Cardiac Rehabilitation Services in Low- and Middle-Income Countries: A Scoping Review

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Abstract

Background: Despite the decreasing rate of cardiovascular disease-related mortality in developed nations, low- and middle-income countries (LMICs) are experiencing an increase. Cardiac rehabilitation (CR) successfully addresses this burden, however the availability and nature of CR service delivery in LMICs is not well-known.

Objective: This scoping review examined: (1) presence and accessibility of CR services, (2) structure of CR services, and (3) effects of CR on patient outcomes in LMICs.

Methods: Search criteria consisted of: (1) nations considered to be low- or middle-income according to World Bank criteria, (2) CR, defined as programs including exercise and education, and (3) adults with cardiovascular diseases. Literature was identified through searching: (a) MEDLINE and EMBASE electronic databases, (b) proceedings from international cardiac conferences, (c) the grey literature, and (d) through consulting experts in the field.

Results: Thirty peer-reviewed publications were identified. Grey literature including websites for individual CR programs revealed that CR is available in 32 (22.1%) LMICs. The most comprehensive data on accessibility stems from Latin America and the Caribbean, where 56% of institutions with cardiac catheterization facilities offered CR. Literature showed that some programs offered exercise, dietary advice, education and psychological support, to assist patients to resume work and other activities of daily living. Fifteen peer-reviewed studies reported on CR outcomes; most of which were positive.

Conclusion: Although patients similarly benefit from CR, few programs are available in LMICs. Policies need to be implemented to increase provision of tailored CR models at the global and national level, with evaluation.

Abstract Word Count: 247

Keywords: Cardiac rehabilitation, low- and middle-income countries

Introduction

Cardiovascular Disease (CVD) is the leading cause of mortality worldwide.[1] The total number of global deaths due to CVD reaches 17.1 million per year.[1-4] In particular, CVD-related mortality rates are on the rise in low and middle-income countries (LMICs).[1] Accordingly, the 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Non-communicable Diseases underscores the urgent need "to promote the effectiveness of secondary and tertiary prevention, including rehabilitation and long-term care, and to ensure that health care systems are responsive to chronic non-communicable diseases and that their management is based on cost-effective health care interventions and equitable access."[5]

Cardiac rehabilitation (CR) is defined by World Health Organization (WHO) as the "sum of activities required to influence favourably the underlying cause of the disease, as well as to provide the best possible physical, mental and social conditions, so that the patients may, by their own efforts, preserve or resume when lost as normal a place as possible in the community".[6] Research shows that CR reduces both morbidity and mortality, positively affects the pathophysiology of CVD, and improves disability and quality of life.[7] While a fully comprehensive CR service model may not be feasible in some middle- and many low-income countries due to shortages of healthcare professionals and other resource constraints, alternative service delivery models are also shown to be effective.[8-10]

To date, no peer-reviewed literature has reviewed CR in LMICs to our knowledge. The objective of this scoping review was to summarize the peer-reviewed and grey literature on CR in LMICs, with regard to (1) availability and accessibility, (2) nature of services, and (3) effects on patient outcomes.

Method

There are several types of literature reviews, from narrative to systematic reviews with meta-analysis. A scoping review is used to assess the extent of a body of literature on a particular topic, document what is already known, and then to develop research questions, concepts and theories to point the way forward.[11] They aim "to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available, and can be undertaken as stand-alone projects in their own right, especially where an area is complex or has not been reviewed comprehensively before."[12] This type of review was undertaken herein.

Scoping Review Eligibility Criteria

Types of studies: Studies of any methodological design were considered for inclusion from the peer- and non-peer-reviewed (i.e., grey) literature. We excluded studies published in a language that was not English. No year of publication restriction was imposed. No quality criteria were applied.

Types of participants: Studies that included adults with coronary heart disease from LMICs eligible for CR were considered. This included patients who had been diagnosed with acute coronary syndrome or undergone a revascularization procedure (e.g., coronary artery bypass graft surgery or percutaneous coronary intervention). Overall, cardiac indications were chosen based on evidence of benefit for CR in accordance with clinical practice guidelines.[13,14]

The World Bank Country List was used to identify LMICs.[15] There are 35 countries classified as low-income and 110 countries classified as middle-income (56 lower-middle and 54 upper-middle). At least one of these nations or their corresponding regions had to appear in the title and/or abstract of a peer-reviewed article for it to be considered for inclusion in this scoping review.

