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RESEARCH ARTICLE

Nordic Walking - The Effectiveness of a New Form of Exercise in Adults After COVID-19 Infection: A Randomized Controlled Trial

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Abstract
The purpose of present study was investigating the effectivenes of Nordic walking exercise (NWE) on physical activity level, physical fitness level**,** dyspnea, fatigue, functional status, depression and life quality after COVID-19 undergoing home isolation.Thirty subjects were randomly assigned in NWE (n=15) and control group (n=15). NWE group performed NWE 3 days a week for 6 weeks. The control group was not given any exercise. For physical fitness level, upper-lower extremity muscular endurance (arm curl test- chair sit and stand test)**,** lower aerobic (two minutes step test) and cardiopulmonary endurance (six minute walk test), flexibility (back scratch and sit and reach test)**,** balance (time up and go test) was assessed. The International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to evaulate physical activity level. The anxiety-depression level was determined by Beck Depression Questionnaire. The dyspnea with Modified Medical Research Council (mMRC), functional status with Post-COVID-19 Functional Status Scale (PCFS), fatigue with Fatigue Severity Scale (FSS) and quality of life with Nottingham Health Profile (NHP) were determined. In NWE group, significant improvements were observed in upper-lower muscular extremity, lower aerobic, cardiopulmonary endurance, balance, mMRC, FSS, NHP energy, emotional reactions, sleep and total scores ($p<0.05$). Upper-lower muscular extremity, lower aerobic, cardiopulmonary endurance, balance, PCFS, IPAQ-SF walking and NHP energy scores were statistically different between groups in favor of NWE group ($p< 0.05$). NWE can be recommended physical activity program to improve physical health and functional status after COVID-19.

Keywords
Nordic Walking, COVID-19, Physical Fitness, Exercise, Functional Status

INTRODUCTION

The adverse effects of COVID-19 on cardiopulmonary, nervous and musculoskeletal system have been reported (Yıldırım et al., 2020; Ekim et al, 2020; Aytür et al., 2020). In addition to its systemic damage, it also causes psychological dysfunction and reduces quality of life (Taş and Çağlayan, 2021). It is emphasized that rehabilitation and treatment models after COVID-19 should be planned due to the concern of facing treatment of a new population of disabled patients (Başaran and Güzel, 2020; Akalın et al., 2020; Amatori et al., 2020; Yavuz and Anar, 2021; Micielska et al., 2021; Sallis et al., 2021).The studies recommend improving respiratory functions, reducing sedentary time, increasing physical activity level, improving quality of life and emotional well-

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being, and increasing independence in daily living activities after COVID-19 (Akalın et al., 2020; Amatori et al., 2020; Yavuz and Anar, 2021; Micielska et al., 2021; Sallis et al., 2021).

Exercise therapy is seen as a safe and cost-effective way of treatment to reduce COVID-19 symptoms and improve well-being (Arslan and Ercan, 2020; Tunç et al., 2020; Xu et al., 2020). Studies generally focus on pulmonary rehabilitation practices in hospitalized patients (Pinho et al., 2020; Rooney et al., 2020). On the other hand, it has been reported that people with moderate and low-intensity infection show symptoms in the 4th and 12th weeks after COVID-19, in similar proportions to those who are hospitalized (Jimeno-Almazán et al., 2021).Based on this information, a rehabilitation program should be applied during and after the infection process for people who have had COVID-19 with isolation at home (Jimeno-Almazán et al., 2021).

Nordic walking exercise (NWE) is a special form of physical activity similar to nordic skiing performed using poles (Cugusi et al., 2017). It has become a form of exercise that attracts people of all ages around the world. It is a simple and feasible form of physical activity that can be performed in any place and population. In this form of exercise, brisk walking is performed using specially designed poles. Unlike other physical activities, upper trunk and upper extremityparticipate more in the activity (Tschentscher et al., 2013).Because of these features, NWE is an example of a whole-body exercise that produces a higher energy expenditure (Cugusi et al., 2017). Studies show that NWE improves aerobic capacity, muscle strength, balance, and well-being (Micielska et al., 2021; Cugusi et al., 2017). Therefore, it is recommended as a primary and secondary prevention method in very different populations in the literature (Tschentscher et al., 2013).

