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Review Article

Barriers and facilitators to participant adherence of dietary recommendations within comprehensive cardiac rehabilitation programmes: a systematic review

Lais Manata Vanzella[1], Veronica Rouse[2], Fatim Ajwani[2], Niloufar Deilami[2], Maureen Pokosh[3], Paul Oh[2] and Gabriela Lima de Melo Ghisi[2,*]

[1]São Paulo State University, School of Technology and Sciences, Presidente Prudente, São Paulo, Brazil: [2]Toronto Rehabilitation Institute, Cardiovascular Prevention and Rehabilitation Program, University Health Network, 347 Rumsey Road, Toronto, ON M4G 2R6, Canada: [3]Library and Information Services, University Health Network, Toronto Rehabilitation Institute, Toronto, ON, Canada

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Abstract

Objective: To identify individual-, provider- and system/environmental-level barriers and facilitators affecting cardiac rehabilitation (CR) participants' adherence to dietary recommendations.

Design: A systematic review of the medical literature was conducted. Six databases were searched from inception through March 2021: APA PsycInfo, CINAHL, Embase, Emcare, Medline and PubMed. Only those studies referring to barriers and facilitators reported by CR participants were considered. Pilot and case report studies, non-peer-reviewed literature and studies published in a language other than English, Portuguese or Spanish were excluded.

Results: Data were extracted and analysed on the basis of individual-, provider- and system/environmental-level factors. Of 2083 initial citations, sixteen studies were included, with nine being qualitative and seven observational in design. From these, ten multi-level barriers and seven multi-level facilitators were identified. Dietary recommendations included developing healthy eating habits, transitioning to vegetarian-rich diets and increasing fish oil and *n*-3 intake. Only one study reported on all of the nutrition education programme factors recommended by the Workgroup for Intervention Development and Evaluation Research.

Conclusion: To the best of our knowledge, this review is the first to summarise specific barriers and facilitators to recommendation adherence among CR participants. Few of the studies offered any conclusions regarding programme design that could facilitate improved dietary adherence practices. Future studies should aim to explore patient perspectives on the nutritional patterns and recommendations outlined in the Mediterranean Diet, the Dietary Approaches to Stop Hypertension Diet, Vegetarian or Vegan diets and the Portfolio Diet.

Keywords
Cardiac rehabilitation
Diet
Treatment adherence and compliance
CVD

Cardiac rehabilitation (CR) is an evidence-based, standard of care for patients with CVD[1]. Comprehensive CR should include exercise training, risk factor modification, psychological support, patient education and dietary recommendations[1]. Dietary recommendations are considered a quality indicator for these programmes[2,3], as diet has been identified not only as a primary modifiable risk factor but also as a determinant of secondary CVD events in patients with existing CVD[4,5]. Despite this, dietary recommendations and education are inconsistent within CR Guidelines[6].

Generally, a healthy dietary pattern that reduces cardiovascular risk includes higher consumptions of whole grains, vegetables, fruits, legumes, nuts and olive

*Corresponding author: Email gabriela.meloghisi@uhn.ca

oil, moderate consumption of fish and dairy products, and a low intake of sugars, sweets, and red or processed meats[4]. Foods that are naturally low in Na, sugar and saturated fat, which contain important sources of vitamins, minerals, antioxidants, mono-and-poly unsaturated fat acids and fibre, ultimately contribute to a wide range of health benefits[5,7–9]. Most recently, dietary recommendations have shifted from single nutrients to adopting food-based recommendations emphasised in the Mediterranean Diet, the Dietary Approaches to Stop Hypertension Diet, Vegetarian or Vegan diets and the Portfolio Diet[10].

The Mediterranean Diet, which consists of fish, unsaturated fat, whole grains, fruits and vegetables, nuts and legumes, has promoted favourable benefits in cardiovascular risk profiles, glucose control and BMI[11]. The Dietary Approaches to Stop Hypertension Diet emphasises fruits and vegetables, low-fat dairy foods and whole grains and has also attracted attention due to its beneficial effects on blood pressure and its potential to reduce risk of left ventricular dysfunction[11–13]. The Vegetarian Diet is based on plant foods such as cereals, legumes, fruits, leafy vegetables, nuts, seeds and sea vegetables. The consumption of vegetarian foods is also associated with reductions in the risk of left ventricular dysfunction and in blood pressure and increases in antioxidant levels in the body, which contributes to reductions in levels of LDL and total cholesterol, and improvements in levels of HDL-cholesterol[14]. The Portfolio Diet, also a plant-based diet, is composed of four core components including nuts, plant protein, soya products or dietary pulses, viscous soluble fibre and plant sterols[15–17]. It leads to reductions in the primary therapeutic lipid target for CVD prevention and other cardiometabolic risk factors[17].

The effectiveness of nutrition counselling within a comprehensive CR programme has been extensively evaluated in the literature, and studies have shown that it is associated with improvements in abnormal blood lipid profiles, high blood pressure, glucose intolerance and overall cardiometabolic risk factors[18–24]. Despite well-established benefits, only a low proportion of CVD patients attend CR programmes[25], and of those who complete the programme, only 34–49 % of them adhere to a healthy diet upon the completion of their comprehensive programme[26,27].

Given the importance of a healthy diet for CR patients, it is important to identify the barriers and facilitators impacting patients' adherence to the dietary recommendations offered in comprehensive CR programmes. Identifying these factors will help CR staff to address patients' concerns and improve the educational strategies to ensure greater adoption. On summary, this systematic review was conducted with the aim to identify the individual-, provider- and organisational/environmental-level barriers affecting participant adherence of dietary recommendations within comprehensive CR programmes.

Methods

This systematic review was registered prospectively with the Open Science Framework. Data are reported in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analyses[28].

Eligibility criteria

Studies from peer-reviewed literature identifying barriers and facilitators affecting adherence to dietary recommendations in patients participating in comprehensive CR programmes were considered for inclusion. We included studies reporting data from patients at risk or diagnosed with CVD receiving any dietary recommendations while participating in a comprehensive CR programme. All barriers to dietary intake described in individual-, provider- and system/environmental-levels were considered and reported. Barriers reported by family members or healthcare providers were not considered. The most common dietary patterns included in the search strategy were the following: the Mediterranean Diet, the Dietary Approaches to Stop Hypertension Diet, Vegetarian or Vegan diets, the Portfolio Diet, and the Carbohydrate-restricted Diet. However, any type of diet recommendation was included in our search and stated in our findings.

Studies of any methodological design were considered for inclusion in this study (i.e. quantitative, qualitative and mixed methods). Narrative, scoping and systematic reviews were considered as a source of additional primary studies. Pilot and case report studies, non-peer-reviewed literature and studies published in a language other than English, Portuguese or Spanish were excluded.

