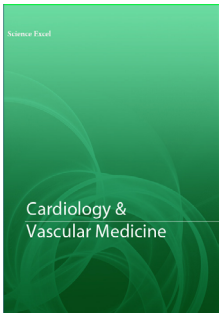
Cardiology and Vascular Medicine

Original Article



Enhancing Quality of Life (QOL) And Cardiac Function in Heart Failure Patients Through Integrated Tele-Cardiopulmonary Rehabilitation And Psychological Support: A Prospective Study

Ashish K Mohapatra, Ayad Alramadan

Bethanien Hospital, Germany

Correspondence

Ashish K Mohapatra

Senior Consultant Interventional and Structural Cardiology, Heart Failure, Bethanien Hospital, Germany
E-mail: drashishmohapatra@gmail.com
ORCID ID: 0000-0003-0040-4630

- Received Date: 10 Aug 2023
- Accepted Date: 15 Aug 2023
- Publication Date: 19 Aug 2023

Keywords

Tele-cardiopulmonary rehabilitation, psychological support, Left ventricle Global longitudinal strain(LV- GLS), 6-Minute Walk Test(6MWT), Peak VO2, quality of life (QOL),Short Form- 12(SF-12)

Abstract

Introduction: Herat failure (HF) is one global pandemic affecting millions of people across the globe. Patients with HF report decreased functional capacity, increased dyspnea and weariness, and a diminished ability to do daily tasks. In previous years there was much advancement in pharmacological therapy against heart failure. Several studies have shown that cardiopulmonary rehabilitation programs are safe and effective in improving functional capacity and quality of life while decreasing readmission rates and all-cause death in heart failure patients. However, heart failure patients' psychological status is often unknowingly neglected, leading to poor quality of life.

Methods: This prospective Study was initiated in May 2022, was conducted for 18 months, and was completed in October 2022. This study is a prospective study of heart failure patients, the effect of an integrated approach of tele-cardiopulmonary rehabilitation along with psychologist-guided psychological support enhancing the quality of life. The patients satisfying the inclusion criteria without exclusion criteria were randomized to intervention and control groups.

Results: The age group of the mean (years)+/- SD(67+/-14.4) in the Intervention Group and (66+/- 14) in the Control group. Both the groups comprised female participants, 63% in the Intervention group and 68% in the control group. The initial evaluation was done at the beginning of this prospective study. The follow-ups were done in 6 weeks, 12 weeks, and 24 weeks. Clinical examination, 6-Minute Walk Test, peak VO2 evaluation in a cardiopulmonary exercise test, and echocardiography with LV-GLS measurements. During the study period, it was noted that there were substantial improvements in LVGLS, 6-Minute Walk Test distance, peak VO2, and Quality of Life.

Conclusion: In Conclusion, based on the findings of this prospective study, the integrated approach of tele- cardiopulmonary rehabilitation and psychological support in heart failure patients has tremendous benefits and remarkable improvement in Quality of Life. As the life span improves, that leads to more heart failure patients presently and in the future. Along with pharmacotherapy against heart failure, telerehabilitation, and psychological support should be emphasized from the beginning of heart failure treatment to achieve a better quality of life. Considering the importance of Rehabilitation, through this study, it would not be wrong to suggest an additional pillar of heart failure treatment along with four other robust pillars in the guidelines.

Introduction

Heart Failure (HF) is a complex clinical syndrome characterized by symptoms and signs induced by structural and functional cardiac abnormalities and corroborated by high natriuretic peptide levels and objective evidence of pulmonary or systemic congestion [1].

HF is a complex cardiovascular condition leading to reduced exercise tolerance, impaired Quality of life (QoL), and increased morbidity and mortality rates. HF is always corroborated by elevated NT Pro BNP level, pulmonary congestion, and systemic congestion. Despite advances in medical therapies, managing HF remains a considerable challenge. In recent years, comprehensive interventions that address HF management's physiological and psychological aspects have gained attention as potential avenues to improve patient outcomes. Integrated tele- cardiopulmonary rehabilitation (CPR) programs, encompassing exercise training and psychological support, have emerged promising to enhance QoL and cardiac function in HF patients.

Traditionally, HF has been classified into three distinct phenotypes based on the left ventricular ejection fraction (LVEF), (HFrEF)Heart failure with reduced EF(LVEF ≤40%),(HFmrEF) heart failure with mildly reduced EF(LVEF 41% to 49%) and (HFpEF)

Citation: Mohapatra AK, Alramadan A. Enhancing Quality of Life (QOL) and Cardiac Function in heart failure patients through Integrated tele-Cardiopulmonary Rehabilitation and Psychological Support: A Prospective study. Cardiol Vasc Med. 2023;3(1):.1-8

***Table 1**. HF classification according to Lefr ventricular Ejection fraction*

HF Classification accrding to EF	
HFrEF(HF with reduced Ejection Fraction)	HF with LVEF ≤40%
HFmrEF(HF with mildly reduced Ejection Fraction)	HF with LVEF 41% to 49%
HFpEF(HF with preserved Ejection Fraction)	HF with LVEF >50%
HFimpEF(HF with imoproved Ejection Fraction)	HF with a baseline EF ≤ 40% with a ≥ 10 point EF increase from baseline and a second EF > 40%

Heart failure with preserved EF(LVEF >50%). Along with the recent advancements in heart failure, a new entity was evolved, (HFimpEF) Heart failure with an improved ejection fraction, HF with a baseline EF ≤ 40% with a ≥ 10 point EF increase from baseline and a second EF > 40% measurement after Therapy [1] (Table-1).

