scientific reports

Check for updates

OPEN

Clinical effectiveness of guided breathing exercises in reducing anxiety, stress, and depression in COVID-19 patients

Sara Sheikh[1], Asma Rostami[1], Azam Shahbazi[2], Fahime Abdollahi Nezhad[2], Omonabi Khazai[2] & Azizollah Arbabisarjou[2]✉

The COVID-19 pandemic has led to an increase in the prevalence of anxiety, stress and depression among affected people. This study was conducted with the aim of investigating the clinical effectiveness of guided breathing exercises in reducing anxiety, stress and depression in patients with COVID-19. A quasi-experimental study design was used, involving a sample of COVID-19 patients who underwent guided breathing exercises as a complementary therapy. After simple sampling, eligible subjects were randomly divided into two groups: intervention (30 patients) and control (30 patients) using random block method. The Depression Anxiety Stress Scale-21 (DASS-21) questionnaire was administered before and after the intervention to evaluate changes in anxiety, stress, and depression levels. The results of this study demonstrated that clinically guided breathing exercises had a significant effect on reducing anxiety and stress in COVID-19 patients. The intervention significantly reduced anxiety and stress scores ($p < 0.001$). However, there was no significant reduction in depression scores among patients who participated in guided breathing exercises ($p = 0.946$). Guided breathing exercises are an effective complementary technique in reducing the level of anxiety and stress in COVID-19 patients. Moreover, the exercises may provide a worthy non-pharmacological approach to managing psychological distress in COVID-19 patients.

Keywords COVID-19, Guided breathing exercises, Anxiety, Stress, Depression, Depression anxiety stress Scale-21 (DASS-21)

The COVID-19, also known as the new coronavirus, is a respiratory disease caused by the SARS-CoV-2 virus. It was first identified in Wuhan, China in December 2019 and has since spread globally, resulting in a pandemic[1,2]. The main symptoms include fever, cough and difficulty breathing, although some people may experience mild or no symptoms. The severity of the disease varies, with older people and those with underlying health conditions being more vulnerable to severe disease[3–5].

Anxiety, stress, and depression have been widely reported among people infected with COVID-19, especially affecting adults during this challenging time[6–8]. This anxiety often includes a preoccupation with physical health, including concern about the unknown duration of symptoms and the potential for long-term health consequences that can further exacerbate anxiety disorders[9–11]. Additionally, the experience of dealing with the physical symptoms of the virus—such as fatigue, coughing, and loss of taste or smell—can be overwhelming and lead to increased stress levels[1,12]. The pandemic has also led to social isolation and major disruptions in daily routines, which can manifest as feelings of loneliness, helplessness, and depression[13,14]. Recognizing the specific nature of anxiety, stress, and depression—both as symptoms and as diagnostic categories—allows for a more comprehensive understanding of the ongoing impact of COVID-19 on mental health and underscores the need for targeted mental health resources[15,16].

Research have been shown that yoga with its combination of physical postures and breathing exercises improves mood and well-being, particularly through the availability of virtual classes[17]. Tai Chi and Qigong offer gentle movement and relaxation benefits, while breath techniques help calm the nervous system. Progressive Muscle Relaxation (PMR) aids in recognizing and relieving physical tension from stress[18]. Visualization and

[1]Department of ICU and nursing management, School of Nursing and Midwifery, Tehran University of Medical Sciences, Tehran, Iran. [2]Community Nursing Research Center, Zahedan University of Medical Sciences, Zahedan, Iran. ✉email: arbabisarjou2007@gmail.com

guided imagery promote calmness through mental imagery, and creative therapies like art and music facilitate emotional expression. Nature therapy, including activities like forest bathing, enhances mental well-being, and maintaining a gratitude journal can foster positivity and resilience during challenging times[19].

Breathing exercises have been shown to play an important role in reducing anxiety, stress and depression through several physiological mechanisms. These exercises, which include techniques such as deep breathing and diaphragmatic breathing, target the body's autonomic nervous system to activate the body's relaxation response[20,21]. Specifically, these exercises promote deeper, slower breathing, which signals the parasympathetic nervous system to take over the sympathetic nervous system, which is responsible for the body's stress response. This change helps to reduce the level of stress hormones such as cortisol and leads to a reduction in anxiety symptoms[22,23]. The physiological effect of these breathing techniques is multifaceted. By increasing oxygen intake and improving oxygenation to the brain, deep breathing helps increase mental clarity, focus, and alertness. In addition, prolonged exhalation stimulates the vagus nerve, causing greater relaxation and the release of neurotransmitters such as serotonin and endorphins, which elevate mood and combat symptoms of depression[24,25]. In relation to COVID-19 patients, existing studies show that breathing exercises are particularly useful for managing psychological distress. Research has shown that these techniques can improve coping mechanisms and emotional resilience in people facing pandemic-related challenges[20,26].

Limited studies have been conducted on the clinical effectiveness of guided breathing exercises in reducing anxiety, stress, and depression in COVID-19 patients. Kong et al. found that COVID-19 patients who engaged in guided breathing exercises experienced a significant reduction in anxiety and stress levels compared to those who did not participate in the exercises[27]. Similarly, Mahendru et al. evaluated the effects of guided breathing exercises on depression in COVID-19 patients[20]. Morgan et al. also analyzed multiple studies on the effectiveness of guided breathing exercises in reducing anxiety, stress, and depression in COVID-19 patients[28]. Overall, the studies showed that guided breathing exercises can be a valuable tool in reducing anxiety, stress, and depression in COVID-19 patients. However, it is important to note that although the benefits appear promising, many of these studies have limitations including small sample sizes, lack of control groups, and different methodologies that may affect the generalizability of findings[29].

