



# openheart Health literacy interventions for secondary prevention of coronary artery disease: a scoping review

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► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/openhrt-2021-001895>).

**To cite:** Beauchamp A, Talevski J, Niebauer J, *et al*. Health literacy interventions for secondary prevention of coronary artery disease: a scoping review. *Open Heart* 2022;**9**:e001895. doi:10.1136/openhrt-2021-001895

Received 8 November 2021

Accepted 5 January 2022

## ABSTRACT

Deficits in health literacy are common in patients with coronary artery disease (CAD), and this is associated with increased morbidity and mortality. In this scoping review, we sought to identify health literacy interventions that aimed to improve outcomes in patients with CAD, using a contemporary conceptual model that captures multiple aspects of health literacy. We searched electronic databases for studies published since 2010. Eligible were studies of interventions supporting patients with CAD to find, understand and use health information via one of the following: building social support for health; empowering people with lower health literacy; improving interaction between patients and the health system; improving health literacy capacities of clinicians or facilitating access to health services. Studies were assessed for methodological quality, and findings were analysed through qualitative synthesis. In total, 21 studies were included. Of these, 10 studies aimed to build social support for health; 6 of these were effective, including those involving partners or peers. Five studies targeted interaction between patients and the health system; four of these reported improved outcomes, including through use of teach-back. One study addressed health literacy capacities of clinicians through communication training, and two facilitated access to health services via structured follow-up—all reporting positive outcomes. Health literacy is a prerequisite for CAD patients to self-manage their health. Through use of a conceptual framework to describe health literacy interventions, we identified mechanisms by which patients can be supported to improve health outcomes. Our findings warrant integration of these interventions into routine clinical practice.

## INTRODUCTION

Despite recent declines in mortality, coronary artery disease (CAD) remains a leading cause of death in adults.<sup>1</sup> CAD results in insufficient oxygen supply to the heart muscle and is the underlying cause of acute coronary syndrome (ACS), myocardial infarction (MI) and subsequent death.<sup>2</sup> To attenuate the progression of CAD, secondary prevention guidelines for heart disease recommend ongoing management of cardiac risk factors through lifestyle

changes, medication use and cardiac rehabilitation (CR).<sup>3</sup> However, these behaviours can be difficult to initiate and sustain in the longer term, with studies finding adherence rates to secondary prevention medications of 35%–71% following MI,<sup>4</sup> attendance rates of CR being approximately 30%<sup>5</sup> and smoking cessation rates 12 months post-MI at only 52%.<sup>6</sup>

One factor that may influence a patient's ability to initiate or maintain positive health behaviours is health literacy, which can be defined as 'the personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services to make decisions about health'.<sup>7</sup> Up to 60% of cardiac patients have limited health literacy,<sup>8,9</sup> which is associated with less engagement in healthy lifestyle behaviours,<sup>10</sup> increased hospital readmissions<sup>11</sup> and increased risk of mortality.<sup>11</sup> However, little is known about effective interventions to address health literacy barriers among patients with CAD. A recent systematic review of health literacy interventions in various adult populations included just two studies in cardiovascular patients.<sup>12</sup> This lack of evidence may be due to a strong focus on 'functional' health literacy within cardiac literature, that is, numeracy and literacy skills only.<sup>12–14</sup> However, more recent interpretations of health literacy are broader, and encompass the resources and supports an individual needs to engage with and apply health information, and the role of clinicians and healthcare organisations in supporting this.<sup>15</sup>

Because health literacy is both an individual attribute and one which is impacted by the 'health literacy environment',<sup>15</sup> interventions to address health literacy barriers must take account of a range of factors across the individual, their social networks and the healthcare system.<sup>13</sup> A conceptual

