**Original Article**

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TANAFFOS

# Effect of Breathing Exercises on Quality of Life and Fatigue in Patients with COVID-19: A Randomized Controlled Trial Study

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**Background:** COVID-19 survivors face the risk of long-term COVID-19 complications, including fatigue and a reduction in quality of life. Breathing exercises can improve the manifestation of patients with respiratory diseases. Therefore, this study aimed to investigate the effect of breathing exercises on quality of life and fatigue in patients with COVID-19.

**Materials and Methods:** A randomized controlled trial was conducted with 72 patients who had recovered from the hospital in Tehran. Patients were divided into intervention and control groups using block randomization. Patients in the intervention group received breathing exercise training, including diaphragmatic and pursed-lip breathing, and the control group did not receive any educational program. The socio-demographic form, quality-of-life questionnaire, and fatigue severity scale were used to collect data. Data were collected by two groups before and after 6 weeks and analyzed using descriptive and inferential statistics in SPSS V20 at a significance level of $P<0.05$.

**Results:** There was no statistically significant difference in mean quality-of-life scores between the two groups (P=0.49) and in fatigue severity (P=0.75) before the intervention. After breathing exercises, the mean scores for fatigue (20.30±1.48 vs. 21.91±1.79) and quality of life (70.80±7.40 vs. 22.32±6.33) were significantly higher in the intervention group than in the control group.

**Conclusion:** The current study indicates that breathing exercises can reduce COVID-19 complications, including fatigue, and improve the quality of life of patients recovered from COVID-19. It is suggested that health policymakers consider incorporating breathing exercises into a conventional educational program for the home care of patients with COVID-19.

**Keywords:** Breathing Exercises; Quality of Life; Fatigue; COVID-19

## INTRODUCTION

The coronavirus disease 2019 (COVID-19), declared a global pandemic by the World Health Organization (WHO) on January 30, 2020, has had a profound global impact (1). As of April 2024, over 704 million cases of COVID-19 have been reported, and Iran is one of the most affected countries (2). In addition to the acute health effects of the disease, many patients experience long-term symptoms even after recovery, known as long-term COVID-19 complications (3, 4). According to CDC reports, potential long-term COVID-19 complications include fatigue, dyspnea, chest pain, headache, and other symptoms (5), and experiencing these complications

will affect the quality of life (QoL) of patients with COVID-19 (6).

QoL is a broad, multidimensional concept encompassing physical, mental, emotional, and social well-being (7) and refers to an individual's perception of their position in life within their cultural and social context, according to WHO reports (8, 9). Many COVID-19 survivors report ongoing symptoms, such as fatigue and dyspnea, even up to 110 days after discharge, leading to a significant reduction in their QoL (10). Fatigue is one of the most commonly reported symptoms and is often caused by factors such as inflammation, mitochondrial dysfunction, sleep disturbances, nervous system abnormalities, and respiratory complications, including lung damage and dyspnea (11). Based on recent research, dyspnea causes fatigue and decreased QoL and daily activity in these patients (12, 13), and rehabilitation programs are needed to address these effects (14).

As the number of COVID-19 survivors continues to rise, effective interventions are essential to address the long-term symptoms that they face (15, 16). Pulmonary rehabilitation, which includes breathing exercises (BEs) such as diaphragmatic breathing and pursed-lip breathing (PLB), is effective in reducing fatigue, improving respiratory function, and enhancing overall health-related QoL (12,17-19). PLB and diaphragmatic breathing are BEs that can improve dyspnea and breathing patterns, release trapped air in the lungs, promote general relaxation, keep airways open longer, and prolong exhalation (20-22). Therefore, nurses play a vital role in patient education on self-management, symptom monitoring, breathing exercises, and rehabilitation (23), and they can significantly reduce complications, improve patient recovery outcomes, and enhance patients' independence from healthcare professionals (24, 25). Therefore, given that COVID-19 can lead to fatigue and respiratory problems in patients and that educational interventions can be helpful for these people, this study aimed to investigate the effect of BEs on QoL and fatigue in patients with COVID-19.

