Instituto Nacional Cardiovascular

Archivos Peruanos de Cardiología y Cirugía Cardiovascular
Arch Peru Cardiol Cir Cardiovasc. 2023;4(3):88-95. doi: 10.47487/apcyccv.v4i3.323.

Sociedad Científica de Medicina Cardiovascular del Perú

Original article

# Effectiveness of tertiary prevention on quality of life and control of risk factors in patients with ischemic heart disease

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Received June 7, 2023
Accepted: September 10, 2023
Online: Setiembre 30, 2023

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**Funding**
Self-financed

**Conflicts of Interest**
The authors declare no conflict of interest.

**Cite as**
Fernández Coronado R, Olórtegui Yzu A. Effectiveness of tertiary prevention on quality of life and control of risk factors in patients with ischemic coronary heart disease. Arch Peru Cardiol Cir Cardiovasc. 2023;4(3):88-95. doi: 10.47487/apcyccv.v4i3.323.



## ABSTRACT

**Objective.** Determine the effectiveness of cardiac rehabilitation (CR) as a tertiary prevention strategy in the quality of life and control of risk factors of patients with ischemic heart disease (IHD) at the National Cardiovascular Institute (INCOR) of EsSalud- Lima during 2018. **Materials and methods**. A retrospective cohort of 280 patients diagnosed with IHD , who had previously undergone medical, interventional, or surgical treatment, were referred to the INCOR CR program for tertiary prevention (PT) in 2018. The program was developed according to the institutional guidelines, spanned eight weeks and included exercise sessions as well as educational, psychological, nutritional, and recreational workshops. Assessments were conducted at the program's outset and upon its completion, including the administration of the Quality of Life After Myocardial Infarction (QLMI 2) quality of life test, along with anthropometric, laboratory, and risk factor control measurements. **Results.** At the conclusion of the CR program, there was a statistically significant improvement in the patients' quality of life across the emotional, social, physical, and overall dimensions ($p < 0.001$). The same positive trend was observed in nutritional parameters, including weight, abdominal circumference, and BMI ($p < 0.001$). Physical capacity also exhibited significant enhancements in terms of muscle strength (12.2% increase), physical activity (38.0% increase), and functional capability (25.4% increase) ($p < 0.001$). However, the results were not uniform for the biochemical metabolic variables. While glycosylated hemoglobin, glycemia, and lipid profile didn't show significant improvements, there was a notable and statistically significant increase in HDL levels ($p < 0.001$). **Conclusions.** CR is an effective central strategy for implementing tertiary prevention in patients with IHD as it significantly enhances their quality of life and effectively manages coronary risk factors.

**Keywords:** Tertiary Prevention; Cardiac Rehabilitation; Quality of Life; Heart Disease Risk Factors (source: MeSH-NLM).

## Introduction

Ischemic heart disease (IHD) is the leading global cause of death and disease burden, which, along with stroke, account for nearly 80% of the overall cardiovascular disease (CVD) problem [1,2]. In Peru, this group of diseases has shown a steady increase in recent decades, shifting from the third to the first leading cause of death and disease burden in individuals over 50 years of age. Furthermore, the prevalence of cardiovascular risk factors (CVRF) has increased in recent years, creating a conducive environment for the spread and progression of IHD in the Peruvian population [3-5].

The current medical management of CVRF is based on pharmacological treatment rather than the comprehensive primary prevention intervention proposed in national and international guidelines for managing these cases [6,7], which would help prevent the progression of the disease in its natural history. Consequently, individuals with CVRF continue to experience the pathophysiological processes that lead to the obstruction of the coronary arteries, ultimately causing a reduction or cessation of blood flow to the myocardium and the subsequent loss of oxygen supply, resulting in angina or myocardial infarction [8,9]. The described scenario, with the increase in mortality and the predominance of the disease burden of IHD, occurs despite the validity of diagnostic methods and the efficacy of existing comprehensive management. Therefore, IHD continues to be a national and global public health issue [2,4,10].

