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RESEARCH ARTICLE

The Role of Cardiac Rehabilitation Programs in Improving Outcomes and Quality of Life for Patients with Ischemic Heart Disease

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ABSTRACT

This study aims to assess the role of cardiac rehabilitation programs in improving IHD patients' quality of life. A Case-control study design was conducted and all participants underwent an exertion test to assess their ability to endure the exercise and ascertain their maximal effort threshold (METS) and activity duration (measured in minutes). The Clinical Analysis Laboratory of the participant's total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, blood glucose, and glycated haemoglobin (HbA1c) were measured. The Medical Outcome Survey Short Form (SF-36) measured quality of life. A total of 95 patients were assessed for both the test and control groups, to report that patients who were younger than 65 years had greater improvements in the SF ($P = 0.000$) and MH ($P = 0.01$) subsections compared to older patients (with an age greater than 65 years). There was a significant improvement in EF, exercise capacity, and resting heart rate among the population ($P < 0.05$). It has been indicated that attaining CR can enhance the overall well-being of individuals diagnosed with PF, BP, PL, and V over 8 weeks.

INTRODUCTION

In contemporary society, cardiovascular diseases are the key factors leading to mortality rates and are the leading cause of hospital admissions [1], comes after hospitals and clinics acquired infections [2,3]. They contribute to around 30% of worldwide deaths and 48% of deaths in Asia, and it is expected that these will increase in the future [4]. In recent decades, there has been a persistent decrease in mortality rates linked to ischemic heart disease (IHD). However, there exists data indicating an increase in the morbidity associated with IHD [5]. Advancements in cardiac treatment have contributed to the improved lifetime of those who have survived IHD and heart failure. 1-3 It has been estimated that the global economic burden of IHD, encompassing both direct and indirect costs, amounts to around USD$108.9 billion [6,7]. Projections indicate that this financial burden is expected to rise to USD$218.7 billion by 2030 [8]. Cardiac rehabilitation (CR) is a well-established concept. A considerable body of study has provided evidence supporting the effectiveness of these therapies in reducing mortality rates associated with coronary heart disease [9], which have been reported to range from 27% to 31% among affected persons. Unfortunately, there are still countries that demonstrate less than desirable levels of participation in these initiatives [10]. There exists a positive correlation between lesser levels of patient engagement in cardiac rehabilitation programs and sociodemographic attributes, as well as those associated with program availability and accessibility, and the relatively low rates of patient referrals to this service [11]. The significance of cardiac rehabilitation is of utmost importance in improving outcomes for persons diagnosed with IHD [12]. CR programs typically incorporate various specialized domains, including food counseling, reduction of risk factors, psychosocial intervention, patient education, and individualized exercise regimens [13].

It was found that the rate of mortalities and hospitalization with duration of being at risk in ICU as well as the physical and emotional performance get improved, were reported significantly by enhancing and applying the CR for patients with IHD [14,15].

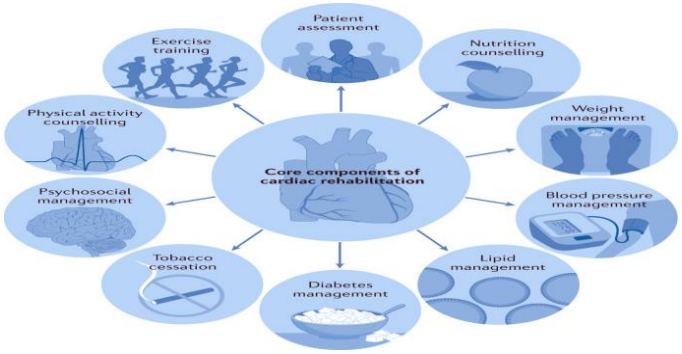

Figure 1. The Cardiac rehabilitation main components [13]

It has been reported that the enhanced and improve of QoL for patients with IHD may be happened by implementing and optimizing CR with certain criteria and strategies [16].

METHODOLOGY AND STATISTICAL ANALYSIS

Sample population

All patients with IHD who met risk criteria according to the American Cardiology Society [17] were included as participants in this study. The participants included in the study were persons aged 65 years or older who exhibited a significant level of cognitive functioning, shown the capacity to participate in cardiovascular exercise using a treadmill or stationary cycle, and displayed competency in using smartphones or tablets.

