

Original Article

Reversing the Deconditioning Effects of the Pandemic in the Elderly via Telerehabilitation

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ABSTRACT

Objective: To investigate the effect of a structured home-based interactive telerehabilitation program on physical activity (PA) level, sleep, and quality of life (QoL) in older individuals who were in home confinement during the pandemic. **Materials and Methods:** A total of 23 participants in the age range of 65–90 (mean: 72.47 ± 5.58) years (15 females) were included in the study. A telerehabilitation exercise program was administered three times per week for 8 weeks. PA levels and sleep parameters were evaluated (using the Sensewear Armband) at baseline and at the end of the 8th week. In addition, the Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale were used for self-reported evaluation of sleep, and the World Health Organization QoL Instrument-Older Adults Module was administered to evaluate the QoL. **Results:** Comparing pre- and postexercise evaluation results demonstrated a significant increase in PA levels and significant improvements in sleep duration, sleep latency, and daytime sleepiness. In addition, a significant increase was observed in the total QoL scores. **Conclusion:** The telerehabilitation exercise program seems to be an effective method to increase PA levels, improve sleep-related parameters, and enhance QoL in older adults affected by home confinement during the pandemic.

KEYWORDS: Aged, deconditioning, physical activity, quality of life, sleep quality, telerehabilitation

INTRODUCTION

Social isolation, home confinement, and lockdown were among the preventive measures in most countries to fight against the novel severe acute respiratory syndrome coronavirus 2 at home or in a limited space.^[1] This threat is more pronounced for the elderly population due to their long home confinement during the pandemic and the consequent decrease in physical activity (PA) to unhealthy levels.^[2] The decrease in muscle strength due to restricted PA, which we refer to as deconditioning, occurred in the elderly, especially during the quarantine period, and as a result, physical, psychological, and functional regression was experienced.^[3] Other undesirable consequences of preventive measures include a decrease in sleep quality, overall well-being, and quality of life (QoL).^[4,5]

The pandemic and national policies to fight against the pandemic have the potential to disrupt sleep and decrease

sleep quality.^[6] Sleep disorders are common in older people due to possible underlying physical and mental health conditions and/or because of the medications used to treat these disorders.^[7,8] Studies have reported that common sleep problems in the elderly include difficulty in falling or remaining asleep, waking up early in the morning, and excessive daytime sleepiness.^[9] Furthermore, it has been shown that decreased PA, changing eating patterns and weight gain, loneliness, and the psychological impact of social isolation (i.e., anxiety and depression) cause further deterioration of sleep quality in the elderly.^[10]

Studies have demonstrated a relationship between PA levels and sleep quality in the elderly and reported

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that regular PA and exercise could improve sleep quality.^[11-13] Engagement in regular PA can reduce the need for sleeping pills, help with falling and remaining asleep (as a result of energy consumption and muscular relaxation), and improve QoL, well-being, and depression in older individuals.^[14-17] It is reported that healthy older adults who regularly participate in moderate-intensity activity for more than 1 h per week have higher QoL – both physically and mentally – than those who are less physically active.^[17]

The rapid global increase in the rate of the elderly population emphasizes the importance of healthy aging – a concept that is closely related to PA.^[18] Studies show that regular PA can improve sleep and QoL and decrease sedentary behaviors.^[14-17] Under the exceptional conditions of the pandemic, regular exercise at home through telerehabilitation is important because it promotes healthy aging while respecting the rules of social distancing. Telerehabilitation is an innovative approach to increase access to rehabilitation services for individuals living in the remote areas with few or no therapists. For the elderly population, telerehabilitation eliminates transportation difficulties and increases exercise participation rates; however, the number of studies on this topic is limited.^[19]

Therefore, our study aimed to examine the effect of a structured, telerehabilitation exercise program on PA, sleep, and QoL in older individuals during home confinement.

MATERIALS AND METHODS

Participants

This study was conducted between July and November 2020 and the sample included individuals age over 65 years living in the rural regions of Nicosia, Cyprus, who responded to our recruitment announcements. Individuals who (1) used orthoses, prostheses, and/or assistive devices for ambulation, (2) had a diagnosed medical and/or physical disability that could prevent regular PA, (3) had a body mass index (BMI) above 30 kg/m², and (4) had a diagnosed sleep disorder were excluded. Out of 31 volunteers, four did not meet the above-mentioned criteria, and four refused to wear the armband. Therefore, the study was completed with a total of 23 participants (mean age: 72.47 ± 5.58 years) (15 women). All participants were informed about the study and each gave signed written consent. Approval was obtained from the noninterventional clinical research ethics committee (YDU/2020/81-1141).