Heart failure is a substantial global health burden, impacting millions globally and accounting for a considerable share of hospitalizations and healthcare expenditures [2]. Patients with HF report decreased functional capacity, increased experiences of dyspnea and tiredness, and a reduced ability to conduct everyday activities. These conditions all lead to decreased QoL, acknowledged as an essential part of HF therapy and a significant predictor of prognosis [3].

HF has been considered a global pandemic, with 64.3 million individuals anticipated to be affected in 2017 [4]. Its prevalence is predicted to rise due to more remarkable survival after an HF diagnosis associated with the availability of life-saving evidence-based therapies and the general population's overall higher life expectancy.

Although multiple studies have found that the mortality rate for heart failure is declining, the overall mortality rate remains high. More than 23% of rehospitalizations for HF are anticipated to occur within 60 to 90 days, and less than 50% of HF patients survive for more than five years [5–7] According to the American Heart Association (AHA) registry data for projections, there will be an increase in the prevalence of HF by 46% between 2012 and 2030, with patients with HF younger than 65 years old having a 6 to 9 times greater risk of experiencing sudden cardiac death when compared to the general population [7].

Several studies have demonstrated that cardiopulmonary rehabilitation programs are safe and beneficial for increasing functional ability and quality of life and lowering readmission rates and all-cause mortality in HF patients [8-10]. Many clinical trials have demonstrated the advantages of hospital-based cardiac rehabilitation for HF patients [11-13]. When compared to hospital-based cardiac rehabilitation, home- based cardiac rehabilitation may be more accessible and acceptable. However, home-based rehabilitation programs have received little attention, and their training effects are unknown [11,14]. Thus, this study aimed to assess the benefits of integrated home-based cardiac rehabilitation and psychological support on functional capacity improvement, QOL enhancement, and readmission rate decrease in HF patients.

Research Methodology

Research objective

This prospective research study aimed to evaluate the impact of integrated cardiopulmonary rehabilitation and psychological support on quality of life and cardiac function in patients diagnosed with heart failure. By investigating the combined effects of structured exercise training and psychological interventions, the study sought to elucidate the potential for a more comprehensive approach to heart failure management that addressed the multifaceted nature of the condition.

By examining changes in QoL, exercise capacity, cardiac function parameters, and psychological well- being, the study contributed valuable insights into the prospective benefits of an integrated approach to heart failure management. By advancing the understanding of the synergistic effects of combining physical and psychological interventions, the research could inform future clinical practices and improve the lives of individuals with heart failure.

Research design

This study was a prospective multicenter randomized research in which 63 individuals participated from May 2022 to October 2022. We thoroughly communicated the study's goal and methodologies to all members involved, including cardiologists, physical therapists, and heart failure nurses. This research group included symptomatic HF patients only.

Before participating in the trial, the selected patients were provided with detailed information about the study and were required to sign the consent form. Patients were free to leave the study at any time. The subjects were randomly assigned to a control group and an intervention group. Data were encrypted before being made available to researchers to guarantee that no personally identifiable information could be acquired from the database at any level.

Research subject

This study included HF patients currently discharged from the hospital recompensation therapy for heart failure and undergoing treatment in the outpatient department. To interpret the effect of this integrated approach of Rehabilitation and psychological support on heart failure effectively, a patient group aged 40-70 years was selected.

Inclusion Criteria-

1. Age 40-70 years
2. Shortness of Breath NYHA II-III
3. Compliance with heart failure medication
4. LVEF > 30%
5. Sign the consent form

Exclusion Criteria-

1. Age <40 years and >70 years
2. Shortness of Breath NYHA IV
3. Pregnancy
4. Patients with any Tumor
5. Patients with musculoskeletal Problems

