Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Article

The effectiveness of diaphragmatic breathing relaxation training for improving sleep quality among nursing staff during the COVID-19 outbreak: a before and after study

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ABSTRACT

Objectives: Recent studies have demonstrated that first-line nurses involved in the coronavirus disease-2019 (COVID-19) crisis may experience sleep disturbances. As breathing relaxation techniques can improve sleep quality, anxiety, and depression, the current study aimed to evaluate the effectiveness of diaphragmatic breathing relaxation training (DBRT) for improving sleep quality among nurses in Wuhan, China during the COVID-19 outbreak.

Methods: This study used a quasi-experimental (before and after) intervention strategy, with 151 first-line nurses from four wards in Leishenshan hospital. The Pittsburgh Sleep Quality Index (PSQI), Self-Rating Anxiety Scale (SAS), and Self-Rating Depression Scale (SDS) to evaluate the effectiveness of DBRT before and after the intervention. Data were examined using the Shapiro–Wilk test, Levene's test, and paired *t*-test.

Results: A total of 140 nurses completed the DBRT sessions. First-line nurses achieved significant reductions in global sleep quality ($p < 0.01$), subjective sleep quality ($p < 0.001$), sleep latency ($p < 0.01$), sleep duration ($p < 0.001$), sleep disturbances ($p < 0.001$), habitual sleep efficiency ($p = 0.015$), daytime dysfunction ($p = 0.001$), and anxiety ($p = 0.001$). There were no significant reductions in the use of sleeping medication ($p = 0.134$) and depression ($p = 0.359$).

Conclusion: DBRT is a useful non-pharmacological treatment for improving sleep quality and reducing anxiety among first-line nurses involved in the COVID-19 outbreak.

The study protocol was clinically registered by the Chinese Clinical Trial Registry. Clinical Trial Registration number: ChiCTR2000032743.

1. Introduction

In recent months, a novel coronavirus (SARS-CoV-2) was detected in Wuhan, the capital of the Hubei province of China, and rapidly spread throughout China and the rest of the world [1]. The new virus, which has infected approximately 10 million people worldwide, causes a severe disease, called coronavirus disease 2019 (COVID-19), which primarily affects the lungs. As of July 4, 2020, COVID-19 has claimed the lives of more than 523,010 people worldwide. Due to the sudden and rapid growth of COVID-19, the World Health Organization (WHO) declared it as a Public Health Emergency of International Concern (PHEIC). More than 30 provinces in China initiated first-level public health incident responses to the COVID-19 outbreak [2,3]. China adopted aggressive

Abbreviations: COVID-19, Coronavirus disease-2019; DBRT, Diaphragmatic breathing relaxation training; ANS, Autonomic nervous system; PHEIC, Public health emergency of international concern; PSQI, Pittsburgh Sleep Quality Index; SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale; ICU, Intensive care unit.

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management policies to slow the spread of COVID-19, which were highly effective in the province of Hubei.

Approximately 28,000 nurses were allocated to provide emergency medical support for the COVID-19 outbreak in the Hubei province of China. In the hospitals, the nurses were placed into a high-risk and high-pressure environment that required extraordinary safety measures to ensure their safety, including heavy personal protective equipment (PPE). In a recent report, nurses involved in the daily COVID-19 endemic were more likely to suffer from psychological (eg, anxiety and depression) and sleep disturbances, which affected their reaction times [4]. Based on the Pittsburgh Sleep Quality Index (PSQI), approximately 21% of nurses in the study could have been clinically diagnosed with insomnia [4]. In another study, Wu et al. [5] found that nurses involved in the COVID-19 endemic suffered from poor sleep quality. In order to ensure that nurses get sufficient sleep, many managers adopted flexible work systems, yet the need for 8-h shift nurses was unavoidable. Shift work can significantly impact sleep patterns, especially for nurses working in intensive care units (ICU) or isolation wards. In addition, nurses have been required to shorter, but more frequent shifts during the COVID-19 outbreak to reduce their daily exposure in high-risk areas and minimize the discomfort of PPE. However, increased shift frequencies have been associated with diminished sleep quality [6]. As sleep is vital to maintain energy and survive, sleep disorders can have significant adverse effects on humans, including thought retardation, memory loss, slow reactivity, low spirit, irritability, and suicidal tendency [7]. Moreover, poor sleep quality negatively affects the quality and efficiency of care provided by nurses [8,9]. Previously, Lim et al. [10] demonstrated that nurses with sleep disturbances were more likely to experience high levels of psychological stress. Hence, it could be postulated that improving the sleep quality of first-line COVID-19 nurses may lead to improved patient care in the clinic.