Information sources and search strategy

Six databases were searched from inception to 15 March 15 2021: APA PsycInfo (Ovid), Cumulative Index to Nursing and Allied Health Literature, Embase (Ovid), Emcare (Ovid), Medline (Ovid) and PubMed (non-Medline). The search strategies were developed by an Information Specialist utilising the PICO framework, subject headings as appropriate for each database and free-text terms relevant to the topical concepts. Relevant studies identified by reviewing the references from included studies were also added (snowballing).

The search strategies were comprised of three main concepts: (1) comprehensive CR: defined as an outpatient CR programme that includes a range of approaches including report risk factor modification support and/or educational strategies associated with dietary recommendations[1]; (2) dietary recommendations: defined as any type of foods and/or dietary patterns recommended for patients while participating in CR programmes; and (3) patient compliance: defined as the act of an individual conforming to professional recommendations with regard to prescribed dosage, timing and frequency of an intervention[29]. The

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Medline search strategy is included as an online supplementary material, Supplemental Table 1).

Study selection

Two reviewers (LMV and GLMG) independently conducted an initial screening of all records identified by the search strategy (title and abstract). To be selected for secondary screening, abstracts had to clearly mention all three concepts. Full text of the relevant screened articles was then obtained and assessed independently for eligibility by the two reviewers, based on defined inclusion and exclusion criteria. Disagreements in any part of the screening process were discussed and used to refine results.

Quality appraisal

The Critical Appraisal Skills Programme was used to assess the quality of qualitative studies included in this systematic review. Critical Appraisal Skills Programme includes two screening questions and eight detailed questions regarding study design, sampling, data collection, reflexivity, ethical issues, data analysis, findings and values of the research[30].

The Downs and Black Modified Checklist was used to assess the quality of quantitative studies. These studies were classified as 'good', 'fair' and 'poor' according to the US Preventive Services Task Force Approach[47]. Qualitative appraisal was performed by both reviewers (LMV and GLMG). No disagreements between reviewers were identified after this classification.

Data extraction, synthesis and analysis

The COVIDENCE online systematic review software programme was used to eliminate duplicate records and conduct initial and secondary screening of the database results. Data from included studies were extracted to a table by the first author and verified by the last. These data included the following: author(s), year of publication, country, study design, method of data extraction, sample size, characteristic of participants, dietary recommendations, components of dietary recommendations within CR, and barriers and facilitators to participant adherence of dietary recommendations. Components of dietary recommendations within CR were reported according to the Workgroup for Intervention Development and Evaluation Research reporting guideline and included the following: characteristics of those delivering the intervention, detailed description of the intervention content, intensity, mode of delivery, duration, the setting for outpatient CR and adherence to delivery protocol[48,49].

Thematic analysis was considered for analysing data from the qualitative studies. Line-by-line coding and free coding were organised and interpreted to generate analytical themes that offered new insights and interpretation[30,50]. Data from quantitative studies were presented according to the Synthesis Without Meta-analysis guideline[51]. Barriers extracted from the quantitative and qualitative studies were grouped and reported on the basis of individual-, provider- and system/environmental-levels, according to the socio-ecological theory[52].

Results

Characteristics of included studies

The initial database search yielded 2083 records, and two additional records were identified through a snowball hand-search. After removing duplicates and conducting an initial screening of titles and abstracts, sixty-one full articles were assessed for eligibility; all were written in English. Overall, sixteen (26 %) articles were included in this study[31–46]. The Preferred Reporting Items for Systematic Review and Meta-Analyses flow diagram, depicting the search results, reasons for exclusion and the study selection totals are shown in Fig. 1.

The characteristics of the included studies are shown in Table 1. Most of the studies were qualitative in design (*n* 9; 56 %)[31–39], with semi-structured interviews used in seven (43 %)[31–37] and focus group sessions used in two (12 %)[38,39]. Seven studies (46 %) were observational[40–46], in which four (25 %) were cross-sectional and three (18 %) were prospective cohort in design.

In total, 742 patients were included in these studies. Patients were geographical comprised of people from the United Kingdom (*n* 117 patients in two studies; 12 %)[31,46]; Canada (*n* 42 patients in two (12 %) studies)[32,33]; Finland (*n* 260 patients in three (18 %) studies)[34,41,45]; Australia (*n* 45 patients in two (12 %) studies)[35,38]; Ireland (*n* 87 patients in two (12 %) studies)[36,42]; the USA (*n* 126 patients in four (25 %) studies)[37,40,43,44]; and Sweden (*n* 113 patients in one (6 %) study). Figure 2 illustrates these countries and notes other countries with comprehensive CR programmes, but with undefined barriers and facilitators to participant adherence of dietary recommendations[53].

Table 1 also shows the quality appraisal of the included studies. Nine studies were classified as 'good' (56 %)[31–35,37–39,46], four (25 %) as 'fair'[36,40,41,44] and three (18 %) as 'poor' quality[42,43,45]. Online supplementary material, Supplemental Tables 2 and 3 show detailed information regarding the quality appraisal of included studies.

Dietary recommendations

Of the sixteen studies, thirteen (81 %) studies[31–35,37–41,44–46] recommended CR patients to develop healthy eating habits, including a prudent diet, and a cholesterol-lowering diet. One (6 %) study[36] recommended a weight-reducing diet. One (6 %)[42] study recommended the increase of fish oil and *n*-3 intake. Finally, one (6 %)[43] study recommended CR patients to transition to vegetarian-rich diets.

Characteristics of dietary recommendations described according to Workgroup for Intervention Development