The first confirmed cases of COVID-19 in Iran were reported on February 19, 2020, in the city of Qom, prompting widespread concern about the virus spreading rapidly. In response, the Iranian government initiated measures on the same day, but an official national emergency was declared later in the month as the situation worsened. By March 2020, the government began implementing strategies to contain the virus, including a range of quarantine and restrictive measures[30]. Various restrictions, such as travel bans and public gathering limitations, were announced, culminating in a nationwide lockdown that started on March 16, 2020, lasting for several weeks, with restrictions fluctuating based on the severity of outbreaks[31]. As the situation progressed into early 2021, Iran commenced its vaccination campaign, prioritizing healthcare workers and eventually rolling out domestic vaccines later in the year[32]. Therefore, the study was conducted in 2020, shortly after the pandemic began. The aim of this study was to clinically evaluate the effectiveness of guided breathing exercises in reducing anxiety, stress and depression in COVID-19 patients.

Methods

Study design

This study utilized a randomized controlled trial design to evaluate the effects of guided breathing exercises on patients with COVID-19 in the COVID-19 respiratory ward of one of Zahedan hospitals in Iran in 2020. Because this study was a randomized controlled trial (RCT) study on the clinical effectiveness of guided breathing exercises in reducing anxiety, stress and depression in COVID-19 patients, CONSORT (Consolidated Standards for Reporting Trials) guidelines were used. The CONSORT flow diagram has been demonstrated in Fig. 1.

Inclusion and exclusion criteria

The inclusion criteria of the study were: (1) participants must provide informed and voluntary consent to participate, (2) they must not have experienced severe stress in the past six months, including significant events such as a severe accident, the death of a loved one, divorce, job loss, mandatory home isolation, financial difficulties, or separation from loved ones, (3) they must not have a history of long-term use of psychedelic drugs in at least the last six months, (4) they must have oxygen saturation levels above 90 and a Glasgow Coma Scale (GCS) score of 15, (5) participants must have been referred between March 2020 and December 2020, and (6) referrals could come from any hospital in Zahedan. The exclusion criteria also included: (1) any unwillingness of patients to continue participating in the study, and (2) deterioration in the patients' medical condition.

Sample size

The sample size was determined based on the error of the first type 0.05 and the power of the test 0.9 that was 60 participants. After simple sampling, eligible subjects were randomly divided into two groups: intervention (30 patients) and control (30 patients) using random block method. The formula to calculate the sample size for a study comparing two independent groups was as follows:

$$n = [(Z\alpha/2 + Z\beta)^2 * (\sigma^2 + \sigma^2)]/(d)^2$$

where:

n = total sample size (both groups combined).
Zα/2 = Z value corresponding to the desired level of significance (e.g. 0.05 for 95% confidence level).
Zβ = Z value corresponding to the desired power of the test (e.g. 0.9 for 90% power).

