Review Article

European Journal of Cardiovascular Nursing

ESC European Society of Cardiology

European Journal of Cardiovascular Nursing
2019, Vol. 18(1) 38–47

DOI: 10.1177/1474515118783157
journals.sagepub.com/home/cnu
SAGE

Factors associated with non-participation in and dropout from cardiac rehabilitation programmes: a systematic review of prospective cohort studies

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Abstract

Background: Although evidence exists for the efficacy of cardiac rehabilitation programmes to reduce morbidity and mortality among patients with cardiovascular disease, cardiac rehabilitation programmes are underused. We aimed systematically to review the evidence from prospective cohort studies on factors associated with non-participation in and/or dropping out from cardiac rehabilitation programmes.

Methods: MedLine, Embase, Scopus, Open Grey and Cochrane Database were searched for relevant publications from inception to February 2018. Search terms included (a) coronary heart disease and other cardiac conditions; (b) cardiac rehabilitation and secondary prevention; and (c) non-participation in and/or dropout. Databases were searched following the PRISMA statement. Study selection, data extraction and the assessment of study quality were performed in duplicate.

Results: We selected 43 studies with a total of 63,425 patients from 10 different countries that met the inclusion criteria. Factors associated with non-participation in and dropout from cardiac rehabilitation were grouped into six broad categories: intrapersonal factors, clinical factors, interpersonal factors, logistical factors, cardiac rehabilitation programme factors and health system factors. We found that clinical factors, logistical factors and health system factors were the main factors assessed for non-participation in cardiac rehabilitation. We also found differences between the factors associated with non-participation and dropout.

Conclusions: Several factors were determinant for non-participation in and dropout from cardiac rehabilitation. These findings could be useful to clinicians and policymakers for developing interventions aimed at improving participation and completion of cardiac rehabilitation, such as E-health or home-based delivery programmes.

Trial Registration: International Prospective Register of Systematic Reviews (PROSPERO) identifier: CRD42016032973.

Keywords

Cardiac rehabilitation, associated factors, systematic review, participation, dropout, adherence

Date received: 26 February 2018; revised: 23 April 2018; accepted: 25 May 2018

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Introduction

The leading cause of non-communicable disease deaths worldwide in 2015 was cardiovascular disease (CVD), accounting for 17.9 million deaths.[1] Cardiac rehabilitation (CR) is recognised as integrated care for patients with CVD and is a class IA recommendation of the American Heart Association, the American College of Cardiology Foundation and the European Society of Cardiology.[2–4] CR comprises multidisciplinary interventions focused primarily on risk factor management, exercise and medication.[2,4]

Empirical evidence on CR has shown that these programmes reduce total mortality by 13–24% in the following one to 3 years after a coronary event, and reduce readmissions in the following year by 31%.[5] Despite the clinical benefits of CR and its cost-effectiveness, uptake of CR remains suboptimal.[2,4] Diverse systematic reviews and meta-analyses find CR referral rates ranging from 22.2% to 73.7%, the rates varying by country and by gender.[6] For referred patients with CVD, participation rates range from 14% to 35%.[2,7,8] Recent reviews have shown that once patients are engaged in CR, adherence ranges from 36.7% to 84.6%,[9] with dropout rates ranging from 12% to 56%.[10]

Several reviews have found factors associated with participation in CR. In particular, patient-oriented factors, medical factors, logistical factors and healthcare system factors have been proposed to explain the variability in CR enrollment.[7,11,12] Literature on factors associated with dropout is scarce. A recent systematic review found that patients with comorbidities[12] and smokers have higher dropout rates.[13] However, these previous reviews have some limitations: (a) the design of the studies included cross-sectional studies, which cannot determine whether the factor precedes the effect, and although retrospective cohort designs do permit this, they are usually more biased than prospective cohort studies; (b) previous systematic reviews did not evaluate the quality of included studies; and (c) no previous systematic review has specifically focused on factors associated with non-participation in and/or dropout from CR.[7,11,12]

Therefore, the aim of this study was systematically to review prospective cohort studies available in the literature examining factors specifically associated with non-participation in and/or dropout from CR programmes. Our results will provide clinicians and policymakers with the best available research evidence to improve CR participation and completion.

Methods

Search strategy and selection of articles

We followed the PRISMA guidelines for reporting systematic reviews[14] (see Figure 1). The protocol was registered in the International Prospective Register of Systematic Reviews(PROSPERO,registrationno.:CRD42016032973) on 1 September 2016 and was last updated on 15 September 2017. Comprehensive literature searches of Scopus, MedLine (through Ovid and Pubmed), Cochrane Database, Embase, Web of Science and Open Grey Repository (system for information on grey literature in Europe) databases were conducted. The first search was carried out in December 2016 and last updated in February 2018 without any restrictions. Two reviewers (DMR and MGH) searched the databases separately.

The search strategy incorporated three concepts using different combinations: (a) coronary heart disease and other cardiac conditions; (b) cardiac rehabilitation and secondary prevention; and (c) non-participation and/or dropout. Searches were piloted in Ovid and then adapted to run across the other databases. The reference lists of the primary studies selected as well as recent reviews in the field were checked. In addition, we contacted expert authors to identify additional articles in our search.

Study selection was over three phases. First, duplicate studies were deleted. Second, a selection of potentially relevant articles was made based on the title and abstract. Third, a final selection was made after reading the full text of the articles. The selection process was done in duplicate (DMR and MGH), and a third reviewer participated in cases of disagreement (EM). The inter-agreement between reviewers measured with the kappa statistic was excellent (κ 0.79; 95% confidence interval (CI) 0.68–0.95).