Information Sources and Search Strategy

Studies were identified by searching electronic databases. First, the Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effectiveness, MEDLINE, ISI Web of Science, Excerpta Medica Database (EMBASE), PsycINFO, and Google Scholar were searched for systematic reviews and/or meta-analyses. Next, MEDLINE (1950-Present) and EMBASE (1980-Present) electronic databases were searched systematically for peer-reviewed articles. These searches were conducted with the assistance of an information specialist at the University Health Network library. The Cochrane terms for exercise and sports were included. Authors of key articles were contacted to identify other relevant publications.

For the grey literature search, we consulted experts in the field and the World Heart Federation, searched the internet using the Google search engine to find CR websites from these countries and conference proceedings such as the World Congress on CR and Secondary Prevention and World Congress of Cardiology. One of the co-authors of this scoping review (SLG) attended the World Congress of Cardiology 2012 and asked other attendees about the availability of CR in their countries, which verified much of what was found through the search strategy described herein (i.e., personal communication; Dubai, UAE).

Data Extraction, Synthesis and Analysis

A database was used to keep a record of search strategies used, personal contacts, and rejected studies. Outcome data from included studies were extracted to a table by the first author, and verified independently by the last author.

Results

Overall, 30 peer-reviewed publications were identified. Grey literature was obtained mainly from websites and conference proceedings. Where possible, results were presented by WHO regions.

Presence and Accessibility of CR Services

Review of the peer-reviewed and grey literature revealed that CR services are available in the following regions: i) America, namely Mexico;[16] ii) Africa, specifically in Kenya,[17] and South Africa;[18] iii) Latin America including Argentina,[16,19] Brazil,[2021] Chile,[16] Colombia,[16] Costa Rica (World Congress of Cardiology Attendee, personal communication, April 21, 2012), Cuba,[22] Panama (World Congress of Cardiology Attendee, personal communication, April 21, 2012), Peru,[16] and Venezuela;[21,23,24] iv) South-East Asia Region counting Bangladesh,[25] Republic of Korea,[26] Thailand,[27] India,[28,29] and Sri Lanka;[30] v) Europe with Belarus,[31] Bosnia and Herzegovina,[32] Bulgaria,[33] Lithuania,[34] Turkey,[35] Russia,[36] Romania,[36,37] and Serbia;[36] vi) Eastern Mediterranean Region specially Afghanistan,[38] Egypt (World Congress of Cardiology Attendee, personal communication, April 21, 2012), Iran,[39-43] and Tunisia;[44,45] and finally vii) Western Pacific Region including China,[46] Malaysia,[47] and Philippines.[48] The 32 LMICs where CR is known to be available based on English peer-reviewed publications and grey literature are shown in Figure 1. This represents 22.1% (32/145) of LMICs worldwide, specifically 11.4% (4/35) low-income countries and 25.5% (28/110) middle-income countries.

The only more comprehensive data on accessibility of CR services stems from a survey conducted by Korenfeld et al. (2009)[49] These researchers administered a telephone-based survey to hospitals in Mexico, Central and South America, and the Caribbean sampled in a random and population-weighted fashion, from a list of 202 centers with cardiac catheterization facilities. Fifty-nine programs (response rate=29.2%) responded from 13 countries. Results showed that 56% of those responding offered CR programs. Avram et al. (2010) reported that of 566 coronary patients surveyed in Romania, 139 (24%) reported being referred to CR, of which 81 (14%) subsequently participated in CR.[37]

Korenfeld et al. (2009)[49] also asked respondents about the most commonly-cited perceived barriers to CR attendance. They found that the barriers among those centers with CR

programs were lack of referral, patient distance to the facility, and financial constraints. Medical institutions that did not include CR sites reported lack of trained personnel, financial constraints, absence of adequate physical space, and lack of perceived benefit or profitability as barriers to implementing a CR program. In addition, lack of insurance coverage and perception that CR is not an investment priority were reported as barriers.