In addition, patients were required to satisfy one or more of the subsequent inclusion criteria: an ejection fraction (EF) ranging from 40% to 55%, a functional capacity ranging from 5% to 7% METS, and/or an elevation in blood pressure after physical exertion.

Study design

A Case control study design with a randomized technique.

An independent investigator randomly allocated the patients to either the control group, which received the standard cardiac rehabilitation program at the hospital, or the experimental group, which received the home-based mixed surveillance program. The randomization technique was conducted using the software application Epidat to ensure a balanced distribution in both groups. The software's algorithm has demonstrated that the likelihood of assigning a new subject to a specific group is inversely related to the prior inclusion of subjects in that group.

Both subjects underwent cardiac rehabilitation therapy for a period of three months. Only two patients were seen to terminate their participation in the surveillance group as a result of personal issues. The diagram presented illustrates the outline design.

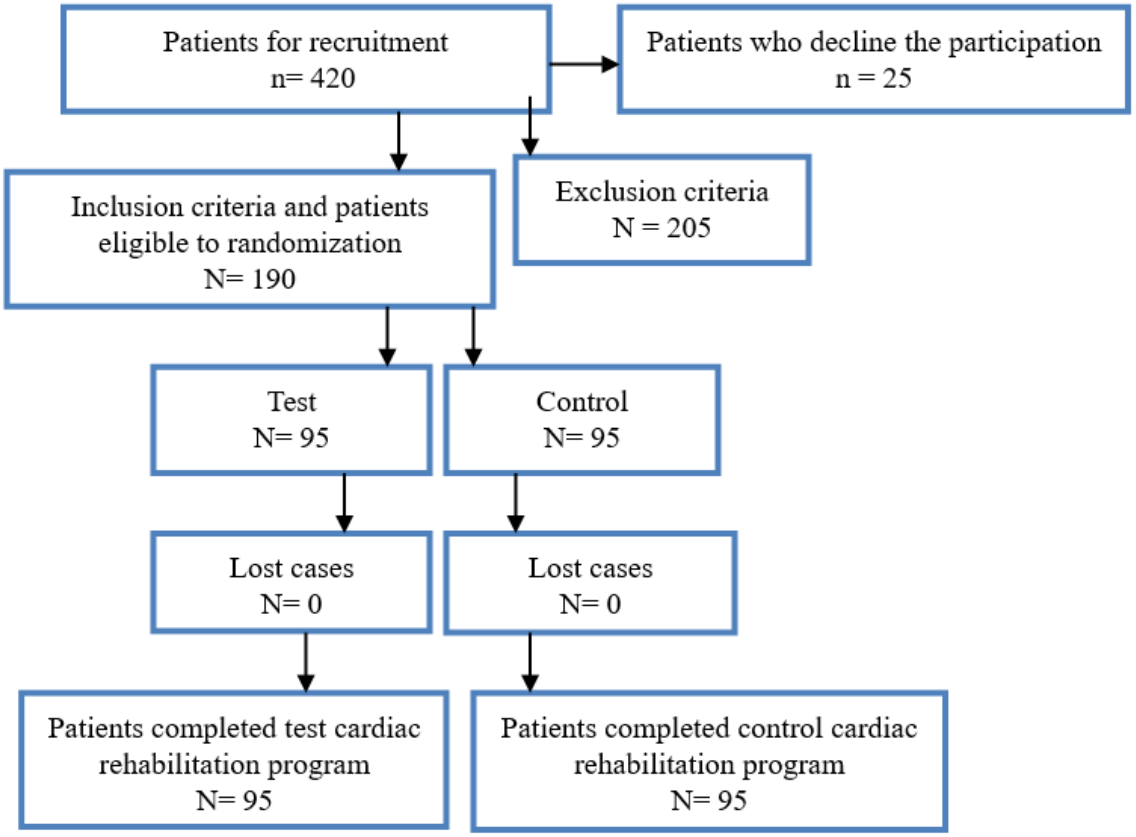

Figure 2. Study Design Flowchart

Intervention

Subsequent to the patients' hospitalization, the initiation of the two cardiac rehabilitation programs occurred approximately 3 to 7 months thereafter. Both programs had a duration of two months and encompassed several components, including physical activity, health education, and physiotherapy.

