A quasi-experimental study to assess the effect of Benson's relaxation on anxiety and depression among patients with heart failure in Jordan

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Background: Despite advancements in treatment, heart failure (HF) remains a leading cause of death. Anxiety and depression (A&D) are highly prevalent among patients with HF, negatively impacting their mortality, and morbidity. The Benson relaxation technique (BRT) is a non-pharmacological approach that is easy to learn, use, and apply for reducing A&D. This study aimed to investigate the effectiveness of the BRT in reducing A&D among patients with HF in Jordan.

Methods: This quasi-experimental pre and post-design study involved a consecutive sample of 204 participants with a confirmed diagnosis of HF. Data were collected from four hospitals in Jordan.

Results: A total of 204 patients participated in this study, with 138 males and 66 females. The mean A&D scores for the sample at baseline were 11.09±2.60 and 10.80±2.30, respectively. In the intervention group, there was a statistically significant difference between pre-intervention anxiety and post-intervention anxiety levels (P<0.001), as well as between pre-intervention depression and post-intervention depression levels (P<0.001). In contrast, the control group showed no statistically significant differences between pre-intervention and post-intervention A&D levels (P=0.83 and P=0.34) respectively.

Conclusion: BRT can be used as an adjunctive intervention for patients with HF to reduce A&D. Healthcare professionals should consider incorporating BRT into treatment plans, while nursing departments can lead its implementation.

Key Words: anxiety; depression; heart failure; relaxation therapy

INTRODUCTION

Heart failure (HF) is a prevalent and debilitating condition that affects 1% to 2% of the global population and is the leading cause of cardiovascular disease-related mortality worldwide [1,2]. In the United States, Europe, Africa, and Asia, there are millions of persons living with HF [3,4]. Arab nations, such as Jordan, Egypt, Sudan, and Saudi Arabia, also face a serious HF problem [5]. Patients' life are impacted by HF which is also the top cause of hospital admis-
sions and re-admissions [6]. As a result, HF results in increased healthcare resource use, hospitalizations, and death.

In addition to physical symptoms of HF which include: edema, fatigue, shortness of breath, and insomnia, Anxiety and depression (A&D) are among common psychological symptoms among this population [5,7]. Prevalence estimates for anxiety in HF patients range from 11% to 70%, and estimates for depression from 9 to 96.1% [7-9]. Patients’ quality of life (QoL) might be negatively affected by A&D since it weakens their capacity to perform activities of daily living [10]. Anxiety and depression are among many variables that influence the outcomes for patients with HF [11,12]. Sex, age, marital status, social support, New York Heart Association (NYHA) functional class, and other demographic characteristics all play a role [11,12].

The physical, mental, and social components of health, as well as QoL, are all negatively impacted by HF. Patients with HF have a 4- to 5-fold greater prevalence of A&D than the general population [13]. As a result of A&D, QoL suffers, treatment fails more often, and more people die and get sick. Their effects on patients are both physical and psychological. QoL declines in patients with HF and have been linked to A&D independently [5,13].

However, there is some inconsistency in the literature on A&D in HF due to various diagnostic criteria and study methodologies [5,14]. Anxiety and depression can cause emotional discomfort, which in turn can reduce treatment adherence and raise the risk of complications and death. While anxiety is not regarded as an independent predictor due to its lesser incidence, depression is a substantial and independent risk for all causes of mortality in patients with HF. Therefore, reducing A&D in patients with HF is a goal of several interventions, including behavioral relaxation training [9,13-16]. Interventions to decrease and manage A&D rates within this cardiac group are thus strongly encouraged.

Non-pharmacological interventions like the Benson relaxation technique (BRT) have been demonstrated to be beneficial in lowering A&D and increasing the quality of sleep in a variety of patients [17]. Although this strategy has been found to be beneficial in lowering A&D in patients undergoing dialysis, emergency treatment [18], and burn rehabilitation [19], its efficacy among patients with HF has not yet been studied.

Dr. Herbert Benson created BRT to alleviate stress and sadness by activating the parasympathetic nerve system [18]. The method calls the practitioner to sit or lie down, close their eyes, loosen their muscles, and concentrate on their breathing while silently repeating a word or phrase. To acquire the appropriate level of relaxation, BRT should be done for 10–20 minutes daily for 8 weeks [18].

