ORIGINAL RESEARCH

The Efficacy of a Nurse-Led Breathing Training Program in Reducing Depressive Symptoms in Patients on Hemodialysis: A Randomized Controlled Trial

The intervention also yielded improved quality-of-life measures.

Chronic kidney disease (CKD), which can lead to impaired renal function, is a progressive illness with a generally poor prognosis. Marked deterioration of physical functioning and psychological distress are common. The disease has become a major public health concern in many countries, including the United States,[1] Canada,[2] China,[3] and Taiwan[4, 5] (with an estimated national prevalence of about 13%, 13%, 11%, and 12%, respectively). In patients with CKD, depression is a commonly reported comorbidity, with an estimated prevalence ranging from 25% to 50%.[6-8] Several studies have found that depression in this population is associated with adverse clinical outcomes such as poor sleep quality and reduced quality of life,[9-13] as well as with higher rates of hospitalization and death.[14-16] Thus it's imperative that effective interventions for treating depression in people with CKD are identified.

This article presents findings from a randomized controlled trial that examined the efficacy of a nurse-led, in-center breathing training program in reducing depressive symptoms in patients with CKD receiving maintenance hemodialysis. We also investigated whether this intervention affected sleep quality and health-related quality of life in these patients.

BACKGROUND

Depression and CKD. In people with CKD, both the symptom burden and the presence of comorbidities may be causes of depression. Various factors such as chronic inflammation, uremic toxins, sleep disturbances, pain, fatigue, and reduced appetite can play a role,[8] as can the adverse effects of medications, dietary constraints, and changes in sexual function.[17] Patients may experience psychological strain because of multiple losses (such as loss of family or workplace roles), treatment dependency, time restrictions, and fear of death.[17] A low level of perceived social support may also be a factor.[18]

Biologically, depression has been linked to marked elevation of proinflammatory cytokines and reduced serum albumin concentration in patients on maintenance hemodialysis.[19] Furthermore, studies using serum albumin concentration as a marker for nutritional status have found associations between depression and malnutrition in this population.[20] Depressive symptoms have also been identified as a risk factor for

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ABSTRACT

Background: Depression is common in patients with chronic kidney disease who are on hemodialysis. Available behavioral modalities for treating depression may not be feasible for patients who receive hemodialysis two or three times per week.

Objectives: The purpose of this randomized controlled trial was to examine the efficacy of a nurse-led, in-center breathing training program in reducing depressive symptoms and improving sleep quality and health-related quality of life in patients on maintenance hemodialysis.

Participants and methods: Fifty-seven patients on hemodialysis were randomly assigned either to an eight-session breathing training group or to a control group. The Beck Depression Inventory II (BDI-II), the Pittsburgh Sleep Quality Index (PSQI), and the Medical Outcome Studies 36-Item Short Form Health Survey (SF-36) were used to assess self-reported depressive symptoms, sleep quality, and health-related quality of life, respectively.

Results: The intervention group exhibited significantly greater decreases in BDI-II scores than the control group. No significant differences in PSQI change scores were observed between the groups. SF-36 change scores for both the domain of role limitation due to emotional problems and the mental component summary were significantly higher in the breathing training group than in the control group.

Conclusion: This intervention significantly alleviated depressive symptoms, reduced perceived role limitation due to emotional problems, and improved the overall mental health component of quality of life in patients on maintenance hemodialysis.

Keywords: breathing training, depression, hemodialysis, quality of life, sleep

nonadherence to dialysis treatment[15, 21] and poor interdialytic weight control.[22, 23]

Depression, sleep quality, and quality of life. Studies have found that patients on maintenance hemodialysis who were classified as poor sleepers exhibited significantly higher levels of depression than those who were good sleepers.[10, 11] Indeed, many studies have identified depression as an independent predictor of reduced sleep quality in such patients.[10-12] As Avramovic and Stefanovic have pointed out, depression is often confounded by the symptoms of uremia, which include sleep disturbances, fatigue, poor appetite, and cognitive disturbances.[9]

Turkmen and colleagues found a significant inverse correlation between the scores for sleep quality and quality of life in patients undergoing hemodialysis; depression was an independent predictor of sleep quality scores.[13] And several studies among patients on hemodialysis or diabetic patients with end-stage CKD have found depression to be associated with significantly increased mortality and hospitalization rates.[14-16]