The implementation of the cardiac rehabilitation program took place within the same facility. Every individual within this cohort participated in the inpatient exercise regimen on a triweekly basis, leading to a cumulative count of 24 sessions. Moreover, it was advised that they engage in home-based physical activity, adhering to the criteria set forth [18].

The participants who constituted the mixed surveillance group for cardiac rehabilitation attended weekly sessions at the cardiac rehabilitation facility with great dedication. During the course of this visit, a meticulously supervised physical exercise session was conducted, precisely reflecting the traditional cardiac rehabilitation regimen. Subsequently, the individuals adhered to a walking regimen lasting one hour, employing the Karvonen formula, while maintaining a heart rate of 70% of their initial level and 80% for the subsequent month. The exercise was closely monitored using a remote electrocardiographic monitoring device called NUUBO®. The participants were directed to participate in physical activity for at least two more days each week, but they were strongly encouraged to exercise every day.

Both cohorts participated in a regular health education session at the medical facility with the aim of enhancing their comprehension and awareness of many topics, such as cardiac architecture and function, cardiovascular risk factors, physical activity, medications, nutrition, erectile dysfunction, and reintegrating into the workforce. Furthermore, each patient actively participated in a standard weekly group psychotherapy session aimed at

addressing the emotional ramifications of the disease, enhancing their overall well-being, mitigating the risk of future myocardial infarctions, fostering acceptance of their diagnosis, and augmenting their quality of life.

MEASUREMENTS

Anthropometrics

The patients' body weight was assessed using a calibrated scale. Measurements were taken on patients who were wearing lightweight clothing and were not wearing any shoes. The body mass index (BMI) is calculated by dividing weight (in kilograms) by the square of height (in meters). The abdominal circumference was assessed using a metric tape while the patient stood erect, with knees together, arms at the sides, and the abdomen in a relaxed state after taking a deep breath. Measurement was conducted on the circumference of the region situated halfway between the costal edge and the upper edge of the iliac crest.

Blood pressure

The systolic and diastolic blood pressure were measured using the Omro M5-I ® electric sphygmomanometer. During a 10-minute period of rest, the arm was positioned on a table to conduct the measurements. Subsequently, the meaning of three readings was recorded.

Exercise capacity

Prior to their inclusion in the study, the participants underwent an exertion test to assess their ability to endure the exercise and ascertain their maximal effort threshold (METS) and activity duration (measured in minutes). The exercise test was conducted on a treadmill, adhering to the criteria advocated by clinical practice, while the patient was consistently monitored using a 12-derivation electrocardiogram (ECG), following the Bruce protocol. The trial was concluded upon the participants' manifestation of fatigue or the display of indications and/or manifestations of intolerance. A record was made of the highest heart rate seen during the stress test. Furthermore, the study also documented the rate at which heart rate returned to normal during the initial minute, as well as the perceived level of exertion, as evaluated using the Borg scale (RPE 6–20).

Laboratory parameters

The total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, blood glucose, and glycated hemoglobin (HbA1c) of the subject were all measured by the Clinical Analysis Laboratory. In order to determine the levels of glucose, cholesterol, and triglycerides, measurements were conducted. The values of HbA1c were determined using the Adams analyzer. The quantification of glucose concentrations was performed using the glucose and hexokinase methods. The cholesterol oxidase method was employed to assess the total cholesterol levels, the enzymatic magnesium dextransulphate method was used to analyze the HDL cholesterol levels, and the selective detergent method was employed to analyze the LDL cholesterol levels. The study utilized the lipase/glycerol kinase methodology to assess the concentrations of triglycerides.