Research shows that BRT can assist a wide range of patients experience less pain, worry, and tension, as well as better sleep and general health [20,21]. Diseases of the digestive tract, nervous system, and cardiovascular system have all benefited from its use [22]. Patients of various ages can benefit from BRT, and nurses can easily instruct them how to use it. In general, BRT is a healthy way to unwind and boost patients’ well-being. An evaluation of the research found that BRT can help people with HF have a better night’s rest by decreasing sleep latency and minimizing sleep disruptions [22]. Pain relief from acute coronary syndrome and better quality of sleep in individuals with chronic cardiac conditions and the QoL after open heart surgery have all been attributed to BRT [23]. Two other studies also showed that BRT significantly reduced anxiety levels among patients undergoing open heart surgery and coronary artery bypass grafting [24,25]. However, one research reported no statistically significant reduction in anxiety among ICU patients with HF who had been given BRT [26].

This research examines whether the BRT reduces A&D among patients with HF. The study was planned to answer the following research questions: (1) what the level of A&D is do patients with HF have, (2) is there a difference in A&D levels based on sociodemographic and clinical characteristics, (3) what the effect of BRT on A&D levels among patients with HF is?

**KEY MESSAGES**

- Benson relaxation technique (BRT) is effective in alleviating symptoms of anxiety and depression among patients with heart failure undergoing outpatient care.
- BRT is an easy, cost-effective intervention that can be implemented by the healthcare team members for effective management of anxiety and depressive symptoms.
- Assessment of anxiety and depressive symptoms among patients with heart failure is necessary to start treatment as early as possible if necessary.
- Long-term effects of BRT and its potential influence on patient outcomes including hospitalization rates and death require more study.
MATERIALS AND METHODS

Study Design
A quasi-experimental pre- and post-design was used. It included two groups of patients diagnosed with HF. The intervention group is the group that used the BRT, and the control group is the group in the experiment without researchers’ intervention.

Study Setting
The healthcare system in Jordan consists of four main sectors: (1) The (public) government sector linked to the Ministry of Health and consists of 31 hospitals with a capacity of 4,738 beds, (2) Royal Medical Services - the military sector, consisting of 13 hospitals and containing 2,526 beds, (3) teaching hospitals: an educational sector with two hospitals containing 1,191 beds, (4) Private hospitals: the private sector, consisting of 61 hospitals, containing 4,419 beds [27]. Participants were recruited from four hospitals in Jordan. The hospitals concerned are a government hospital, a private hospital, a teaching hospital, and a hospital for the Royal Medical Services. These hospitals are considered as a referral hospital for patients with HF.

Patient Population
A consecutive sampling technique was used to recruit participants for this study. In this type of sampling, every patient visiting the study sites during the data collection period was screened for inclusion and exclusion criteria. Participants who meet the inclusion criteria and agrees to participate, were included in the study until the required sample size was achieved. Patients who agreed to participate in the BRT, was assigned to the intervention group. Patients who agreed to participate in the study but refused to be in the intervention group, was be asked to be in the control group.

The patients were included in the study if (1) they had a confirmed diagnosis of HF by a cardiologist, and (2) aged 18 years or over. Patients were excluded from the study if they: (1) had any chronic disease that might affect QoL such as cancer, (2) have been diagnosed with (anxiety or depression), and (3) are taking anti-anxiety or antidepressant medications.

The sample size was calculated by the G* power program using the following assumptions: (1) Power of 0.8, (2) α 0.05, (3) medium effect size of 0.25. Also, the following: descriptive statistics for question one, independent t-test or analysis of variance (ANOVA) with post hoc including four groups for question two and independent and paired t-test for question three. Based on these assumptions, the total number required was 128 for independent t-test, 180 for ANOVA, and 68 for the paired t-test. Based on that the need sample size is 180 participants. Due to the longitude nature of the study, the possible dropout 10% of the sample size was therefore, the size was 204.

Ethical Considerations
This study was approved by the Institutional Review Board Committee at Faculty of Nursing, Applied Science Private University (No. 2020-2021-2-2) and from all institutions prior to the data collection phase. All patients’ rights including privacy, dignity and confidentiality were guaranteed on the basis of ethical principles. All patients’ data retrieved were kept in a locked cabinet so that only the researcher can access it. Furthermore, the data were encoded and entered into a password-protected computer with access granted only to the investigator and the principal advisor. Also, the total data used for publication were be kept without any patients’ identifiers and were used in aggregate form. In addition, all participants signed an informed consent prior to data collection to ensure they understood the study, its purpose, benefits, and risks to ensure voluntary participation.