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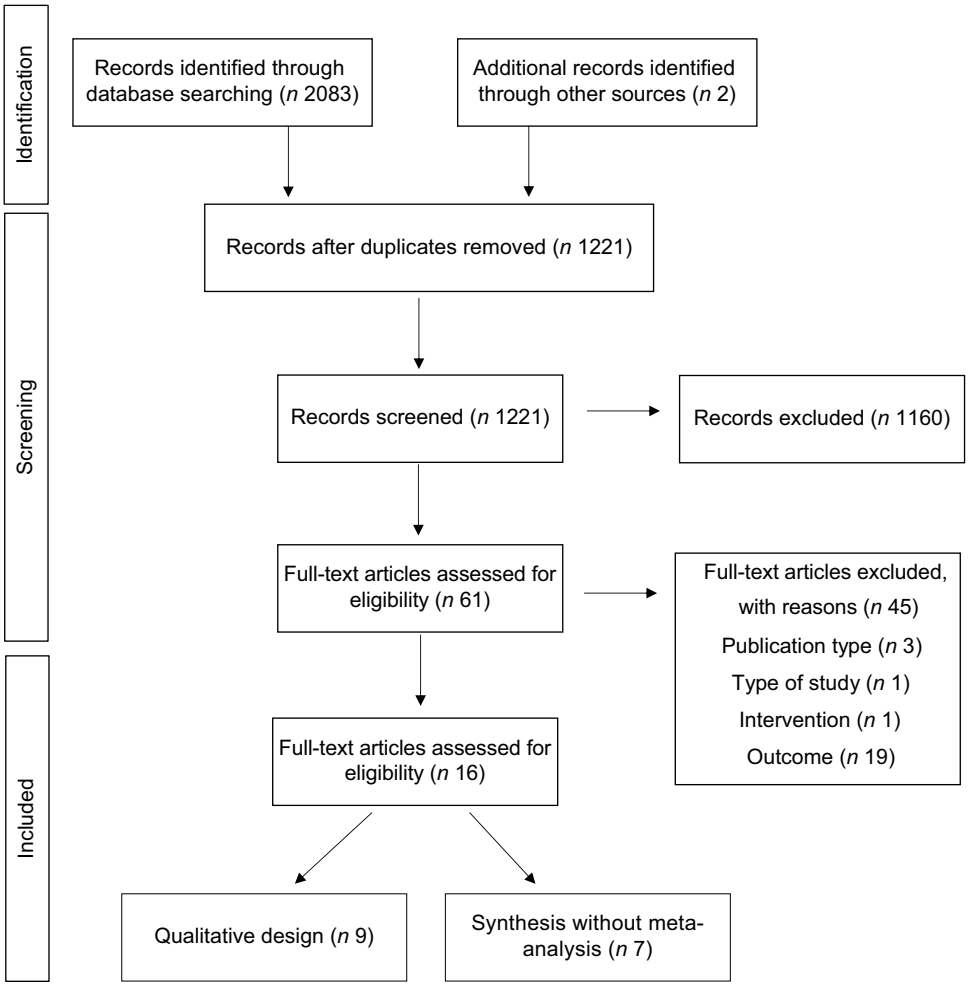

Fig. 1 Summary of the study selection process

and Evaluation Research were reported by the following number of studies: delivering the intervention by eight8 (50 %) studies[32,34,36,40,42–45], detailed description of the intervention content by four (25 %) studies[34,36,41,44], intensity by five (31 %) studies[36,40,41,43,44], mode of delivery by ten (62 %) studies[32–34,36,40–45], duration by five (31 %) studies[34,36,40,41,44], setting by 16 (100 %) studies[31–46] and adherence to delivery protocol by 6 (37 %) studies. Overall, one (6 %)[44] study reported all seven characteristics of the nutrition education, and two (12 %)[36,41] reported six of them. The other studies included in this systematic review described an average of 2·6 characteristics (range 0–5)[31–35,37–40,42,43,45,46].

Barriers affecting adherence to dietary recommendations

Barriers affecting adherence to dietary recommendations were identified by CR participants in fourteen studies. These barriers cover individual- and system/environmental-levels. No barriers at a provider-level were identified by any of the included studies (refer to Table 1 and Fig. 3).

The identified individual-level barriers included were the following: food habits, financial situation, personal reasons, time constraints, psychological and cultural aspects. Food habits were the most common barrier, being reported in eight studies (50 %). These studies recommended CR participants to develop healthy eating habits and transition to vegetarian-rich diets[31,34,39–41,43–45]. CR participants reported that the taste of healthy foods and difficulties in not eating their favourite foods were important aspects contributing to low adherence to dietary recommendations.

Financial situation[31,33,34,41,42,44,45] and personal reasons[33,34,36,41,42,44,45] were reported by seven studies each (37 %), as barriers to adopting healthy eating habits and increasing fish oil and *n*-3 intake. The financial cost of food emerged as a strong barrier to adopting the nutritional changes recommended. Participants reported that 'the instructed diet was expensive'. Personal reasons included insecurity about how the diet would affect their health or body, a lack of interest or motivation to change their current eating habits, having their foods prepared by others, and difficulties in controlling their appetites and food choices when seeing food advertisements or

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Table 1. Characteristics of the included studies

Author Year of publication Country	Study design Method of data extraction Quality assessment	Sample size (% of eligible patients) Characteristic of participants	Dietary recommendations*	Components of dietary recommendations with CR according to WIDER[30]	Barriers (level)	Facilitators (level)
Astin *et al.* 2008[31] United Kingdom	Qualitative study Individual Semi-Structured interviews using thematic topic guidelines Good (9/10)†	65 participants (58·0 %) 'White' European (*n* 20) and 'South Asian' (*n* 24) patients Diagnosis of unstable angina, or myocardial infarction followed or not by coronary bypass graft surgery 36 (55·4 %) male Mean age = 62·0 ± 1·3 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: ND Duration: ND The setting: in-hospital CR Adherence to delivery protocol: ND	Food habits (individual-level) Cultural aspects (individual-level) Time constrains (individual-level) Lack of knowledge (individual- and provider-levels) Financial situation (individual-level)	Family support (system/environmental-level) Financial situation (individual-level)
Galdas *et al.* 2010[32] Canada	Qualitative study Individual Semi-Structured interviews using thematic topic guides Good (10/10)†	15 participants (ND) Sikh and Punjabi speakers with history of myocardial infarction 10 (66·0 %) male Age ranged from 45 to 80 years old (mean and SD ND)	Developing healthy eating habits	Characteristics of those delivering the intervention: dietitians Detailed description of the intervention content: healthy eating orientations, details ND Intensity: ND Mode of delivery: questions and answers, and advices during CR sessions Duration: ND The setting: in-hospital CR Adherence to delivery protocol: ND	Lack of knowledge (individual- and provider-levels) Language barriers (individual- and provider-levels)	Knowledge (individual- and provider-levels) Support from the CR (provider-level)
Galdas *et al.* 2012[33] Canada	Qualitative study Individual Semi-Structured interviews using thematic topic guides Good (10/10)†	27 participants (ND) Sikh and Punjabi speakers with history of myocardial infarction 27 (100·0 %) male Mean age = 65·7 years old (ranged from 41 to 86; SD ND)	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: health and lifestyle educational sessions, workshops and individual counselling Duration: ND The setting: in-hospital CR Adherence to delivery protocol: ND	Lack of family support (system/environmental-level) Cultural aspects (individual-level) Financial situation (individual-level) Personal reasons (individual-level)	Knowledge (individual- and provider-levels) Support from the CR (provider-level) Family support (system/environmental-level)
Koikkalainen *et al.* 1996[34] Finland	Qualitative study Individual Semi-Structured interviews using thematic guide Good (8/10)†	48 participants (ND) History of myocardial infarction or other heart disease diagnosis 33 (68·7 %) male Mean age = 61·0 ± 10·4 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: dietitian Detailed description of the intervention content: Nutritional counselling and lecture on healthy diet Intensity: ND Mode of delivery: Nutritional counselling Duration: 90 min The setting: Outpatient CR Adherence to delivery protocol: ND	Social aspects (individual- and system/environmental-levels) Food habits (individual-level) Lack of family support (system/environmental-level) Lack of knowledge (individual- and provider-levels) Time constrains (individual and system/environmental-levels) Personal reasons (individual-level) Psychological aspects (individual-level) Financial situation (individual-level) Availability of food (system/environmental-level)	ND