A final element of accessibility and availability is the cost of CR. One study addressed issues of cost, and was undertaken in Brazil (see Table 1).[20] Rebelo et al. (2007) compared expenses, including medical visits, hospitalizations, procedures and tests, pre- and post-CR in a treatment and control group. The cost of CR was estimated at R$ 270 ($135 US as of May 8th 2013) per year. The change in costs in the CR treatment group from the pre- to post-assessment points was -546.30 (-$273.15) ±424.84 ($212.42) versus. +138.27 ($69.14) ±89.78 ($44.90) for the controls. Overall however, there were no significant differences in costs over time or by CR attendance.

Structure of CR Services in LMICs

According to the Canadian Association of Cardiac Rehabilitation Guidelines,[13] CR programs should offer core components that include appropriate medical assessment, a multidisciplinary team of health care professionals (including a physician), exercise prescription, the ability to provide exercise testing procedures, client and family education, and structured risk factor identification and behaviour modification.

Guzman et al. (1986) administered a survey to CR centers in 33 countries that examined the organization of CR, program components, funding, cardiovascular indications treated, and attitudes toward CR.[24] While non-representative and outdated, replies were obtained from 50 CR centres, which makes this the most geographically-broad study to our knowledge. The results were not interpreted quantitatively, but the qualitative description suggested that CR was

oriented predominantly towards physical training but did often, even 25 years ago, offer comprehensive program components. Services were predominantly institution-based (either as in- or outpatient treatment), but some home-based programs were offered.

Korenfeld et al. (2009)[49] reported that 79% of Latin American programs offered multi-disciplinary services, with 100% of them having a physician on staff. Other literature from LMICs showed that some programs offered exercise, dietary advice, education and psychological support to assist patients to resume work and other activities of daily living.[36] However, it could not be ascertained the degree to which exercise testing was offered.

The services were offered to patients diagnosed with myocardial infarction, and following percutaneous coronary intervention, coronary artery bypass surgery, and valve surgery (see Table 1). Some programs also included heart failure, peripheral artery disease,[16] and heart transplant patients.[21] They also reported that availability of CR phases and characteristics of the programs were similar in public- and privately-funded programs.[49] Some studies reported provision of a home-based CR model. In addition, results from a survey conducted in Europe found that phases I-III CR programs are also offered in some countries.[36]

Effects of CR on Patient Outcomes

Twenty-three peer-reviewed studies examined patient outcomes following CR participation in LMICs, of which nine were abstracts. A summary of the studies with full-text articles available is shown in Table 1. All WHO Regions were represented by at least one study. As shown, three studies applied randomized designs. Benefits were tested with regard to risk factors, anthropometrics, health behaviours, functional capacity, and quality of life.

Discussion

This scoping review summarized the peer-reviewed and grey literature on CR in LMICs. Although there is a limited amount of published research, the existing data suggest that CR

programs have successfully been implemented in several LMICs, and patients benefit from participation in CR programs in these contexts. It was somewhat difficult to discern the structure and organization of CR program offerings where available, as descriptions were not framed within a commonly-accepted framework (e.g., guidelines) nor were they comprehensive descriptions. The cardiac indications for CR were generally consistent with those of national guidelines (e.g.,[13]). Overall, the need to conduct and disseminate more research on CR services in LMICs is clear.

Although reports suggest the existence of CR programs in LMICs, findings of this scoping review should form the basis for primary research to formally assess the presence and nature of CR services in these, and other, LMICs. Moreover, it is important to determine at a population level, the number of patients who are eligible for CR as per common indications across national guidelines,[13,14] and of those, how many actually are accessing CR. Moreover, research should investigate the effectiveness of existing CR programs in LMICs, particularly with regard to the major outcomes of morbidity and mortality. Overall, more research on the patient and health system costs of CR in LMICs is needed.

Clinical and Policy Implications

Many LMICs are now offering expensive acute interventions (as evidenced also by the participant samples in the studies identified herein), but still not referring their patients to inexpensive and effective CR services.[49] It was surprising that only 56% of Latin American countries with these acute therapies had CR programs, but that some LICs such as … did. Thus, it is necessary that CR is included as one of the priorities on the national health care agenda in LMICs. Given the many benefits of CR and the increasing CVD-related deaths in LMICs, it is necessary to increase access to these services and improve the capacity of these programs to serve eligible patients.

