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Four-week remotely supervised aerobic exercise during the COVID-19 era

Exploring physical performance and psychosocial health in adults without COVID-19 living in rural settings

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Abstract

Background: Remote health interventions have been widely adopted during the coronavirus-19 pandemic to support physical and psychosocial health. This study explored the impacts of a 4-week remotely supervised aerobic exercise regimen on physical activity, physical performance, and psychosocial health in adults without coronavirus-19 living in rural settings.

Methods: Fifty-six adults living in the rural district of Muş and Denizli cities were randomized into remotely supervised aerobic exercise (n = 28) and control (n = 28) groups. The intervention group received a 4-week remotely supervised aerobic exercise regimen delivered through WhatsApp by a specialist physical therapist. Primary outcomes included physical activity levels, physical performance, and quality of life; anxiety was assessed as a secondary outcome. Physical activity levels were evaluated using the International Physical Activity Questionnaire-Short Form. Physical performance was assessed through the Short Physical Performance Battery, Single-Leg Standing Test, Four Square Step Test, and Timed Up and Go test. Quality of life was evaluated using the Short Form-36, and anxiety was evaluated using the Beck Anxiety Inventory.

Results: There were no differences in sociodemographic and clinical characteristics between groups at baseline ($P > .05$). Two-way mixed-design repeated-measures analysis of variance test revealed no significant group × time interactions for physical performance or psychosocial health outcomes ($P > .05$). However, physical activity levels significantly improved in the exercise group ($P = .001$).

Conclusion: Although 4 weeks of remotely supervised aerobic exercise improved physical activity levels, it did not significantly enhance physical performance or psychosocial health among rural residents. The short-term health benefits of a remotely supervised aerobic exercise regimen may appear limited in rural settings; however, the potential for longer and more intensive aerobic training requires further investigation.

Level of evidence: Level I – randomized-controlled study.

Abbreviations: ANOVA = analysis of variance, BAI = Beck Anxiety Inventory, COVID-19 = coronavirus-19, FSST = Four square step test, HRQoL = health-related quality of life, IPAQ-SF = International Physical Activity Questionnaire-Short Form, MET = metabolic equivalents of task, RPE-15 = Rating of Perceived Exertion-15, SF-36 = Short Form-36, SPPB = Short Physical Performance Battery, TUG = Timed Up and Go, WHO = World Health Organization.

Keywords: aerobic exercise, anxiety, COVID-19, physical activity, quality of life

1. Introduction

The rapid spread of the coronavirus disease-19 (COVID-19) has led clinicians to new and alternative methods and led the way for various health practice strategies.[1] Digital health is defined by the World Health Organization (WHO) as "the practice of medicine and public health supported by electronic processes and communication."[2] Remote health interventions enable health professionals to transfer information, education, and exercise training for health consumers via the internet and remote communication. It is emphasized that remote applications are technology and services that can be used during the COVID-19 pandemic process.[3] An earlier investigation

Written consent was obtained from each participant after a full explanation of the study procedure.

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

The study was approved by the Muş Alparslan University Scientific Research and Publication Ethics Committee (51099/8-45).

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conducted in countries such as the United Kingdom, the United States, and Australia has shown that remote health applications can be implemented using telephone and video technologies, as outlined in the guidelines.[4]

The benefits of participation in exercise training programs include improvements in physical performance, aerobic endurance, self-efficacy for exercise, self-assessed health, and pain relief.[5] The COVID-19 pandemic has caused significant disruptions to global health systems and has accelerated the transition to remotely accessible counseling and home-based rehabilitation.[6] Implementing remotely supervised exercise interventions provides advantages such as increased entry and accessibility and addressing common barriers to face-to-face supervised exercise.[1,7] During the COVID-19 pandemic, remote exercise, where workout sessions are delivered via video conferencing technology, has emerged as a way for community-based programs to maintain follow-up exercise sessions while complying with physical distancing restrictions.[5] Research has shown that remote exercise sessions are feasible and acceptable for older adults.[8] Additionally, social isolation, which became a critical issue during the pandemic, leads to significant changes that negatively impact public health and physical activity levels.[9] The remote exercise methods during the COVID-19 pandemic predominantly focused on patients with chronic diseases and the older population.[1,9,10]