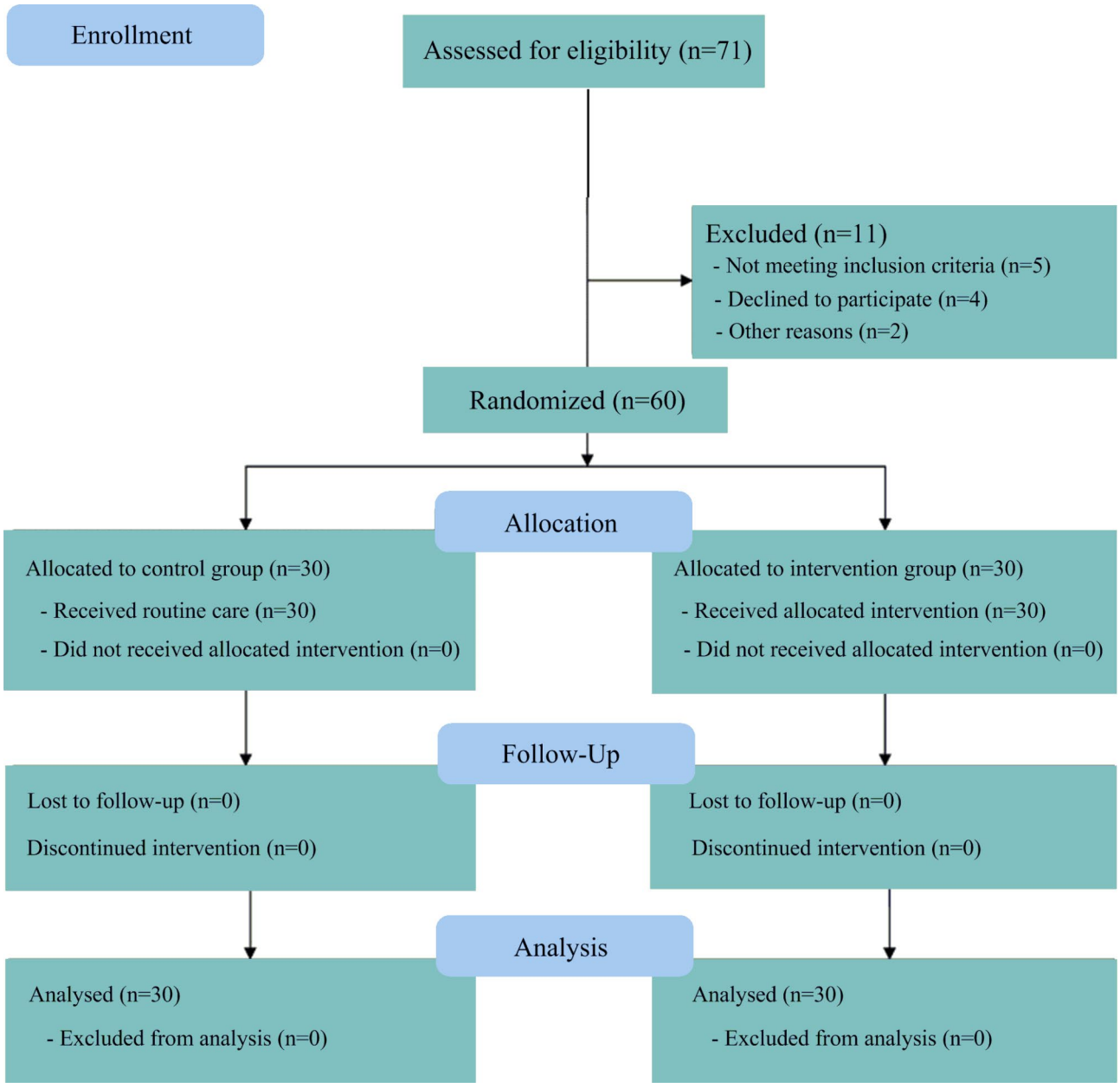

Fig. 1. Research flow diagram based on CONSORT statement.

σ = standard deviation of the outcome variable.
d = minimum clinically important difference.
n per group = n/2.
Therefore:
n = 60.
n per group = 60/2 = 30.

Sampling

The participants who met inclusion criteria were assigned a random identification number using a computerized randomization list. These numbers were used to determine their allocation to the intervention or control group. A randomized blocking method is used to ensure an equal number of participants in each group. Blocking is usually considered to balance the number of samples assigned to each of the study groups. This feature helps researchers to equalize the number of samples assigned to each of the study groups where intermediate analyzes are required during the sampling process. In this method, the size of all blocks was equal, and in a two-group experiment, eight-piece blocks including four participants in the intervention group and four participants in the control group are randomly selected as AA, BB, AB, and BA.

Participants

The participants were randomly assigned to either an intervention group, which received guided breathing exercises, or a control group, which received standard care without guided breathing exercises. In total, 60 participants were included in the study. The demographic profile of these patients included the Male and female patients 18 years and older. Additionally, pertinent clinical characteristics such as the severity of COVID-19 symptoms were assessed using WHO criteria and clinical judgment. Among the participants, 13 presented with mild symptoms, 26 with moderate symptoms, and 21 with severe symptoms at the time of hospitalization. It's important to note that all patients were admitted over a specific timeframe 8 weeks rather than simultaneously, which could influence the course and management of their illness. Regarding their hospitalization experience, patients were in complete isolation, affecting their social support and emotional wellbeing during treatment. In addition, data were collected on whether it was their first COVID-19 infection, previous hospitalizations or their previous mental health disorders. Such variables may influence the levels of stress, anxiety, and depression experienced during a hospital stay.

Data collection tool

In this study, the stress anxiety depression scale questionnaire (DASS-21) was used to evaluate the levels of anxiety, stress and depression in the participants. The Stress Anxiety Depression Scale (DASS-21) is a commonly used questionnaire designed to assess the levels of stress, anxiety, and depression in individuals. The DASS-21 contains 21 items, with 7 items for each of the three constructs[33]. Participants are asked to rate the frequency and severity of their symptoms over the past week on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time)[34].

Understanding mental health includes recognizing the different levels of severity of symptoms such as stress, depression and anxiety. Symptoms can range from normal to very severe, with normal severity reflecting controllable emotions and daily challenges. Mild severity causes mild discomfort, moderate severity may affect daily functioning, severe severity requires professional help, and very severe severity indicates severe distress and the need for immediate intervention. It is important to accurately assess symptoms and seek appropriate help based on the severity of the experience[35].

Validity and reliability of the tool

In this study, the considered method for measuring anxiety, depression and stress is a standard questionnaire that was used in previous studies. To determine the validity of this questionnaire, Lovibond et al. (1995) declared the validity of the DASS-21 questionnaire as 0.77. Additionally, Lovibond declared the reliability of the DASS-21 questionnaire and its components by Cronbach's alpha coefficient[35,36]. In the present study, the validity cited in previous studies has been referred to them. For ensuring reliability, all 60 people completed the questionnaire, and Cronbach's alpha was obtained 0.85%.

The components of DASS-21 were evaluated based on their reliability through Cronbach's alpha coefficients. The Cronbach's alpha was calculated using the entire sample size. The results indicated that the component measuring depression had a high reliability score of 0.89, suggesting that it effectively assesses the underlying constructs related to depressive symptoms. The anxiety component also showed strong reliability with a coefficient of 0.84, indicating its effectiveness in capturing anxiety-related issues. Furthermore, the stress component had a reliability score of 0.82, demonstrating its adequacy in measuring stress levels. Overall, the combined measure of stress, anxiety, and depression demonstrated a Cronbach's alpha of 0.83, reflecting a good level of reliability across these interconnected constructs.

Procedure

After obtaining informed consent, the patients were randomly assigned to either an intervention group that received guided breathing exercises, or a control group that received standard care without breathing exercises. The data collection process included the implementation of a questionnaire at the beginning of the study and again at the end of the five-day intervention period. The first questionnaire was completed on the day of recruitment, while the post-intervention questionnaire was administered on the fifth day. During this time, the participants were still hospitalized, which allowed monitoring of their condition and the effects of the intervention. The participants in the control group received standard care, which included the usual medical treatment and monitoring typically provided to patients recovering from COVID-19. For the intervention group, breathing exercises were introduced on the first day of the study. The participants were instructed to perform breathing exercises four times a day, each session lasting approximately 15–20 min. These exercises consisted of 10 deep breaths per hour using an incentive spirometer, holding the breath for 2 to 3 s, and exhaling slowly through pursed lips. After each exhalation, the participants were instructed to cough at least five times, followed by a 30-second rest period. Monitoring was performed during the first four days to ensure proper technique and adherence to the exercise routine. The rationale for performing breathing exercises over 5 consecutive days was based on existing literature showing that continuous exercise can improve lung function and recovery from respiratory diseases[37]. All instructions for use of the incentive spirometer, including when and how to perform breathing exercises, were provided by trained healthcare personnel to ensure patient safety and proper technique.