To our knowledge, no studies were found that show the efficacy of NWE that is a new form of exercise in adults after COVID-19 in the literature. In addition, there was no study researching the effects of exercise program in the group undergoing home isolation. Therefore the purpose of present study was to examine the effectiveness of NWE on physical fitness, physical activity level, anxiety-depression, dyspnea, fatigue, functional status and life quality in adults after COVID-19 undergoing home isolation.

MATERIALS AND METHODS

Study Design and Subjects

The present study was planned as a prospective and single-blind, parallel-group, randomized controlled trialat the evidence II level and was conducted between September 2022 and January 2023. The Medical Ethics Committee approval was obtained (KA22/355) with clinical trials number UMIN000050232.
Sociodemographic and clinical information were recorded after acquring the verbal and written consent from subjects.

The subjects with COVID-19 symptoms such as fever, pain, cough, loss of sense of taste and smell while PCR tests are positive who had been diagnosed at least 3 months and at most of 10 months past after the diagnosis of COVID-19 and treated with home isolation, were aged between 22 and 50 years were carried out in this study. The exclusion criterias of study were being musculoskeletal, neuromuscular and cardiovascular diseases, cognitive problems; being hospitalized for COVID-19 treatment, having no symptoms while PCR positive, undergone surgery in last six months that may prevent exercise tests and training.

The study of Nemoto et al. was used while investigating the sample size according to the time up go test datas (Nemoto et al., 2021). As a result, it was found that a total of 30 patients, at least 15 in each group were required to calculate a large effect with 95% power and 5% error probability.

Randomization

The simple random sampling was performed in this study.The subjects were randomly assigned to either the the NWE group (n=15) or control group (n=15) as shown in CONSORT flow diagram (Figure 1) using randomization program (https://www.graphpad.com/quickcalcs/randomize1/) by a study member team who was not involved in the evaluation of subjects. Subsequently, outcome mesaurements were performed by two physiotherapists, followed by NWE that were administered by different three physiotherapists. Assessors for testing were blinded to the groups.Due to the nature of the study, participants could not be blinded.