## MATERIALS AND METHODS

### Design, population, and setting of the study

This randomized controlled trial enrolled ICU-hospitalized patients with clinically confirmed COVID-19 admitted to Imam Khomeini Hospital, the national university-based referral center in Tehran, between January 2021 and August 2021. Patient randomization was performed using a central computer system, and 84 eligible patients were assigned to two equal groups.

### Characteristics of participants

The patients were enrolled in the study according to the following inclusion criteria: confirmed COVID-19 disease by nasal swab sampling, age range from 18 to 60 years, having respiratory symptoms with radiological manifestations such as unilateral or bilateral multilobar infiltration on CT scan or chest radiography, having symptoms of fatigue associated with COVID-19 two weeks after discharge from the hospital, having a smartphone and the ability to use it. Patients who were unwilling to continue attending the study or did not perform breathing exercises for more than three consecutive days or four alternating days and who were readmitted to the hospital or died were excluded from the study.

At first, informed written consent was obtained from enrolled participants. Then, participants were allocated to two intervention and control groups using a random block allocation method with a computer and the website www.random.org in a 1:1 ratio. Next, the generated numbers were placed in dark envelopes to keep the participants blind to the allocation. The intervention and control groups were represented by A and B, respectively.

### Sample size

Given an effect size of 0.84 from a previous study (26), the first- and second-type error probabilities were set at 5% and 10%, respectively. The sample size calculation, based on G*Power software, was 31 patients per group. Due to the possibility of the sample falling, 20% was added to the sample size, and finally, 36 people were considered in each group (Figure 1).