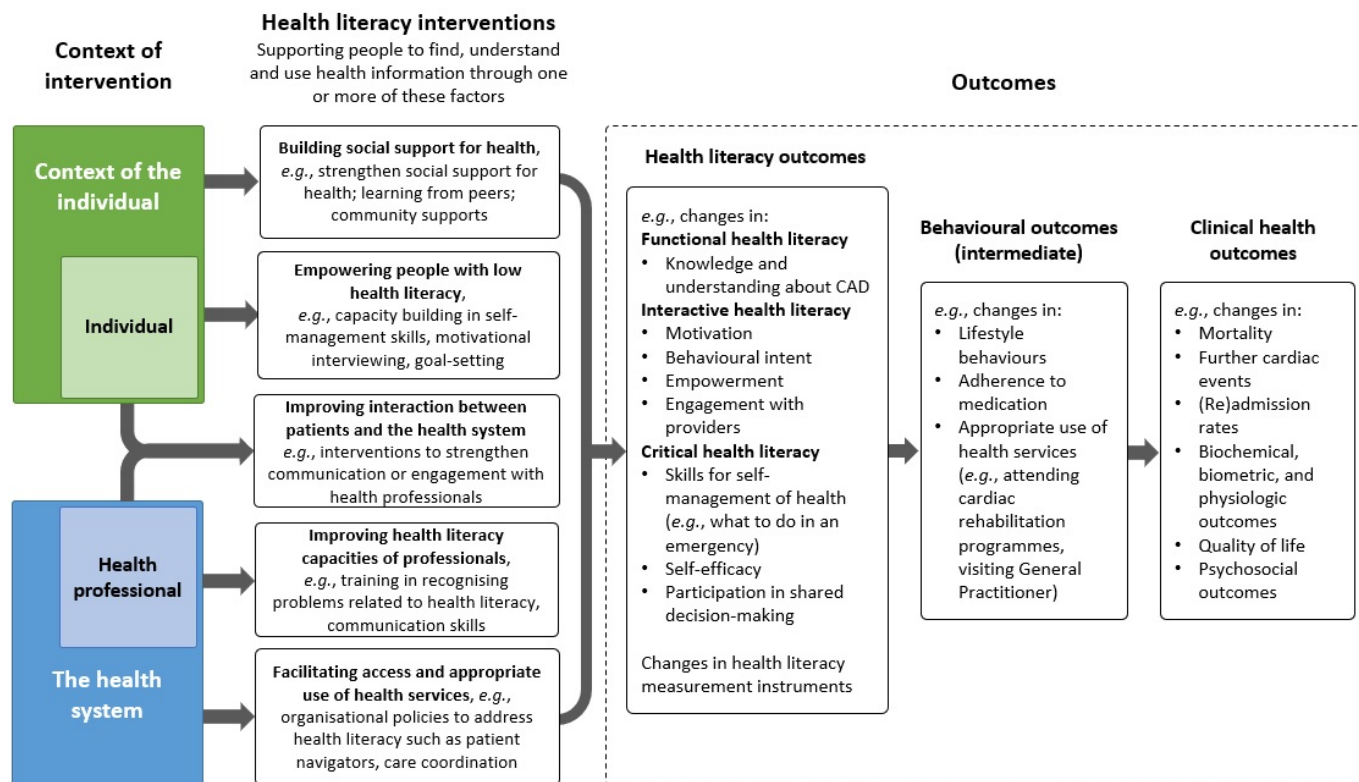


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**Figure 1** Health literacy intervention model for coronary artery disease (guided by the Geboers' Health Literacy Intervention Model).

model recently developed by Geboers<sup>16</sup> considers that health literacy interventions should address at least one of the following factors: (1) the context of the individual (eg, family, peers); (2) empowerment of individuals with lower health literacy (eg, capacity building); (3) improving interactions between an individual and the healthcare system; (4) improving health literacy capacities of health professionals and (5) improving accessibility to health services. Accordingly, a 'health literacy intervention' can be defined as a programme or process that supports people to find, understand and use health information by targeting one or more of these five factors. Applying this conceptual model to patients with CAD, intervention outcomes may be grouped into three interlinked categories: (1) health literacy outcomes, (2) behavioural outcomes and (3) clinical health outcomes (figure 1).

Given the limited evidence for effective interventions to address health literacy among cardiac patients, there is need for an up-to-date review based on broad search terms that capture the multidimensional nature of health literacy. The aim of this review was to describe the current evidence about health literacy interventions among patients with CAD using a conceptual model to guide our definition of a 'health literacy intervention'. Specific objectives were to identify the size and types of evidence, to map the evidence against the conceptual model and to describe any gaps in research.

## METHODS

We conducted a scoping review to address our research objectives. Scoping reviews address an exploratory research question by mapping key concepts, types of evidence and gaps in research related to a defined area.<sup>17</sup> This review was not registered in PROSPERO as protocols for scoping reviews are not accepted. A protocol for this review has been drafted and may be requested from the corresponding author.

### Step 1: identification of the research question

The research question was 'Are health literacy interventions associated with improved health literacy, behavioural outcomes and/or clinical outcomes in CAD patients?'

### Step 2: identification of relevant studies

An electronic search using Ovid MEDLINE, CINAHL and PsycINFO was performed for literature published between January 2010 and February 2021 (online supplemental file 1). Reference lists from eligible studies, systematic reviews and grey literature were also reviewed. Inclusion criteria were defined according to the Population, Intervention, Comparison, Outcome, Study type framework (table 1). Additional inclusion criteria included peer-reviewed publications in English or German languages, accessible in full text, and published since 2010 (to capture more recent evidence). Studies of cardiac conditions other than CAD were excluded unless outcomes were reported separately for CAD. This

**Table 1** Study eligibility criteria according to the PICOS framework

Population	The study recruited participants with established CAD (cardiovascular disease, coronary heart disease, acute MI, acute coronary syndrome), or if results were reported separately for participants with CAD when the study sample included other clinical groups.
Intervention(s)	All interventions that fit the conceptual model of health literacy adopted for this review. The intervention was described as a 'health literacy intervention' by the study authors; the authors examined whether the intervention was effective in people with low versus high health literacy; or the intervention matched the health literacy definition of supporting people to find, understand and use information through at least one of the mechanisms shown in the conceptual model in <a href="#">figure 1</a> : building social support for health; empowering people with lower health literacy; improving interaction between patients and the health system; improving the health literacy capacities of health professionals; facilitating access and appropriate use of health services.
Comparison	Any comparison, that is, an alternative intervention, usual care, or no care.
Outcome(s)	Participant outcomes relating to changes in health literacy, health behaviours (eg, physical exercise, appropriate use of health services) or clinical health outcomes (eg, hospital admissions, depression).
Study types	The study investigated the effect of an intervention, in a controlled (randomised, quasi-randomised or non-randomised) or uncontrolled (eg, before and after comparison) study design.

