the number of people attending the same session was between 1 and 4. When working with groups of 4 people, the video call was configured so that the coach could see them all simultaneously and provide feedback.

For the in-person training group, the training plan for this group was the same as for the remote training group but in person. Depending on the participants' schedules, the number of people attending the same session may be between 1 and 4.

The control group did not receive any training. We arranged to meet the participants at the university for the initial measurements only; they were trained on the importance of physical activity for their health. The researchers conducted a monthly follow-up phone call to confirm that no participants had engaged in any physical activity program.

Statistical Analysis

A preliminary test was performed before the planned statistical analyses to check data distribution normality (Shapiro-Wilk). Continuous variables were expressed as mean and standard deviation. The differences between the groups in baseline measurements (pre-intervention) were compared through a one-way ANOVA. Subsequently, a repeated measures ANOVA established the differences before and after the intervention. The statistical significance level was set at a $p < 0.05$ value. Cohen's d for effect size was also calculated to determine the magnitude of the group differences. The criteria to interpret the magnitude of the ES was as follows: trivial (< 0.2), small (0.2–0.59), moderate (0.60–1.19), large (1.2–2.0), or very large (> 2.0) (13). A two-way mixed covariance (ANCOVA) analysis with repeated measures was used to test the effect of interaction between in-person and remote training. All statistical analyses were performed using IBM Statistical Analysis SPSS Statistics version 24.0 (Chicago, IL, USA).

RESULTS

Table 1 presents the baseline characteristics of the three groups. The groups were statistically similar in all the variables except for total cholesterol and triglycerides.

Table 2 shows that in-person training significantly improved the values of weight ($p = 0.031$, $d = 1.005$), muscle percentage ($p = 0.001$, $d = 1.231$), fat percentage ($p = 0.001$, $d = 1.216$), and visceral fat ($p = 0.001$ $d = 0.466$), total cholesterol ($p = 0.001$, $d = 1.141$), HDL ($p = 0.001$, $d = 1.632$), LDL ($p = 0.001$, $d = 0.962$), triglycerides, ($p = 0.001$, $d = 0.735$), glucose ($p = 0.001$, $d = 1.028$) and grip strength ($p = 0.001$, $d = 1.205$). Likewise, in the remote training group, significant gains were evident in the variables of weight ($p = 0.042$, $d = 1.119$), muscle percentage ($p = 0.032$, $d = 0.499$), and fat percentage ($p = 0.001$, $d = 1.132$). , visceral fat ($p = 0.032$, $d = 0.424$), total cholesterol $p = 0.001$, $d = 1.213$), HDL $p = 0.001$, $d = 0.534$), LDL ($p = 0.001$, $d = 0.973$), triglycerides ($p = 0.001$, $d = 0.583$), and grip strength ($p = 0.001$, $d = 1.201$). In the control group, there was no difference between the evaluated variables. When comparing the effects between the remote and in-person training groups, it is evident that the improvements were similar in all variables, except for glucose, in which the in-person group had a greater reduction in values.

Table 1. Baseline characteristics in the three intervention groups.

Characteristic	In-person training *n* = 10	Remote training *n* = 10	Control group *n* = 10	*P*-value
		Body composition		
Age (years)	22 (2.1)	23.1 (3.8)	21.1 (1.8)	0.345
Weight (kg)	67.7 (5.73)	64.8 (2.7)	64.2 (2.1)	0.268
Height (cm)	172.8 (0.06)	170.8 (0.09)	171.8 (0.01)	0.246
Muscle percentage (%)	41.2 (5.46)	40.7 (7.4)	44.4 (5.4)	0.673
Fat percentage (%)	17.0 (2.67)	18.1 (4.5)	19.4 (3.5)	0.373
Visceral fat	5.2 (2.4)	4.1 (3.4)	7.5 (2.3)	0.273
		Metabolic profile		
Total cholesterol (mg/dL)	144.1 (23.7)	133.1 (23.7)	121.3 (24.5)	0.043*
HDL (mg/dL)	47.4 (10.1)	42.4 (12.1)	47.4 (12.1)	0.342
LDL (mg/dL)	74.8 (15.3)	80.5 (11.1)	78.5 (14.4)	0.323
Triglycerides (mg/dL)	88.9 (33.1)	85.9 (33.1)	110.3 (22.2)	0.024*
Glucose (mg/dL)	88.2 (7.3)	87.3 (6.3)	80.4 (6.4)	0.434
		Physical condition		
Grip strength (kg)	44.2 (5.3)	41.3 (8.2)	45.4 (9.4)	0.358

The data are expressed as mean and standard deviation. *Significant differences between

Table 2. Effects of training protocols.

