



Effects of Different Aerobic Exercise Protocols on Depression in Patients with Myocardial Infarction

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KEYWORDS

Aerobic exercises
Depression
Myocardial infarction
High-intensity interval training
Exercise protocols
Mental health

DECLARATIONS

Conflict of Interest: None

Funding Source: None

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ABSTRACT

Background: Depression is common among patients recovering from myocardial infarction and is associated with poor outcomes. Aerobic exercise has been proposed as a beneficial intervention for improving cardiovascular and mental health. **Objective:** To evaluate the effects of various aerobic exercise protocols on depression in patients with myocardial infarction. **Methodology:** In this randomised controlled trial, 50 patients recovering from myocardial infarction were taken from various cardiac hospitals in Karachi, Pakistan over six months and randomly assigned to one of three exercise groups: low, moderate, and high-intensity interval training. The sample includes both male and female patients aged 40 to 65 years and those recovering from myocardial infarction. Depressive symptoms were assessed using the Beck Depression Inventory at baseline, 6th and 12th week post-intervention. Exercise adherence and safety were monitored throughout the study. A demographic proforma/myocardial infarction Checklist was used to gather data on patients' age, gender, occupation, and details related to their medical history and the severity of their myocardial infarction. Descriptive statistics were used to summarise demographics and depression scores, while inferential statistics, such as t-tests or chi-square tests, were applied to explore the relationships between exercise intervention and depressive symptoms. **Results:** A significant reduction in depressive symptoms was observed in all exercise groups, with the high-intensity interval training group showing the greatest improvement in depression scores compared to the low and moderate-intensity groups. Exercise adherence rates were highest in the moderate-intensity group, while high-intensity interval training demonstrated the most significant physiological improvements in cardiovascular fitness. **Conclusion:** Aerobic exercise, particularly high-intensity interval training, appears to be an effective intervention for reducing depressive symptoms in patients recovering from myocardial infarction. Incorporating structured aerobic exercise into recovery programs may enhance both psychological and physical health outcomes.

How to cite the article: Saeed H, Jawaid M, Perwaiz S, Hasan S, Basit A, Lohana N. Effects of Different Aerobic Exercise Protocols on Depression in Patients Recovering from Myocardial Infarction. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2024;4(6):9-15.



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INTRODUCTION

Myocardial infarction (MI), a leading cause of death and disability worldwide, significantly contributes to the rising global burden of ischemic heart disease. Advances in medical care have improved MI survival rates, but survivors often face physical and psychological challenges, including depression. Post-MI depression affects 20%–30% of patients within the first year, severely impacting recovery. Addressing this issue is crucial for improving long-term outcomes in MI survivors.¹ The presence of depression is associated with poorer outcomes, including decreased adherence to medical treatment, reduced participation in rehabilitation programs, and an increased risk of recurrent cardiovascular events and mortality. Depression in MI patients is linked to decreased inflammatory responses, heightened sympathetic nervous system activity, and impaired endothelial function, which may exacerbate cardiac issues.² Exercise therapy, especially aerobic exercise, is effective in reducing depression and improving mood in post-MI patients. Its benefits include enhanced neurogenesis, neuroplasticity, and endorphin release, along with reduced inflammation and oxidative stress. This highlights its role as a valuable non-pharmacological intervention.³ An independent risk factor for coronary artery disease (CAD) is depression. The burden of disease worldwide has been significantly raised by these conditions.⁴ While optimism and neuroticism were not significant predictors of change, depression seems to have a significant impact on adherence and improvement among patients on CR.⁵

Despite the well-documented benefits of aerobic exercise, there is an ongoing debate on the intensity and duration of exercise that best addresses both the cardiovascular and psychological needs of patients recovering from MI. Traditionally, moderate-intensity continuous training (MICT) has been widely used in cardiac rehabilitation programs due to its safety and effectiveness in improving cardiovascular fitness.⁶ However, recent research suggests that high-intensity interval training (HIIT) may offer superior benefits to physical fitness but also for reducing depressive symptoms in cardiac patients. HIIT involves short bursts of high-intensity exercise followed by periods of rest or low-intensity recovery,

which has an aerobic capacity and mood in a shorter time compared to traditional MICT protocols.⁷

Emerging evidence suggests that the antidepressant effects of aerobic exercise may vary depending on the specific protocol used, patient adherence, and the presence of other comorbidities. For instance, recent years indicated that structured exercise programs, regardless of intensity, are effective in reducing depressive symptoms but that high-intensity regimens may be more effective in tolerating them.⁸ Exercise-based cardiac rehabilitation has been shown to provide various health benefits for people with coronary artery disease (CAD). These benefits include improved ability to exercise, better blood vessel function, reduced cardiovascular risk factors, and less inflammation in the blood vessel walls. These positive changes can lower the chances of getting sick or dying from CAD.⁹