CAD, coronary artery disease; MI, myocardial infarction; PICOS, Population, Intervention, Comparison, Outcome, Study.

covers studies of patients with heart failure. While heart failure is frequently a consequence of CAD, the aims of treatment may differ. We also excluded studies targeting primary CAD prevention.

### Step 3: study selection

Title and abstracts were screened by the authors with ineligible records removed. Full texts of the remaining records were screened independently by two authors. Where a screening decision was uncertain, the final decision was made through discussion between AB and STK.

### Step 4: charting the data

Data charting (extraction) from full-text articles was conducted by all reviewers. The following information was extracted: first author, publication year, country, study aim(s), study design, setting, sample description, intervention description, comparison/control group description (if applicable), outcome measures and key findings.

### Step 5: synthesis of results

Findings were synthesised in a qualitative synthesis, using descriptive tables and concept maps to address the review objectives.

### Quality assessment

The methodological quality of studies was assessed using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool, which has been developed and validated for use in controlled clinical trials, case-control and observational study designs.<sup>18</sup> Criteria used to assess study quality were selection bias, study design, control for confounders, data collection methods and reporting of withdrawals and dropouts. Blinding was not used as a criterion as this was not relevant to most interventions. Studies were reported as weak (those with at least two out of five weak ratings), moderate (one weak rating) or strong (no weak ratings). Quality appraisal and data extraction were conducted by two independent reviewers, with differences resolved through discussion with a third reviewer.

## RESULTS

### Study characteristics

The electronic search yielded 2206 potential articles for review. From these, 21 unique studies were identified as eligible for inclusion ([figure 2](#)).

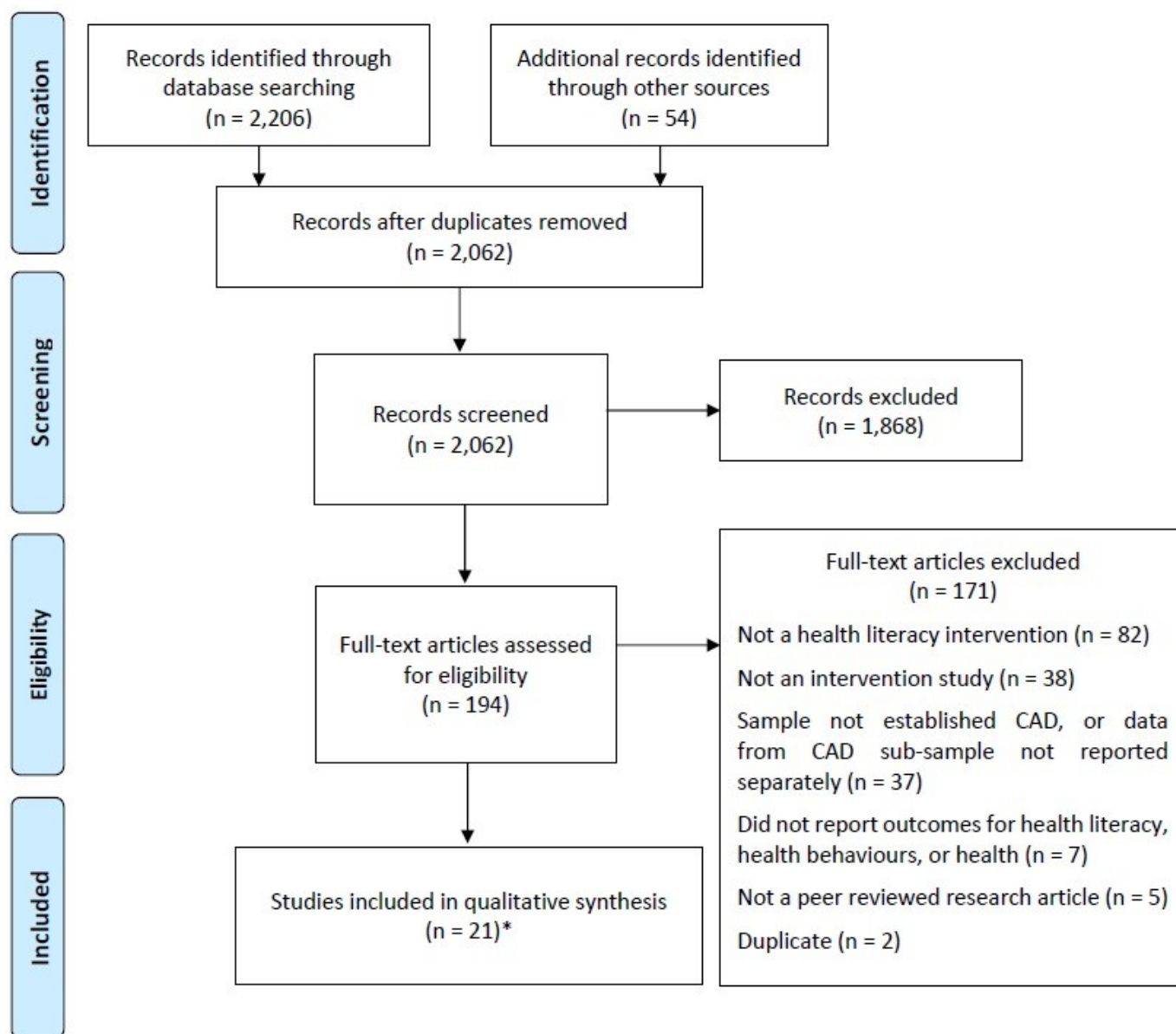
There were 14 randomised controlled trials (RCTs), 4 before and after studies, 2 prospective cohort studies and 1 controlled clinical trial. Most studies were from the USA (n=4), Iran (n=4) or China (n=3); with two studies each from Canada, Denmark and the UK. Studies were implemented across various settings including hospitals (n=12), outpatient clinics (n=3), community health/primary care centres (n=3) and cardiac rehabilitation centres (n=1). Most studies were in older adults (mean age: >50 years; n=20) and included a higher percentage of men (n=16). Studies were performed in subgroups of patients with CAD: four studies in patients with coronary heart disease (CHD); four among patients undergoing coronary artery bypass surgery (CABG); four in patients with ACS; three in patients with acute MI and one study in patients with angina pectoris. The methodological quality of included studies varied: 12 studies were rated as strong, 6 as moderate quality and 3 as weak. Study characteristics are summarised in [table 2](#).

