Impact of a physical exercise program through cardiac telerehabilitation in patients with heart failure: a randomized controlled clinical trial

Impacto de un programa de ejercicio físico mediante telerehabilitación cardíaca en pacientes con insuficiencia cardíaca: un ensayo clínico aleatorizado y controlado

Authors

Jhonatan Betancourt-Peña [1, 2]
Iago Portela-Pino [3]
María José Martínez-Patiño [2]

[1] University Institution National School of Sport (Cali, Colombia)
[2] University of Vigo (Vigo, Spain)
[3] University of León (León, Castilla y León, España)

Corresponding author:
Jhonatan Betancourt-Peña
johnnatanbp@hotmail.com

Received: 09-04-26
Accepted: 30-05-26

How to cite in APA

Betancourt Peña, J., Portela-Pino, I., & Martínez-Patiño, M. J. (2026). Impact of a physical exercise program through cardiac telerehabilitation in patients with heart failure: a randomized controlled clinical trial. *Retos, 83*, 507-520. https://doi.org/10.47197/retos.v83.119652

Abstract

Introduction: Cardiac rehabilitation stands out as the main recommendation for patients with heart failure. Lack of adherence, attributed to a lack of self-care, education, and follow-up, negatively impacts the disease. Telerehabilitation is presented as a valuable tool to achieve improvements similar to those of cardiac rehabilitation in functional aerobic capacity, depression/anxiety and quality of life. The primary objective is to determine the effects of a physical exercise program and Telephone educational follow-up mediated by Cardiac Telerehabilitation (TCTR) in patients with heart failure on functional aerobic capacity compared with Cardiac Telerehabilitation (CTR) and Conventional outpatient Cardiac Rehabilitation (CCR).
Method: Three-arm randomized controlled clinical trial (TCTR, CTR, CCR) following the CONSORT recommendations for clinical trials. Evaluating functional aerobic capacity, clinical variables, anxiety/depression and health-related quality of life.
Results: The functional aerobic capacity in all groups presented a statistically significant improvement in the distance traveled in the 6MWT p-value <0.05 at the beginning and end of the intervention, presenting a mean difference of 73.36±2.56, being greater than in the CTR and CCR groups.
Conclusions: More favorable improvements are evident with the implementation of cardiac telerehabilitation, education and telephone follow-up in functional aerobic capacity.
Clinical trial: ClinicalTrials.gov (NCT05761639).

Keywords

Exercise; health education; heart failure; telerehabilitation; rehabilitation.

Resumen

Introducción: La rehabilitación cardíaca se destaca como la principal recomendación para pacientes con insuficiencia cardíaca. La falta de adherencia, atribuida a la falta de autocuidado, educación y seguimiento, impacta negativamente la enfermedad. La telerehabilitación se presenta como una herramienta valiosa para lograr mejoras similares a las de la rehabilitación cardíaca en la capacidad aeróbica funcional, la depresión/ansiedad y la calidad de vida. El objetivo principal es determinar los efectos de un programa de ejercicio físico y Seguimiento educativo telefónico, mediado por Telerehabilitación Cardíaca (STRC), en pacientes con insuficiencia cardíaca sobre la capacidad aeróbica funcional, en comparación con la Telerehabilitación Cardíaca (TRC) y la Rehabilitación Cardíaca ambulatoria Convencional (RCC).
Método: Ensayo clínico controlado aleatorizado de tres brazos (RCC, TRC, STRC) siguiendo las recomendaciones CONSORT para ensayos clínicos. Se evaluaron la capacidad aeróbica funcional, variables clínicas, ansiedad/depresión y calidad de vida relacionada con la salud.
Resultados: La capacidad aeróbica funcional en todos los grupos presentó una mejora estadísticamente significativa en la distancia recorrida en la prueba de marcha de 6 minutos ($p < 0,05$) al inicio y al final de la intervención, con una diferencia media de 73,36 ± 2,56, superior a la observada en los grupos TRC y RCC.
Conclusiones: Se observan mejoras más favorables con la implementación de la telerehabilitación cardíaca, la educación y el seguimiento telefónico en la capacidad aeróbica funcional.

Palabras clave

Ejercicio; educación para la salud; insuficiencia cardíaca; telerehabilitación; rehabilitación.

Introduction

Heart failure (HF) represents the final stage of several heart diseases and is considered a public health problem, occurring in people between 75 and 80 years of age; in Latin America, the prevalence is 1% (Ciapponi et al., 2016). Therefore, frequent hospitalisations, deterioration in quality of life and morbidity and mortality are associated with the decompensations inherent to this disease(de la Espriella et al., 2022; Sicras-Mainar et al., 2022).

HF represents enormous resources in the health system, being the first cause of hospitalisation in people over 65 years of age, representing 3% of hospital admissions and 2.5% of health care; in 2010, 3% of men and 10% of women died from this disease(Sayago-Silva et al., 2013; Sicras-Mainar et al., 2022).

For the treatment of HF, Cardiac Rehabilitation (CR) has Type I level A evidence, where patients improve exercise tolerance, quality of life, functional capacity, survival and reduce hospitalisations(Heidenreich et al., 2022; McDonagh et al., 2021).

Poor patient adherence to treatment contributes to patient decompensations and hospitalisations attributed to poor health literacy, the presence of depressive symptoms, cognitive deficits and the presence of multiple comorbidities(Betancourt-Peña et al., 2024; Tinoco et al., 2021; van Leunen et al., 2023). Thus, lack of knowledge is related to reduced adoption of self-care behaviours, reduced quality of life and poor adherence to treatment(van Leunen et al., 2023).

However, closely following up patients on their treatment and lifestyle habits reduces the likelihood of treatment abandonment; the implementation of technologies such as telephone calls, considered accessible and easy-to-use means of communication, as a means to maintain quality of care, facilitate rapid access to care, can reduce patient travel costs and minimise the frequency of clinic visits(Dalli-Peydró et al., 2024; McDonagh et al., 2021; Pitta et al., 2022).

The implementation of cardiac telerehabilitation allows for greater coverage of the population, and has similar benefits to CR in terms of quality of life, exercise tolerance and cholesterol reduction; in addition to this, it is well tolerated, safe, effective and has high compliance rates among HF patients(Piotrowicz et al., 2010; Thamman & Janardhanan, 2020), which clearly favours implementation in contexts where rehabilitation centres are scarce(Pitta et al., 2022; Thamman & Janardhanan, 2020).

The primary objective is to determine the effects of a physical exercise programme and telephone educational follow-up mediated by cardiac telerehabilitation in patients with heart failure on functional aerobic capacity compared with cardiac telerehabilitation and conventional outpatient cardiac rehabilitation.

The secondary objectives are to determine the effects of a physical exercise programme and telephone educational follow-up mediated by cardiac telerehabilitation in patients with heart failure on clinical variables, anxiety/depression and health-related quality of life compared to cardiac telerehabilitation and conventional outpatient cardiac rehabilitation.

A comparison of these methods is necessary due to the expanding usage of telerehabilitation in cardiac care and the possible supplementing effect of educational techniques. The comparative evidence gap between regular outpatient care and telerehabilitation with and without educational support is addressed in this study.

