ISSN 2791-156X
Journal of Health and Rehabilitation Research (JHRR)

Vol. 3, Issue 2

Original Article

Effects of Cardiac Rehabilitation Program on Vitals, Level of Daily Physical Activity Through Accelerometer in Patients of Post Myocardial Infarction

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No conflict of interest declared | Received: 28-10-2023; Revised & Accepted: 05-11-2023; Published: 13-11-2023.

ABSTRACT

Background: Myocardial Infarction (MI) remains a predominant cause of global morbidity and mortality, with an estimated 22,200 individuals experiencing acute MI annually. Assessing and enhancing physical activity levels are crucial for improving Activities of Daily Living (ADLs) in this patient population. The International Physical Activity Questionnaire (IPAQ) serves as a tool to gauge patient engagement in physical activities.

Objective: This study aimed to evaluate the comparative effectiveness of supervised clinical cardiac rehabilitation and home-based exercise programs on the physical activity of patients with Myocardial Infarction stage IV.

Methods: In a randomized controlled trial conducted at Younas Hospital in Daska, 34 participants were recruited via convenience sampling and assigned to either Group A (supervised clinical rehab) or Group B (home-based exercise), using a simple randomization method involving opaque sealed envelopes. Over seven days, Group A engaged in a supervised aerobic exercise regimen, while Group B participated in a home-based aerobic program. Physical activity was quantified using the IPAQ questionnaire, with data analysis performed via SPSS version 27.

Results: The average age of participants was 60.99 ± 7.172 in Group A and 60.18 ± 5.09 in Group B. Results were statistically significant ($p < 0.05$), with Group A showing a more substantial increase in physical activity levels from a mean of 432.3 ± 130.93 (pre-treatment) to 3405.8 ± 371.60 (post-treatment), compared to Group B, which improved from a mean of 330.58 ± 73.96 (pre-treatment) to 2867.64 ± 902.24 (post-treatment).

Conclusion: The supervised clinical rehabilitation program demonstrated a more pronounced improvement in physical activity levels among MI-IV patients than the home-based exercise program. This suggests that structured, clinician-guided rehabilitation may be more effective for this patient demographic.

Keywords: Activities of Daily Living, Cardiac Rehabilitation, Home-Based Exercise, Myocardial Infarction, Physical Activity

INTRODUCTION

Myocardial Infarction (MI), commonly referred to as a heart attack, is a leading contributor to the increase in both morbidity and mortality rates (1). This study specifically focuses on Type 4 MI. The management of MI requires a multidisciplinary approach, with cardiac rehabilitation being a central component. Cardiac rehabilitation is crucial for improving patients' health and lifestyle after an MI (2).

MI is a significant cause of death worldwide, with coronary artery disease (CAD) accounting for 13.2% of deaths annually (3). Standard baseline treatment for MI includes medications such as aspirin and nitro-glycerine (3). MI is classified into five types: Type 1 is ischemic due to thrombus formation from plaque erosion, Type 2 results from an imbalance between myocardial oxygen supply and demand, Type 3 typically denotes sudden death before a diagnosis can be confirmed, Type 4 occurs within 48 hours following stent stenosis, and Type 5 occurs within 48 hours post-Coronary Artery Bypass Grafting (CABG) (4).

MI often presents as ST elevation in younger patients (5). While the epidemiology of MI in younger demographics is not well-defined, factors such as smoking and being male significantly increase the risk (6). Activities of Daily Living (ADLs) are greatly impacted by MI. Sleep patterns, for instance, play a critical role; individuals with poor sleep quality or insufficient sleep duration have a 20% higher risk of experiencing an MI. Conversely, adequate rest coupled with a healthy diet can diminish the likelihood of a heart attack. Moreover, certain lifestyle choices, such as binge drinking, are associated with a heightened risk of MI due to their negative impact on diet and overall health (7).

