Turk J Phys Med Rehab 2023;69(4):488-499
DOI: 10.5606/tftrd.2023.11605
Available online at www.turkishjournalpmr.com

Original Article

Effect of yoga-based exercises on functional capacity, dyspnea, quality of life, depression, anxiety, and sleep of infected healthcare workers during the COVID-19 pandemic: A prospective clinical trial

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Received: August 31, 2022 **Accepted:** May 04, 2023 **Published online:** October 12, 2023

ABSTRACT

Objectives: The study aimed to investigate the effect of yoga-based exercises on functional capacity, dyspnea, quality of life, depression, anxiety, and sleep quality following coronavirus disease 2019 (COVID-19).

Patients and methods: Forty-one COVID-19-infected healthcare professionals (35 females, 6 males; mean age: 39.7±6.5 years; range, 28 to 55 years) who were actively working during the subacute period were included in the prospective controlled study between March 2021 and September 2021. The participants were divided into two groups: the yoga-based exercise group (YBEG; n=26) and the nonintervention group (n=15). Besides routine recommendations, the YBEG performed stretching, relaxation, isometric strengthening, breathing, and meditation exercises of 60 min twice a week for eight weeks. Clinical outcome was measured with flexibility tests (shoulder flexibility and sit and reach tests), hand grip strength, 6-min walk test, dyspnea score, Beck Depression and Anxiety Inventory, Short Form 36 (SF-36) quality of life, Pittsburgh sleep quality index (PSQI), and the International Physical Activity Questionnaire (IPAQ) before and after eight weeks in both groups.

Results: Beck anxiety scores, IPAQ scores, PSQI, SF-36 pain, and social functioning subparameters were positively statistically significant in the YBEG ($p<0.05$). The only parameter found to be insignificant in time and between groups was the SF-36 mental health subparameter ($p>0.05$). In addition, the YBEG had significant improvements in muscle strength, flexibility, functional capacity, physical activity level, quality of life, anxiety, depression levels, and sleep scores between before and after the eight-week intervention period ($p<0.05$).

Conclusion: Yoga programs have led to an increase in functional capacity and physical performance, a decrease in anxiety and depression complaints, and an increase in the quality of life in healthcare professionals who were in the process of returning to work during the post-COVID-19.

Keywords: COVID-19, healthcare workers, yoga.

Coronavirus disease 2019 (COVID-19) is a disease that can affect many systems in the body, particularly the pulmonary system, and causes physical, psychological, and widespread dysfunction together with disorders of the systems. The disease affects the musculoskeletal, neurological, digestive, cardiovascular, hematological, mental, and cognitive systems at different levels and may present with different symptoms.[1,2] Arthralgia, myalgia and widespread pain, weakness, dyspnea, cough, decline in effort capacity, fatigue, concentration

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Cite this article as:
Önal R, Ordu Gökkaya NK, Korkmaz S, Utku B, Yaşar E. Effect of yoga-based exercises on functional capacity, dyspnea, quality of life, depression, anxiety, and sleep of infected healthcare workers during the COVID-19 pandemic: A prospective clinical trial. Turk J Phys Med Rehab 2023;69(4):488-499. doi: 10.5606/tftrd.2023.11605.

difficulty, sleep disturbance, and depression are the leading complaints, particularly in the first four weeks and the following period after exposure to the infectious agent, which is called the post-COVID-19 period. It is known that the continuation of all these symptoms is independent of the severity of the acute disease and the humoral immune response.[3,4] In several studies, it has been reported that due to the increased workload, physical fatigue, and concerns about the health and safety of family and friends, mental health problems, such as anxiety, depression and sleep disorders, posttraumatic stress disorder, and suicide, are more observed in healthcare professionals who are at the forefront of the fight against COVID-19 in Türkiye, as well as all over the world.[5-7]