Sleep is regulated largely by the autonomic nervous system (ANS) [11]. The ANS includes a sympathetic system and parasympathetic system; the latter predominately involves the vagus nerve. As good sleepers transition from wake to sleep, respiratory rate slows and becomes more regular as parasympathetic tone increases [11,12]. These suggested that changing the rate of breathing can help people fall asleep faster. Diaphragmatic breathing relaxation training (DBRT), also known as breathing training or deep breathing relaxation training, is a comprehensive body-mind training method based on diaphragmatic breathing [13]. The participants consciously control their activities following the specific program in a quiet environment, effectively slowing down their breathing and contracting the diaphragm muscle to move air downward into the body, resulting in a state of relaxation [14,15]. The benefits of DBRT have been shown by Stromberg et al. [16] and Aslan et al. [17]. They demonstrated that DBRT is an effective non-pharmacological intervention for improving sleep and emotions, resulting in reduced levels of anxiety, depression, and stress. And deep breathing has been shown to cause cardiopulmonary synchronization [18], resulting in stronger sympathetic inhibition [19]. In contrast, irregular and fast breathing can lead to sympathetic excitation [20,21]. Detrimental effects of stress, anxiety of the ANS might be counteracted by relaxation and breathing [22]. In addition, DBRT has some other non-pharmaceutical advantages, including its excellent safety profile, minimal space requirement, and simplicity for learning and practicing the techniques [23]. Recently, Lee et al. [24] found that diaphragmatic breathing produces a circadian effect between the heart rate and blood pressure of young adults. It can increase parasympathetic activity during the night will improve sleep quality [25]. Furthermore, a comparative study by Subbalakshmi et al. [26] reported that DBRT increases parasympathetic nervous system activity in patients with type 2 diabetes, which has been shown to improve sleep quality [25]. In submarine soldiers who practiced DBRT for 28 consecutive days, 10–15 min of DBRT before sleep significantly reduce the frequency of insomnia symptoms [27]. Therefore, DBRT has been used as a component of relaxation therapy for insomnia [28].

Most studies in the literature have focused on the effects of DBRT in patients with particular conditions, yet there is limited information about the effectiveness of DBRT in the non-diseased population. As nurses working directly with COVID-19 patients have a substantial risk of becoming infected with the virus in cases, it is important to pay attention to their sleep and mental status to minimize the risk of unintended exposure and spread of e disease [29]. In the current study, our aim was to investigate the effects of DBRT on sleep quality, anxiety, and depression of first-line nurses fighting against COVID-19 in Wuhan, China.

In this study, we hypothesize that four weeks of DBRT would significantly improve the sleep quality, anxiety and depression levels of first-line nurses, as demonstrated through significant improvements between the sleep quality, anxiety and depression pre-tests and post-tests.