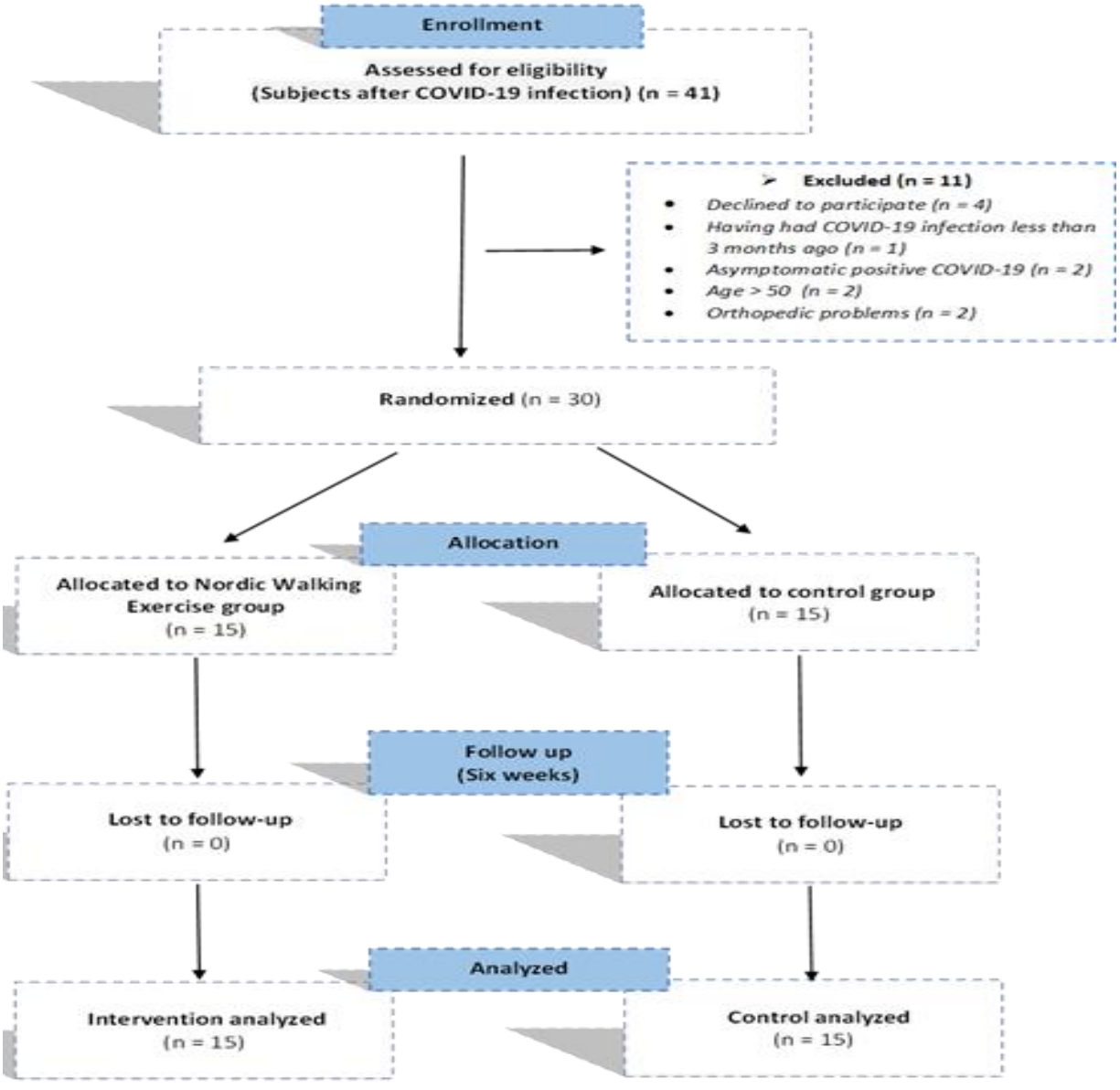

Figure 1. The flow diagram of study

Intervention

Subjects in NWE group were performed NWE three days a week for sixweeks after oneweek practice protocol under the supervision of a physiotherapist to control pulse, blood pressure and oxygen saturation. Subjects in control group did not performed any exercise program, only evaluations were made to them before and after research period.

NWE Protocol

The subjects walked outside using specially-designed poles which are attached to the hands via a strap, so propel themselves forwards with poles(Figure 2).

The practice protocol was applied threedays as 15 minutes onthefirstday, 15 minutes onthesecond day, and 20 minutes on the thirdday for oneweek. NWE was applied for sixweeks, increasing to 25 minutes in first week, 35 minutes in second week, and 45 minutes between third and sixth weeks at 60-80% of maximal heart rate and 4-6 scores according to Modified Borg Scale rated dyspnea or fatigue.

Before and after NWE, warming up and cooling down exercises including lower and upper extremity stretching, normal joint movement and breathing exercises were performed for 5 minutes each.

Figure 2. Nordic walking exercise

Outcome Measurements

PhysicalFitness Level

In order to evaluate the physical fitness levels, muscular and aerobic endurance, balance, flexibility and cardiopulmonary endurance were evaluated with following seven tests (Millor et al., 2017; Ducsky et al., 2011; Węgrzynowska-Teodorczyk et al., 2016; Miyamoto et al., 2018; Bassey, 1998; Steffen et al., 2002; ATS statement, 2002).

