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CARDIOVASCULAR REHABILITATION WITH AN EMPHASIS ON PHYSICAL EXERCISE FOR PATIENTS WITH CORONARY ARTERY DISEASE: A CRITICAL REVIEW OF THE CURRENT SCENARIO

REABILITAÇÃO CARDIOVASCULAR COM ÊNFASE NO EXERCÍCIO FÍSICO PARA PACIENTES COM DOENÇA ARTERIAL CORONARIANA: VISÃO CRÍTICA DO CENÁRIO ATUAL

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ABSTRACT

Coronary artery disease (CAD) is one of the most lethal cardiovascular diseases both in Brazil and worldwide. It is a multifactorial disease associated with modifiable risk factors. In addition to conventional treatments, it is recommended that patients with CAD also include lifestyle changes and exercise-based cardiovascular rehabilitation (EBCR) programs in their treatment. It is well known that regular physical exercise combined with lifestyle changes contributes to a reduction in the progression of atherosclerosis and in mortality in patients with CAD. Moreover, physical exercise has a beneficial impact on functional capacity and quality of life. A EBCR program is an effective, safe strategy for the treatment of CAD with an excellent cost-benefit ratio. However, even though it is a therapy recommended by the main health agencies, public health policies in Brazil are extremely scarce and the number of specialized centers that offer EBCR is low. Problems of adherence, participation, and motivation are evident when these programs are evaluated. This review looks at the main studies that have been the basis for the recommendations of EBCR over last decades and critically analyzes the current scenario, making it clear that new strategies for action and monitoring should be explored and encouraged such that EBCR programs will be included effectively in the treatment of patients with CAD.

Keywords: Coronary Artery Disease; Cardiac Rehabilitation; Physical Exercise.

RESUMO

A doença arterial coronariana (DAC) é umas das doenças cardiovasculares que mais mata no Brasil e no mundo. É uma doença multifatorial, associada a fatores de risco modificáveis. Além dos tratamentos convencionais, é recomendado que pacientes com DAC também incluam modificações no estilo de vida e programas de reabilitação cardiovascular com ênfase no exercício físico (RCEE) em seu tratamento. Sabidamente, o exercício físico regular somado às mudanças no estilo de vida contribui para a diminuição do avanço da doença aterosclerótica e da mortalidade dos pacientes com DAC. Além disso, o exercício físico tem impacto benéfico na capacidade funcional e qualidade de vida. Um programa de RCEE é uma estratégia eficaz, segura e com excelente razão de custo-benefício para o tratamento da DAC. Contudo, mesmo sendo uma terapia recomendada pelos principais órgãos de saúde, no Brasil as políticas públicas de saúde são extremamente escassas e a quantidade de centros especializados que oferecem a RCEE também é baixa. Problemas de adesão, participação e motivação são evidentes quando os programas são avaliados. Esta revisão mostra os principais estudos que, ao longo das últimas décadas, deram base para as recomendações da RCEE e faz uma análise crítica do cenário atual, deixando claro que novas estratégias de atuação e monitoramento devem ser exploradas e incentivadas para que os programas de RCEE sejam incluídos efetivamente no tratamento dos pacientes com DAC.

Descritores: *Doença da Artéria Coronariana; Reabilitação Cardíaca; Exercício Físico.*

INTRODUCTION

Cardiovascular diseases (CVD) are among the main chronic noncommunicable diseases and are the leading cause of mortality worldwide.[1,2] In most cases CVD is multifactorial and is associated with other comorbidities and health problems, which further aggravate the patient's condition. Despite advances in drug and surgical treatment, other strategies have been considered important for the successful treatment of CVD. In addition, health promotion strategies that encourage multidisciplinary treatment and ensure the overall well-being of these patients are of utmost importance.

Coronary artery disease (CAD) is a major CVD. It is known that most CAD-associated morbidities are caused by modifiable behaviors such as physical inactivity, inadequate diet, smoking and alcohol abuse.[1] Therefore, the incidence of CAD could be significantly reduced through interventions focused on changing style of patients' lives. Myers et al.[3] have shown that reduced physical capacity is a powerful predictor of mortality in CVD patients. On the other hand, consistent evidence from the literature has shown beneficial effects of regular exercise for patients with CAD. Physical exercise improves the pathophysiology of the disease, functional capacity, quality of life and associated risk factors, as well as total and cardiovascular mortality.[4-10] According to the Cardiac Rehabilitation Guideline of the Brazilian Society of Cardiology, the recommended treatment for CAD, as with other CVDs, should be multifactorial and characterized by behavioral change.[4] In this context, exercise-based cardiovascular rehabilitation (EBCR) appears as an effective, safe, cost-effective therapy, Class I recommendation and Level A of evidence.[4,5,11-14]

Despite the proven benefits of regular exercise, has this therapy been effectively inserted into cardiovascular rehabilitation programs for the treatment of CAD? Are there EBCR programs available for these patients? Also, are patients with CAD referred for EBCR programs? In this sense, the objective of this review is, first, to show the main studies that over the last decades have been based on the recommendations of the EBCR for patients with CAD. And second, to make a critical analysis of the current scenario of the EBCR.