Method

Study design

This is a three-arm prospective randomised controlled clinical trial type study, blinded to the assessors, investigators and outcome analysts. For its design, the recommendations for clinical trials from the CONSORT list and for non-pharmacological interventions were followed (Boutron et al., 2008) in turn, was registered at ClinicalTrials.gov (NCT05761639).

The ethical principles of the Helsinki declaration and resolution 008430 of 1993 of the Colombian Ministry of Health and Social Protection were adopted. The protocol received approval from the ethics committee act 17115. Prior to recruitment, participants were provided with detailed information about the study, followed by obtaining signature of informed consent. All measurements were performed in a clinic in the city of Cali, Colombia, where patients were assessed at baseline and at the end of the intervention.

Participants

The target population of the study was represented by patients diagnosed with HF who were admitted to a cardiac rehabilitation programme in the city of Santiago de Cali, Colombia.

Inclusion criteria were established as patients of both sexes, aged between 18 and 80 years, diagnosed with HF by a specialist in Cardiology, adopting the recommendations of the European Society of Cardiology (ESC)(McDonagh et al., 2021) with indications for exercise. In addition, the participants had to have electronic technological equipment such as a computer, tablet or mobile phone. On the other hand, as exclusion criteria, the following were taken into account: patients with respiratory comorbidity or who presented some limitation to perform active and resistive movements (recent fractures, recent haemodynamic alterations, coronary heart disease after the diagnosis of cardiovascular disease, infectious diseases and neuromuscular limitations).

Sample

Since the main result was intended to compare quantitative variables, the mean and standard deviation were taken into account as a measure of variation in the distance covered in metres in the 6-minute walk test (6MWT)(Kikuchi et al., 2021). The total distance in the Conventional Outpatient Cardiac Rehabilitation (CCR) group was 378.5 (SD 96.9) and in the Cardiac telerehabilitation (CTR) group 432 (SD 83). Random sampling was performed estimating 95% confidence, Error α: 5% (0.05), Error β: 20% (0.20), Power: 1-β: 80%, K: 7.9 (value taken from the table K(Zα+Zβ)2), additionally increased by 12% for possible problems in the measurements or dropout of study participants, so that an n=52 per intervention group was established for a total of 156 HF patients.

Randomisation

The allocation of the intervention was carried out in a block randomised manner using the sealed envelope method, which were previously prepared by the researchers. After the patients had finished with the specialist doctor, a person not involved in the research asked the patient to choose one of the envelopes. Subsequently, the intervention process was scheduled.

Unblinding only occurred in case the patient dropped out or failed to comply with his rehabilitation sessions and continued with his conventional rehabilitation sessions in case he had been assigned to telerehabilitation. Consequently, a place was released in the intervention group to which the patient belonged.

Intervention

Before starting the rehabilitation or telerehabilitation programme, the patients were summoned in person at the clinic for the evaluation of anthropometric data (height, weight, percentage of fat, water, muscle mass and abdominal perimeter), laboratory tests (total cholesterol, HDL, LDL, Triglycerides, Functional aerobic capacity (6MWT and 1-minute sit to stand test), depression and anxiety questionnaire (HADS, Patient health questionnaire 9 PHQ-9), functional capacity (Duke Activity Status Index (DASI)) and health-related quality of life (HRQoL) Minnesota Living with Heart Failure Questionnaire (MLHFQ)(Tinoco et al., 2021). These data were collected again at the end of the 12-week intervention programme.

A detailed description of each of the interventions performed in this study, the allocation of the intervention according to experimental group and the exercise prescription for each group is described below.

Experimental groups

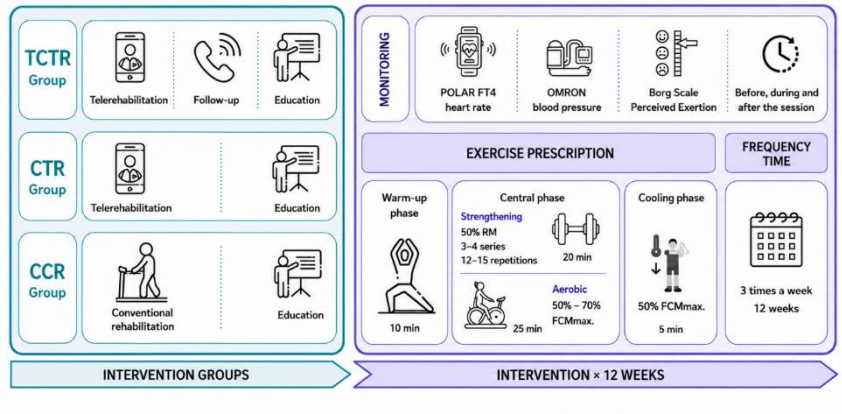
- CCR: The programme was carried out face-to-face at the clinic's cardiac rehabilitation centre. This programme included exercise sessions supervised by a physiotherapist specialised in the cardiovascular pulmonary area. The duration of each session was 60 minutes, with sessions three times a week for 12 weeks.
- CTR: The programme was carried out by means of synchronous technological assistance through the 'Google Meet' platform, where the person exercised at home using a computer, tablet or mobile phone. This programme included exercise sessions supervised by a physiotherapist specialised in the cardiovascular pulmonary area. The duration of each session was 60 minutes, with sessions taking place three times a week for 12 weeks.
- For the Telephone-monitored Cardiac Rehabilitation and Telerehabilitation (TCTR) group, telephone calls were made three times a week, on days other than those assigned for the telerehabilitation sessions, in order to monitor the activities and exercises to be performed at home and to collect information. In the calls, details were obtained on heart rate, perception of exertion in the activities and a recommendation was made to rest at least once a week.
- Education: Conducted once a week by medical specialists, the education session lasted 30 minutes for each patient and could be conducted in group or individual sessions. Topics covered included: knowledge of the disease, identification of warning signs, anxiety management, use of medications, home exercises, application of relaxation techniques, guidelines for proper nutrition, sexuality issues. These sessions were conducted virtually for the TCTR and CTR groups, and in person for the CCR group.
- Exercise prescription, monitoring and rate; Telerehabilitation patients were provided with a heart rate monitor (POLAR FT4) and a blood pressure monitor (OMRON). These devices allowed them to accurately monitor their heart rate and blood pressure. In addition, they were instructed on the use of the BORG scale to assess their perception of exertion before, during and after each session. For conventional rehabilitation patients, these data were collected with the instruments available in the clinic.

As for the exercise prescription, it consisted of three main phases. The warm-up phase involved changes of position and self-loading. The central phase was divided into strengthening at 50% of the Maximum Repetition (RM) and aerobic exercise where work was performed at 50% to 70% of the FCMax or at a perceived exertion between 11-13/20 on the BORG scale. Finally, the cool-down phase was carried out by working below 50% of the FCMax or below 11/20 on the BORG scale. Over the weeks, the exercise intensity was progressed according to the patient's prescription and tolerance.

No adverse events occurred during the telerehabilitation intervention. Constant monitoring of their hemodynamic stability was performed, and in the event of any complications, immediate attention from the attending physician was guaranteed.

These advances were based on previously established ranges, which are also detailed in figure 1.

Figure 1. Distribution of experimental groups, monitoring, frequency and prescription of exercise.