Cardiovascular rehabilitation is crucial for patients recovering from a Myocardial Infarction (MI). It significantly enhances recovery by increasing cardiovascular fitness and oxygen utilization. Specifically, aerobic exercises are instrumental in improving VO2 max, a measure of cardiovascular efficiency (8). Cardiac rehabilitation not only mitigates the risk of disability but also lowers morbidity and mortality rates. A thorough evaluation marks the commencement of any rehabilitation program (9).

Exercise training within these programs is designed to optimize energy expenditure. Both home-based and hospital-based cardiac rehabilitation programs are available to cater to patient preferences and needs. Clinical evidence suggests that supervised programs can lead to increased peak oxygen consumption, thereby enhancing the patient's quality of life. Cardiac rehabilitation is a collective effort involving physicians, physiotherapists, dieticians, and nurses working in unison (10). Before initiating exercise protocols, comprehensive testing is performed as part of this multidisciplinary approach. Home-based programs offer a less expensive and more accessible alternative for those reluctant to participate in clinical settings. Accelerometers are utilized to monitor energy expenditure effectively, proving to be an essential tool in assessing patient progress and vitality during home-based programs (11).

Cardiac rehabilitation significantly improves patient lifestyles, which is particularly pertinent in contemporary society where MI patients are susceptible to health deterioration due to poor lifestyle choices. Factors such as an unhealthy diet, disrupted sleep cycles, and nicotine intake can adversely affect heart health, leading to heart attacks and potentially fatal outcomes (12). Conversely, a diet rich in fruits and vegetables promotes healthy blood circulation and 'good' cholesterol levels, whereas carbonated drinks, junk food, and nicotine contribute to 'bad' cholesterol and an increased risk of heart attacks (13). The program also involves endurance training and lifestyle modifications, pivotal for reducing mortality and morbidity. Interestingly, elevated cholesterol levels have not been shown to diminish exercise tolerance, and adherence to the exercise plan is associated with a notable improvement in VO2 max (14).

While most literature on cardiac rehabilitation focuses on patients undergoing Coronary Artery Bypass Grafting (CABG) in phases I, II, and III, patients with MI who have had angioplasty also require careful attention due to their elevated risk of future complications. Therefore, initiating cardiac rehabilitation during the early phases post-MI is essential to preempt further complications (15, 16).

Smoking is a significant contributor to cardiac problems and poor lifestyle choices. A majority of hospitalized cardiac patients are smokers, often resistant to quitting. However, cessation of smoking post-MI, particularly in younger patients, has been shown to decrease the risk of mortality by 70% (17). Moreover, research has highlighted the dangers of prolonged sedentary behavior, which is linked to an increased risk of coronary heart disease and MI. Such inactivity can impede blood circulation, disrupt digestion, and raise cholesterol levels, all of which contribute to a higher mortality rate (17).

This study aimed to compare the effects of home-based versus supervised cardiac rehabilitation programs on physical activity levels in patients with Type 4 MI. The rationale is to determine the most effective approach for improving patient outcomes, considering the accessibility, cost, and individual patient compliance, with the goal of enhancing post-MI recovery and reducing the risk of subsequent cardiac events.

MATERIAL AND METHODS

The research was conducted as a randomized controlled trial, duly registered with the WHO registry of IRCT under the reference number IRCT20191117045462N8. The sample comprised individuals recruited from Younas Hospital, Daska. A sample size of 34 was calculated using G*Power Analysis Software, Version 3.1.9.4, assuming an 80% power of the study, a 5% margin of error, and a 95% confidence interval. The study received ethical approval from the ethical committee of RCR & AHS before data collection commenced.

Initially, there were 38 individuals were assessed for eligibility. Of these, 4 were excluded for various reasons: 3 were not eligible, 1 declined to participate, and 1 was excluded for other reasons not specified. The remaining 34 participants were randomized into two groups: an intervention group and a control group, with 17 participants in each. All participants who were allocated to either group received the planned intervention, and none were lost to follow-up, indicating full compliance and retention. Consequently, all 17 individuals in each group were included in the final analysis. There were no exclusions post-randomization, which suggests a robust study design with complete data for all participants who entered the trial.