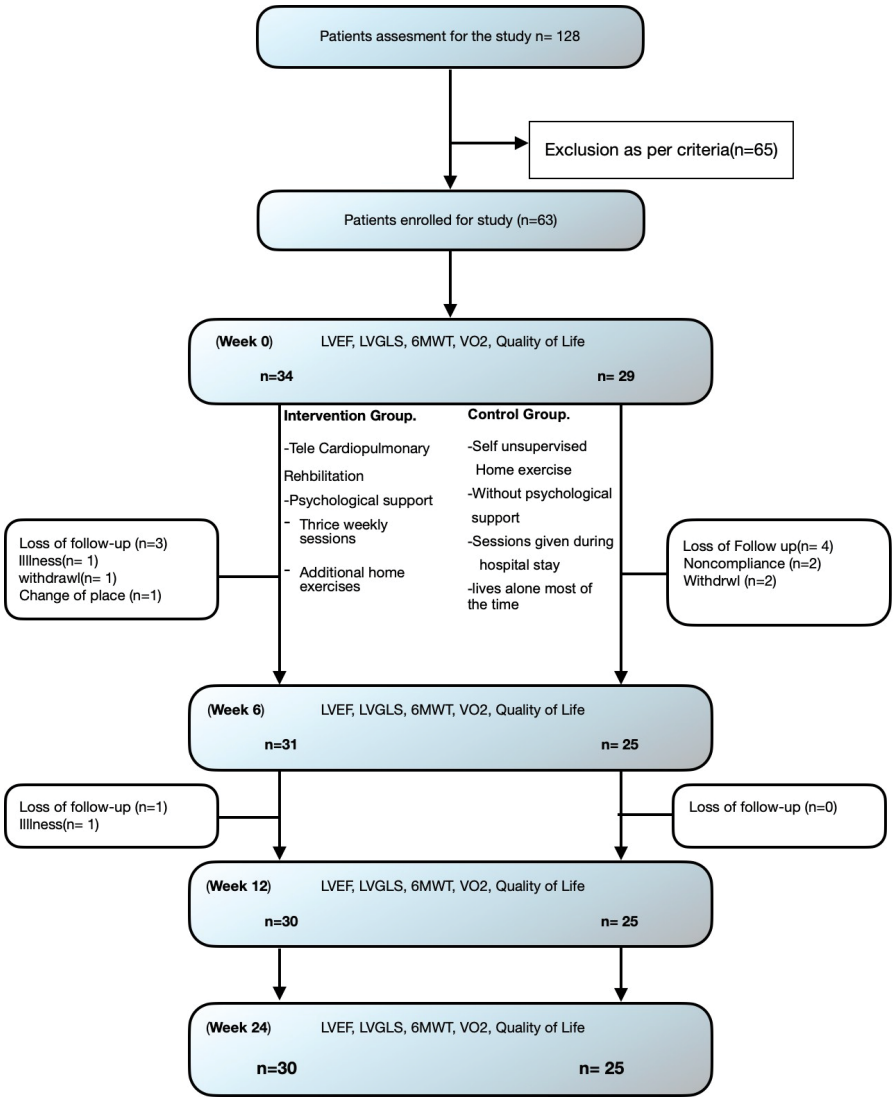


Figure 1. *Flowchart of the prospective study*

6. High morbidity status
7. LVEF <30%
8. Noncompliance to Therapy
9. Fails to sign the consent form

Study Flow-Chart

As depicted by the flowchart in Figure 1, 63 participants were enrolled. The enrolled patients were randomized into two groups, 34 in the intervention group and 29 in the control group.

Control group

The control group received a rehabilitation program per the recommended guidelines comprising education, aerobic, and strength training exercises. The patients in the control group were provided with a printed exercise protocol guide for further reference at home. Each session consisted of a 10-minute warm-up, 40 minutes of aerobic and strength exercises and a 10-minute cool-down. The timing of the exercise protocol was variable as per the patients' convenience—76% of the patients performed in the morning and rested in the afternoon. The exercise protocol was personalized as per the patient's initial evaluation. The control group attended education sessions at the hospital on the day of discharge—a multidisciplinary team of heart failure cardiologists, nurses, dietitians, and physiotherapists. Self- management, dietary counseling, physical activity counseling, psychological therapies, pharmaceuticals, and risk factor management were among the subjects discussed.

Intervention group

The telerehabilitation program was provided to the enrolled patients in the intervention group in the home through synchronous videoconferencing. The physiotherapist coached participants through an exercise regimen identical to the control group using two-way video communication. The physiotherapist saw individuals executing the exercises, gave real-time feedback and modification as needed, and provided peer support from other participants using this technique. A virtual group-based program was chosen because many persons undergoing cardiac rehabilitation value professional supervision, group interaction, and social support. Each Participant was given extra home exercise sessions, identical to the control group.

Educational subjects were supplied as computerized slide presentations, recorded during education sessions for a center-based program, identical to printed handouts provided to the patients in the control group. Participants were invited to watch the selected presentation in their own time, either alone or with a support person, in preparation for future online group discussions. Each telerehabilitation session comprises one initial interaction phase before the exercise protocol.

Before the telerehabilitation Program, the prerequisites were assured, including a laptop, internet broadband connection, weighing m machine, automated Blood Pressure measurement machine, a pulse- oximeter, lightweight dumbells in pair (2 kg and 5 Kg), and resistance bands.