Statistical analysis

Descriptive statistics was performed to summarize the characteristics of the study population. Student's t-test was used to compare the mean scores of anxiety, stress, and depression between the two groups. Chi-square test was also employed to compare the proportions of participants with different severity levels of anxiety, stress, and depression. Data analysis was conducted using SPSS version 21 software and two-sided P-value < 0.05 were considered statistically significant.

Variable		Intervention group No (%)	Control group No (%)	Chi-square test result
Gender	Female	15 (50%)	20 (66%)	$X^2=1.09$ $p=0.443$
	Male	15 (50%)	10 (34%)	
Marital status	Married	12 (40%)	14 (46%)	$X^2=1.73$ $p=0.630$
	Single	8 (25%)	7 (23%)	
	Divorced	8 (25%)	5 (16%)	
	Spouse decease	4 (12%)	3 (10%)	
Underlying disease	Renal	4 (12%)	2 (6%)	$X^2=6.28$ $p=0.197$
	Cardiac	3 (10%)	4 (12%)	
	Pulmonary	8 (25%)	10 (34%)	
	More than one disease	13 (43%)	13 (43%)	
	Other	2 (6%)	1 (3%)	
Job status	Government employee	12 (40%)	13 (43%)	$X^2=0.19$ $p=0.925$
	Unemployed	10 (33%)	8 (25%)	
	Self-employment	8 (26%)	9 (30%)	

Table 1. Demographic characteristics of the patients with COVID-19.

Variable	Group	Mean± SD (Before intervention)	Mean± SD (After intervention)	Mean± SD (Variations)	Paired t-test
Anxiety	Study group	14.86±2.06	8.44±1.12	-6.42±0.94	T=7.058 DF-59 $p<0.001$
	Control group	15.87±2.69	15.67±3.01	-0.2±0.02	T=1.01 DF-59 $p=0.315$
	Independent T-test	T=1.620 DF-59 $p=0.274$	T=12.144 DF-59 $P=0.001$	T=0.68 DF-59 $p<0.001$	-
Stress	Study group	15.13±2.87	8.55±1.63	-6.58±1.24	T=7.096 DF-59 $p<0.001$
	Control group	15.45±2.30	15.00±2.05	-0.45±0.25	T=1.52 DF-59 $p=0.242$
	Independent T-test	T=0.476 DF-59 $p=0.636$	T=11.673 DF-59 $p<0.001$	T=11.737 DF-59 $p<0.001$	-
Depression	Study group	14.58±2.32	14.31±2.17	-0.27±0.15	T=1.529 DF-59 $P=0.132$
	Control group	14.35±2.81	14.23±2.68	-0.12±0.13	T=0.568 DF-59 $p=0.454$
	Independent T-test	T=0.357 DF-59 $p=0.722$	T=0.068 DF-59 $p=0.946$	T=1.993 DF-59 $p=0.163$	-

Table 2. Mean scores of anxiety, stress and depression before and after the intervention in the intervention and control groups.

Results

The mean age of participants in the intervention group was 54.1 ± 16.4 years, while in the control group it was 58.23 ± 14.9 years. The results of the chi-square and Fisher's exact test for age ($p=0.843$), gender ($p=0.443$), education level ($p=0.843$), marital status ($p=0.630$), underlying conditions ($p=0.197$), and occupation ($p=0.925$) are presented in Table 1. The mean anxiety scores before and after the intervention, along with corresponding standard deviations for both groups, is detailed in Table 2. Specifically, the intervention group exhibited mean scores of 14.86 ± 2.06 before the intervention and 8.44 ± 1.12 after it. In contrast, the control group's mean scores were 15.87 ± 2.69 prior to the intervention and 15.67 ± 3.01 afterwards. Furthermore, the mean stress scores before and after intervention is also shown in Table 2. The intervention group presented scores of 15.13 ± 2.87 and 8.55 ± 1.63, respectively, whereas the control group had consistent scores of 15.13 ± 2.87 before and 15.67 ± 3.01 after the intervention. Lastly, the depression scores for both groups are summarized in Table 2, with the intervention group showing scores of 14.58 ± 2.32 pre-intervention and 14.31 ± 2.17

post-intervention. The control group demonstrated scores of 14.35 ± 2.81 and 14.23 ± 2.68 for pre- and post-intervention, respectively (Table 2).

Discussion

The results showed the anxiety and stress of patients with COVID-19 in the study group after the intervention was reported less than before, while there was no significant difference in the control group. Based on the results, breathing exercises can be effective in reducing the anxiety and stress of patients with COVID-19. Although, the results indicated that breathing exercises had no significant affect the depression of COVID-19 patients in the intervention and control groups.

