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Effects of a Continuous and Periodic Aerobic Exercise Rehabilitation Program on Depression and Anxiety in Hypertension Patients

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Quantitative Study

Abstract

Background: Depression and anxiety can lead to a variety of diseases and increase the risk of developing hypertension (HTN). The current study was conducted with the aim to assess the effects of a continuous and periodic aerobic exercise rehabilitation program on depression and anxiety in patients with HTN.

Methods: The research method was quasi-experimental and simple random sampling was used. The statistical population included 139 individuals. The selected 60 patients were divided into 2 groups, continuous and periodic aerobic exercise. These patients took part in the trial twice, 3 times a week, for 16 weeks. The Costello-Comrey Anxiety and Depression Scales with acceptable validity and reliability were used to assess the subjects' anxiety and depression before and after the training. Data were analyzed using independent and paired t-test in SPSS statistical software. Additionally, ANCOVA was used to investigate depression and anxiety parameters in greater detail.

Results: According to the t-test results, continuous and intermittent exercise programs significantly reduced the patient's anxiety and depression ($P < 0.01$). In contrast, the results of ANCOVA revealed no significant difference in anxiety and depression improvement between the 2 exercise groups ($P > 0.05$). Furthermore, in group A, the dissatisfaction component changed the most (16.4%), while the body factor changed the least (4.4%). In group B, the dissatisfaction component (16.7%) changed the most, while the behavioral factor (5.2%) changed the least.

Conclusion: Both continuous and intermittent aerobic exercise programs can assist individuals with HTN in reducing anxiety and depression.

Keywords: Depression; Anxiety; Aerobic exercise; Hypertension

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Introduction

In many countries, high blood pressure is one of the most important risk factors for cardiovascular disease (CVD), the leading cause of heart failure and stroke, and the leading cause of kidney failure (Neves et al., 2018). CVDs are the world's leading cause of death. About a third of individuals with high blood pressure are completely unaware of their condition. A person can have high blood pressure (hypertension) for years without experiencing any symptoms. Uncontrolled high blood pressure increases the risk of catastrophic illnesses like stroke and heart attack. The amount of blood pumped by the heart and the degree of resistance to blood flow by the arteries determine blood pressure (Shou, Wang, Jin, Zhu, Ren, & Wang, 2019). The higher the blood pressure, the more blood the heart pumps and the smaller the arteries are. Fortunately, high blood pressure is easily recognized, and once diagnosed, a person can work with their doctor to manage their blood pressure. Blood pressure is the force created when blood strikes the artery walls, forcing blood to flow from the heart to the rest of the body (Zupkauskiene et al., 2022).

The most accurate and practical definition of blood pressure is the point at which the advantages of therapy outweigh the hazards of going untreated. As a result, the numerical criteria for determining blood pressure are standard. Hypertension (HTN) is defined as a systolic blood pressure (SBP) of 140 mmHg or higher and a diastolic blood pressure (DBP) of 90 mmHg. The aim of the diagnosis and treatment of high blood pressure is to lower the risk of CVD and death. As a result, categorizing blood pressure levels can help in identifying patients at higher risk and choosing suitable treatment options (Dalla Vecchia & Bussotti, 2018).

Many global societies are focusing on mental health as one of the most critical challenges. The purpose of mental health is to promote mental well-being by avoiding mental disease, reducing risk factors for mental illness, and fostering a healthy environment conducive to the development of normal human interactions (Kagioglou et al., 2021). Health, according to the World Health Organization (WHO), is defined as a state of complete physical, mental, and social well-being rather than simply the absence of sickness (Bhattacharya, Shen, & Sambamoorthi, 2014).

Psychophysiological disorders are medical conditions in which emotions are assumed to play a significant role. Psychophysiology research has been limited to disorders like asthma, HTN, gastrointestinal ulcers, intestinal inflammation, and rheumatoid arthritis (Oeland, Laessoe, Olesen, & Munk-Jorgensen, 2010). Researchers are increasingly attempting to relate each illness to certain attitudes or coping mechanisms in response to stressful experiences. The most typical reaction to stressful stimuli is anxiety. Anxiety is a negative emotion that manifests itself in states such as "anxiety," "worry," "tension," and "fear" (Chia et al., 2022; Pierce, Madden, Siegel, & Blumenthal, 1993).