Assessment of health-related quality of life

The questionnaire known as the Medical Outcome Survey Short Form (SF-36) was utilized in order to evaluate the quality of life status. Scores on the SF-36 range from 0 to 100, and it is comprised of 36

criteria that evaluate eight different characteristics all together. The variables under study encompass a spectrum of constraints that emerge from several reasons, including bodily pain, physical ailments, psychological welfare, social performance or role, limitations arising from emotional considerations, vitality, energy or fatigue, and overall health perception. There has been a large amount of research done on the metric properties of the Spanish adaptation of the SF-36, which has resulted in strong empirical data that verify its reliability, validity, and sensitivity [19].

Cardiovascular complications

Throughout the course of the cardiac rehabilitation regimens, the study meticulously documented a wide range of difficulties that was encountered. The research determined that there are a number of problems, including hypoglycemia, hyperglycemia, acute myocardial infarction (AMI), cardiorespiratory arrest or death, severe arrhythmias, arterial hypertension, arterial hypotension, and intermittent claudication as a consequence of peripheral arterial disease.

Statistical analysis

An analysis of variance (ANOVA) with two-way repeated measures was utilized in the research project in order to assess the impact of time, both before and after the intervention, as well as the interaction between time and the group. For the purpose of determining whether or not the distributions were normal, the Shapiro-Wilk test was utilized. Descriptive analyses, which included confidence intervals, indices of central tendency, and percentages, were utilized in order to characterize both the sample and the outcomes of the study. The study employed a significance level of $p < 0.05$.

RESULTS

A total of 95 patients were assessed for both the test and control groups, as indicated in Table 1. The analysis revealed the characteristics of the population under study. As shown in Table 2, there were notable enhancements seen in the levels of pulmonary function (P = 0.00), blood pressure (P = 0.005), volume (P = 0.01), peripheral lymph node (P < 0.001), and GH (P = 0.006) among all patients. In terms of gender groupings, it was shown that females saw significantly bigger improvements in V (P = 0.001), MH (P = 0.00), and PF (P = 0.003) in comparison to males that were analyzed in Table 3 .

The data presented in Table 4 indicates that patients who were younger than 65 years old experienced greater improvements in the SF (P = 0.000) and MH (P = 0.01) subsections as compared to patients who were older (with an age more than 65 years). On the basis of the data presented in Table 5, it can be observed that there was a noteworthy enhancement in the levels of exercise capacity, resting heart rate, and EF among the population (P < 0.05).

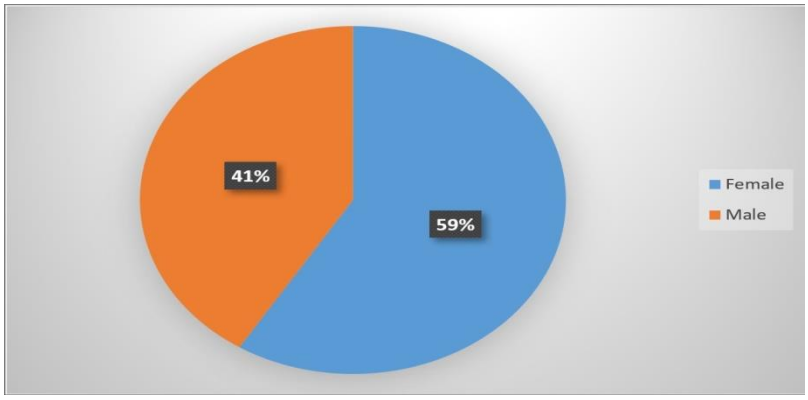

Figure 3. The gender distribution among the control and test populations

Table 1. Attributes of the population under study

	Total (n = 190)	Case (n = 95)	Control (n = 95)
	Mean ± SD	Mean ± SD	Mean ± SD
Age	48.7 ± 9.1	47 ± 11.2	49.1 ± 10.2
Weight (kg)	54.6 ± 11.2	49.2± 9.6	50.6 ± 1.1
Education level			
Primary	40.3%	19.6%	61.1%

Secondary	51.3%	46.8%	11.9%
University	8.4%	33.6%	27%
Living with partner	87%	89.5%	91.4%
Disease			
CABG	51.4%	16.3%	12.2%
PTCA	16.5%	29.2%	21.4%
MI	3.1%	51.6%	10.0%
CAD	29.0%	2.9%	56.4%
Disease risk			
Low	61.4%	32.3%	41.4%
Intermediate	22.7%	61.2%	29.7%
High	21.4%	19.5%	28.1%
< 65 years old	70%		
≥ 65years old	30%		