The studies selected had to meet specific inclusion criteria presented in Table 1. Based on previous studies, several cardiovascular conditions were included with the aim of comprising all patients eligible for CR.[2,15] We focused on studies with factors associated with non-participation in/or dropout from CR. For this purpose, prospective cohort studies were selected as they provide greater evidence of causality and better quality than cross-sectional, retrospective cohort and case–control studies. Finally, this systematic review focused only on secondary prevention and CR programmes. All languages and all settings were considered for inclusion.

Summary measures

The summary measures included in the studies selected were relative risk (RR) and odds ratio (OR). In those studies that did not provide RR and/or OR, factors resulting from the logistic regressions were included.

Data synthesis

We developed a data extraction sheet, pilot tested it on four randomly selected included studies and refined it accordingly. The main characteristics of these studies were rigorously extracted by DMR, and verified by a second reviewer (MGH). Any discrepancies were resolved by discussion between the two reviewers. Thirteen discrepancies were resolved by a third reviewer (EM).

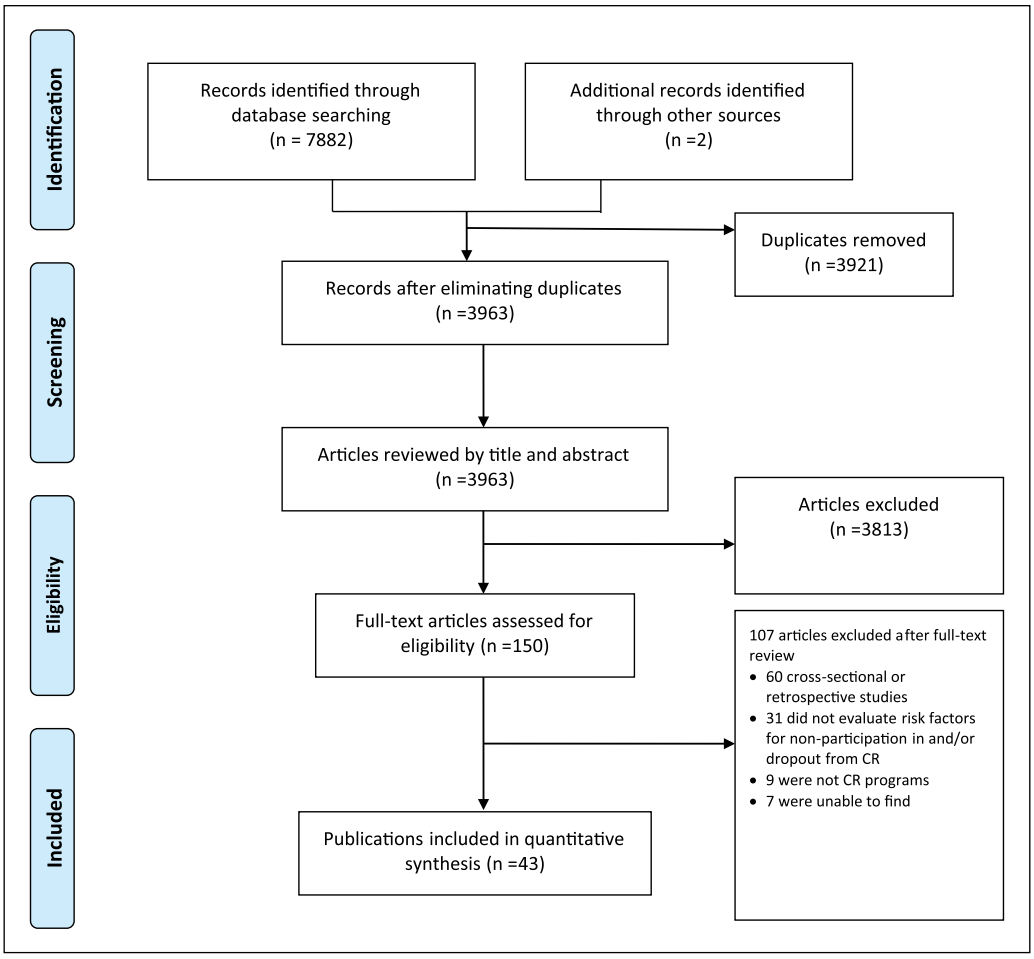

Figure 1. Flow chart of articles included and excluded after the systematic review.

Following previous studies,[16,17] the type of non-participation was divided into non-participation (patients were referred but never attended) and dropout (patients who attended at least one session before abandoning treatment). For each study, information was collected about the author(s), year of publication, study country, follow-up period of the cohort, sample size, diagnosis, mean age of the participants at baseline, cluster risk factor, outcome variable (non-participation or dropout), procedure for data collection, statistically significant associated factor(s) and risk of bias (see Supplementary Table 1). Factors that were not clearly identified were not included in the categories. Complementary categories (e.g. younger age and older age) and studies that presented factors associated with CR adherence or CR completion were reverted into factors for non-participation in and dropout from CR by inverting the OR or RR.