The specialized multidisciplinary approach to CR is most likely not feasible in many LMICs due to shortage of health care workers and other resources. Thus, literature suggests community-based rehabilitation as an alternative approach. It builds on the community's resources as well as those offered at district, provincial, and central levels. This approach is being provided in more than 90 countries that are mostly low- and middle-income.[29] Indeed, a 1993 report by WHO outlines nicely how CR can be designed and implemented in developing nations, and provides some hands-on exercise tools for programs.[6] With evidence-based updates to the clinical recommendations therein, this could serve as replicable community-based model for standardized and rigorous testing.

In LMICs with large rural areas, it is unreasonable to require patients to travel long distances to participate in CR programs. Guzman et al. reported that home-based CR is commonly-offered in the Asian area, and was feasible and safe.[24] Telemedicine approaches are effective in reaching patients who cannot otherwise attend CR sessions in-person due to distance and transportation issues.[50] While the feasibility of implementing telemedicine rehabilitation in many LMICs needs to be further examined, perhaps this delivery modality could be implemented in areas where the internet is available to improve access to rehabilitation. An assessment of the availability of different technologies should be undertaken in under-served regions, in order to develop CR materials in the most cost-effective format which is accessible to patients.

CR programs can be offered without the need for expensive equipment. Research suggests that non-equipment-based programs using tai chi for instance offer alternative strategies for promoting cardiovascular fitness, and reduction in cardiac risk factors.[51] Exercise testing can be undertaken using a two-step test and intermittently measuring blood pressure, where a treadmill or bicycle ergometer is not available.[24] Exercise options such as walking tailored to the regions' climate could be incorporated into the rehabilitation regime to minimize costs.

Given the critical shortages of human and financial resources in LMICs, national policies that address common risk factors (i.e., physical inactivity, unhealthy diet, tobacco use, and abuse of alcohol) and determinants that are shared across major non-communicable diseases should be implemented, to address this major burden of CVD. In addition, these policies should be consistent and coherent with other health and social policies, as the responsibility to combat this burden is in the hands of multiple sectors of a national government (i.e., health in all policies). Given that CR is evidence-based and cost-effective, national non-communicable diseases policy development can provide a basis for legislation and regulation in relation to activities such as promotion of a healthy diet.[52]

CR organizations and associations in developing countries may consider partnering and collaborating with those in the 70 high-income countries to support capacity-building and provide tangible toolkits for CR program development, initiation and maintenance, and the developed world could share resources online for health care training and for patient education materials with the LMICs. Clearly more work needs to be done to better understand availability of CR services globally, so we can meet the rising burden of non-communicable disease.

Limitations

This scoping review has several limitations which warrant caution when interpreting the conclusions drawn. First, it is likely that CR is present in more countries than identified herein for two reasons: (1) Although English may not be the primary language in many of these countries, this review excluded non-English peer-reviewed publications and grey literature, and (2) many low-income countries would not have the capacity to evaluate their services and publish, or to develop program websites for marketing purposes. Second, extrapolating from publications reporting on single programs to the state of CR in the entire country is problematic. Third, given that some of the publications included in the review were outdated, they may not

accurately represent the current state of CR in these countries. Finally, due to the limited availability of peer-reviewed literature, article quality was not considered. Most of the studies identified did not apply randomization, and therefore threats to validity of the results should not be overlooked.

In conclusion, this scoping review of the peer-reviewed and grey literature suggests that CR services are available in few LMICs. The limited research on CR outcomes demonstrates benefits of participation in CR similar to those shown in developed countries. The structure and organization of available programs is not well-known. It is crucial that we address the need for context-appropriate and evidence-based CR delivery models in LMICs.

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- CR is available in at least 22.1% of low- and middle-income countries worldwide: 11.4% of low-income countries and 25.5% middle-income countries
- Similar to high-income countries, participation in CR resulted in improved risk factors, anthropometrics, health behaviours, functional capacity, and quality of life

Figure 1. World Map Denoting Low and Middle-Income Countries Where CR Is Known to Be Offered Based on English Peer-reviewed Publications and Grey Literature

Figure 1. World Map Denoting Low and Middle-Income Countries Where CR Is Known to Be Offered