Characteristic	In-person Pre-intervention n = 10	In-person Post-intervention n = 9	p-value	Cohen's d	Remote Pre-intervention n = 10	Remote Post-intervention n = 7	p-value	Cohen's d	Interaction effect p-value	Control Pre-intervention n = 10	Control Post-intervention n = 10	p-value	Cohen's d
Body composition													
Weight (kg)	67.7 (5.73)	62.1 (5.4)	0.031*	1.005	64.8 (2.7)	61.432	0.042*	1.119	0.732	64.2 (2.1)	63.2 (2.5)	0.954	0.001
Muscle percentage (%)	41.2 (5.46)	48.6 (7.3)	0.001*	1.231**	40.7 (7.4)	43.5 (4.1)	0.032*	0.499	0.097	44.4 (5.4)	43.3 (6.1)	0.835	0.001
Fat percentage (%)	17.0 (2.6)	14.3 (3.8)	0.001*	1.216**	18.1 (4.5)	15.3 (2.1)	0.001*	1.132	0.844	19.4 (3.5)	19.1 (3.1)	0.253	0.001
Visceral fat	5.2 (2.4)	4.1 (1.2)	0.001*	0.466	4.1 (3.4)	3.7 (1.2)	0.032*	0.424	0.843	7.5 (2.3)	7.4 (2.1)	0.724	0.001
Metabolic profile													
Total cholesterol (mg/dL)	144.1 (23.7)	115.2 (18.1)	0.001*	1.144	133.1 (23.7)	121.3 (19.2)	0.001*	1.213**	0.748	121.3 (24.5)	118.1 (23.2)	0.603	0.001
HDL (mg/dL)	47.4. (10.1)	52.5 (8.1)	0.001*	0.632	42.4 (12.1)	45.1 (10.5)	0.001*	0.534	0.654	47.4 (12.1)	46.3 (9.2)	0.831	0.001
LDL (mg/dL)	74.8 (15.3)	63.2 (13.4)	0.001*	0.962	80.5 (11.1)	73.2 (8.5)	0.001*	0.973	0.456	78.5 (14.4)	75.2 (10.2)	0.432	0.001
Triglycerides (mg/dL)	123.2 (33.1)	101.2(21.1)	0.001*	0.735	118.1(23.1)	101.3 (25.2)	0.001*	0.583		110.3 (22.2)	108.1 (22.1)	0.699	0.001
Glucose (mg/dL)	88.2 (7.3)	80.1 (9.2)	0.001*	1.028	87.3 (6.3)	84.5 (5.2)	0.532	0.355	0.045***	80.4 (6.4)	78.2 (4.3)	0.326	0.001
Physical condition													
Grip strength (kg)	44.2 (5.3)	50.2 (6.1)	0.001*	1.205**	41.3 (8.2)	47.1 (7.2)	0.001*	1.201**	0.745	45.4 (4.4)	46.2 (3.1)	0.831	0.001

The data are expressed as mean and standard deviation. *Significant differences between baseline and post-intervention. **Large effect sizes. ***Significant differences in the effects generated in the intervention groups

DISCUSSION

This study's main finding was that remote and in-person training are equally effective methods for improving body composition and metabolic profile in physically inactive young adults. However, the in-person approach is slightly more effective in improving glucose values. Additionally, it likely ensures greater adherence to physical activity programs.

The COVID-19 pandemic caused many trainers to adapt their work methodologies from in-person to remote; however, there needs to be more research on the effectiveness of this new strategy. The results of this study reveal that this way of exercising from home, while supervised by an exercise professional, continues to be a validated alternative to produce positive effects on people's health.

Although the improvements in both groups were similar in almost all the variables evaluated, there were differences in the effects on blood glucose. One of the reasons that could explain these findings is the motivational component that a user may have when receiving instructions from the trainer in person. In this regard, recent scientific evidence has concluded that the main reasons for abandoning a physical training process are the feeling of seeing few results and the monotony of exercise routines (11, 20). Regarding this aspect, the in-person methodology could generate an ideal scenario for the trainer to use strategies that guarantee that the user does not become demotivated and performs each proposed exercise enthusiastically, while the remote modality makes it challenging to control this type of motivational component.

When comparing the results of the group that trained remotely with previous findings in the scientific literature from in-person methodologies, similar improvements are evident in body composition and the metabolic profile. On this point, a study conducted on 102 physically active young adults demonstrated that 24 weeks of combined in-person strength and resistance training significantly improved physical fitness, blood lipids, and body composition, specifically the components of muscle and fat percentage (3). These results are similar to those reported in our study in a remote training group in those same variables ($P \leq 0.001$). Likewise, Garcés et al. (4) showed that a physical exercise program carried out on adults three times a week, one hour per session, had significant effects on total cholesterol and triglycerides, and improvements reached up to 20% when nutritional aspects were controlled. In contrast, Albarello et al. (1) demonstrated that a 15-week training focused on muscle strength without the supervision of nutritional intake does not present significant effects on cholesterol, LDL, and blood glucose, but presents positive increases in HDL, due to the rise in the degradation and synthesis of the liver, which could suggest an improvement in the other variables in the future.

When reviewing what has been written about remote training modalities, multiple investigations show positive aspects of this exercise methodology. On this topic, a systematic review determined that physical exercise interventions performed remotely in which patients receive constant feedback on their changes and improvements are effective in improving different health markers in older adults (6). In addition, Grandes Freire established that a physical exercise program based on explosive strength for six weeks, training twice a week virtually by video call, can improve grip strength by up to 5.8% (7).

Even though many investigations have evaluated the effects of remote training on various variables, no study developed in the Colombian population focused on comparing its effects versus a face-to-face modality. In this sense, these findings are innovative and propose a training alternative that may present various advantages that promote physical exercise more frequently and in a more significant number of people. Likewise, remote training can be the ideal strategy for people with little time or difficulty getting around to incorporate physical exercise into their lifestyles.

One of the limitations of the study was that it did not control the eating habits of the groups. Although some general recommendations were developed to try to control this confounding variable, it cannot be ensured that everyone ate the same during the intervention. Another limitation was that the sample was selected using a non-probabilistic sample for convenience. This prevents us from affirming that the results can be extrapolated to the total population.

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