The results of this study demonstrated that there is no significant difference between the intervention group and the control group in terms of age, gender, education level, marital status, underlying disease, and occupation. This indicated that the two groups were initially comparable. In terms of anxiety, the average score before the intervention was 14.86 in the intervention group and 15.87 in the control group. After the intervention, the average scores in the intervention group decreased to 8.44 and in the control group to 15.67. This demonstrated that guided breathing exercises were effective in reducing anxiety in the intervention group. Similarly, the mean pre-intervention stress scores in both intervention and control groups was 15.13. After the intervention, the average scores in the intervention group decreased to 8.55 and remained constant in the control group. This indicated that guided breathing exercises were effective in reducing stress in the intervention group but not in the control group. In terms of depression, the average scores before the intervention were 14.58 in the intervention group and 14.35 in the control group. After the intervention, the average scores in the intervention group decreased to 14.31 and in the control group to 14.23. This revealed that guided breathing exercises had no significant effect on reducing depression in both groups.

Breathing exercises, involve specific techniques aimed at regulating breath and increasing awareness of the breath cycle. Together, these practices have been studied for their potential effects on mental health, particularly in alleviating symptoms of anxiety, stress, and depression. As self-care practices, they offer a holistic approach that empowers individuals to take control of their mental health. Numerous studies have explored the impact of yoga and breathing exercises on mental health outcomes[38–40]. Saoji et al. evaluated the effects of yogic breath regulation. The results of their study showed that yogic breathing had beneficial effects on neurocognitive, psychophysiological, respiratory, biochemical and metabolic functions in healthy people. They concluded that yoga breathing can be considered safe if practiced under the guidance of a trained teacher[41].

Saoji et al. also in another study showed the correlation between the duration of yoga practice with state mindfulness, mind-wandering and state anxiety. In their results, the baseline assessment showed a positive correlation between yoga practice duration with State mindfulness attention awareness scale (SMAAS) scores and a negative correlation with Mind-Wandering Questionnaire (MWQ) and state anxiety scores. At the end of 8 weeks, both groups showed improved psychological functions, but the experimental group that received additional yoga breathing performed better than the group that practiced yoga alone. Additionally, an additional practice of yogic breathing with intermittent breath holding was found to enhance psychological functions in young yogis[42].

The effects of yoga and breathing exercises on anxiety, stress, and depression can be traced to several interconnected mechanisms. Firstly, these practices induce physiological changes by influencing the autonomic nervous system, particularly through enhancing parasympathetic activity[43]. This shift results in reduced heart rate, lower blood pressure, and decreased levels of stress hormones such as cortisol. As relaxation is promoted and physiological arousal linked to anxiety and stress diminishes, individuals may experience a profound sense of calm that significantly contributes to their mental health[44]. Moreover, yoga and breathing exercises cultivate mindfulness, which involves the practice of being present in the moment without judgment. This state of mindfulness has been associated with decreased rumination and an enhanced ability to manage stress effectively[45]. By directing attention towards their breath and bodily sensations, individuals can break the cycle of negative thinking patterns that are commonly linked to anxiety and depression, providing a constructive pathway towards emotional stability[46]. In addition to these benefits, engaging in yoga and breathing exercises can significantly enhance emotional regulation and awareness. Many studies have been reported that these practices improve mood, increase resilience, and foster the development of positive emotions[47].

Yadav, et al. investigated the effect of Yoga-based breathing practices on the mental state of patients with COVID-19. Their results indicated that the experimental group had better scores for depression, anxiety, stress, DASS total scores and fear of COVID-19 compared to the control group. Within group, analyzes showed improved scores in all domains in the yoga group ($p < 0.001$) by the end of the intervention. In contrast, the control group only improved in stress scores ($p = 0.002$), DASS total scores ($p = 0.012$) and fear of COVID-19 ($p = 0.039$). No adverse effects are observed with yoga-based breathing exercises in these patients[48]. Yoga-based breathing exercises have been found to have a positive effect on mental health in patients with COVID-19 during hospitalization[49].

Furthermore, Mahendru et al. also reported that meditation and breathing exercises on depression level ($P < 0.001$), stress level ($P = 0.004$) and sleep quality (difficulty falling asleep ($P = 0.007$), difficulty staying asleep (0.004) ($P = 0.003$) and feeling after waking up in the morning ($P = 0.003$) had a statistically significant effect. Although in their study, the positive effect of the intervention on the level of anxiety of patients in isolation was also observed, this difference was not statistically significant ($P = 0.528$). They concluded that meditation and breathing exercises have positive effects on depression, stress level and sleep quality in patients with COVID-19 who are in severe institutional isolation[20]. The results of the present study were in accordance with the results obtained from their study in terms of reducing the amount of stress, and in terms of reducing the amount of depression, the results of their study did not confirm the results obtained from this study.

During the periods of isolation, feeling part of a community, sharing experiences, and participating in communal activities can increase emotional well-being and reduce feelings of loneliness. In addition, many patients with COVID-19 report sleep disturbances that are exacerbated by anxiety and health concerns[50]. Various studies have been shown that yoga-based exercises may improve sleep quality through relaxation techniques, promote better recovery and mental clarity, which is crucial for managing the psychological effects of the disease. Engaging in self-directed exercises such as yoga also gives patients a sense of control over their mental and emotional states. This empowerment can significantly counterbalance the feelings of helplessness often experienced during a serious illness and foster a more positive outlook[51].

Kepenek-Varol et al. reported that the fear of COVID-19 scale, the Hamilton Anxiety Rating Scale, and the Pittsburgh Sleep Quality Index were significantly improved compared to the control group, with large effect sizes (0.135, 0.313, and 0.200, respectively). Although the EQ-5D-3 L index and the EQ-5D-3 L visual analog scale were not statistically significantly different compared to the control group, a small effect size was observed for the difference between the two groups (0.056 and 0.013, respectively). They found breathing and relaxation exercises to be an effective and practical approach to reducing anxiety and increasing sleep quality during the COVID-19 pandemic[52]. The results obtained from their study confirmed the results of the present study.