The introduction of a rehabilitation program that includes exercises specific to the patient's current clinical signs and symptoms is one of the key principles for more effective and swift management of the process. It has been proven that yoga-based exercises (YBEs) have positive effects on the musculoskeletal system, such as muscle strength, balance, and flexibility, in addition to its several positive effects, including increasing cardiovascular endurance, reducing depression and anxiety, and improving sleep quality.[8] These holistic practices support body-mind coordination.[8] In addition, its effects have been investigated in many other diseases. Pain, bronchial asthma, diabetes, endometriosis, inflammatory bowel diseases, stroke, cancer, anxiety, and depression are among the diseases that YBE are most frequently investigated.[8-10] It has been shown in many studies that the combination of yoga with pranayama exercises and appropriate breathing techniques is effective in many lung diseases, specifically chronic obstructive pulmonary disease (COPD), and provides improved lung function parameters, increased diffusion capacity, decreased perception of dyspnea, and improved quality of life (QoL).[11-13] The literature also holds studies on infections.[14,15] The exercises have a supporting effect on the immune system. Mind-body therapies have been found to reduce inflammatory cytokines and increase the levels of multiple immunoglobulins and natural killer cells in meta-analysis.[16] In these studies, it has been shown that personalized yoga and meditation practices can provide a broad-spectrum immune response in the body. Thus, it has been stated that yoga programs can be beneficial in preventing and treating COVID-19 during the quarantine period by reducing the viral load with its anti-inflammatory effect during the pandemic.[16,17]

In this study, we aimed to investigate the effects of the YBE program, implemented within the Wellness in Health Program, on functional capacity, dyspnea, QoL, depression, anxiety, and sleep quality of healthcare professionals who have suffered from the COVID-19 infection and are currently practicing their profession.

PATIENTS AND METHODS

The prospective controlled study assessed for eligibility 60 patients who had positive polymerase chain reaction results for COVID-19 or were diagnosed with COVID-19 pneumonia by computed tomography at the Ankara Bilkent City Hospital between March 2021 and September 2021. The inclusion criteria were as follows: having completed their medical treatment, having an event duration of two to six months, having a stable health condition, having ongoing fatigue, dyspnea, decreased stamina, difficulty in activities of daily living, anxiety, or depression complaints, actively working, and being between 25 to 60 years of age, naive to yoga, meditation, or any mind-body intervention. Patients who were hemodynamically unstable, whose cardiac and pulmonary system stability could not be maintained, with rheumatic, neurological, and psychological disorders, and those who could not continue the program due to working conditions were excluded from the study. A total of 52 healthcare professionals who were diagnosed and recovered from the COVID-19 infection met the inclusion criteria and wanted to get involved in a tracking program were included in the study. Thirty participants were allocated to the YBE group (YBEG). Twenty-two health professionals who stated that they could not provide continuity due to personal causes and could not comply with the program consecutively for an eight-week period were determined as the nonintervention group (NIG). The NIG was not instructed to perform any exercises. However, four individuals from the YBEG and seven individuals from the NIG could not complete the study. Consequently, 41 COVID-19-infected healthcare professionals (35 females, 6 males; mean age: 39.7±6.5 years; range, 28 to 55 years) who were actively working during the subacute period were included in the final analyses. Patient allocation and drop outs were remarked at the study flowchart (Figure 1).

The Wellness in Health Program had begun in the first months of 2021 for the COVID-19-infected healthcare professionals at the Ankara Bilkent City Hospital Physical Medicine and Rehabilitation Hospital. The program was designed to eliminate the musculoskeletal and psychological distress observed

