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Improving Cardiovascular Health: The Impact of a Cardiac Rehabilitation and a Home-Based Aerobic Exercise Programs Together on Exercise Capacity in Patients with Cardiovascular Disease

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Abstract:

Background: Cardiovascular disease (CVD) is the nation's prevailing cause of mortality among men and women of all races.

Purpose: This study aimed to determine the effect of cardiac rehabilitation program (CRP) on heart rate (HR), systolic and diastolic blood pressure (SBP and DBP), and exercise capacity (EC) in patients with CVD.

Methods: This study was based on a two-arm parallel group randomized comparative design that included sixty-four participants (n=32/group) with CVD (mean age, 64.53±6.99 years) and was randomly allocated to two groups (CRP vs. Control). CRP Group received the CRP and home-based aerobic exercise program (AEP). The Control Group received the home-based AEP only. The outcomes, HR, SBP, DBP, and EC, were assessed using a sphygmomanometer and a six-minute walk test (6MWT). The t-test and Wilcoxon test were used to analyze between and within-group comparisons for all the outcomes scores, keeping the level of significance α at 95% ($P<0.05$) for all the statistical analyses.

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Results: The mean scores comparison of the outcomes, HR and 6MWT were found significant (95% CI, $P<0.05$) within CRP and Control groups; however, SBP and DBP mean scores were found insignificant (95% CI, $P>0.05$) within both groups, except DBP mean score which was found significant ($P<0.05$) within CRP Group. Comparing the outcomes mean scores between the groups at four-week post-intervention, HR, SBP, DBP, and 6MWT were found to be insignificant ($P>0.05$).

Conclusions: The CRP and home-based AEP together and home-based AEP alone were equally effective in decreasing HR and improving EC in patients with CVD.

Keywords: Cardiac rehabilitation program, Aerobic exercise program, Hypertension, Exercise capacity, Quality of life. Cardiovascular disease.

Running title

Effect of CRP and Home-Based AEP on EC in Patients with CVD

Introduction

The World Health Organization (WHO) 2013 has indicated that cardiovascular disease is the first leading cause of death worldwide among non-communicable diseases (NCDs); it is the nation's prevailing cause of mortality among men and women of all races.[1] People died annually about 17.3, 7.5, 4.2, and 1.3 million from cerebrovascular disease, cancer, respiratory diseases, and diabetes, respectively; among them, cerebrovascular diseases are the foremost cause of burden to the health system.[2]

Cardiovascular disease (CVD) is a fatal disorder responsible for 48% of cardiovascular deaths in Europe and other developed countries.[3] These occur as a result of the high prevalence of smoking, remarkably low HDL cholesterol levels, increased unhealthy habits of food consumption, no exercise, and a sedentary lifestyle, which leads to an increase in plasma triglycerides levels as well as the incidence of decreased exercise capacity, obesity, diabetes, hypertension, and poor quality of life.[3,4]

Management of CVD includes a multi-model approach, such as patients' and family education and motivation, pharmacological and surgical management, and therapeutic interventions, including cardiac rehabilitation programs aiming to improve cardiac fitness, exercise capacity, and overall quality of life. [5]

Surgical management of CVD cases, such as Coronary Artery Bypass Graft, valvular repairs, and arterial and venous shunting, is an effective surgical measure for alleviating and returning to optimal physical capacity and functional performance in patients with CAD. [6,7]

An effective enhancement in physical capacity and functional performance in CVD patients suggests a better QOL and resumption of professional activity. [8,9] It has increased the survival rates by about 50% and is subsequently the candidate for cardiac rehabilitation. In patients with CVD, cardiac rehabilitation is a central component of patient management for the long-term success of procedures performed on the patient. [8,9]

Cardiac rehabilitation programs are endorsed for CVD, as defined by the World Health Organization (WHO), "the totality of the activities obligatory to safeguard the best imaginable physical, mental and social conditions, so that the cardiac patients may resume a place as possible in the life of the community." A cardiac rehabilitation program is a multifaceted/multidisciplinary program of smoking prohibition, exercise training, balanced diet, cholesterol management, psychosocial elements, i.e., stress management, anxiety, depression, occupational assessment, and counseling. [10]