CAD EPIDEMIOLOGY AND PHYSIOPATHOLOGY

According to data published by the World Health Organization, in 2016 chronic noncommunicable diseases led to 40.5 million people worldwide, with CVD accounting for 44% of these deaths.[1] Recent data from the American Heart Association showed that the main cause The cause of cardiovascular mortality in the United States is CAD, which represents 43.8% of all deaths from CVD.[15] In Brazil, CVD also has high mortality rates. Data from the Health Surveillance Secretariat of the Ministry of Health showed that CVD are among the top five causes of death in Brazil.[16] More recently, the Health Surveillance Secretariat has shown that ischemic heart disease, regardless of gender, is the first cause of death in Brazil, for adults between 30 and 69 years old, as well as for the older population, over 70 years old.[17]

CAD can be characterized by partial or complete impairment of coronary artery blood flow, which impairs oxygen transport to the myocardium, causes ischemia and increases the risk of acute myocardial infarction. The main cause of decreased oxygen supply is the formation of atherosclerotic plaques (atherosclerosis),[18] which is the result of a complex, progressive inflammatory process characterized by lipid accumulation, activation of inflammatory response, and migration of smooth muscle cells. contribute to the formation of atheromatous plaque and reduced coronary lumen.[19,20] It begins in childhood/adolescence, progresses throughout life and is aggravated by risk factors for CVD such as hypertension, diabetes mellitus and dyslipidemia. The manifest clinical manifestation in CAD includes angina and/or acute myocardial infarction.[21]

PHYSICAL EXERCISE, MORBIMORTALITY, FUNCTIONAL CAPACITY AND QUALITY OF LIFE

Over the years, several studies have shown that decreases in high lipoprotein levels may slow the progression of coronary atherosclerotic injury.[22-24] Reduction in body weight, intake of foods high in saturated fat and cholesterol, associated with exercise are associated with decreased lipid levels, reduced atherosclerotic plaques and, consequently, decreased disease progression and CAD mortality.[24-26] In fact, some randomized controlled trials have shown that regular aerobic exercise practice Moderate intensity plus lifestyle changes effectively contribute to the regression of coronary atherosclerosis, improving the prognosis of CAD.[25-31] In the 1990s, Haskell et al.[26] evaluated, in a prospective study, the effect of exercise unsupervised aerobic exercise associated with low-fat diet and cholesterol in patients with CAD. After four years of follow-up, the authors observed a decrease in the rate of progression of atherosclerosis in the group that adhered to lifestyle changes when compared to the group that received the usual clinical treatment.[26] Another prospective study by Niebauer et al.[27] it also showed beneficial effects when patients with CAD adopted lifestyle changes, including supervised aerobic exercise. After six years of follow-up, approximately 80% of the patients who started, completed the protocol and were reevaluated. The authors show that patients who adopted the new lifestyle had a significant decrease in disease progression, persistent improvement in lipoprotein levels and physical capacity compared with the usual care group.[27] In this study, the authors also demonstrated that increased physical capacity is an independent predictor of angiographic changes, and that those who practiced an average of four hours per week of moderate aerobic exercise had the greatest regression of coronary stenosis.[27] At the same time, Hambrecht et al.[29] followed patients with CAD for 12 months and showed that regular aerobic exercise, accompanied by diet, has significant effects on CAD. The authors observed that patients with an average caloric expenditure of 1,400kcal per week improved physical capacity, and patients with an average caloric expenditure of 2,200kcal per week (approximately five to six hours of regular physical exercise per week) presented, besides an improvement in functional capacity, regression of atherosclerotic plaque, showing that higher levels of physical activity effectively contribute to reduce disease progression. A few years later (2004),[6] a meta-analysis that included 48 randomized controlled trials with 8940 patients

compared the effect of EBCR programs, including aerobic and resistance exercise, with the usual clinical treatment. Taylor et al.[6] demonstrated a 20% reduction in total mortality and 26% in cardiac mortality in patients with CAD who participated in the EBCR program. Furthermore, the authors showed that the mechanisms that influenced the improvement in survival were: improved myocardial oxygen supply, endothelial function and autonomic tone, as well as decreased inflammatory markers and collateral vessel development. More recently (2011),[8] another meta-analysis reaffirmed these findings, showing a reduction in the mortality rate (28%) and hospital readmission (31%) in patients with CAD who underwent EBCR, including aerobic and resistance exercises, for a period of 12 months. months or more. In summary, this body of evidence shows the clinical impact and importance of recommending EBCR programs for patients with CAD.