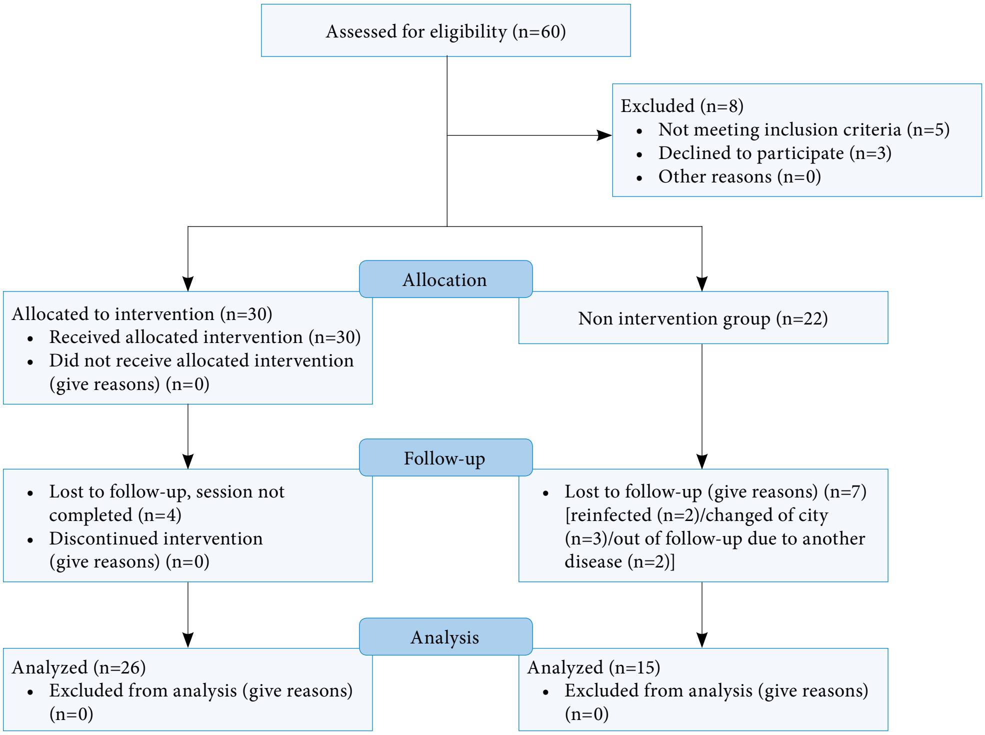

Figure 1. Study flowchart.

in healthcare professionals who have COVID-19, facilitate return to work, ensure the continuation of well-being, and increase body resistance. Program based on yoga exercises were tailored for the Wellness in Health Program, which was held at the Ankara Bilkent City Hospital Physical Medicine and Rehabilitation Hospital for the healthcare professionals committee (two physical medicine and rehabilitation specialist, one sports medicine specialist, and one yoga instructor). Exercises were based on three branches. The first one was the range of motion, isometric strengthening, and posture exercises, the second was breathing exercises, and the third was relaxation exercises. Exercises were selected to relieve the pain and blockage of the most stressful areas that patients complain about as the vertebral spine, shoulder girdle, hip, and thorax, normalize the breathing rhythm, and produce meditation. Exercises were administered by a yoga instructor under the supervision of a physical medicine and rehabilitation specialist for eight weeks, two sessions a week, and with sessions of 60 min, using personal mats and equipment in a 2475 m^3 (18×25×5.5 m) gym area that belonged to our hospital in the form of group therapy for five people and in accordance with the social distancing rules. The YBE program consists of physical postures (asanas) to improve the body's muscle strength and flexibility, breathing exercises (pranayama-asana with breathing exercises) to increase respiratory function, and relaxation and meditation (dhyana) techniques. The exercise program and its components are given in Table 1. The YBEG was monitored by the physical medicine and rehabilitation specialist during the session in terms of strain level and dyspnea perception.

The patients were questioned in terms of demographic, anthropometric, and disease-specific parameters. Their detailed musculoskeletal and neurological system examinations and flexibility tests were performed. Functional capacity, hand grip strength, depression, and anxiety level, QoL, sleep problems, and physical activity level was assessed. Flexibility tests were performed by the sports medicine specialist, and other assessments and tests were performed by physical medicine and rehabilitation specialists.

The back scratch test was used to assess upper body flexibility, and the lower body flexibility was evaluated by the sit and reach test. The hand grip strength measurement, which is one of the indirect measurement methods with the highest correlation of respiratory muscle strength of the patients, was calculated using a hand dynamometer (Baseline Hydraulic, White Plains, NY, USA).[18] The dominant hand was used in the

TABLE 1
The yoga-based exercises program

		Duration (min)
Pranayama	Calm breathing	3
	Balance breathing from right and left nostrils (nadi shodhana)	5
	Spine bending exercise with breathing	3
Sitting cross-legged*	Hand, arm, shoulder exercises in cross-legged sitting position (pavana muktasana)	5
	Neck relaxation exercises	2
Extending the legs*	Foot and ankle exercises (pavana muktasana)	5
	Seated twist (ardha matsyendrasana)	3
	Bending over legs (janu sirsasana)	3
Table pose*	Cat-cow (marjaryasana-bitilasana)	3
Lying face down*	Tiger breathing on the elbows (vyagrasana)	3
	Sphinx pose and breathing (salamba bhujangasana)	3
	Cobra (bhujangasana)	3
Lying on your back *	Half bridge (setubandhasana)	3
	Leg, shoulder relaxation exercise (pavana muktasana)	3
	Twist (bharadvajasana)	3
Meditation	Deep rest (savasana)	10