A supervised aerobic exercise program (AEP) is integral to phase II cardiac rehabilitation. It has been reported that progressive physical activities delay long-term cardiovascular mortality. In addition, regularly supervised, steady, and long-term AEP benefits cardiorespiratory fitness, psychological status, and quality of life. [11] One study has shown that combined resistive aerobic training and exercise programs in elderly patients have increased body strength post-coronary revascularization. [12] Exercise prescription may include minimum resistance training in patients with reasonable exercise tolerance without adverse signs. This regimen may be important in breaking the vicious cycle of physical inactivity, exercise intolerance, myocardial insufficiency, and more physical inactivity. In recent years, more studies are reporting the safety and efficacy of resistance training in cardiac patients showing better recovery. [13-15] Recently, it has been highlighted that peripheral factors such as arteriolar dilatation and skeletal muscle pumping action are the main factors behind the circulatory response to exercise. [16] Minimum resistant training using these factors in early management can prove very beneficial and affect the circulatory response. [17] Fear of increased blood pressure with such training should not be a limiting factor for CVD patients, especially low-risk patients with good left ventricular function, if resistance is minimal. [16,18]

In recent practice, cardiac rehabilitation programs are usually maintained for a limited duration because of financial restrictions, and early return to previous work and occupation is the main objective. Therefore, this study aimed to determine the efficacy of a cardiac rehabilitation program and a home-based aerobic exercise program together on HR, systolic and diastolic BP, and EC in patients with CVD. The study hypothesized that there would be or would not be an improvement in the HR, SBP, DBP, and EC in patients with CVD post-CRP and home-based AEP together. If improvements in the main vital parameters, overall exercise capacity, the study will be significant and can be implicated for future prospects. Moreover, the present study will develop a short-term, comprehensive, cost-effective cardiac rehabilitation program that can benefit CVD patients to fasten the process of an early return.

Materials and Methods

Study Design

The study was based on a two-arm parallel group randomized comparative design. It was used to study the effects of a cardiac rehabilitation program (CRP) on HR, BP, and EC in CVD patients. The study followed a CONSORT checklist describing the steps followed while conducting it.

Ethical Consideration

The university's institutional review board (IRB) approved the study. The study followed the standard ethical guidelines for conducting human research by the local ethical body. This study was conducted per the Helsinki Declaration of 1975, revised in 2000 (available at http://www.wma.net/e/policy/17-c_e.html). The participants from each group returned with a signed, completed informed-consent form before the beginning of the study.

Study Settings

A consultant physician referred patients with CVD to the outpatient department physiotherapy of the medical facility to receive the cardiac rehabilitation program. Awareness of the present study was spread through posters hanging outside and inside the physician chamber, the physiotherapy department, and outside the hospital premises. The study complied with all the protocols related to the COVID-19 pandemic to ensure the study’s participants, assessors, and therapists’ safety. It was completed within fourteen months, starting from June 2021 until August 2022.

Sample Size Estimation

Computer software G*Power 3.1.9.4 was used to estimate the effective sample size. A priori t-test (independent means): computer required sample size- given α (0.05), power (0.80), and effect size (mean1±SD:425.37±109.19, mean2±SD:495.75±87.34, d=0.71). A total of sixty-four, thirty-two participants in each group (n=32/group) was estimated to satisfy the power of an effective sample. Assuming a 25% sample attrition, eighty participants were required to

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conduct this study. The six-minute walk test score was used to calculate the intervention's effect size.

Study Participants

The participants were recruited for this study based on inclusion and exclusion criteria. The participants with CVD, including essential hypertension not greater than 140-159/90-94 mmHg, post coronary artery bypass grafting, Myocardial infarction, peripheral vascular disease, a chronic cerebrovascular accident within 6 to 12 months, and chronic heart disease, aged within 45 to 65 years, ejection fraction greater than 45%, and passed the exercise stress tests, were included for this study. The participants with uncontrolled diabetes and metabolic disturbances, poorly controlled hypertension, acute cerebrovascular accident, neurological/muscular disorders, uncontrolled arrhythmias, hemodynamically unstable, and showed non-cooperation were excluded from this study.

