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ORIGINAL ARTICLE

Mental Health

Effects of using a stress ball on anxiety and depression in patients undergoing hemodialysis: A prospective, balanced, single-blind, crossover study

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Abstract

Introduction: Use of a stress ball is a known *t* non-pharmacological method to distract attention and to relieve stress and anxiety. The goal of our study was to evaluate the effect of stress ball use on anxiety and depression in hemodialysis patients.

Methods: The study utilized a single-blind, balanced crossover design. There were two sequential 4-week intervention periods separated by a 4-day washout period. During one intervention period stress ball use at home was encouraged while the other 4-week "intervention" period served as a control. The order in which the two evaluation periods were applied was randomized for a given patient. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale before and after each 4-week intervention period.

Findings: A total of 65 patients participated in this study. There were statistically significant reductions in both anxiety ($p < 0.001$) and depression ($p < 0.001$) during the stress ball intervention periods vs. no change during the control interventions. A delayed follow-up evaluation showed that the anxiety level of patients remained reduced after 1 month of no longer using a stress ball.

Discussion: The use of a stress ball at home for 4 weeks significantly decreased anxiety and depression levels in our group of hemodialysis patients.

KEYWORDS
anxiety, depression, hemodialysis, stress ball

INTRODUCTION

Hemodialysis is stressful and poses psychological and social challenges to patients.[1] In addition to dealing with a chronic disease, patients on hemodialysis also experience pain, fatigue, weakness, anxiety, stress, and a feeling of inadequacy.[2] Anxiety is a common symptom, experienced by up to 31% of patients on dialysis, and high levels of anxiety have been associated with a decrease in patients' adherence to treatment, deterioration in quality of life, and increases in hospitalizations and mortality rates.[3,4] Depression is another common challenge and one of the most important psychological problems among patients undergoing hemodialysis.[5] On one meta-analysis, the prevalence of depression was 39% as evaluated using a screening questionnaire, and 23% as evaluated using clinical interviews.[6] Therefore, stress management in patients on dialysis can play a key role in reducing anxiety and depression and maintaining both physical and mental well-being.[7]

TABLE 1 Time frame of the groups' periods.

Sequence	First period				Wash-out period	Second period			
SB-CTRL	M-W-F pts. Stress ball (+)				4 days	M-W-F pts. Stress ball (−)			
CTRL-SB	T-Th-Sat pts. Stress ball (−)					T-Th-Sat pts. Stress ball (+)			
Week	1	2	3	4		1	2	3	4

Abbreviations: CTRL-SB, control-stress ball; M-W-F, patients dialyzed on Monday, Wednesday, and Friday; SB-CTRL, stress ball-control; T-Th-Sat, patients dialyzed on Tuesday, Thursday, and Saturday.

Use of a stress ball is a non-pharmacological method of distracting individuals who are consciously focused on a stimulus.[8] Stress balls have been used to reduce stress, tension, and anxiety. The nerves of the hands are stimulated by squeezing the ball, and the resulting stimulus is sent to the limbic region of the brain.[9,10] Currently there is limited scientific research to support such a mechanistic hypothesis, however, using a stress ball is an easy and cost-effective method for relieving the mind of stress and maintaining mental well-being.[11]

The few available studies on the effects of using stress balls on anxiety have reported varying results in different patient groups. The use of a stress ball during surgical operations has been reported to reduce patient levels of anxiety.[12,13] On the other hand, a study reported that using a stress ball during a skin excision had no effect on anxiety.[14] One study evaluated the effect of using a stress ball on anxiety levels[15] in patients undergoing dialysis and did find a benefit. No study has evaluated the effect of stress ball use on depression in hemodialysis patients. Our study aimed to evaluate the effects of short-term stress ball use on anxiety and depression in patients undergoing dialysis.