* Coordinated asana with breathing technique.

measurements, the measurement was repeated three times, and the average was calculated in kilograms. Functional capacity was evaluated with the 6-min walk test (6MWT), dyspnea severity during activity was evaluated by the modified Medical Research Council (mMRC) dyspnea scale, depression level was assessed by Beck Depression and Anxiety Inventory, the QoL was assessed by the Short Form 36 (SF-36) questionnaire, and sleep quality was analyzed with the Pittsburgh Sleep Quality Index (PSQI). In addition, using the International Physical Activity Questionnaire (IPAQ), the physical activity durations at different levels in the past week were recorded and converted to MET (metabolic equivalent) values.[19] Assessments and measurements of the anthropometric, clinical, and disease-specific parameters of all patients were recorded before and after eight weeks.

Statistical analysis

The power analysis was conducted by R version 3.0.1 software (R Foundation for Statistical Computing, Vienna, Austria). In a randomized controlled study conducted by Kaminsky et al.[20] in COPD patients, pranayama increased 6MWT by 26.0±18.2 meters at the end of week 12, compared to the 9±6.2 meters in the control group. Based on these results, a minimum sample size of at least 15 subjects, with a power of 80% and a type 1 error of 0.05, was calculated for our study.

Statistical analyses were performed using the IBM SPSS version 22.0 (IBM Corp., Armonk, NY, USA). The normality distribution analysis of the continuous variables was done using the Shapiro-Wilk test. Descriptive statistics of the continuous variables were given as mean ± standard deviation and median (interquartile range). Descriptive statistics for the categorical variables were given as the number of cases (n) and percentage (%). Repeated measurement analysis of variance (ANOVA) was performed for those who met the assumption of normal distribution; the Brunner-Langer F1-LD-F1 statistical method was performed for those who did not. In variables with significant interaction for between-group comparisons, the independent samples t-test was used if repeated measures ANOVA was performed, and if Brunner-Langer was performed, the Mann-Whitney U test was performed. For within-group comparisons, the paired two-sample t-test was used if repeated measures ANOVA was performed, and the Wilcoxon signed-rank test was performed if Brunner-Langer was performed. In variables with nonsignificant interaction, the *p* values obtained for the group and time (within-group) as a result of the analysis (Brunner-Langer or repeated measures ANOVA) were interpreted. A p-value <0.05 was considered statistically significant.

RESULTS

The demographic and clinical characteristics of the patients are given in Table 2. According to the repeated measures ANOVA test of parametric variables, the mean values of the parameters with

TABLE 2
Demographic and clinical characteristics of the patients

	Yoga group (n=26)			Control group (n=15)			
Variables	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			40.58±6.9			38.4±5.92	0.313
Sex							0.460
Male	3	11.5		3	20		
Female	23	88.5		12	80		
Marital status							0.558
Married	24	92.3		13	86.7		
Single	2	7.7		2	13.3		
Educational level							0.441
Associate	6	23.1		2	13.3		
Undergraduate	10	38.5		7	46.7		
Graduate	7	26.9		2	13.3		
Postgraduate	3	11.5		4	26.7		
Smoking status							0.393
Non-smoker	17	65.4		11	73.3		
Smoker	6	23.1		4	26.7		
Quit	3	11.5		-	-		
Pneumonia							0.138
Yes	9	34.6		2	13.3		
No	17	65.3		13	86.7		
Hospitalization	6	23.1		1	14.3		0.179

SD: Standard deviation.

significant group × time interaction are shown in Table 3. The mean values of the parameters with nonsignificant group × time interaction according to the repeated measures ANOVA of parametric variables are presented in Table 4. The median values of the parameters with significant group × time interaction according to the Brunner-Langer test of the nonparametric variables are given in Table 5. Finally, the median values of the parameters with insignificant group × time interactions according to the Brunner-Langer test of the nonparametric variables are demonstrated in Table 6.