Chair sit and stand test was used to evaluate lower extremity muscular endurance. Subjects were asked to sit and stand up from a chair for 30 seconds. The number of repetitions made was noted (Millor et al., 2017).

Arm curl test was used to determine upper extremity muscular endurance. The bilateral number of elbow flexion and extension repetitions for 30 seconds was recorded (Ducsky et al., 2011).

Two-minute step test was used to assesslower extremityaerobic endurance. The midpoint of patella and iliac crestwas determined and line of this point was marked on the wall. Subject was asked to pull one knee and then other knee to reach this line for 2 minutes. The number of steps were recorded (Węgrzynowska-Teodorczyk et al., 2016).

Sit and reach test was used to measure lower extremity flexibility. Subject was instructed to reach forward with his torso with both hands without bending the knee. The distance between finger and toe tip was recorded in centimeters (Miyamoto et al., 2018).

Back scratch test was used to assess upper extremity flexibility. Hands were tried to be brought together on the back with one arm in external rotation and other arm in internal rotation. The distance between the longest fingers was recorded in centimeters (Bassey, 1998).

Timed up and go test was used to determine balance. Subjects were instructed to standing up from a chair, walking 3 meters, turning around and sitting in a chair andthe elapsed time was recorded (Steffen et al., 2002).

6-minute walk test (6MWT) wasperformed to examine cardiopulmonary endurance. Subjects were asked to walk as fast as possible at their own walking speed for six minutes on a 30-meter straight corridor. 6MWT distancewas recordedin meters(ATS statement, 2002).

Physical Activity Level

The physical activity levels were evaluated with the International Physical Activity Questionnaire Short Form (IPAQ-SF). The number of days people do activities, duration (minutes) and certain metabolic equivalentof task (MET)values of the activities are multiplied and the “MET-minute/week” unit score is obtained. It supplies time and energy consumption records for walking, moderate, vigorous and total physical activity level (Öztürk, 2005).

Anxiety-Depression Level

Anxiety and depression levels were determined by Beck Depression Scale (BDS) (Hisli, 1989; Beck et al., 1961).The total score changes from 0 to 63 points. As the total score increases, the severity of depression increases (Hisli, 1989).

Dyspnea

The dyspnea was determined by the Modified Medical Research Council Dyspnea Scale (mMRC). In the scale, the option “0” means “no dyspnea”, “1” option was “mild dyspnea”, “2” option was “moderate dyspnea”, “3” option was “severe dyspnea”, “4” option was “ very severe dyspnea” (Bestall et al., 1999).

Fatigue Severity

The fatigue severity was determined by the Fatigue Severity Scale. This scale consists of 9 items. The total score obtained when all scores obtained for each condition are added together and divided by nine was scale score. Those with score of 4 and above are considered tired (Armutlu et al; 2007).

Functional Status

The Post-COVID-19 Functional Status Scale was used to assess the functional status after COVID-19. The survey classifies functional status limitation as follows: death (grade 5) severe functional limitations (grade 4), moderate functional limitations (grade 3), slight functional limitations (grade 2), negligible functional limitations (grade 1) and no functional limitations (grade 0) (Çalik Kütükcü et al., 2021).

Quality of Life

Nottingham Health Profile (NHP) was used to evaluate quality of life. It consists of thirty eight items, six sub-dimensions (physical activity, sleep disturbance, social isolation, emotional reactions, pain and energy) and total scores. Each section is scored from 0 to 100. As the score increases, quality of life decreases (Kücükdeveci et al., 2000).

Statistical Analysis

The datas was analyzed by using the SPSS version 25. Confidence interval was accepted at 95%. Statistical significance level is accepted at $p<0.05$ value. Quantitative analysis was reported as median and change intervals (minimum-maximum). The frequency and percentage values are given for qualitative variables. The outcomes of homogeneity (Levene's test) and normality (Shapiro-Wilk) tests were used to determine that statistical methods should be used to make a comparison the research groups. Mann-Whitney U-test was used comparisons between groups and Wilcoxon test was applied comparisons between baseline and after training for each group for variables that did not meet parametric test assumptions. Chi-square test was performed to determine the distinction between categorical variables.