In another study by Espinoza-Bravo et al. in a within-group comparison, the functional training group showed improvements in fatigue, functional capacity, and perceived stress, while the aerobic training group improved perceived stress. There was no significant difference in the effect between groups for the studied variables. A significant difference was observed in the overall patient impact change scale in favor of the functional training group compared to the aerobic training group, and the quality of life reached the minimum clinically important difference for both groups. Both remote rehabilitation exercise methods are effective in improving stress symptoms and quality of life in patients with prolonged COVID-19. Based their results, for improving fatigue and functional performance, functional exercise indicated more promising results[53]. The results obtained from the present study were similar to the results of their study.

Breathing exercises have been shown to be effective in reducing anxiety, stress and depression in various populations, including COVID-19 patients. These exercises mainly focus on breathing control and promoting relaxation, which can have a positive effect on mental health[22,27]. Anxiety is a common mental health problem experienced by COVID-19 patients as they face uncertainty, fear of illness and often isolation. Breathing exercises can help reduce anxiety symptoms by activating the body's relaxation response[54]. Deep breathing techniques, such as diaphragmatic breathing or abdominal breathing, help lower heart rate, lower blood pressure, and reduce the production of stress hormones such as cortisol[53]. Additionally, COVID-19 patients may experience high levels of stress due to physical symptoms of the virus, health concerns, financial strain, and social isolation. Breathing exercises can relieve the stress response by activating the body's relaxation response[55]. In addition, COVID-19 patients may also experience depressive symptoms such as low mood, lack of energy, and feelings of hopelessness[6]. Breathing exercises can improve mood and reduce the symptoms of depression by increasing the production of endorphins, which are neurotransmitters associated with feeling good[27].

In practice, health care providers can incorporate breathing exercises into treatment plans, particularly in urgent care settings, to improve outcomes for patients with mental health concerns. Additionally, policymakers may consider promoting guided these exercises in mental health programs, especially during public health crises, to promote overall mental well-being and reduce health care costs. On an individual level, guided breathing can serve as a daily stress management tool and help with resilience and self-care. This practice can be supported by educational initiatives and digital platforms that provide accessible resources. In addition, the development of mobile applications that provide guided breathing exercises could increase accessibility and encourage self-directed mental health practices.

Limitations

The participants who considered participating in guided breathing exercises may have had different baseline characteristics, such as higher motivation to practice self-care, compared to those who did not participate in the exercises. Moreover, reliance on self-reported measures of anxiety, stress, and depression may have introduced bias. The participants were also informed about the importance of the technique of the breathing, but no data were collected on whether they practiced the technique outside of supervised sessions. Additionally, changes in pandemic severity, virus types, public health responses, and how COVID-19 affects individuals may have led to fluctuations in anxiety, stress, and depression independent of the intervention. Acknowledging these limitations is important for accurate interpretation of study findings and for guiding future research in this area.

Conclusion

This study found that guided respiratory exercises can be an effective intervention to reduce anxiety and stress in COVID-19 patients. The results demonstrated that the inclusion of these exercises in the clinical care of COVID-19 patients may improve their psychological well-being during the epidemic. The considerable reduction of anxiety and stress scores among patients involved in guided respiratory exercises showed the potential benefits of this intervention. This shows that patient education and guidance through appropriate respiratory techniques can effectively reduce some of the psychological disorders that COVID-19 patients experience. However, there was no significant decrease in depression scores among patients involved in guided respiratory exercises. This indicates that although these exercises may be effective for anxiety and stress, they may not have the same effect on depression in COVID-19 patients. Extra or alternative interventions may be necessary to relieve depression in this population. Further research is needed to investigate the long-term effects of guided respiratory exercises and their impact on other consequences of mental health in COVID-19 patients. Furthermore, the examination of the potential mechanisms in which respiratory exercises guided by them may provide valuable insights for the development of targeted interventions for different aspects of mental health in this population.

Data availability

All data generated or analyzed during this study are included in this article.

Received: 15 May 2024; Accepted: 29 October 2024
Published online: 04 November 2024