At the beginning of each rehabilitation session, participants were instructed to self-monitor and report their blood pressure, heart rate, and oxygen saturation levels. As personalized messages during the video conference keeping the privacy of each individual. Body Weight, blood sugar level, the degree of peripheral edema, and psychological and physical well-being were also measured.

Outcome measures

Primary outcome: All the enrolled patients in both groups performed a 6-minute walk test(6MWT) at the beginning of this prospective study and subsequently in 6 weeks, 12 weeks,18 weeks, and 24 weeks to evaluate the impact of interventions on physical activity levels and compare the two groups.

Secondary outcomes: Secondary outcome measures such as LV GLS, peak VO2 (Spiroergomerty test), and quality of life were assessed at this prospective study's beginning and subsequent phases.

Validated surveys were used to measure health-related quality of life and patient satisfaction.

The Short-Form-12(SF-12) is a general health questionnaire comprised of 12 questions that assess the patient's state of health across eight distinct dimensions: General health perception – 1 question, Physical health – 2 questions, Limited physical role function – 2 questions, Physical pain – 1 question, Vitality – 1 question, Mental health – 2 questions, Limited emotional role function – 2 questions, Social functioning – 1 question.

Cardiopulmonary Tele-Rehabilitation Program-

Components

1. Physician evaluation once a week
2. supervised telerehabilitation exercises as per protocol personalized 3-psychological evaluation and support
3. nutritional guidance 5-Disease education
4. Life style modifiocation(optimize blood sugar, weight,blood pressure,smoking cessation,alcohol limitation etc.)

1. **Physician Evaluation**

Once a week, the patients were examined by one heart failure physician. Vital parameters measured and evaluation of signs and symptoms of heart failure.

2. **Supervised Tele-Rehabilitation-(Figure 2)**

Thrice weekly sessions(60 minutes per session)

Exercise Protocol-

3 phases

Phase-1

Warm up for 10 minutes.

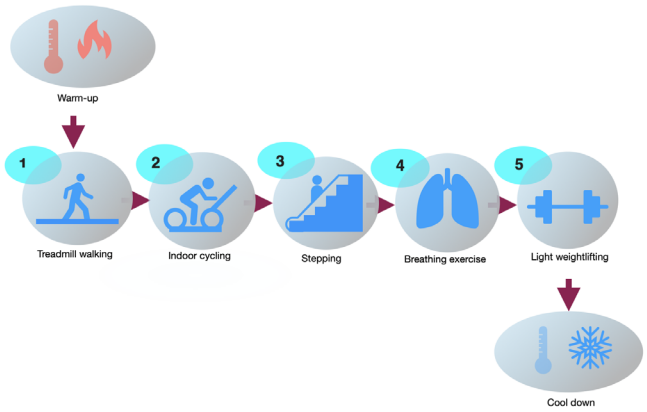


Figure 2. *Exercise Protocol*

Phase-2

Rehabilitation Exercise for 40 minutes Divided into 5 parts-(each 5- 10 minutes)

- Treadmill walking
- Indoor cycling
- Stepping
- Breathing exercises(Spirometry)
- Light weightlifting(gradual increment of weights over some time after three weeks)

Phase-3

Cool down for 10 minutes.

3. Psychological Evaluation and support Psychologist evaluation every 15 days.

The patients and family members were counseled on the emotional aspects of managing heart failure.

4. Nutritional Guidance

The Patients and family members were educated on nutrition and heart-healthy diet planning.

5. Disease Education

The patients were educated by a heart failure nurse about the heart failure, present condition, and how to manage it.

6. Life style Modifiocation

The patients were counseled about the necessity of lifestyle modification and helped to perform it. For example, to optimize Blood pressure, optimize blood sugar, cessation of smoking, and limitation of alcohol.

Safety measures-

All the enrolled patients and their family members were trained by heart failure nurses to measure Blood pressure, pulses, and body temperature.

All the enrolled patients and their family members were trained by heart failure nurses to measure Blood pressure, pulses, and body temperature.

The patients were assessed for the following-

- Fever
- Symptomatic hypotension
- Hypertension with resting Systolic BP >160 mm Hg
- Tachycardia in rest >100 bpm
- Dyspnea at rest

Results

Fifty-five patients were recruited in this study (with age distribution in years 67 ± 14.4 in the intervention Group,66± 14 in the Control Group, and female participants 63% in the intervention Group, 68% in the Control Group). Of the participants in this prospective study,55% of patients completed tele- cardiopulmonary rehabilitation (n=30). The rest 45% of participants followed the advised self-rehabilitation program at their place (n = 25). CV risk factors, cardiac intervention, medical treatment, and baseline characteristics of both groups are described in Table 2. At baseline, there were no significant differences between the telerehabilitation and self-rehabilitation groups. No adverse events occurred during this prospective study period, and all individuals finished the exercise regimen.