Data Collection
The researcher contacted the heart clinics and took the approval from the nursing office and the doctor in charge to start collecting data from the patients. Data collected using the Arabic version of Hospital Anxiety and Depression Scale (HADS) to measure A&D levels. Data collected for each patient included demographic information age, ejection fraction (EF), years of disease, sex, history of hypertension (HTN) history of diabetes mellitus (DM), history of previous (myocardial infarction, stent, and angina), marital status, educational level, and NYHA classification. NYHA classification was described based on the symptoms as the following. Class I: no limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea (shortness of breath), class II: slight limitation of physical activity. Comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea (shortness of breath), class III: marked limitation of physical activity. Comfortable at rest. Less than ordinary activity causes fatigue, palpitation, or dyspnea, class IV: unable to carry on any physical activity without discomfort. Symptoms of HF at rest. If any physical activity is undertaken, discomfort increases [5,28].

The first meeting included a sociodemographic report, in-
When distracting thoughts occur, ignore them, and keep re-attracting and allow the relaxation to happen at its own pace. First, sit quietly for 10 min. You may open your eyes to check the time, but do not use an alarm. (5) When you finish, sit quietly for several minutes at first with closed eyes and later with opened eyes.

**Measuring of Variables**

Anxiety and depression were measured using the Arabic version of HADS. This tool assesses A&D symptoms without investigating physical symptoms [29]. It consists of 14 components: 7 for anxiety and 7 for depression. Participants rated their level on a (0–3) grading system, with a range of (0–21) for each subscale. Higher scores indicated higher levels of anxiety and depressive symptoms [30].

The results are categorized as follows: (0–7), normal (8–10), mild (11–14), moderate and (15–21), severe A&D [29,30]. The Arabic version of the HADS has been used in previous research, and it has been shown that it has good psychometric properties. The Cronbach’s α for anxiety and depression subscales were 0.78 and 0.87, respectively [30].

**Study Intervention**

BRT was explained to participants in this group who received two 10-minute sessions of BRT repeated twice daily for 8 weeks. Furthermore, the BRT Technology CD was provided with distributed copies of the BRT performance so that participants could watch the video and read the instructions when needed. Participants were asked to perform the BRT as follows: Sit quietly in a comfortable position. (1) Close your eyes. (2) Deeply relax all your muscles, beginning at your feet, progressing up to your face, and keep them deeply relaxed. (3) Breathe through your nose. Become aware of your breathing. As you breathe out, say the word “one” silently to yourself. (4) Continue for 10 min. You may open your eyes to check the time, but do not use an alarm. (5) When you finish, sit quietly for several minutes at first with closed eyes and later with opened eyes [31].

Patients would be instructed not to worry about their success at achieving a deep level of relaxation. Maintain a positive attitude and allow the relaxation to happen at its own pace. When distracting thoughts occur, ignore them, and keep repeating the one. With practice, the response should come with a little effort. Practice this technique twice a day for 10 minutes before meals.

There was a self-reporting “Scorecard Form” that was filled out daily by participants to ensure their compliance with BRT. Every week, the facilitator met with the participants to encourage them to perform the technique and at the same time, their Scorecard Form was collected. Moreover, to ensure that the participants went through the intervention appropriately, the participants were asked to perform the technique again in the presence of the interventionist. The interventionist created a group on WhatsApp for all the participants and sent them a BRT video twice a day at specific times to remind the participants of the technology’s performance. Furthermore, the participants were given an ID card for the interventionist and were asked to contact the interventionist if they had any questions regarding the technology.

**Statistical Analysis**

Descriptive statistics, such as means, standard deviations (SD), frequencies and percentages, were used to describe the demographic and clinical characteristics of the participants and to answer research question number one (the levels of A&D both at baseline and after intervention for both study groups). To answer research question number two, independent samples t-test, correlation test, and one-way ANOVA, was used to assess the correlation between A&D and other variables. To answer research question number three, four steps were done as the following: First, the levels of the A&D between the two groups at baseline prior to initiation of the intervention were compared using independent samples t-test, to make sure that there were no differences and to avoid bias. Second, the levels of A&D were compared between the two groups after the intervention using independent samples t-test. Third: the levels of A&D were compared between the pre-intervention and post-intervention in the intervention group using paired t-test. Four: the levels of A&D were compared between the base line and follow up measurement for the control group using paired t-test.