MATERIALS AND METHODS

Study design

This study was conducted using a single-blind, balanced, controlled, crossover design. There were two intervention periods of 4 weeks each, applied sequentially, and separated by a 4-day washout period. During one 4-week period, patients were instructed in using a stress ball at home, and during the other intervention period, which was a control, a stress ball was not used. The order in which these two intervention periods were applied was balanced: half of the patients began with the stress-ball intervention period, and the other half began with a 4-week control period. After the washout period, patients were instructed in the opposite intervention. The design could be summarized as sequence stress ball-control (SB-CTRL) for half of the patients and sequence control-stress ball (CTRL-SB) for the other half of the patients (Table 1). This design was modeled after a study that evaluated the effects of listening to music on various outcome parameters in hemodialysis patients that included anxiety and depression.[16]

Setting and participants

This study included patients who were treated in the hemodialysis unit of a state hospital in Turkey between April and August 2022. The study was offered to patients aged 18 years and older who had been treated with hemodialysis for at least 3 months, given thrice a week for 4 h per session. Additional inclusion criterion was absence of a psychiatric disorder that would prevent communication. Patients with any health problems related to the hand or arm with which they would handle the stress ball were excluded.

Sample size

The PASS 2022 program[17] was used to calculate the sample size. The target alpha value was 0.05 and targeted beta value was 20%, using two-tailed test. The sample size analysis suggests that at least 24 individuals would be required in each group. A value 20% higher than the sample-size calculated value was targeted in anticipation of a patient dropout rate of 20%.

Sequence of treatment assignment and masking

Patients undergoing hemodialysis sessions on Monday, Wednesday, and Friday were assigned to *Sequence CTRL-SB* (*control*, *stress ball*), while those undergoing sessions on Tuesday, Thursday, and Saturday were assigned to

Sequence SB-CTRL to minimize the chances of any time-related and carryover effects and to limit the chances of patients influencing one another.

Intervention protocol

Period SB: At the start of the 4-week stress ball intervention period, the patients were instructed on how to use the stress ball. The patients were asked to demonstrate use of the ball, and it was confirmed that they could use the ball correctly. The patients were asked to use the ball for at least 10 min during each dialysis treatment and whenever they felt stressed or unwell at home or at work. Patients with an arteriovenous fistula or arteriovenous graft were instructed to use the stress ball in the contralateral hand, that is, using the arm in which there was no vascular access.

Patients were instructed to squeeze and release the ball once after counting to three, to inhale each time they squeezed the ball, exhale when they loosened their grip, and focus only on the ball.[11,18] The stress ball used was of medium hardness and was made of high-quality silicone. The balls were provided to the patients free of charge. The patients used the stress ball for 1 month and recorded the time they spent using the ball at home and at work. At the end of each dialysis session, the researchers recorded how long a patient had used the ball at home or work, according to information provided by the patient.

Period CTRL: During the control "intervention" period, the patients did not use a stress ball.

Measurement of depression and anxiety: The Hospital Anxiety and Depression Scale (HADS)[19] was used, administered by dialysis unit nurses who were blinded to the intervention to which each patient was assigned. The HADS was evaluated four times for each patient (at the start, at the end of each 4-week intervention period). Information and training on how to evaluate the forms were provided to nurses by the second co-author.

A questionnaire on the descriptive characteristics of the participants as well as the HADS questionnaire were filled in by face-to-face interviews with the patients on the day of commencement of the study. At the end of 1 month, HADS was completed by an independent dialysis nurse. A 4-day period followed, serving as a wash-out period.

Outcomes

Data were collected with questionnaires on the descriptive characteristics of the participants and HADS.

Questionnaire on the participants' descriptive characteristics: This semi-structured form, which was developed by the researchers after reviewing relevant literature,[2–4,8,11,12,16,18] was comprised of 10 questions regarding sociodemographic and medical data.

Hospital Anxiety and Depression Scale (HADS): This scale was developed by Zigmond and Snaith to determine the risk of anxiety and depression in patients, and to measure the level and change in severity.[20] A validity and reliability study of the scale in Turkey was performed by Aydemir, Güvenir, Küey, and Kültür.[19] Seven of the 14 questions are designed to measure anxiety, while seven other questions measure depression. Responses are scored using a four-point Likert scale between 0 and 3 points. The lowest score that patients could obtain on both subscales was 0, and the highest score was 21. The cutoff points in the Turkish version of the HADS were 10 and 7 for the anxiety and depression subscales, respectively.[19]

Ethical considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki. The study was approved by the local ethics committee (Meeting Date: February 28, 2022, Decision No: 2022/014). We obtained all necessary institutional permission and written informed consent from the participants. The trial was registered on the ClinicalTrials.gov website number with NCT05533398.

Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows version 25.0 (IBM Corp.) and Number Cruncher Statistical Systems, v.2021 (NCSS, LLC., Utah, ABD) statistical software. In the representation of descriptive statistics of continuous numerical variables: number (n), percent (%), and mean ± standard deviation were used. The analysis of the crossover design experiment was performed using the "t-test for 2 × 2 crossover design." In this study, the statistical significance of the effect between applications, period, and transfer effects was investigated. All p values <0.05 were considered statistically significant.

RESULTS

Socio-demographic and clinical variables

A total of 65 participants, including 33 following *Sequence SB-CTRL* treatments (stress ball followed by

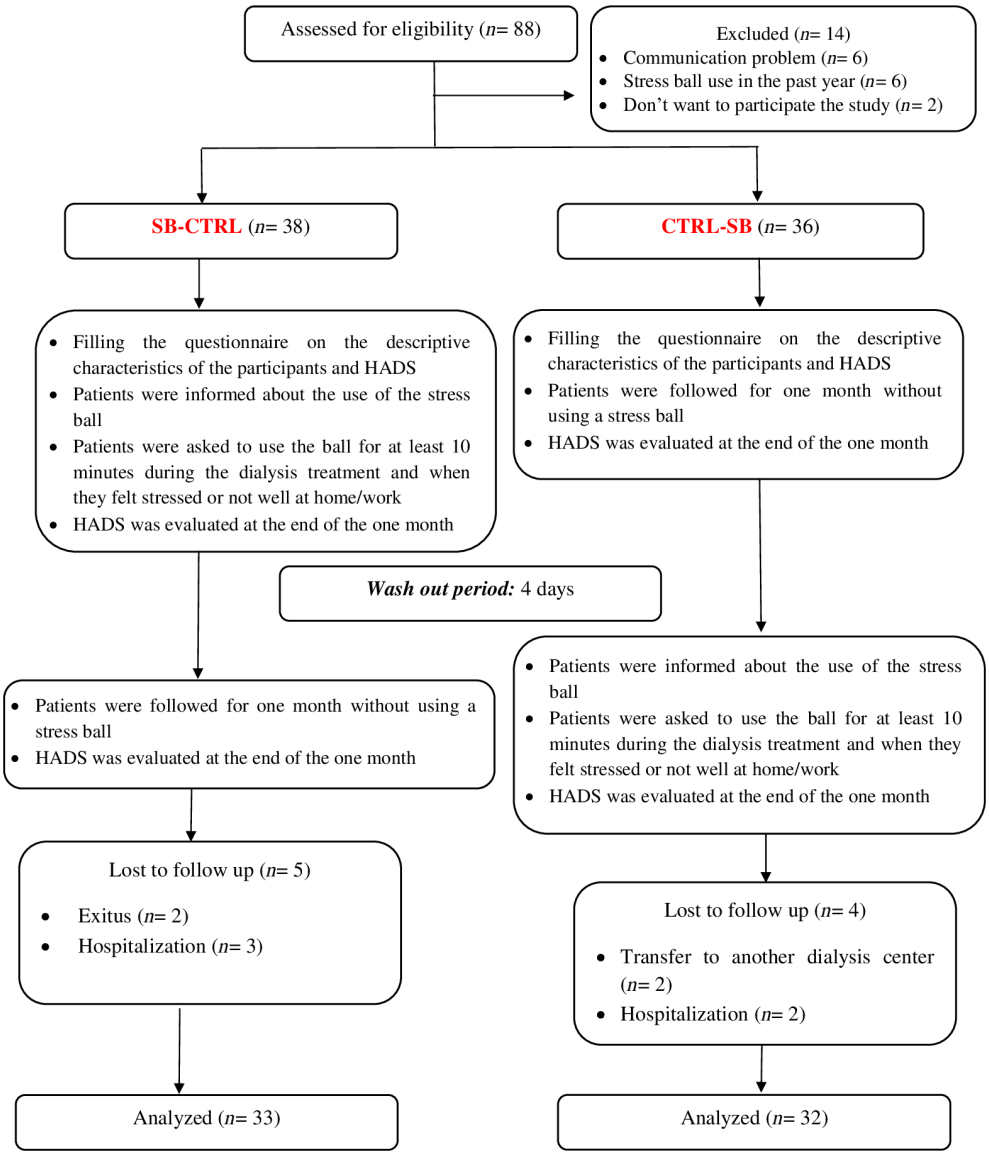

FIGURE 1 Flow of participants through trial [Color figure can be viewed at wileyonlinelibrary.com]