Measuring results

Functional aerobic capacity was assessed as the main outcome of the study: the distance covered in the 6MWT was taken into account(Demers et al., 2001) The test was conducted in a 30-meter-long corridor with two cones at each end to delimit the distance to be covered. Each patient was encouraged to walk as quickly as possible, and the remaining time was indicated for each minute elapsed. Two tests were performed, and the test with the greatest distance traveled was recorded, with peripheral oxygen saturation (SpO2), heart rate, and blood pressure measured with a blood pressure monitor and aneroid sphygmomanometer (WelchAllyn® DS44-11CBT). Repetitions were also taken in the 1 minute Sit to Stand with the patient sitting from an upright position in a chair against a standard 46 cm high wall without armrests and should stop and sit down as quickly as possible for 1 minute(Kato et al., 2022) Additionally, the Duke Activity Status Index (DASI) was used to evaluate functional capacity(Lugo-Agudelo et al., 2018).

As secondary measures, clinical variables were taken through the initial measurements on entry to the CR programme, structured interview and the patients' medical history in which risk factors, symptoms, anthropometry (body mass index, abdominal circumference, fat percentage, water percentage, lean mass), left ventricular ejection fraction (LVEF), total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglycerides were taken into account.

Anxiety and depression were measured with the Hospital Anxiety and Depression Scale (HADS), the scale score is between 0 and 21 points, it is classified on a Likert scale ranging from 0 to 3, the higher the score, the greater the intensity or severity of the symptoms(Yamamoto-Furusho et al., 2018); the Patient health questionnaire 9 (PHQ-9), which considers nine symptoms of depression according to the DSM-IV criteria, was also used.(Cassiani-Miranda et al., 2021).

Health-related quality of life: HRQoL was conducted with the Minnesota Living with Heart Failure Questionnaire (MLHFQ), an instrument used to assess the quality of life of HF patients, providing information for two dimensions, physical and emotional, in addition to the total score(Lugo-Agudelo et al., 2018).

Independent variables such as age, sex, marital status, health regime, occupation, level of schooling and socio-economic stratum were taken into account.

Statistical analysis

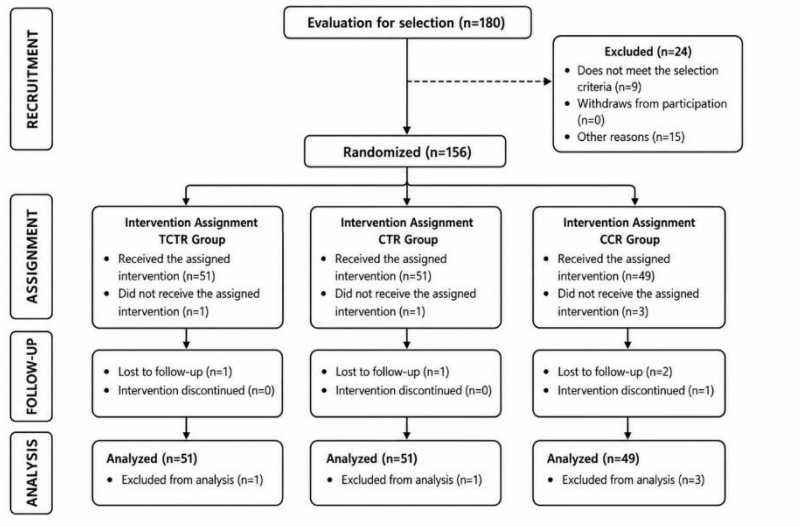
The collected data were entered into a Microsoft Office Excel 2010 database and subsequently exported to Stata version 16 (StataCorp, College Station, TX, USA) for statistical analysis. The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. Continuous variables with an approximately normal distribution were summarized using means and standard deviations. Within-group comparisons between pre- and post-intervention measurements were performed using paired-samples t-tests. Between-group comparisons among the three intervention groups were conducted at baseline and after the intervention. Homogeneity of variances was assessed prior to between-group comparisons. When the assumption of homogeneity of variances was met, a one-way analysis of variance

(ANOVA) was performed, followed by Tukey–Kramer post hoc comparisons when appropriate to account for unequal group sizes. When homogeneity of variances was violated, Welch's ANOVA was used, followed by Dunnett's T3 post hoc test for pairwise comparisons. Statistical significance was set at $\alpha = 0.05$, and 95% confidence intervals were reported.

Results

Eligibility for the trial was assessed in 180 patients referred for CR during a 9-month period (April to December 2024). Fifteen patients were excluded because they had previously undergone CR and another nine patients had symptoms of HF decompensation at admission and were referred by the emergency department for follow-up. A total of 156 patients were enrolled in the trial and randomly assigned to the TCTR, CTR and CCR groups. There was a dropout rate of 5 patients (3.2%); 2 patients could not be transported to the clinic and 1 patient had decompensation requiring hospital management for the CCR group; for the TCTR and CTR groups there were 2 dropouts each related to difficulties connecting via internet from home. At the end of the intervention, the TCTR group had 51 patients, the CTR group had 51 patients and the CCR group had 49 patients (Figure 2).

Figure 2. Flowchart of the recruitment, assignment, monitoring and analysis process.



Primary results

At baseline, sociodemographic variables such as age, sex, marital status, level of education and socioeconomic status did not show statistically significant differences p-value=≥0.05. Other clinical variables such as risk factors, symptoms, LVEF and NYHA also showed no differences between patients (Table 1).

Table 1. Sociodemographic and clinical variables of the patients

Variables	Total n= 151	TCTR n=51	CTR n=51	CCR n=49	P-Value
Age*	61.91 ± 12.86	61.25 ± 12.31	62.51 ± 13.23	61.98 ± 13.26	0.886
Sex					0.939
Male	101 (66.9%)	34 (66.7%)	35 (68.6%)	32 (65.3%)	
Female	50 (33.1%)	17 (33.3%)	16 (31.4%)	17 (34.7%)	
Marital Status					0.335
Stable Union	92 (60.9%)	27 (52.9%)	34 (66.7%)	31 (63.3%)	
No Stable Union	52 (39.1%)	24 (47.1%)	17 (33.3%)	18 (36.7%)	
Education Level					0.928
None	4 (2.6%)	1 (2.0%)	2 (3.9%)	1 (2.0%)	
Incomplete Primary	5 (3.3%)	3 (5.9%)	1 (2.0%)	1 (2.0%)	
Complete Primary	16 (10.6%)	4 (7.8%)	6 (11.8%)	6 (12.2%)	
Incomplete Secondary	11 (7.3%)	2 (3.9%)	4 (7.8%)	5 (10.2%)	
Complete Secondary	50 (33.1%)	21 (41.2%)	16 (31.4%)	13 (26.5%)	