2. Materials and methods

2.1. Study design and participants

A quasi-experimental (before and after) intervention study design was used in this study. Randomized grouping was not used due to the limited external factors of sleep quality, and blinding was not possible as all participants were from the same support team. Clinical first-line nurses were recruited from a hospital in the Liaoning supportive medical team in Wuhan. After arriving in Wuhan, the nurses were assigned to COVID-19-designated hospitals. The sample size for this study was calculated using the following formula: $n = [(Z_{1-\alpha/2} + Z_{1-\beta})^2\sigma^2]/\delta^2$. Referring to the effect sizes of 3 and 3.4, significant level (α) of 0.05 and statistic power (1-β) of 0.9 in the previous study [30], a minimum of 14 participants were required for this study. The inclusion criteria were as follows: (1) nurses directly taking care of COVID-19 patients; (2) nurses participated in the prevention and control of COVID-19 for more than one week; and (3) nurses provided written informed consent to voluntarily participate in the study. The exclusion criteria were as follows: (1) nurses with a history of physical health problems, such as respiratory diseases, autoimmune diseases, neuropathy, or drug and alcohol abuse; (2) nurses who practiced yoga or another mind-body training.

2.2. Materials

This study was comprised of four questionnaires, including the following: (1) demographic information questionnaire; (2) Pittsburgh Sleep Quality Index (PSQI); (3) Self-Rating Anxiety Scale (SAS); and (4) Self-Rating Depression Scale (SDS).

2.2.1. Demographic information questionnaire

The demographics collected in this study included age, gender, work unit, years of work experience, clinical ladder level, highest educational level, marital status, previous infectious disease experience (yes or no), and days of fighting against COVID-19.

2.2.2. Pittsburgh Sleep Quality Index (PSQI)

The PSQI [31] was used to measure the sleep quality of nurses for one month. The PSQI consists of 18 items and measures seven dimensions, including subjective sleep quality, sleep duration, sleep latency, habitual sleep efficiency, sleep disturbances, the use of sleeping medication, and daytime dysfunction. Each dimension

ranges between 0 and 3 points. The overall PSQI score ranges from 0 to 21, with higher scores reflecting poorer sleep quality. A revised PSQI score of 7 or higher is considered poor sleep quality. If the score of any individual dimension is higher than 1, there is a problem with that specific dimension. Questions regarding the effects of roommates were excluded due to the age of participants in this study. The PSQI has been verified to have excellent reliability and validity, with a Cronbach's α of 0.83 [31]. In the current study, the Cronbach' α for internal consistency was 0.768.

2.2.3. Self-rating anxiety scale (SAS)

The SAS, designed by Zung in 1971 [32], has been used to assess the subjective symptoms of anxiety for up to one week. The SAS consists of 20 items, and each item is rated on a four-point Likert scale. The scores for each time were added together to determine the overall rating, with a higher score being indicative of increased anxiety levels. A revised Chinese version of the scale has been created with a standard score of 50, and a score greater than 50 was indicative of anxiety symptoms; scores of 50–59 for mild anxiety, 60 to 69 for moderate anxiety, and 70 or higher for severe anxiety. The Cronbach's α was 0.859.

2.2.4. Self-rating depression scale (SDS)

The SDS, designed by Zung in 1965 [33], has been used to assess the subjective symptoms of depression for up to one week. The SDS consists of 20 items, and each item is rated on a four-point Likert scale. The scores for each time were added together to determine the overall score, with a higher score being indicative of increased depression levels. A revised Chinese version of the scale has been created with a standard score of 53, and a score of greater than 53 was indicative of depressive symptoms; scores of 53–62 for mild depression, 63 to 72 for moderate depression, and 73 or higher for severe depression. The Cronbach's α was 0.892.

2.3. Procedures

The materials required for the intervention consisted of four parts, including the DBRT information guide, MP_3 audio recording, demonstration video, and self-training record. The DBRT information guide can reference Table 1, the MP_3 audio included background music and instruction. The background music was selected from the "Psychological Decompression Series" recorded by the Music Therapy Center of the Central Conservatory of Music, and the instructional training was recorded by the psychological counselor, which primarily included environmental preparation. The implementation and action steps were recorded by the researcher to form a video. In the current study, the DBRT instructor was an experienced trainer in DBRT.