Assessment tools

SenseWear armband

The SenseWear Pro3 Armband (SWA, SenseWear®) is a multi-sensor body monitor that can collect up to 2 weeks of lifestyle data. Worn on the triceps of the right arm, it calculates energy consumption and real metabolic PA in free-living conditions. It allows continuous recordings of levels and duration of PA and sleep, total energy expenditure (TEE) (effective and resting energy consumption), metabolic equivalent (MET, kCal/kg/h), and physiologic signals from the body [Figure 1].^[20]

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) evaluates sleep quality and can be used for research, clinical, or diagnostic purposes. It consists of 24 questions that collect subjective data regarding sleep quality, latency, and duration, habitual sleep efficiency, sleep disturbance, sleep medication, and daytime dysfunction. Higher scores indicate poor quality of sleep. The validity and reliability studies of the Turkish version of the scale were conducted by Agargun.^[21]

Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS) assesses daytime sleepiness. In this self-administered questionnaire, the individual rates how likely they are to fall asleep on a normal day in certain situations. Each item of the 8-item scale has an assigned score from 0 (no chance of dozing) to 3 (high chance of dozing). The total score can range from 0 to 24, and scores above 10 indicate excessive daytime sleepiness. The ESS is valid and reliable for the Turkish population.^[22]

World Health Organization Quality of Life Instrument-Older Adults Module

The World Health Organization Quality of Life Instrument-Older Adults Module (WHOQOL-OLD)

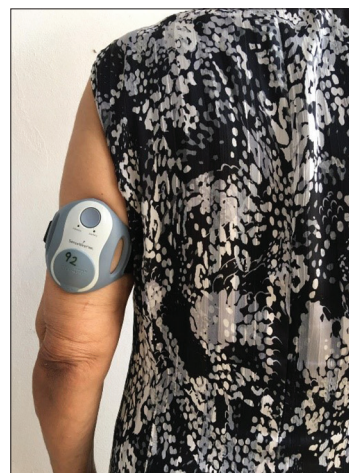


Figure 1: SenseWear Armband

covers six facets (sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, and intimacy), with four items in each. The response format is a five-point Likert scale, and the total score is the sum of all item scores. Higher scores indicate higher QoL.^[23]

Protocol

Demographic data including age, height (via wall-mounted rigid measuring tape), weight (via Tanita MC-180MA III device), and medical history (if any) were recorded. A physiotherapist administered the PSQI, ESS, and WHOQOL-OLD scales in face-to-face sessions with each participant. The participants were asked to wear the SenseWear armband for 24 h on a typical ordinary day and night. Instructions were provided regarding where and how to wear the armband. The participants were required to perform their routine daily life activities, as usual, to avoid contact with water (i.e., remove the device before bathing or swimming), and to put it back on as soon as possible after removal. All tests were performed twice: (1) at baseline (pre-PE/before physical exercise) and (2) within the week after the telerehabilitation program (post-PE/after physical exercise) [Figure 2].

Exercise program

A 40-min exercise program was administered by a physiotherapist three times per week for 8 weeks using video call applications (e.g., WhatsApp, Zoom, or Google Meet). Necessary modifications were made to the exercise program to meet specific conditions (e.g., joint limitations) of the individuals. Each session included:

1. Ten minutes of warm-up: Consisting of aerobic exercises (such as stepping on the spot and indoor walking), followed by static and dynamic stretching exercises (the participants were asked to perform stretches as the physiotherapist demonstrated).

Three repetitive stretches (15 s of stretching and 5 s of relaxation) were applied to the gastrocnemius, hamstring, and pectoralis major muscles

2. Twenty-five minutes of training: Consisting of aerobic, strengthening, balance, coordination, and breathing exercises. The weight, number of repetitions, duration, and/or difficulty level of the exercises were gradually increased every 2 weeks. All exercises were performed in combination with breathing exercises
3. Five minutes of cool-down: To reduce the risk of injury, the stretching exercises applied in the warm-up phase were repeated.

Statistical analysis

The SPSS version 22 program was used for the statistical analysis (IBM Corp., New York, USA). The distribution of the data within the group was examined using the Shapiro–Wilk test. The Wilcoxon-signed rank test was used for pre- and post-telerehabilitation comparisons because the data were nonnormally distributed. In the statistical analysis, $P \leq 0.05$ was set as statistical significance.