In this stage, the patient with IHD receives treatment to reverse or reduce the coronary obstruction, which can be either surgical, interventional, or pharmacological. The sequence described up to this point shows that patients who have reached this stage of IHD have completed two of the three recognized stages in the natural history of the disease: i) the prepathogenic period, and ii) the pathogenic period. The developmental context outlined by this theory indicates that primary prevention corresponds to the first stage, and secondary prevention to the second stage. Consequently, the third stage (disease resolution) must be completed with tertiary prevention [10-13], which in the case of the patient who have experienced CIHD, a recognized and proven effective strategy for tertiary prevention is cardiac rehabilitation (CR) [14,15] **(Table 1).**

"As a goal, tertiary prevention aims to delay the course of the disease, improve the residual functions of the individual, and minimize the onset or severity of disability, allowing them to achieve the highest level of autonomy, well-being, and quality of life" [16]. Within this framework, CR has emerged as a subspecialty of cardiovascular medicine, responsible for the

**Table 1.** Natural history of IHD, it shows the stages of the disease and its relationship with prevention levels and their strategies.

| **Prepathogenic stage** | **Pathogenic stage** | |
|---|---|---|
| **Exposure phase** | **Clinical-disease horizon** | **Resolution** |
| Cardiovascular risk factors | Medical interventions | Recovery strategies |
| Hypertension | Surgical intervention | Limitation of sequelae |
| Physical inactivity | Invasive hemodynamic treatment | Recovery of maximum potential |
| Nutritional status | Pharmacological treatment | Social and productive reintegration |
| Diabetes | | Improvement in quality of life |
| Metabolic syndrome | | |
| Other recognized factors | | |
| Family history | | |
| Epigenetic factors | | |
| Social and environmental factors | | |
| **Primary intervention** | **Secondary prevention** | **Tertiary prevention** |
| Comprehensive management | Timely diagnosis and prevention of complications | Self-assessment |
| Pharmacological control of CVRF | Timely access to care | Nutritional education |
| Lifestyle change | Comprehensive services | Educación nutricional |
| Eating habits | Quality of care | Physical activity training and education |
| Physical activity | | Management of psychological overload |
| Rest and/or relaxation | | Adherence to therapeutic measures |
| | | Sustainability of a healthy lifestyle |

Prepared from references 6, 7 and 8

tertiary prevention in patients with heart disease, with the goal of controlling cardiovascular risk factors (CVRF) and improving the patient's quality of life [14,15]. Despite the recognized achievements and position of CR, its use is not widespread enough. In Peru, the most significant program is led by the National Cardiovascular Institute "Carlos Alberto Peschiera Carrillo" of EsSalud (INCOR), which comprehensively applies the recognized CR models within the subspecialty.

The limited reach and coverage of CR is a situation that needs to be changed, and to do so, it is necessary to generate evidence of its efficacy and effectiveness in our context. Therefore, the aim of this research is to evaluate how tertiary prevention through a cardiac rehabilitation program improves the quality of life and risk factors of patients with CVD, specifically in those affected by IHD.

## Materials and Methods

### Study design

The research was conducted on a retrospective cohort of patients from the CR program, with baseline measurements taken at the beginning and end of the program. This program was carried out in the Functional Unit of Cardiac Rehabilitation at INCOR, following institutional guidelines that specify the conditions of development and involve a multidisciplinary team of professionals to help patients with coronary conditions recover their physical, mental, social, and work conditions. Patients receive cardiological, physical, psychological, and nutritional assessments at the start and end of the program. In the meantime, they participate in 24 exercise sessions three times a week, attend educational workshops on nutrition, receive psychological counseling, and engage in recreational activities [17].

### Study population

The study population consisted of all INCOR patients aged 15 years and older who were diagnosed with IHD and completed the CR program during 2018.

### Variables

The main study variable were quality of life, physical capacity, nutritional status, lipid profile, and blood glucose levels, all measured before and after the completion of the CR program by the patients.