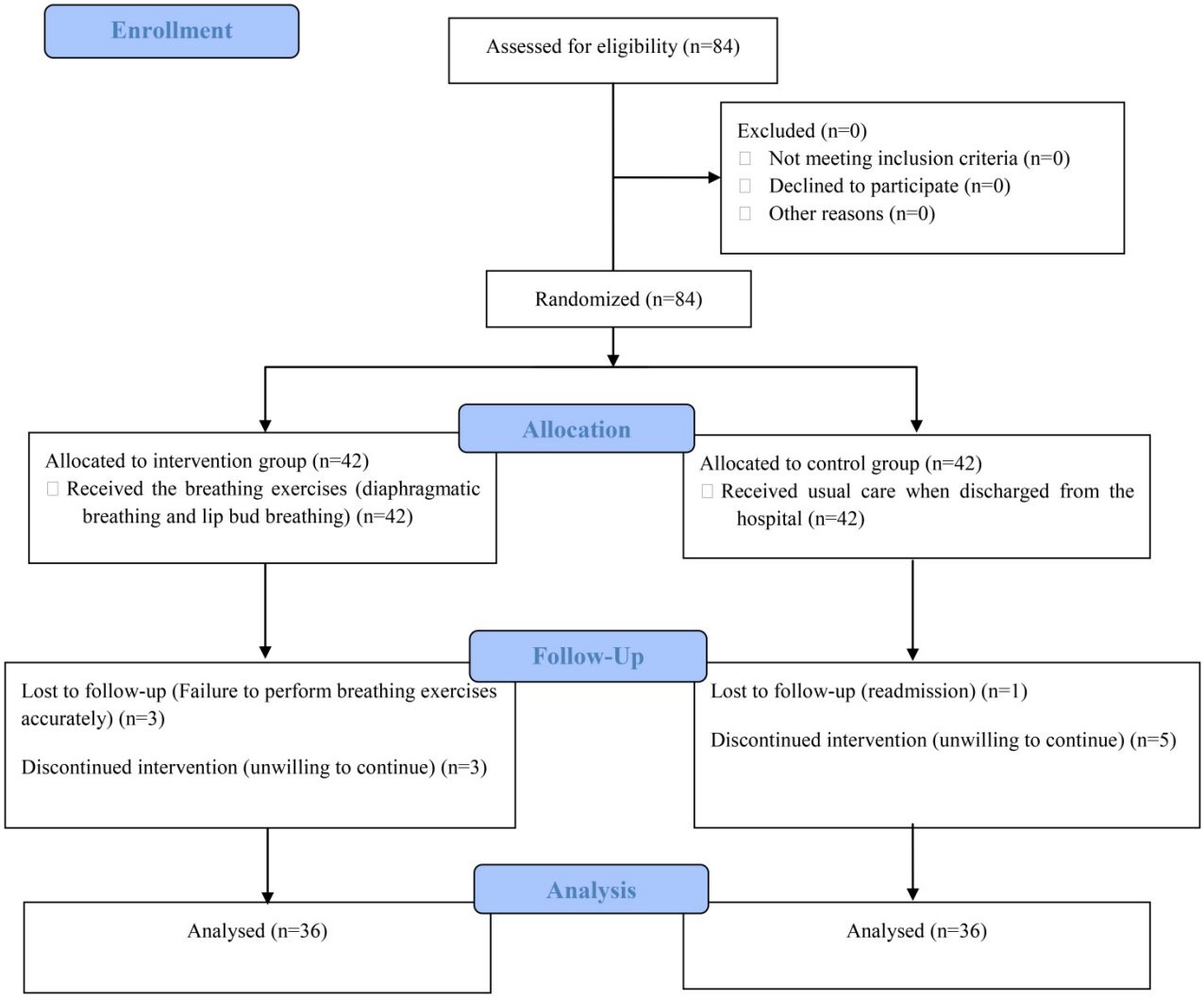



**Figure 1.** CONSORT (Consolidated Standards of Reporting Trials) diagram

## Data collection instruments

After obtaining permission from Imam Khomeini Hospital to access medical records, patients who met the inclusion criteria were identified, and their phone numbers were recorded. Notably, due to the lack of face-to-face contact during the COVID-19 era and the long distances from patients to the hospital, including those living in other cities, we had no time limit on phone calls, and calls continued until the research team completed the questionnaires. At the beginning of the intervention, the socio-demographic data of the patients were collected via telephone using the Socio-demographic characteristics form, and the 36-item Short-Form survey questionnaire and Fatigue severity scale were provided to the patients via WhatsApp. The following tools were used to collect the required information:

### *Socio-demographic characteristics form*

This researcher-developed form included variables such as participants' age, gender, marital status, economic status, employment status, education level, history of underlying disease, physical symptoms, oxygen therapy, length of hospitalization, and blood oxygen saturation ($SpO_2$).

### *36-Item Short-Form survey questionnaire (SF-36)*

To assess QoL, the 36-item Short-Form survey questionnaire (SF-36), originally developed by Ware and

Sherbourne in 1992 in the United States, was used (27). In Iran, Montazeri et al. found that the Persian version of the SF-36 scales had minimum standard reliability coefficients (Cronbach's alpha in the range of 0.77-0.90), and their validity (correlation coefficients in the range of 0.58-0.95) was obtained (28).

#### *Fatigue severity scale (FSS)*

The FSS fatigue severity scale includes nine questions. Each question has a score of 0 to 7. A score of 0 means the person completely agrees, and a score of 7 means the person completely disagrees. The total score is obtained by summing the scores, and if it is 36 or higher, the person is considered to be suffering from fatigue. The higher the score, the greater a person's fatigue intensity. It is a valid self-report scale that was designed by Krupp in 1989 (29). The validity and reliability of the Persian version of this scale have been tested and confirmed (30). In Iran, Shahvarughi Farahani et al. reported a reliability of r=0.96 from retesting, and Zakerimoghadam et al. reported a reliability of 0.91 using Cronbach's alpha (31, 32).