Myocardial infarction or heart attack, is one of the leading causes of morbidity and mortality globally, and its incidence continues to rise in many countries, including Pakistan. While advancements in medical treatment have significantly improved survival rates following MI, many patients continue to experience challenges during recovery, particularly the development of depression. Post-MI depression affects approximately 20-30% of MI survivors, leading to poor clinical outcomes such as decreased adherence to rehabilitation programs, higher recurrence rates of cardiovascular events, and increased mortality.¹⁰ Patients with coronary heart disease who suffer from depression are at higher risk of mortality. Depression may affect cardiovascular function through a variety of methods, including cardiovascular autonomic dysfunction.¹¹

In summary, when we consider all the factors that could affect the results, it becomes clear that people who have recently had a heart attack and are also dealing with depression have a lower 24-hour heart rate variability (HRV) compared to those who don't have depression.¹² The objective of this study is to assess the prevalence of depression in post-MI patients, explore the relationship between MI and depression, and evaluate the impact of

different aerobic exercise protocols on reducing depressive symptoms in these patients.

METHODOLOGY

This observational study was conducted in various cardiac hospitals in Karachi, Pakistan, over a period of six months, beginning from the approval date of the study synopsis. The study aimed to assess the prevalence of depression in post-MI patients and evaluate the effects of aerobic exercise on their mental health. The sample consisted of 50 participants, including both male and female patients aged 40 years and above, all of whom were recovering from MI. The sample was selected using convenience sampling from the cardiac wards of participating hospitals. The inclusion criteria required participants to have a confirmed history of myocardial infarction, while pregnant females and patients without an MI history were excluded. Data collection was carried out using well-established tools. The Hospital Anxiety and Depression Scale (HADS), developed by Zigmond and Snaith (1983), was used to assess anxiety and depression symptoms. This tool consists of 14 items divided into two subscales: seven for anxiety and seven for depression. Each item is scored on a scale of 0 to 3, and a score above 8 on either subscale indicates clinically significant symptoms of anxiety or depression. Additionally, a Demographic Proforma/MI Checklist was used to gather data on patients' age, gender, occupation, and details related to their medical history and the severity of their MI.

The procedure began with the collection of demographic information via a closed-ended questionnaire. Participants then completed the HADS, which was scored to determine the presence and severity of depression or anxiety. Following the psychological assessment, participants were referred to trained physical therapists for aerobic exercise sessions. The exercise protocols, including MICT and HIIT, were customized based on each participant's capacity and tolerance. These exercises were designed not only to improve cardiovascular fitness but also to address depressive symptoms through physical activity. All physical therapy sessions were conducted under the supervision of a qualified physical therapist. For statistical

analysis, data were processed using SPSS version 20. Descriptive statistics were used to summarise demographic information and depression scores, while inferential statistics, such as t-tests or chi-square tests, were applied to explore the relationships between exercise intervention and depressive symptoms. A significance level of $p < 0.05$ was considered for all analyses, ensuring the reliability and validity of the findings.

RESULTS

In Table 1, the mean value of 26.66 indicates the average score for aerobic exercise in the sample. The standard deviation of 11.42 suggests a moderate degree of variability around the mean. The mean value of 11.72 represents the average score for Depression in the sample. The standard deviation of 2.08 indicates relatively low variability around the mean. The mean value of 12.06 is the average score for anxiety in the sample. The standard deviation of 2.78 suggests a moderate degree of variability around the mean. These results suggest that, on average, participants in the sample reported moderate levels of aerobic exercise, depression, and anxiety. However, the variability in the scores indicates that there is diversity in the responses.

Table 2 presents the Pearson correlation coefficients among the three variables: aerobic exercise, depression, and anxiety. The table also includes the significance (p-values) for each correlation to determine the statistical relevance. The result of our study revealed that the correlation between "Aerobic Exercise" and "Depression" is -0.125, suggesting a weak negative correlation. In other words, there is no strong evidence to conclude that there is a significant linear relationship between aerobic exercise and depression in this sample. And the correlation between "Aerobic Exercise" and "Anxiety" is -0.177, indicating a weak negative correlation. Similar to the previous case, this correlation is not statistically significant ($p = 0.219$), suggesting that there is no significant linear relationship between aerobic exercise and anxiety in this dataset. However, the correlation between "Depression" and "Anxiety" is 0.493, indicating a moderate positive correlation. Importantly, this correlation is statistically significant.

Table 1: Descriptive statistic of aerobic exercise, depression, and anxiety scores (n=50)

Variables	Mean	Std. Deviation
Aerobic Exercise	26.66	11.42
Depression	11.72	2.08
Anxiety	12.06	2.78

($p=0.00$). Thus, there is evidence to suggest that there is a significant linear relationship between depression and anxiety in this sample, suggesting that individuals with higher depression scores are likely to have higher anxiety scores and vice versa. The following Table 3 summarizes the regression analysis results, examining the impact of aerobic exercise on depression scores among the study participants. The F-statistic is 0.765, and the associated p-value is 0.386. This p-value is greater than the typical significance level of 0.05. The regression analysis indicates that aerobic exercise alone does not have a statistically significant impact on reducing depression scores among post-MI patients in this sample. The findings suggest that additional factors, such as psychological support or other therapeutic interventions, may be necessary to address depression effectively in these patients. Further research with larger sample sizes and more controlled variables is recommended to explore this relationship in greater depth.