Quality of life was assessed using the Quality of Life After Myocardial Infarction (QLMI 2) questionnaire, which has been enhanced and validated in the Spanish language [18]. It consists of 27 items and three dimensions: physical, social, and emotional. Physical capacity was determined using two variables: the first was muscle strength measured with a dynamometer, and the second was functional capacity measured through ergometry and the 6-minute walk test (6MWT). Patient nutritional status variables, including weight, BMI (body mass index), and abdominal circumference, were collected from the physical records of the program, which, according to the institutional CR guidelines, were recorded by the program's nutritionist [17]. Lipid profile and blood glucose tests were conducted by the clinical laboratory service contracted by INCOR for diagnostic support.

Complementary variables, such as the presence of CVRF (hypertension [HTN], diabetes mellitus, dyslipidemia, tobacco use, obesity, and a history of CVD) and the patient's pharmacological treatment, were collected from institutional clinical records, primarily the electronic medical records and their physical supplements were collected by the principal investigator and the psychologist on the CR team, and they were entered into an Excel® spreadsheet.

### Statistical analysis

Data quality was assessed through a descriptive analysis of data correspondence and consistency. Inconsistencies observed were cross-checked with the corresponding records and corrected.

For the descriptive analysis, absolute and relative frequency distributions (categorical variables) and measures of central tendency and dispersion were calculated according to the normality of the numeric variable. In the second phase, the normality of variable distributions was determined using the Shapiro-Wilk test, a process carried out with the SPSS v 22 software [19].

To determine the statistical significance of changes in quality of life before and after CR, as well as the studied variables, the Wilcoxon signed-rank test was used due to the non-normal distribution of all variables ($p < 0.001$ in all cases). The JASP v 0.18.1 software was used for this analysis [20].

### Ethical aspects

The study was approved on March 9, 2020, through Note No. 32-CE-DIR-INCOR-ESSALUD-2020, by the Institutional Research Ethics Committee of INCOR.

## Results

During 2018, all 280 patients with IHD who entered the INCOR's CR program were enrolled in the study; the minimum age was 31 years, and the maximum age was 85 years. Of these, 88.6% were male, with a mean age of 64.4 years, while the mean age for females was 62.3 years.

Regarding the distribution of CVRF, high proportions were observed in all cases. HTN was the most prevalent factor, followed by a history of CVD, dyslipidemia, and a history of tobacco use. he distribution by gender showed no significant differences, except for dyslipidemia, which had a higher prevalence among women, and tobacco consumption, which was more common among men **(Table 2)**.

**Table 2.** Distribution of risk factors by sex. Cardiac Rehabilitation Program. INCOR, 2018.

| History and risk factors | Male (n = 248) | | Female (n = 32) | | Overall | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| HTN | 154 | 62.1 | 21 | 65.6 | 175 | 62.5 |
| DM2 | 72 | 29.0 | 8 | 25.0 | 80 | 28.6 |
| Dyslipidemia | 110 | 44.4 | 19 | 59.4 | 129 | 46.1 |
| Tobacco use | 108 | 43.5 | 12 | 37.5 | 120 | 42.9 |
| Obesity | 49 | 19.8 | 7 | 21.9 | 56 | 20.0 |
| History of CVD | 119 | 48.0 | 16 | 50.0 | 135 | 48.2 |

HTN = hypertensionl, DM2 = type 2 diabetes mellitus, CVD: cardiovascular disease.

When it comes to the treatment of IHD, 66.8% of patients underwent coronary angioplasty, 21.8% had surgical revascularization, 7.9% received only pharmacological management, and 3.6% underwent hybrid revascularization.

At the start of the program, as part of the pharmacological treatment for IHD, patients were prescribed an average of 4.9 medications/patient, with 61.8% of them receiving five or more medications. The most frequently prescribed medications included beta-blockers (90.7%), antiplatelet agents (95.4%), and dual antiplatelet therapy (74.3%) **(Table 3)**.

### Cardiovascular risk factors

Although the values of the lipid profile and glucose levels showed a decrease at the end of CR, these changes were not statistically significant, except for the levels of HDL ($p < 0.001$) **(Table 4)**.