Residents of rural areas frequently demonstrate higher rates of obesity, elevated instances of smoking, and a greater prevalence of preexisting health conditions. These factors suggest that rural populations may be more susceptible to adverse outcomes from COVID-19, largely attributable to the health behaviors prevalent in these communities.[11] For those who are not regularly active, it is advisable to begin and gradually elevate their levels of physical activity, as the WHO guidelines for adults highlight the benefits of aerobic and muscle-strengthening exercises supported by substantial evidence.[12] Additionally, there is a need for randomized controlled trials in the literature addressing remote physical exercise informed by the COVID-19 experience.[13] Thus, it becomes essential to evaluate physical activity levels and physical performance in adults during the pandemic and assess how the remote aerobic exercise regimen might impact these factors. Additionally, while much of the existing literature has focused on physical activity during the early phase of the COVID-19 pandemic,[7,14] there remains a need for randomized controlled trials that explore how remotely supervised exercise intervention can inform of implications moving forward in rural settings. This study aimed to investigate the effects of a remotely supervised aerobic exercise regimen on physical activity, physical performance, and psychosocial health in adults without COVID-19 living in rural settings. We hypothesized that a 4-week remotely supervised aerobic exercise regimen would enhance physical activity, physical performance, and psychosocial health compared to a control group, offering insight into how such an intervention might serve as a viable strategy in future remote exercise, both in post-pandemic and beyond.

2. Materials and methods

2.1. Study design

This prospective randomized-controlled study was conducted between 2022 and 2023 in adults without COVID-19 living in the rural areas of Muş and Denizli cities. The study was conducted and adhered to the principles of the Declaration of Helsinki. The purpose of the study was explained to all participants, and participants were informed that they could withdraw from the study at any time. Written informed consent was obtained from participants who agreed to participate in the study. The study was approved by the Muş Alparslan University Scientific Research and Publication Ethics Committee (51099-2022/45). The clinical trial number approval for the study was registered in the ClinicalTrials.gov database (ID: NCT06517771).

2.2. Sample size and randomization

Adults without diagnosed COVID-19 living in the rural areas of Muş and Denizli cities constitute the population of this study. The effect size obtained from the reference study's Timed Up and Go test (TUG) was large ($d = 0.85$).[15] Based on the power analysis conducted using the G*Power software (Version 3.1, Heinrich-Heine-Universität Düsseldorf, Germany), we determined that with an anticipated effect size of this magnitude ($d = 0.85$), a sample size of at least 46 participants (23 per group) would yield 80% power at a 95% confidence level. Following baseline primary and secondary outcomes, each participant was randomly assigned to a remotely supervised aerobic exercise or control group by computerized block randomization, as shown in the flowchart of the study (Fig. 1). Considering power analysis, the study was initiated with 56 participants: 28 in the remotely supervised aerobic exercise and 28 in the control groups. Inclusion criteria were as follows: not diagnosed with COVID-19 before the study participation or during the study period, residing in the rural areas of the Muş and Denizli cities, not having any known mental or physical problem preventing running and jumping, being between 40 and 60 years of age, having a medium level of physical activity according to the International Physical Activity Questionnaire-Short Form (IPAQ-SF), being able to speak and understand the Turkish language, and being able to understand verbal and written information given. Exclusion criteria were determined as having a diagnosis of COVID-19, having an injury affecting the lower or upper extremities within the last 6 months, and participating in any exercise or strengthening training within the last 3 months.

2.3. Assessments

The assessments comprised sociodemographic (age, gender, body mass index, and educational status) and clinical data (dominant extremity, number of chronic diseases, and number of falls in the last year), primary (physical activity level, physical performance assessments, and health-related quality of life [HRQoL]) and secondary (anxiety) outcomes to evaluate the effect of aerobic exercise training on the participants. Following baseline primary and secondary outcomes, the remotely supervised aerobic exercise group performed an aerobic exercise regimen using the WhatsApp mobile application's videoconference method. Final assessments were conducted after the completion of the remotely supervised aerobic exercise regimen. The assessments were conducted by a specialized, blinded researcher with 10 years of experience, unaware of the participants' group assignments. To ensure blinding, the outcome assessor was not involved in the allocation process and received only anonymized data identified by participant codes, with no information regarding group assignment. All assessments were performed using standardized assessment forms designed to prevent disclosure of intervention allocation.