RESULTS

Sixty-five percent of the participants were female ($n = 15$), with a mean age of 72.20 ± 5.97 years, and 35% were male ($n = 8$) with a mean age of 73.00 ± 5.13 years. There was no significant difference between pre and post-PE mean BMI values (26.42 ± 3.38 kg/m² and 26.07 ± 3.51 kg/m², respectively).

Pre- and post-PE values of active and TEE, PA duration, number of steps, sleep duration, time of inactivity and activity (categorized as mild, moderate, and vigorous based on METs), and PSQI, ESS, and WHOQOL-OLD scores were examined.

- TEE: The mean pre- and post-PE TEE of the participants were 8043.35 ± 2113.65 kJ and

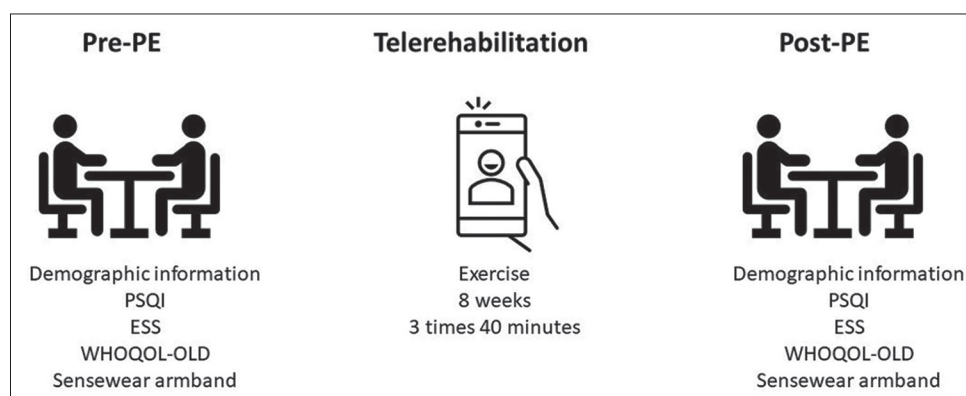


Figure 2: Telerehabilitation program flow chart. Pre-PE: Prephysical exercise, Post-PE: Postphysical exercise WHOQOL-OLD: World Health Organization Quality of Life Instrument-Older Adults Module, PSQI: Pittsburgh Sleep Quality Index, ESS: Epworth Sleepiness Scale

8346.13 $\pm$ 1778.65 kJ, respectively. The increase in post-PE TEE was not statistically significant

- Active energy expenditure (AEE): The mean pre- and post-PE AEE of the participants were 375.74 $\pm$ 865.67 kJ and 730.39 $\pm$ 1342.37 kJ, respectively, which was significantly different ($P = 0.024$) [Figure 3]
- PA duration: The mean pre- and post-PE PA duration of the participants were 19.26 $\pm$ 38.26 and 39.35 $\pm$ 67.11 min, respectively, which was significantly different ($P = 0.023$) [Figure 3]
- Activity and inactivity time: There was an increase in the duration of mild activity (1.5–3.0 MET) (pre-PE: 206.35 $\pm$ 142.96, post-PE: 220.74 $\pm$ 166.14 min), moderate activity (3.0–6.0 MET) (pre-PE: 19.17 $\pm$ 37.88, post-PE: 37.83 $\pm$ 63.01 min), and vigorous activity (6.0–9.0 MET) (pre-PE: 0.09 $\pm$ 0.42, post-PE: 1.52 $\pm$ 4.86 min). However, only the increases in moderate and vigorous activity periods were statistically significant (respectively $P = 0.030$; $P = 0.042$) [Figure 4]
- Sleep time: The mean pre- and post-PE sleep duration of the participants were 347.52 $\pm$ 130.44 and 414.22 $\pm$ 106.83 min, respectively, which was significantly different ($P = 0.033$) [Figure 5 and Table 1].
- PSQI: Sleep latency (pre-PE: 1.61 $\pm$ 0.50, post-PE: 1.43 $\pm$ 0.51) and habitual sleep efficiency (pre-PE: 2.78 $\pm$ 0.42, post-PE: 2.48 $\pm$ 0.51) (respectively $P = 0.046$; $P = 0.020$) [Figure 5 and Table 1].
- WHOQOL-OLD scores: The mean pre- and post-PE WHOQOL-OLD scores of the participants were 74.48 $\pm$ 10.91 and 75.09 $\pm$ 10.56, respectively, which were significantly different ($P = 0.015$) [Figure 6]
- ESS scores: The mean pre- and post-PE ESS scores of the participants were 11.57 $\pm$ 3.16 and 10.91 $\pm$ 2.81, respectively, which were significantly different ($P = 0.013$) [Figure 6].