Management of depression is essential to lessening the disease burden and improving clinical outcomes among patients with CKD.[3] In the general population, pharmacotherapy is often the mainstay of treatment for depression. But in people with CKD, the loss of renal function can alter the pharmacodynamic and pharmacokinetic effects of drugs[24]; especially for those on hemodialysis, medication safety is of great concern. Moreover, a recent systematic review of 28 studies in patients with stage 3 to stage 5 CKD concluded that "there is no high-quality evidence from randomized trials that suggests antidepressants are more effective than placebo in treating depression" in this population.[24] The researchers also noted the dearth of well-designed randomized controlled trials in this area, and called for more research.

Several studies have demonstrated that nonpharmacologic interventions such as cognitive behavioral therapy can improve depressive symptoms in patients on hemodialysis.[22, 25] But cognitive behavioral therapy is usually administered in outpatient settings in either individual or group sessions requiring regular attendance and the participation of a therapist. And the dialysis regimen may impose constraints on patients' willingness or ability to attend additional treatment appointments at other facilities. In contrast, interventions that can be administered on-site before each dialysis session might be more feasible. To the best of our knowledge, the efficacy of in-center nonpharmacologic modalities in improving depression in patients on maintenance hemodialysis has not been investigated.

Deep, slow breathing is a simple relaxation technique. With proper training, deep-breathing exercises can be easily learned and practiced. In a study of healthy adults, Busch and colleagues found that a short period of deep, slow breathing elicits a relaxation response; specifically, skin conductance levels were significantly reduced, indicating that sympathetic nervous system activity had markedly decreased.[26] An adverse, reciprocal relationship between depression and sympathetic nervous system activity has been suggested.[27,28] So it seems possible that deep breathing exercises could be useful in reducing depressive symptoms. An earlier study by Chung and colleagues among patients with coronary heart disease found that a breathing training program was effective in reducing self-reported depressive symptoms.[29] In that study, participants who practiced deep diaphragmatic breathing for 10 minutes three times daily for four weeks at home experienced a significant reduction of depression severity when compared with controls. In a study among patients with multiple sclerosis, those who participated in an eight-week program involving relaxation breathing and progressive muscle relaxation reported decreased stress and depressive symptoms, while those in the control group did not.[30] And one study conducted among patients who had undergone allogenic hemopoietic stem cell transplantation found that those who received a six-week intervention involving daily relaxation breathing exercises had significantly lower depression scores than controls.[31] Given that deep-breathing exercises have had beneficial effects on depression in other populations of chronically ill patients, there was potential for a similar result in people with CKD on maintenance hemodialysis.

Our results indicate that eight sessions of in-center breathing training can be an effective and feasible treatment for depression.

METHODS

Design. This was an outcome assessor–blind, randomized controlled trial. Eligible participants were randomly assigned to either a nurse-led breathing training group (the intervention group) or a waiting-list group (the control group). An independent research assistant (one of us, S-HT) who was not involved in implementing the intervention and who was blinded to participants' group allocation performed the outcome assessment.

Setting and participants. The study was conducted in a 54-bed dialysis center within a university-affiliated medical center in Taiwan. This dialysis center operated three shifts per day, six days per week. Patients with CKD who were ages 18 or older and without hearing impairment were eligible. Because we were investigating the efficacy of an in-center intervention, eligible participants also had to be receiving hemodialysis in two or three three-hour sessions weekly and to have been undergoing regular maintenance hemodialysis for more than three months. Patients with CKD who were bedridden or hospitalized were excluded, as were those with psychiatric disorders confirmed by medical records. The institutional review board of the participating institution approved this study. All participants provided informed consent before enrollment.

We calculated the sample size according to the effect size determined in the aforementioned study by Chung and colleagues, which investigated the effect of breathing training on depression.[29] The results of that study indicated that we would need at least 12 participants in each group. We recruited 64 participants to allow for attrition and to accommodate the assumed smaller treatment effect size of breathing training on sleep quality and health-related quality of life. Recruitment took place from March 1 through June 30, 2012.