Higher Education	65 (43.1%)	20 (39.2%)	22 (43.1%)	23 (47.1%)	
Socioeconomic Stratum					0.093
Low	43 (28.5%)	14 (27.5%)	20 (39.2%)	9 (18.4%)	
Medium	84 (55.6%)	32 (62.7%)	23 (45.1%)	29 (59.2%)	
High	24 (15.9%)	5 (9.8%)	8 (15.7%)	11 (22.4%)	
Risk Factor					
Dyslipidemia	81 (53.6%)	33 (64.7%)	23 (45.1%)	25 (51.0%)	0.126
Hypertension	93 (61.6%)	36 (70.6%)	26 (51.0%)	31 (63.3%)	0.121
Diabetes	48 (31.8%)	14 (27.5%)	15 (29.4%)	19 (38.8%)	0.432
Hypothyroidism	23 (15.2%)	10 (19.6%)	8 (15.7%)	5 (10.2%)	0.422
Postmenopause	41 (27.2%)	15 (29.4%)	14 (27.5%)	12 (24.5%)	0.857
Current Smoker	3 (2.0%)	2 (3.9%)	1 (2.0%)	0 (0%)	0.373
Ex-smoker	63 (41.7%)	19 (37.3%)	19 (37.3%)	25 (51.0%)	0.275
Family History	90 (59.6%)	32 (62.7%)	31 (60.8%)	27 (55.1%)	0.722
Sedentary Lifestyle	140 (92.7%)	44 (86.3%)	49 (96.1%)	47 (95.9%)	0.094
Symptoms					
Chest Pain	47 (31.1%)	21 (41.2%)	10 (19.6%)	16 (32.7%)	0.060
Syncope	5 (3.3%)	1 (2.0%)	1 (2.0%)	3 (6.1%)	0.408
Dyspnea	88 (58.3%)	33 (64.7%)	27 (52.9%)	28 (57.1%)	0.475
Lower Limb Fatigue	96 (63.6%)	33 (64.7%)	34 (66.7%)	29 (59.2%)	0.724
Palpitations	57 (37.7%)	24 (47.1%)	16 (31.4%)	17 (34.7%)	0.228
Lower Limb Edema	37 (24.5%)	12 (23.5%)	11 (21.6%)	14 (28.6%)	0.704
Claudication	9 (6.0%)	4 (7.8%)	2 (3.9%)	3 (6.1%)	0.696
LVEF (%)					
HFpEF	57 (37.7%)	19 (37.3%)	19 (37.3%)	19 (38.8%)	0.792
HFmrEF	55 (36.4%)	16 (31.4%)	21 (41.2%)	18 (36.7%)	
HFrEF	39 (25.8%)	16 (31.4%)	11 (21.6%)	12 (24.5%)	
NYHA					
II	112 (74.2%)	36 (70.6%)	38 (74.5%)	38 (78.4%)	0.560
III	39 (25.8%)	15 (29.4%)	13 (25.5%)	11 (21.6%)	

*Values are expressed as means and standard deviation.
LVEF: left ventricular ejection fraction; NYHA: New York Heart Association.

In functional aerobic capacity it was evident that all groups presented statistically significant improvements in the distance covered in the 6MWT p-value<0.05 at the beginning and end of the intervention, with the TCTR group presenting the greatest mean differences of -73.36±2.56, followed by the CTR group -63.53±1.32 and CCR -58.53±2.17. Similarly, the results of VO2e 6MWT (ml/kg/min) and METs 6MWT are presented with statistically significant changes p-value<0.05 (Table 2).

Table 2. Changes in the functional aerobic capacity of patients

VARIABLES	TCTR n=51				CTR n=51				CCR n=49			
	Basal	Final	Difference of means ± EE	P-Value	Basal	Final	Difference of means ± EE	P-Value	Basal	Final	Difference of means ± EE	P-Value
Distance 6MWT (m)	254.29±48.25	327.65±48.69	-73.36±2.56	0.001	258.81±55.0	322.33±52.26	-63.53±1.32	0.001	278.55±59.21	337.08±54.23	-58.53±2.17	0.001
VO2e 6MWT (ml/kg/min)	7.74±0.80	9.42±1.58	-1.68±0.18	0.001	7.81±0.92	8.87±0.87	-1.06±0.02	0.001	8.15±0.98	9.12±0.90	-0.97±0.04	0.001
METs 6MWT	2.21±0.23	2.69±0.45	-0.48±0.05	0.001	2.23±0.26	2.53±0.25	-0.30±0.01	0.001	2.33±0.26	2.60±0.25	-0.28±0.01	0.001
Sit to Stand (Repetitions)a,b	17.90±3.98	25.76±5.71	-7.86±0.65	0.001	18.59±5.02	29.80±7.10	-11.22±0.61	0.001	17.86±4.79	29.43±5.76	-11.57±0.66	0.001
DASI Total	32.43±16.48	44.52±11.54	-12.09±1.8	0.001	30.30±17.10	43.70±10.47	-13.40±1.7	0.001	25.04±14.27	40.08±10.97	-15.04±1.8	0.001
DASI VO2 Max	23.55±7.09	28.73±4.97	-5.19±0.77	0.001	22.63±7.35	28.38±4.51	-5.75±0.73	0.001	20.35±6.14	26.82±4.71	-6.47±0.77	0.001

DASI METs	6.73±2.02	8.22±1.43	-1.49±0.22	0.001	6.46±2.1	8.12±1.3	-1.65±0.21	0.001	5.82±1.76	7.67±1.35	-1.85±0.22	0.001

Final post hoc tests - statistically significant differences p<0.05 of group: a - TCTR with respect to CTR group (p=0.006), b - TCTR with respect to CCR group (p=0.006).

VO2e 6MWT: Estimated oxygen consumption in the 6-minute walk test; DASI: Duke Activity Status Index.

The TCTR experimental group showed further significant improvements in the Sit to Stand 1 minute repetitions, DASI total, DASI VO2 Max and DASI METs values with a mean difference at the end of the intervention of 7.86±0.65, 12.09±1.8, 5.19±0.77 and 1.49±0.22 respectively p-value<0.05. The CTR group significantly improved in the 1 minute Sit to Stand repetitions, DASI total, DASI VO2 Max and DASI METs values with a mean difference at the end of the intervention of 11.22±0.61, 13.40±1.7, 5.75±0.73 and 1.65±0.21 respectively p-value<0.05. The CCR group presented a significant improvement in the repetitions of the Sit to Stand 1 minute, values of the total DASI questionnaire, DASI VO2 Max and DASI METs with a mean difference at the end of the intervention of 11.57±0.66, 15.04±1.8, 6.47±0.77 and 1.85±0.22 respectively value-p-value<0.05. Finally, in the 1 minute Sit to Stand repetitions in the intra-group comparison, significant differences were found at the beginning of the intervention between the TCTR vs CTR group and TCTR and CCR (Table 2).

Resu Secondary sides

As for the secondary variables, the TCTR experimental group showed no significant differences at the end of the intervention in the variables weight, BMI, water percentage and Triglycerides p-value=≥0.05. In the variables LVEF, abdominal perimeter, fat percentage, muscle mass, total cholesterol, HDL, LDL, HADS anxiety, HADS depression, PHQ-9, MLHFQ Physical, MLHFQ Emotional and MLHFQ Total there were significant changes at the end of the intervention p-value<0.05 (Table 3).

Table 3. Changes in clinical variables, anxiety, depression and quality of life of patients.