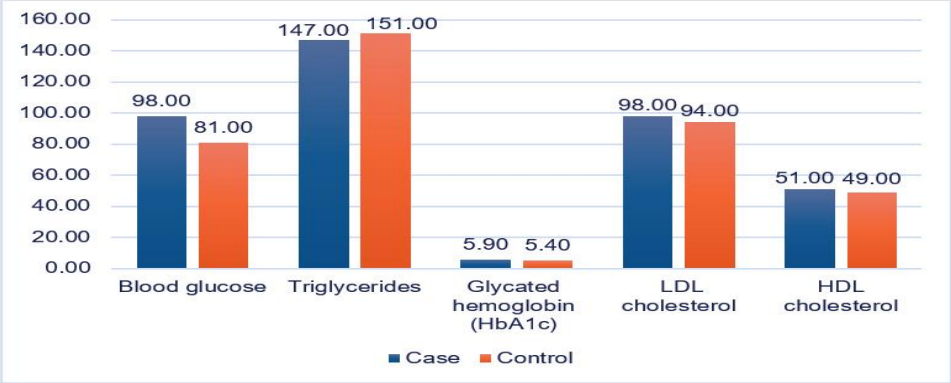

Figure 4. The clinical laboratory results among case and control (n=190)

Table 2. Pre- and post-cardiac rehabilitation program quality of life scores in the entire population

SF-36 subscale	Before	After	P value
	Mean ± SD	Mean ± SD	
Body pain	64.7 ± 19.9	71.81 ± 13.4	0.005
Physical limitation	29.5 ± 29.2	51.15 ± 35.6	< 0.001
Social function	69.17 ± 12.4	74.17 ± 19.3	0.91
Vitality	58.5 ± 19.6	59.4 ± 29.5	0.01
General health	56.15 ± 17.4	59.2 ± 20.2	0.006

Emotional limitation	49.78 ± 21.7	57.10 ± 12.9	0.55
Mental health	62.18 ± 19.7	61.14 ± 19.2	0.61
Physical function	59.5 ± 13.4	88.19 ± 12.7	0.000

Table 3. The average percentage of changes in quality-of-life items for both males and females

SF-36 subscale	Male	Female	P value
	Mean ± SD	Mean ± SD	
Vitality	9.1 ± 19.1	44.2 ± 29.4	0.001
Social function	6.61 ± 23.2	19.7 ± 12.8	0.51
Emotional limitation	7.45 ± 2.4	9.13 ± 21.1	0.730
Body pain	18.2 ± 3.1	19.01 ± 4.8	0.6220
General health	19.4 ± 9.2	18.12 ± 9.3	0.750
Physical function	10.12 ± 6.9	52.9 ± 9.1	0.003
Mental health	4.12 ± 8.1	39.19 ± 14.1	0.00
Physical limitation	19.81 ± 15.5	51.8 ± 1.2	0.220

Table 4. A Comparative Analysis of the Mean Percentage Changes in Quality-of-Life Items between Patients Aged 65 and Below

SF-36 subscale	< 65 years (n = 64)	≥ 65 years (n = 31)	P value
	Mean ± SD	Mean ± SD	
Physical function	19.18 ± 7.2	19.7 ± 4.02	0.44
Physical limitation	39.46 ± 24.9	-3.40 ± 14.1	0.124
Emotional limitation	17.12 ± 4.11	-10.12 ± 1.13	0.33
Vitality	24.91 ± 6.6	13.11 ± 29.6	0.21
Mental health	26.2 ± 1.18	-3.12 ± 1.1	0.01
Social function	19.1 ± 11.4	-6.13 ± 39.3	0.000
Body pain	23.16 ± 5.3	15.7 ± 4.12	0.99
General health	18.8 ± 9.4	14.14 ± 19.5	0.624