Risk of bias in individual studies

Quality assessment was performed independently in duplicate (DMR and MGH) and a third reviewer participated in cases of disagreement (PMP). The quality of the studies was assessed using the Newcastle–Ottawa Scale (NOS) for cohort studies.[18] The NOS awards stars for three categories: selection, comparability and outcome, each divided into further subcategories (see Supplementary Table 2). As our outcome was non-participation in or dropout from CR, in all studies the outcome of interest was not present at the start of the study. In addition, follow-up was considered to be adequate in all studies as the outcome was assessed at the end of the CR programme. The maximum number of stars that can be achieved in a study with the NOS is nine, which indicates complete absence of bias. The inter-rater agreement with the kappa statistic was 0.74 (95% CI 0.55–0.88) and only two studies have a quality rate lower than five stars.[19,20]

Results

Search results

The search strategy produced 7882 potentially relevant studies (the PRISMA flow diagram provides detailed information on the selection process, see Figure 1). A further two

articles were identified from among the references of the articles selected. Of these, 3921 were duplicates. Of those remaining, 3813 were excluded after reviewing the title and abstract. After reviewing the full text of the remaining articles, another 107 were excluded for the following main reasons: 60 were cross-sectional or retrospective studies, 31 did not evaluate factors associated with non-participation in and/or dropout from CR and nine were not CR programmes. Finally, 43 articles were selected. The data from these studies were extracted and summarised in Supplementary Table 2.

The studies were based on samples from the USA (34.9%), Europe (27.9%), Canada (18.6%) and Oceania (18.6%). The studies included a total sample of 63,425 participants, with a mean age of 63 years. Of the 43 articles included, four (9.3%) employed a sample of women only and 22 (51.16%) had been published in the past decade. All the studies were in hospital-based settings. The assessment of non-participation in and/or dropout from CR was carried out through medical records (30.2%), questionnaires (25.6%), both interviews and medical records (25.6%), or interviews (18.6%). With respect to non-participation, 29 (67.4%) studies used samples that had never participated in CR: 11 (25.6%) studies included participants who dropped out from CR; and three studies (7%) included participants who either had not participated in or dropped out from CR programmes. Forty-one articles reported logistical regressions with OR,[19–57] two with beta,[58,59] one reported chi-square statistic[60] and one a Cox hazard proportional model.[61]

Study quality

The results of the quality assessment of the included studies are presented in Supplementary Table 1. The total mean NOS was 7.05 (standard deviation 1.4; range 4–9). Of the 43 studies, 37 were representative of their community and 30 objectively evaluated the associated factors. The analysis of comparability revealed that 26 studies controlled for gender and 30 controlled for any other factor. In 29 studies, the outcome was measured through medical records and/or structured interviews. The losses during the follow-up period did not exceed 15% in 24 studies. Finally, 29 studies provided adjusted results.

Associated factors

Following a socio-ecological health model, associated factors both for non-participation in and for dropout from CR were divided into six main categories: intrapersonal factors, clinical factors, interpersonal factors, logistical factors, CR programme factors and health system factors (see Table 2).

Intrapersonal factors. Eight studies reported older age as a factor associated with non-participation in CR (OR range 1.01–4.76),[23,25,35,40,42,44,45,57] but only one study described this as a factor affecting dropout.[56] Conversely, four studies found being young to be a factor associated with non-participation (OR range 1.04–1.72),[19,27,45,46] and in four studies this was associated with dropout (OR range 1.12–1.67).[49,53,55,56] With respect to gender, all the studies that evaluated the relationship between gender and non-participation found that female patients have up to four times higher odds of non-participation (OR range 1.64–4.17),[20,24,40,45,46,55] whereas two studies found that being a man was associated with higher dropout rates,[51,53] and only one study found being a woman to be a factor associated with dropout (95% CI 5.59).[55] Eight studies explored the relationship between indicators of low socioeconomic status (e.g. low income, living in a high deprivation area or lack of insurance) and either non-participation in or dropout from CR.[21,29,37,39,40,44,56] All of them found that patients in a more vulnerable socioeconomic situation had a higher risk of non-participation in and dropout from CR.

Comorbid conditions were associated with up to nearly twice the odds of non-participation[44] and with higher odds of dropout from CR.[50] Depressive symptoms and personal stressful events were associated with up to nearly five times higher odds of non-participation (OR range 1.20–4.76).[27,32,36] Only one study found that anxiety was associated with participation in CR.[29] In line with this, the five studies that evaluated the relationship between depression and anxiety with dropout found a positive relationship between these variables (OR range 1.15–7.17).[48–50,52,55,59]

Low self-efficacy for managing the disease was associated with non-participation (OR range 1.05–2.17),[29,35] and reporting irrational health beliefs, higher self-efficacy, lower disease consequences and poorly perceived treatment control were factors associated with CR dropout (OR range 1.34–2.01).[55,58] Finally, not feeling the need for CR and not having the intention to attend were associated with non-participation in CR (OR range 1.49–17.32).[19,25,41]

Clinical factors. Being a smoker has been associated with nearly twice the odds of non-participation (OR 1.69, 95% CI 0.44–0.80),[40] and with more than three times the odds for CR dropout (OR range 1.20–3.30).[47,51,53,54,57] Four studies found that higher body mass index increased the risk of non-participation in and dropout from CR,[35,51,52,54] whereas one study found that obesity was associated with participation in[26] and another study with completion of CR.[53] Poor functional capacity and reduced physical function have been associated with higher rates of non-participation in CR (OR range 1.02–1.19).[23,40] Physical inactivity, poor functional capacity and lower exercise capacity were factors associated with higher dropout from CR.[47,51,54,57] Not having controlled cholesterol levels and not having a previous history of high cholesterol were associated with non-participation in CR.[24,46] Type II diabetes mellitus has been associated with up to nearly twice the odds of non-participation in CR.[61]

Table 1. Inclusion and exclusion criteria for the studies included in the review.