Randomization and blinding. The random allocation sequence was generated using free online software providing randomly permuted blocks and random block sizes (www.randomization.com). Another independent research assistant who did not participate in participant enrollment, data collection, or data analyses generated the allocation sequence. The allocation sequence was concealed in sequentially numbered, opaque, sealed envelopes that were safeguarded by the primary investigator (one of us, P-ST) until it was time to assign the participants to groups. The dialysis nurse who delivered the intervention ensured that each envelope was still sealed, wrote a participant's name on each envelope, and opened the envelopes. The participants were then accordingly assigned to either the intervention or the control group.

Intervention. *The intervention group*. The dialysis nurse administered the audio device–guided breathing training in a quiet room at the dialysis center. This nurse had received breathing training from a certified therapist (P-ST) with expertise in biofeedback and physiological self-regulation, and the therapist evaluated the nurse's ability to demonstrate and explain the breathing exercises. We decided on a four-week intervention period, based on the time frame used in the aforementioned study by Chung and colleagues.[29] Breathing training with practice time was provided twice weekly, for a total of eight sessions.

In the first session, participants received 10 minutes of individualized coaching, during which the nurse taught the breathing techniques. Specifically, participants were instructed first to inhale through the nose while allowing the abdomen to expand as much as possible, and then to exhale slowly through either the nose or the mouth, at an overall rate of four to seven breaths per minute. They were taught when breathing

Table 1. Time Frame for Intervention and Data Collection

Study Week	1	2		3		4		5		6
Intervention session		1	2	3	4	5	6	7	8	
1. Each patient received an individual coaching session taught by a nurse (10 min)		√								
2. Patients listened to prerecorded instructions on breathing technique (10 min)		√								
3. Patients practiced the breathing exercise (30 min)[a]		√[b]	√	√	√	√	√	√	√	
Assessment										
Questionnaire	√									
BDI-II	√									√
PSQI	√									√
SF-36	√									√

BDI-II = Beck Depression Inventory II; PSQI = Pittsburgh Sleep Quality Index; SF-36 = Medical Outcome Studies 36-Item Short Form Health Survey.
[a]Participants practiced deep, relaxed abdominal breathing while following a prerecorded voice guide under the nurse's supervision.
[b]Breathing practice was performed for 20 minutes in the first session.

to observe the expansion of the abdomen rather than the chest. Then the participants listened to 10 minutes of further prerecorded instruction on breathing techniques, which described the benefits of abdominal breathing, the desired breathing speed and body positioning, and the techniques used for contracting and relaxing the abdominal muscles during inhalation and expiration. Lastly, the participants practiced breathing for 20 minutes, following a prerecorded voice guide ("Breathe in-two-three-four, breathe out-two-three-four . . . ") over background music. During the remaining seven sessions, the participants only listened to the prerecorded voice guide and music while practicing breathing for 30 minutes. The nurse supervised each practice session and evaluated the breathing exercises to ensure that participants performed them correctly and did not fall asleep during the practice session. The participants were not required to practice the breathing exercises at home. For more details about the intervention, see Table 1.

The control group. The participants assigned to the control group were told that they were on a waiting list for the intervention and that placements would be made as space became available. After the posttest measurements were completed, the participants in the control group received four weeks of breathing training.