2.3.1. Primary outcomes. The Short Physical Performance Battery (SPPB) measures functional status and physical performance. The SPPB is calculated from 3 components: the ability to stand (up to 10 seconds) with feet positioned in 3 ways (side-by-side, semi-tandem, and tandem), time to complete a 3-m walk, and time to stand from a chair 5 times. Each part is scored out of 4, with the scores from the 3 tests calculated to give a total of 12 and a minimum of 0. A higher score indicates a better function, while lower scores indicate a lower level of function.[16]

The single-leg standing test is performed on the participant's dominant foot with the other hip and knee at 90 degrees and hands on the hips. The time starts when the participant lifts the nondominant foot off the ground. The time is stopped and

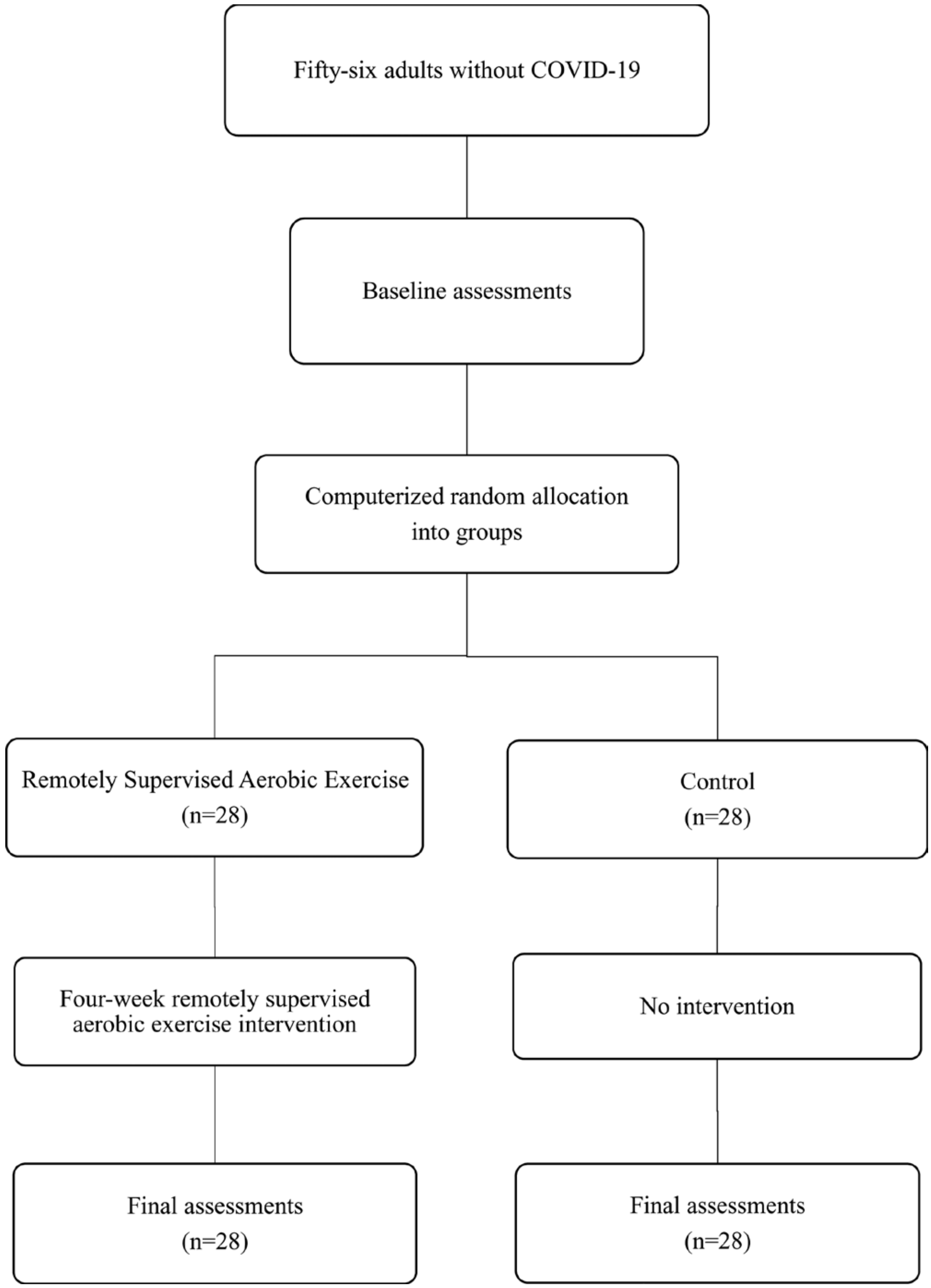

Figure 1. Flowchart of the study.