Aspects considered	Inclusion criteria	Exclusion criteria
Population	Patients with cardiovascular disease eligible for CR programme[1]	Patients not eligible for CR programme
Outcome	Factors associated to nonparticipation in and/or dropout from CR programmes	Studies in which the variables assessed are not associated with non-participation in and/or dropout from CR programmes; or in which results did not differentiated type of non-adherence
Design	Prospective cohort	Retrospective cohort, cross-sectional, case–control, clinical trials, systematic reviews and meta-analyses, protocols, clinical case and editors' letters, interventional studies, qualitative studies
Type of intervention	Secondary prevention programmes, CR programmes, interventions at phase II[2]	Primary and/or tertiary prevention programmes Interventions at phase I and/or phase III
Language	All languages	None
Setting	Home-based, community-based, hospital-based	None

[1]Type of patients. Patients had to be diagnosed with one of the following conditions: cardiovascular disease, coronary heart disease, arteriosclerosis, acute coronary syndrome, myocardial infarction, or angioplasty. Studies focusing on patients who underwent coronary artery bypass grafting surgery or cardioverter defibrillator implantation were also included.
[2]Core components of a cardiac rehabilitation programme: baseline assessment, nutritional counseling, risk factor management (lipids, blood pressure, weight, diabetes mellitus and smoking), psychosocial interventions, physical activity counseling and exercise training.
CR: cardiac rehabilitation.

Three studies found that diabetes was associated with three times higher odds of dropout from CR (OR range 1.44–3.38,[54,57,61] whereas only one was found to be associated with completion.[51] High disease severity has been associated with lower odds of non-participation[41] and higher odds of dropout (OR range 1.67–4.20).[51,53] Having a coronary artery bypass has been associated with higher rates of participation (OR range 0.02–0.49),[22,27,28,32,34,44] while other cardiac events or a previous history of CVD were factors associated with non-participation in[39,40,44,46,57] and dropout from CR.[50]

Interpersonal factors. Being single was associated with non-participation in CR in seven studies (OR range 1.30–2.50)[22,26,38–40,42,44] and with dropout from CR in two studies (95% CI 2.89).[50,54] Being unemployed or retired was associated with higher rates of non-participation[27,37] in two studies and with dropout in men in one,[57] whereas being employed has been associated with higher odds of non-participation in[43] and dropout from CR.[51] Low practical and social support have been identified as factors associated with non-participation in CR (95% CI 1.12–2).[19,33,38]

Logistical factors. Longer travel times (95% CI 1.16–10),[23,31] being a non-driver,[57] lack of transport,[56] living in a rural area[19,35] or in a geographically inaccessible area[44] were associated with non-participation in CR. Only one study found that being dependent on transport was associated with twice the odds of dropout from CR (OR 2.01, 95% CI 1.16–3.47).[50]

CR programme factors. Having participated previously in a CR programme was associated with higher participation.[56] Attending CR twice per week was associated with higher odds of dropout than attending three times per week (95% CI 3.76).[50]

Health system factors. Seven studies found that lack of a referral to CR or having a low strength of endorsement from physicians has been associated with non-participation (OR range 1.49–2514).[20,22,25,28,30,31,34] With respect to dropout, longer intervals between the first and second visit to the general practitioner after the cardiac event were associated with nearly four times greater odds of dropout from CR (OR 3.45, 95% CI 3.05–3.91).[47]

Discussion

We identified 43 prospective cohort studies that ascertained 63 statistically significant factors associated with non-participation in and/or dropout from CR programmes. To our knowledge, this systematic review is the first to provide a comprehensive overview of differential factors associated with both non-participation in and/or dropout from CR that included only prospective cohort studies. Our systematic review found factors consistent with previous reviews, such as intrapersonal factors, clinical factors, health system factors and logistical factors.[11,12,62] However, we also found new associated factors that have not appeared in previous reviews, such as CR programme factors.

One of our main findings is that there are still several factors with scarce evidence of their association with non-participation in and/or dropout from CR, such as ethnicity, employment, practical support and illness beliefs. Moreover, we found that age, gender and employment

Table 2. Factors associated with non-participation in and dropout from CR programmes.