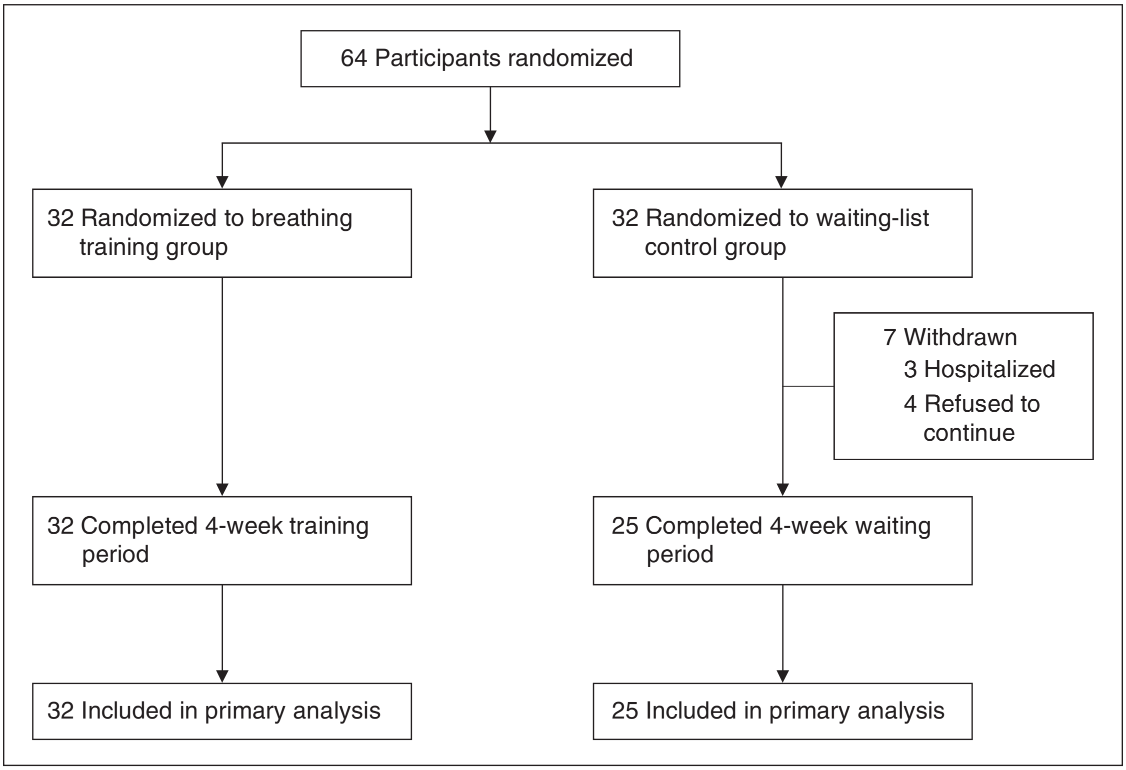
Primary and secondary outcomes. The primary outcome was self-reported depressive symptoms. The secondary outcomes were self-reported sleep quality and health-related quality of life.

Self-reported depressive symptoms. The severity of depression was measured using the Beck Depression Inventory II (BDI-II), Chinese version. The BDI-II, which consists of 21 multiple-choice self-report questions, is used to assess the intensity of a person's depression during the past two weeks.[32] The total score can range from 0 to 63, with lower scores indicating milder depressive symptoms. The validity and reliability of the BDI-II for both clinically depressed and normal patients are well established, and have been demonstrated for the BDI-II Chinese version as well.[33]

Self-reported sleep quality. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). The PSQI assesses a person's sleep during the previous month and consists of 19 self-report items: 15 multiple-choice items and four write-in items.[34] The multiple-choice items evaluate subjective sleep quality and frequency of sleep disturbances; the write-in items ask respondents to record their typical bedtime, sleep-onset latency, sleep duration, and wake-up time. The total score can range from 0 to 21, with lower scores indicating higher subjective sleep quality. The validity and reliability of the PSQI are well established. A Chinese version of the PSQI has exhibited satisfactory psychometric properties, including internal consistency, test–retest reliability, and contrast group validity.[35]

Health-related quality of life was assessed using the Medical Outcome Studies 36-Item Short Form Health Survey (SF-36). The SF-36 is used to measure a respondent's perceived health-related quality of life over the preceding four weeks. Higher scores indicate higher perceived quality of life. The validity and reliability of the SF-36 are well established, and the SF-36 Taiwan version has exhibited satisfactory psychometric properties as well.[36, 37] Standard SF-36 scoring algorithms were

Figure 1. Flow of Participants in the Study



used to determine subscale scores in eight domains: physical functioning, bodily pain, general health, vitality, mental health, role limitation due to physical health problems (role–physical), role limitation due to emotional problems (role–emotional), and social functioning. Physical component summary and mental component summary scores were also calculated.

Data collection. At baseline (Week 1), using a questionnaire we developed, we collected demographic data, as well as data on the use of sleeping pills, comorbidities (diabetes mellitus and heart disease), dialysis characteristics (frequency, shift, and number of years on dialysis, and type of vascular access), and dialysis treatment adequacy. Participants in both groups also completed the BDI-II, PSQI, and SF-36 before the four-week intervention began. Except for our questionnaire, the same tools were administered again one week after the four-week intervention period ended (Week 6).