recorded when the participant's foot in the air touches the floor, when the arms leave the hips, or when the foot on the floor moves on the floor surface. The time of the single leg standing of the participant can maintain balance on one leg for 0 to 30 seconds is calculated as a score. If the participant reaches 30 seconds, the time is stopped. The test is repeated 3 times, and the average score is recorded.[17]

The 4 square step test (FSST) has been shown to measure dynamic standing balance and mobility in different adult populations. For the FSST, flat bars in the shape of a plus (+) are placed on the floor, and the participant starts from a square with both feet, steps clockwise to the starting square, and returns to the starting square without stopping (start: right-back-left-front; return: back-right-front-left), and the time is recorded as seconds. The participant is instructed to complete the sequence as fast as possible without touching the bars on the floor and that both feet should touch the floor in each square.[18]

TUG test evaluates functional mobility, dynamic balance, fall risk, and postural stability and can be applied for various purposes in diverse age groups. For the TUG test, a tape is placed on the floor 3 meters away from a standard chair. Participants are seated with their backs against the chair and instructed to walk normally. In this test, the participant must get up from the chair, walk 3 meters, walk around the line on the floor, walk back to the chair, and sit down. The time is recorded in seconds.[19]

The participants' physical activity levels were evaluated with the IPAQ-SF. The IPAQ-SF is a scale developed to determine the physical activity levels of participants aged 15 to 65 years and aims to obtain information about the time individuals spend in vigorous, moderate-to-vigorous activities and walking.[20] The calculation of the IPAQ-SF total score includes the sum of the duration and frequency of walking, moderately vigorous, and vigorous activity in the last week. In physical activity level classification, individuals with a physical activity score of <600 metabolic equivalents of task (MET) min/week are classified as low level, individuals with physical activity between 600 and 3000 MET min/week are classified as medium physical activity level, and individuals with physical activity more than 3000 MET min/week are classified as high physical activity level.[21]

HRQoL was evaluated with the Short Form-36 (SF-36). SF-36 is a patient-reported questionnaire developed and used to determine life quality. SF-36 is a self-assessment scale with generic criteria. In this study, the SF-36 physical function and general health subscales were utilized. The subscales assess health on a 0 to 100 scale, with 0 indicating poor health and 100 indicating good health.[22]

2.3.2. Secondary outcome. The Beck Anxiety Inventory (BAI) was utilized to evaluate the participants' anxiety levels. This self-report instrument comprises 21 items that assess subjective anxiety and physical symptoms, with each item scored on a Likert scale ranging from 0 to 3. The total score on the BAI can range from 0 to 63, with higher scores reflecting more severe anxiety.[23]