References

1. Naderi, M., Ebrahimzadeh, G., Alimohammadi, M. & Past, V. Effect of ozone on the inactivation of indoor airborne viruses with the COVID-19 virus approach: A systematic review. *Tehran Univ. Med. J.* **80**, 82–90 (2022).
2. Alimohammadi, M. & Naderi, M. Effectiveness of ozone gas on airborne virus inactivation in enclosed spaces: A review study. *Ozone: Sci. Eng.* **43**, 21–31 (2021).
3. Baj, J. et al. COVID-19: Specific and non-specific clinical manifestations and symptoms: The current state of knowledge. *J. Clin. Med.* **9**, 1753 (2020).
4. Laires, P. A. & Nunes, C. Population-based estimates for high risk of severe COVID-19 disease due to age and underlying health conditions. *Acta Med. Port.* **33**, 720–725 (2020).
5. Javadzadeh, M. et al. Evaluation of female infertility and viral diseases: A systematic review of coronaviruses. *Sex. Disabil.* 1–23 (2024).
6. Turna, J. et al. Anxiety, depression and stress during the COVID-19 pandemic: Results from a cross-sectional survey. *J. Psychiatr. Res.* **137**, 96–103 (2021).
7. Rettie, H. & Daniels, J. Coping and tolerance of uncertainty: Predictors and mediators of mental health during the COVID-19 pandemic. *Am. Psychol.* **76**, 427 (2021).
8. Past, V. et al. The application of ozone gas in inactivation of Surface and Airborne SARS-CoV-2 in hospitals: A systematic review. *Ozone: Sci. Eng.* 1–21 (2024).
9. Sharafi, K. et al. Epidemiological study of acute food poisoning recorded at Imam Khomeini Hospital of Kermanshah during 4 years period (2008–2011). (2014).
10. Sadeghi, R., Babaee, T., Bakhshandeh, H. & Naderi, M. The effect of preoperative in-person education on the pain severity of patients undergoing coronary artery bypass graft (CABG) surgery. *J. Pain Res. Manag.* **1**, 1–10 (2024).
11. Ebrahimzadeh, G., Omer, A. K., Naderi, M. & Sharafi, K. Human health risk assessment of potentially toxic and essential elements in medicinal plants consumed in Zabol, Iran, using the Monte Carlo simulation method. *Sci. Rep.* **14**, 23756 (2024).
12. Sun, N. et al. Qualitative study of the psychological experience of COVID-19 patients during hospitalization. *J. Affect. Disord.* **278**, 15–22 (2021).
13. Vasiliu, O., Vasile, D., Vasiliu, D. G. & Ciobanu, O. M. Quality of life impairments and stress coping strategies during the COVID-19 pandemic isolation and quarantine—A web-based survey. *Rom J. Military Med.* **124**, 10–21 (2021).
14. Ercoli, L., Gammada, E., Niles, P. & Wyte, Y. Coping with dementia caregiving stress and burden during COVID-19. *Gerontol. Geriatr. Res.* **7**, 1047 (2021).
15. Czeisler, M. É., Howard, M. E. & Rajaratnam, S. M. Vol. 35 301–311 (SAGE Publications Sage CA: Los Angeles, CA, (2021).
16. Erfanifar, E. et al. Evaluating the Effect of Mindfulness-based cognitive therapy (MBCT) on sexual function and sexual self-efficacy of Postpartum women: A systematic review. *Sex. Disabil.*, 1–32 (2024).
17. Farris, S. R. et al. Online mindfulness may target psychological distress and mental health during COVID-19. *Global Adv. Health Med.* **10**, 21649561211002461 (2021).
18. Muhammad Khir, S. et al. Efficacy of progressive muscle relaxation in adults for stress, anxiety, and Depression: A systematic review. *Psychol. Res. Behav. Manage.* 345–365 (2024).
19. Waters, L. et al. Collective wellbeing and posttraumatic growth during COVID-19: How positive psychology can help families, schools, workplaces and marginalized communities. *J. Posit. Psychol.* **17**, 761–789 (2022).
20. Mahendru, K. et al. Effect of meditation and breathing exercises on the well-being of patients with SARS-CoV-2 infection under institutional isolation: A randomized control trial. *Indian J. Palliat. Care* **27**, 490 (2021).
21. Toussaint, L. et al. Effectiveness of progressive muscle relaxation, deep breathing, and guided imagery in promoting psychological and physiological states of relaxation. *Evidence-Based Complementary and Alternative Medicine* (2021). (2021).
22. Zaccaro, A. et al. How breath-control can change your life: A systematic review on psycho-physiological correlates of slow breathing. *Front. Hum. Neurosci.* 353 (2018).
23. Odual, N. N., Agah, R., Amakuro, B. A., Wilbrayi, M. D. & Hamilton-Ekeke, J. T. Understanding the science of stress: Implications for mental and social health in the COVID-19 era. *Nigerian J. Health Promotion* **15** (2022).
24. Noble, D. J. & Hochman, S. Hypothesis: Pulmonary afferent activity patterns during slow, deep breathing contribute to the neural induction of physiological relaxation. *Front. Physiol.* **10**, 1176 (2019).
25. Lamb, D. & Cogan, N. Coping with work-related stressors and building resilience in mental health workers: A comparative focus group study using interpretative phenomenological analysis. *J. Occup. Organizational Psychol.* **89**, 474–492 (2016).
26. Drigas, A., Mitsea, E. & Skianis, C. Intermittent oxygen fasting and digital technologies: From antistress and hormones regulation to wellbeing, bliss and higher mental states. *Technium BioChemMed.* **3**, 55–73 (2022).
27. Kong, X. et al. Effect of psychological–behavioral intervention on the depression and anxiety of COVID-19 patients. *Front. Psychiatry* **11**, 586355 (2020).
28. Morgan, S. P., Lengacher, C. A. & Seo, Y. A systematic review of Breathing Exercise interventions: An Integrative Complementary Approach for anxiety and stress in adult populations. *J. Holist. Nurs.* 08980101241273860 (2024).
29. Williamson, A., James, M. B. & Tucker, V. Sympathetic holding and parasympathetic release: Vagal tone and beta, alpha and theta in bio-somatic dance movement naturotherapy. *Dance Mov. Spiritualities* **6**, 199–229 (2020).
30. Zaccara, L. The impact of COVID-19 on Iranian politics. *Global Discourse* **10**, 465–473 (2020).
31. Ghanbari, M. K. et al. Assessing Iran's health system according to the COVID-19 strategic preparedness and response plan of the World Health Organization: Health policy and historical implications. *J. Prev. Med. Hyg.* **61**, E508 (2020).
32. Blandenier, E. et al. Initial COVID-19 outbreak: An epidemiological and socioeconomic case review of Iran. *Int. J. Environ. Res. Public Health* **17**, 9593 (2020).
33. Norton, P. J. Depression anxiety and stress scales (DASS-21): Psychometric analysis across four racial groups. *Anxiety Stress Coping* **20**, 253–265 (2007).
34. Coker, A. O., Coker, O. & Sanni, D. Psychometric properties of the 21-item depression anxiety stress scale (DASS-21). *Afr. Res. Rev.* **12**, 135–142 (2018).
35. Lee, B. & Kim, Y. E. Validity of the depression, anxiety, and stress scale (DASS-21) in a sample of Korean university students. *Curr. Psychol.* **41**, 3937–3946 (2022).
36. Lovibond, P. F. & Lovibond, S. H. The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behav. Res. Ther.* **33**, 335–343 (1995).
37. Güell, M. R. et al. Benefits of long-term pulmonary rehabilitation maintenance program in patients with severe chronic obstructive pulmonary disease. Three-year follow-up. *Am. J. Respir. Crit Care Med.* **195**, 622–629 (2017).