Left ventricle - longitudinal strain (LV-GLS) (Figure 3)

According to the meta-analysis, a Left ventricular global longitudinal strain (LV-GLS) of -16% indicates poor myocardial dysfunction even if the Left ventricle ejection fraction is average. (15) In this prospective study, we used

Table 2. *Baseline characteristics of participants of both groups of this Study.*

Baseline Characteristic of patients	Intervention (n = 30)	Control (n = 25)
Age (yr), mean +/-SD)	67 +/- 14.4	66+/- 14
Gender, n female (%)	19(63)	17(68)
BMI (kg/m2), mean +/- SD	27 +/- 3.8	28 +/- 3.2
Social situation, n (%)		
lives alone	0 (0)	18(72)
lives with others	30 (100)	7 (28)
Aetiology, n (%)		
ischaemic cardiomyopathy	16 (53)	15 (60)
valvular cardiomyopathy	6 (20)	4 (16)
dilated cardiomyopathy	8 (27)	6 (24)
HFpEF	9(30)	11(44)
LVEF (%), mean (SD)	44(19)	45 (18.6)
Atrial arrhythmia, n (%)	8 (27)	10 (40)
Co-morbidities, n (%)		
diabetes mellitus	12 (48)	9 (36)
respiratory illness	5 (17)	12 (48)
depression	4 (13)	7 (28)
stroke	3 (10)	1 (4)
arthritis	5 (17)	7 (28)
NYHA functional class, n (%)		
II	13 (43)	17 (68)
III	17 (57)	8 (32)
Heart failure Medications, n (%)		
Home oxygen, n (%)	3 (10)	2 (8)
Resting SBP (mmHg), mean (SD)	136 (24,6)	137 (24,2)
Resting DBP (mmHg), mean (SD)	73 (11)	70 (14)
Resting HR (beats/min), mean (SD)	69 (10)	71 (8)

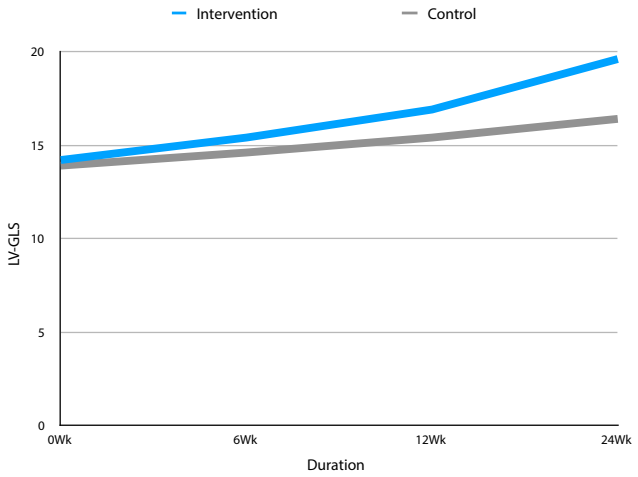


Figure 3*. (Effect of Tele-cardiopulmonary Rehabilitation and psychological support on LV-GLS)*

-16% as the cutoff value for LV GLS based on the multicenter study utilizing different Echocardiography equipment and echocardiographers. We evaluated the effect of supervised telerehabilitation on GLS as a marker of cardiac function. As depicted in the graphical representation, supervised telerehabilitation, along with psychological support, showed an improvement in LV-GLS.

Peak VO2 (Figure 4)

Peak oxygen consumption (peak VO2) remains the gold standard for predicting prognosis in heart failure. (16) All participating patients of both groups have successfully performed cardiopulmonary exercise tests at the baseline and subsequent study intervals. The graph shows that the patients who underwent supervised training and psychological support showed substantial improvement in peak VO2, with a visible difference in progress after six weeks.

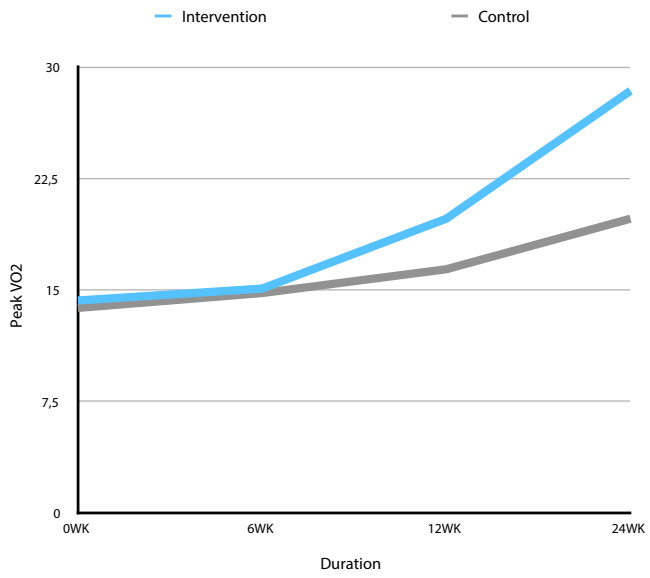


Figure 4*. (Effect of Tele-cardiopulmonary Rehabilitation and psychological support on Peak VO2)*