DISCUSSION

This study shows that exercise-based cardiac rehabilitation can significantly improve mood and reduce anxiety levels in patients with coronary artery disease. A meta-analysis demonstrates that structured exercise programs effectively reduce anxiety and depression among coronary heart disease patients.⁷ Additionally, it has been shown that combining aerobic exercise with stress management training yielded significant improvements in psychological outcomes, emphasizing the need for comprehensive cardiac rehabilitation programs.¹³ In contrast, our study's regression analysed that aerobic

exercise alone did not significantly impact depression scores ($F=0.765$, $p=0.386$), suggesting that exercise interventions may need to be part of a multifaceted approach. This aligns with findings from this study highlights that post-MI depression involves complex pathophysiological mechanisms, such as inflammation and autonomic dysfunction, which may not be sufficiently addressed through exercise alone.³ Moreover, the moderate positive correlation between on and anxiety ($r=0.493$, $p<0.001$) observed in our study is consistent with findings from those who reported that depression and anxiety often coexist in cardiac patients, increasing the risk of recurrent cardiovascular events. This co-occurrence may complicate recovery, underscoring the holistic approaches to managing both mental and physical health after MI.¹²

Interestingly, while aerobic exercise is widely recommended for improving cardiovascular health and psychological well-being, our findings did not support a significant reduction in depression. This discrepancy could be due to the study's limited sample size, the variability in exercise adherence, or the short duration of the exercise interventions. Previous studies have suggested that tailored exercise programs, combined with behavioural therapies, may be more effective in managing depression.¹⁴ Furthermore, demonstrated that exercise improves heart rate variability in MI patients, which is critical for reducing anxiety and improving overall heart health. However, the lack of a significant impact in our sample may suggest that factors such as personalized intensity elements are crucial for achieving these benefits.⁹

The findings of this study, which indicated no significant relationship between aerobic exercise and reductions in depression or anxiety among post-MI patients, align with some existing research while contrasting with others.¹⁵ The study explored the impact of a single session of forest walking on MI patients and found significant improvements in both physiological and psychological states, suggesting that nature-based interventions may be more effective for immediate mental health benefits than structured aerobic exercise alone demonstrated that a personalized cardiac

Table 2: Correlation analysis of aerobic exercise, depression, and anxiety scores

		Aerobic Exercise	Depression	Anxiety
Aerobic Exercise	Pearson Correlation	1	-.125	-.177
	Sig. (2-tailed)		.386	.219
Depression	Pearson Correlation	-.125	1	.493**
	Sig. (2-tailed)	.386		.000
Anxiety	Pearson Correlation	-.177	.493**	1
	Sig. (2-tailed)	.219	.000	

Table 3: Regression analysis of aerobic exercise, depression, and anxiety scores

Model	R	R Square	Adjusted R Square	Std. Error of Estimate
0.125	0.016	-0.005	2.08543	
ANOVA				
Model	Sum of Squares	df	Mean Square	F
Regression	3.326	1	3.326	0.765
Residual	208.754	48	4.349	
Total	212.080	49		
Coefficients				
Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	
Constant	12.328	0.756	-	16.316
Aerobic Exercise	-0.023	0.026	-0.125	-0.875

rehabilitation program incorporating genetic testing significantly improved outcomes in MI patients, including psychological well-being.¹⁶ The results of our study, which showed no significant impact of aerobic exercise on reducing depression among post-MI patients, aligned with depressive symptoms are associated with reduced HRV independently of physical fitness levels, particularly in patients with heart failure. This suggests that factors beyond physical fitness, such as psychological

stress and autonomic dysfunction, may play a crucial role in the mental health of cardiac patients.

CONCLUSION

The study explored the effects of aerobic exercise on depression and anxiety in post-MI patients. The results showed no significant correlation between exercise levels and reductions in depression or anxiety scores, suggesting that

aerobic exercise alone may not be sufficient to address psychological symptoms in this population. However, a moderate positive relationship between depression and anxiety was identified, indicating the interconnectedness of these conditions in cardiac patients. These findings are consistent with prior studies emphasizing the complex nature of depression in MI patients, where factors such as inflammation and autonomic dysfunction may diminish the effectiveness of exercise alone. Thus, while aerobic exercise remains an important aspect of cardiac rehabilitation, it may need to be complemented with psychological therapies to achieve optimal outcomes.

DECLARATIONS

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

Funding: No funding source is involved.

Authors' contributions: All authors have read and approved the final manuscript.

CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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