### Intervention group

The electronic booklet and the weekly checklist of breathing exercises were sent to the intervention group via WhatsApp. The electronic training booklet included explanations and pictures on how to perform breathing exercises (diaphragmatic breathing and Pursed-Lip breathing), was prepared from reliable scientific sources, and its content validity was confirmed by professors and experts. The steps for performing breathing exercises were outlined in the breathing exercises checklist, which included 5 to 10 Pursed-lips breathing and diaphragmatic breathing, to be performed 5 to 15 times per session at home, twice a day (morning and evening), for 42 consecutive days. In addition to providing educational content to the intervention group, breathing exercises were followed up on weekly via patient contact for 6 weeks. To verify proper performance of the breathing exercises, the intervention group was contacted twice a week during the first 4 weeks and once a week during the last 2 weeks. Each conversation lasted 10-15 minutes, and the content included an introduction, a review of the patient's general health, and encouragement to follow the recommendations. At the end of each week, the self-reported breathing exercises checklist, which listed the stages of the exercises, was collected from the samples. Finally, both groups completed the SF-36 questionnaire and the FSS scale at the end of the 6-week intervention.

### Control group

The control group did not receive any educational content and received only usual care upon discharge from the hospital.

### Ethical considerations

This scientific research study has been approved by the Ethics Committee of Tehran University of Medical Sciences with the code number IR.TUMS.FNM.REC.1400.088 on July 27, 2021. All procedures performed in studies involving human participants were in accordance with the guidelines of the national/institutional research committee and the Declaration of Helsinki. Iranian Registry of Clinical Trials approved the research project before we commenced data collection (Ethics approval code: IRCT20210717051910N1). Other ethical considerations include research objectives, voluntary participation, methods of study implementation, obtaining informed written consent, providing the right to withdraw from participation at any time, ensuring data confidentiality, and providing results upon request. All participants provided informed written consent.

### Statistical analysis

Data analysis was done with "IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp." using descriptive (Frequency, Mean, and Standard Deviation) and inferential statistics (Independent *t*-test, Paired *t*-test, Chi-square, and Analysis of Covariance) with a 95% confidence interval at a significance level of $P<0.05$.

## RESULTS

### Baseline characteristics

There were no significant differences between the intervention and control groups in terms of socio-demographic and clinical characteristics (P>0.05). The mean age of participants was similar in both groups (47.50

years in the intervention group vs. 47.97 years in the control group, *P*=0.88). Most participants were male (55.6% in both groups), with the majority holding a high school diploma (44.4% in the intervention group vs. 41.7% in the control group). A higher proportion of participants in the intervention group were employed (50% vs. 38.9%). The socio-demographic and clinical characteristics of patients with COVID-19 in both intervention and control groups are presented in Table 1.

## Main outcomes

Before the intervention, there were no significant differences between the groups in physical or mental health scores (*P*=0.89 and *P*=0.31, respectively). However, after the BEs, the intervention group showed significantly higher scores in both physical (68.22 vs. 25.65, *P*<0.001) and mental health dimensions (73.38 vs. 18.98, *P*<0.001). ANCOVA results confirmed that the intervention group had a significant improvement in overall QoL scores compared to the control group (*P*<0.001). The intervention group's mean QoL score after the intervention was 70.80, significantly higher than the control group's score of 22.32 (*P*<0.001), with a large effect size (0.892) (Table 2).

Also, the results showed no statistically significant difference in mean fatigue severity between the two groups before the intervention (*P*=0.75). However, after the BEs, fatigue severity significantly decreased in the intervention group (*P*<0.001), while no such change was observed in the control group. The effect size for the improvement in fatigue severity in the intervention group was 0.206. A comparison of changes in fatigue severity scores before and after the intervention showed a significant difference between the two groups (*P*=0.001) (Table 3).

**Table 1.** Socio-demographic and clinical characteristics of patients with COVID-19 in two intervention and control groups