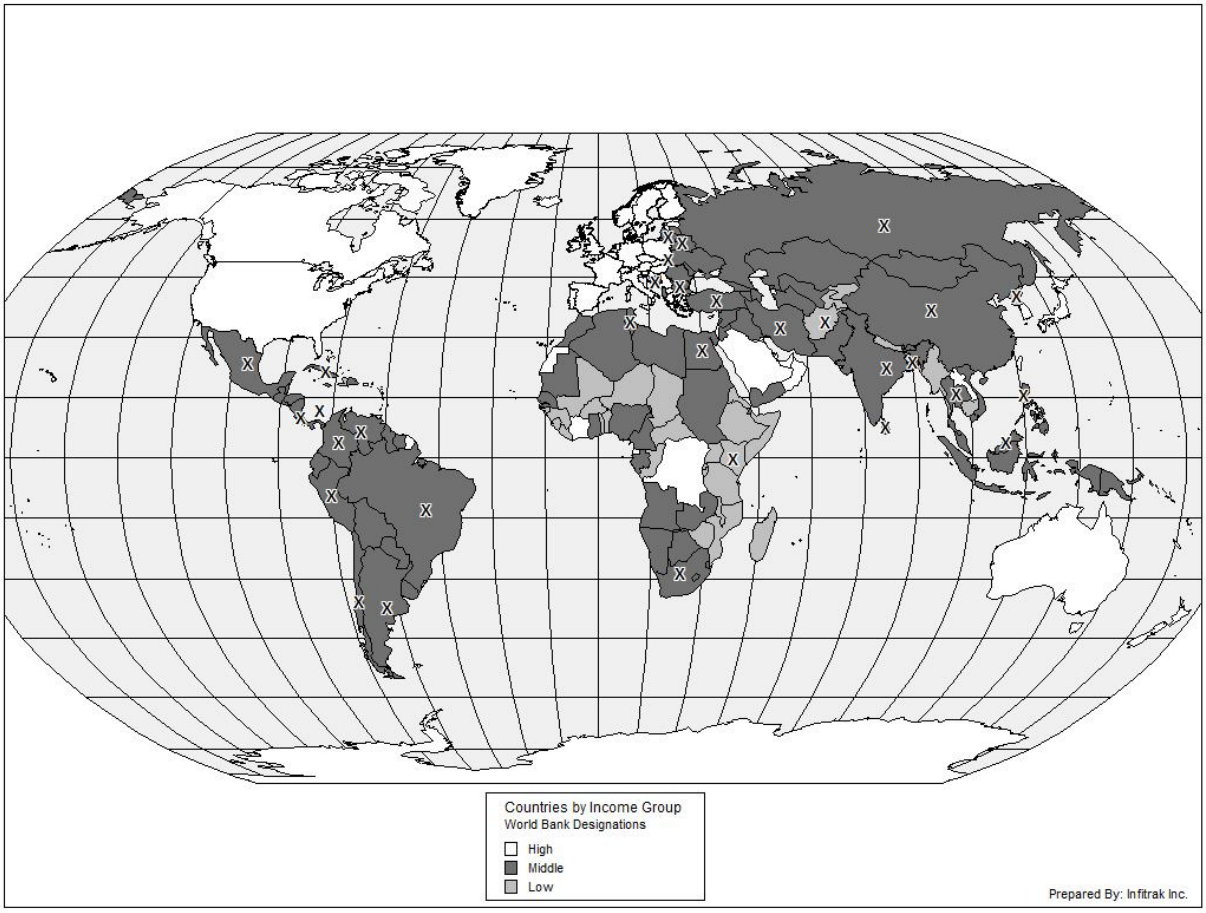

Table 1. Summary of peer-reviewed publications in relation to CR Outcomes, in alphabetic order of country