It is noteworthy that the impact of EBCR programs is not limited to changes in the pathophysiology and progression of CAD. The objective of the EBCR is the satisfactory restoration of the individual's clinical, physical, psychological and labor conditions.[32] In patients with CAD, as in other CVDs, regular exercise increases functional capacity, muscle strength, performance in daily tasks, decreases depression and anxiety, improves stress control, and ultimately improves the quality of life of these patients.[7,9,10,25,26,29,33-47] According to Bruning et al.,[13] hardly any pharmacological interventions could provide as many benefits as regular exercise. In fact, Toobert et al.[39] conducted a randomized clinical trial evaluating postmenopausal women with CAD. They noted that an EBCR program that included stress management, a low-fat diet, and regular exercise reduced risk factors, increased muscle mass, and improved quality of life over a two-year follow-up. Some authors have also shown that EBCR significantly improves overall health status, body pain score, vitality, mental health, flexibility and muscle function, thus improving the functional capacity and quality of life of elderly with CAD.[41,42,44] Table 1 shows the studies published over the last decades that have evaluated lifestyle changes and EBCR programs for patients with CAD. The beneficial effect of interventions on both pathophysiology, morbidity and mortality, functional capacity and quality of life is evident.

RECOMMENDATIONS, PARTICIPATION AND ADHESION TO EBCR PROGRAMS

The world's leading health institutions, such as the World Health Organization, the American Heart Association, the American College of Sports Medicine (ACSM), the European Society of Cardiology, and the Brazilian Society of Cardiology recommend an EBCR program that includes aerobic, localized muscle strength and flexibility as part of the treatment of patients with CAD.[1,4,15,48,49] The first studies relating physical activity and cardiovascular diseases appeared in the 1930's, but only around the 1950's did some authors begin to early advocate early mobilization as part of treatment. However, it was from the 1960s to 1970s that regular exercise prescribing methods for CVD patients appeared and supervised program centers began to emerge.[32] In 1975, ACSM published its first guidelines on exercise prescribing for CVD patients. Since then, until the present day (latest version published in 2018) the guidelines published by the ACSM are the most widespread among professionals working in cardiovascular rehabilitation.[48]

In the United States, health plans offer EBCR in their insurance package for heart disease patients, including those with CAD. Patients who have suffered acute myocardial infarction or have been rehospitalized for any worsening of CAD participate in a program that includes assessment, early mobilization, identification and education on risk factors, and assessment of readiness for physical activity. Data from the European Cardiac Rehabilitation Inventory Survey show that in Europe at least 64% of countries have EBCR programs.[50]

In Brazil, despite consistent recommendations on EBCR programs for the treatment of CVD patients, centers providing these programs are scarce. In São Paulo, in the 1970s, the cardiovascular rehabilitation section was inaugurated at Dante Pazzanese Institute of Cardiology and the cardiovascular rehabilitation program at Hospital das Clínicas/FMUSP in association with the School of Physical Education/USP.[32] Some particular services such as Procordis and Fitcor.[32] also arose. Currently, in the city of São Paulo, other private services are found in large hospitals such as Hospital Sírio Libanês, Hospital Israelita Albert Einstein, among others. However, the number of programs offered falls short of the demand of CVD patients, especially those aimed at the neediest populations. Public EBCR programs that encourage and/or allow regular exercise, even if not supervised, could have a major impact on public health in the country, contributing to reduced spending on drug treatment, disease prevention and health promotion. Another important point is the lack of dissemination and knowledge of existing EBCR programs. Private programs have their own dissemination system, but public programs, when they exist, do not appear to be well publicized or easily accessible to the population. In addition, published data on the effectiveness, adherence and accessibility of available programs are very rare in Brazil. Few public or private EBCR programs publish their findings and experiences. Finally, referral and enrollment of CVD patients in EBCR programs still appears to be low, according to a national study.[51] In fact, Ruano-Ravina et al.[52] published in 2016 a systematic review gathering data on participation and EBCR programs. We included 29 prospective/retrospective cohort studies and cross-sectional studies with an N greater than 350,000 patients, including studies conducted in the US, UK, Canada, Belgium, Denmark, Germany and Australia. Women, unemployed, elderly and poorly educated patients with lower family income had the lowest adherence and participation in the EBCR programs. In addition, participants who lived farther away from the EBCR program facilities or had difficulty reaching the venue, ended up attending less of the programs. According to Bruning et al.[13], the main barrier for implementing lifestyle changes in patients with CAD is adherence and access to necessary resources. However, lifestyle changes, such as regular exercise, are likely to be "under-prescribed" for patients with CAD.[53] It is estimated that 20-30% of eligible patients receive referrals to EBCR programs.[53-55] Of the referred patients, approximately 40% actually participate in the programs, and women, especially older women, are less likely to be referred or participate in the programs.[53,56] Standards for adherence and participation in EBCR programs may differ across countries due to culture