| Socio-demographic | Intervention group n=36 | | Control group n=36 | | *P*-value |
|---|---|---|---|---|---|
| | Number (n) | Percent (%) | Number (n) | Percent (%) | |
| **Gender** | | | | | 1[a] |
| Male | 20 | 55.6 | 20 | 55.6 | |
| Female | 16 | 44.4 | 16 | 44.4 | |
| **Marital status** | | | | | 0.23[a] |
| Single | 7 | 19.4 | 6 | 16.7 | |
| Married | 28 | 77.8 | 25 | 69.4 | |
| Widow | 1 | 2.8 | 5 | 13.9 | |
| **Education** | | | | | 0.51[a] |
| High school | 13 | 36.1 | 10 | 27.8 | |
| High school diploma | 16 | 44.4 | 15 | 41.7 | |
| University degree | 7 | 19.4 | 11 | 30.6 | |
| **Employment status** | | | | | 0.24[a] |
| Employee | 14 | 38.9 | 18 | 50 | |
| Housewife | 14 | 38.9 | 15 | 41.7 | |
| Retried | 8 | 22.2 | 3 | 8.3 | |
| **Underlying disease** | | | | | 0.804[a] |
| Yes | 24 | 66.7 | 23 | 63.9 | |
| No | 12 | 33.3 | 13 | 36.1 | |
| **Physical symptoms** | | | | | 0.24[a] |
| fatigue | 6 | 16.7 | 3 | 8.3 | |
| dyspnea | 6 | 16.7 | 13 | 33.3 | |
| Decreased smell | 9 | 25 | 5 | 13.9 | |
| Other | 15 | 41.6 | 16 | 44.4 | |
| **Oxygen therapy** | | | | | 0.307[a] |
| Simple mask | 19 | 52.8 | 22 | 61.1 | |
| Reservoir bag mask | 8 | 22.2 | 10 | 27.8 | |
| Nasal cannula | 9 | 25 | 4 | 11.1 | |
| **Age (years) Mean ± SD** | 47.50±13.13 | | 47.97±13.21 | | 0.88[b] |
| **Hospitalization period (days) Mean ± SD** | 11.28±3.94 | | 9.78±2.62 | | 0.062[b] |
| **$SPO_2$ (%) Mean ± SD** | 94.44±1.40 | | 94.78±1.07 | | 0.261[b] |

a: Chi-square test; b: Independent *t*-test

**Table 2.** Mean quality of life (physical and mental health) scales in two intervention and control groups

| Variables | Group | Before intervention Mean± SD | After the intervention Mean± SD | Mean difference | Intergroup statistical estimation |
|---|---|---|---|---|---|
| Quality of life | Intervention | 19.74±7.55 | 70.80±7.40 | -51.05 | $t^a = -30.32$ P<0.001 |
| | Control | 20.77±4.98 | 22.32±6.33 | -1.54 | $t^a = -1.29$ P=0.20 |
| | Intergroup estimation at each stage | $t^b = -0.68$ P=0.49 | $F^c = 893.40$ P<0.001 Partial Eta Squared = 0.928 | $t^b = -23.96$ P<0.001 | - |
| Physical health | Intervention | 24.23±9.28 | 68.22±10.65 | -43.99 | $t^a = -18.01$ P<0.001 |
| | Control | 23.97±7.56 | 25.65±9.53 | -1.68 | $t^a = -0.95$ P=0.348 |
| | Intergroup estimation at each stage | $t^b = 0.13$ P=0.89 | $F^c = 315.14$ P<0.001 Partial Eta Squared = 0.820 | $t^b = -140.02$ P<0.001 | - |
| Mental health | Intervention | 15.26±10.61 | 73.38±10.38 | -58.12 | $t^a$ = -24.40 P<0.001 |
| | Control | 17.57±8.81 | 18.98±9.14 | -1.40 | $t^a = -0.76$ P=0.44 |
| | Intergroup estimation at each stage | $t^b = -1.01$ P= 0.31 | $F^c = 559.64$ P<0.001 Partial Eta Squared = 0.890 | $t^b = -18.85$ P<0.001 | - |

a: Paired t-test, b: Independent t-test, c: Analysis of covariance test

**Table 3.** Mean fatigue severity in the two intervention and control groups

| | Group | Before intervention Mean± SD | After the intervention Mean± SD | Mean difference | Intergroup statistical estimation |
|---|---|---|---|---|---|
| Fatigue severity | Intervention | 1.80±21.30 | 1.48±20.30 | 1 | $t^a = 3.70$ P=0.001 |
| | Control | 1.18±21.41 | 1.79±21.91 | -0.50 | $t^a = -1.45$ P=0.15 |
| | Intergroup estimation at each age | $t^b = -0.31$ P= 0.75 | $F^c = 17.928$ P<0.001 Partial Eta Squared = 0.206 | $t^b = 3.43$ P<0.001 | - |

a: Paired t-test, b: Independent t-test, c: Analysis of covariance test

## DISCUSSION

The present study investigated COVID-19 patients referred to Imam Khomeini Hospital in Tehran to determine the effect of BEs on QoL and fatigue.