### Intervention effectiveness

Online supplemental file 2 provides a description of each health literacy intervention (grouped into the categories shown in [figure 1](#)) and summarises the key findings of each study. Although there was some variability among studies in relation to populations, settings and outcomes, 17 studies (81%) reported positive findings for primary outcomes.

### Building social support for health

Ten studies included an intervention that primarily focused on building social support for health.<sup>19–26</sup> Three RCTs included interventions involving patients and partners and all achieved significant improvements in their primary outcome.<sup>19–21</sup> Strategies included encouraging creation of a social support network or involving partners



**Figure 2** PRISMA flow diagram. \*Two studies consisted of two publications reporting on different outcome measures and were recorded as one study in this review. CAD, coronary artery disease; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analysis.

in education. Of these RCTs, one reported increased physical activity and improved family support following an intervention in which patients with CHD and partners together developed action plans for home exercise.<sup>19</sup> This theory-based intervention used a health behaviour change model called the Health Action Process Approach (HAPA). A fourth RCT also used the HAPA model to design an online patient education intervention. This RCT did not include partners and reported improvements in patient health behaviours but no effect on social support.<sup>27</sup> Six studies assessed the use of peers for education or support.<sup>22–26 28</sup> Overall findings were inconclusive, with four of the six studies showing improvements in primary outcomes.<sup>22 23 25 28</sup> These included one online intervention aiming to support women with CAD to learn about cardiac self-management from peers,<sup>28</sup> and three

face-to-face peer education sessions.<sup>22 23 25</sup> The two peer-based interventions that were less effective included one study in which post-CABG patients were matched with a peer volunteer who provided 6 weeks of telephone support<sup>24</sup> and an angina self-management programme facilitated by lay people with experience of CAD.<sup>26</sup>

#### Empowerment for people with low health literacy

This category refers to interventions that are targeted specifically at people with low health literacy. No studies were identified within this category.

#### Improving the interaction between patients and the health system/health professionals

Five studies focused on improving interaction between patients and health professionals, with four of these reporting