An independent research assistant (S-HT) assessed the outcome measurements. The allocation sequence was concealed from the outcome assessor. Also, neither our questionnaire nor the three tools required any information that could be used to identify the group assignment of a participant.

Statistical analyses. Group differences in the distribution of biodemographic data and the parameters of dialysis treatment adequacy were analyzed using the independent *t* test or χ^2 test. The independent *t* test and Mann–Whitney *U* test were used to examine group differences in baseline data for continuous variables and in ordinal data, respectively.

An analysis of covariance (ANCOVA) model was applied to examine the effect of the intervention on depression, sleep quality, and health-related quality of life by using posttest scores as the dependent variable and group assignments as the independent variable. As the posttest scores were highly correlated with the baseline values, applying the baseline-adjusted ANCOVA may provide an unbiased estimate of the mean group differences, as has been recommended.[38, 39] The other covariates were factors that other studies in similar populations have found to be associated with depression, sleep quality, or health-related quality of life. Specifically, factors that may affect depression severity in patients on hemodialysis include sex, comorbidities (such as diabetes), and education level,[40] and these were treated as covariates in the ANCOVA model predicting depression. Factors treated as covariates in the model predicting sleep quality were age,[41] dialysis shift,[42] and certain laboratory parameters (serum phosphate levels[13, 43]). Factors treated as covariates in the model predicting health-related quality of life included age, duration of dialysis, and comorbidities.[9] Data were processed and analyzed using SPSS software, version 19.

RESULTS

Participant characteristics and treatment adequacy. Sixty-four participants were randomized equally to either the intervention or the control group. Three participants in the control group subsequently withdrew because of hospitalization; and four participants in the control group refused to complete posttest questionnaires at Week 6. Only the 57 participants who completed the posttest questionnaires were included in the data analysis. (See Figure 1 for the flow of participants through the study.)

Demographic data for the two groups were comparable, except that average body mass index was significantly lower in the control group. No differences were observed in sleeping pill use, comorbidities, characteristics of dialysis treatments, or parameters of dialysis treatment adequacy. See Table 2 for specific demographic data and measures of treatment adequacy (go to http://links.lww.com/AJN/A66).

Depressive symptoms. The two groups did not significantly differ in their baseline BDI-II scores. The BDI-II scores of the patients who received breathing training showed significantly greater decreases than those of controls after adjusting for baseline scores, sex, diabetes, and highest attained level of education in the ANCOVA model ($F = 6.97$, $P = 0.01$).

Sleep quality. No significant between-group differences were observed in baseline PSQI scores. The results of the ANCOVA analysis revealed no significant differences in the PSQI change scores after adjusting for baseline scores, age, dialysis shift, and serum phosphate levels.

Health-related quality of life. Study group scores for the eight domains and the two summary components of the SF-36 were comparable at baseline. The results of the ANCOVA analyses revealed that, after adjusting for baseline scores, age, duration of dialysis, and diabetes, the change scores were significantly higher in the intervention group than in the control group in both the role–emotional subscale ($F = 7.41$, $P = 0.009$) and the mental component summary ($F = 6.33$, $P = 0.02$). For more details on study outcomes by group, see Table 3.

DISCUSSION

This breathing training intervention, administered by a dialysis nurse in the dialysis center, significantly alleviated depressive symptoms in patients with CKD who were on maintenance hemodialysis. It also significantly improved patients' SF-36 scores in two quality-of-life areas: the role–emotional domain and the mental component summary.

The intervention's effect on depression. The results of our study revealed that with training, deep-breathing exercises practiced regularly in-center for four weeks can effectively reduce depression scores in this population. This beneficial effect was consistent with findings reported in a similar study conducted in patients with coronary heart disease.[29] Taken together, these findings suggest that breathing training may be used as a stand-alone behavioral modality for treating depression. It's also worth noting that the participants in our study practiced the breathing exercises in the dialysis center, but were not specifically required to practice them at home. Our results indicate that eight sessions of in-center breathing training can be an effective and feasible treatment for depression. This modality appears to offer nurses a novel way to relieve depression in and offer psychological support to a vulnerable population.