2.3.3. Interventions. *Remotely supervised aerobic exercise regimen*: Participants in the remotely supervised group performed an aerobic exercise regimen 3 days a week for 4 weeks under the supervision of a physiotherapist, using the WhatsApp application in groups of 2. During the exercise session, the physical therapist and the participants could activate a camera and a microphone to receive feedback on exercise execution or ask questions. Participants were instructed to perform the aerobic exercises in a safe, wide home environment and access a firm support surface (a chair or wall) if needed. Remotely supervised aerobic exercise of each training session, including warm-up, aerobic, and cooling exercises, was presented in Table 1. Before starting the aerobic exercise regimen, warm-up exercises were performed. For the upper extremity, full elbow extension with shoulder retraction in full shoulder flexion (Exercise V), elbows at 90 degrees flexion with shoulder retraction in 90 degrees abduction (Exercise U), and full elbow flexion with shoulders at retracted and 30 degrees extension (Exercise W) were performed. Standing hip abduction-extension, single-leg standing, heel raising, chair sit-to-stand (arms crossed at shoulders), squatting, and tandem walking exercises were performed in the lower extremities (Fig. 2). After completing the aerobic exercise regimen, cooling exercises were performed. Total exercise duration ranged from 35 to 50 minutes per session. Since the participants had a medium physical activity level, exercise progression was performed at a level of 11 to 13, which is recommended for less-trained individuals according to the Borg Rating of Perceived Exertion-15 (RPE-15) scale. On the RPE-15 (6–20) scale, the minimum exertion is scored as 6 (no effort/rest), 7 (very, very light), 9 (very light), 11 (fairly light), 13 (somewhat hard), 15 (hard), 17 (very hard), 19 (extremely hard), and 20 (maximally hard).[24] After the fifth or sixth training session, the exercise intensity was gradually increased to a somewhat hard level (13) of the RPE-15 scale through adjustments in sets and repeats/time/steps. During the 12 aerobic exercise sessions, all participants in the remotely supervised aerobic exercise group were informed that individuals who did not participate in 3 or more exercise sessions would be excluded from the study. The control group did not engage in any exercise training during the 4 weeks and were instructed to avoid strenuous physical activities.

2.4. Statistical analysis

The data were analyzed using the Statistical Package for the Social Sciences software (SPSS Version 25, IBM Corporation, Armonk). Continuous variables were given as mean ± standard deviation or minimum to maximum scores, and categorical variables were presented as frequencies and percentages. The sociodemographic variables' conformity to the normal distribution was analyzed using visual (histogram) and analytical (Kolmogorov–Smirnov) testing methods. Independent samples *t*-test and Pearson chi-square tests were utilized to compare sociodemographic and categorical variables. The assumptions of analysis of variance (ANOVA) included independence of observations (between-subjects and within-subjects factors), normality (Shapiro–Wilk test and Q-Q plots), homogeneity of variances (Levene test), and homogeneity of covariances (Box M test), and those were confirmed before performing the ANOVA test. A 2-way mixed-design repeated measures of ANOVA was used to estimate the main effect of groups (remote aerobic exercise vs control), time (baseline vs after 4 weeks), and the group-by-time interactions for primary and secondary outcomes. The statistical significance level was accepted as $P < .05$.

3. Results

Between 2022 and 2023, the study was completed with a final sample of 56 participants (28 in both groups), surpassing the targeted sample size. None of the remotely supervised aerobic exercise group participants missed 3 or more sessions. The participants completed 296 of 336 aerobic exercise sessions, and the training adherence rate was 88.09%. No adults were harmed or displayed unintended effects after the aerobic exercise regimen.

Data on the sociodemographic and clinical characteristics of participants are given in Table 2. When demographic data were analyzed, there was no difference between the groups in age, body mass index, mean year of education, number of chronic diseases, number of falls in the last year, gender, and dominant extremity ($P > .05$). However, the control group displayed a higher rate of smoking than the remotely supervised aerobic exercise group ($P = .014$).

The baseline, after the fourth week, and score changes for the physical performance of the groups are shown in Table 3. The 2-way mixed-design repeated measures of ANOVA of the baseline versus after 4 weeks in SPPB ($P = .253$), single-leg standing test ($P = .268$), FSST ($P = .868$), and TUG test

Table 1

Remotely supervised aerobic exercise regimen.

	Number of sets	Repeat/time/step
Warm-up exercises		
Walking	–	2 min
Marching	–	1 min
Bilateral reciprocal shoulder flexion-extension	1–2	10 repeats
Shoulder horizontal abduction-adduction	1–2	10 repeats
Drawing a circle with unilateral shoulder flexion	1–2	10 repeats
Aerobic exercises		
V, U, W exercises with shoulder elevated	1–2	10 repeats
Standing hip abduction (bilateral)	1–2	10 repeats/10 s
Standing hip extension (bilateral)	1–2	10 repeats/10 s
Single leg standing (with hip-knee at 90° flexed, bilateral)	1–2	10 repeats/10 s
Heel raising (bilateral)	1–2	10 repeats/10 s
Chair sit-to-stand (arms crossed at shoulders)	1–2	10 repeats
Squatting (with ball or pillow between the knees)	1–2	3 repeats/10 s
Tandem walking	–	100 steps
Cooling exercises		
Gastro-soleus-hamstrings stretching at the wall	3–4	10 s
Shoulder posterior capsule stretching	3–4	10 s
Shoulder inferior capsule stretching	3–4	10 s