**Table 2** Characteristics of included studies

First author, year	Country	Study design	Setting	Participant characteristics				Quality rating	
				Sample size (I/C)	Age (years), mean (±SD)	% Male	Condition		Primary outcome(s)
Aliabad <i>et al.</i> , 2014 <sup>19</sup>	Iran	RCT	Hospital	96 (48/48)	I: 57.8 (8.7) C: 56.7 (9.0)	84.4%	CHD	Risk perception, self-efficacy, behavioural intention, outcome expectancies, action planning	Strong
Bates <i>et al.</i> , 2014 <sup>29</sup>	USA	Pre-post study	Hospital	189 (92/97)	I: 64.0 (11.0) C: 62.0 (10.8)	69.3%	Post-CABG	30-day readmission rate; patient perception of care	Moderate
Cao <i>et al.</i> , 2017 <sup>35</sup>	China	RCT	Hospital	236 (118/118)	I: 68.1 (9.4) C: 68.1 (10.2)	72.9%	CHD	30-day and 90-day re-admission rates	Strong
Colella and King-Shier, 2018 <sup>24</sup>	Canada	RCT	Hospital	209 (69/140)	I: 63.6 (9.9) C: 63.4 (10.7)	100%	Post-CABG	Depression; perceived social support; health service use	Strong
Dontje <i>et al.</i> , 2013 <sup>32</sup>	USA	Before and after study	Primary care centre	34*	–	69.0%	CAD	CAD knowledge; confidence with shared decision-making	Weak
Duan <i>et al.</i> , 2018 <sup>27</sup>	China	RCT	CR centre	114 (60/54)	I: 45.8 (14.7) C: 51.6 (11.6)	46.5%	CHD	Physical activity; fruit and vegetable consumption	Strong
Eckman <i>et al.</i> , 2012 <sup>38</sup>	USA	RCT	Ambulatory practice (outpatient)	170 (83/87)	I: 58.5 C: 61.4	38.8%	CAD, Angina, MI	CAD knowledge; weight and blood pressure; diet; exercise; smoking status	Moderate
Fors <i>et al.</i> , 2015 <sup>31</sup>	Sweden	RCT	Hospital and outpatient	199 (94/105)	I: 60.5 (9.3) C: 61.3 (8.9)	72.4%	ACS	Self-efficacy; return to work; return to prior activity level	Moderate
Furze <i>et al.</i> , 2012 <sup>26</sup>	UK	RCT	Hospital	142 (70/72)	I: 65.3 (9.7) C: 63.6 (10.2)	52.8%	Angina	Frequency of angina	Strong
Hald <i>et al.</i> , 2019 <sup>35</sup>	Denmark	Prospective cohort study	Hospital	379*	57.0	75.0%	Acute MI	Health service use, annual consultations, all-cause or CVD hospital admissions	Strong
Cohen <i>et al.</i> , 2012 <sup>39</sup>	USA	RCT (four arms)	Primary care centre	435 (102, 121 <sup>2</sup> , 116 <sup>3</sup> /96)	I <sup>1</sup> : 64.9 (10.4) I <sup>2</sup> : 63.6 (11.3) I <sup>3</sup> : 62.8 (10.0) C: 63.7 (9.3)	44.4%	CHD	Medication refill adherence	Strong
Lau-Walker <i>et al.</i> , 2016 <sup>33</sup>	UK	Before & after study	Heart centre (Outpatient)	74*	58.0 (12.0)	78.4%	Acute MI	Cardiac self-efficacy; anxiety and depression; quality of life	Moderate
Lee <i>et al.</i> , 2019 <sup>30</sup>	Taiwan	Prospective cohort study	Hospital	282 (206/76)	I: 67.1 (14.6) C: 72.1 (12.4)	66.7%	ACS	Prescription rate of ACS medications	Weak
Lynggaard <i>et al.</i> , 2017 <sup>23</sup>	Denmark	RCT	Hospital	827 (413/414)	I: 63.0 (10.0) C: 63.0 (11.0)	75.6%	IHD, Heart failure	Adherence to exercise training or education sessions	Strong
Mohammadpourhodki <i>et al.</i> , 2019 <sup>25</sup>	Iran	RCT	Hospital	60 (30/30)	42–65†	65%	Acute MI	Anxiety	Strong
O'Brien <i>et al.</i> , 2014 <sup>20</sup>	Ireland	RCT	Hospital	1136 (685/551)	I: 62.9 (11.1) C: 64.3 (11.2)	72.2%	ACS	Knowledge, attitudes and beliefs	Moderate
Sabzmakan <i>et al.</i> , 2010 <sup>21</sup>	Iran	RCT	Heart centre (outpatient)	54 (27/27)	I: 56.9 (7.2) C: 56.6 (7.6)	–	Post-CABG	Depression; quality of life; self-help behaviours	Strong

Continued

Table 2 Continued

First author, year	Country	Study design	Setting	Participant characteristics				Primary outcome(s)	Quality rating
				Sample size (I/C)	Age (years), mean (±SD)	% Male	Condition		
Sakakibara <i>et al.</i> , 2017 <sup>28</sup>	Canada	Before and after study	Hospital+outpatient	35*	57 (10)†	0%	CAD	Self-management; social support; quality of life	Weak
Shen <i>et al.</i> , 2018 <sup>34</sup>	China	Controlled clinical trial	Community centre	120 (68/52)	I: 70.2 (7.8) C: 69.2 (7.8)	53.3%	CAD	Self-management of CHD; knowledge and self-efficacy	Moderate
Tongpeth <i>et al.</i> , 2018 <sup>37</sup>	Australia	RCT	Hospital	70 (35/35)	I: 65.0 (12.5) C: 64.0 (10.9)	62.9%	ACS	Knowledge, attitudes and beliefs	Strong
Varaei <i>et al.</i> , 2014 <sup>22</sup>	Iran	RCT	Hospital	60 (30/30)	I: 58.9 (8.3) C: 60.7 (8.0)	76.7%	Post-CABG	Cardiac self-efficacy; hospital re-admissions	Strong

\*Mean &amp; 95% CI.

†Range.

‡Median (IQR).

ACE, ACE converting enzyme; ACS, acute coronary syndrome; CABG, coronary artery bypass surgery; CAD, coronary artery disease; CHD, coronary heart disease; CR, cardiac rehabilitation; CVD, cardiovascular disease; I, intervention group; IHD, ischaemic heart disease; MI, myocardial infarction; RCT, randomised controlled trial.

improved outcomes.<sup>29–32</sup> In one before-and-after study, patients with CABG received education using ‘teach-back’ to check and clarify information. Intervention participants had significantly decreased readmission rates 30-days postintervention.<sup>29</sup> Two interventions aimed to increase frequency of interactions between patients and providers, both reporting positive findings in behavioural and health literacy outcomes.<sup>30–31</sup> The two remaining studies aimed to build patients’ capacity to communicate with health providers, including a before-and-after study in patients with CAD<sup>32</sup> and a pre–post study in patients with MI.<sup>33</sup> This pre–post study<sup>33</sup> was the least effective intervention in this category, with improvements seen only in single aspects of illness perception and quality of life.