**RESULTS**

**Sample Characteristics**

A total of 204 patients were included in this study; 100 in the intervention and 104 in the control. There were 138 (68.0%) males and 66 (32.0%) were females. The mean age of the par-
participants was 57.46 years (SD, 10.36 years). The duration that patients had HF ranged from 1 to 17 years, with a mean of 6.73 years (SD, 3.56 years). The mean for the EF was 34.62 (SD, 4.10). Most of the study sample (63.7%) had HTN, and nearly half (52.0%) had diabetes. Sample characteristics are presented in Table 1.

**Levels of A&D among Patients with HF**
The total mean score for the sample A&D at baseline was 11.09±2.60, and 10.80±2.30, respectively. According to the HADS categories, this result indicates a moderate level of A&D among participants. Bivariate correlations were measured between selected socio-demographics (age, EF, and years of disease) and the level of depression with HF at the beginning of the study. Only a significant and negative correlation between depression level and the EF level were found (P≤0.01, Spearman Coefficient=–0.71). However, there were no differences between the intervention and the control group in regard to the numbers of patients in each group of NYHA class (P≥0.05).

**Effect of BRT on A&D among Patients with HF**
At baseline, an independent t-test indicated that there was no significant difference between the intervention group and the control group in terms of A&D levels (P≥0.05) (Table 2). Another independent t-tests were done comparing levels of A&D after the intervention. The results showed that the intervention group had significantly lower levels of A&D compared to the control group (Table 2). A paired t-test was performed to compare effect of BRT on A&D before and after the intervention in both intervention and control groups. There was a significant difference within the intervention group in terms of their anxiety levels before and after the intervention (P<0.001) (Table 3). On contrary to the control group in which the anxiety and depression levels remain similar and not statistically different over the time (P≥0.05).

The depression levels similarly dropped significantly in the intervention group after the intervention (P<0.001), while the depressions levels remained unchanged in the control group (P≥0.05) (Table 3). Figures 1 and 2 depict the change of A&D in both group at baseline and after the intervention or over time (i.e. in the control group).

**DISCUSSION**
This study aimed to investigate the effects of BRT on A&D among patients with HF in Jordan. The major findings of the study indicated that BRT was effective in reducing A&D among this population. In addition, the results indicated that patients with HF suffer from moderate levels of A&D. An important outcome of this study also is that depression in inversely cor-

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**Table 1.** Sociodemographic and clinical characteristics of the sample (n=204)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>58±10</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>138 (68.0)</td>
</tr>
<tr>
<td>Female</td>
<td>66 (32.0)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>14 (7.0)</td>
</tr>
<tr>
<td>Married</td>
<td>162 (79.0)</td>
</tr>
<tr>
<td>Divorced</td>
<td>10 (5.0)</td>
</tr>
<tr>
<td>Widow</td>
<td>18 (9.0)</td>
</tr>
<tr>
<td>Educational status</td>
<td></td>
</tr>
<tr>
<td>Less than secondary</td>
<td>52 (26.0)</td>
</tr>
<tr>
<td>Secondary</td>
<td>20 (10.0)</td>
</tr>
<tr>
<td>Diploma</td>
<td>48 (24.0)</td>
</tr>
<tr>
<td>Bachelor</td>
<td>84 (41.0)</td>
</tr>
<tr>
<td>History of HTN</td>
<td>130 (64.0)</td>
</tr>
<tr>
<td>History of DM</td>
<td>98 (52.0)</td>
</tr>
<tr>
<td>NYHA class</td>
<td></td>
</tr>
<tr>
<td>Class I/II</td>
<td>54 (26.5)</td>
</tr>
<tr>
<td>Class III/IV</td>
<td>150 (73.5)</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>34.6±4.1</td>
</tr>
<tr>
<td>History of angina</td>
<td>72 (35.3)</td>
</tr>
<tr>
<td>History of myocardial infarction</td>
<td>90 (44.1)</td>
</tr>
<tr>
<td>History of stent</td>
<td>38 (18.6)</td>
</tr>
<tr>
<td>Years of disease</td>
<td>6.7±3.5</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation or number (%). HTN: hypertension; DM: diabetes mellitus; NYHA: New York Heart Association.
Table 2. Independent sample t-tests at baseline and follow-up measurements

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Group</th>
<th>Mean±SD</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>Intervention</td>
<td>10.80±2.30</td>
<td>1.53</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>10.59±1.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>Intervention</td>
<td>11.09±2.60</td>
<td>0.30</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>10.97±2.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>Intervention</td>
<td>8.38±2.73</td>
<td>-6.82</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>10.48±1.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>Intervention</td>
<td>10.59±2.17</td>
<td>-2.64</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>10.99±2.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SD: standard deviation; NS: not significance.