control) and 32 following *Sequence CTRL-SB* (control followed by stress ball) were included in the final analysis (Figure 1). There were no statistically significant differences between the two groups in terms of the sociodemographic and clinical characteristics ($p > 0.05$) (Table 2).

Anxiety

In the Monday–Wednesday–Friday (M-W-F) patients, who underwent the interventions in SB-CTRL order, during the stress ball intervention, a statistically significant reduction in anxiety score was observed between the pre-test and post-test values. ($p < 0.001$). There was no statistically significant difference in pre-test versus, post-test anxiety scores during the control intervention period ($p > 0.05$).

In the Tuesday–Thursday–Saturday (T-Th-Sat) patients, who underwent the interventions in CTRL-SB order, there was no statistically significant difference between the pre-test and post-test values in anxiety scores during the initial control period ($p > 0.05$), but there was a statistically significant difference between the pre-test and post-test anxiety scores during the stress ball period ($p = 0.009$).

Figure 2 and Table 3 show the mean change curves for anxiety scores during the control and stress ball intervention periods for the two groups.

Depression

In the M-W-F patients, who underwent the interventions in SB-CTRL order, a statistically significant difference was observed between the pre-intervention and post-intervention depression scores for the stress ball period

TABLE 2 Comparison of baseline characteristics of the groups ($n = 65$).

Variables		M-W-F patients (sequence SB-CTRL) ($n = 33$)		T-Th-Sat patients (sequence CTRL-SB) ($n = 32$)			
		n	%	*n*	%	Statistic	*p-value*
Sex	Female	11	33.3	16	50.0	1.858	0.173
	Male	22	66.7	16	50.0		
Educational status	Not literate	8	24.2	3	9.4	3.372	0.289
	Literate	11	33.3	9	28.1		
	Secondary school	11	33.3	17	53.1		
	High school and uper	3	9.1	3	9.4		
Income status	Income less than expense	27	81.8	30	93.8	1.180	0.277
	Income equal to expense	6	18.2	2	6.3		
Presence of chronic disease	Yes	19	57.6	21	65.6	0.170	0.505
	No	14	42.4	11	34.4		
HT*	No	16	48.5	16	50.0	0.015	0.903
	Yes	17	51.5	16	50.0		
DM *	No	22	66.7	22	68.8	0.032	0.857
	Yes	11	33.3	10	31.3		
CHF*	No	28	84.8	27	84.4	0.003	0.958
	Yes	5	15.2	5	15.6		
Vascular access	AVF	29	87.9	26	81.3	0.548	0.459
	CVC	4	12.1	6	18.8		
Age (year)		48.24 ± 16.59		50.72 ± 14.10		−0.648	0.520
Hemodialysis treatment duration (months)		70.61 ± 40.67		56.53 ± 47.15		−1.706	0.088
Height (cm)		166.0 ± 7.68		163.84 ± 9.35		1.018	0.313
Weight (kg)		69.24 ± 13.63		68.59 ± 19.20		0.157	0.876

Note: Data were presented as *n* (%) or median ± standard deviation. * *n* was folded.
Abbreviations: AVF, arteriovenous fistula; CTRL-SB, control-stress ball; CVC, central venous catheter; CHF, chronic heart failure; DM, diabetes mellitus; HT, hypertension; M-W-F, patients dialyzed on Monday, Wednesday, and Friday; SB-CTRL: stress ball-control; T-Th-Sat, patients dialyzed on Tuesday, Thursday, and Saturday.

($p < 0.001$), while there was no statistically significant difference between the pre-test and post-test depression scores for the control period ($p > 0.05$).