DISCUSSION

Our findings demonstrated a significant increase in active energy consumption and PA duration as a result

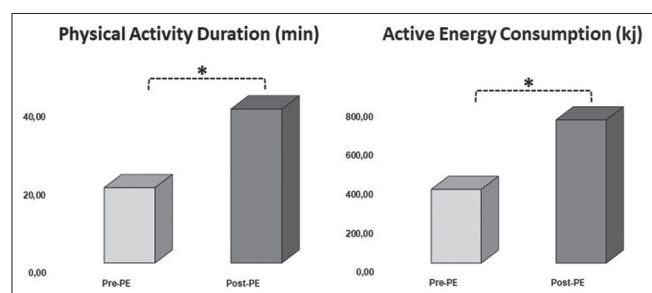


Figure 3: Average duration of physical activity and average active energy consumption of the participants are shown ($n = 23$). Participants' physical activity time is shown in minutes, and the active energy consumption is shown in kilojoules ($*P \leq 0.05$)

of an 8-week telerehabilitation exercise program in older people who were in home confinement during the pandemic. The positive effects of this structured exercise program were also observed in sleep quality, duration, and latency, and daytime sleepiness. The higher levels of PA and improvements in sleep parameters led to an increase in the QoL of the participants.

According to a systematic review, technology-based interventions were 12% more effective in increasing PA compared with nontechnologic interventions.^[24] Similarly, telerehabilitation caused an increase in AEE and the PA duration of our participants.

A systematic review demonstrated that although exercise did not affect sleep duration, sleep efficiency, and daytime functioning in adults aged over 40 years, it led to improvements in PSQI total scores and sleep latency and decreased the use of sleeping pills.^[13] Oudegeest-Sander *et al.* investigated the effect of exercise training on sleep efficiency in healthy older individuals and reported that 12 months of exercise training had no effect on sleep latency, total sleep duration, sleep efficiency, and the number of night awakenings.^[25]

Table 1: Objective and subjective sleep behavior values of the participants ($n=23$)

	Mean $\pm$ SD	Minimum	Maximum	P
Sleep time (min)				
Pre-PE	347.52 $\pm$ 130.4	54	532	0.033
Post-PE	414.22 $\pm$ 106.8	185	614	
Sleep latency				
Pre-PE	1.61 $\pm$ 0.50	1	2	0.046
Post-PE	1.43 $\pm$ 0.50	1	2	
Habitual sleep efficiency				
Pre-PE	2.78 $\pm$ 0.40	2	3	0.020
Post-PE	2.48 $\pm$ 0.50	2	3	

* $P \leq 0.05$. SD: Standard deviation, PE: Physical exercise

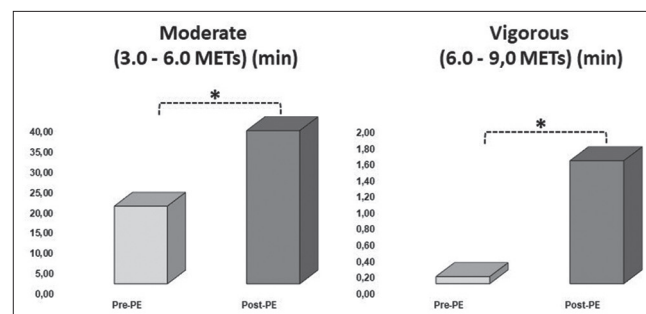


Figure 4: Average moderate (3.0–6.0 metabolic equivalent) and vigorous activity (6.0–9.0 metabolic equivalent) times of the participants are shown ($n = 23$). The activity times of the participants are shown in minutes ($*P \leq 0.05$)