In the flexibility tests, a statistically significant improvement was observed for the YBEG in the intergroup assessment with the right back scratch and sit and reach tests (p<0.05), whereas no significant difference was observed in the between-group comparison (p>0.05, Table 5). The change in the left back strach test scores of the YBE and control groups over time was statistically significant (p=0.001). The difference between groups was not statistically significant (p=0.969, Table 6).

A statistically significant improvement was observed for YBEG in the within-group assessment with the hand grip strength test (p<0.05), whereas no significant difference was observed in the between-group comparison (p>0.05, Table 5).

In both groups, within-group analysis showed a statistically significant improvement in the 6MWT (p<0.05). When evaluated between groups, no significant difference was found (p>0.05). The mean difference and standard deviation between the initial and final values of patients' 6MWT results were 56.57±33.15 m (range, 0 to 114 m) in the YBEG and 11.26±9.39 m (range, -5 to 24 m) in the NIG (Table 3). The mean of 6MWT results of YBEG was above 25 m, which was considered a significant difference.[21]

A statistically significant improvement was observed in the perception of dyspnea for the YBEG in the intergroup assessment with mMRC (p<0.05), while no significant difference was observed in the between-group comparison (p>0.05, Table 5).

In the IPAQ within-group evaluation, a statistically significant improvement was observed in the YBEG, and a significant difference was found in the comparison between groups (p<0.05). The mean difference and standard deviation between

TABLE 3
Comparison according to the repeated measures ANOVA of parametric variables; the parameters with significant group × time interaction

	Yoga group	Control group	Independent samples t test
	Mean±SD	Mean±SD	*p*
Six-minute walk test (m)			
Before	430.12±42.6	469±38.75	0.006
After	485.53±35.77	480.2±36.59	0.578
Paired samples t test, *p* value	**0.001**	**0.001**	
IPAQ (met-min/week)			
Before	575.4±271.3	728.8±218.99	0.070
After	1518±655.18	814.73±198.79	**0.001**
Paired samples t test, *p* value	**<0.001**	0.065	
Beck's anxiety			
Before	16.15±7.23	10±3.76	0.001
After	13.57±6.04	10.46±3.35	**0.041**
Paired samples t test, *p* value	**0.015**	0.472	
General health			
Before	48.84±15.25	59.66±10.6	0.020
After	55.38±18.05	56.66±9.57	0.768
Paired samples t test, *p* value	**0.024**	0.189	
Vitality			
Before	38.84±18.67	50.0±11.49	0.043
After	49.61±17.14	49.0±10.55	0.888
Paired samples t test, *p* value	**0.002**	0.619	

ANOVA: Analysis of variance; SD: Standard deviation; IPAQ: International Physical Activity Questionnaire; This table represents the comparison of the before-after differences between and within groups.

the initial and final values of patients' IPAQ results were 942.9±538.6 MET-min/week in the YBEG and 85.9±166.1 MET-min/week in the NIG (Table 3).

There was a statistically significant change in Beck depression scores with time (p<0.05); however, the difference between the groups was nonsignificant (p>0.05). The mean change between the initial and final values of patients' Beck depression results was -1.92±2.91 in the YBEG and -0.20±2.04 in the NIG (Table 4).

In the Beck anxiety score intergroup evaluation, statistically significant improvement was observed in the YBEG, and a significant difference was found in the comparison between groups (p<0.05). The mean difference between the initial and final values of patients' Beck anxiety results were -2.57±0.46 in the YBEG and 0.46±2.44 in the NIG (Table 3).

The PSQI scores for group × time interaction were nonsignificant. The change in time for PSQI scores was not statistically significant (p>0.05), but the differences between the groups were significant (p<0.05; Table 4).