RESULTS

The follow-up of groups lasted for 6 weeks, and all of subjects were conducted in the analysis without any lost (Figure 1). The descriptive characteristics the groups were similar ($p > 0.05$) expect for gender ($p = 0.011$) (Table 1).

After 6 weeks of intervention there was a statistically significant improve in the chair sit to stand test ($p = 0.001$), bilateral arm curl test (right arm, $p = 0.006$; left arm, $p = 0.001$), two-minute step test ($p = 0.011$), time up-go test scores ($p = 0.001$) and 6MWT distance ($p = 0.001$) in the NWE group.It was not found significant difference in physical fitness parameters score between baseline and last measurement of the study in control group (Table 2).

When the NWE and control groups were compared at the after 6 weeks, chair sit to stand test ($p = 0.041$), bilateral arm curl test (right arm, $p = 0.018$; left arm, $p = 0.041$), two-minute step test ($p = 0.020$), time up-go test scores ($p < 0.001$) and 6MWT distance ($p < 0.001$)were statistically different between groups in favor of the NWE groupin Table 2. No statistically significant difference was observed in sit and reach test and bilateral back scratch test ($p > 0.05$) (Table 2).

There was no significant statistical differences were found between the NWE and control groups after 6 weeks for IPAQ total physical acitivity level ($p > 0.05$). The only significant improvement in physical activity levels was in the IPAQ walking score ($p = 0.018$) in the inter-group comparisons of values after 6 weeks in favor of the NWE group (Table 3).

It was found that dyspnea ($p = 0.014$) and fatigue severity ($p = 0.004$) statistically significant decreased after NWE. According to outcome measurement of baseline and after 6 weeks, while there were no significant between-group differences in anxiety-depression level, dyspnea, fatigue severity, there was a significant improvement in functional status ($p = 0.005$) (Table 3). There was a significant improvement in the emotional reactions ($p = 0.018$), energy ($p= 0.042$), sleep disturbance ($p = 0.012$) and total ($p = 0.036$) sub-dimensions of NHP in NWE group. It was found that only NHP energy score ($p = 0.002$) statistically significant different in the inter-group comparisons of values after 6 weeks in favor of the NWE group. There was no significant difference in sub-dimensions of NHP in the control group ($p > 0.05$) (Table 3).

Table 1. Descriptive characteristics of subjects

Variables	**NWE Group (n=15)** Median (min-max)	**Control Group (n=15)** Median (min-max)	**Z**	**p[a]**
Age (years)	24 (22-49)	24 (22-50)	-0.233	0.838
BMI (kg/m^2)	23.20 (20.00-31.25)	26.80 (17.24-35.19)	-1.162	0.250
Cigarette Consumption (packet*year)	0 (0-60)	0 (0-180)	-1.492	0.250
Duration of After COVID-19 (month)	6 (6-16)	8 (6-18)	-0.737	0.486
Gender	**n (%)**		**X^2**	**p[b]**
Female	12 (80)	10 (66.66)	6.533	**0.011**
Male	3 (20)	5 (33.33)		

p<0.05. [a] Mann Whitney U test. [b] Chi-Square test.min, Minumum; max, Maximum; BMI, Body Mass Index; NWE, Nordic Walking Exercise.

Table 2. The physical fitness scores between Nordic walking exercise and control groups.