#### Building health literacy capacities of professionals

Only one controlled clinical trial was identified in this category. This study described an education intervention for community nurses working with patients with CHD.<sup>34</sup> The nurses’ self-efficacy improved, as did self-management behaviours among their patients.

#### Facilitated access and appropriate use of health services

Two studies included interventions that aimed to facilitate access and appropriate use of health services.<sup>35–36</sup> A prospective cohort study<sup>35</sup> in socially vulnerable patients reported that receiving ‘expanded CR’ was associated with more annual chronic care consultations at 2 and 5 years. An RCT of a hospital-to-community transitional programme for patients with CHD (structured follow-up in the community; teach-back to reinforce patient understanding of treatment) found lower readmission rates in the intervention group.<sup>36</sup>

#### Described as a health literacy intervention or effects examined by health literacy level

No included studies were described explicitly as a ‘health literacy intervention’ by the study authors, although three studies examined intervention effects according to the health literacy levels of patients.<sup>37–39</sup> All three studies reported that intervention effects did not differ between health literacy groups. Two studies showed significant improvements in their primary outcome, including an RCT evaluating an Avatar app for education of patients with CHD.<sup>37</sup> This study found improved knowledge among the intervention group, but health literacy was not associated with these improved scores. In the second RCT,<sup>38</sup> participants received printed booklets about CAD and watched videos of other patients who explained their own preferences. Improvements were seen in CAD knowledge and behaviours, with lower health literacy associated with a larger improvement. In a third RCT<sup>39</sup> patients, received medication refill reminder postcards, illustrated medication schedules or both interventions for 1 year. No overall differences were seen across treatment groups, but this lack of effect did not differ according to patients’ health literacy.

## DISCUSSION

To our knowledge, this is the first scoping review appraising the broad range of health literacy

interventions for patients with CAD. Most interventions had a primary focus on building social support for health or on improving the interaction between patients and the health system/health professionals. Key findings were: (1) involving partners in health education can be effective at reducing depression, increasing knowledge and improving physical activity; (2) use of peers for education or support may decrease anxiety, increase self-efficacy and improve health behaviours; (3) the teach-back method helps patients understand information and is associated with reduced hospital readmissions and (4) providing structured follow-up support may improve appropriate use of health services and reduce readmissions.

Evidence for the effectiveness of health literacy interventions among patients with CAD is limited in comparison to systematic reviews in other areas such as health promotion<sup>12</sup> or chronic disease.<sup>12 40</sup> However, similar to CAD, much of this evidence focuses on functional health literacy only. Use of a conceptual framework in our study has enabled identification of a wider range of studies that go beyond functional health literacy and may be useful in other health conditions to identify characteristics of interventions associated with improved behavioural and clinical outcomes. In relation to types of evidence, two-thirds of the included studies were RCTs, and this is reflected in the relatively large proportion of studies of strong methodological quality.

We found no studies addressing empowerment of people with low health literacy, and a paucity of studies addressing health literacy capacities of health professionals or those facilitating access and appropriate use of health services. We also found heterogeneity between interventions, even within intervention categories, with regards to theoretical basis, recipients of the intervention, duration and frequency of interaction and target outcomes. Outcome measures were equally spread across the health literacy, behavioural and clinical health domains. However, few studies comprehensively covered more than one outcome aspect; therefore, it is difficult to conclude whether health literacy outcomes lead sequentially to behavioural and clinical health outcomes. This is a gap in the literature that limits our knowledge of the potential causal mechanisms and long-term health benefits of health literacy interventions.

Findings from this review suggest that involving partners is an effective way of building social support for health behaviours.<sup>19–21</sup> Of note, two of these interventions used a theoretically informed educational approach (the HAPA model), including strategies for engaging family members.<sup>19 21</sup> Other studies using this approach in non-CAD populations have also shown improved physical activity,<sup>41</sup> and smoking cessation.<sup>42</sup> For patients with CAD, the practical and emotional help provided by others can assist with understanding health information and decision-making about management of their condition.<sup>43 44</sup> This is aligned with the concept of ‘distributed health literacy’ where patients share tasks of finding, understanding and using health information with others,

often drawing on health literacy abilities of others to manage their own health.<sup>44</sup> Consideration should, therefore, be given to interventions that build social support systems to assist patients to find, understand and apply health information, including use of proven theoretically based approaches.