Author, year, country	Nature of cardiac condition, sample size	Design	Results
Rebelo et al.,[19] 2007, Brazil	48 CR participants (treatment group) and 48 CR non-participants (control group) matched for age, gender, profession and diagnosis	Case-series for outcomes	Treatment group means pre and post CR, respectively: TC (mg/dL) 242.5±48.32 and 189.47±39.83 ($p<0.001$); LDL (mg/dL) 162.0±37.72 and 116.3±33.28 ($p<0.001$); HDL (mg/dL) 46.5±8.59 and 57.8±10.36 ($p<0.001$); TG (mg/dL) 165.15±90.24 and 113.29±54.92 ($p<0.001$); TC/HDL 5.42 ±1.10 and 3.35±0.81 ($p<0.001$); $VO_{2\ peak}$ (mL/Kg/min) 26.92±7.0 and 32.64± .92 ($p<0.001$); BMI 29.35±3.93 and 28.12±3.55 for women ($p<0.001$) and 29.17 ±5.14 and 27.88±4.83 for men ($p<0.001$); W/H 0.93±0.05 and 0.94±0.04 for women ($p=0.4$) and 0.93±0.07 and 0.92±0.06 for men ($p=0.03$); SBP (mmHg) 151±13.89 and 132±9.56 ($p<0.001$); DBP (mmHg) 83±8.07 and 77±5.92 ($p<0.001$).
Jiang et al.,[44] 2007, China	167 coronary heart disease patients	Randomized controlled trial; 6 months; nurse-led CR vs. usual care	Walking performance for baseline vs 6 months=Intervention: 2.78±1.61 vs 10.63±2.13; Control: 2.68±1.50 vs 8.62±2.98 ($p=0.002$) Step II diet adherence for baseline vs 6 months=Intervention: 81.12±30.88 vs 83.53±23.02; Control: 84.52±25.05 vs 71.83±28.79 ($p=0.002$) Medication adherence for baseline vs 6 months=Intervention: 4.85±0.35 vs 4.47±0.62; Control 4.86±0.35 vs 4.27±0.78 ($p=0.143$) TG (mmol/l) for baseline vs 6 months=Intervention 2.13±0.73 vs 1.90±0.56; Control 2.02±0.64 vs 1.89±0.52 ($p=0.011$) TC (mmol/l) for baseline vs 6 months=Intervention 5.26±0.81 vs 4.76±0.61; Control 5.09±0.76 vs 4.92±0.67 ($p=0.001$) HDL (mmol/l) for baseline vs 6 months=Intervention 1.06±0.14 vs 1.08±0.12; Control 1.02±0.16 vs 1.03±0.13 ($p=0.293$) LDL (mmol/l) for baseline vs 6 months=Intervention 3.29±0.70 vs 2.84±0.58; Control 3.15±0.71 vs 3.00±0.58 ($p=0.001$) Weight (kg) for baseline vs 6 months=Intervention 65.26±10.45 vs

			65.10±10.03; Control 66.22±7.96 vs 66.61±7.17 (p=0.099) SBP (mmHg) for baseline vs 6 months=Intervention 128.62±14.18 vs 129.80±12.12; Control 128.06±13.58 vs 130.73±15.01 (p=0.216) DBP (mmHg) for baseline vs 6 months=Intervention 77.26±10.29 vs 78.30±8.56; Control 77.10±9.84 vs 79.36±9.89 (p=0.148) Smoking cessation – quitters 17% intervention vs 15% controls (p=0.346)
Rivas Estany et al.,[21] 1988, Cuba	25 myocardial infarction patients	Prospective, no control; pre and post 3 month program	exercise test using cycle ergometry mean HR at submaximal load pre=143±15.6 beats/min post=124±18.5 (p<0.001). mean physical work capacity pre=95.6±21 post=126±24 (p<0.001). Resting HR p=n.s.
Rajendran et al.,[27] 2004, India	74 in-hospital patients who underwent coronary artery bypass graft surgery	Prospective – pre-surgery and 3 month follow-up (no control)	FBS (mg/dL)=109.73±40.72 and 97.55±19.7 (p=0.002); TC=173.03±41.14 and 159.49±41.61 (p=0.037); LDL=99.54±34.23 and 92.07±30.65 (p=0.148); HDL=43.65±7.02 and 42.80±8 (p=0.457); TG=164.96±84.93 and 134.6±57.62 (p=0.003); LDL/HDL=2.26±0.61 and 2.11±0.47 (p=0.117); TC/HDL=3.94±0.54 and 3.7±0.55 (p=0.007); W/H=0.96±0.046 and 0.92±0.054 (p<0.001); BMI=24.66±2.90 and 23.73±2.39 (p<0.001); RPP=9615.94±1409.92 and 8840.56±1370.07 (p<0.001).
Kabir et al., 2012, Iran[39]	547 coronary heart disease patients	Retrospective cross-sectional study; pre- and post- 24-session CR	Cases with metabolic syndrome decreased from 42.8% to 33.3% after CR program (p<0.001). Pre- vs post-CR results: Decrease in high fasting plasma glucose (117.4±4.5 vs 109.1±3.9, p=0.015), triglyceridemia (247±15.5 vs 198.8±12.8, p=0.002), SBP (137.7±2.8 vs 127.4±2.9, p<0.001), and DBP (81.5±1.7 vs 75.1±1.7, p=0.002), and increase in HDL (34±.9 vs 38.1±1.3, p=0.002), functional capacity (9.4±.3 vs 12.2±.4, p=0.001), and LVEF (48.2±1.8 vs 52.6±1.6, p=0.026) was more prominent in the Metabolic syndrome without obese group. However, TC (244.2±3.9 vs 220.2±3.5, p<0.001), LDL (155.3±3.5 vs 134.8±3.1, p<0.001), weight (75.5±.9 vs 73.6±.9, p<0.001), BMI (30.5±.4 vs 29.7±.4, p<0.001), and WC (107.4±.6 vs 103.9±.6, p<0.001) showed a greater decrease in groups with obesity.
Sarrafzadegan et al.,[40] 2008,	547 coronary heart disease	Retrospective self-controlled	Pre- vs post-CR results: Weight (kg) 73.1±0.47 vs 71.5±0.46, p<0.001; BMI (kg/m2) 27.2±0.16 vs 26.6±0.16; p<0.001; WC (cm) 99.3±0.44 vs