Outcome Measurements	**NWE Group (n=15)**			**Control Group (n=15)**				
	Baseline Median (min-max)	**6 Weeks** Median (min-max)	**p[a]**	**Baseline** Median (min-max)	**6 Weeks** Median (min-max)	**p[a]**	**p[b]**	**p[c]**
Physical Fitness Parameters								
Chair sit and stand test (repetition)	14 (10-19)	18 (16-22)	**0.001**	13 (10-23)	17 (13-19)	0.167	1.000	**0.041**
Arm curl test (right) (repetition)	21 (12-27)	25 (20-30)	**0.006**	23 (11-38)	20 (13-30)	0.123	0.383	**0.018**
Arm curl (left) (repetition)	20 (10-28)	24 (20-30)	**0.001**	21 (11-26)	21 (13-30)	0.505	0.441	**0.041**
2-minutes step test (repetition)	92 (60-130)	106 (102-168)	**0.011**	101 (71-152)	97 (90-120)	0.460	0.191	**0.020**
Sit and reach test (cm)	1 (-20-12)	0 (-15-6)	0.101	5 (-14-13)	7 (-15-11)	0.550	0.228	0.088
Back scratch test (right) (cm)	0 (-9-7)	0 (-8-7)	0.408	0 (-8-9)	0 (-11-9)	0.490	0.387	0.387
Back scratch test (left) (cm)	0 (-10-4)	0 (-10-5)	0.172	-1 (-12-9)	-3 (-10-8)	0.256	0.310	0.424
Time up-go test (seconds)	6 (4-9)	4 (3.5-5)	**0.001**	6 (4-8)	5.6 (4.80-6.20)	0.051	0.900	**0.001**
6 minutes walking test distance (meter)	448 (230-600)	580 (520-710)	**0.001**	442.80 (200-650)	524 (470-570)	0.140	0.819	**0.001**

p<0.05. [a] Wilcoxon Test. [b,c] Mann Whitney U Test. min, Minumum; max, Maximum; NWE, Nordic Walking Exercise; p[a]: Baseline and after 6 week in each groups difference p values. p[b]: outcome measurement of baseline values p-values between groups. p[c]: outcome measurement of the end values p-values between groups

Table 3. The physical activity level, anxiety-depression, dyspnea, fatigue, functional statues and quality of life scores between Nordic walking exercise and control groups.

Outcome Measurements	NWE Group (n=15)			Control Group (n=15)				
	Baseline Median (min-max)	**6 Weeks** Median (min-max)	**p[a]**	**Baseline** Median (min-max)	**6 Weeks** Median (min-max)	**p[a]**	**p[b]**	**p[c]**
Physical activity level								
IPAQ walking score	630 (360-1260)	1039 (630-3150)	0.087	450 (150-4050)	660 (440-1702)	0.638	0.661	**0.013**
IPAQ moderate activities score	0 (0-1350)	120 (0-1260)	0.359	0 (0-2880)	0 (0-2160)	0.599	0.325	0.271
IPAQ vigorous activities score	0 (0-1440)	0 (0-1440)	0.285	0 (0-1440)	0 (0-1440)	0.344	0.229	0.386
IPAQ total score	1139 (360-2295)	1560 (695-3150)	0.112	1200 (405-4050)	1440 (600-10182)	0.182	0.646	0.967
Anxiety-depression level								
BDS score	4 (0-29)	5 (0-30)	0.968	2 (1-26)	5 (0-47)	0.125	0.883	0.631
Dyspnea								
mMRC score	1 (0-3)	0 (0-2)	**0.014**	1 (0-3)	1 (0-3)	0.157	0.808	0.380
Fatigue severity								
FSS score	4.20 (2.44-5)	3.30 (0-4.22)	**0.004**	3.77 (1.66-9)	3.77 (0-6.44)	0.184	0.868	0.245
Functional status								
PCFS score	0 (0-2)	0 (0-2)	0.102	0 (0-3)	2 (0-2)	0.297	0.346	**0.005**
Quality of life								
NHP pain	0 (0-47)	0 (0-26)	0.141	0 (0-83.78)	0 (0-89.50)	0.498	0.490	0.079
NHP energy	0 (0-100)	0 (0-24)	**0.042**	24 (0-100)	24 (0-100)	0.306	0.129	**0.002**
NHP emotional reactions	0 (0-31.51)	0 (0-9.36)	**0.018**	0 (0-76.25)	0 (0-100)	0.575	0.753	0.054
NHP sleep disturbance	16.10 (0-77.63)	0 (0-27)	**0.012**	43 (0-77.13)	0 (0-87.43)	0.114	0.320	0.107
NHP social isolation	0 (0-41)	0 (0-0)	0.180	0 (0-60.51)	0 (0-63.99)	0.465	0.162	0.073
NHP physical activity	0 (0-58.83)	0 (0-22.33)	0.068	10.79 (0-45.53)	0 (0-65.54)	0.138	0.839	0.153
NHP total	37.40 (0-184.48)	0 (0-63.89)	**0.036**	10 (0-92)	0 (0-85)	0.432	0.052	0.057