	Non-participation *N* studies evaluating (OR range)	Dropout *N* studies evaluating (OR range)
Intrapersonal factors		
Older age[19,23,25,27,35,40,42,44–46,49,53,55-57]	11 (0.58–4.76)	4 (0.42–1.82)
Women[20,24,40,45,46,51,53,55]	6 (1.64–4.17)	3 (0.55–5.59)
Lower educational level[40,41]	2 (1.5–1.81)	
Arab[60]	1 (7.57)	
Non-Caucasian[40]	1 (1.72)	
Medium deprivation area[56]		1 (2.38)
High deprivation area[37,56]	1 (1.20)	1 (2.04)
Low income[21,29,39,44]	4 (1.47–5)	
High economic burden[40]	1 (1.78)	
No insurance[40]	1 (2.56)	
Comorbid condition[44,50]	1 (1.22)	1 (2.55)
Depressive symptoms[32,36,48,49,52,59]	2 (1.20–3.85)	4 (1.15–2.51)
Anxiety/depression symptoms[50,55]		2 (1.48–7.17)
Anxiety[29]	1 (0.53)	
Stressful events[27]	1 (4.76)	
Low disease self-efficacy[29,35,55]	2 (1.05–2.17)	1 (0.50)
Poor perceived treatment control[55]		1 (1.96)
Irrational health beliefs[58]		1 (1.34)
Low disease consequences[55]		1 (1.64)
Not feeling the need for CR[25]	1 (10.11)	
No intention to attend[19,58]	2 (1.04–17.32)	
Clinical factors		
Smoker[40,47,51,53,54,57]	1 (1.69)	5 (1.20–3.33)
Higher body mass index[26,35,51–54]	2 (0.18–1.12)	4 (0.94–3.33)
Poor functional capacity[23,47,51,54]	1 (1.02)	3 (1.01–1.90)
Lower frequency of activity[37,57]	1 (1.13)	1 (7.32)
Sedentary lifestyle[26]	1[a] (0.02–0.09)	
Lower physical function[40]	1 (1.19)	
Total cholesterol level[24,46]	2 (1.82 −2.73)	
Hypertension[40]	1 (1.72)	
Disease severity[20,51,53]	1 (0.92)	2 (1.67–4.20)
Type II diabetes mellitus[51,54,57,61]	1 (1.82)	4 (0.50–3.38)
Thrombolysis status[37]	1 (0.55)	
ECG T-wave inversion[39]	1(2.5)	
Peripheral artery disease[40]	1 (2.32)	
Congestive heart failure[44]	1 (1.28)	
History of CVA[50]		1 (4.18)
Previous PCI[40]	1[b] (1.56–1.82)	
No previous angina[46]	1 (2.3)	
PCI[28,44,57]	3 (0.55–9.78)	
AMI[56,57]	2 (0.64–5.13)	
CABG[22,27,28,32,34]	5 (0.02–0.49)	
Reperfusion therapy[37]	1 (0.13)	
β-Blocker therapy[50]		1 (0.47)
No family history of CVD[47]		1 (1.17)
Interpersonal factors		
Single/no partner[22,26,30,39,40,42,44,50,54]	7 (1.30–16.73)	2 (2–2.86)
Unknown marital status[44]	1 (1.92)	
Low social support[19,33]	2 (1.12–1.22)	
Low practical support[38]	1 (2)	
Unemployed or retired[27,37,43,51,57]	3 (0.48–5)	2 (0.48–4.69)

Table 2. (Continued)

	Non-participation *N* studies evaluating (OR range)	Dropout *N* studies evaluating (OR range)
Logistical factors		
Long travel time[23,31]	2 (1.16–10)	
Non-driver or dependency for transport[50,57]	1 (3.09)	1 (2.01)
Lack of transport[56]	1 (1.85)	
Rurality[19,35]	2 (1.91–4.55)	
Less proximity to CR[42]	1 (3.12)	
Geographically inaccessible[44]	1 (1.28)	
CR programme factors		
Previous CR participation[56]	1 (0.42)	
Frequency of programme[50]		1 (3.76)
Health system factors		
Lack of referral[22,25,28,31,34]	5 (4.03–2514)	
Low strength of endorsement[20,30]	2 (1.49–2.04)	
Emergency admission[44]	1 (0.71)	
Public or other type of hospital (not private)[44]	1 (1.54)	
Post-discharge health support[43]	1[c] (0.32–0.38)	
Longer interval between visits 1 and 2[47]		1 (3.45)

[a]The study by Farley et al. (2003)[26] reported information for two sets of pools (whole sample and male sample).
[b]The study by Parashar et al. (2012)[40] reported information for two follow-up times (4 weeks and 6 months).
[c]The study by Soo-Hoo et al. (2016)[43] reported information for two follow-up times (4 weeks and 6 months).
AMI: acute myocardial infarction; CR: cardiac rehabilitation; CVA: cardiovascular accident; CABG: coronary artery bypass graft surgery; PCI: percutaneous coronary intervention; CVF: cardiovascular disease.

status were controversial for non-participation in and dropout from CR. However, these results are in contrast with previous systematic reviews that found that being older, being a woman and being unemployed were factors associated with non-participation.[11,12,62,63] The explanation for these differences could be that previous systematic reviews included several study designs. Therefore, more prospective cohort studies evaluating these factors (such as age, gender, employment status, retirement and socioeconomic level) and their interactions with other factors are needed.

Similar to previous reviews, being single and having low social support were associated with non-participation in and dropout from CR.[11,12] Patients with low social profiles should receive specific reinforcement to improve adherence to CR through community-based CR.

Low socioeconomic status and lower educational level were also risk factors for non-participation in and dropout from CR. These results suggest that these patients might have fewer resources and lower education in personal self-care, which might be related to the presence of cardiovascular risk factors.[64] Throughout providing education about the cardiac risk profile and the benefits of adopting a healthier lifestyle, healthcare professionals should pay special attention to this vulnerable population as they have a higher risk of both developing CVD and of non-adherence to healthcare interventions. Moreover, risk factors such as higher body mass index or a sedentary lifestyle are also related to the development of diabetes, which we found to be associated with a higher risk of non-participation and dropout.[54,57,61] It is plausible that patients with diabetes have more comorbidities or reduced physical function that may interact with their CR adherence. Cardiovascular professionals should assess the specific needs of patients with diabetes in order to offer more adaptive programmes, such as specific CR modular components.

We found that depressive patients are almost four times as likely not to participate and seven times as likely to dropout from CR.[32,50] These results support the need for psychological screening prior to starting a CR programme, which has already been recommended in prevention guidelines.[65] Related to this, psychological counseling focused on health beliefs about CVD and beliefs about its treatment could increase adherence to CR programmes.

Similar to previous reviews, the strength of physician recommendation is one of the factors associated with patient CR participation.[11,12,66] Physician recommendation may be influenced by the patient's diagnosis as we have found that patients who have received coronary artery bypass graft therapy have higher probabilities of participating in CR. Achieving systematic referral of all eligible patients could decrease rates of non-participation in CR. Further studies addressing the relation between the frequency of the programme and dropout rates are also needed.