VARIABLES	TCTR n=51				CTR n=51				CCR n=49			
	Basal	Final	Difference of means ± EE	P-Value	Basal	Final	Difference of means ± EE	P-Value	Basal	Final	Difference of means ± EE	P-Value
LVEF (%)	43.59±13.7	47.33±11.6	-3.74±1.07	0.001	±10.98	47.82±9.85	-2.88±0.25	0.001	46.18±10.23	49.20±8.95	-3.02±0.27	0.001
Weight (kg).	74.13±17.55	74.23±16.41	-0.10±0.37	0.783	68.95±14.13	69.79±12.90	-0.84±0.38	0.031	70.05±12.60	69.85±12.09	0.19±0.17	0.253
Height (m)	1.64±0.1	1.64±0.1	-	-	1.66±0.85	1.66±0.85	-	-	1.65±0.88	1.65±0.88	-	-
BMI (kg/m2)	27.28±5.96	27.34±5.57	-0.06±0.14	0.679	24.91±4.30	25.23±3.80	-0.32±0.14	0.026	25.71±4.06	25.69±3.74	0.02±0.09	0.853
Waist circumference (cm)a,d	98.31±12.81	96.53±11.83	1.78±0.29	0.001	91.89±11.39	89.53±15.91	-2.36±1.72	0.178	94.01±11.01	92.96±10.53	1.05±0.19	0.001
Fat (%)a,d	30.89±7.85	29.36±7.87	1.53±0.39	0.001	25.87±7.24	25.18±6.99	-0.69±0.40	0.088	28.20±13.12	26.02±7.81	2.18±1.84	0.241
Water (%)a,b,d,e	46.94±5.76	47.36±5.68	-0.42±0.25	0.093	50.78±4.83	50.89±4.64	-0.11±0.32	0.725	51.01±5.49	51.01±5.36	-0.05±0.10	0.628
Mass (kg)a,b,d,e	40.58±10.5	42.27±9.84	-1.68±0.55	0.004	47.43±10.02	48.25±11.01	-0.82±0.65	0.212	46.90±9.75	47.24±9.47	-0.35±0.08	0.001
Total Cholesterol c,e,f	156.06±39.53	145.37±33.19	10.69±2.77	0.001	151.98±38.86	139.39±32.91	12.59±1.62	0.001	173.06±37.38	164.43±31.29	8.63±1.98	0.001

HDL (mg/dL)	41.47±10.71	43.82±10.42	-2.35±0.50	0.001	40.77±8.98	42.45±8.42	-1.69±0.17	0.001	38.15±7.12	39.80±6.71	-1.65±0.17	0.001
LDL (mg/dL)	83.50±30.02	76.96±22.42	6.54±2.20	0.005	74.12±28.18	72.22±22.92	-1.90±0.95	0.051	82.66±23.68	79.37±18.35	3.29±1.27	0.013
Triglycerides (mg/dL)	140.14±50.84	134.94±47.63	5.20±3.23	0.114	147.73±58.17	138.24±42.51	-9.49±3.03	0.003	146.0±86.07	135.14±38.07	10.86±8.80	0.223
HADS Anxiety a,d,e	2.88±1.07	0.25±0.56	2.63±0.26	0.001	4.29±2.66	1.31±1.63	2.98±0.32	0.001	3.35±2.06	0.73±1.17	2.61±0.21	0.001
HADS Depression a	1.47±1.35	0.08±0.27	1.39±0.17	0.001	2.73±2.79	0.18±0.48	2.55±0.38	0.001	2.27±2.04	0.04±0.20	2.22±0.29	0.001
PHQ-9	6.39±6.04	4.88±5.62	1.51±0.39	0.001	4.27±3.79	2.45±3.21	1.82±0.35	0.001	4.76±4.6	2.06±2.59	2.69±0.33	0.001
MLHFQ Physical	15.71±11.60	9.90±7.89	5.80±1.06	0.001	14.35±11.11	10.49±8.99	3.86±0.63	0.001	14.53±9.73	8.43±5.66	6.10±5.43	0.001
MLHFQ Emotional	7.76±6.39	6.22±5.31	1.54±0.63	0.017	7.43±5.96	5.57±5.20	1.86±0.48	0.001	8.18±6.66	4.65±3.88	3.53±0.57	0.001
MLHFQ Total	35.16±23.32	25.06±18.64	10.10±1.75	0.001	34.24±23.57	24.49±19.32	9.75±1.42	0.001	37.55±22.43	22.04±13.66	15.51±1.61	0.001

Baseline post hoc tests - statistically significant group differences p<0.05: a - TCTR with respect to the CTR group, b - TCTR with respect to the CCR group, c - TCTR with respect to the CCR group.
Final post hoc tests - statistically significant differences p<0.05 of group: d - TCTR with respect to CTR group, e - TCTR with respect to CCR group, f - CTR with respect to CCR group.
LVEF: Left ventricular ejection fraction; BMI: Body mass index; HDL: High density lipoproteins; LDL: Low density lipoproteins; BUN: Blood urea nitrogen; MLFHQ: Minnesota Living with Heart Failure Questionnaire; PHQ-9: Patient health questionnaire 9.

The CTR group did not present significant differences at the end of the intervention in the variables abdominal perimeter, water/fat/mass percentage and LDL p-value=≥0.05. The variables LVEF, weight, BMI, total cholesterol, HDL, triglycerides, HADS anxiety, HADS depression, PHQ-9, MLHFQ Physical, MLHFQ Emotional and MLHFQ Total showed significant changes at the end of the intervention p-value<0.05 (Table 3).

The CCR group did not present significant differences at the end of the intervention in the variables weight, BMI, water/fat percentage and Triglycerides p-value=≥0.05. The variables LVEF, abdominal circumference, total cholesterol, HDL, LDL, HDL, HADS anxiety, HADS depression, PHQ-9, MLHFQ Physical, MLHFQ Emotional and MLHFQ Total showed significant changes at the end of the intervention p-value<0.05 (Table 3).

In the intra-group comparison at the beginning of the intervention, there were differences in the variables abdominal perimeter, fat percentage, water percentage, muscle mass, total cholesterol, HADS anxiety and HADS depression p-value<0.05. At the end of the intervention there were differences in the variables abdominal perimeter, fat percentage, water percentage, muscle mass, total cholesterol and HADS anxiety p-value<0.05 (Table 3).

Discussion

Against the primary objective the results showed that CTR, TCTR and CCR are statistically significant in patients after 12 weeks of intervention, however, better results are observed in TCTR and CTR.

In the sociodemographic characteristics, patients had a mean age of 61.91±12.86 and 66.9% were male; results were similar to those previously reported(Piotrowicz et al., 2010),(Ho et al., 1993; Peng et al., 2018).

According to the NYHA classification, patients predominantly reported values corresponding to Class II (74.2%), followed by Class III (25.8%). This distribution resembles that presented by different studies

(Bernocchi et al., 2018; Hwang et al., 2017), who observed a higher predominance of Class II, however, in another study (Peng et al., 2018) report that Class III was predominant.

Statistically significant improvements were evident in the difference in distance in metres travelled at the first assessment versus the second assessment in the 6MWT for all three groups, with a p-value <0.001. Specifically, a difference of -73.36±2.56 was observed in the TCTR group, -63.53±1.32 in the CTR group, -58.53±2.17 in the CCR group. These results are consistent with the findings reported by Palmira Bernocchi et al(Bernocchi et al., 2018) who found that a group undergoing telerehabilitation with telephone call monitoring showed a difference of 60 metres between pre- and post-intervention measurements. In contrast, the group receiving conventional rehabilitation experienced a 15-metre decrease in their test values.