Regarding the nutritional variables assessed, weight, abdominal circumference, and BMI all exhibited statistically significant reductions, although the decreases were less than 3.0% between the pre- and post-CR medians **(Table 4)**.

For the physical capacity variables, CR also resulted in favorable and statistically significant changes ($p < 0.001$). Muscle strength improved by 10.3% compared to baseline. Physical activity time increased by 37.4% in the same direction, and functional capacity improved by 24.4%, all calculated from pre- and post-CR medians **(Table 4)**.

**Table 3.** Distribution of medications administered to patients in the Cardiac Rehabilitation Program. INCOR, 2018.

| Prescribed medication | n | % |
|---|---|---|
| Acetylsalicylic acid | 267 | 95.4 |
| Atorvastatin | 266 | 95.0 |
| Beta-blockers | 254 | 90.7 |
| Clopidogrel | 208 | 74.3 |
| Angiotensin II blockers | 114 | 40.7 |
| Warfarin | 63 | 22.5 |
| ACE inhibitors | 59 | 21.1 |
| Nitrates | 41 | 14.6 |
| Metformin | 41 | 14.6 |
| Spironolactone | 28 | 10.0 |

ACE: Angiotensin-Converting Enzyme

### Quality of life

Mean quality of life dimensions at post-RC increased by 10.3, 13.6 and 9.5 in the emotional, physical, and social aspects, respectively, compared to the baseline measurement. For the overall QLMI 2 indicator, the increase reached 33.5 points.

To determine whether the described change obtained was related to the patients' participation in CR, the Wilcoxon signed-rank test ($p < 0.001$) was applied, since, as indicated in materials and methods section, the distribution did not conform to a normal distribution according to the Shapiro test ($p < 0.001$).

In this regard, the Wilcoxon test showed statistically significant results for the emotional, physical, and social dimensions, as well as for the overall quality of life indicator ($p < 0.001$) **(Figure 1)**.

The significance obtained for the QLMI 2 quality of life measure clearly demonstrates that the CR program is substantially effective in influencing the natural history of IHD. However, as can be seen in the Raincloud plot in Figure 1 (the leftmost representation of each component), some cases did not show improvement, and even a few showed a decrease after RC. This result may be related to the need to extend the duration of RC, depending on the individual patient's evaluation during the program.

## Discussion

This study, conducted on 280 patients with coronary heart disease found that CR, as a tertiary prevention strategy, improves

**Table 4.** Comparative distribution of variables in the biochemical, nutritional, and physical capacity profile of patients in the Cardiac Rehabilitation Program. INCOR, 2018.

| Variables | Median | | p-value * |
|---|---|---|---|
| | Pre-CR | Post-CR | |
| Biochemical profile | | | |
| Glycated hemoglobin (mg/dL) | 6.0 | 5.8 | 1.000 |
| Glucose (mg/dL) | 103.0 | 100.0 | 1.000 |
| Total cholesterol (mg/dL) | 118.0 | 117.5 | 0.073 |
| HDL (mg/dL) | 37.0 | 40.0 | < 0.001 |
| LDL (mg/dL) | 52.8 | 53.0 | 0.071 |
| VLDL (mg/dL) | 21.5 | 20.8 | 0.996 |
| Triglycerides (mg/dL) | 108.0 | 106.5 | 0.986 |
| Nutritional | | | |
| Weight (kg) | 73.0 | 71.6 | < 0.001 |
| Body mass index | 26.87 | 26.20 | < 0.001 |
| Abdominal circumference (cm) | 96.0 | 93.9 | < 0.001 |
| Physical capacity | | | |
| Muscle strength (kg) | 29.0 | 32.0 | < 0.001 |
| Distance walked (meters) | 334.0 | 459.0 | < 0.001 |
| Functional capacity (METS) | 5.97 | 7.43 | < 0.001 |

CR: cardiac rehabilitation, HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein, VLDL: Very Low-Density Lipoprotein
* Statistical significance: Wilcoxon signed-rank test.

quality of life parameters measured by the QLMI2 questionnaire and coronary risk factors at the end of the CR session program.