As an effective and useful treatment, exercise can assist individuals with HTN in preventing and treating depression, both directly and indirectly. Exercise is more successful than other treatments in treating depression and improving high blood pressure without having negative effects. Furthermore, it aids in the improvement of these patients' cardiovascular function by removing cardiovascular diseases (Jennings, 2019). Patients who exercise the following therapy are also less likely to develop disease-related risk factors (Annesi, 2022; Cheung et al., 2005).

It must be understood that focusing on the dimensions of health improves health and creates an atmosphere conducive to the development of latent abilities (Thoren, Floras, Hoffmann, & Seals, 1990). It appears that mental health should be sought first in the components that play a vital role in its maintenance, exercise and physical activity in this context. Exercise plays such a significant role in people's mental health that the WHO coined the phrase "mobility health code" in 2002 (Winroth, Hassmén, & Stevens, 2021). A psychological alteration or experience follows every motor experience or physical change. As sports activities bring individuals closer in terms of distance and space, exercise is an effective method of physical, psychological, and social growth. Exercise improves health and physical fitness, emotional balance and stability, and self-confidence, provides a positive physical and social image, and meets friendship, competition, group strengthening, and security demands. Happiness is another aspect linked to mental health (Ginty, Carroll, Roseboom, Phillips, & de Rooij, 2013). Happiness lowers stress perception and improves a person's ability to work and work hard. In recent years, psychologists working on positive psychology have focused on potential causes of good emotions like happiness (Breeden, Gillis, Salas, & Scherrer, 2022). The emotional variables that describe the emotional experience of happiness, joy, contentment, and other good emotions, and the cognitive appraisal of satisfaction from various domains of life, which implies patience and psychological well-being, are two categories of positive psychology (Khuwaja, Lalani, Dhanani, Azam, Rafique, & White, 2010).

Exercise, according to psychiatrists, has two direct effects on mood and health; one is the release of endorphins, which cause pleasant emotions, and the other is a decrease in the level of the hormone cortisol, which is secreted by the blood pressure in the blood. Endorphins are natural painkillers, and physical activity can increase endorphin levels, resulting in pleasant feelings. In general, exercise and physical activity significantly impact the mental health and happiness of those who engage in such activities (Mahmood et al., 2019; Stanton & Arroll, 1996).

Although much study has been done on the positive effects of exercise on anxiety and even its putative mechanisms there are still many unanswered questions about problems like the type and frequency of exercise and the impacts of cultural differences (Tsai et al., 2003). Exercise's ability to reduce anxiety and sadness is influenced by several factors (Bussotti & Sommaruga, 2018). Exercise can have anti-anxiety effects on a biological level by allowing people to achieve physical fitness, changing the levels of anxiety-related neurotransmitters, affecting stress hormones, and lowering muscle tension (Jaworska, Courtright, De, MacQueen, & MacMaster, 2019). From a psychological standpoint, as a result of increasing the level of activity, the positive reinforcements conditioned by the response provide a situation that distracts the person from threatening and anxious situations and creates a foundation for increasing self-confidence and feeling good. Self-empowerment can reduce anxiety (Li et al., 2015; Yan et al., 2020).

However, research on the impact of exercise in general and specific types of vigorous exercise programs on psychological symptoms such as anxiety and depression associated with HTN is sparse. Little research has been done on the effect of exercise in general and the comparison of low-intensity and high-intensity programs, according to the findings of this study. This study was conducted with the aim to assess the impact of continuous and intermittent, almost strenuous exercise on the level of anxiety and depression in patients with HTN.

Methods

The present quasi-experimental study was performed at the Al-Yarmouk Care Center in Baghdad, Iraq, with a pretest-posttest design. Coordination was established with the center's treatment and rehabilitation department personnel prior to starting the study procedure, and then, with patients referred for the rehabilitation program from July to November 2021. Patients who were able to participate in 48 sessions (16 weeks) of rehabilitation were among those who were invited to take part in the study (60 patients). A simple random sample was selected from a statistical population of 139 patients. A sports physiologist who recommended exercise regimens watched and prescribed more than 450 individuals with HTN for 12 months before the trial to fully prepare them for it (Johansen, Holmen, Stewart, & Bjerkeset, 2012).