Furthermore, our results are comparable with other research in the field; (Peng et al., 2018) reported a difference of 21.87 metres in their telerehabilitation group compared to the conventional rehabilitation group, which had a difference of 4.07 metres. Similarly, differences of 30.0 metres have been reported in their telerehabilitation group compared to 20.7 metres in the conventional rehabilitation group (Piotrowicz et al., 2010).

In relation to expressed VO2 consumption, our patients presented statistically significant differences, with a notable increase in the TCTR group of 1.68, in the CTR group of 1.06 ml/kg/min and in the CCR group of 0.97 ml/kg/min. These results are in line with those reported by other authors (Piotrowicz et al., 2010; Tauda, 2025), who also reported an increase in VO2 consumption in their telerehabilitation intervention group with a difference of 0.95 ml/kg/min compared to the conventional rehabilitation group where it did not occur. The findings presented above do not present telephone follow-up in patients, so it is considered that this strategy allows maintaining better results in the primary variable compared to the other intervention groups.

Consequently, high values for these variables suggest increased exercise tolerance, improved functional capacity, decreased mortality and improved quality of life(Bjarnason-Wehrens et al., 2020; Moraga Rojas et al., 2021). Overall, our findings support the efficacy of telerehabilitation, which corresponds to the existing literature, and underline the relevance of considering this modality as an effective option compared to conventional cardiac rehabilitation, highlighting significant improvements in functional capacity measured through the 6MWT, the 1-minute sit to stand and even functional capacity with the DASI questionnaire.

In terms of LVEF after the 12-week intervention programme for all three groups, significant changes were evident, especially in the TCTR group with-3.74±1.07, CRT -2.88±0.25 and CCR -3.02±0.27. These results are in agreement with the conclusions of Jamie J et al (Edwards & O'Driscoll, 2022) in their systematic review and meta-analysis of clinical trials on exercise in heart failure in 2022; noting that exercise significantly improves diastolic function, with marked improvements in LVEF. In addition, similar improvements in paraclinical markers such as total cholesterol, LDL, HDL and triglycerides have been reported(Piotrowicz et al., 2019).

This effect can also be attributed to the comprehensive approach of the intervention plan, which includes educational components. In addition, patients demonstrated adherence to their pharmacological treatment, and exercise facilitated adaptation to significant improvements that are directly related to functional capacity(Pecilla & Sharma, 2021).

HF is associated with an increased likelihood of depression according to meta-analysis studies describe the overall prevalence of depression in HF to be around 20% to 30%, and the presence of depression and HF are associated with increased mortality and morbidity in patients(Sbolli et al., 2020). In this study, depression and anxiety were assessed with the HADS questionnaire and the PHQ-9, showing statistically significant changes in the groups at pre- and post-intervention programme time. It is postulated that this change may be attributed to the inclusion of emotion management education during our intervention and to the effects attributable to exercise, which is recognised as an antidepressant(Herring et al., 2010).

These are considered positive changes, as the presence of depressive symptoms in patients has previously been associated with non-adherence to cardiac rehabilitation in heart failure(Betancourt-Peña et al., 2024). In addition, the reason why the CCR group experiences more significant change compared to

the telerehabilitation groups may be due to the limited face-to-face social interaction that characterises telerehabilitation programmes(Peng et al., 2018).

The MLHFQ questionnaire assesses the quality of life of people with HF; in this study it was present in all intervention groups ($p<0.005$); the Bernocchi et al., (2018) and Peng et al., (2018) have shown statistically significant differences in the groups, and these results remained consistent throughout the 4-month follow-ups and 6 months(Bernocchi et al., 2018). Given that quality of life is often impaired in individuals with HF, improving functional capacity through exercise not only translates into physical benefits, but also substantial improvements in overall quality of life (Edwards & O'Driscoll, 2022). These results reinforce the importance of integrating exercise programmes into the comprehensive management of heart failure, highlighting its sustained impact on quality of life over time.

In relation to the frequency and duration of the telerehabilitation programme, significant variations were observed between studies, with durations ranging from 8 to 18 weeks(Bernocchi et al., 2018; Kikuchi et al., 2021; Pastora-Bernal et al., 2021; Piotrowicz et al., 2010; van Leunen et al., 2023). In this study, a 12-week programme was chosen, with sessions scheduled three times a week, similar to previous clinical trials with interventions 3-5 times a week(Bernocchi et al., 2018; Kikuchi et al., 2021; Pastora-Bernal et al., 2021; Piotrowicz et al., 2010; van Leunen et al., 2023).

With the results of this study, the implementation of telerehabilitation, education and monitoring programmes can be considered as effective interventions in HF patients, as well as allowing greater coverage and adherence of patients who cannot access hospital-based exercise programmes(Espinoza Pérez et al., 2023). Additionally, telephone follow-up could be a strategy to avoid early drop-outs and maintain improvements during telerehabilitation(LaValley et al., 2019).

Limitations

The limitations of this study are that cardiopulmonary exercise tests were not performed to establish a reference parameter in functional aerobic capacity; however, the application of other recommended tests such as the 6MWT, Sit to Stand Test and DASI can provide relevant information and generate cost-effective impacts since few cardiac rehabilitation programmes have the conditions to perform this type of test; on the other hand, aspects related to a duration longer than 12 weeks of the intervention to provide follow-up and maintenance of the benefits was not possible due to administrative conditions and the health system in Colombia. Access to technological devices and internet networks can be difficult to access for certain populations, especially in rural areas. However, this problem was not addressed in this study, as most of the study population resided in urban environments. Nevertheless, it is considered that this remains a great alternative for people in urban areas due to accessibility and transportation issues. The lack of participant blinding is another drawback that might have affected self-reported outcomes like adherence and perceived exertion. Future studies could include assessor blinding and objective digital adherence tracking to reduce bias, even though blinding in behavioral interventions is sometimes impractical(Boutron et al., 2008).

Finally, no monitoring of nutritional habits was carried out throughout the intervention period; however, the results of the study reveal significant findings. Importantly, Finally, nutritional habits were not monitored during the intervention period; however, the study results reveal significant findings. The study design is noteworthy, as it was a three-arm study incorporating telephone follow-up and education within a Latin American context.

Conclusions

The physical exercise programme and educational telephone follow-up via cardiac telerehabilitation improves the functional aerobic capacity of patients significantly compared to conventional cardiac rehabilitation and telerehabilitation.

Financing

This work was supported by call for internal research program 003 National School of Sport.

Author Affiliations

Jhonatan Betancourt-Peña 1*, Iago Portela-Pino 2, María José Martínez-Patiño 3

1. Faculty of Health and Rehabilitation - Olympic Studies Center, University Institution National School of Sport (Cali, Colombia). University of Vigo (Vigo, Spain).

2. Department of General and Specific Didactics and Theory of Education. University of León (León, Castilla y León, España).