The inclusion criteria for the study were: individuals of either gender, aged 18 or older, who had been clinically diagnosed with Type 4 Myocardial Infarction (MI-IV). Exclusion criteria included patients with unstable angina, any respiratory disease, rib fractures, and those exhibiting red flags such as fever, night sweats, or malaise. The International Physical Activity Questionnaire (IPAQ), a 27-item self-reported measure, was employed to assess physical activity levels. Physiological parameters such as heart rate and oxygen saturation levels were monitored using a pulse oximeter, while blood pressure measurements were taken with a mercury sphygmomanometer.

Upon meeting the inclusion criteria, patients were enrolled via convenience sampling and randomized to their respective groups using the opaque sealed envelope method. Group labels were indicated by a '0' for Group A and a '1' for Group B. At the outset of the trial, participants attended a 30-minute educational session conducted by a physiotherapist to familiarize them with the treatment and intervention procedures. Data collection occurred at the commencement of the program and after six weeks, recording both pre-treatment and post-treatment values. Group A participants received inpatient care and, following discharge, attended regular medical checkups and supervised clinical rehabilitation. During a 7-day period, they completed their initial IPAQ questionnaire, undertook baseline measurements, performed the prescribed aerobic exercises—which included 10 minutes of warm-up, 30 minutes on a cycle ergometer, and a 10-minute cool-down—and then completed a post-intervention IPAQ questionnaire and post-exercise measurements.

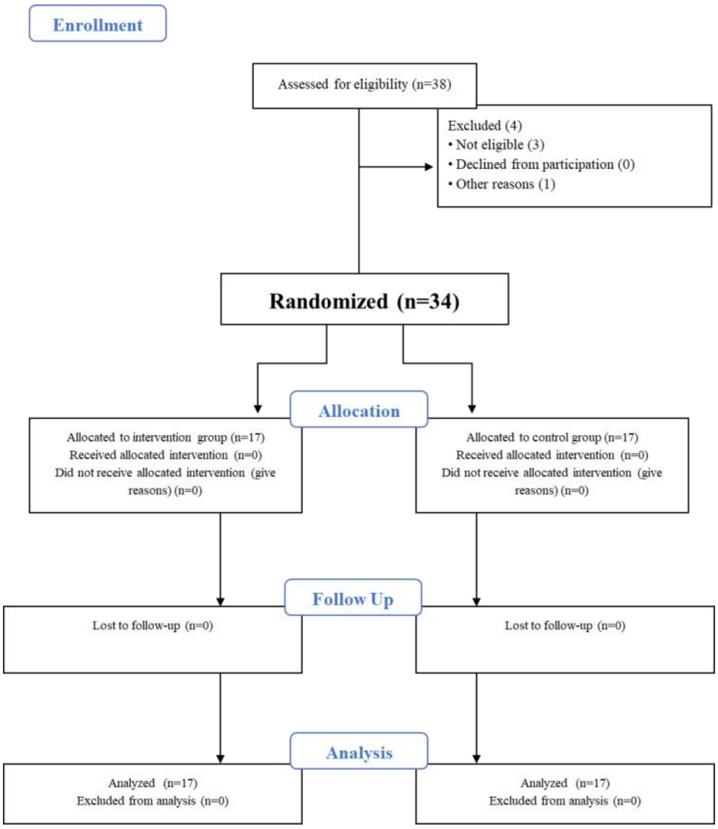

Figure 1 COSORT Flow Chart

Participants in Group B were introduced to the home exercise regimen through a demonstration and education session, although they also attended regular medical checkups. Their 7-day exercise plan mirrored that of Group A, with adjustments suitable for a home setting—comprising 10 minutes of warm-up, 30 minutes of brisk walking, and a 10-minute cool-down period. Following the exercise plan, they revisited the hospital to complete the post-intervention IPAQ. All collected data were entered and subsequently analysed using SPSS software, version 27.