38. Jerath, R., Crawford, M. W., Barnes, V. A. & Harden, K. Self-regulation of breathing as a primary treatment for anxiety. *Appl. Psychophysiol. Biofeedback* **40**, 107–115 (2015).
39. Epe, J., Stark, R. & Ott, U. Different effects of four yogic breathing techniques on mindfulness, stress, and well-being. *OBM Integr. Complement. Med.* **6**, 1–21 (2021).
40. Gerritsen, R. J. & Band, G. P. Breath of life: The respiratory vagal stimulation model of contemplative activity. *Front. Hum. Neurosci.* **12**, 397 (2018).
41. Saoji, A. A., Raghavendra, B. & Manjunath, N. K. Effects of yogic breath regulation: A narrative review of scientific evidence. *J. Ayurveda Integr. Med.* **10**, 50–58 (2019).
42. Saoji, A. A., Raghavendra, B., Madle, K. & Manjunath, N. Additional practice of yoga breathing with intermittent breath holding enhances psychological functions in yoga practitioners: A randomized controlled trial. *Explore*. **14**, 379–384 (2018).
43. Mendo, B., Gonçalves, M., Lopes, L., Matos, L. C. & Machado, J. *Healthcare* 1934 (MDPI).
44. Pascoe, M. C. et al. Psychobiological mechanisms underlying the mental health benefits of yoga-based interventions: A narrative review. *Mindfulness* 1–13 (2021).
45. La Rocque, C. L., Mazurka, R., Stuckless, T. J., Pyke, K. & Harkness, K. L. Randomized controlled trial of bikram yoga and aerobic exercise for depression in women: Efficacy and stress-based mechanisms. *J. Affect. Disord.* **280**, 457–466 (2021).
46. Decker, J. T., Brown, J. L. C., Ashley, W. & Lipscomb, A. E. Mindfulness, meditation, and breathing exercises: Reduced anxiety for clients and self-care for social work interns. *Social Work Groups* **42**, 308–322 (2019).
47. Zhang, Y., Fu, R., Sun, L., Gong, Y. & Tang, D. How does exercise improve implicit emotion regulation ability: Preliminary evidence of mind-body exercise intervention combined with aerobic jogging and mindfulness-based yoga. *Front. Psychol.* **10**, 1888 (2019).
48. Yadav, S. S. et al. Effect of yoga-based breathing practices on depression, anxiety, stress, and fear of COVID-19 positive hospitalized patients: A randomized controlled trial. *J. Ayurveda Integr. Med.* **15**, 100897 (2024).
49. Ghorashi, Z., Poor, M. H. & Molamomanaei, Z. The effects of yoga-based breathing techniques and meditation on outpatients' symptoms of COVID-19 and anxiety scores. *J. Nurs. Midwifery Sci.* **9**, 173–179 (2022).
50. Patel, R. & Veidlinger, D. Exploring the benefits of yoga for mental and physical health during the COVID-19 pandemic. *Religions* **14**, 538 (2023).
51. Bhandari, R. B., Sangodkar, N. P. & Balkrishna, A. Psychosocial implications of yoga for healthcare workers during Covid-19. *Neurosci. Yoga: Theory Practice: Part.* **1**, 101–121 (2024).
52. Kepenek-Varol, B., Zeren, M., Dinçer, R. & Erkaya, S. Breathing and relaxation exercises help improving fear of COVID-19, anxiety, and sleep quality: A randomized controlled trial. *J. Integr. Complement. Med.* **28**, 579–586 (2022).
53. Espinoza-Bravo, C. et al. Effectiveness of functional or aerobic exercise combined with breathing techniques in telerehabilitation for patients with long COVID: A randomized controlled trial. *Phys. Ther.* **103**, pzad118 (2023).
54. Coelho, C. M., Suttiwan, P., Arato, N. & Zsido, A. N. On the nature of fear and anxiety triggered by COVID-19. *Front. Psychol.* **11**, 581314 (2020).
55. Riva, G. et al. A virtual reality-based self-help intervention for dealing with the psychological distress associated with the COVID-19 lockdown: An effectiveness study with a two-week follow-up. *Int. J. Environ. Res. Public Health* **18**, 8188 (2021).

Acknowledgements
The authors thank Zahedan University of Medical Sciences and the management of Ali-Ibn-Abitaleb Hospital for their cooperation and coordination within the department for the successful implementation of the research.

Author contributions
S.S. conducted conceptualization, A.R. done methodology, A.S. performed validation, F.A.N. conducted investigation, O.K. carried out writing - original draft and A.A. performed review & editing. All authors reviewed the manuscript.

Funding
The study was financially supported by Zahedan University of Medical Sciences.

Declarations

Competing interests
The authors declare no competing interests.

Ethical consideration
The study was conducted in accordance with ethical principles and guidelines. Informed consent was also obtained from all participants and they had the right to withdraw from the study at any time without any negative consequences. The participants' confidentiality and privacy were protected and data were securely stored and analyzed. In addition, this study was approved in 2019 by the Research Ethical Committee with the ethical code of IR.ZAMUS.REC.1402.185.

Additional information

Correspondence and requests for materials should be addressed to A.A.

Reprints and permissions information is available at www.nature.com/reprints.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

© The Author(s) 2024