Six-Minute Walk Test (6MWT) (Figure 5)

The 6-minute walk test (6MWT) is a vital parameter that provides a functional, therapeutic response and predictive data for managing patients with respiratory and cardiac illnesses. It is frequently utilized because of its simplicity and consistency in delivering a consolidated view of the cardiovascular and musculoskeletal response to exercise. It requires no special training on the part of the staff performing it, and items and equipment available at any clinician's office or hospital may be used. It is safe and well- tolerated by most patients at any stage of disease, with the test being highly reflective of usual daily activity and exercise performance [17]. In this prospective study, it has been shown that there was a definite improvement in both groups. However, there was a substantial visible improvement in the case of an integrated approach with tele-cardiopulmonary rehabilitation along with psychological support.

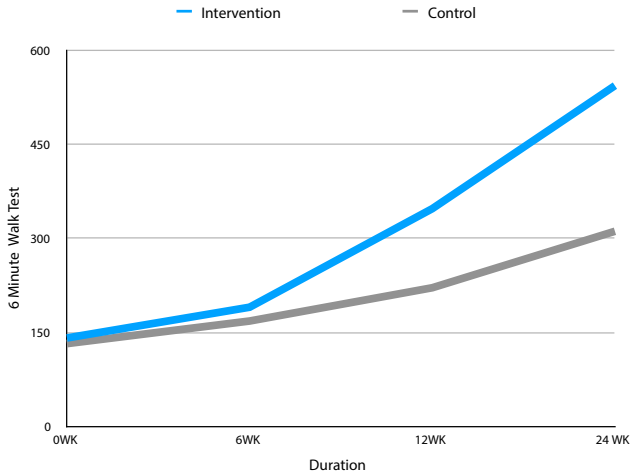


***Figure 5**. (Effect of Tele-cardiopulmonary Rehabilitation and psychological support on 6MWT)*

Quality of Life (QOL) Assessment

The SF-12 is a health-related quality-of-life questionnaire comprised of twelve items that assess physical and mental health by measuring eight health areas. General Health (GH), Physical Functioning (PF), Role Physical (RP) and Body Pain (BP) are physical health domains. Vitality (VT), Social Functioning (SF), Role Emotional (RE), and Mental Health (MH) are all mental health domains. The instrument has been validated for various chronic illnesses and disorders [18, 19]. We utilized the SF-12 for QOL Assessment in both groups and computed two summary scores of the SF-12—physical and mental health—for each participant using the eight domains.

As shown in the graphical representation of the QOL Assessment scores using SF-12 (Figure-6), there is a remarkable improvement in Physical Component Score (PCS) and mental component Score (MCS) in the patients who undergone integrated approach comprising of tele- cardiopulmonary rehabilitation and psychological support (Figure 7).