Outcomes Measures

The study outcome measures, such as HR and BP (systolic and diastolic BP), were assessed by a sphygmomanometer; a six-minute walk test measured EC. The six-minute walk test is a self-paced timed walking test that assesses the distance the patient can walk on a flat surface over six minutes but requires at least one training session. [19, 20]

The average score of two readings for each outcome measure was recorded and considered for the data analysis to observe the intervention effects. The study duration was four weeks, and the outcomes scores were assessed at baseline and four-week post-intervention by the same assistant physiotherapist kept blinded to the group allocation. The instruments used in this study were as follows; sphygmomanometer (Diamond Mercurial Type Regular BP Monitor, Model: BPMR-111, Industrial Electronic & Allied Products, India), pulse oximeter (CONTEC pulse oximeter, CONTEC Medical Systems Co., Ltd. China), stethoscope (3M™ Littman Stethoscope, USA.), stopwatch, treadmill, measuring tape, and weight cuffs (Figures 1. a, b.).

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Figure 1. Shows a free lane for a six-minute walk test (a) for assessing exercise capacity; and a sphygmomanometer, stethoscope, and pulse oximeter (b) for measuring systolic and diastolic blood pressure, heart rate, and oxygen saturation, respectively.

Procedures

Thirty participants diagnosed with CVD were referred to O.P.D. physiotherapy, screened, and recruited for the study based on inclusion and exclusion criteria, randomly allocated to the experimental, i.e., CRP Group (cardiac rehabilitation program (CRP) and home-based aerobic exercise program (AEP)) and Control group (home-based AEP only), and obtained the signed informed consent form from the participants before the start of the study. A simple random sampling method of randomization was used to allocate the participants to the intervention group using a lottery technique in which sixty-four chits with equally written group numbers (15/group) were enclosed and mixed inside a jar. The participants were instructed to take a

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chit individually from the JAR. According to the written group number, they were allocated simultaneously to the CRP and Control groups. Baseline measurements were taken for the outcomes by an assistant physiotherapist before the start of the study intervention. The CRP group received a cardiac rehabilitation program and home-based AEP together. However, the participants from the control group were instructed to do only home-based AEP at home. The CRP and home-based AEP were explained by a specialist physiotherapist (cardiac physiotherapist) who was not blind to the participants' group distribution. The assistant physiotherapist, who was kept blind to the group allocation, took the outcomes scores at baseline and four-week post-intervention. Two readings were recorded for each outcome score, and the average score of the two readings was taken for the data analysis. A CONSORT (2010) flow diagram presents the study procedures, including enrolment, randomization, allocation, follow-up, and analysis, in Figure 2.