After the nurses completed the pre-DBRT questionnaires, the participants were given the DBRT information guide, MP_3 audio recording, and self-training record. The demonstration video was transmitted through WeChat. The nurses were required to complete the DBRT at 8:00 PM. First, the nurse chose a comfortable couch/bed in a quiet environment to play the MP_3 audio or demonstration video. Next, they followed the steps (Table 1) in the audio recording or video to practice. The duration of each DBRT was 30 min. To increase the effectiveness of DBRT, the first-line nurses were required to practice at least once per day. If the shift nurses fail to participate in the DBRT at 8:00 PM, they were told to choose another time to practice and to self-record the new training time. After continuing the DBRT sessions for four weeks, and the PSQI, SAS, and SDS were administered at the end of the intervention. If the nurses felt uncomfortable during the practice, the DBRT was suspended immediately. The researchers answered all questions from the nurses. The study protocol was clinically registered by the Chinese Clinical Trial Registry (code number: ChiCTR2000032743).

2.4. Ethical considerations

This study followed the principles of the Declaration of Helsinki, and ethical approval was obtained from the Ethics Committees of the First Affiliated Hospital of Dalian Medical University (PJ-KS-KY-2020-34) and Zhongnan Hospital of Wuhan University (please see Attachment #1). The nurses provided written informed consent before they were included in the study.

2.5. Data collection

The researchers thoroughly explained the purpose and objective of the study to the participants. They could discontinue the study at any time without penalty. All personal information would be kept confidential. To minimize the risk of infection, an electronic survey was utilized in this study. After applying the inclusion and exclusion criteria, 151 first-line nurses in four wards of Leishenshan hospital were recruited for the study, yet 140 nurses completed the study. The data were collected between February 2020 and March 2020. The same DBRT instructions were provided to all of the nurses. The participants were required to complete four online questionnaires lasting 10–15 min. After completing the DBRT, the nurses were required to complete four additional internet questionnaires (Fig. 1).

2.6. Data analysis

SPSS 19.0 was used for the statistical analysis (IBM, Chicago, IL, USA). A value of $p < 0.05$, based on the two-tailed t-test, was considered statistically significant. Before the comparison, the Shapiro–Wilk test was used to verify the compliance of numerical variables with the normal distribution, while the Levene's test was used to verify the homogeneity of variances. All variables were found to be normally distributed. Descriptive statistics were used for frequencies and percentages of categorical variables. Means and

Table 1
Description of the standardized DBRT intervention components.

Sequences		
Beginning	• Sitting • Flatten the shoulders, open the legs, and place your arms at your sides naturally • Close your eyes and focus on your present feelings	5 min
Relaxation	• Abdominal breathing - Inhale deeply through the nose and exhale slowly through the mouth - Inspiration: contract the diaphragm, relax the abdominal muscles, and bulge the abdomen - Expiration: relax the diaphragm, contract the abdominal muscles, and retract the abdomen • 8–10 times/min	20 min
Ending	• Close your eyes and focus your present feelings • Relax the whole body	5 min

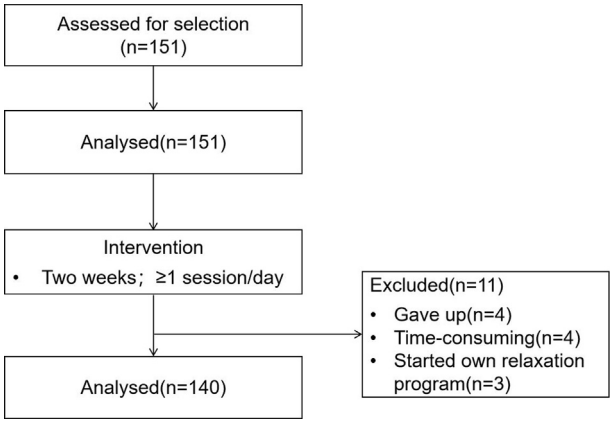

Fig. 1. Consort flow diagram depicting the enrollment of subjections, metrics of intervention, and disposition status.

standard deviations (SD) were used for continuous variables related to the demographics and clinical characteristics. The paired *t*-test was used to analyze the overall effect of DBRT on sleep quality.