Figure 2. Remotely supervised aerobic exercises. (A) Full elbow extension with shoulder retraction in full shoulder flexion (Exercise V). (B) Elbows at 90 degrees flexion with shoulder retraction in 90 degrees abduction (Exercise U). (C) Full elbow flexion with shoulders at retraction and 30 degrees extension (Exercise W). (D and E) Standing hip abduction. (F and G) Standing hip extension. (H and K) Single leg standing. (M) Heel raising. (N and O) Chair sit-to-stand (arms crossed at shoulders). (P and R) Squatting. (S) Tandem walking.

(P = .273) indicated that remote aerobic exercise and control groups demonstrated similar outcomes in physical performance with no significance in group × time interaction. Within-group comparisons regarding the main effect (time) demonstrated improvements in SPPB in the aerobic exercise group (P = .025) but no significant improvements in the single-leg standing test, FSST, and TUG test (P > .05).

The baseline, after the fourth week, and score changes for the physical activity level, HRQoL, and anxiety outcomes of the groups are shown in Table 4. The 2-way mixed-design repeated measures of ANOVA of the baseline versus after 4 weeks in SF-36 physical function (P = .074), SF-36 general health (P = .133), and BAI (P = .641) indicated that remotely supervised aerobic exercise and control groups demonstrated similar outcomes in HRQoL and anxiety with no significance in group × time interaction. However, as expected, the remotely supervised aerobic exercise group's IPAQ-SF score improved significantly than the control group (P = .001). Within-group comparisons regarding the main effect (time) demonstrated improvements in IPAQ-SF (P < .001), SF-36 physical function (P = .008) and general health (P = .017), and BAI (P = .003) in the aerobic exercise group.

4. Discussion

This study hypothesized that a 4-week remotely supervised aerobic exercise regimen would yield enhancements in physical activity, physical performance, and psychosocial health in adults without COVID-19 compared to the control group. The study findings revealed no difference in physical performance and psychosocial health between the aerobic exercise group and the control group following the 4-week training. The IPAQ-SF level of physical activity increased significantly in the aerobic exercise group compared to the control group. Therefore, the study's hypothesis was partly supported.

During COVID-19, encouraging regular exercise is essential to promote physical activity among adults.[12,25] WHO suggested that adults who need health benefits should do regular

Table 2

The comparison of sociodemographic characteristics of remotely supervised aerobic exercise and control groups

	Remotely supervised aerobic exercise (n = 28)		Control (n = 28)			
	Mean	SD	Mean	SD	*t*	*P*†
Age (yr)	52.32	4.40	50.03	5.52	1.711	.093
Body mass index (kg/m²)	27.33	3.58	26.78	4.01	0.543	.589
Mean years of education	8.42	4.88	9.03	4.14	–0.502	.618
Number of chronic diseases	0.57	0.79	0.39	0.62	0.936	.354
Number of falls in the last year	0.39	0.62	0.21	0.56	1.115	.270

	Remotely supervised aerobic exercise (n = 28)		Control (n = 28)		
	n	%	n	%	*P*‡
Gender					
Male	11	39.3	14	50	.420
Female	17	60.7	14	50	
Dominant extremity					
Right	26	92.9	27	96.4	.553
Left	2	7.1	1	3.6	
Smoking					
Yes	3	10.7	11	39.3	**.014***
No	25	89.3	17	69.7	

SD = standard deviation, *t* = independent samples *t*-test.
*Statistical significance.
†Value of independent group comparison analyses.
‡Pearson Chi-square test statistical significance value.

Table 3

Comparison of the 2-way mixed design repeated-measure ANOVA test in physical performances between groups.