3. Faculty of Education and Sport Sciences. University of Vigo. University of Vigo (Vigo, Spain).

References

Bernocchi, P., Vitacca, M., La Rovere, M. T., Volterrani, M., Galli, T., Baratti, D., Paneroni, M., Campolongo, G., Sposato, B., & Scalvini, S. (2018). Home-based telerehabilitation in older patients with chronic obstructive pulmonary disease and heart failure: A randomised controlled trial. *Age and Ageing*, *47*(1), 82–88. https://doi.org/10.1093/ageing/afx146

Betancourt-Peña, J., Portela-Pino, I., & Amaral-Figueroa, M. (2024). Factors related to non-adherence to cardiac rehabilitation in patients with heart failure. *Revista Clínica Española (English Edition)*, *224*(1), 24–33. https://doi.org/10.1016/j.rceng.2023.12.010

Bjarnason-Wehrens, B., Nebel, R., Jensen, K., Hackbusch, M., Grilli, M., Gielen, S., Schwaab, B., Rauch, B., & for the German Society of Cardiovascular Prevention and Rehabilitation (DGPR). (2020). Exercise-based cardiac rehabilitation in patients with reduced left ventricular ejection fraction: The Cardiac Rehabilitation Outcome Study in Heart Failure (CROS-HF): A systematic review and meta-analysis. *European Journal of Preventive Cardiology*, *27*(9), 929–952. https://doi.org/10.1177/2047487319854140

Boutron, I., Moher, D., Altman, D. G., Schulz, K. F., Ravaud, P., & CONSORT Group. (2008). Extending the CONSORT statement to randomized trials of nonpharmacologic treatment: Explanation and elaboration. *Annals of Internal Medicine*, *148*(4), 295–309. https://doi.org/10.7326/0003-4819-148-4-200802190-00008

Cassiani-Miranda, C. A., Cuadros-Cruz, A. K., Torres-Pinzón, H., Scoppetta, O., Pinzón-Tarrazona, J. H., López-Fuentes, W. Y., Paez, A., Cabanzo-Arenas, D. F., Ribero-Marulanda, S., & Llanes-Amaya, E. R. (2021). Validez del Cuestionario de salud del paciente-9 (PHQ-9) para cribado de depresión en adultos usuarios de Atención Primaria en Bucaramanga, Colombia. *Revista Colombiana de Psiquiatría*, *50*(1), 11–21. https://doi.org/10.1016/j.rcp.2019.09.001

Ciapponi, A., Alcaraz, A., Calderón, M., Matta, M. G., Chaparro, M., Soto, N., & Bardach, A. (2016). Burden of Heart Failure in Latin America: A Systematic Review and Meta-analysis. *Revista Española de Cardiología (English Edition)*, *69*(11), 1051–1060. https://doi.org/10.1016/j.rec.2016.04.054

Dalli-Peydró, E., Prades Martí, M., Tuzón-Segarra, M. T., Fresneda-Fresneda, A., Muñoz-Ramos, N., & Cosín-Sales, J. (2024). Coste-utilidad de la telerrehabilitación cardiaca frente a la rehabilitación hospitalaria convencional tras SCA en España. *Revista Española de Cardiología*, *77*(1), 99–101. https://doi.org/10.1016/j.recesp.2023.07.001

de la Espriella, R., Santas, E., Zegri Reiriz, I., Górriz, J. L., Cobo Marcos, M., & Núñez, J. (2022). Cuantificación y tratamiento de la congestión en insuficiencia cardíaca: Una visión clínica y fisiopatológica. *Nefrología*, *42*(2), 145–162. https://doi.org/10.1016/j.nefro.2021.04.006

Demers, C., McKelvie, R. S., Negassa, A., & Yusuf, S. (2001). Reliability, validity, and responsiveness of the six-minute walk test in patients with heart failure. *American Heart Journal*, *142*(4), 698–703. https://doi.org/10.1067/mhj.2001.118468

Edwards, J. J., & O'Driscoll, J. M. (2022). Exercise Training in Heart failure with Preserved and Reduced Ejection Fraction: A Systematic Review and Meta-Analysis. *Sports Medicine - Open*, *8*(1), 76. https://doi.org/10.1186/s40798-022-00464-5

Espinoza Pérez, J., Fernández Coronado, R. O., Olórtegui Yzú, A., Fernández Coronado, J. A., Palomino Vilchez, Y. R., Heredia Ñahui, M. A., Soca Meza, R. E., & Silva Valenzuela, H. (2023). Cardiac tele-

rehabilitation in times of pandemic. Experience at the Instituto Nacional Cardiovascular—INCOR in Lima-Peru. *Archivos Peruanos de Cardiología y Cirugía Cardiovascular*, *4*(1), 13–20. https://doi.org/10.47487/apcyccv.v4i1.281

Heidenreich, P. A., Bozkurt, B., Aguilar, D., Allen, L. A., Byun, J. J., Colvin, M. M., Deswal, A., Drazner, M. H., Dunlay, S. M., Evers, L. R., Fang, J. C., Fedson, S. E., Fonarow, G. C., Hayek, S. S., Hernandez, A. F., Khazanie, P., Kittleson, M. M., Lee, C. S., Link, M. S., … Yancy, C. W. (2022). 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*, *145*(18), e895–e1032. https://doi.org/10.1161/CIR.0000000000001063

Herring, M. P., O'Connor, P. J., & Dishman, R. K. (2010). The effect of exercise training on anxiety symptoms among patients: A systematic review. *Archives of Internal Medicine*, *170*(4), 321–331. Scopus. https://doi.org/10.1001/archinternmed.2009.530

Ho, K. K., Pinsky, J. L., Kannel, W. B., & Levy, D. (1993). The epidemiology of heart failure: The Framingham Study. *Journal of the American College of Cardiology*, *22*(4 Suppl A), 6A-13A. https://doi.org/10.1016/0735-1097(93)90455-a

Hwang, R., Bruning, J., Morris, N. R., Mandrusiak, A., & Russell, T. (2017). Home-based telerehabilitation is not inferior to a centre-based program in patients with chronic heart failure: A randomised trial. *Journal of Physiotherapy*, *63*(2), 101–107. https://doi.org/10.1016/j.jphys.2017.02.017

Kato, H., Watanabe, H., Koike, A., Wu, L., Hayashi, K., Konno, H., Machino, T., Nishi, I., Sato, A., Kawamoto, H., Aonuma, K., Sankai, Y., & Ieda, M. (2022). Effects of Cardiac Rehabilitation With Lumbar-Type Hybrid Assistive Limb on Muscle Strength in Patients With Chronic Heart Failure — A Randomized Controlled Trial —. *Circulation Journal*, *86*(1), 60–67. https://doi.org/10.1253/circj.CJ-21-0381

Kikuchi, A., Taniguchi, T., Nakamoto, K., Sera, F., Ohtani, T., Yamada, T., & Sakata, Y. (2021). Feasibility of home-based cardiac rehabilitation using an integrated telerehabilitation platform in elderly patients with heart failure: A pilot study. *Journal of Cardiology*, *78*(1), 66–71. https://doi.org/10.1016/j.jjcc.2021.01.010

LaValley, G., Storer, A., Szalai, H., Farah, M., & Pack, Q. R. (2019). A Motivational Telephone Intervention to Reduce Early Dropouts in Cardiac Rehabilitation: A FEASIBILITY PILOT STUDY. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *39*(5), 318. https://doi.org/10.1097/HCR.0000000000000425