In the general health and vitality subparameters of SF-36, a significant improvement was observed in the YBEG, while no significant difference was observed when comparing the groups (Table 3). The mean difference between the initial and final values of patients' general health results was 6.53±13.8 in the YBEG and -3.0±8.40 in the NIG; vitality results were 10.76±16.10 in the YBEG and -1.0±7.60 in the NIG. The change in mental health with time was nonsignificant in the YBEG, and the difference between groups was nonsignificant (Table 4). The change in physical function with time was significant in the YBEG, and the difference between groups was nonsignificant. (Table 4). The mean difference between the initial and final values of patients' physical function results was 10.76±17.87 in the YBEG and 3.33±10.11 in the NIG. The pain was observed that the change in time was

TABLE 4
Comparison according to the repeated measures ANOVA of parametric variables; the parameters with nonsignificant group × time interaction

	Yoga group	Control group	Interaction	Time	Group
	Mean±SD	Mean±SD	*p*	*p*	*p*
Beck's depression					
Before	12.19±6.42	10.06±3.36	0.0504	**0.017**	0.456
After	10.26±6.03	9.86±2.92			
PSQL					
Before	11.76±3.29	9.86±2.94	0.642	0.054	**0.049**
After	10.69±2.72	9.2±2.45			
Physical function					
Before	58.07±18.55	65±8.23	0.148	**0.008**	0.509
After	68.84±20.79	68.33±10.46			
Pain					
Before	60.48±19.37	53.5±19.08	0.067	**<0.001**	**0.028**
After	77.79±16.23	60.66±19.19			
Mental health					
Before	61.38±15.91	66.13±12.63	0.053	0.168	0.708
After	66.76±13.7	65.2±11.35			

ANOVA: Analysis of variance; SD: Standard deviation; PSQL: Pittsburgh Sleep Quality Index.

TABLE 5
Comparison according to the Brunner-Langer test of nonparametric variables; the parameters with significant group × time interaction

	Yoga group		Control group		
	Median	Q1-Q3	Median	Q1-Q3	*p*
Right back scratch test (cm)					
Before	-6	-10.25/0	-5	-7/0	0.226
After	-2	-9/1	-2	-6/1	0.796
Wilcoxon test, *p* value	**<0.001**		0.150		
Sit and reach test (cm)					
Before	4	-6.5/10	3	-5/6	0.481
After	8.5	-1.25/12.75	4	-4/8	0.058
Wilcoxon test, *p* value	**<0.001**		0.084		
Hand grip test (kg)					
Before	24.25	20-27.8	24.6	21-31.6	0.456
After	27.0	22-30.07	24.3	22.3-32.0	0.713
Wilcoxon test, *p* value	**<0.001**		0.232		
Physical role restriction					
Before	50	25-75	75	50-100	0.002
After	75	25-100	75	50-75	0.694
Wilcoxon test, *p* value	**0.005**		0.655		
Emotional role restriction					
Before	33.3	0-66.6	100	66.6-100	0.001
After	66.6	33.3-100	66.6	66.6-100	0.129
Wilcoxon test, *p* value	**0.027**		0.579		
mMRC dyspnea					
Before	2	2-3	2	1-2	0.005
After	1	1-2	2	1-2	0.354
Wilcoxon test, *p* value	**<0.001**		0.480		

Q: Quartile; mMRC: Modified medical research council dyspnea; This table represents the comparison of the before-after differences between and within groups.

TABLE 6
Comparison according to the Brunner-Langer test of nonparametric variables; the parameters with nonsignificant group × time interaction

	Yoga group		Control group		Interaction	Time	Group
	Median	Q1-Q3	Median	Q1-Q3	*p*	*p*	*p*
Left back scratch test (cm)							
Before	0	-6/0	-2	-5/0	0.084	**0.001**	0.969
After	0	-6 /2	0	-5/1			
Social functioning							
Before	62.5	37.5- 75	62.5	50-87.5	0.985	**0.001**	**0.044**
After	75	50-75	75	62.5-100			

Q: Quartile.

significant, and the difference between groups was significant ($p<0.05$). The mean difference between the initial and final values of patients' pain results was 17.31±19.1 in the YBEG and 7.16±10.8 in the NIG (Table 4). The change in social functioning with time was significant in the YBEG, and the difference between groups was significant ($p<0.05$, Table 6). In physical role restriction and emotional role restriction, a significant improvement was observed in the YBEG, while no significant difference was observed when comparing the groups (Table 5).