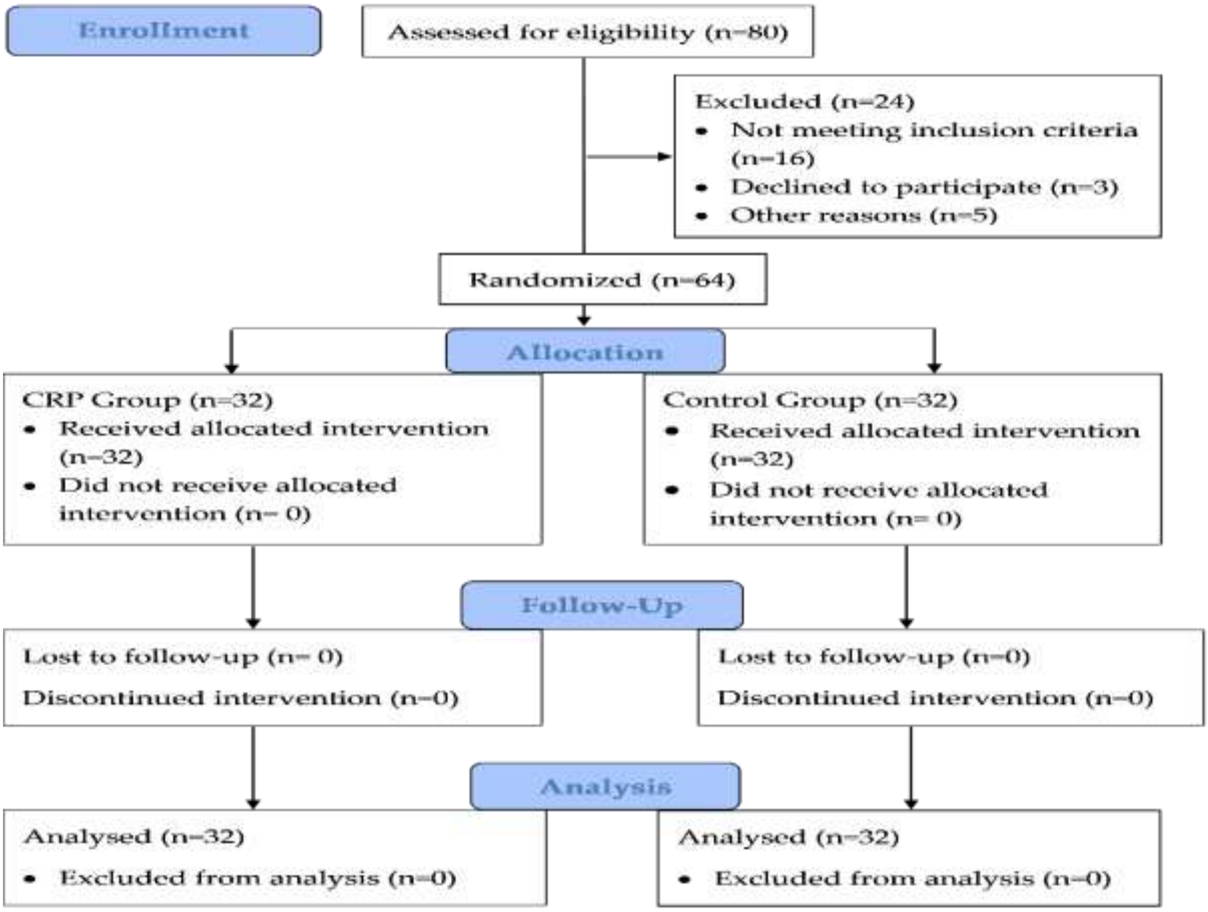

Figure 2. A CONSORT (2010) flow diagram presents the study's procedures, including enrolment, randomization, allocation, follow-up, and analysis.

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Intervention

The participants from the CRP group performed a phase II cardiac rehabilitation program under the supervision of a specialist physical therapist. They were instructed to perform home-based AEP at home, too. However, the participants from the Control group were instructed to perform only home-based AEP at home. The participants from both groups were advised to continue their stipulated exercise protocol three alternate days a week for four weeks.

Cardiac Rehabilitation Program (CRP)

CRP, an exercise regime, was developed, including a warm-up phase for 10 minutes, a conditioning phase for 20 minutes, and a cool-down phase for 10 minutes. [21] Protocol was followed for three alternate days per week for four weeks. The vital parameters, such as HR, RR, SPO_2, and BP, were monitored every 10 minutes during the training session to avoid uneven consequences. Blood pressure was recorded again at the end of the exercise session in a sitting position. Intermittent rest periods for 5 minutes were given to the patients whenever required.

Warm-Up Phase

It starts before the strengthening phase, including the following exercise patterns with ten daily repetitions: 1). Simple neck movements, including neck flexion, extension, and lateral side flexion; 2). Deep breathing exercises, including butterfly exercises and cross-shoulder breathing (Figures 3. a, b.); 3). Upper limb free exercises, including shoulder flexion, extension, protraction, and retraction; 4). Trunk mobility exercises include bilateral side flexion, extension, and bilateral trunk rotation; and 5). Knee marching in standing with hands supported. [22]

Figures 3. a. Shows deep breathing techniques, such as a. Butterfly breathing and b. Cross-shoulder breathing.

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Conditioning Phase

It starts after the warm-up phase. It exhibits light-weight resistance exercises and aerobic training on a treadmill for a total duration of 20 minutes. A lightweight resistance exercise was carried out using 1/2kg weight cuffs for the upper and lower limbs, with ten repetitions of each movement per session (Figures 4. a, b.). [23]

Figure 4. Shows lightweight resistance exercise for upper limb (a) and lower limb (b).

Aerobic training was carried out using a treadmill, keeping zero elevation (0^0) and training intensity at 70% of the maximum heart rate for ten-minute per session. [24]

Figure 5. Shows participants performing aerobic training on a treadmill (a) at zero-degree elevation (b).

Cool Down Phase

It starts at the end of the conditioning phase. It exhibits the stretching and flexibility exercises of the targeted limb/muscles and the exercises done in the warm-up phase. The patients were also asked to follow regular walking at their own pace for 30 minutes daily.