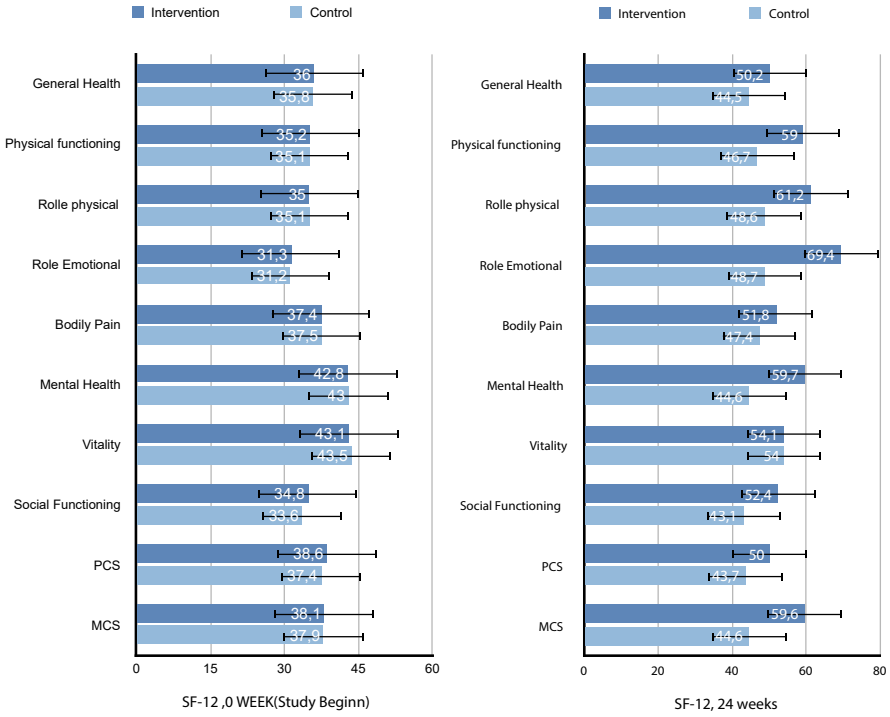


***Figure 6.** Effect of Tele-cardiopulmonary Rehabilitation and psychological support on QOL.*

Table 3. *SF-12 (Quality of Life)Questionnaire and Scale*

Domain	Question No.	Description	Response Scale
General Health	2	General health	1–5
Physical Functioning	3a	Health affected moderate activities	1–3
	3b	Health affected step climbing	1–3
Role Physical	4a	Physical health affected ability to accomplish	1–5
	4b	Physical health affected kind of work or other activities	1–5
Role Emotional	5a	Emotional health affected ability to accomplish	1–5
	5b	Emotional health affected kind of work or other activities	1–5
Bodily Pain	6	Pain interfered with normal work	1–5
Mental Health	7a	Felt calm and peaceful	1–5
	7c	Felt downhearted or depressed	1–5
Vitality	7b	Had a lot of energy	1–5
Social Functioning	8	Amount of time physical or emotional problems interfered with social activities	1–5

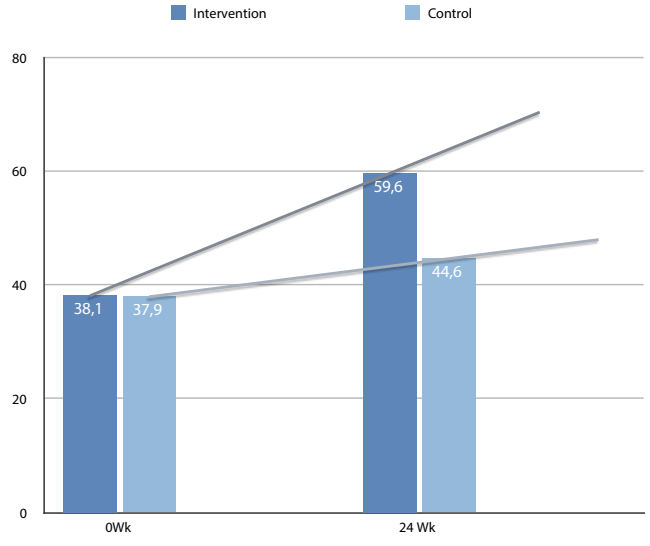


Figure 7. *Effect of Tele-cardiopulmonary Rehabilitation and psychological support on MCS*

Discussion

This prospective study examined the cardiopulmonary benefits after a 6, 12, and 24 weeks of telerehabilitation along with psychological support compared to conventional postoperative care at home along with self exercise program advised at the time of discharge. The main findings of this research were a remarkable improvement of LV-GLS, Peak VO2 peak, and 6MWT in the case of an integrated approach comprising telerehabilitation and psychological support guided by a psychologist.

Enhanced cardiopulmonary functional capacity is the main objective in case of heart failure patients to obtain a better quality of life [20]. In this study, patients who followed a tele-cardiopulmonary rehabilitation and psychological support program showed an increase in peak VO2 peak 38.5% in 12 weeks. Though there was an improvement in the control group, the peak VO2 improvement was only 18.8% after 12 weeks. The duration of the interventional integrated tele-cardiopulmonary rehabilitation and psychological support strategy was 12 weeks, like other investigations in the previous studies [21].

Regular exercise has increased vascular endothelial cell activity, potentially improving lower cardiac output and peripheral vasoconstriction in individuals with HF. Furthermore, exercise reduces cytokine secretion and neurohormonal system activation, improves oxygen utilization in mitochondria of peripheral muscle cells, increases muscle mass, increases respiratory efficiency without negatively impacting left ventricular remodeling, and ultimately improves the clinical outcome of HF patients [22].

The 6MWT showed a tremendous improvement in the intervention group undergoing telerehabilitation from mean±SD (141 ± 14.4m) to (543 ± 19,8m), whereas, in the control group, the improvement was considerably less(132± 12m to 311 ± 14.6m). The LVGLS follow-up measurements reflected a gain of 38% in 24 weeks in the intervention group.

As shown in figure-7, there is substantial improvement in the mental health component in the intervention group, which underwent an integrated approach of supervised rehabilitation and psychologist-guided psychological support.

Conclusion

Because its efficacy, safety, and guideline level are established globally, Cardiopulmonary- Rehabilitation (CR) has become acknowledged as an essential component in the continuum of therapy for heart failure patients; however, the actual rate of participation in CR is relatively low due to many interfering factors, such as physician factors and patient factors. Physician factors are a lack of referral from cardiologists, lesser well-trained heart failure rehabilitation specialists, and overburdened doctors. Patient factors are lack of motivation, depression, family support, and unwillingness to modify lifestyles. Therefore, during hospitalization, each patient should be encouraged to participate in CR and to eliminate their barriers to CR before discharge. Furthermore, home-based tele-cardiopulmonary rehabilitation programs should be encouraged for patients unable to access center-based CR.

This prospective study found that telerehabilitation might be a viable alternative to traditional center-based CR. This novel mode of healthcare delivery is a feasible, acceptable, safe, and cost-effective approach. In the future, this strategy might help persons with geographical or social accessibility issues maintain continuity of treatment.