3. Results

3.1. Baseline characteristics of participants

The nurses reported no serious adverse effects during the study. For the 140 participants in this study, the mean age was 32.39 ± 5.92 years (range 22–54), and the nurses had fought against COVID-19 for 46.47 ± 6.20 days. The majority participants were married (61.5%). In addition, 85.7% of the participants had a university degree or above. The specific results are shown in Table 2.

Table 2
Characteristics of participants in this study (n = 140).

Characteristic	N (%)/Mean ± SD
Age	32.39 ± 5.92
Gender	
Male	9 (6.4)
Female	131 (93.6)
Work unit	
A4	35 (25.0)
A8	45 (32.1)
A13	29 (20.7)
B1	31 (22.2)
Marital status	
Married	86 (61.5)
Single	52 (37.1)
Divorced	2 (1.4)
Education level	
Master or above	2 (1.4)
Bachelor	118 (84.3)
Associate degree	17 (12.2)
Secondary school degree	3 (2.1)
Years of working experience	10.47 ± 5.86
Level of clinical ladder	
N0	19 (13.6)
N1	65 (46.4)
N2	46 (32.9)
N3	9 (6.4)
N4	1 (0.7)
Previous experience for fighting infectious diseases	
Yes	8 (5.7)
No	132 (94.3)
Days of fighting against COVID-19	46.47 ± 6.20

3.2. Differences in PSQI scores before and after DBRT

When compared the PSQI scores of the nurses before and after the DBRT intervention, the differences were statistically significant in sleep quality (Table 3), including global sleep quality (11.25 ± 4.61 to 8.12 ± 3.31) ($p < 0.01$), subjective sleep quality (1.59 ± 0.75 to 1.15 ± 0.61) ($p < 0.001$), sleep latency (3.46 ± 1.71 to 1.91 ± 0.91) ($p < 0.01$), sleep duration (1.64 ± 0.75 to 1.28 ± 0.63) ($p < 0.001$), sleep disturbances (1.31 ± 0.62 to 1.06 ± 0.63) ($p < 0.001$), habitual sleep efficiency (1.41 ± 1.16 to 1.07 ± 0.93) ($p = 0.015$), and daytime dysfunction (1.63 ± 0.97 to 1.31 ± 0.94) ($p = 0.001$). However, there was no significant difference in the use of sleeping medication before and after the DBRT invention ($p = 0.134$).

3.3. Differences in anxiety and depression scores before and after DBRT

DBRT participants showed significantly better improvements in anxiety levels (47.80 ± 13.86 to 43.13 ± 10.99) ($p < 0.01$; Table 4), while depression levels were not significantly reduced.

4. Discussion

To our knowledge, this is the first study to investigate the effectiveness of DBRT in first-line nurses during the COVID-19 endemic, in terms of sleep quality, anxiety, and depression. In the present study, the self-reported practice adherence to DBRT was high. The COVID-19 first-line nurses in this study reported poorer sleep quality before the intervention, which is consistent with previous findings [5]. When the supportive nurses arrived in Wuhan, they faced changes in their work environment, types of patients, shift status, and climate. All of these factors could have affected the mental and physical endurance and sleep quality of first-line nurses [34]. The mean pre-test scores for sleep quality of the current study align with findings from Cai et al. [35]. It is important that nurses experience good sleep quality to improve their efficiency and work commitment during the COVID-19 outbreak.