Table 1. *Continued*

Author Year of publication Country	Study design Method of data extraction Quality assessment	Sample size (% of eligible patients) Characteristic of participants	Dietary recommendations*	Components of dietary recommendations with CR according to WIDER[30]	Barriers (level)	Facilitators (level)
Meyer *et al.* 2014[35] Australia	Qualitative study Individual Semi-Structured interviews using thematic guide topics Good (10/10)†	37 participants (37·0 %) Diagnosis of heart disease or those taking statin to reduce cholesterol 22 (59·4 %) male Age ranged from 32 to 80 years old (mean and SD ND)	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: ND Duration: ND The setting: outpatient CR Adherence to delivery protocol: ND	Lack of knowledge (individual- and provider-levels)	ND
Reid *et al.* 1984[36] Ireland	Qualitative study Individual Semi-Structured interviews using thematic guide topics Fair (5/10)†	38 participants (ND) History of myocardial infarction or unstable angina 38 (100·0 %) male Mean age = 50·0 years old (range from 28 to 59; SD ND)	Based on patient's needs, it included a prudent diet, cholesterol-lowering diet, weight-reducing diet or a combination of these	Characteristics of those delivering the intervention: dietitian Detailed description of the intervention content: dietary advice based on participant's deficient intakes of vitamins, minerals, cholesterol, carbohydrates, fibre and alcohol Intensity: 30–60 min Mode of delivery: nutritional interviews and questions and answers via telephone Duration: 12 months The setting: outpatient CR Adherence to delivery protocol: ND	Lack of knowledge (individual- and provider-levels) Personal reasons (individual-level) Lack of family support (system/environmental-level)	ND
Rowland *et al.* 2018[37] USA	Qualitative study Individual Semi-Structured interviews using thematic guide topics Good (10/10)†	11 participants (32·3 %) History of coronary artery bypass graft surgery 9 (81·8 %) male Mean age = 64·3 ± 3·3 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: ND Duration: ND The setting: outpatient CR Adherence to delivery protocol: ND	Lack of family support (system/environmental-level)	ND
Fletcher *et al.* 2014[38] Australia	Qualitative study Focus Group Sessions with Semi-Structured interviews using thematic topic guides Good (9/10)†	8 participants (44·4 %) History of myocardial infarction followed by coronary artery bypass grafting or stenting, or cardiomyopathy 7 (87·5 %) male Mean age = 71·7 years old (SD not reported)	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: ND Duration: ND The setting: outpatient CR Adherence to delivery protocol: ND	ND	Support from the CR (provider-level)

Table 1. *Continued*

Author Year of publication Country	Study design Method of data extraction Quality assessment	Sample size (% of eligible patients) Characteristic of participants	Dietary recommendations*	Components of dietary recommendations with CR according to WIDER[30]	Barriers (level)	Facilitators (level)
Karner *et al.* 2005[39] Sweden	Qualitative study Focus Group Sessions with Semi-Structured interviews using thematic topic guides Good (10/10)†	113 participants (26·5 %) Diagnosis of CHD with history of myocardial infarction followed by percutaneous coronary intervention and/or coronary artery bypass surgery 75 (55·0 %) male Mean age = 59·1 ± 7·1 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: ND Duration: ND The setting: in-hospital CR Adherence to delivery protocol: individual interviews at baseline and one year later	Psychological aspects (individual-level) Lack of family support (system/environmental-level) Lack of knowledge (individual- and provider-levels) Food habits (individual-level)	Knowledge (individual- and provider-levels) Family support (system/environmental-level)
Sharp *et al.* 2012[40] USA	Observational study Prospective cohort Questionnaires using quantitative questions (the Healthy Eating Benefits and Barriers Scale) Data collected in two time points: (1) 6 weeks after hospital discharge; (2) 12 weeks after hospital discharge Fair (12/18)‡	51 participants (ND) Diagnosis of coronary artery disease 14 (27·4 %) male Mean age = 66·0 ± 9·8 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: dietitians and cardiac rehab team Detailed description of the intervention content: nutritional orientations, details on content ND Intensity: 3 d/week Mode of delivery: pamphlets, booklets, verbal discussions, videotapes, flip charts, lecture, hand-outs and return demonstration Duration: 6 weeks The setting: outpatient CR Adherence to delivery protocol: ND	Barriers to health dietary intake reported by 2·91 (0·10) (Mean (SE)) participants Food habits (individual-level) Time 1: CR participants – mean, 2·48 Time 2: CR participants – mean, 2·38 Availability of food (system/environmental-level) Time 1: CR participants – mean, 2·52 Time 2: CR participants – mean, 2·67 Lack of knowledge (individual- and provider-levels) Time 1: CR participants – mean, 2·93 Time 2: CR participants – mean, 2·26	ND
Koikkalainen *et al.* 1999[41] Finland	Observational study Cross-sectional study Questionnaire using quantitative yes-no questions Fair (12/18)‡	91 participants (ND) Diagnosis of myocardial infarction 91 (100·0 %) male Mean age = 49·3 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: participants received a written evaluation of the nutrient's intakes on their own diaries Intensity: 120–180 min Mode of delivery: nutritional counselling Duration: one session offered 4– to 8 weeks after the beginning of the CR The setting: outpatient and in-hospital CR Adherence to delivery protocol: daily food diaries	Outpatient CR rehabilitation Mean (SD) barriers reported: 4·3 (3·3) Differences between low and high fat groups (4·0 *v.* 4·5 barriers) ($P > 0·05$) In-hospital CR rehabilitation Mean (SD) barriers reported 3·2 (3·3) Differences between low and high fat groups (2·9 *v.* 3·4 barriers) ($P < 0·05$). Social aspects (individual- and system/environmental-levels) Financial situation (individual-level) Availability of food (system/environmental-level) Time constrains (individual-level) Food habits (individual-level) Personal reasons (individual-level) Lack of family support (system/environmental-level) Lack of knowledge (individual- and provider-levels)	ND