Based on the findings of the present study, BEs had a positive effect on QoL and its subscales, including physical and mental health, in patients with COVID-19. Our results align with those of Öner Cengiz et al., who demonstrated that BEs could improve QoL in COVID-19 patients by enhancing $SpO_2$ and reducing respiratory rate (RR) (12). Similarly, Johnson and Mathews found that aerobic exercise was beneficial in improving QoL in post-COVID-19 patients by relieving symptoms, improving pulmonary function, and enhancing overall well-being. This supports the idea that interventions targeting respiratory health can significantly improve QoL (33). Our results showed that after the BEs, the intervention group had significantly higher scores on both physical and mental health dimensions. In patients recovering from COVID-19, mental health challenges often accompany physical symptoms, affecting overall QoL. In line with our studies, Ahmed et al. (2021) suggested that aerobic exercise improves both the physical and mental dimensions of QoL, which may be attributable to the psychological impact of COVID-19, including fear, isolation, and reduced social contact. This resonates with previous studies that have highlighted the

mental health challenges faced by post-COVID-19 patients (34, 35). In non-COVID-19 patients, BEs have also been shown to enhance QoL in those with respiratory conditions. Li et al. demonstrated that BEs could improve the QoL of patients with chronic obstructive pulmonary disease (COPD) by improving lung function (36). Similarly, a network meta-analysis by Cai et al. showed that specific BEs, such as diaphragmatic and pursed-lip breathing, increased inspiratory muscle strength and enhanced QoL in patients with COPD. These findings reinforce the therapeutic potential of BEs in respiratory conditions (37).

Our study also revealed a significant reduction in fatigue intensity in the intervention group after performing BEs. This result is consistent with the findings of Kalantari et al., who observed that home-based pulmonary rehabilitation, including BEs, was effective in alleviating fatigue in COVID-19 patients (38). Both COVID-19 and COPD are associated with fatigue due to reduced $SpO_2$ levels, increased RR, and reliance on secondary respiratory muscles (39). The positive impact of BEs on fatigue has also been reported in other populations, such as patients with COPD and pregnant women in the third trimester. In addition, BEs can alleviate patients' fatigue by improving relaxation and comfort (40-42). Moreover, Mulhaeriah et al. showed that BEs, by reducing stress, creating mental and physical relaxation, reducing energy consumption, and improving oxygen transfer in blood circulation, led to reduced fatigue in women with cancer undergoing chemotherapy (43). Therefore, it seems that BEs can play an effective role in alleviating fatigue in patients with COVID-19 by improving oxygen supply, reducing respiratory muscle fatigue, reducing stress, and promoting mental relaxation.

The limitation of this study was the possibility of inaccurate responses from patients, which was mitigated by explaining the confidentiality of the data and asking for an appropriate time for the call so that the patients' physical conditions and the surrounding environment were suitable. Also, there was no guarantee that participants in the control group would receive only routine training. There was a possibility that patients would receive information from the media, friends, colleagues, and family that was beyond the research team's control.

## CONCLUSION

Nowadays, considering that the number of people who have recovered from COVID-19 is increasing and they are struggling with the long-term complications of COVID-19, it is necessary to manage these complications of COVID-19. The current study indicates that BEs can reduce long-term complications of COVID-19, including fatigue, and improve patients' QoL and physical and mental health. BEs, as a non-invasive and affordable pulmonary rehabilitation program, can be a useful tool for the healthcare system that is affected by the COVID-19 pandemic.

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