References

1. Bozkurt B, Coats AJS, Tsutsui H, et al. Universal definition and classification of heart failure: a report of the Heart Failure Society of America, Heart Failure Association of the European Society of Cardiology, Japanese Heart Failure Society and Writing Committee of the Universal Definition of Heart Failure: Endorsed by the Canadian Heart Failure Society, Heart Failure Association of India, Cardiac Society of Australia and New Zealand, and Chinese Heart Failure Association. Eur J Heart Fail. 2021;23(3):352-380.
2. Savarese G, Lund LH. Global Public Health Burden of Heart Failure. Card Fail Rev. 2017;3(1):7-11.
3. Bekelman DB, Havranek EP, Becker DM, et al. Symptoms, depression, and quality of life in patients with heart failure. J Card Fail. 2007;13(8):643-648.
4. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 [published correction appears in Lancet. 2019 Jun 22;393(10190):e44]. Lancet. 2018;392(10159):1789-1858.
5. Jackevicius CA, de Leon NK, Lu L, Chang DS, Warner AL, Mody FV. Impact of a Multidisciplinary Heart Failure Post-hospitalization Program on Heart Failure Readmission Rates. Ann Pharmacother. 2015;49(11):1189-1196..
6. Chriss PM, Sheposh J, Carlson B, Riegel B. Predictors of successful heart failure self-care maintenance in the first three months after hospitalization. Heart Lung. 2004;33(6):345-353..
7. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics--2015 update: a report from the American Heart Association. Circulation. 2015;131(4):e29-e322.
8. Chien CL, Lee CM, Wu YW, Chen TA, Wu YT. Home-based exercise increases exercise capacity but not quality of life in people with chronic heart failure: a systematic review. Aust J Physiother. 2008;54(2):87-93..
9. Dangardt FJ, McKenna WJ, Lüscher TF, Deanfield JE. Exercise: friend or foe?. Nat Rev Cardiol. 2013;10(9):495-507.
10. Ades PA, Keteyian SJ, Balady GJ, et al. Cardiac rehabilitation exercise and self-care for chronic heart failure. JACC Heart Fail. 2013;1(6):540-547..
11. O'Connor CM, Whellan DJ, Lee KL, et al. Efficacy and safety of exercise training in patients with chronic heart failure: HF-ACTION randomized controlled trial. JAMA. 2009;301(14):1439-1450..
12. Maiorana A, O'Driscoll G, Dembo L, et al. Effect of aerobic and resistance exercise training on vascular function in heart failure. Am J Physiol Heart Circ Physiol. 2000;279(4):H1999-H2005.
13. Selig SE, Carey MF, Menzies DG, et al. Moderate-intensity resistance exercise training in patients with chronic heart failure improves strength, endurance, heart rate variability, and forearm blood flow. J Card Fail. 2004;10(1):21-30..
14. Jolly K, Taylor RS, Lip GY, et al. A randomized trial of the addition of home-based exercise to specialist heart failure nurse care: the Birmingham Rehabilitation Uptake Maximisation study for patients with Congestive Heart Failure (BRUM-CHF) study. Eur J Heart Fail. 2009;11(2):205-213.
15. D'Elia N, Caselli S, Kosmala W, et al. Normal Global Longitudinal Strain: An Individual Patient Meta-Analysis. JACC Cardiovasc Imaging. 2020;13(1 Pt 1):167-169.
16. Arena R, Myers J, Aslam SS, Varughese EB, Peberdy MA. Peak VO2 and VE/VCO2 slope in patients with heart failure: a prognostic comparison. Am Heart J. 2004;147(2):354-360.
17. Holland AE, Spruit MA, Troosters T, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. Eur Respir J. 2014;44(6):1428-1446..
18. Salyers MP, Bosworth HB, Swanson JW, Lamb-Pagone J, Osher FC. Reliability and validity of the SF-12 health survey among people with severe mental illness. Med Care. 2000;38(11):1141-1150.
19. Cheak-Zamora NC, Wyrwich KW, McBride TD. Reliability and validity of the SF-12v2 in the medical expenditure panel survey. Qual Life Res. 2009;18(6):727-735.
20. Price KJ, Gordon BA, Bird SR, Benson AC. A review of guidelines for cardiac rehabilitation exercise programmes: Is there an international consensus?. Eur J Prev Cardiol. 2016;23(16):1715-1733.
21. Batalik L, Dosbaba F, Hartman M, Batalikova K, Spinar J. Benefits and effectiveness of using a wrist heart rate monitor as a telerehabilitation device in cardiac patients: A randomized controlled trial. Medicine (Baltimore). 2020;99(11):e19556.
22. Tabet JY, Meurin P, Driss AB, et al. Benefits of exercise training in chronic heart failure. Arch Cardiovasc Dis. 2009;102(10):721-730.