Table 1. *Continued*

Author Year of publication Country	Study design Method of data extraction Quality assessment	Sample size (% of eligible patients) Characteristic of participants	Dietary recommendations*	Components of dietary recommendations with CR according to WIDER[30]	Barriers (level)	Facilitators (level)
Cannon *et al.* 2014[42] Ireland	Observational study Cross-sectional Questionnaire using quantitative multiple-choice and open-ended questions Poor (5/18)‡	49 participants (61·2 %) No other characteristics reported 33 (69·0 %) male 32 (66·0 %) participants aged older than 60·0 years old (mean age ND)	Increasing fish oil and *n*-3 intake	Characteristics of those delivering the intervention: dietitians Detailed description of the intervention content: ND Intensity: ND Mode of delivery: nutritional sessions Duration: ND The setting: in-hospital CR Adherence to delivery protocol: checked by questionnaires (time points not described)	Financial situation (individual-level) 'Too expensive': participants, 34·7 % Personal reasons (individual-level) 'I am vegetarian/vegan': participants, 0·0 % 'Allergic to fish': participants, 2·0 % 'Difficult cooking it': participants, 4·1 % 'Dislike it': participants, 12·2 % 'Other': participants, 14·3 % 'Had not thought about it': participants, 26·5 % Availability of food (system/environmental-level) 'No fish shops nearby': participants, 2 %	ND
Franklin *et al.* 1995[43] USA	Observational study Prospective cohort study Questionnaire using quantitative multiple-choice questions (seven-point Likert scale) †Data from barriers and facilitators were extracted from qualitative clinical interviews Poor (6/18)‡	10 participants (ND) Diagnosis of coronary artery disease, or history of myocardial infarction 7 (70 %) male Mean age = 50·0 years old (SD not reported)	Transitioning to vegetarian-rich diets	Characteristics of those delivering the intervention: dietitians Detailed description of the intervention content: orientations to a total vegetarian diet with less than 10 % energy from fat (more details ND) Intensity: once a week Mode of delivery: individual nutritional sessions, cooking and educational resources Duration: ND The setting: outpatient CR Adherence to delivery protocol: surveys delivered at 7, 11, 28 weeks, at 1 year and after holidays (between 11 and 28 week-surveys)	Food habits (individual-level) Availability of food (system-level) Social aspects (individual- and system/environmental-levels)	Support from the CR (provider-level)
Hamalainen *et al.* 2000[44] USA	Observational Study Prospective cohort study Diaries and Questionnaires using quantitative open-ended questions †Data from barriers were extracted from personal subjective options Fair (8/18)‡	54 participants (ND) Anginal symptoms or ischaemic left ventricular dysfunction 46 (85·0 %) male Mean age = 54·3 ± 8·1 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: dietitian Detailed description of the intervention content: orientations to reduce 20 % of total energy intake, promote unsaturated instead of saturated fats, increase the use of complex carbohydrate and maintain the level of dietary protein Intensity: once a week Mode of delivery: educational counselling, cooking and resources Duration: 40–120 min The setting: outpatient CR Adherence to delivery protocol: food diaries monitored before, and each 3 months after the initial nutritional counselling; individual open-ended questions about dietary intake	Financial situation (individual-level) 'Instructed diet was expensive': baseline – participants, *n* 1; 6-months – participants, *n* 2. Personal reasons (individual-level) 'Person preparing the food was not willing to carry out the recommended changes': baseline – participants, *n* 0; 6-months – participants, *n* 3. Food habits (individual-level) 'Foot with low fat content to be tasteless': baseline – participants, *n* 2; 6-months – participants, *n* 7	ND

Table 1. *Continued*

Author Year of publication Country	Study design Method of data extraction Quality assessment	Sample size (% of eligible patients) Characteristic of participants	Dietary recommendations*	Components of dietary recommendations with CR according to WIDER[30]	Barriers (level)	Facilitators (level)
Lappalainen *et al.* 1998[45] Finland	Observational study Cross-sectional study Questionnaires using quantitative yes-no questions Poor (6/18)‡	121 participants (ND) History of myocardial infarction 96 (79·3 %) male Mean age = 50·0 years old (ranged from 32 to 60; SD ND)	Developing healthy eating habits	Characteristics of those delivering the intervention: dietitian Detailed description of the intervention content: information about the intake of carbohydrates, proteins, fats (fatty acids and cholesterol) (more details ND) Intensity: 4–8 weeks in total (week visits ND) Mode of delivery: educational counselling and resources Duration: ND The setting: outpatient CR Adherence to delivery protocol: 4 days food diaries (2 week and 2 weekend days)	Overall barriers Mean reported barriers, 4·4 Male – mean, 4·5 *v.* Female – mean, 2·9 ($P < 0·05$) Age <50 – mean 4·6 *v.* >50 – mean, 4·3 ($P > 0·05$) BMI ≤ 27 – mean, 5·0 *v.* ≥ 27 – mean, 3·8 ($P > 0·05$) Education lower – mean, 5·3 *v.* higher – mean, 3·6 ($P < 0·05$) Social aspects (individual- and system/environmental-levels) 'Positive decisions about diet are forgotten while eating in company': participants, *n* 61 (male, *n* 52 *v.* female, *n* 8; $P < 0·05$) 'Healthful diet is easily forgotten while eating outside the home': participants, *n* 39 (BMI ≤ 27, *n* 24 *v.* BMI ≥ 27, *n* 13; $P < 0·05$) 'I eat like others in my company without thinking about what to eat', participants, *n* 25 'I eat like my friends and colleagues, because I do not want to be different from them', *n* 13 (BMI ≤ 27, *n* 10 *v.* BMI ≥ 27, *n* 3; $P < 0·05$/educational low, *n* 10 *v.* high, *n* 2) 'Positive decisions about diet are forgotten while eating alone': participants, *n* 13 Financial situation (individual-level) 'Food prices dictates what I buy': participants, *n* 31. Time constrains (individual- and system/environmental-levels) 'I have no time for proper meals at work': participants, *n* 27 (male, *n* 25 *v.* female, *n* 2; $P < 0·05$)/ Age<50, *n* 17 *v.* Age>50, *n* 10; $P < 0·05$) 'I am very busy, therefore, I have no time to think specially about food', participants, *n* 15 (education lower, *n* 13 *v.* high, *n* 2; $P < 0·01$). Food habits (individual-level) 'Low-fat foods are not appetising': participants, *n* 15 (male, *n* 14 *v.* female, *n* 0; $P < 0·05$) Personal reasons (individual-level) 'I am satisfied with my body and I do not want to change my eating habits', participants, *n* 15	ND