Lugo-Agudelo, L. H., Sánchez Ropero, E. M., Navas Rios, C. M., Ortiz Rangel, S. D., Vera Giraldo, C. Y., Rodríguez Guevara, C., Vargas Montoya, D. M., & Aguirre Acevedo, D. C. (2018). Validation for Colombia of the questionnaire measuring functional capacity in patients with heart failure and its correlation with WHODASII. *Annals of Physical and Rehabilitation Medicine, 12th World Congress of the International Society of Physical and Rehabilitation Medicine. Paris. 8-12 July 2018*, *61*, e546. https://doi.org/10.1016/j.rehab.2018.05.1271

McDonagh, T. A., Metra, M., Adamo, M., Gardner, R. S., Baumbach, A., Böhm, M., Burri, H., Butler, J., Čelutkienė, J., Chioncel, O., Cleland, J. G. F., Coats, A. J. S., Crespo-Leiro, M. G., Farmakis, D., Gilard, M., Heymans, S., Hoes, A. W., Jaarsma, T., Jankowska, E. A., … ESC Scientific Document Group. (2021). 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) With the special contribution of the Heart Failure Association (HFA) of the ESC. *European Heart Journal*, *42*(36), 3599–3726. https://doi.org/10.1093/eurheartj/ehab368

Moraga Rojas, C., Soto Fonseca, J. D., Moraga Rojas, C., & Soto Fonseca, J. D. (2021). Prescripción de ejercicio durante la rehabilitación cardiaca de pacientes con Insuficiencia Cardiaca. *Revista Costarricense de Cardiología*, *23*(1), 21–27. http://www.scielo.sa.cr/scielo.php?script=sci_abstract&pid=S1409-41422021000100021&lng=en&nrm=iso&tlng=es

Pastora-Bernal, J.-M., Hernández-Fernández, J.-J., Estebanez-Pérez, M.-J., Molina-Torres, G., García-López, F.-J., & Martín-Valero, R. (2021). Efficacy, Feasibility, Adherence, and Cost Effectiveness of a mHealth Telerehabilitation Program in Low Risk Cardiac Patients: A Study Protocol. *International Journal of Environmental Research and Public Health*, *18*(8), 4038. https://doi.org/10.3390/ijerph18084038

Pecilla, A., & Sharma, S. (2021). Guía ESC 2020 sobre cardiología del deporte y el ejercicio en pacientes con enfermedad cardiovascular. *Revista Española de Cardiología*, *74*(6), 545.e1-545.e73. https://doi.org/10.1016/j.recesp.2020.11.026

Peng, X., Su, Y., Hu, Z., Sun, X., Li, X., Dolansky, M. A., Qu, M., & Hu, X. (2018). Home-based telehealth exercise training program in Chinese patients with heart failure. *Medicine*, *97*(35), e12069. https://doi.org/10.1097/MD.0000000000012069

Piotrowicz, E., Baranowski, R., Bilinska, M., Stepnowska, M., Piotrowska, M., Wójcik, A., Korewicki, J., Chojnowska, L., Malek, L. A., Klopotowski, M., Piotrowski, W., & Piotrowicz, R. (2010). A new model of home-based telemonitored cardiac rehabilitation in patients with heart failure: Effectiveness, quality of life, and adherence. *European Journal of Heart Failure*, *12*(2), 164–171. https://doi.org/10.1093/eurjhf/hfp181

Piotrowicz, E., Piotrowicz, R., Opolski, G., Pencina, M., Banach, M., & Zaręba, W. (2019). Hybrid comprehensive telerehabilitation in heart failure patients (TELEREH-HF): A randomized, multicenter, prospective, open-label, parallel group controlled trial-Study design and description of the intervention. *American Heart Journal*, *217*, 148–158. https://doi.org/10.1016/j.ahj.2019.08.015

Pitta, N. C., Furuya, R. K., Freitas, N. D. O., Dessotte, C. A. M., Dantas, R. A. S., Ciol, M. A., Schmidt, A., & Rossi, L. A. (2022). Effect of an educational program on physical activity in individuals undergoing their first percutaneous coronary intervention: A randomized clinical trial. *Brazilian Journal of Physical Therapy*, *26*(5). https://doi.org/10.1016/j.bjpt.2022.100443

Sayago-Silva, I., García-López, F., & Segovia-Cubero, J. (2013). Epidemiología de la insuficiencia cardiaca en España en los últimos 20 años. *Revista Española de Cardiología*, *66*(8), 649–656. https://doi.org/10.1016/j.recesp.2013.03.014

Sbolli, M., Fiuzat, M., Cani, D., & O'Connor, C. M. (2020). Depression and heart failure: The lonely comorbidity. *European Journal of Heart Failure*, *22*(11), 2007–2017. https://doi.org/10.1002/ejhf.1865

Sicras-Mainar, A., Sicras-Navarro, A., Palacios, B., Varela, L., & Delgado, J. F. (2022). Epidemiología y tratamiento de la insuficiencia cardiaca en España: Estudio PATHWAYS-HF. *Revista Española de Cardiología*, *75*(1), 31–38. https://doi.org/10.1016/j.recesp.2020.09.014

Tauda, M. E. (2025). Impacto del entrenamiento físico en la fracción de eyección y Vo2max en pacientes con insuficiencia cardíaca: Revisión sistemática y metaanálisis. *Retos*, *66*, 143–170. https://doi.org/10.47197/retos.v66.110423

Thamman, R., & Janardhanan, R. (2020). Cardiac rehabilitation using telemedicine: The need for tele cardiac rehabilitation. *Reviews in Cardiovascular Medicine*. https://doi.org/10.31083/j.rcm.2020.04.201

Tinoco, J. de M. V. P., Figueiredo, L. da S., Flores, P. V. P., Padua, B. L. R. de, Mesquita, E. T., & Cavalcanti, A. C. D. (2021). Efectividad de la educación en salud para el autocuidado y la adhesión al tratamiento de pacientes con insuficiencia cardíaca: Meta-análisis. *Revista Latino-Americana de Enfermagem*, *29*, e3389. https://www.scielo.br/j/rlae/a/QHMSCpnbqyQnFtbnjhzgw8S/?lang=es

van Leunen, M. M. C. J., de Lathauwer, I. L. J., Verstappen, C. C. A. G., Visser-Stevelink, D. M. G., Brouwers, R. W. M., Herkert, C., Tio, R. A., Spee, R. F., Lu, Y., & Kemps, H. M. C. (2023). Telerehabilitation in patients with recent hospitalisation due to acute decompensated heart failure: Protocol for the Tele-ADHF randomised controlled trial. *BMC Cardiovascular Disorders*, *23*, 379. https://doi.org/10.1186/s12872-023-03407-4

Yamamoto-Furusho, J. K., Sarmiento-Aguilar, A., García-Alanis, M., Gómez-García, L. E., Toledo-Mauriño, J., Olivares-Guzmán, L., & Fresán-Orellana, A. (2018). Hospital Anxiety and Depression Scale (HADS): Validation in Mexican patients with inflammatory bowel disease. *Gastroenterología y Hepatología (English Edition)*, *41*(8), 477–482. https://doi.org/10.1016/j.gastre.2018.08.009

Authors and translators' details:

Jhonatan Betancourt Peña	johnnatanbp@hotmail.com	Author
Iago Portela-Pino	iporp@unileon.es	Author
María José Martínez-Patiño	mjpatino@uvigo.es	Author
Iago Portela-Pino	iporp@unileon.es	Translator