Improving partnerships between patients and health providers may also be effective, although of the five studies in this category, we found only two that focused on building patients’ capacity to communicate with healthcare providers.<sup>32 33</sup> This is an area for further investigation; for example, a 2017 systematic review found most evidence in healthcare communication is centred on improving the communication skills of providers rather than patients.<sup>45</sup> We also found that interventions targeting both providers and patients were effective, including those using teach-back.<sup>29</sup> The teach-back method of checking and clarifying information can be considered a health literacy intervention because it helps patients both understand information and recall it later at home. While there is strong evidence for the effectiveness of teach-back in chronic disease populations,<sup>46</sup> surprisingly few papers have explored its role among patients with CAD.

We found few studies aiming to build health literacy capacity of health professionals or to empower patients with low health literacy. Some evidence from other settings indicates that interventions among lower health literacy groups are effective at increasing empowerment (eg, telehealth support,<sup>47</sup> community health education)<sup>48</sup> and these may warrant investigation in patients with CAD. This research should include vulnerable populations in whom health literacy and empowerment are known to be lower.<sup>1</sup> Future studies in this area should also consider assessing health literacy using multidimensional tools rather than measuring functional health literacy only.<sup>14</sup> Of note, those studies that did assess interventions across different health literacy groups found no difference in effects between patients with lower and higher health literacy; although all three used a functional health literacy instrument.<sup>37–39</sup>

It is noteworthy that only three studies in this review investigated interventions that incorporated digital technologies. Digital health approaches are progressing rapidly across all fields of medicine, including cardiology. The potential benefit of digital technologies to support health literacy is manifold, such as equity of access to health-related information, convenient delivery of educational content in different audio-visual formats and languages and the possibility to incorporate user interaction for additional intervention effect.<sup>49</sup> At the same time, digital technology interventions must consider the *digital* health literacy of user groups, that is, the degree to which individuals have the capacity to find, understand, appraise and apply health information from electronic sources.<sup>50</sup> This review, therefore, highlights an opportunity for future research to develop and investigate digital health literacy interventions for patients with CAD. In

line with key findings from this review, the effectiveness of these digital technologies may be further enhanced by strengthening social support or by targeting patient-provider partnerships.

### Strengths and limitations

The strengths of this review include a rigorous methodology and comprehensive search strategy. Scoping reviews are an appropriate method to assess the size and scope of research literature and to identify the nature and extent of research evidence.<sup>17</sup> Use of a conceptual framework enabled us to identify a wider range of studies that go beyond functional health literacy and can be used for future systematic reviews. Limitations should also be considered. While we attempted to include only those studies meeting our definition of a health literacy intervention, some studies have multiple mechanisms of effect, not all of which fit into our conceptual framework. As such, we cannot be clear that outcomes were due to the health literacy aspects of the intervention. Searches were limited to published studies, subjecting this review to the possibility of publication bias. Finally, the majority of included studies were conducted in high-income or middle-income countries, and our findings and conclusions may not be relevant for lower income countries where overall literacy of the population may be low, and health systems are poorly resourced. There is limited evidence describing health literacy in low-income countries, including in cardiac conditions. A recent systematic review<sup>51</sup> identified that health literacy interventions in low-income and middle-income countries were primarily functional in nature, i.e., focused on improving knowledge and understanding at the individual level—there was less emphasis on the role of health services and systems in addressing health literacy barriers. Further research in low-income and middle-income countries is required that incorporates individual and system-level factors; however, it is important that this is locally driven with an understanding of contextual factors.<sup>52</sup>

### CONCLUSIONS

Through the use of a broad conceptual health literacy framework, this scoping review has identified the available literature and described key characteristics of effective health literacy interventions for patients with CAD. These include social support by partners or peers, teach-back, codesign of discharge plans, increased frequency of patient-provider interactions and facilitated access to health services. Our findings warrant integration of these interventions into clinical practice. Identified areas for future research are interventions for patients with CAD with low health literacy, health literacy skills of health professionals, facilitated access and appropriate use of health services, health literacy interventions, which employ digital technologies and interventions to improve digital health literacy.

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**Acknowledgements** We wish to acknowledge the contribution of Dr Thomas Stütz to study selection and data extraction.

**Contributors** AB conceived the study. AB and STK designed the study. AB, STK and JT conducted literature searches. AB, STK, JG, EK, BM, MS and JT contributed to study selection and data extraction. AB, STK and JT conducted the quality assessments, summarised the results and drafted the manuscript. All authors critically revised the manuscript and approved the final version.

**Funding** This work was supported by the National Health & Medical Research Council Grant Number: 1 198 006 to AB.

**Competing interests** None declared.

**Patient consent for publication** Not applicable.

**Ethics approval** This study does not involve human participants.

**Provenance and peer review** Not commissioned; internally peer reviewed.

**Data availability statement** Data sharing not applicable as no datasets generated and/or analysed for this study.

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**Supplementary File 1:** Full electronic search strategy (Ovid MEDLINE)