Table 1. *Continued*

Author Year of publication Country	Study design Method of data extraction Quality assessment	Sample size (% of eligible patients) Characteristic of participants	Dietary recommendations*	Components of dietary recommendations with CR according to WIDER[30]	Barriers (level)	Facilitators (level)
					'I do not have enough energy to think about food, I have other worries in my life', participants, *n* 15 (education low, *n* 12 *v.* high, *n* 3; $P < 0{\cdot}05$) Lack of knowledge (individual- and provider-levels) 'It is difficult to obtain information on nutrition', participants, *n* 13 Availability of food (system/environmental-level) 'Because of work I have to eat what is available': participants, *n* 44 (male, *n* 44 *v.* female, *n* 3; $P < 0{\cdot}01$/BMI ≤ 27, *n* 32 *v.* BMI ≥ 27, *n* 14) 'There is too much food available': participants, *n* 28 (male, *n* 26 *v.* female, *n* 2; $P < 0{\cdot}05$) 'It is too difficult to select food while shopping in the supermarket': participants, *n* 28 (BMI ≤ 27, *n* 10 *v.* BMI ≥ 27, *n* 2; $P < 0{\cdot}05$)	
Leong *et al.* 2004[46] United Kingdom	Observational study Cross-sectional study Questionnaires using quantitative multiple-choice questions (five-point Likert scale) Good (14/18)‡	52 participants (61·1 %) Diagnosis of thrombolysis or coronary artery disease 42 (80·8 %) male Mean age = 65·0 ± 10·8 years old	Developing healthy eating habits	Characteristics of those delivering the intervention: ND Detailed description of the intervention content: ND Intensity: ND Mode of delivery: ND Duration: ND The setting: outpatient CR Adherence to delivery protocol: ND	ND	Family support (system/environmental-level) Correlation with adherence to healthy eating habits: $r_s = 0{\cdot}50$; $P < 0{\cdot}001$ Older age (individual-level) Correlation with adherence to healthy eating habits: $r_s = 0{\cdot}31$; $P < 0{\cdot}05$

ND, not described.
*Same name used in the publication; quality assessment score (classification).
†Critical Appraisal Skills Programme, scores ranged from 0 to 10 (poor: 0–4; fair: 5–7; good: 8–10).
‡Downs and Black Modified Checklist; scores ranged from 0 to 18 (poor: 0–6; fair 7–12; good 13–18).

presented with the greater availability of different or cheaper foods in local stores.

Four studies (25 %) reported time constraints[31,34,41,45] as a barrier affecting adherence to dietary recommendations. CR participants identified irregular work hours and lack of time to prepare healthy foods as a barrier. Making dietary changes was described as 'time consuming' and 'factors that create unnecessary work'. Psychological aspects[34,39] and cultural aspects[31,33] were also reported as barriers affecting adherence to dietary recommendations in two studies each (12 %). Patients indicated they did not have enough energy or a psychological state that motivate them to engage in healthy eating habits. Cultural aspects were raised by the South Asian population attending CR programmes. In their culture (Punjabi Sikh), meals are usually prepared by women for the whole family, and men have little control on what will be prepared. According to this cultural group, it was not appropriate to change dietary habits for the whole family because of healthy eating requirements necessary for one family member.

Barriers at the system/environmental-level were listed as lack of family support and a poor availability of recommended foods. Lack of family support was reported in six (37 %) studies[33,34,36,37,39,41]. Since meals are often prepared by one family member, it was often regarded as 'too much work' to prepare a different meal for only one person within the family.

The availability of certain foods was reported as a barrier in six (37 %) studies that recommended adopting healthy eating habits, increasing fish oil and *n*-3 intake, and transitioning to vegetarian-rich diets[34,40–43,45]. Lack of healthy choices in restaurants, limited healthy ingredients in local grocery stores, the absence of fish shops close to home and difficulty in finding fresh vegetables during certain seasons of the year (such as winter) were described by patients.

Multi-level barriers included a lack of knowledge, language difficulties and social aspects. Lack of knowledge was the most common barrier reported by studies that recommended healthy eating habits (*n* 9; 56 %)[31,32,34–36,39–41,45], and it was characterised as both an individual- and provider-level barrier. Some participants indicated they did not know how to choose healthy and acceptable foods or expressed challenges in understanding the association between diet and their cardiovascular condition. Language was also characterised as both an individual- and provider-level barrier. One study[32] recommended establishing healthy eating habits to Punjabi-speaking CR patients noted that they were not able to engage in private discussions about their dietary choices because translators were not available. Lastly, social factors were reported as both an individual- and system-level barrier to dietary adherence by four (25 %) studies[34,41,43,45]. CR participants identified challenges of choosing healthy foods on workdays or while eating with others. While associating with other people, patients prefer to eat what others are eating because they 'do not want to be different' from their friends and colleagues.

Facilitators affecting adherence to dietary recommendations

Seven (43 %) studies reported specific facilitators for improving adherence to dietary recommendations in comprehensive CR programmes[31–33,38,39,43,46]. These factors, also characterised on an individual-, provider- and system/environmental-level, are described in Table 1 and illustrated in Fig. 3.

Two individual-level facilitators for developing healthier eating habits included the participants' financial situation and an older age. Financial circumstances were reported by one (6 %) study[31] and impacted the nature of meals since as dependent on the food purchased. Participants were more likely to purchase healthy foods when shopping with family members. A positive correlation between adhering to healthy eating habits and older age was reported by one study[46]. According to this study, older people are more likely to follow healthy eating recommendations.

At the provider-level, support from CR programmes was reported by four studies (25 %) as a facilitator to developing healthy eating habits or adopting a vegetarian-rich diet adherence[32,33,38,43]. Participants indicated receiving ongoing support and reassurance from CR providers was a critical element for their adhering to healthier eating habits.

At the system/environmental-level, family support was identified as a key facilitator to developing healthier eating habits in four studies (25 %)[31,33,39,46]. There are 'several ways in which families supported patients in adopting healthier dietary habits', including partners deciding to change their diet habits as well or family members helping with healthy food preparation and encouraging CR participants to follow dietary recommendations.

Knowledge was identified as a multi-level (provider- and individual-level) facilitator for establishing healthy eating habits as reported by three studies (18 %)[32,33,38,43]. Participants who understood the association between unhealthy eating habits and their cardiovascular conditions were more likely to change their eating habits.