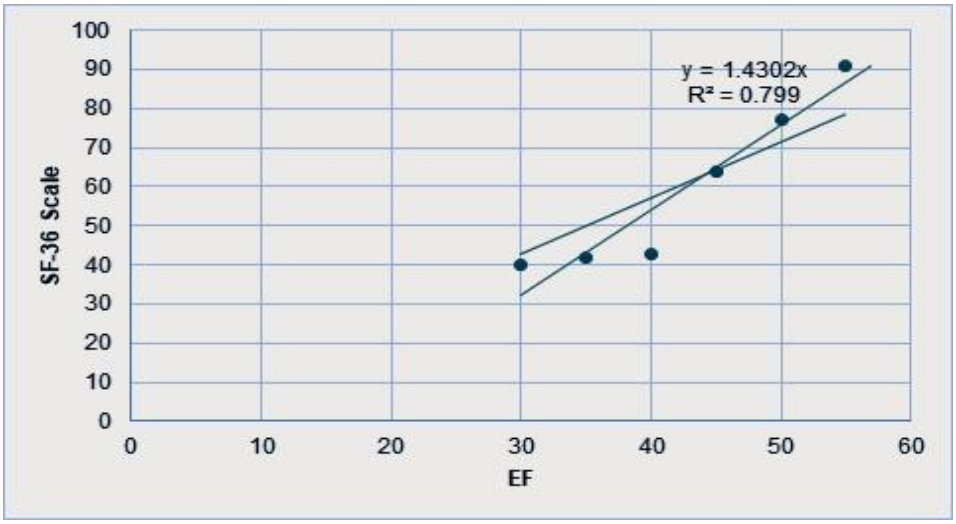

Figure 5. The correlation between SF-36 score measured in this study and the EF values for only Case population (n= 95)

Table 5. Pre- and post-cardiac rehabilitation measurements of ejection fraction, exercise capacity, and resting heart rate

		Before	After	P value
		Mean ± SD	Mean ± SD	
Ejection fraction	Total	59.1 ± 8.7	49.8 ± 19.0	< 0.005
	Male	51.2 ± 12.3	52.9 ± 8.7	
	Female	50.13 ± 9.1	52.4 ± 8.9	
Exercise capacity	Total	9.43 ± 2.1	11.71 ± 1.7	
	Female	7.14 ± 2.3	9.45 ± 3.3	
	Male	8.42 ± 2.7	12.4 ± 1.9	
Resting heartrate	Total	89.4 ± 13.4	79.1 ± 12.2	
	Female	91.8 ± 11.4	81.4 ± 10.7	
	Male	79.7 ± 11.3	77.26 ± 5.3	

The cardiac rehabilitation regimen in this study has numerous important elements, as shown in Figure 1 [13]. This includes patient education, exercise, psychological support, and food advice. Figure 2 depicts the participant recruitment study design flowchart. Among 312 eligible volunteers, 190 were randomized to the test or control group. See Figures 3 for test and control population gender distributions. More men are in both groups. The case and control groups (n=190)' baseline and 12-week cardiac rehabilitation clinical laboratory results are shown in Figure 4. The case group had decreased LDL, triglycerides, and HDL cholesterol. SF-36 scores, which evaluate health-related quality of life, are favorably connected with EF values for the case group only (n=95), as shown in Figure 5. High EF values were linked to enhanced self-reported quality of life in cardiac rehabilitation participants. Figure 4 shows the baseline and 12-week cardiac rehabilitation clinical

laboratory results for the case and control groups (n=190). Interestingly, the case group had higher HDL cholesterol and decreased triglycerides and LDL cholesterol. In the case population (n=95), EF values are positively correlated with the SF-36 score, a measure of health-related quality of life (Figure 5). Cardiovascular rehabilitation program participants with higher EF values had higher self-reported quality of life.

DISCUSSION

The recent study observed a significant improvement in the quality of life (QOL) following an 8-week total CR, specifically in the subcategories of PF, PL, V, BP, and GH. Women experienced a more pronounced improvement in the PF, V, and MH subcategories compared to males [8]. Patients below the age of 65 demonstrated a more substantial enhancement in the mental health (MH) and SF subcategories in comparison to older individuals.