Variables	Remotely supervised aerobic exercise(n = 28) Mean (95% CI)	Control(n = 28) Mean (95% CI)	Between group differences in change scores Mean (95% CI)	Main effect (time) *P*†	Group × time (interaction) *F*/*P*‡ value	η²
Physical performance						
Short Physical Performance Battery						
Baseline	8.82 (8.13–9.51)	9.39 (8.68–10.11)	–0.28 (–0.86 to 0.29)	**.025***	1.333/.253	0.024
After4 weeks	9.25 (8.56–9.93)	9.53 (8.79–10.29)				
Single-leg standing test						
Baseline	23.48 (19.89–27.07)	24.67 (20.68–28.67)	–1.11 (–2.89 to 0.66)	.912	1.250/.268	0.023
After4 weeks	23.98 (20.35–27.61)	24.06 (20.78–27.35)				
Four square step test						
Baseline	11.11 (9.75–12.48)	11.06 (9.88–12.26)	0.11 (–1.01 to 1.23)	.842	0.028/.868	0.001
After 4 weeks	10.99 (9.35–12.64)	11.05 (9.38–12.73)				
TUG test						
Baseline	8.10 (7.43–8.79)	7.92 (7.02–8.83)	0.19 (–0.13 to 0.51)	.832	1.227/.273	0.022
After4 weeks	7.99 (7.36–8.63)	8.01 (7.01–8.99)				

η² = eta square effect size, CI = confidence interval for means, TUG = Timed Up and Go.
*Statistical significance.
†Within group comparison (time).
‡Group comparison (group).

physical activity because any physical activity is better than no physical activity.[26] In adults, 150 to 300 minutes of moderate-intensity aerobic activity per week is reported to have substantial health benefits.[12] According to an earlier investigation, web-based exercise training could improve physical activity with small to medium effect sizes in adult and older adult populations.[27,28] However, during COVID-19, lockdowns and physical inactivity forced adults to reconsider their physical health status. Restating the importance of physical activity during the pandemic is crucial to keep adults informed and aware of the health implications.[29] In an earlier study, a home-based remote aerobic exercise was implemented for individuals aged 60 and above during the COVID-19 pandemic for 3 sessions per week for 4 weeks. The study findings highlighted the significant benefits of this home-based exercise protocol with remote monitoring in boosting physical activity.[9] Similarly, a previous randomized controlled trial found that 8 weeks and 5 sessions per week of remote exercise via video conferencing significantly increased physical activity levels in physically inactive individuals.[30] Furthermore, prior research indicated that remotely supervised physical exercise can be an effective means of achieving increased activity levels within a healthy population.[31] Although conducted at 11 to 13 levels on the RPE-15 scale, the current study's findings revealed that the remotely supervised aerobic exercise group significantly improved physical activity levels compared to the control group.

The COVID-19 pandemic has led to a decrease in the physical performance of individuals in lockdown and physically inactive. Individuals who are not regularly physically active and have no health contraindications should initiate and gradually increase

Table 4

Comparison of the 2-way mixed design repeated-measure ANOVA test in physical activity level, quality of life, and anxiety between groups.

	Remotely supervised aerobic exercise (n = 28)	Control (n = 28)	Between group differences in change scores	Main effect (time)	Group × time (interaction)	
Variables	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	$P^{\dagger}$	$F/P^{\ddagger}$ value	η^2
IPAQ-SF						
Baseline	1033.33 (955.94–1110.74)	983.87 (915.68–1052.07)	−446 (−175.5 to 393)	**<.001***	56.528/**.001**	.511
After4 weeks	1528.33 (1422.30–1634.38)	1032.87 (960.41–1105.34)				
SF-36						
Physical function						
Baseline	67.50 (60.20–74.80)	83.03 (74.54–91.53)	−4.10 (−8.91 to 0.70)	**.008***	3.319/.074	.058
After4 weeks	72.67 (65.23–80.13)	84.10 (75.76–92.45)				
General health						
Baseline	55.89 (48.72–63.07)	61.96 (55.22–68.71)	−2.32 (−5.13 to 0.49)	**.017***	2.325/.133	.041
After4 weeks	58.92 (51.48–66.38)	62.67 (55.59–69.77)				
Beck Anxiety Index						
Baseline	10.03 (7.53–12.55)	8.53 (6.08–10.99)	0.46 (−1.66 to 2.59)	**.003***	0.221/.641	.004
After4 weeks	8.29 (6.27–10.30)	7.25 (5.01–9.49)				