Nine studies (56 %) did not identify specific facilitators for establishing a healthy diet in CR participants[34–37,40–42,44,45]. Unfortunately, none of the studies identified facilitators for increasing fish oil and *n*-3 intake.

Synthesis Without Meta-analysis of quantitative studies

Seven quantitative studies included in this systematic review could not be meta-analysed as the relevant information required for statistical analysis was not reported[40–46]. These seven studies used different strategies to report barriers and facilitators, including average[40], total absolute number[44], total percentage of participants that reported

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Fig. 2. Countries in which cardiac rehabilitation programmes are reported. Data from availability of CR programs around the world were extracted from study published by Turk-Adawi *et al.*[53]

barriers and facilitators affecting dietary intake[42], the mean number of barriers and facilitators reported by CR participants[41,45] or correlation between facilitators that affects adherence to dietary intake[46]. Furthermore, although classified as quantitative, one study reported barriers based on qualitative clinical interviews[43]. Data from these results are shown in Table 1, and barriers and facilitators were incorporated into the model described above.

Discussion

To the best of our knowledge, this is the first systematic review that investigates barriers and facilitators affecting adherence to dietary recommendations in patients participating in comprehensive CR programmes. Although a limited number of published studies were identified, the existing data suggested that CR patients experienced barriers affecting dietary recommendations at an individual-, provider- and system/environmental-level. Dietary recommendations included in these studies were listed as developing healthy eating habits, transitioning to vegetarian-rich diets, and increasing fish oil and *n*-3 supplements. Barriers affecting adherence to dietary recommendations, in descending order of appearance, were lack of knowledge, financial situation, personal reasons, lack of family support, availability of food, food habits, time constraints, social aspects, food habits, cultural aspects, psychological aspects and language. Facilitators affecting adherence to dietary recommendations were identified and, in descending order, included: support from the CR programme, family support, knowledge and older age.

Although barriers and facilitators to participant adherence of dietary recommendations were identified, those are only representative of recommendations to developing healthy eating habits, transitioning to vegetarian-rich diets and increasing fish oil and *n*-3 supplements. The dietary patterns noted in the Mediterranean Diet, the Dietary Approaches to Stop Hypertension Diet, the Portfolio Diet, and Vegetarian and Vegan diets are highly recommended for patients participating in CR programmes. However, the perceived barriers and facilitators experienced by patients trying to follow these dietary patterns are often not reported in the literature[11,12,14,15,17,18,54]. This is an important literature gap, identified by this systematic review, that should be addressed in future studies.

Furthermore, this review was not able to identify a standardised intervention for delivery of dietary recommendations in CR as most of the studies did not reported main characteristics following the Workgroup for Intervention Development and Evaluation Research recommendations[48]. This lack of existing data to guide healthcare providers on the optimal setting, mode of delivery, intensity, duration and content of dietary recommendations for patients participating in CR is concerning. Cardiac College – a comprehensive and evidence-based virtual patient education programme[55,56] – is available in eight languages for CR programmes to use and address nutritional education in a standardised way. This tool could be of great use to programmes around the globe in addressing some of the educational gaps related to dietary recommendations.

Availability of food was reported as a barrier affecting adherence to healthy eating habits, increasing fish oil

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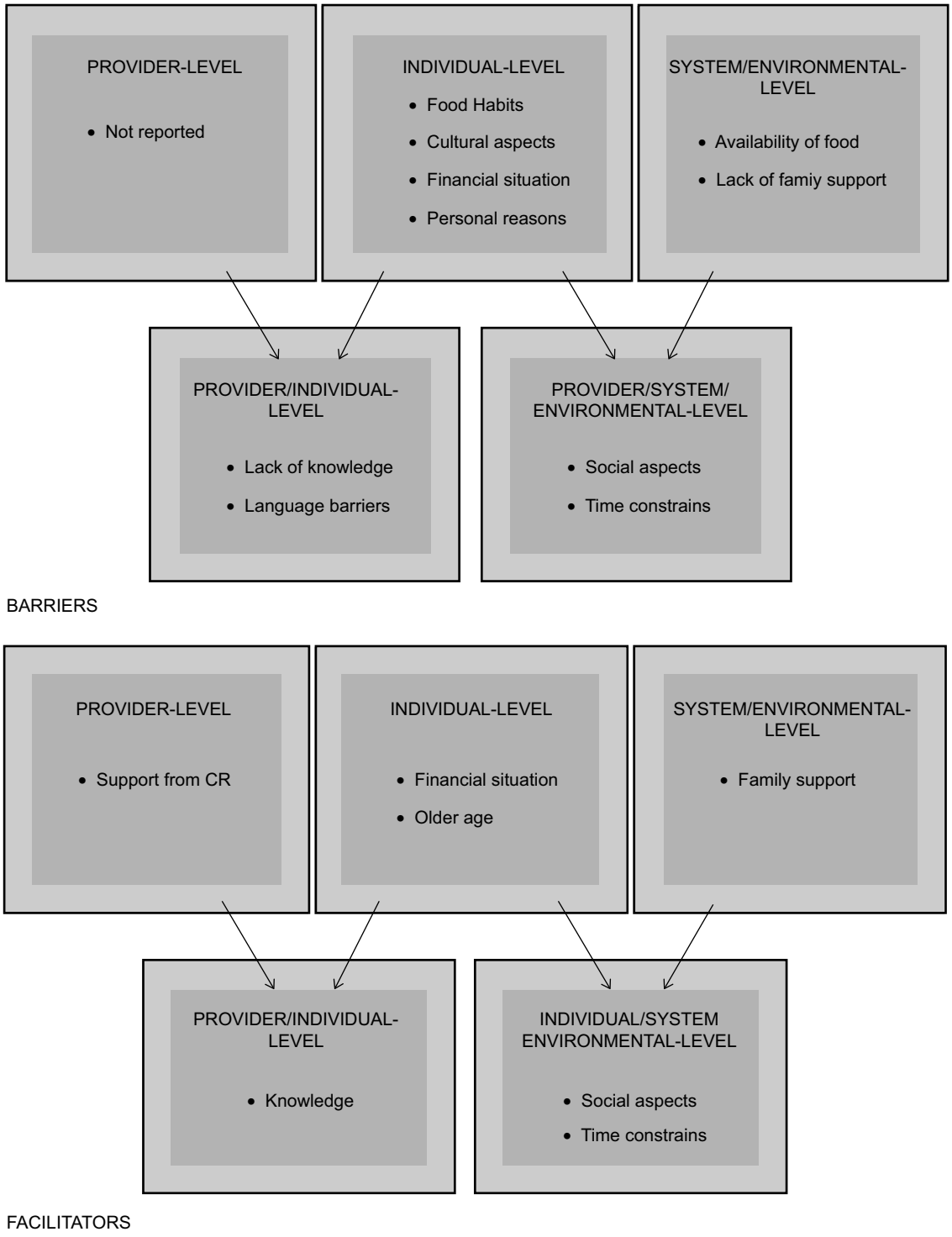