In the T-Th-Sat patients, who underwent the interventions in CTRL-SB order, there was no statistically significant difference between the pre-test and post-test depression scores for the control period, ($p > 0.05$). The decrease in depression scores during the SB intervention period was of borderline statistical significance ($p = 0.52$), Table 3. Figure 3 and Table 3 show the mean change curves for depression scores during the control and stress ball intervention periods for the two groups.

Cross-design analysis results about anxiety

The estimated value of the period effect and transferred effect were calculated as −2.297 and 4.304, respectively. When the 95% confidence interval of the estimated values was examined, it did not include zero, which indicated a *p*-value of <0.05. The difference between the periods when stress balls were used vs. control periods was statistically significant ($t = 3.5752$; $p < 0.001$) (Table 4).

Cross-design analysis results about depression

The estimated values of the period and transferred effects were calculated as −1.663 and 4.170, respectively. When the 95% confidence interval of the estimated values was examined, it did not include zero, which indicated a *p*-value of <0.05. The difference between the periods when a stress ball was used vs. the control periods was statistically significant ($t = 3.087$; $p < 0.001$) (Table 4).

DISCUSSION

This single-blind, balanced, controlled crossover study revealed that patients on dialysis had decreased levels of anxiety and depression during 1-month periods during which they were using a stress ball, while anxiety and depression levels were unchanged during 1-month control periods during which a stress ball was not used.

Patients undergoing chronic hemodialysis therapy are subject to multiple stressful and life-threatening situations from the moment of diagnosis[21]; moreover, these situations have been shown to have a negative effect on quality of life as well as on patients' physical, emotional,

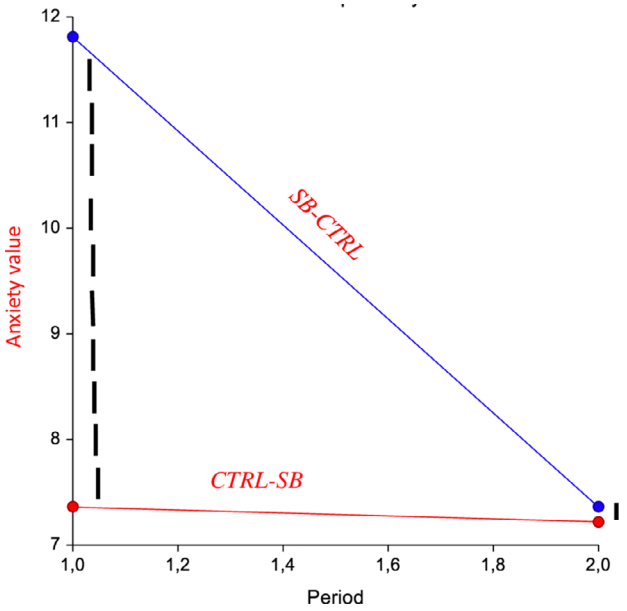

FIGURE 2 Trends in anxiety for the SB-CTRL and CTRL-SB. [Color figure can be viewed at wileyonlinelibrary.com]

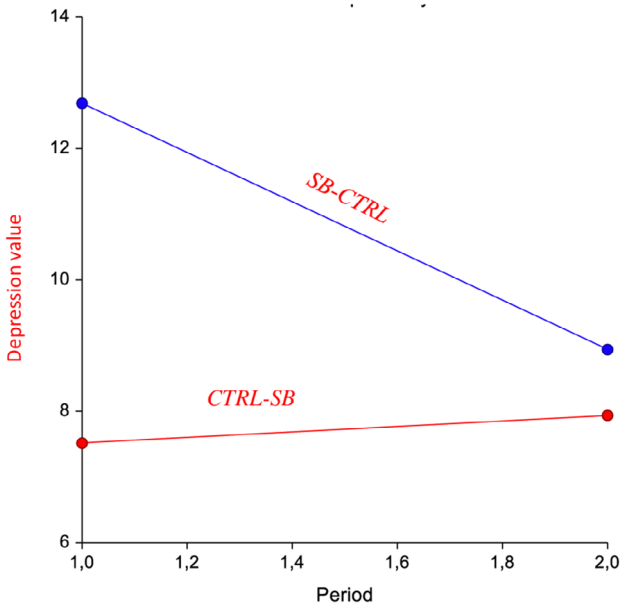

FIGURE 3 Trends in depression for the SB-CTRL and CTRL-SB. [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Anxiety and depression levels before and after patients according to method and order group.