Consistent with our first hypothesis, after four weeks of DBRT, the first-line nurses made significant progress in PSQI scores, including global sleep quality, subjective sleep quality, sleep latency, sleep duration, sleep disturbances, habitual sleep efficiency, and daytime dysfunction. DBRT had positive effects on sleep quality, which confirms previous reports in healthy adults [13,36]. A review also demonstrated that slow breathing can regulate psychological status [37]. According to the literature, the psychophysiological mechanisms underlying the beneficial effects of DBRT

Table 3
Differences in PSQI scores before and after DBRT intervention.

Variable	Pre-test Mean ± SD	Post-test Mean ± SD	*t*	*p*
PSQI	11.25 ± 4.61	8.12 ± 3.31	7.946	<0.001**
Subjective sleep quality	1.59 ± 0.75	1.15 ± 0.61	5.682	<0.001**
Sleep duration	1.64 ± 0.75	1.28 ± 0.63	2.380	<0.001**
Sleep latency	3.46 ± 1.71	1.91 ± 0.91	9.587	<0.001**
Habitual sleep efficiency	1.41 ± 1.16	1.07 ± 0.93	2.464	0.015*
Sleep disturbances	1.31 ± 0.62	1.06 ± 0.63	3.574	<0.001**
Use of sleeping medication	0.48 ± 0.84	0.35 ± 0.94	1.507	0.134
Daytime dysfunction	1.63 ± 0.97	1.31 ± 0.94	3.434	0.001*

Note. PSQI: Pittsburgh Sleep Quality Index.
*$p < 0.05$ **$p < 0.001$.

Table 4
Differences in SAS and SDS scores before and after DBRT intervention.

Variable	Pre-test Mean ± SD	Post-test Mean ± SD	*t*	*p*
Anxiety	47.80 ± 13.86	43.13 ± 10.99	3.382	0.001**
Depression	47.50 ± 9.80	46.52 ± 9.78	0.921	0.359

Note. SAS: Self -Rating Anxiety Scale; SDS: Self -Rating Depression Scale.
**$p < 0.001$.

are primarily mediated by the autonomic nervous system and mental states. Moreover, diaphragmatic breathing techniques promote the abdominal plexus and parasympathetic activities by reducing the respiratory rate, cortisol secretion, and neurohumoral transmission, while increasing the extent of diaphragm movement and gas exchange [25,38]. Cognitive-behavioral specialists have suggested that DBRT is a form of relaxation training [39]. DBRT can reduce fatigue and stress responses by optimizing brain energy consumption and cortisol secretion [25]. Therefore, after undergoing DBRT intervention, global PSQI and subjective sleep quality scores improved significantly.

Before the training session, several factors impacted the mental health and sleep latency of the nurses, including isolation, heavy PPE, shift work, and emotional changes. The presence of sleep latency problems in shift nurses may be due to the disruption of circadian rhythms. In our study, 85.7% of nurses took longer than 15 min to fall asleep. The most statistically significant change after the DBRT was a reduction in sleep latency. The effect of DBRT on insomnia was affected by the practice time. DBRT was scheduled for 8:00 PM, when some individuals may be sleepy, while the self-practice time of shift nurses was scheduled for two hours before going to sleep. Moreover, diaphragmatic breathing can influence blood pressure and heart rate variability [24,30]. Increased variability of the heart rate is a robust marker of enhanced parasympathetic activity and signifies a calm and relaxed state [40]. After the intervention, blood pressures reduced, and heart rate variability increased, which may help to fall asleep quickly. In addition to the impact on sleep latency, our study indicated that the improvements in global sleep quality experienced by DBRT might be related to reductions in daytime dysfunction, sleep disturbances, sleep duration, and habitual sleep efficiency. In return, this reduced daytime napping and lowered fatigue, resulting in better sleep continuity [41]. However, while there was a decrease in sleeping medication use among the nurses, DBRT had no significant effect. The pre-test scores did not meet the diagnostic criteria of sleep medication use in the PSQI (sleep medication score higher than 1), suggesting that when nurses have sleep problems, they tend to choose non-pharmacological interventions. This was confirmed in a study [42], when nurses have sleep problems, majority of them may tend to choose complementary/alternative medicine, over-the-counter medication, or even no active intervention.