Fig. 3. Diagram of barriers and facilitators affecting adherence to dietary recommendations in CR programmes in an individual-, provider- and system/environmental-level. CR, cardiac rehabilitation

and *n*-3 supplement intake and transitioning to vegetarian-rich diets, as patients reported difficulty in finding healthy food options close to their homes[34,40–43]. Previous studies have identified an association between availability of healthy food and race/ethnicity, financial situation, and access to grocery stores and supermarkets[57–59]. In the American city of Baltimore, Morland *et al.*[57] suggested that high availability of healthy foods was present in only 19 % of predominately black neighbourhoods compared with 68 % of white neighbourhoods. People living in areas with long distances to supermarkets, low access to fresh foods and with an abundance of unhealthy processed fast food outlets were less likely

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to adhere to dietary recommendations[57–59]. Patients' income also has an important impact on their adherence to dietary recommendations[60]. A comprehensive analysis of food purchase patterns from a representative sample of 4826 American households showed that low-income households purchased lower amounts of healthy food than recommended[57]. Overall, low-income households were less likely to purchase fruits and vegetables and more likely to purchase sugar-sweetened beverages. The higher food prices for higher quality foods may account for this behaviour as healthy food purchases required spending more money, which might force patients to choose unhealthy eating options instead[60].

The global burden of CVD shifted to low-and-middle income regions such as Eastern Europe and Central Asian countries as a result of a combined effect of population growth, ageing, high intake of processed foods and alcoholic drinks, high prevalence of smokers and inadequate strategies to reduce cardiovascular risk factors[61–63]. However, barriers and facilitators affecting adherence to dietary recommendations reported by patients participating in CR programmes of these countries remain unknown. This systematic review included studies conducted in high-income countries and, therefore, conclusions cannot be extrapolated to middle- and low-income countries where socio-economic disparities are more evident. In high-income countries such as Canada and the USA, immigration status can also impact food purchases as immigrants usually incorporate unhealthy and fast foods into their traditional diet[63]. In this context, studies have shown that culture creates challenges to immigrant adherence to dietary recommendations in CR programmes[64,65]. The main reasons for this fact include limited access to familiar foods or ingredients, such as types of vegetables or spices, uncertainty or unfamiliarity with new foods and cultural preparation practices, and digestion problems related to the consumption of unfamiliar products[66–68].

Food habits are also important barriers to healthy dietary intake, mainly associated with the taste of the food[69]. The human attraction to sweet and savoury foods is known, so food companies add a large amount of sugar and Na to most processed products, which may contribute to an increase of low-quality food intake, obesity and cardiovascular risk in overall populations[69–72]. Although not reported by the included studies, food taste and choice can also be influenced by branding and marketing, as advertisements that promote fun, happiness and excitement are linked to positive sensory thoughts with the target food, and contribute to the specific consumption of that product[73].

Social determinants, including family and social support, have been recognised as a powerful influence in food choices and eating patterns[74–77]. Family support was identified in this systematic review as both a barrier and a facilitator to adherence of dietary recommendations. Overall, conflicts with home habits and social environments result in patients being poor compliers, whereas when family and friends build nutrition changes together it influences patients to adopt healthier dietary choices[76,77]. Lack of family support may also affect patients by producing negative emotions such as anxiety, depression, uncertainty, fatigue, irritability, poor concentration and insomnia[78–80]. Some reasons affecting family support include beliefs and attitudes towards CVD, motivations to adopt dietary changes with their family members diagnosed with CVD and knowledge regarding the impact of dietary habits on patients' cardiovascular health[78–80]. Language barriers, identified in this systematic review as a barrier affecting adherence to dietary recommendations, might be associated with patients and family members' limited information and misconceptions[79]. Support provided by the CR team, identified in this study as a facilitator affecting dietary recommendations, might contribute to overcoming lack of family support and language barriers[32,33,38]. Knowledge improvements and translation services can help patients and family members understand their cardiovascular conditions and impact their potential risk of having future events, improving the engagement of family members.

Finally, our review identified that elderly populations are more likely to follow dietary recommendations than young individuals[46]. This finding may be potentially associated with time constraints commonly reported by young productive populations, such as working long hours and family commitments to children and senior family members[81–84]. Studies with young individuals identified difficulties committing time to exercise and adopt healthy eating behaviours due to competing priorities or poor time-management skills[85,86].

Limitations

Results from this study should be interpreted with caution. We acknowledge that most of the studies included in this systematic review discuss barriers and facilitators to improving healthy eating habits. Only a small number of studies included detailed descriptions of healthy eating strategies recommended to patients participating in CR programmes. This makes it difficult to understand whether specific dietary characteristics address barriers and facilitators for healthy dietary intake. Furthermore, our results report data from CR participants only in high-income countries. Barriers and facilitators identified by people participating in CR programmes in other countries may be different. In addition, results extracted from these studies are only generalisable to patients who are referred and attend CR programmes, which are a low proportion of total cardiac outpatients.

Conclusions

Some recommendations described in the literature would help to overcome barriers related to patients' financial situation, lack of knowledge, lack of family member support and the cultural aspects reported by CR participants.

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Overall, the literature suggests financial incentives as important modulators of behaviour change[86,87]. Restrictions on advertisements of unhealthy food may also help to improve diet quality in this population[87,88]. CR programmes should also consider improving knowledge and providing culturally sensitive resources for patients and family members on culturally relevant dietary recommendations and on the importance of healthy food consumption and its impact on cardiovascular health. Furthermore, the use of technology (such as text messages)[89] may help CR providers to disseminate nutritional information to patients in need.

Results from this review highlighted the complex interaction between individuals, providers and systems in the adherence of dietary recommendations. Efforts to change eating behaviours, especially in secondary prevention programmes like CR, must carefully consider all described factors in this review to be successful. In addition, these results also suggest avenues for future research. First, researchers need to better understand barriers and facilitators from highly recommended diets to patients participating in CR programmes to help with policy changes. Second, healthcare providers need to counsel patients, if relevant, about culturally appropriate ways to engage in a healthy diet and to increase their knowledge and motivation, which can help with the provision of direct assistance in ways to access education resources. Finally, intervention strategies tailored to the unique life contexts of patients should be implemented at multiple levels to encourage healthy dietary behaviours, including all three levels addressed in this review.

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Supplementary material

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