Home-Based Aerobic Exercise Program (AEP)

A home-based AEP was also followed for the same duration. Under the exercise regimen, they were instructed to do the following for ten repetitions each twice per day as follows: 1). Simple neck movements (including neck flexion and extension, deep breathing exercises (butterfly breathing and cross shoulder breathing techniques), upper limb free exercises (shoulder flexion, extension, protraction, and retraction). Trunk mobility exercises (flexion, extension, bilateral side flexion, and bilateral trunk rotation). [25]

At baseline and after 4 weeks, outcome measure viz. exercise capacity (EC) was measured by the six-minute walk test (6MWT). The required data were collected for the given variables and evaluated statistically.

Statistical Analysis

A statistical package for social science (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp) was used to analyze the study's data. A Shapiro-Wilk test of normality was performed to check the normal distribution of the data within each group. An unpaired t-test was used to analyze the between-group comparisons of post-intervention HR, SBP, DBP, and MWT scores. The between-group factor was time and

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outcomes, measured at baseline and after four weeks for all four dependent variables. A paired t-test was used to analyze the outcomes scores within-group across the two-time points. For all the statistical analyses, the confidence interval alpha (α) was set at 95% to be considered a significant value (P<0.05).

Results

Sixty-four out of eighty participants with CVD were recruited for the study. Sixteen participants were excluded due to the following reasons; meeting the exclusion criteria of the study(n=16), the unavailability of time (n=3), and other reason (n=5). The selected participants (n=64) were randomly distributed into two groups, an experimental group, i.e., the CRP Group (n=32), and a Control group (n=32). A Shapiro-Wilk normality test revealed a normal distribution for the participants' characteristics (age, height, and weight) and the baseline outcome measures of HR, SBP, DBP, and 6MWT, within each group. In Tables 2-4, the letter 't' represents the t-statistics of the t-test. The participants' characteristics and baseline scores for all the outcomes are presented in Table 1.

Variables	Groups (N=64)	Mean ±SD	Minimum	Maximum
Weight(kgs)	CRP Group	62.46±7.70	52.00	78.00
	Control Group	66.60±6.27	54.00	76.00
Height(cms)	CRP Group	163±7.06	153.00	176.00
	Control Group	165.3±4.12	158.00	172.00
Age(years)	CRP Group	59±7.29	48.00	76.00
	Control Group	58.8±6.73	45.00	72.00
Heart rate	CRP Group	87.13±14.71	72.00	122.00
	Control Group	84.33±9.80	74.00	108.00
Systolic BP (mmHg)	CRP Group	123.66±12.61	100.00	150.00
	Control Group	123.66±9.67	110.00	148.00
Diastolic BP (mmHg)	CRP Group	81.33±5.81	70.00	90.00
	Control Group	84.73±10.26	70.00	110.00
6 MWT (m)	CRP Group	176.47±50.09	80.50	303.60
	Control Group	208.52±53.22	100.00	298.00

Table 1. Participants' demographic characteristics and baseline measures of the outcomes (n=32/group).

BP: Blood Pressure; 6MWD: Six-Minute Walk Test; SD: Standard Deviation; m: Meter; mmHg: millimeter of mercury (Hg). N/n=Total number of participants in both groups/each group.

Within-group comparison

The within-group comparison revealed insignificant differences (95% CI, P>0.05) for the outcomes (HR, SBP, and DBP) except 6MWT (95% CI, P<0.05) when comparing the baseline scores with 4-week post-intervention scores within CRP Group, presented in Table 2. However, except SBP scores (95% CI, P>0.05), all the outcomes (HR, DBP, and 6MWT) showed significant differences (95% CI, P<0.05) within the Control Group compared to the baseline scores with 4-week post-intervention scores, presented in Table 3.

Variables (n=32)	Baseline	4 Weeks	Paired t-test	
	Mean ± SD	Mean ± SD	t	P
Heart rate	87.13 ± 14.71	82.06 ± 14.48	3.134	.007*
Systolic BP (mmHg)	123.66 ± 12.61	120.46 ± 8.13	1.045	.314
Diastolic BP (mmHg)	81.33 ± 5.81	78.66 ± 8.54	1.586	.135
6 MWT (m)	176.47 ± 50.09	465.3 ± 119.2	14.68	.001*

Table 2. Within-group comparison for the outcomes of HR, SBP, DBP, and 6MWT within CRP Group (n=32) using paired t-test (95% Confidence interval for means).