The described result is supported by the improvement in the emotional, physical, and social components, leading to an increase in the quality of life of the patients studied, regardless of the treatment received. Consequently, RC should be recommended for every patient with this type of disease, as shown in similar studies [21,22].

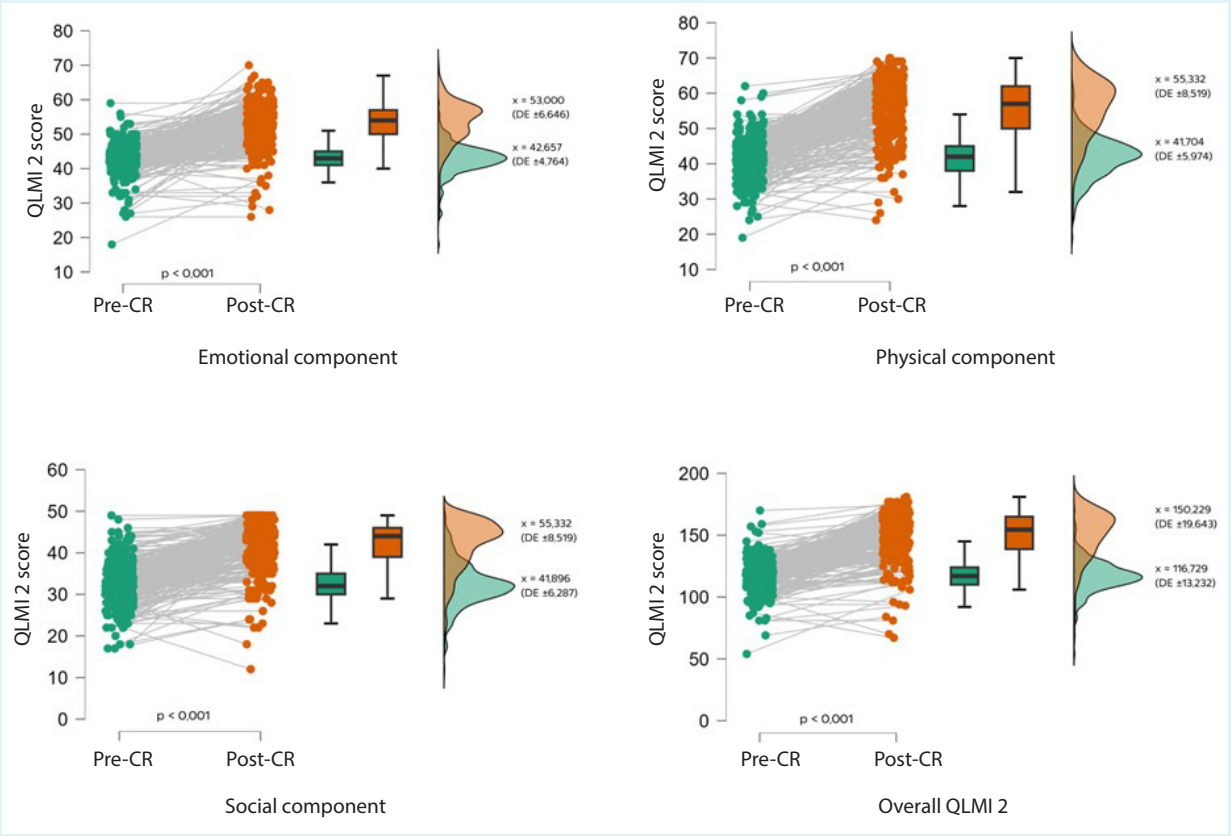
The observed change, although present in all three components, was comparatively smaller in the social aspect, which is related to the time it takes for the patient and their family to fully reintegrate into their social life as well as the short duration of the CR program at INCOR, insufficient to achieve changes in personal and family habits that sustain the lifestyle transformation sought by CR [16,23-25].