p<0.05.[a]Wilcoxon Test. [b,c.] Mann Whitney U Test.min, Minumum; max, Maximum; NWE, Nordic Walking Exercise; IPAQ, International Physical Activity Questionnaire; NHP, Nottingham Health Profile; mMRC, Modified Medical Research Council Dyspnea Scale; FSS, Fatigue Severity Scale; PCFS, BDS, Beck Depression Scale; Post-COVID Functional Status Scale; p[a]: Baseline and after 6 week in each groups difference p values. p[b]: outcome measurement of baseline values p-values between groups. p[c] : outcome measurement of the end values p-values between groups.

DISCUSSION

This study showed that compared to the non-exercise group, NWE resulted in benefits on physical activity, physical fitness, functional status, dyspnea, fatigue and life quality however, there was no impact in depression level.To the authors' knowledge, this is the first study to examine the efficacy of 6-week NWE on physical activity, physical fitness, anxiety-depression, dyspnea, fatigue, functional status and life quality in adults after COVID-19 undergoing home isolation.

Regarding the previous literature about positive effects of NWE, several studies showed that NWE increased physical fitness level and also had more improvement than the normal walking, because of the use of poles that involved a higher upper extremity muscles activations and more coordination movements (Ahmadi Hekmatikar et

al., 2022; Grigoletto et al., 2022; Cokorilo et al., 2022; Marciniak et al., 2020; Prince et al., 2019; Saulicz et al., 2015; Reed et al., 2022). We observed an improvement upper and lower extremity endurance, dinamic balance and cardiorespiratory endurance sub-parameters of health-related physical fitness after NWE. However, no improvement in flexibility was shown. The chair sit and stand, bilateral arm curl, two-minute step, time up-go test scores and 6MWT distance were shown to be superior to the control group at the end of our study. A significant increase in the distance covered during 6MWT and lower extremity endurance is not surprising, because it may be natural consequence of systematically practiced walking. Because arm activity is essential to walking with poles, an increase in upper extermity endurance manifested as an improvement in the arm curl test scores. While NWE, the use of the oxygen energy system and perform the movements that require coordination and balance, such as walking with buttons attach the hands may be the possible reason why it had greater effects on the development of aerobic fitness, muscular endurance, and balance than flexibility. As a result, although most studies in the literature were conducted with participants with cardiovascular disesases and elderly people, our results of physical fitness level are consistent with the other studies on the effects of NWE (Cugusi et al., 2017; Tschentscher et al., 2013; Nemoto et al., 2021).

As expected, while improvements in IPAQ walking parameter score after NWE were greater than in control group, no improvement was indicated in IPAQ moderate, vigorous activities and total score. Nemoto et al. evaluated the physical activity with accelerometry, found that maximal walking speed among the NWE group significantly improved compared with the simple walking group (Nemoto et al., 2021). Therefore, differences between methods evaluating physical activity may have affected this result.