The specialized doctor voluntarily picked 60 patients (16 men and 44 women) following the call and initial clinical evaluations (history, previous medical history, clinical examinations, diagnostic tests, and exercise tests). These patients were separated into 2 groups according to the type of activity. The study inclusion criteria included absence of a mobility barrier, the individual's willingness to participate, and an ejection fraction of higher than 30%. The absence of patients from more than 3 sessions of the exercise program and their lack of interest, during which none of the subjects met the exclusion criteria, was the physician's diagnosis**.** The questionnaire was completed without the participants' names. Moreover, the participants were also assured that their identities would not be revealed.

Data collection: Before beginning the exercise program, all subjects participated in a joint training session based on a pre-determined plan for rehabilitation program participation, and the study method was thoroughly explained. Then, 60 patients who met the inclusion criteria were chosen and divided into 2 groups. Continuous aerobic activity was performed in group A (30 individuals; 8 men and 22 women) and periodic aerobic exercise was performed in group B (30 people; 8 men and 22 women). The number of subjects required to obtain the desired statistical results were calculated based on previous research. Table 1 shows the demographic characteristics of the research groups.

Continuous aerobic exercise program: This progressive program was developed using the principles of exercise design, the guidelines of the American College of Sports Medicine, and research, and was based on the individual's starting capacity and capacity after the exercise test. This program was created to gradually increase the workload, diversify the program, and tailor the program to each individual's needs (to increase performance capacity). Based on the program presented in table 1, the continuous program was built and changed using two devices, a tape recorder and a manual ergometer. Patients initially ran on a revolving bar, then had their blood pressure taken, and then, resumed work on a manual ergometer, and ultimately, exercised on a stationary bicycle.

Table 1. Comparison of frequency and demographic characteristics of research groups

Demography variables		Group A		Group B	
		Number	Percentage	Number	Percentage
Gender	Male	8	27	8	27
	Female	22	73	22	73
Marital status	Single	5	17	7	24
	Married	25	83	23	76
Age category (year)	< 40	7	24	9	29
	41-50	10	33	11	38
	50-65	13	43	10	33
Education level	High school	14	47	9	29
	Diploma	7	24	10	33
	Undergraduate	8	27	8	27

Table 2. Description of a continuous exercise program

Device type	Variables	Exercise sessions							
		1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48
Revolving bar	Intensity (%)	70	72	74	76	78	80	82	84
	Time (min)	10-13	13-16	16-19	19-21	21-24	24-27	27-30	30-33
Manual ergometer	Intensity (watt)	30	32	34	36	38	40	42	44
	Time (min)	10-13	13-16	16-19	19-21	21-24	24-27	27-30	30-33
Stationary bike	Intensity (watt)	20	22	24	26	28	30	32	34
	Time (min)	10-13	13-16	16-19	19-21	21-24	24-27	27-30	30-33

Periodic aerobic exercise program: The exercise regimen for group B was based on that presented in table 1. It was similar to that of the program presented by Wisloff et al. and the American College of Sports Medicine's criteria. Each patient's record was documented using the sports control sheet based on the patient's initial condition and the exercise test results that were recorded on the patient's file, heart rate range and level, and intensity or speed of exercise equipment. Depending on the conditions, patients slept for 5 to 15 minutes between use intervals.

Anxiety and depression assessment: The Costello-Comrey Depression and Anxiety Scales (1967) are used to assess sadness and anxiety. Subjects determine their agreement with each item on a 5-point Likert scale ranging between 0 and 25. The emotional, cognitive, behavioral, and physical components are studied for anxiety, and, elements such as disappointment, disability, absence, and helplessness are investigated for depression (Costello & Comrey, 1967). This scale's validity and reliability have been studied and confirmed in the study by Ghorbani, Bing, Watson, Davison, and Mack (2002). Cronbach's alpha coefficients of the anxiety and depression scales were 0.78 and 0.91, respectively.

Terms and conditions of the test: Patients' blood pressure and heart rate were measured at the start and end of the program to assess their physical and physiological state. The patient's ECG was printed simultaneously as the exercise intensity was reduced in the event of abnormality and acute abnormality during exercise. In addition, the program was terminated if necessary based on the patient's health and in the event of symptoms such as chest pain, dizziness, or nausea, and the patient was sent to a rehabilitation physician along with the file and history of that session, and, if necessary, a cardiologist. Each patient followed the previously given directions and inserted leads in 3 different locations, which were then placed on the device and connected to the remote control device, allowing them to do sports activities. Factors such as ECG, anomalies occurring during exercise, and heart rate were managed during the exercise test using a remote control system (Hamer, 2006).