Table 1. Chronological studies that used cardiovascular rehabilitation with emphasis on physical exercise in patients with coronarry artery disease.

Studies	Type	Population	Interventions	Follow-up Time	Outcomes
Froelicher V, 1984 [38]	RCT	146 middle-aged men with CAD	45 min of supervised aerobic exercise; 3x week; 60 to 80% of VO_2peak; *vs.* usual care	12 months	Functional capacity ↑
Ornish D, 1990 [28]	RCT	36 men and 5 middle-aged women with CAD	Vegetarian diet; Smoking cessation; Stress control; Aerobic exercise (minimum 30 min/session walk); 180 min/week; *vs.* usual care	12 months	Atherosclerotic disease ↓
Schuler G, 1992 [25]	RCT	113 middle-aged men with stable angina	Low fat diet; 30 min of daily aerobic exercise (cycle ergometer); at least 2x week supervised; 75% of MHR; *vs.* usual care	12 months	Functional capacity ↑ Atherosclerotic disease ↓
Hambrecht R, 1993 [29]	RCT	62 middle-aged men with CAD	30 min of daily aerobic exercise (cycle ergometer); at least 2x week supervised; 75% of VO_2max; *vs.* usual care	12 months	Functional capacity ↑ Atherosclerotic disease ↓
Haskell WL, 1994 [26]	RCT	300 men and 41 middle-aged women with CAD	Low fat diet; Smoking cessation; Weight loss; Aerobic exercise without supervision; *vs.* usual care	four months	Functional capacity ↑ Atherosclerotic disease ↓
Niebauer J, 1997 [27]	RCT	113 middle-aged men with CAD	Low calorie diet; 30 min of daily aerobic exercise (cycle ergometer); 2x week supervised (60 min/week); *vs.* usual care	six years	Functional capacity ↑ Atherosclerotic disease ↓
Ornish D, 1998 [30]	RCT	32 men and three middle-aged women with CAD	Vegetarian diet; Smoking cessation; Stress control; Aerobic exercise (minimum 30min/session walk); 3h/week; 50 to 80% of MHR; *vs.* usual care	five years	Atherosclerotic disease ↓
Manchanda SC, 2000 [31]	RCT	42 men with CAD	Low calorie diet; Control of risk factors; Moderate Aerobic Exercise and Yoga; *vs.* usual care	12 months	Functional capacity ↑ Atherosclerotic disease ↓
Toobert DJ, 2000 [39]	RCT	28 middle-aged women with CAD	Vegetarian diet; Smoking cessation; Stress control; 60 min moderate aerobic exercise; 3x week; *vs.* usual care	two years	Functional capacity ↑ Atherosclerotic disease ↓
Jolliffe JA, 2001 [5]	Review	51 studies (8440 patients with CAD)	EBCR*		Morbidity and mortality ↓
Belardinelli R, 2001 [40]	RCT	99 men and 20 middle-aged women with CAD	30 min aerobic exercise; 3x week; 60% VO_2 peak; *vs.* Usual care	six months	Functional capacity ↑ Quality of life ↑
The Vestfold Heartcare Study Group, 2003 [35]	RCT	197 middle-aged men with CAD	Low calorie diet; Smoking cessation; Regular exercise; 2x week; 13-15 on Borg's subjective perception of effort; *vs.* usual care	two years	Morbidity and mortality ↓
Seki E, 2003 [44]	RCT	38 elderly men with CAD	20 min warm up + 20-30 min continuous aerobic exercise + 20 min muscle strength and stretching; *vs.* usual care	six months	Quality of life ↑
Taylor RS, 2004 [6]	Systematic review and meta-analysis	48 studies (8940 patients with CAD)	EBCR*		Morbidity and mortality ↓

Table 1. Chronological studies that used cardiovascular rehabilitation with emphasis on physical exercise in patients with coronarry artery disease.