Table 3. Paired samples t-tests between baseline and follow-up

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th>Follow-up</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>10.80±2.30</td>
<td>8.38±2.73</td>
<td>10.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Anxiety</td>
<td>11.09±2.60</td>
<td>10.59±2.17</td>
<td>2.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Control group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>10.59±1.89</td>
<td>10.48±1.98</td>
<td>0.95</td>
<td>NS</td>
</tr>
<tr>
<td>Anxiety</td>
<td>10.97±2.60</td>
<td>10.99±2.75</td>
<td>-0.21</td>
<td>NS</td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation. NS: not significance.

related with EF which is usually used as an objective measure of the function ability of the heart.

HF is a chronic, incurable syndrome with significant physical and psychological impacts on patients’ lives. The disease is characterized by symptoms such as fatigue, shortness of breath, edema, and insomnia, with risk factors like DM, HTN, hyperlipidemia, aging, and sex which further exacerbating the condition. These factors negatively influence not only the patients’ physical health, but also their social, emotional, psychological, and economic well-being, ultimately affecting their QoL.

Improving the lives of patients with HF and managing the
Our study revealed elevated levels of A&D among participants, further complicating the situation. According to the literature, when anxiety and depression coexist, they can exacerbate a patient’s condition, potentially leading to severe consequences, including death [13,16]. This might be explained by the strong negative association that depression has with EF [34]. When depression increases EF decreases lead to inability of the heart to function well [34]. Also higher levels of depression were associated with fatigue, bad eating habits, lack of exercise and energy, and insomnia [35,36].

The results demonstrated that the intervention group exhibited higher levels of A&D before implementing BRT. After utilizing BRT, the levels of A&D in the intervention group significantly decreased. Depression and sleep issues can worsen each other, creating a vicious cycle that can be difficult to stop. Some people’s depression may even be triggered by inadequate sleep. A recent review also reported the positive effects of BRT on sleep hygiene among HF patients [37], affecting global average sleep quality, reducing sleep latency, sleep disturbance, daytime dysfunction, and the use of sleeping pills. This evidence supports our findings that BRT can potentially improve sleep quality and overall well-being in HF patients by reducing their depression levels [37]. Another recent study in Iran revealed the positive effects of BRT on sleep quality following open-heart surgery [23].

Furthermore, a study conducted in Iran demonstrated the impact of BRT on physiological symptoms in patients undergoing open-heart surgery, showing significant positive effects in reducing respiratory rate, pulse rate, systolic and diastolic blood pressure, and promoting relaxation [38]. Our study aligns with Titi et al. [39], which examined the effects of BRT on reducing pain in acute coronary syndrome patients. Similar to our findings, BRT effectively reduced pain levels from moderate (6/10) to mild (3.6/10) among coronary patients and patients undergoing chest surgery [40].

Depression and anxiety can stimulate sympathetic nervous system and increase the need for oxygen and leading to chest pain fatigue and insomnia. BRT excretes its effect by stimulation of para sympathetic nervous system which has a contradictory effect generated by anxiety and depression. Therefore, there is no wonder that the intervention group has lower levels of A&D compared to the control group.

Conclusions and Recommendations
This study adds to the growing body of evidence supporting the use of BRT as an adjunctive intervention for the management of patients with HF. There is evidence that this intervention can help patients with HF feel less anxious and depressed, which may improve their QoL. Patients having open-heart and chest operations have benefited from BRT’s ability to improve sleep hygiene, alleviate physiological symptoms, and lessen discomfort.

The findings of this study indicate the usefulness of BRT in alleviating symptoms of anxiety and sadness in HF patients undergoing outpatient care. We urge doctors and nurses to include BRT into standard therapy for patients with HF who also suffer from significant anxiety and sadness. This non-medical intervention may be implemented without costing patients or the healthcare system anything.

Outpatient and inpatient nursing services are ideally positioned to drive the widespread implementation of BRT for patients with HF. The results of this study can be used by nursing instructors to stress the importance of non-pharmacological therapies in enhancing patient outcomes. These low-cost therapies may be administered by nurses and have no known negative effects.

In order to manage the physical and psychological symptoms of HF, healthcare providers should think about using BRT as part of their treatment programs. Long-term effects of BRT and its potential influence on patient outcomes including hospitalization rates and death require more study. Training programs for healthcare personnel, especially nursing staff, on the effective implementation of BRT are essential for ensuring the consistent delivery of this intervention across a variety of healthcare settings.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.
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REFERENCES