Changes in blood pressure, heart rate, and device speed in 5, 10, 15, and 20 minutes were recorded and compared with previous sessions to ensure program progress and, if necessary, alter the intensity and length of the program. The specific benefits of the sports program were also addressed before engaging in the program during the sessions to increase patients' desire to participate in the program, change their inactive patterns, and improve their attitude toward sports activities.

Data processing method: The essential characteristics of the patients were described using descriptive statistical methods (mean and standard deviation). The Kolmogorov-Smirnov test was used to assess the normality of the variable distribution. The paired t-test was used to assess the influence of sports activity in sports groups. The independent t-test was used to compare and contrast the groups. Analysis of covariance (ANCOVA) was employed to examine depression-related and anxiety-related parameters in greater depth.

Table 3. Description of a periodic exercise program

Device type	Variables	Exercise sessions							
		1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48
Revolving	Intensity (%)	70	73	76	79	82	85	88	91
bar	Time (min)	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26
Manual	Intensity (watt)	30	33	36	39	42	45	48	51
ergometer	Time (min)	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22
Stationary	Intensity (watt)	20	23	26	29	32	35	38	41
bike	Time (min)	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20

SPSS statistical software (version 19; SPSS Inc., Chicago, IL, USA) was used to perform all statistical calculations. All tests had a significance level of less than or equal to 0.05.

Results

Table 3 contains a list of the subjects' physical characteristics. A paired t-test and an in-group comparison of means before and after the exercise program revealed that both training approaches significantly affected anxiety and depression in hypertensive patients (Table 4).

In addition, no statistically significant differences were observed between the groups before the test. However, the assessment of anxiety and depression after the program revealed a significant difference in these variables. Moreover, there was no significant difference between the two groups in terms of the absolute quantity of anxiety and depression changes (first-stage anxiety and depression, and second-stage anxiety and depression). In addition, the percentage of reduction in anxiety and depression following the completion of the two training methods was nearly identical. Based on the results of ANCOVA, continuous and periodic interventions are associated with improving patients' health in each of the parameters of depression and anxiety ($P < 0.01$) (Table 5). There were no statistically significant differences between the two groups' results ($P > 0.01$).

Table 6 compares the anxiety and depression factor scores for each group.

Figure 1 depicts the amount of change in the values of each factor following the program for group A. However, the dissatisfaction factor changed the most (16.4%), while the body factor changed the least (4.4%).

Figure 2 depicts the amount of change in the values of each factor following the program for group B. Furthermore, the disappointment component changed the most (16.7%), while the behavioral factor changed the least (5.2%).

According to the results, it seems that the factors of depression have changed more than the factors of anxiety.

Discussion

The current study was conducted with the aim to determine the impact of continuous and periodic aerobic exercise on anxiety and depression in hypertensive patients.

Table 4. Comparison of pretest and posttest anxiety and depression scores within groups

Variable	State	Group A (mean ± SD)	Group B (mean ± SD)	P
Anxiety	Pretest	83.07 ± 5.09	87.49 ± 5.24	0.014
	Posttest	77.23 ± 3.89	81.93 ± 4.76	
Depression	Pretest	74.39 ± 4.26	76.62 ± 4.83	0.001
	Posttest	68.81 ± 3.62	69.43 ± 3.86	

SD: Standard deviation

Table 5. ANCOVA for each of the parameters of depression and anxiety

Components	Evaluation variables	Total squares	Degrees of freedom	Mean squares	F	P
Emotional	Intervention	47.26	1	47.26	9.16	0.002
	Group	93.74	1	93.74	36.54	0.201
	Error	47.32	22	2.15		
	Total	982.27	30			
Cognitive	Intervention	45.17	1	45.17	11.09	0.001
	Group	90.48	1	90.48	43.71	0.673
	Error	59.38	22	2.70		
	Total	1329.14	30			
Behavioral	Intervention	36.94	1	36.94	9.43	0.009
	Group	87.61	1	87.61	31.74	0.094
	Error	48.18	22	2.19		
	Total	2439.47	30			
Body	Intervention	34.67	1	34.67	6.41	0.007
	Group	79.14	1	79.14	32.09	0.076
	Error	41.27	22	1.88		
	Total	3749.35	30			
Disappointment	Intervention	35.12	1	35.12	13.84	0.004
	Group	97.16	1	97.16	54.19	0.140
	Error	52.09	22	2.37		
	Total	2194.67	30			
Disability	Intervention	29.07	1	29.07	8.43	0.011
	Group	128.63	1	128.63	56.49	0.219
	Error	67.52	22	3.07		
	Total	2649.37	30			
Absence	Intervention	28.86	1	28.86	5.79	0.001
	Group	94.73	1	94.73	21.60	0.0712
	Error	43.16	22	1.96		
	Total	1342.76	30			
Helplessness	Intervention	22.04	1	22.04	4.31	0.004
	Group	79.14	1	79.14	18.64	0.117
	Error	34.27	22	1.56		
	Total	794.23	30			