Participation in CR may be influenced by geographical access, but dropout is not. Related to this, a recent systematic review found referral to a site closer to home and home-based CR delivery were evidence-based strategies

to improve CR participation.[6]. To increase participation and prevent dropout, health system policies could include CR programmes in primary care settings. Another health system policy consideration for those participants with low socioeconomic status, or with logistical problems regarding transport to the programme, could be to include free access to a shuttle service to and from the programme. Moreover, community-based CR may reinforce social support, which has been reported to be a factor associated with participation.

Finally, clinical factors, logistical factors and health system factors were the main factors assessed for non-participation in CR. It would be interesting to know the patients' opinion regarding how these factors are associated with CR dropout.[67]

These findings argue in favour of automatic referral regardless of cardiovascular diagnosis and sociodemographic factors such as gender, age, or geographical location. In addition, E-health CR programmes or the combination of inpatient CR and community resources would decrease non-participation and dropout rates due to a better adaptation to the patient profile.

Strengths and limitations

The present systematic review involved a large number of factors associated with non-participation in/and dropout from CR. Using a multifactorial approach, this review has updated and generated further evidence concerning the importance of each of these factors. The quality of the studies included in this systematic review was adequate in all cases, except in two,[19,20] but the results were in line with those with higher quality. In addition, by including only prospective cohort studies, we minimised the risk of effect bias. Finally, the findings of our systematic review have wide external validity as the majority of the studies involved community studies and included an elevated number of participants from several countries. In addition, most of the studies that evaluated factors associated with dropout from CR were conducted within the past decade. This shows a new trend to identify why patients with CVD do not complete CR programmes.

However, our review has several limitations that should be taken into account. First, although most of the studies that assessed dropout from CR included adjusted results, only half of the studies that evaluated non-participation in CR provided adjusted results. Second, although we minimised the heterogeneity of the studies included by means of our inclusion and exclusion criteria (prospective cohort studies, patients with CVD eligible for CR programme, etc.), a certain degree of heterogeneity remains due to variations in follow-up time, sample size and CR characteristics. Third, as there is no common definition of non-participation in or dropout from CR in the literature, the authors' definitions have been used. Fourth, as most of the studies were carried out in the USA or in specific European countries, these results should be taken with caution. Finally, meta-analysis was not performed due to the heterogeneity of the studies. For this reason, the individual factor effect has been given but not the pooled effect.

Conclusions

In conclusion, following a socio-ecological health model we identified 63 factors associated with non-participation in and/or dropout from CR divided into six categories: intrapersonal factors, clinical factors, interpersonal factors, logistical factors, CR programme factors and health system factors. Identifying these factors has demonstrated the complexity of adherence to CR programmes. In order to improve CR adherence, health policies should address practical implications in each category.

Implications for practice

- Finding 63 significant associated factors influencing non-participation in and/or dropout from cardiac rehabilitation programmes demonstrates the complexity of attending cardiac rehabilitation.
- Cardiac rehabilitation programme planning strategies should incorporate communities and primary care centres.
- Health system policies should include an automatic referral process.

Author contribution

All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

1. Global Burden of Disease Study, 2016. Causes of Death Collaborators. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study. 2016. *Lancet* 2017; 390: 1151–1210.
2. Balady GJ, Ades PA, Bittner VA, et al. Referral, enrollment, and delivery of cardiac rehabilitation/secondary prevention programs at clinical centers and beyond: a presidential