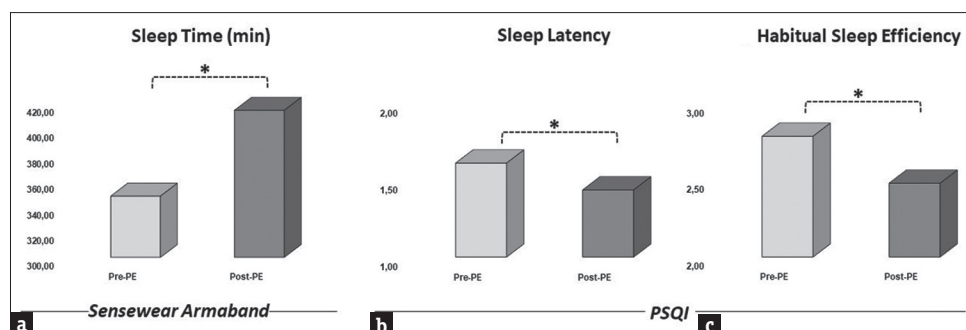


Figure 5: (a) The average sleep times of the participants as measured using the SenseWear armband are shown (min). (b) The mean sleep latencies of the participants evaluated with PSQI are shown. (c) The average sleeping habits of the participants evaluated with Pittsburgh Sleep Quality Index are shown (* $P \leq 0.05$)

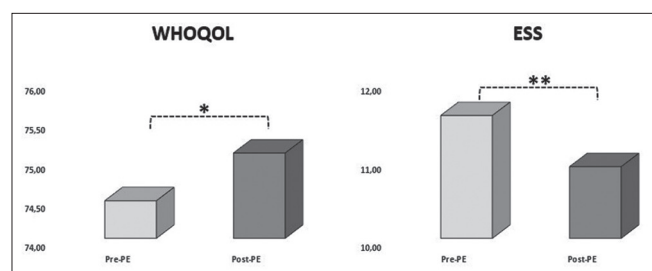


Figure 6: World Health Organization Quality of Life and Epworth Sleepiness Scale survey results of the participants are shown ($n = 23$). Columns shown in the light gray indicate preexercise and columns in dark gray indicate pos-exercise (* $P \leq 0.05$, ** $P \leq 0.01$)

According to a previous study, although aerobic exercises did not affect the PSQI scores of older men, they could reduce the total number of night awakenings and increase the depth and continuity of sleep after falling asleep again.^[26] Chan and Chen performed an exercise program consisting of stretching, strengthening, endurance, and aerobic exercises three times per week for 6 months on adults aged over 65 years. The authors stated that sleep latency and sleep duration improved significantly in the exercise group compared with the control group.^[27] We observed that our telerehabilitation program (consisting of aerobic and strengthening exercises), improved total sleep time, sleep latency, and habitual sleep quality, and decreased daytime sleepiness.

The number of studies examining the effect of telerehabilitation on sleep quality in the elderly is quite limited. In the study conducted by Jeong *et al.*, 17 patients with multiple sclerosis (age range: 39–76 years) exercised with a home-based telerehabilitation program for 3 months.^[28] Similar to our findings, they observed that the telerehabilitation program had a positive effect on sleep efficiency and quality. Studies have shown that a higher quality of sleep indirectly leads to higher QoL through increasing physical, mental, and social well-being.^[29,30] Reid *et al.* evaluated the effect of moderate aerobic PA on sleep, psychological state, and QoL in older adults with chronic insomnia, and reported

an increase in total sleep quality scores, but no significant difference in total QoL scores.^[31] In contrast, Oh *et al.* examined the effect of different types of exercise on QoL in the elderly and stated that QoL scores were higher in physically active individuals, regardless of the type of exercise.^[32] In our study, in addition to the improvement in sleep quality, PA levels, and general well-being after telerehabilitation, a significant increase was observed in QoL scores.

To our knowledge, the number of studies on the effects of telerehabilitation exercise programs on sleep and QoL is limited, and the results are ambiguous.^[28] Restrictions of the COVID-19 pandemic have made telerehabilitation practices a key element in reducing the risks of increased inactivity in the elderly and improving their sleep state and QoL. The present study documented the positive effects of structured telerehabilitation on sleep and QoL in older individuals affected by home confinement during the pandemic and highlighted the importance and efficacy of telerehabilitation practices in this population.

CONCLUSION

Considering the adverse effects of the pandemic on healthy aging, it is essential to develop new strategies to promote and maintain physical and mental well-being in the elderly. Home confinement prevents outdoor PA and exercise, but telerehabilitation offers an invaluable opportunity to keep the elderly physically active in their homes. Considering the favorable results of the present study, telerehabilitation is recommended as a simple, safe, and inexpensive option to increase PA levels and improve sleep and life quality in older adults.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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