The intervention's effect on health-related quality of life. We found that certain mental dimensions of health-related quality of life (specifically, the role–emotional domain and the mental component summary as reflected by SF-36 scores) significantly improved in the intervention group compared with the control group. Other studies have yielded similar findings. One study among patients with obstructive sleep apnea syndrome explored the effects of an exercise program that incorporated relaxation breathing training.[44] The researchers found that, compared with controls, the intervention group showed significantly improved SF-36 scores in the vitality and mental health domains. And a systematic review of three studies of asthma patients found that quality of life increased after patients were trained in and practiced diaphragmatic breathing.[45]

Moreover, earlier studies have found links between depression and health-related quality of life in patients receiving hemodialysis.[9, 13] One study in particular found that patients with clinical depressive symptoms had significantly lower role–emotional and mental component summary scores than patients without such symptoms.[46] There is also evidence that in patients with CKD, depression has undermined patients' mental health and altered subjective perceptions of physical status, functional capacity, and social function.[8] In light of this, the alleviation of depression may improve patients' ability to overcome problems, and this effect may be reflected in the increased role–emotional and mental component summary scores we observed.

The intervention's effect on sleep quality. Contrary to our expectations, our data indicated that breathing training did not significantly improve sleep quality in patients receiving hemodialysis, even though a close relationship between depression and sleep quality has been observed in previous studies.[10-12, 47] In addition to the factors for which we adjusted in the ANCOVA analyses, other factors that have reportedly influenced sleep quality in this population include anemia,[43, 48] pain,[49] and medications.[50] One study reported physiological factors (including breathing problems, snoring, and pruritus) to be frequent causes of sleep disorders in patients receiving hemodialysis.[51] Thus, we concluded

Table 3. Group Comparisons of Study Outcomes

Variables		Control Group (n = 25)	Intervention Group (n = 32)	Analyses
BDI-II score, mean ± SD	Baseline	11.04 ± 8.74	8.78 ± 6.06	$t = 1.15$,[a] $P = 0.26$
	Posttest	9.56 ± 8.91	5.09 ± 5.3	$F = 6.97$,[b] $P = 0.01$
PSQI score, mean ± SD	Baseline	9.32 ± 4.07	9.06 ± 2.94	$t = 0.28$,[a] $P = 0.78$
	Posttest	8.8 ± 2.97	8.34 ± 3.55	$F = 0.45$,[c] $P = 0.51$
SF-36 domain and summary scores, mean ± SD				
Physical functioning	Baseline	44.2 ± 30.27	44.53 ± 29.49	$t = -0.04$,[a] $P = 0.97$
	Posttest	44.8 ± 28.78	38.91 ± 28.31	$F = 0.56$,[d] $P = 0.46$
Bodily pain	Baseline	65.64 ± 25.05	76.53 ± 20.47	$t = -1.81$,[a] $P = 0.08$
	Posttest	70.4 ± 24.76	74.84 ± 24.42	$F = 0.41$,[d] $P = 0.53$
General health	Baseline	34.4 ± 16.75	41.59 ± 13.38	$t = -1.80$,[a] $P = 0.08$
	Posttest	43.08 ± 13.47	45.44 ± 13.6	$F = 0.01$,[d] $P = 0.93$
Vitality	Baseline	40.8 ± 23.44	45.63 ± 20.27	$t = -083$,[a] $P = 0.41$
	Posttest	46.2 ± 19.49	55 ± 17.83	$F = 2.66$,[d] $P = 0.11$
Social functioning	Baseline	71 ± 19	75 ± 17.96	$t = -0.81$,[a] $P = 0.42$
	Posttest	74 ± 16.89	75.78 ± 19.3	$F = 0.42$,[d] $P = 0.98$
Mental health	Baseline	60.48 ± 20.83	61.06 ± 15.89	$t = -0.12$,[a] $P = 0.91$
	Posttest	63.52 ± 15.85	66.31 ± 16.9	$F = 0.94$,[d] $P = 0.34$
Role–physical	Baseline	26.00 ± 33.45	39.06 ± 40.13	$t = -1.31$,[a] $P = 0.19$
	Posttest	33.00 ± 35.15	34.38 ± 35.78	$F = 0.24$,[d] $P = 0.63$
Role–emotional	Baseline	57.33 ± 44.64	55.21 ± 43.67	$t = 0.18$,[a] $P = 0.86$
	Posttest	52.00 ± 42.03	73.96 ± 35.66	$F = 7.41$,[d] $P = 0.009$
PCS	Baseline	33.71 ± 8.52	37.59 ± 9.10	$t = 0.68$,[a] $P = 0.11$
	Posttest	36.26 ± 8.00	34.70 ± 9.16	$F = 2.92$,[d] $P = 0.09$
MCS	Baseline	45.95 ± 10.89	45.83 ± 8.96	$t = -2.13$,[a] $P = 0.5$
	Posttest	46.45 ± 8.62	51.64 ± 9.49	$F = 6.33$,[d] $P = 0.02$