Findings revealed that exercise and mental health have a good relationship (Crombie, Cisler, Hillard, & Koltyn, 2021).

Table 6. Comparison of the scores of different anxiety and depression factors

Variable	State	Group A (mean ± SD)	Group B (mean ± SD)	P-value
Emotional	Pretest	46.05 ± 3.26	50.62 ± 3.47	0.017
	Posttest	42.28 ± 3.01	45.83 ± 3.17	
Cognitive	Pretest	48.34 ± 4.09	54.19 ± 4.27	0.006
	Posttest	43.51 ± 3.21	48.52 ± 4.16	
Behavioral	Pretest	42.61 ± 3.16	45.18 ± 3.46	0.041
	Posttest	38.94 ± 2.87	42.81 ± 3.04	
Body	Pretest	43.19 ± 3.29	44.53 ± 3.38	0.037
	Posttest	41.28 ± 2.73	42.17 ± 2.83	
Disappointment	Pretest	37.41 ± 2.64	39.73 ± 2.81	0.011
	Posttest	31.29 ± 2.43	33.08 ± 2.59	
Disability	Pretest	32.55 ± 2.49	31.49 ± 2.27	0.024
	Posttest	28.67 ± 2.09	27.93 ± 1.86	
Absence	Pretest	35.71 ± 2.58	36.97 ± 2.78	0.037
	Posttest	31.49 ± 2.23	31.70 ± 2.29	
Helplessness	Pretest	26.14 ± 2.16	27.63 ± 2.24	0.0.009
	Posttest	23.59 ± 1.72	25.19 ± 2.06	

SD: Standard deviation

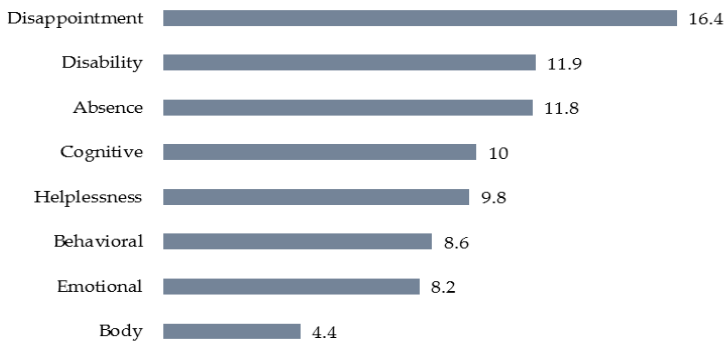

Figure 1. Changes in group A parameters as a percentage in the posttest

The findings of the current study point to a link between physical activity and mental well-being. In other words, exercise causes a good attitude and, as a result, increases a person's satisfaction with life through influencing the type of sentiments and emotions a person experiences (Yang et al., 2022).

According to the t-test results, continuous and intermittent aerobic exercise significantly reduced anxiety and depression in hypertensive patients ($P < 0.01$). The results indicated that the type and intensity of exercise had little impact on the outcomes ($P < 0.01$). According to the ANCOVA results, there was no significant relationship between the groups ($P > 0.05$); the groups achieved similar results despite participating in different exercise regimens. While ANCOVA demonstrated that the intervention reduced anxiety and depression in these patients, the effect was insignificant ($P < 0.01$). In group A, disappointment changed the most (16.4%), while body changed the least (4.4%). In group B, disappointment changed the most (16.7%), while behavior changed the least (5.2%).

Numerous studies have been conducted in this field and have reported findings consistent with the current investigation findings. Prugger et al. (2017) demonstrated that mental health issues harm the physical activity of heart patients and patients with coronary heart disease (CHD) and severe symptoms of depression engage in very little regular exercise.