Studies in the literature generally reported improvement in mood after NWE (Prince et al., 2019; Saulicz et al., 2015; Reed et al., 2022; Özdamar et al., 2022; Acar et al., 2022; Thaller et al., 2022). Prince et al. investigated that the effects of NWE on anxiety-depression level in heart failure patients and compared with standard exercise training. Anxiety-depression levels of heart failure patients decreased similarly in both groups (Prince et al., 2019). In our study, no improvement was observed in the depression score in NWE group either in post comparisons. We thought the reason for our results was that our subjects already had a low BDS score prior to training.

In our study, we showed a reduction in both fatigue and dyspnea level after NWE, although there was no statistically significant difference compared to control group.In the literature, very few studies have been found to determine the severity of fatigue and dyspnea after NWE (Santoyo-Medina et al., 2022; Breyer etl al., 2010). The study reported that similar fatique severity reduction both after NWE and conventionel aerobic exercise in multiple sclerosis patients (Santoyo-Medina et al., 2022). It was seen that a previous study reported exercise-induced dyspnea decreased after NWE compared to the control group in chronic obstructive pulmonary diseases patients (Breyer etl al., 2010). In addition, it is known that lower subjective fatigue, dyspnea and greater confidence occur during NWE when walking with poles (Tschentscheret al., 2013).

In a new review, showed that different training programs consist of aerobic and resistance exercises reduced activity-induced dyspnea and fatigue, increased muscle strength, functional independence and improved life quality in post-COVID-19 patients discharged from the hospital. The present study showed similar results with studies examining the effectiveness of different exercise training (Ahmadi Hekmatikar et al., 2022).Although there was no statistical improvement in functional status after NWE in our study, a significant improvement in favor of NWE was determined in the comparison of the NWE and control group.

Quality of life is an indicator of treatment success in biopsychosocial models refers to changes in physical, psychological, and social functioning (Haraldstad et al., 2019). In present study, positive improvement in energy, emotional reaction, sleep disturbance and total sub-scores of NHP were shown in NWE group. Besides, only energy sub-parameters of NHPstatistically superior to control group at the end of the study. NWE, which is an outdoor exercise form, has been shown to be effective on sleep quality and emotional state, as well as physical health. There are randomized controlled trials and reviews in many patient populations that have proven NWE

improves quality of life (Marciniak et al, 2020; Reed et al., 2022).

Although our study was conducted selfessly by experienced physiotherapists and our results consistent with the literature, we did'nt havelong-term follow-up that is a major limitation. Besides, we think that the effects of NWE can be compared with another aerobic exercise for example ordinary walking in future studies.

Conclusion

It was concluded that NWE enhances physical activity, physical fitness, dyspnea, fatigue, functional status and quality of life, however, there was no impact in depression level in people after COVID-19 in home isolation. The increase physical fitness and acitivity level, which is the most important determinant of chronic diseases with increasing incidence after COVID-19, shows that NWE can be a promising new form of physical activity in preventing future diseases.

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Author Contributions

Conceptualization, M,A.; methodology, M.A., D.Ö., D.D., K.D, İ.A.,; formal analysis, M.A., D.Ö., D.D., K.D, İ.A; investigation, M.A., D.Ö., D.D., K.D, İ.A; data curation, M.A; writing-original draft preparation, M,A.; writing—review and editing, M.A., D.Ö., D.D., K.D, İ.A; supervision, M,A.; project administration, M.A. All authors have read and agreed to the published version of the manuscript.

Declaration of Interest

The authors report there are no competing interests to declare.

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Ethics Statement

The study was conducted according to the guidelines of the Declaration of Helsinki. This study was approved by the Medical Ethics Committee of Baskent University (KA22/355). The registration of the study to clinical trials was done with the number UMIN000050232.

Informed Consent Statement

Informed consent was obtained from all participants involved in the study. Written informed consent has been obtained from the patients to publish this paper.

Data Availability Statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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