RESULTS

In this randomized control trial, 34 patients with myocardial infarction were divided into two groups to compare the effects of supervised clinical rehabilitation and home-based exercise programs. Each group comprised 17 patients, and the outcomes measured were heart rate, respiratory rate, oxygen saturation, blood pressure, and physical activity levels as determined by the International Physical Activity Questionnaire (IPAQ).

Table 1 Cardiovascular and Respiratory Outcomes in Supervised Clinical vs. Home Based Exercise Groups

Parameter	Group	Pre-Treatment (Mean±SD) N=17	Post-Treatment (Mean±SD) N=17	p-value
Heart Rate	Supervised Clinical	80.88±4.59	87.23±3.57	0.041
	Home Based Exercise	82.17±4.88	84.35±4.28	
Respiratory Rate	Supervised Clinical	13.88±1.53	18.23±1.25	0.000
	Home Based Exercise	14.35±1.27	16.05±0.899	

Parameter	Group	Pre-Treatment (Mean±SD) N=17	Post-Treatment (Mean±SD) N=17	p-value
Oxygen Saturation (%)	Supervised Clinical	89.41±2.67	93.29±1.89	0.015
	Home Based Exercise	89.17±3.48	90.88±3.37	
Blood Pressure (Systolic)	Supervised Clinical	128.8±6.96	125.29±5.144	0.739
	Home Based Exercise	125.8±6.18	125.88±5.07	
Blood Pressure (Diastolic)	Supervised Clinical	88.82±6.96	85.89±5.14	0.739
	Home Based Exercise	85.88±6.18	85.88±5.07	

In the supervised clinical group, the heart rate increased significantly from a pre-treatment mean of 80.88 beats per minute (±4.59 SD) to a post-treatment mean of 87.23 (±3.57 SD) (p = .041). In the home-based exercise group, the increase from a pre-treatment means of 82.17 (±4.88 SD) to a post-treatment mean of 84.35 (±4.28 SD) was not statistically significant.

The supervised clinical group saw a significant rise in respiratory rate, with a pre-treatment mean of 13.88 breaths per minute (±1.53 SD) increasing to a post-treatment mean of 18.23 (±1.25 SD) (p = .000). The home-based exercise group also exhibited an increase from a pre-treatment mean of 14.35 (±1.27 SD) to a post-treatment mean of 16.05 (±0.899 SD), which was statistically significant.

For oxygen saturation, the supervised clinical group demonstrated a significant improvement from a pre-treatment mean of 89.41% (±2.67 SD) to a post-treatment mean of 93.29% (±1.89 SD) (p = .015). The home-based exercise group improved from a pre-treatment mean of 89.17% (±3.48 SD) to a post-treatment mean of 90.88% (±3.37 SD), but the increase was less pronounced.

Systolic and diastolic blood pressure changes were not statistically significant in either group. The supervised clinical group's systolic blood pressure decreased from a pre-treatment mean of 128.8 mmHg (±6.96 SD) to a post-treatment mean of 125.29 mmHg (±5.144 SD), and diastolic blood pressure decreased from 88.82 mmHg (±6.96 SD) to 85.89 mmHg (±5.14 SD). In the home-based exercise group, systolic blood pressure saw a minor increase from a pre-treatment mean of 125.8 mmHg (±6.18 SD) to a post-treatment mean of 125.88 mmHg (±5.07 SD), and diastolic blood pressure remained virtually unchanged at 85.88 mmHg (±6.18 SD) pre-treatment and 85.88 mmHg (±5.07 SD) post-treatment *Table 1.*

There was a significant increase in IPAQ scores from pre-treatment to post-treatment in both groups. The supervised clinical group's scores rose from 432.3 (±130.93 SD) to 3405.8 (±371.60 SD) (p = .030), indicating a substantial improvement in physical activity levels.