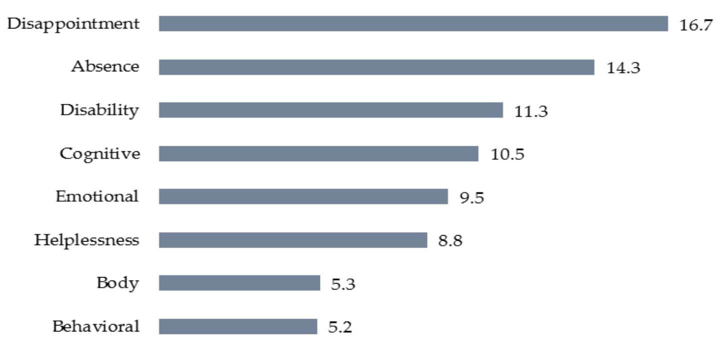

Figure 2. Changes in group B parameters as a percentage in the posttest

Therefore, severe depressive symptoms may prevent CHD patients from exercising regularly. Strohle (2009) has demonstrated that the beneficial effects of exercise on anxiety and depression are on the rise. However, clinical applications such as psychological and pharmacological approaches are still in their infancy. In addition, specifying the impact of the type, intensity, and the number of cycles of more effective sports activities on psychological aspects will aid in maximizing the effectiveness of exercise programs. Studies have shown that moderate-intensity cardiovascular exercise positively affects the depressive behavior of sedentary adults. Several studies have demonstrated that exercise is more effective and durable than other treatments. Counseling and exercise improved patients' anxiety and depression in the first year compared to the control group, but the exercise had more lasting effects and no adverse effects. Additionally, the exercise program improved the patient's general health, health-related factors, and health. Raja Koplan et al. demonstrated that blood flow-dependent vasodilation was significantly reduced in depressed patients compared to a matched control group. Although Chrapko, Jurasz, Radomski, Lara, Archer, and Le Melledo (2004) showed that nitric oxide levels and nitric oxide synthase activity were significantly lower in healthy depressed subjects than in the non-depressed control group, vascular activation disorders may be associated with depression. Additionally, Lesperance, Frasure-Smith, Theroux, and Irwin (2004) demonstrated that the amount of soluble intracellular adhesion molecule in patients with acute and depressed coronary syndromes was significantly higher than in non-depressed individuals; this indicates chronic activation of endothelial tissue in patients with acute coronary syndrome.

Although the mechanism by which regular exercise improves mental health is unknown, several theories have been presented in this regard. The theories of distraction and growing mass communication have been offered from the standpoint of psychological causes, and the idea of endorphins has been proposed for physiological mechanisms. According to the findings of this study, regular exercise can be a factor in both physical and mental health, as well as one of the approaches to regulating and treating anxiety and depression in vulnerable groups.

In summary, the outcomes of this study and other studies suggest that exercise can reduce anxiety and depression symptoms at any level of hypertension severity and enhance patients' mental health in general. There is no evidence that the effects of type (constant, periodic, resistance, aerobic, etc.) and intensity (low, moderate, and severe) on psychological aspects differ. However, it has been suggested that long-term continuous exercise accompanied by endorphin release and euphoria has more positive psychological effects.

Conclusion

The effects of continuous and periodic aerobic exercise were not shown to be significantly different in this study; in other words, both continuous and periodic exercise showed anti-anxiety effects. Overall, the findings of this study support the anti-anxiety effects of both continuous and intermittent exercise in lowering anxiety and demonstrate that exercise can be utilized as a useful method to reduce anxiety. This study has methodological flaws and limitations that should be addressed in future studies. The small sample size and a lack of bio-physiological and biochemical assessments are examples of these flaws. Other limitations of this study include the rigorous examination of the mechanism of impact of exercise and psychological evaluations (to investigate the psychological mechanism of the effect of exercise accurately), long-term follow-up of anti-anxiety effects, and so on. Future studies will be required to elucidate the major mechanisms of exercise's anti-anxiety effects. It is suggested that future studies analyze and compare the effects of aerobic and anaerobic exercise on anxiety and depression reduction. Assessments in other groups with various diseases should also be carried out. Future studies should investigate the impact of the length of exercise programs, combined exercise interventions, and relaxation activities on mental health issues. Furthermore, it is suggested that the efficacy of exercise therapy, in conjunction with other psychotherapeutic interventions, be investigated in psychotherapy clinics among patients with mental problems.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

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