Sequence	Before stress ball Mean ± SD	After stress ball Mean ± SD	*t*	*p*	Before stress ball Mean ± SD	After stress ball Mean ± SD	*t*	*p*
Anxiety								
	M-W-F patients ($n = 33$)							
	SB intervention				Control intervention			
SB-CTRL	12.06 ± 6.46	7.36 ± 4.30	3.881	**<0.001***	12.34 ± 4.51	11.81 ± 4.62	1.080	0.288
	T-Th-Sat patients ($n = 32$)							
	Control intervention				SB intervention			
CTRL-SB	6.48 ± 3.49	7.36 ± 4.02	−1.275	0.211	8.69 ± 4.48	7.22 ± 3.76	−2.797	**0.009***
Depression								
	M-W-F patients ($n = 33$)							
	SB intervention				Control intervention			
SB-CTRL	12.7 ± 6.11	7.52 ± 3.87	4.271	**<0.001***	13.19 ± 5.27	12.69 ± 5.35	1.149	0.260
	T-Th-Sat patients ($n = 32$)							
	Control intervention				SB intervention			
CTRL-SB	7.15 ± 3.42	8.94 ± 4.35	1.777	0.085	9.56 ± 4.59	7.94 ± 3.62	2.024	0.052

Note: Data were mean ± standard deviation (SD). t = Dependent sample t-test.
Abbreviations: CTRL-SB, control-stress ball; SB-CTRL: stress ball-control.
*$p < 0.01$.

TABLE 4 Cross design analysis results chart about anxiety and depression.

Parameter	Estimated effect	Standard deviation	Test value	*p-value*	95% confidence interval	
					Lower	Upper
Anxiety						
P_2–P_1	−2.297	0.642	−3.5752	**<0.001****	−3.581	−1.013
C_A–C_K	4.304	1.632	2.6375	**0.010***	1.043	7.565
Depression						
P_2–P_1	−1.663	0.645	−2.5775	**0.012***	−2.952	−0.374
C_A–C_K	4.170	1.728	2.4129	**0.018***	0.716	7.624

Abbreviations: C, carryover effect; P, period effect.
*$p < 0.05$.
**$p < 0.01$.

and social conditions.[22] Studies show that there is a high prevalence of anxiety in patients undergoing chronic hemodialysis therapy.[23] One previous study evaluated the effect of using a stress ball on anxiety in patients undergoing dialysis.[15] In that study, by Nurdina et al.[15] after patients used a stress ball for approximately 20–30 min during eight hemodialysis sessions, their anxiety levels decreased significantly.

In our study, we found similar results: Use of a stress ball at home for a 1-month period decreased anxiety levels, and the anxiety level of these patients remained low for the month following, during which a stress ball was not used. Depression is an important problem in patients undergoing dialysis, and depressed dialysis patients are often underdiagnosed and to untreated.[24,25] In our study, we observed that the use of a stress ball for 1 month caused a decrease in the patients' levels of depression.

Strengths and limitations

One of the strengths of our study was the fact that each patient served as his or her own control. Also, the balanced design helped to control for time-dependent and carryover effects. We were able to demonstrate that the anxiety level of the patients remained low up to 1 month after the discontinuation of using stress balls. A novel finding was, that using a stress ball was effective for reducing the degree of depression, which is frequently overlooked in patients undergoing hemodialysis.

Our study has some limitations. Anxiety and depression were evaluated using a subjective scale based on patient reports. Second, the patients' non-use of the stress ball during the control intervention period was based on their own statements. No objective measurements were made regarding the duration of use. Our results are not broadly generalizable, as the study was conducted at a single dialysis center.

In conclusion, 1-month use of a stress ball was found to reduce anxiety and depression in patients undergoing dialysis. Stress balls can be offered to patients as a cost-effective, non-pharmacological method for managing anxiety and depression.

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CONFLICT OF INTEREST STATEMENT

No conflict of interest has been declared by the author(s).

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