DISCUSSION

As in the rest of the world, healthcare professionals who were at the forefront in Türkiye were among the working group with the highest exposure to COVID-19. In the present study, we investigated the effectiveness of YBEs in healthcare professionals who had COVID-19 and ongoing deterioration of physical performance after returning to work, decrease in activities of daily living, and psychosocial complaints. A YBE program consisting of range of motion, isometric strengthening, posture, and breathing exercises and meditation was given to the YBEG, and there were significant improvements in muscle strength, flexibility, functional capacity, physical activity level, QoL, anxiety, and depression levels, as well as improvements in sleep scores. When both groups were analyzed, improvement was observed in all parameters during the eight-week follow-up period, while the gains achieved in YBEG were statistically significant.

Yoga is a form of treatment method performed in coordination with breathing exercises and meditation that is known to be useful in increasing exercise capacity and QoL. It has been performed for 5,000 years and administered in the context of evidence-based medicine in Western medicine in recent years. There are also studies suggesting yoga's potential supportive response role in disaster settings.[22] The COVID-19 pandemic may be considered one of the latest disasters experienced by today's world. In the present study, we aimed to examine the supportive role of yoga programs during disaster periods and their effects observed in patients who were in active healthcare from the perspective of the COVID-19 pandemic. In the study of Nagarathna et al.,[23] in which the physical health, mental health, lifestyle, and coping skills of individuals during the COVID-19 quarantine were evaluated, it has been reported that significant successful results have been noted in those who actively practiced yoga compared to those who did not. Kanchibhotla et al.[24] reported that during the COVID-19 pandemic, stress, anxiety, and depression among healthcare professionals were reduced with yoga breathing techniques and meditation that were performed as a home program through online training. Similar results were reported with online and multimedia yoga interventions in another study.[25] As mentioned, fear, depression, and anxiety in healthcare professionals, who are the most exposed occupational group to COVID-19, encounter a decrease in functional capacity, performance of working life and QoL, and motivation.[5] According to the results of this present study, it may be beneficial for healthcare professionals to include YBEs, which have supportive aspects that have been observed in all these features, in the invigorating process due to all these constructive features.

Coronavirus disease 2019, which usually affects the musculoskeletal system, often exhibits a decline in muscle strength and physical performance and a deterioration in biometric measurements.[26] At the end of the program, the patients who were in the NIG had significant deterioration in anthropometric measurements, such as shoulder flexibility, sit and reach test, and hand grip strength, compared to the YBEG. The slight improvement in the mentioned parameters at the NIG might be related to the spontaneous healing process of the infection. Petric et al.[27] reported that they observed significant biometric changes in shoulder extension and hamstring flexibility tests in their two sessions per week, a five-week-long flexibility study performed on nine healthy women. In their eight-week yoga program, Raj et al.[28] measured physical performance and flexibility with the hamstring tension and sprint speed of male Rugby players during 35-min sessions performed twice a week, and Amin and Goodman[29] conducted a six-week Iyengar yoga program that consisted of 190-min sessions performed once a week. Both studies had results similar to those in the present study.

Hand grip strength, which is a biometric measurement, is an important indicator of peripheral muscle strength and an indirect indicator of the strength of the respiratory muscles.[18] In the study of Thangavel et al.,[30] an increase in hand grip strength was observed in healthy volunteers who practiced yoga exercises compared to the control group. In the measurements made by Madanmohan et al.[31] in healthy volunteers after 12 weeks of yoga training, a 21% increase in grip strength was observed in the measurements made using a hand dynamometer. In the present study, the 11% increase observed in the dominant hand grip strength measurements in the YBEG directly supports the increase in peripheral muscle strength achieved by yoga exercises. It is obvious that the YBEG has higher gains than the NIG on hand grip strength. Nevertheless, it is hard to talk about the direct evidence of the measurement of respiratory muscle strength. We could not measure by spirometry or by mouth pressure methods due to the strict contamination restrictions.