Iran	patients	observational study; pre- and post- 24-session CR, some of the patients received antilipid drugs	96.3±0.44, p<0.001; Hip circumference (cm) 104.2±0.32 vs 101.4±0.31, p<0.001; W/H 0.95±0.003 vs 0.95±0.003, p=0.006; TC 225.2±2.1 vs 206.7±1.9, p<0.001; LDL 144.2±1.8 vs 127.5±1.6, p<0.001; HDL 39.8±0.38 vs 40.8±0.37, p=0.014; TG 218±5.4 vs 192.5±3.98, p<0.001; FBS (mg/dl) 107.7±1.68 vs 104.2±1.29, p=0.005; Functional capacity (Mets) 9±0.12 vs 11.2±0.13, p<0.001; LVEF (%) 50.3±0.51 vs 54.1±0.46, p<0.001; SBP (mmHg) 124.8±0.96 vs 121.9±0.83, p=0.003; DBP (mmHg) 75.9±0.53 vs 75±0.48, p=0.1; HR (per min) 83±0.78 vs 79.9±0.74, p<0.001; Depression score 4.3±0.19 vs 2.87±0.12, p<0.001; Anxiety score 17.1±0.59 vs 15.5±0.53, p<0.001
Toufan et al.,[38] 2009, Iran	65 patients with coronary artery disease; 92% had revascularization intervention	Prospective, assessment pre and post 8-12 week CR program	Total METs increased from 8.7 to 10.8 post-CR (p<0.001). Significant improvement in lipid profile also reported (no mean or p-values provided); Also reported significant improvement in general well-being (p<0.001) but assessment tool not stated.
Kim et al.,[25] 2011, Korea	91 percutaneous coronary intervention or coronary artery bypass graft surgery patients	Prospective; -45 supervised CR participants and 46 community / self CR participants (low risk), pre and 6 months post-CR	HRmax (beats/min) supervised=138.5 and 147.4 (p<0.05) community=139.2 and 140.5 (p=n.s.) HRrest (beats/min) supervised 78.8 and 71.6 (p<0.05) community=73.8 and 71.2 (p=n.s.) RPPmax (mmHg×bpm) supervised=27,420 to 26,905 (p=n.s.), and community=24,633 to 24,685 (p=n.s.); RPPsubmax (mmHg×bpm) supervised=17,144 vs 14,609 (p<0.05) and community=15,373 vs 13,745 (p<0.05) VO_{2max} (ml/kg/min) supervised=26.2 30.7 (p<0.05) and community= 28.6 30.7(p<0.05). With regard to change scores, supervised had significantly greater increase in VO_{2max} (21.1) vs community (8.6, p<0.05). All other change differences p=n.s.
Avram et al.,[36] 2010, Romania	81 coronary patients who attended CR,	Prospective– 16 months	SBP (mmHg) Baseline=137.16 ± 22.07, 16 months=140.22±18.91, p=0.34; DBP (mmHg) Baseline=82.16±12.25, 16 months=80.55 ± 12.91, p=0.41); TC (mg/dl) Baseline=195.67±51.09, 16