Studies	Type	Population	Interventions	Follow-up Time	Outcomes
Hambrecht R, 2004 [47]	RCT	101 middle-aged and elderly men with CAD	20 min daily aerobic exercise (cycle ergometer); at least 1x week supervised; 70% of VO_2max; *vs.* usual care	12 months	Morbidity and mortality ↓ Functional capacity ↑
Bäck M, 2008 [41]	RCT	32 men and 2 middle-aged and elderly women with CAD	30 min aerobic exercise (cycle ergometer); Muscle strength exercises; 70% of VO_2max; *vs.* Percutaneous coronary intervention	eight months	Functional capacity ↑ Quality of life ↑
Seki E, 2008 [42]	RCT	34 elderly men with CAD	20 min warm up + 20-30 min continuous aerobic exercise + 20min muscle strength and stretching exercises; *vs.* usual care	six months	Functional capacity ↑
Wise FM, 2010 [7]	Review	-	Aerobic and strength exercises		Morbidity and mortality ↓
Taylor RS, 2010 [36]	Systematic review	12 studies (1938 patients with CAD)	EBCR in rehabilitation centers *vs.* home rehabilitation		Morbidity and mortality ↓ Quality of life ↑
Heran BS, 2011[8]	Systematic review	47 ERC studies (10,794 patients with CAD)	EBCR*		Morbidity and mortality ↓
Anderson L, 2014 [9]	Systematic review	148 studies (98,093 patients with CAD)	EBCR*		Morbidity and mortality ↓ Quality of life ↑
Bruning RS, 2015 [13]	Review	-	Aerobic exercise training		Morbidity and mortality ↓
Maddison R, 2015 [45]	RCT	139 men and 32 middle-aged women with CAD	Telephone intervention (vídeo messaging intended to increase active behavior); *vs.* usual care	four months	Quality of life ↑
Anderson L, 2016 [34]	Systematic review and meta-analysis	63 ERC studies (14,486 patients with CAD)	EBCR* *vs.* usual care	six months	Morbidity and mortality ↓ Hospital internment ↓ Quality of life ↑
Uddin J, 2016 [10]	Meta-analysis	55 ERC trials (26 studies; 2395 patients with CAD)	EBCR* *vs.* usual care		Functional capacity ↓
Yamamoto S, 2016 [43]	Meta-analysis	21 ERC studies (1095 middle-aged and elderly patients with CAD)	RM training *vs.* RM + aerobic training (combined) *vs.* Aerobic training – All within one EBCR program*.		All trainings: Functional capacity ↓ RM training: muscle strength of MMSS and MMII ↑
Gomes-Neto M, 2017 [59]	Systematic review and meta-analysis	12 studies with 609 patients	High intensity interval training *vs.* EBCR*		Functional capacity ↑ more in the interval group Quality of life ↑ in both groups.

CAD= Coronary Artery Disease; EBCR = exercise-based cardiovascular rehabilitation; RCT = Randomized Controlled Trial; MHR= Maximum Heart Rate; RM= Muscle Strength; MMSS= Upper Limbs. MMII= Lower Limbs; ↑=Increase; ↓=Decrease. * EBCR = Comprehensive and long-term programs involving medical evaluation, prescription of moderate aerobic exercise, localized muscle strength and stretching/flexibility (average 60min session/3x/week), education for modification of cardiac risk factors and psychological counseling.

and different health systems. However, it is clear that public health policies in Brazil regarding the recommendation and promotion of the EBCR for patients with CAD are still insufficient, ineffective and reach a minimal portion of the population. The project launched in 2011 by the Ministry of Health in Brazil called the "Health Academy" Program[57] is a promising health promotion strategy, as it encourages the practice of physical activities in the communities, but does not directly encompass the EBCR for CVD patients.