Our results corroborate findings from various studies, demonstrating that CR, regardless of its different approaches, methods, or durations, consistently provides benefits for the patient. In the specific case of our research, the retrospective approach used, with its inherent limitations associated with secondary data sources, does not diminish, or alter the beneficial effects that CR offers to cardiac patients, adding greater consistency to the existing knowledge on the effectiveness of this tertiary prevention strategy [14,23-27].

The strength of a CR program in achieving the described effectiveness in various studies, as well as in this research, is associated with its comprehensive and specific approach. Thus, effective nutritional control, obtained through exercise prescription and nutritional guidance, results in weight and BMI improvement, leading to better obesity control. Our CR program has achieved this change, which is consistent with what has been described in other programs regarding this component [28-30].

Our study shows a significant improvement in physical capacity with CR, with the functional capacity component being particularly noteworthy. In this case, the 25.4% increase in METs at the end compared to baseline clearly indicates the enhancement of physical capacity. Scientific literature also describes the interrelationship of these components, as functional capacity is associated with increased physical activity duration and muscular strength in patients with heart disease, both of which showed improvement in our results [31-33].

The metabolic aspects studied also showed improvement, although they did not reach statistical significance. Both glucose levels, glycated hemoglobin, and blood lipids displayed variations towards normal values, but these changes were of small magnitude. This could be attributed to the relatively short duration of the program, which lasted for two months with an average of 21.1 sessions per patient. This duration is considered insufficient, especially when compared to most CR programs that extend beyond 3 months and even up to twelve months, depending on service availability and patient evaluation [33-36]. This limitation is linked to the limited availability of CR services. At the time of the




Statistical significance: Wilcoxon signed-rank test; QLMI-2: Quality of Life After Myocardial Infarction, CR: cardiac rehabilitation.

**Figure 1.** Effectiveness of tertiary prevention in the dimensions of quality of life measured with QLMI 2 in patients in the Cardiac Rehabilitation Program. INCOR, 2018.

study's publication, INCOR was the only national program with all the necessary components and logistics, which restricts the coverage of tertiary prevention for IHD and cardiovascular diseases [28,37,38]. his situation is not only related to the limited availability of these services but also to inadequate perspectives and approaches among both cardiologists and non-cardiologists [39-41].

The premise and context described are of significant importance, especially when considering that varying proportions of physicians do not refer their patients to CR programs, despite the proven benefits they offer to patients with heart disease. In this scenario, raising awareness among both cardiologists and non-cardiologists about the concept of tertiary prevention as part of the natural history of IHD and the continuity of its stages, as well as its relationship with primary and secondary prevention levels, will be very useful, not only to improve referral and utilization of CR services, but also to encourage the creation and implementation of more CR services, which, as indicated, is the strategy by definition of tertiary prevention for IHD [7,11,37,42].

Among the limitations of the study, the main one is common to all secondary data source studies, which are characterized by the heterogeneity of records and the need to use complementary sources to integrate missing data. In this study, data collection could be completed due to the researchers' ease of access to supplementary program records.

In conclusion, CR is an effective central strategy for carrying out tertiary prevention in patients with IHD as it significantly improves their quality of life and coronary risk factors. The final proposal of this study, which we hope will be integrated into the training of specialists and continuous medical education programs, is that tertiary prevention is the next, mandatory, and beneficial stage for every patient who has received secondary prevention (timely diagnosis and early treatment) for IHD. This recommendation is based on the consistent results regarding the effectiveness of CR in improving the progression and prognosis of patients with IHD.

## Author contributions

RFC: conceptualization, data curation, investigation, project administration, supervision, validation, visualization, and writing - review & editing. AOI: formal analysis, methodology, resources, software, validation, visualization and writing - original draft.

## Acknowledgements

To the team of professionals: physicians, nurses, physiotherapists, nutritionists, and psychologists of the CR program at the National Cardiovascular Institute INCOR, and to the support staff of the institute, who selflessly collaborated with the research team in the preparation of this work.

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