The study has yielded empirical data suggesting that participation in physical exercise significantly impacts an individual's QoL, as increased levels of physical activity are linked to improved QOL. Conversely, increasing exercise capacity has a beneficial effect on patients' capacity to engage in everyday activities, work, and leisure activities, hence improving their overall quality of life. The recent study observed a significant increase in exercise capacity following CR in both the overall population and each gender group. Enhancing the physical well-being of patients has a significant impact on their psychological state, hence facilitating their reintegration into the workforce, engagement in social activities, and overall improvement of well-being [1]. Numerous studies conducted in this field have revealed variations in the interventions employed and the individuals under study [20,21]. A study was conducted to examine the impact of home-based cardiac rehabilitation on the quality of life among individuals diagnosed with MI [22]. This study was a comparative analysis of effects the CR with considering both genders and all age ranges for patients with several cardia problems. Additionally, both studies examined the quality of life (QOL) in both the case and control groups. Multiple studies have presented evidence suggesting that the quality of life (QOL) improved after CR, but anxiety and melancholy did not show significant changes after CR [23].

A study conducted on female participants revealed that the use of CR resulted in enhanced quality of life and reduced levels of anxiety. While this study did not assess anxiety and despair, it is crucial to recognize that the SF-36 for Quality of Life includes a separate part specifically dedicated to mental health. Study has demonstrated that cardiovascular rehabilitation (CR) had the capacity to alleviate psychological stress frequently experienced by those afflicted with cardiovascular diseases, hence enhancing their

overall well-being. Individuals with cardiac issues have shown that undergoing a 12-month CR can enhance their physical indices and quality of life (QOL). The study examined the effects of a two-month home-based cardiac rehabilitation course on the quality of life of patients who have been diagnosed with myocardial infarction. Based on their study, it was seen that CR exhibited a favorable influence on both the physical and mental dimensions of quality of life, however it did not demonstrate a statistically significant impact on the social element of quality of life. The outcomes of the present study were consistent with the results of the previous study [24].

There are many studies that have demonstrated that those experiencing more intricate psychological distress had more substantial benefits from cognitive reform as compared to their counterparts. However, several studies have shown contrasting results. The findings of the study indicate that CR had a notable effect on individuals experiencing acute psychological distress, namely in terms of their physical, mental, and social dimensions of QoL. A substantial body of study has yielded empirical support for a positive correlation between the QoL, and the degree of psychological distress experienced by individuals.

Furthermore, studies have shown that CR can significantly enhance QOL and reduce anxiety, especially among this specific group of patients [25]. According to [26], the findings of the study revealed that the effects of CR were uniform across all age groups. According to the findings of the study, CR was found to have a positive impact on the overall well-being of those who were 65 years of age or older, as well as individuals who were younger than 65 years of age.

Furthermore, the study demonstrated that patients in cases group had more significant enhancing and an improve when compared to the control groups and in alignment with other clinical trials. The findings of this

study indicated that females shown greater improvements in vital signs, emotional being, and activities in forms of physical performance as related to females over males at the same age to observe that the exercise many enhance the physical well-being in comparing to other rehabilitation procedures [27,28].

CONCLUSION AND RECOMMENDATIONS

This study indicated that the CR has the potential impact to potentially enhance the IHD patients' status to have with higher quality of life by measuring and diagnosing PF, PL, BP, and V for a program duration for rehabilitation around 2 months. The presence of control group to compare the findings of it to test group in form of some clinical data in addition to measuring the significance of rehabilitation program in only test data is a limitation but did not interfere with the results' significance. There is limited study conducted in Asian region to investigate the CR impact on the quality of life for all test group in relation to age, gender, and other clinical laboratory studies. Other kinds of coronary and cardiac rehabilitation must be implemented and tested with other clinical trials and in compared to control groups as case control cohorts.

Ethical standards and considerations

a. Conflict of interest

The authors declare there is no conflict of interest.

b. Funding

This study did not obtain any funds or grants.

c. Ethical approval

An Institutional Review Board (IRB) approval was obtained with a number 321-1993cAdditionally, the study participants were provided with detailed information about the study methods, and then their written informed consent was obtained on both cases and controls.

d. Data availability

All data is available upon request from any editorial or reviewing board.

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