	population based sample from single EuroAspire III centre ascertained retrospectively from diagnostic records of discharge lists		months=174.8±49.25, p=0.01; LDL (mg/dl)Baseline= =109.2±14.43, 16 months=103.8±42.79, p=0.10; HDL (mg/dl) Baseline= 41.83±7.33, 16 months= 40.56±9.72, p=0.23; TG (mg/dl) Baseline=211.2±67.98, 16 months=151.8±92.06, p<0.01; BMI (kg/m^2) Baseline=32.70±27.52, 16 months= 28.86±14.71, p=0.21; FBS (mg/dl) Baseline=134.18±39.51, 16 months=131.92±45.9, p=0.35
Digenio et al.,[17] 1991, South Africa	All 387 coronary heart disease patients referred to a single CR centre over a 2 year period; 289 (75.1%) of participants who attended more than 40% of sessions in first 6 months of 18 month program were assessed	Prospective, assessed pre-program and at 6 months	50% dropout at 12 months. VO_2 (ml/kg/min) p<0.01, weight (kg) p<0.05 only for those participating in greater than 60% of sessions, and skinfold p<0.01 only for those participating in greater than 60% of sessions; TC=n.s.; TG p<0.01 only for those participating in greater than 80% of sessions; HDL=n.s.; LDL=n.s.; TC/HDL p<0.05 only for those participating in greater than 80% of sessions.
Charoenkul et al.,[26] 2007, Thailand	34 coronary heart disease patients, 6 week home-	Randomized controlled trial, patients matched on age and sex	Thai SF-36 quality of life - Intervention group had significantly greater change in physical performance (3.24 ± 18.70 vs 15.00 ± 18.54, p=0.038), physical role limitation (-1.47 ± 46.33 vs 41.18 ± 37.44, p=0.003), general health (3.82 ± 10.61 vs 23.65 ± 26.61, p=0.005),

	based CR program	2 parallel arms: home-based CR vs usual care Assessed pre-discharge and 6 weeks post-CABG	vitality (10.59 ± 24.42 vs 29.12 ± 17.87, p=0.009), social functioning (7.35 ± 27.97 vs 22.06 ± 17.98, p=0.039), and reported health transition (0.18 ± 1.01 vs -0.94 ± 0.97, p=0.007) compared to the control group. There were no significant differences between control and interventions groups in bodily pain (-3.00 ± 30.50 vs 14.94 ± 36.95, p=0.066), emotional role-limitation (3.92 ± 56.37 vs 21.57 ± 35.24, p=0.141), and mental health (12.94 ± 24.02 vs 22.82 ± 16.05, p=0.084)
Karapolat et al.,[34] 2008, Turkey	40 heart transplant patients	Randomized controlled trial, pre- and post- 8 wk CR comparison; randomized to hospital or home-based program	Hospital-based VO_{2peak} (ml/kg/min) pre- 16.73±3.9, post- 19.53 ± 3.89, (p = 0.002); Duke Treadmill Score pre- 4.74±1.17, post- 5.61 ± 1.11, (p=0.002); HR reserve pre- 26.9 ± 14.6, post 34.6 ± 14.6 (p=0.01).HR recovery p=n.s.; chronotropic response index p=n.s. Home-based all ps=n.s. Hospital vs home VO_{2peak} p=0.01, Duke Treadmill Score p=0.04. all other indicators p=n.s.

CR, Cardiac Rehabilitation; TC, Total Cholesterol; LDL, Low-Density Lipoprotein; HDL, High-Density Lipoprotein; TG, Triglycerides; TC/HDL, Total Cholesterol to High-Density Lipoprotein ratio; Kg, Kilogram; BMI, Body Mass Index, W/H, Waist-to-Hip ratio; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; LDL/HDL, Low-Density Lipoprotein to High-Density Lipoprotein ratio; FBS, Fasting Blood Sugar; HR, Heart Rate; RPP, Rate Pressure Product; VO_2, Oxygen uptake; MET, Metabolic Equivalent of Task; SF-36, Short Form-36; LVEF, Left Ventricular Ejection Fraction