Herein, the results of this study prove that DBRT has a positive effect on nurses' anxiety levels, but it did not affect depression levels. Thus, the second hypothesis was partially supported. As previously mentioned, DBRT can affect both emotional and mental states. Brown and Gerbarg [43] proposed that breathing control may be a non-pharmacological intervention to relieve stress, anxiety, and depression. Nevertheless, the changes in depression among COVID-19 first-line nurses were insignificant. Although nurses had negative emotions, it could not be defined as depression, which was likely due to the gap with the diagnosed score. This may be related to the strong support of the Chinese government and the management of hospitals. When nurses worked with COVID-19 patients, they are less likely to worry about PPE and daily life. National and social support can comfort the emotions of medical staff during the COVID-19 outbreak.

This study has several limitations. First, this was a quasi-experimental (before/after) intervention/self-contrast study and lacked a control group. Due to the COVID-19 outbreak, previous studies have shown that first-line nurses have sleep disorders and anxiety problems. To effectively improve this situation, we did not set up a control group and conduct a rigorous randomized controlled trial. Instead, we recruited all nurses who served as supportive medical team from Liaoning to Wuhan Leishenshan Hospital and explored the effectiveness of DBRT in the sleep quality for first-line nurses to the greatest extent This may lead to a bias in the results, suggesting that improvements in sleep and anxiety may be a natural adaptation. Second, although there were trained instructors in the study, objective indicators, such as respiratory rate, heart rate, and blood pressure, were lacking in the outcomes. Moreover, the frequency of self-training DBRT was based on unverified, subjective self-reports from each participant. Finally, after four weeks of DBRT intervention, the spread of COVID-19 was effectively curbed, and the nurses ended their assistance in Wuhan and carried out collective isolation and recuperation. Thus, the long-term effects of DBRT were not observed.

5. Implications for clinical practice

Findings from the present study have some implications for general public health and nursing administrators. During the COVID-19 outbreak, the general public may have anxiety and sleep problems that adversely affected their physical health, especially clinical first-line nurses. This study could provide more understanding of the effectiveness profile of mind-body medicine and stimulate more rigorous mind-body medicine studies. Nursing administrators should identify adverse factors and provide effective interventions. The findings of this study can be used by nursing administrators to choose an effective non-pharmaceutical sleep intervention method and help COVID-19 first-line nurses improve their sleep quality and anxiety levels.

6. Conclusions

In conclusion, our findings highlight the effectiveness of DBRT among nursing staff in Wuhan, China, during the COVID-19 outbreak. Our findings demonstrate that DBRT is effective for improving sleep quality and reducing anxiety. Nursing administrators are tasked with helping front-line nurses deal with the stress of the environment. Thus, nursing administrators can teach them relaxation techniques, such as DBRT, while assessing the sleep quality and anxiety levels of clinical first-line nurses. These findings should be considered preliminary until they are verified in a randomized controlled trial. As a relaxation technique, DBRT showed no adverse effects and may be used to alleviate sleep problems and anxiety. The next logical step is to conduct randomized controlled trials and to compare DBRT with conventional measures to understand the contributions of mind-body components.

Authors' contributions

YL: Literature search, study design, data analysis, data interpretation, writing.
TTJ: Literature search, study design, data analysis, data interpretation, writing.
TYS: Study design, data analysis, data interpretation, writing.
YNL: Study design, data analysis, data interpretation, writing.

XML: Data collection, data analysis, data interpretation.
GJX: Data collection, data analysis, data interpretation.
FLL: Data analysis, data interpretation.
YLW: Data collection.
XYW: Data collection.

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Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Conflict of interest

The authors declare that there is no conflict of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2020.12.003.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2020.12.003.

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