*- Significant value if P<0.05; BP: Blood Pressure; 6MWT: Six-Minute Walk Test; SD: Standard Deviation; m: Meter; mmHg: millimeter of mercury (Hg); n=Total number of participants in CRP group.

Variables (n=32)	Baseline	4 Weeks	Paired t-test	
	Mean ± SD	Mean ± SD	t	P
Heart rate	84.33 ± 9.80	81.86 ± 7.72	2.581	.022*
Systolic BP (mmHg)	123.66 ± 9.67	121.13 ± 8.23	1.363	.194
Diastolic BP (mmHg)	84.73 ± 10.26	78.33 ± 10.80	2.469	.027*
6 MWT (m)	208.52 ± 53.22	490.75 ± 91.49	11.891	.001*

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Table 3. Within-group comparison for the outcomes of HR, SBP, DBP, and 6MWT within the Control Group (n=32), using paired t-test (95% Confidence interval for means).

*- Significant value if *P*<0.05; BP: Blood Pressure; 6MWT: Six-Minute Walk Test; SD: Standard Deviation; m: Meter; mmHg: millimeter of mercury (Hg); n=Total number of participants in Control group.

Between-group comparison

The between-group comparison revealed insignificant differences (95% CI, *P*>0.05) for all the outcomes (HR, SBP, DBP, and 6MWT) compared to the scores between the groups at 4-week post-intervention (CRP vs. Control), presented in Table 4.

Variables	CRP Group (n=32)	Control Group (n=32)	Unpaired t-test	
	Mean ± SD	Mean ± SD	t	P
Heart rate	82.06 ± 14.48	81.86 ± 7.72	.047	.963
Systolic BP	120.46 ± 8.13	121.13 ± 8.23	2.23	.825
Diastolic BP	78.66 ± 8.54	78.33 ± 10.80	.094	.926
6 MWT (m)	465.37 ± 119.28	490.75 ± 91.49	6.54	.579

Table 4. Between-group comparison for the outcomes of HR, SBP, DBP, and 6MWT at four weeks post-intervention, using an unpaired t-test (95% Confidence interval for means).

*- Significant value if *P*<0.05; BP: Blood Pressure; 6MWT: Six-Minute Walk Test; SD: Standard Deviation; m: Meter; mmHg: millimeter of mercury (Hg); n=Total number of participants in each group.

Discussion

This study aimed to determine the effect of the CRP on exercise capacity in participants with CVD. During baseline readings, CRP and Control Groups were demographically identical without significant differences in their descriptive statistics.

It has been demonstrated that intense physical activities and fitness minimize the causes of mortality and mortality rate of CVD. Therefore, for health promotion, exercising regularly within intensities ranging from 4o to 90% of the maximum volume of oxygen uptake per minute per kilogram (VO2 max) is endorsed among patients with CVD. However, aerobic exercise programs are often conducted at low to moderate intensities. A previous study has revealed a significant contrary relationship between participation in CRP and reduced progression of CAD. [26]

The results of this randomized controlled study demonstrated that with aerobic exercise training at low to moderate intensities, the enhancement in exercise capacity was evident in both the groups: the CRP group and the Control group, after a 4-week cardiac rehabilitation program. Within-group analysis (CRP group) revealed a statistically significant result in heart rate (p=.007) and 6MWD (p=.001). Similar statistically significant results were obtained from group B (home-based exercise group) in heart rate (p=.022), 6MWD (P=.000). Strikingly, there was a significant p-value for DBP (p=.022). Cardiac patients in both groups walked significantly farther in each 6-minute walk. Heart rate and saturation of oxygen were monitored during the 6-minute walk distance. The Borg scale measured the perceived exertion rate during the walk.

The present study is one of the few reported on a four-week multidisciplinary phase II cardiac rehabilitation program. It has been important in improving exercise capacity in participants with CVD. A similar study involving CVD patients, including MI and CABG (n=60), was conducted for a ten-week and a four-week CRP, where the patient's exercise capacity was compared. The findings concluded that the CVD patients, such as MI and CABG, undergoing ten weeks and a four-week CRP significantly enhanced their exercise capacity, general health, and well-being following CRP within-group. However, insignificant differences were detected between-group analyses. [27] This is consistent with the current study's findings, where no significant results were found in the between-group analysis. But these data suggest that short-term courses of CRP are advantageous to patients with CVD in improving their exercise capacity and promoting more widespread use of the CRP. [27]