η^2 = eta square effect size, CI = confidence interval for means, IPAQ-SF = International Physical Activity Questionnaire-Short Form, SF-36 = Short Form-36.
*Statistical significance.
†Within group comparison (time).
‡Group comparison (group).

their physical activity levels during COVID-19.[12] Prior studies have noted the importance of physical performance after remote exercise, including the healthy population, and investigated the effects of 4 to 24 weeks of home-based exercise training on the physical performance of older adults.[9,28,32] The findings of these studies indicated significant improvements in the participants' physical performance after remotely supervised exercise intervention.[9,28] In a previous study in which remote exercise was practiced for 3 sessions per week for 12 weeks, physical performance, including agility and walking speed of exercise, and control groups were compared. The findings indicated that remote exercise improved lower body strength, agility, and gait speed and reduced depressive symptoms, suggesting a feasible intervention to improve physical performance.[33] Contrary to earlier findings,[9,28,33] our study did not reveal significant group × time interaction between the remotely supervised aerobic exercise and control groups regarding physical performance outcomes, including SPPB, single-leg standing test, TUG test, and FSST. One potential explanation for this outcome could be the fairly light to somewhat hard level of intensity (rated 11–13 on the RPE-15 scale) during the remotely supervised aerobic exercise sessions, which may not have provided a sufficient physiological stimulus to elicit significant improvements. It is plausible that the participants exhibited baseline increased levels of physical performance, thereby limiting the potential for observable improvement. Additionally, the relatively short duration of the intervention, particularly compared to previous studies that spanned longer timeframes, may have contributed to the lack of significant findings.

The COVID-19 process has had a global impact, negatively affecting anxiety[34] and HRQoL[35,36] worldwide. This underscores the importance of studying HRQoL and anxiety outcomes in sedentary populations.[12] Engaging in regular physical activity reveals itself as a vital tool for improving both physical health and mental well-being.[25] Research has shown that individuals with COVID-19 who participated in aerobic and extremity-strengthening exercise regimens experienced marked improvements in their HRQoL, as evidenced by significant enhancements in their SF-36 scores following a 7-week intervention.[37] While research on the impact of remote exercise on HRQoL and anxiety during the COVID-19 process is limited and primarily focused on the older adult population, a previous study found promising results.[4] The authors of the study demonstrated that remote health interventions, including exercise training and home care, can enhance participants' HRQoL and anxiety management. Furthermore, remote exercise has shown the potential to improve HRQoL[5] and anxiety[9,35] in adult and older adult populations. However, our study results did not demonstrate the impact of remotely supervised aerobic exercise on psychosocial health, possibly due to the participants' high overall HRQoL and mild baseline anxiety levels, as well as the low intensity of the intervention.

The study's strengths include its focus on an adult population within a specific age range, the performance of an aerobic exercise regimen over 4 weeks, and the high adherence rate of 88.09% for the entire aerobic exercise regimen. However, this study has its limitations. First, the intensity of the remote aerobic exercise was low throughout the study due to the study duration. This limited variability in aerobic exercise intensity may have restricted the physiological and psychological benefits typically associated with more progressive aerobic training programs. Second, the duration of the aerobic exercise regimen was relatively short compared to the literature, potentially limiting the impact of the aerobic exercise on the participants' health benefits. This may have hindered the experience of more substantial improvements in health outcomes, particularly those related to physical fitness and mental well-being. Addressing these limitations in future research by implementing a longer intervention period with a structured progression in aerobic exercise intensity would allow for observing dose-response relationships and the sustainability of health benefits and contribute to developing strategic frameworks for effective remote exercise interventions.

5. Conclusions

Four weeks of remotely supervised aerobic exercise promoted physical activity but did not significantly improve physical performance or psychosocial well-being. Nonetheless, implementing such an intervention is consistent with WHO guidelines and may offer indirect benefits, including enhanced social engagement, specifically in rural settings. While the short-term health benefits of a remotely supervised aerobic exercise regimen may appear limited for rural residents, the potential for more prolonged and intensive remote aerobic training requires further investigation. Future research should focus on longer-duration and higher-intensity aerobic exercise regimens to achieve greater physical and psychosocial improvements.

Author contributions

Conceptualization: Gökhan Bayrak, Ummuhan Baş Aslan.
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Software: Gökhan Bayrak.
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