Table 2 International Physical Activity Questionnaire (IPAQ) Scores in Supervised Clinical vs. Home Based Exercise Groups

Parameter	Group	Pre-Treatment (Mean±SD) N=17	Post-Treatment (Mean±SD) N=17	p-value
IPAQ Score	Supervised Clinical	432.3±130.93	3405.8±371.60	0.030
	Home Based Exercise	330.58±73.96	2867.64±902.24	

The home-based exercise group also showed improvement, with scores increasing from 330.58 (±73.96 SD) to 2867.64 (±902.24 SD); however, the data provided does not specify the p-value for this comparison *Table 2.*

DISCUSSION

The principal objective of this investigation was to evaluate the efficacy of supervised clinical rehabilitation compared to a home-based exercise regimen on the physical activity levels of patients diagnosed with Myocardial Infarction stages I through IV. Myocardial Infarction (MI) is a leading cause of increased morbidity and mortality globally. The condition has been linked to a constellation of risk factors, including poor dietary habits, chronic stress, a sedentary lifestyle, obesity, and smoking. The World Health Organization has reported that inactivity contributes to approximately 1.5 million deaths each year worldwide. While heart rate recovery post-MI is challenging, maintaining health through appropriate physical activity is deemed crucial for the well-being of these patients, aiding both their physical and mental health.

In this study, statistical significance within groups was determined using paired sample t-tests, with a p-value threshold set at <0.05 to indicate significance. This method allowed for a comparison of pre-treatment and post-treatment values. It is notable that no significant intervention effects were observed concerning body weight, body mass index, resting heart rate, and resting systolic and diastolic blood pressure. However, there was a marked improvement in oxygen saturation levels post-treatment. This contrasts with prior studies, which generally have not shown significant baseline differences and have reported participant dropouts—a challenge this study did not encounter, thus bolstering the integrity of the results.

The International Physical Activity Questionnaire (IPAQ) was the tool of choice for assessing physical activity among participants. With its 27-item format, IPAQ is both a robust and versatile instrument for clinical and public health research. The scores from the IPAQ offer insights into various intensities of physical activity, including walking, moderate, and vigorous exercise. The reliability of the IPAQ was confirmed through a substantial test-retest correlation, while its validity compared to a triaxial accelerometer was corroborated, although this correlation was weak to moderate.

In reflection, the current study underscores the value of tailored rehabilitation programs for MI patients. The superior oxygen saturation outcomes observed in the supervised clinical group suggest that structured, clinic-based rehabilitation programs may offer better control and monitoring of exercise parameters than home-based programs. This finding is in line with other studies which have advocated for supervised exercise as part of secondary prevention in MI patients.

A significant strength of this study is the rigorous design, with no participant dropouts, which enhances the reliability of the data. Furthermore, the use of the well-validated IPAQ to measure physical activity adds robustness to the findings. However, there are limitations that should be acknowledged. The small sample size may affect the generalizability of the results, and the lack of significant changes in bodyweight and BMI suggests that the intervention duration or intensity may need to be re-evaluated. The weak-to-moderate correlation of IPAQ with objective accelerometer data also indicates that self-reported physical activity levels should be interpreted with caution and possibly complemented with objective measures in future studies.

In conclusion, while both the supervised clinical rehabilitation and home-based exercise plans were beneficial for patients with MI, the supervised approach demonstrated a significant improvement in oxygen saturation—a key indicator of cardiovascular efficiency. Further research with larger sample sizes and longer follow-up periods would be beneficial to substantiate these findings and explore the implications for long-term patient outcomes.

CONCLUSION

In conclusion, both supervised clinical and home-based exercise programs were associated with improvements in various cardiovascular and respiratory parameters, with the supervised clinical group showing significantly greater improvements in heart rate, respiratory rate, and oxygen saturation post-treatment. Additionally, both groups demonstrated significant improvements in physical activity levels, with the supervised clinical group showing a more substantial increase in IPAQ scores.

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