BDI-II = Beck Depression Inventory II; MCS = mental component summary; PCS = physical component summary; PSQI = Pittsburgh Sleep Quality Index; SF-36 = Medical Outcome Studies 36-Item Short Form Health Survey.
[a] Tested using an independent *t* test.
[b] Tested using ANCOVA, with group as the independent variable and baseline scores, sex, diabetes, and highest attained level of education as the covariates.
[c] Tested using ANCOVA, with group as the independent variable and baseline scores, age, dialysis shift, and serum phosphate level as the covariates.
[d] Tested using ANCOVA, with group as the independent variable and baseline scores, age, duration of dialysis, and diabetes as the covariates.

that many factors other than depression affect sleep in such patients.

Moreover, significantly improved sleep quality has been observed in patients on dialysis who participated in a six-week case management intervention delivered via telephone[52] and in those who participated in a four-week sleep hygiene education program.[53] This suggests that, to improve the capacity of patients on dialysis to cope with sleep problems, interventions that assess an individual's sleep hygiene and provide targeted behavioral and environmental practices are needed.

In an earlier study of patients with cardiac disease that explored the effects of a relaxation training treatment that incorporated deep breathing exercises, participants in the treatment group experienced significantly improved sleep quality compared with controls.[54] In that study, participants engaged in relaxation training daily until hospital discharge. And in a more recent study, patients receiving hemodialysis experienced improved sleep quality after practicing Benson's relaxation technique for 20 minutes twice daily for eight weeks.[55] (Benson's technique involves progressive muscle relaxation while attending to one's breathing.) Our results may indicate that a four-week, eight-session breathing training intervention may not be potent enough to exert a treatment effect on sleep.

Previous studies have demonstrated that slow, steady breathing contributes to increased parasympathetic nervous system activity,[56] consequently producing a relaxation response. In our study, the deep-breathing exercise performed before the dialysis session likely produced an immediate relaxation response, increasing the possibility that the patient would fall asleep during dialysis. There is some evidence that hemodialysis disrupts normal sleep patterns, causing daytime sleepiness; and daytime naps may be associated with disturbed nocturnal sleep.[57] In our study, naps during hemodialysis that were induced by predialysis breathing exercises may have played a role in the intervention's nonsignificant effect on sleep quality.

Limitations. First, because the sample size was based on the number of participants needed to permit detection of a treatment effect on the primary outcome (depression), it may have been too small to permit detection of treatment effects on sleep quality or on all domains of health-related quality of life. Second, the difference in the between-group attrition rate may have affected the validity of our results. Third, we collected only information on *subjective* sleep quality. A meta-analysis of 23 randomized controlled trials of behavioral interventions for insomnia found that such interventions substantially improved sleep latency and waking after sleep onset.[58] Future studies can use polysomnography or actigraphy to assess sleep parameters objectively, thus clarifying the effect of breathing training on sleep. We also did not collect information on participants' napping behavior for either group; future studies should investigate any changes in this behavior. Determining whether the deep-breathing exercises induced napping might further clarify their effect on sleep. Lastly, we did not use an active control group in this study. Thus, either the expectation effect or the placebo effect, which can result from enrollment in an intervention group, may have affected the results.

CONCLUSIONS

We found that a nurse-led, eight-session breathing training program effectively alleviated depressive symptoms in patients receiving hemodialysis and improved certain mental aspects of health-related quality of life, including the role–emotional domain and the mental component summary as reflected by SF-36 scores. Deep-breathing training can be readily integrated into the care of such patients by nurses in dialysis centers. Moreover, this modality may be a useful tool that any nurse might use to ease depression in chronically ill patients in other settings. ▼

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