Recent studies also showed that the endothelial progenitor cells (EPC), i.e., circulating premature cells generated from bone marrow, could significantly modulate cardiovascular function by enhancing angiogenesis, promoting vascular repair, and improving endothelial function. [28, 30] Running exercise increases circulating premature cells. MI and CABG acutely increase the circulating premature cell numbers, showing that post-trauma vascular health and repair processes involve increased premature cell numbers. [30] This comes in adjunct to Belardinelli's (2001) study, where he established that physical training progresses endothelial function, exercise capacity, and collateralization in patients with CVD, including CAD, CHF, and PADs. [31] Also, at least 20-30 minutes of exercising is desirable to enforce beneficial effects on cardiovascular health and body weight. Likewise, moderate instead of intensive programs are endorsed to prevent cardiovascular events. [30, 31]

The baseline heart rate and blood pressure readings in all the subjects (n=30) were similar without significant differences. With the improvement in exercise capacity, a significant decline in HR was revealed in both groups ($P<0.05$). Significant changes were seen in the DBP (p=.027) of the Control group in contrast to the experimental group during within-group analysis. In the CRP group, heart rate and blood pressure increased during strength training sessions but returned to their resting levels once the session was over. The increase in SBP during the strength training in the CRP group was due to circulatory changes in response to the training session. Increased metabolic demand increased due to muscle work and improved muscle flow. Arterial vasoconstriction and increased cardiac output, too, resulted in increased heart rate and blood pressure values. [32, 33]

No between-group differences were detected in comparing heart rates in subjects under a 4-week and 10 week cardiac rehabilitation given by Angela, Cahill et al. [27] These results were in line with this study where heart rate and blood pressure declined with no between group differences. Reduction in blood pressure was also seen in patients with hypertension who underwent short-term endurance training programs after CABG, as suggested by Bienkowska in 2004. [34] The decline in blood pressure can be explained due to the relative increase in vagal activity and reduction in sympathetic activity. [33]

In contrast, a study by Jean Marie on the early short-term intensive cardiac rehabilitation program (2-3 months) in an intervention group (n=105) and control group came up with puzzling results. [35] Smoking cessation influenced the body weight of the experimental group, which was relatively profound. No changes in blood lipid levels were present. It became clear that exercise alone does not impact total or LDL cholesterol except when associated with robust diet modifications. The resting systolic and diastolic pressure was significantly higher. They postulated that the deceptive increase in blood pressure was possible because of the impulsive retrieval of the left ventricular function post-CABG and acute MI. [35]

These results of this study are similar to the findings by Kelly Smith and Heather Arthur (2004), who revealed that if a designated CRP is continued until six months, its observed effects on exercise capacity would be maintained for the next 12 months in the home group while declined in the hospital group.[36] However, the study outcomes, including cardiovascular fitness and psychological and vocational status, were maintained until twelve months of intervention cessation in home and hospital groups. The results of the above-mentioned studies complied with this study regarding improved exercise capacity and well-being in both groups.

Another study has highlighted the superiority of a home-based CRP over a hospital-based CRP with a possible mechanism that may be that monitored home-based cardiac rehabilitation brought up better patient self-efficacy than hospital-based rehabilitation. [37, 38]

Burns et al. found that leisure physical activity predicted cardiac exercise self-efficacy in cardiac rehabilitation patient's post-CABG or MI. [39]

However, since this study aimed to see the improvement in exercise capacity in the subjects, the between-group findings support that both groups maintained increased exercise capacity until four weeks.

The current study was limited to four weeks- a relatively short intervention duration and lack of an assessment/follow-up program to observe the long-term effects of CRP in patients with CVD. The study's sample was taken from a one hospital representing a particular local area; thus, the report's generalizability could limit to a particular geographical area. Furthermore, educational awareness was not provided on weight management and smoking cessation. Future studies should consider these limitations to observe the long-term effect of the cardiac rehabilitation program, make more aware of weight management and smoking cessation, economic evaluation in terms of cost-effectiveness for each program session, and generalize the reports globally. It should also evaluate the cost-effectiveness of each program session.

Conclusion

The combined cardiac rehabilitation and home-based aerobic exercise programs and the home-based aerobic exercise program alone were equally effective in reducing heart rate and improving exercise capacity in patients with cardiovascular diseases.

Conflict of interest: All authors declare no conflict of interest in this study

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