From the perspective of functional capacity, the positive effect of yoga has been proven by many studies.[12,13] Thokchom et al.[32] conducted a study with COPD patients and described an improvement in the respiratory muscle parameters, pulmonary function test parameters, 6MWT, and dyspnea-related parameters. They have stated that the combined use of asana (postures) and pranayama (breathing exercises with asanas) provides an increase in muscle flexibility, strength, and aerobic tolerance, as well as an increase in the static and dynamic strength of the body. In the present study, the 6MWT, which we used for the evaluation of functional capacity, was significantly lower compared to the expected values in all patients before the program. The significant improvement in mMRC values and the walking distance at the 6MWT after the YBE program compared to the NIG supported the facilitated recovery of cardiorespiratory capacity and regulated the coordination of the inspiratory and expiratory muscles. In addition, the mMRC values and the 6MWT improvements and improvement in hand grip strength might reflect the improvement of inspiratory and expiratory respiratory muscle strength. In the study of Pooja et al.,[33] an increase in IPAQ levels of physical activity was observed in healthy volunteers who practiced yoga exercises compared to the control group. These results are similar to our study.

The positive effects of yoga programs on anxiety, depression, and the perception of QoL are known and have been studied in many diseases.[5,6] In a randomized controlled study conducted on COPD, the most frequently studied pulmonary disease group, it was found that there was a significant improvement in depression and anxiety scales with a 12-week yoga program.[34] In addition, online applications began to proliferate since the COVID-19 pandemic, which caused a sizeable working population to shift to work from home, bringing on additional challenges and increasing work-related stress. In a six-week pilot study evaluating these online processes, it was reported that there were significant improvements in terms of perceived stress, mental health, depression, and coping self-efficacy in the yoga group compared to the control group.[35]

In the last two years, it has been emphasized in many studies that significant anxiety, depression, and anxiety disorders have been observed in patients and healthcare professionals, as well as healthy people, during the pandemic process.[5,6] We believe that the supportive effect of yoga on all these psychological components will help patients successfully cope with the psychological stress they face during the pandemic. With our YBE program, which includes perceived stress, relaxation, and awareness techniques, our patients' depression and anxiety levels decreased and their QoL improved compared to before the program. The feeling of loneliness could decrease during face-to-face group exercises. The improvement observed in these parameters may be particularly due to the biochemical changes by increasing multiple neurotransmitters and hormones, such as GABA, serotonin, and dopamine.[36]

In studies analyzing the effect of yoga on sleep, it has been reported to decrease sleep-onset latency, increase sleep quality, and have a potentiating effect on melatonin.[37,38] In Özer et al.'s[39] study consisting of 60 patients with chronic respiratory disease, an increase in sleep quality and a decrease in fatigue symptoms were reported in the yoga group compared to the control group. These results are similar to our study.

There are some limitations to this study. This study took place in the peak period of the second wave among health professionals, which was an enormous obscurity period. Although physical hardship and mental fatigue were the main obstacles during this period, the high work pace, prejudice against yoga, and fear of reinfection resulted in constraints for the sample group to participate in the study period. The strengths of the present study are its prospective controlled design, the study being conducted in a face-to-face environment in an extended place designed for sports, and the ability to practice for eight weeks in the form of group therapy under the supervision of a doctor and accompaniment of a yoga instructor. This is the first known YBE study conducted during the COVID-19 pandemic evaluating the effect on musculoskeletal parameters, functional capacity, dyspnea, QoL, depression, anxiety, and sleep quality in a comprehensive manner.

In conclusion, the present study emphasizes that YBEs could be an effective, reliable, and complementary treatment option in the post-COVID-19 period. In light of these findings, face-to-face exercise programs that include yoga, coordinated breathing exercises, and meditative approaches for the cardiopulmonary, physical, and psychological dysfunctions that develop after COVID-19, with the allocation of sufficient time, provide an increase in the functional capacity, physical activity level, and QoL of health professionals and reduce depression and anxiety. Therefore, we emphasize that the positive effects of YBE programs in the treatment process should be considered and tailored.

Acknowledgments: We would like to express our gratitude to all hardworking Turkish healthcare professionals with admirable sacrifice and patience in fighting COVID-19 pandemia.

Ethics Committee Approval: The study protocol was approved by the Ankara City Hospital Clinical Research Ethics Committee (date: 24.02.2021, no: E2-2021-156). The study was conducted by the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Methodology, conceptualization, writing-original draft, reviewing and editing: R.Ö.; Conceptualization, supervision, writing-reviewing, validation: N.K.O.G.; Methodology, data curation, data visualization: B.U.; Intervention: S.K.; Resources: E.Y.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

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