advisory from the American Heart Association. *Circulation* 2011; 124: 2951–2960.
3. Piepoli MF, Hoes AW, Agewall S, et al. European guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J* 2016; 37: 2315–2381.
4. Smith SC, Benjamin EJ, Bonow RO, et al. AHA/ACCF Secondary prevention and risk reduction therapy for patients with coronary and other atherosclerotic vascular disease: 2011 update. *Circulation* 2011; 124: 2459–2473.
5. Heran BS, Chen JMH, Ebrahim S, et al. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database Syst Rev* 2011; 6: CD001800.
6. Colella TJF, Gravely S, Marzolini S, et al. Sex bias in referral of women to outpatient cardiac rehabilitation? A meta-analysis. *Eur J Prev Cardiol* 2015; 22: 423–441.
7. Dalal HM, Doherty P and Taylor RS. Cardiac rehabilitation. *BMJ* 2015; 351: h500.
8. Suaya JA, Shepard DS, Normand ST, et al. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation* 2007; 116: 1653–1662.
9. Oosenbrug E, Marinho RP, Zhang J, et al. Sex differences in cardiac rehabilitation adherence: a meta-analysis. *Can J Cardiol* 2016; 32: 1316–1324.
10. Turk-Adawi KI and Grace SL. Narrative review comparing the benefits of and participation in cardiac rehabilitation in high-, middle- and low-income countries. *Heart Lung Circ* 2015; 24: 510–520.
11. Jackson L, Leclerc J, Erskine Y, et al. Getting the most out of cardiac rehabilitation: a review of referral and adherence predictors. *Heart* 2005; 91: 10–14.
12. Ruano-Ravina A, Pena-Gil C, Abu-Assi E, et al. Participation and adherence to cardiac rehabilitation programs. A systematic review. *Int J Cardiol* 2016; 223: 436–443.
13. Gaalema DE, Cutler AY, Higgins ST, et al. Smoking and cardiac rehabilitation participation: associations with referral, attendance and adherence. *Prev Med* 2015; 80: 67–74.
14. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med* 2009; 151: 264–269.
15. Anderson L, Oldridge N, Thompson DR, et al. Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Systematic Review and Meta-analysis. *J Am Coll Cardiol* 2016; 67: 1–12.
16. Resurrección DM, Motrico E, Rigabert A, et al. Barriers for nonparticipation in and dropout of women in cardiac rehabilitation programs: a systematic review. *J Womens Health* 2017; 26: 849–859.
17. Gaalema DE, Cutler AY, Higgins ST, et al. Smoking and cardiac rehabilitation participation: associations with referral, attendance and adherence. *Prev Med* 2015; 80: 67–74.
18. Wells GA, Shea B, O'Connell D, et al. The Newcastle–Ottawa Scale (NOS) for assessing the quality of non-randomized studies in meta-analyses. 2011. www.ohri.ca/programs/clinical_epidemiology/oxford.asp (accessed 4 June 2018).
19. Johnson JE, Weinert C and Richardson JK. Rural residents' use of cardiac rehabilitation programs. *Public Health Nurs* 1998; 15: 288–296.
20. Shanks LC, Moore SH and Zeller RA. Predictors of cardiac rehabilitation initiation. *Rehabil Nurs* 2007; 32: 152–157.
21. Allen J, Scott LB, Stewart JK, et al. Disparities in women's referral to and enrollment in outpatient cardiac rehabilitation. *J Gen Intern Med* 2004; 19: 747–753.
22. Barber K, Stommel M, Kroll J, et al. Cardiac rehabilitation for community-based patients with myocardial infarction: Factors predicting discharge recommendation and participation. *J Clin Epidemiol* 2001; 54: 1025–1030.
23. Brual J, Gravely-Witte S, Suskin N, et al. Drive time to cardiac rehabilitation: at what point does it affect utilization? *Int J Health Geogr* 2010; 9: 27–38.
24. Buckley B, Murphy AW, Glynn L, et al. Selection bias in enrollment to a programme aimed at the secondary prevention of ischaemic heart disease in general practice: a cohort study. *Int J Clin Pract* 2007; 61: 1767–1772.
25. Dunlay SM, Witt BJ, Allison TG, et al. Barriers to participation in cardiac rehabilitation. *Am Heart J* 2009; 158: 852–859.
26. Farley RL, Wade TD and Birchmore L. Factors influencing attendance at cardiac rehabilitation among coronary heart disease patients. *Eur J Cardiovasc Nurs* 2003; 2: 205–212.
27. Gallagher R, McKinley S and Dracup K. Predictors of women's attendance at cardiac rehabilitation programs. *Prog Cardiovasc Nurs* 2003; 18: 121–126.
28. Gravely S, Anand SS, Stewart DE, et al. Effect of referral strategies on access to cardiac rehabilitation among women. *Eur J Prev Cardiol* 2014; 21: 1018–1025.
29. Grace SL, Abbey SE, Shnek ZM, et al. Cardiac rehabilitation II: referral and participation. *Gen Hosp Psychiatry* 2002; 24:127–134.
30. Grace SL, Gravely-Witte S, Brual J, et al. Contribution of patient and physician factors to cardiac rehabilitation enrollment: a prospective multi-level study. *Eur J Cardiovasc Prev Rehabil* 2008; 15: 548–556.
31. Higgins RO, Murphy BM, Goble AJ, et al. Cardiac rehabilitation program attendance after coronary artery bypass surgery: overcoming the barriers. *Med J Aust* 2008; 188: 712-714.
32. Hoffmann A, Spinnler B, Buchs M, et al. Rehabilitation enrollment after cardiac procedures. *Cardiovasc Med* 2013; 16: 203–207.
33. Husak L, Krumholz HM, Lin ZQ, et al. Social support as a predictor of participation in cardiac rehabilitation after coronary artery bypass graft surgery. *J Cardiopulm Rehabil* 2004; 24: 19–26.
34. Jankowski P, Pajak A, Lysek R, et al. Cardiac rehabilitation in real life. *Medicine (Baltimore)* 2015; 94: e1257.
35. King KM, Humen DP, Smith HL, et al. Predicting and explaining cardiac rehabilitation attendance. *Can J Cardiol* 2001; 17: 291–296.
36. Kronish IM, Rieckmann N, Halm EA, et al. Persistent depression affects adherence to secondary prevention behaviors after acute coronary syndromes. *J Gen Intern Med* 2006; 21: 1178–1183.
37. Lane D, Carroll D, Ring C, et al. Predictors of attendance at cardiac rehabilitation after myocardial infarction. *J Psychosom Res* 2001; 51: 497–501.
38. Molloy GJ, Perkins-Porras L, Bhattacharyya MR, et al. Practical support predicts medication adherence and attendance at cardiac rehabilitation following acute coronary syndrome. *J Psychosom Res* 2008; 65: 581–586.