Another important factor that deserves to be highlighted is the inclusion of technology in favor of patient adherence to effective lifestyle changes and, consequently, participation

in EBCR programs. A study published in 2015 involving 171 men and women with CAD found the effect of cell phone follow-up over a six-month period. This follow-up included text messaging and videos that encouraged active behavior and exercise. Although no effective improvement in maximal oxygen uptake was observed, increased leisure-time physical activity and walking were observed, as well as improved quality of life in these patients.[45] According to a recent meta-analysis, advances in the use of technology will increasingly help in adhering patients to EBCR programs.[46] The application of digital monitoring could be useful for maintaining healthy habits even after program discharge or for those who cannot attend supervised program centers. The benefits of using technology could go beyond monitoring secondary prevention to include primary care strategies such as using motivational text messaging, behavioral counseling and lifestyle change incentives, thus addressing at risk for CVD. In this sense, some studies have observed similar clinical results in patients with CAD who underwent supervised programs in specialized centers and home programs.[9,36] This evidence suggests that unsupervised EBCR programs with remote monitoring may be an alternative for patients that do not need supervision.[58]

Finally, we can highlight the importance of the type of activities included in RCEE programs. If we think about adherence, limiting exercise to a single modality, such as treadmill aerobic exercise or cycle ergonomics, does not seem to be a good strategy. Other modalities can bring benefits both in relation to disease regression, decreased morbidity and mortality, as well as improved functional capacity and quality of life of this population. In addition, diversified modalities can increase motivation and, consequently, adherence to EBCR programs. However, this theme is little explored in the literature. Evidence from the literature on moderate-intensity aerobic exercise is numerous and consistent, but studies of other modalities are much smaller compared to aerobic exercise. In recent decades, interest in interval training has been increasing as an alternative for patients with CAD. Although not part of the recommendations for these patients, some studies have shown its potential. A meta-analysis that analyzed 609 patients with CAD compared high intensity interval training with moderate continuous training and showed that patients who participated in interval training had a greater increase in VO_2 max when compared with the group that underwent moderate continuous training. On the other hand, in a subanalysis of isocaloric protocols this difference disappeared. In addition, there was no difference between interval training and moderate continuous training in relation to the physical, emotional and social domains of quality of life assessment in patients with CAD.[59] Similarly, Brazilian authors have shown that high intensity interval training has superior effect on oxygen pulse improvement in patients with CAD, but has similar effect to moderate intensity aerobic training on the relationship between ventilation and carbon dioxide production (VE/VCO_2 slope) and oxygen uptake efficiency slope (OUES).[60] Although data is not yet conclusive, interval training may be a good alternative for patient motivation, participation and adherence. In this sense, researcher Taylor J.'s group has been studying issues such as feasibility, safety, efficacy and adherence to high intensity interval training in patients with CAD in Australia. The authors hope to show encouraging results that support the development of a standard protocol that includes high intensity interval exercise in the EBCR programs as another exercise option for patients with CAD.[61]

In addition to aerobic training, resistance training is another modality that is recommended and is already part of most EBCR programs. A meta-analysis by Yamamoto et al.[43] involving more than 1,000 patients showed that resistance training increases upper and lower limb muscle strength and physical capacity in middle-aged CAD patients. In addition, this type of exercise promotes additional mobility improvement in elderly patients with CAD. The association of aerobic exercises with muscular strength exercises is related to the reduction in mortality in this class of patients, highlighting the importance of including resistance exercises in EBCR programs.[7,8] Other less conventional modalities such as yoga, dance, pilates, meditation, among others, can also contribute to the treatment of patients with CAD. For example, a study by Manchanda et al.[31] showed the effect of yoga incorporated into lifestyle changes in a group of 42 men with CAD. After one year of follow-up, the authors observed regression of coronary atherosclerosis in these patients. These findings highlight the importance of broadening the types of exercise studied in future research so that the recommended modalities for an EBCR program can increase and improve the participation and adherence of patients with CAD in RCEE programs.

FINAL CONSIDERATIONS

Given the above, it is evident that the EBCR is effective and provides many benefits for the patient with CAD. EBCR is advocated by several health organizations as part of the treatment of patients with CAD. However, despite decades of published studies proving their efficacy and safety, the number of EBCR programs, as well as the number of participants in available programs, is still very small. Effective public policies as well as private investment are needed to increase supervised EBCR programs for the treatment of patients with CAD. Alternatively, investing in home or telemonitored EBCR programs may be an option for effective treatment of these patients. In addition, including different exercise modalities in an EBCR program seems to be an important strategy for improving patient compliance and participation. Therefore, we conclude that future studies should be conducted to evaluate and develop strategies for the implementation, maintenance and improvement of EBCR programs for patients with CAD and CVD.

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CONFLICTS OF INTEREST

The author declares that he has no conflicts of interest in this work.

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