39. Nielsen KM, Faergeman O, Foldspang A, et al. Cardiac rehabilitation: health characteristics and socio-economic status among those who do not attend. *Eur J Public Health* 2008; 18: 479–483.
40. Parashar S, Spertus JA, Tang F, et al. Predictors of early and late enrollment in cardiac rehabilitation, among those referred, after acute myocardial infarction. *Circulation* 2012; 126: 1587–1595.
41. Sanderson BK, Shewchuk RM and Bittner V. Cardiac rehabilitation and women: what keeps them away? *J Cardiopulm Rehabil Prev* 2010; 30: 12–21.
42. Smith KM, Harkness K and Arthur HM. Predicting cardiac rehabilitation enrollment: the role of automatic physician referral. *Eur J Cardiovasc Prev Rehabil* 2006; 13: 60–66.
43. Soo Hoo SY, Gallagher R and Elliott D. Predictors of cardiac rehabilitation attendance primary percutaneous coronary intervention for ST-elevation myocardial infarction in Australia. *Nurs Health Sci* 2016; 18: 230–237.
44. Sundararajan V, Bunker SJ, Begg S, et al. Attendance rates and outcomes of cardiac rehabilitation in Victoria, 1998. *Med J Aust* 2004; 180: 268–271.
45. Witt BJ, Jacobsen SJ, Weston SA, et al. Cardiac rehabilitation after myocardial infarction in the community. *J Am Coll Cardiol* 2004; 44: 988–996.
46. Worcester MU, Stojcevski Z, Murphy B, et al. Factors associated with non-attendance at a secondary prevention clinic for cardiac patients. *Eur J Cardiovasc Nurs* 2003; 2: 151–157.
47. Fitzpatrick P, Lonergan M, Collins C, et al. GP-delivered secondary prevention cardiovascular disease programme; early predictors of likelihood of patient non-adherence. *Eur J Gen Pract* 2010; 16: 241–243.
48. Glazer KM, Emery CF, Frid DJ, et al. Psychological predictors of adherence and outcomes among patients in cardiac rehabilitation. *J Cardiopulm Rehabil* 2002; 22: 40–46.
49. Casey E, Hughes JW, Waechter D, et al. Depression predicts failure to complete phase-II cardiac rehabilitation. *J Behav Med* 2008; 31: 421–432.
50. Pardaens S, De Smedt D, De Bacquer D, et al. Comorbidities and psychosocial characteristics as determinants of drop-out in outpatient cardiac rehabilitation. *J Cardiovasc Nurs* 2017; 32: 14–21.
51. Sanderson BK, Phillips MM, Gerald L, et al. Factors associated with the failure of patients to complete cardiac rehabilitation for medical and nonmedical reasons. *J Cardiopulm Rehabil* 2003; 23: 281–289.
52. Sanderson BK and Bittner V. Women in cardiac rehabilitation: outcomes and identifying risk for dropout. *Am Heart J* 2005; 150: 1052–1058.
53. Sarrafzadegan N, Rabiei K, Shirani S, et al. Drop-out predictors in cardiac rehabilitation programmes and the impact of sex differences among coronary heart disease patients in an Iranian sample: a cohort study. *Clin Rehabil* 2007; 21: 362–372.
54. Wittmer M, Volpatti M, Piazzalonga S, et al. Expectation, satisfaction, and predictors of dropout in cardiac rehabilitation. *Eur J Prev Cardiol* 2012; 19: 1082–1088.
55. Yohannes AM, Yalfani A, Doherty P, et al. Predictors of drop-out from an outpatient cardiac rehabilitation programme. *Clin Rehabil* 2007; 21: 222–229.
56. Doolan-Noble F, Broad J, Riddell T, et al. Cardiac rehabilitation services in New Zealand: access and utilisation. *N Z Med J* 2004; 117: U955.
57. Worcester MU, Murphy BM, Kee VK, et al. Cardiac rehabilitation programmes: predictors of non-attendance and drop-out. *Eur J Cardiovasc Prev Rehabil* 2004; 11: 328–335.
58. Anderson DR and Emery CF. Irrational health beliefs predict adherence to cardiac rehabilitation: a pilot study. *Health Psychol* 2014; 33: 1614–1617.
59. Swardfager W, Herrmann N, Marzolini S, et al. Major depressive disorder predicts completion, adherence, and outcomes in cardiac rehabilitation: a prospective cohort study of 195 patients with coronary artery disease. *J Clin Psychiatry* 2011; 72: 1181–1188.
60. Reges O, Vilchinsky N, Leibowitz M, et al. Identifying barriers to participation in cardiac prevention and rehabilitation programmes via decision tree analysis: establishing targets for remedial interventions. *Open Heart* 2014; 1: e000097.
61. Armstrong MJ, Sigal RJ, Arena R, et al. Cardiac rehabilitation completion is associated with reduced mortality in patients with diabetes and coronary artery disease. *Diabetologia* 2015; 58: 691–698.
62. Supervía M, Medina-Inojosa JR, Yeung C, et al. Cardiac rehabilitation for women: a systematic review of barriers and solutions. *Mayo Clin Proc* 2017; 92: 565–577.
63. Scott LAB, Ben-Or K and Allen JK. Why are women missing from outpatient cardiac rehabilitation programs? A review of multilevel factors affecting referral, enrollment, and completion. *J Womens Health* 2002; 11: 773–791.
64. Kelly MP, Stewart E, Morgan A, et al. A conceptual framework for public health: NICE's emerging approach. *Public Health* 2009; 123: e14–e20.
65. Mosca L, Barrett-Connor E and Wenger NK. Sex/gender differences in cardiovascular disease prevention: what a difference a decade makes. *Circulation* 2011; 124: 2145–2154.
66. Ghisi GL, Polyzotis P, Oh P, et al. Physician factors affecting cardiac rehabilitation referral and patient enrollment: a systematic review. *Clin Cardiol* 2013; 36: 323–335.
67. Resurrección DM, Motrico E, Rubio-Valera M, et al. Reasons for dropout from cardiac rehabilitation programs in women: a qualitative study. *PlosOne* submitted.