Search number	PICOS element	Sub-category	Search terms (in title/abstract)
#1	Population	Coronary heart disease	cardiovascular disease OR CVD OR heart OR cardiac OR coronary artery disease OR coronary heart disease OR coronary artery disease OR AMI OR myocardial infarction OR ACS OR acute coronary syndrome OR STEMI
		Excluded health conditions	NOT (primary prevention OR diabetes OR chronic heart failure OR CHF OR heart failure OR children OR cancer OR HIV OR AIDS OR acquired human immunodeficiency syndrome OR human immunodeficiency virus)
#2	Intervention	Health literacy	patient education OR health education OR health knowledge OR health attitudes OR health practice OR health literacy OR ehealth literacy OR e-health literacy OR functional health literacy OR interactive health literacy OR critical health literacy OR literacy OR numeracy OR HLQ OR Health Literacy Questionnaire OR HLS-EU OR REALM OR TOFHLA OR S-TOFHLA OR AAHLS OR Newest Vital Sign OR Brief Health Literacy Screener OR single item screener OR Health literacy scale OR CAHPS OR eHEALS OR HeLMS
		Social peer support	OR peer support OR social support OR support group OR peer support groups OR mutual support groups OR self-help groups OR social networks OR social networking OR social networking sites OR social media

		Empowerment	OR motivational interviewing OR MI OR motivational interview OR behaviour change intervention OR behavior change intervention OR goal setting OR capacity building OR patient empowerment OR patient participation OR patient involvement OR patient engagement
		Patient provider communication	OR patient provider communication OR patient clinician communication OR teach-back OR “Show-me” OR “Closing the loop” OR “Closing the cycle” OR “Ask-tell-ask” OR “Repeat back” OR “Verbal exchange” OR patient provider relationship
		Health literacy of professionals	OR clinician health literacy OR clinician health literacy capacity OR clinician health literacy responsiveness OR health professional health literacy
		Reduction in access barriers	OR access to health care OR access to healthcare OR access to care OR accessibility OR interpreters in healthcare OR interpreter OR translator OR interpretation OR patient navigators OR organisation health literacy OR organization health literacy OR organisational health literacy OR organizational health literacy OR organisation health literacy responsiveness OR organization health literacy responsiveness OR care coordination OR case management OR organisational policies and practices OR organizational policies and practices OR organisational policy OR organizational policy

#3	Study type		intervention OR randomised controlled trials OR randomized controlled trials OR quasi-randomised controlled OR quasi-randomized controlled OR non-randomised controlled OR non-randomized controlled OR uncontrolled intervention OR "before and after" OR comparison study
#4			#1 AND #2 AND #3
#5			#4 Limits (01 January 2010 to current)

**Supplementary File 2:** Description of each health literacy intervention and key study findings

<b>Author</b>	<b>Intervention</b>	<b>Key findings</b>
<b><i>Building social support for health</i></b>		
Aliabad et al., 2014	Training of individual patients over three face to face sessions. Used the Health Action Process Approach (HAPA) which focuses on translation of action plans into behaviour and promotion of social support to prevent relapse. Patients' partners participated in a session to discuss ways to increase social support for health such as exercising together.	At 4-months, the intervention significantly improved all social cognitive factors, family support and physical activity compared with the UG (p<0.001)
Colella et al., 2018	Men in the IG were matched with a peer volunteer based on age (+/-5 years), who phoned the participant 3-4 days post discharge and then weekly for 6 weeks. Peers all had CABG previously, all completed a training session on skills required for telephone support. IG also received usual pre-discharge education and routine follow up appointments.	No difference between groups in depression (p=0.49) or social support scores (p=0.94) at 12- weeks; the intervention group had significantly lower health care use (p<0.05)
Duan et al., 2018	8-week online intervention based on the HAPA approach. The intervention aimed to improve physical activity and fruit/vegetable consumption, including through strategies to harness existing social supports, or if none, strategies to develop a social support network to prevent relapse.	Intervention group reported significantly less decrease in physical activity and fruit and vegetable consumption post-intervention than the control group (p<0.05). No significant intervention effect on social support.

Furze et al., 2012	An angina self-management program, facilitated by lay workers with experience in heart disease. Included a workbook and relaxation program, introduced in a 45min interview during which behavioural goals were introduced. Brief follow-up phone calls or home visits from the lay workers who were trained and managed by a community CR nurse with regular group and individual supervision.	No significant differences in angina frequency between both groups at 6-month follow-up
Lynggaard et al., 2017	All patients attended 8-week CR program. The IG also had individual interviews to clarify their needs, with group education sessions then tailored to these needs. Experienced former CR patients participated as co-educators and narrators in all of the education sessions and in one exercise training session per week.	The intervention group had higher adherence at cardiac rehabilitation in terms of exercise training and education (OR=1.48; 95% CI:1.07-2.05,p=0.018)
O'Brien et al., 2014	40 minute individualised education session on appropriate management of ACS symptoms and the need to inform someone else of symptoms. Patients nominated a person they would notify if symptoms arose; this person could also attend the education session. Action plans were practiced using role play.	There was a significant effect of the intervention on mean knowledge (p<0.001), attitudes (p=0.003) and belief (p<0.001) scores at 3 and 12 months.
Mohammadpourhodki et al., 2019	Two face-to-face education sessions for patients 72 hours post-MI. Education provided by trained peers (patients with previous MI and no history of anxiety). Content of education sessions not described.	At 30-day follow-up, anxiety score was significantly lower in the intervention group compared to the control group (p=0.001)

Sabzmakan et al., 2010	9-week training program based on the PRECEDE Model (Predisposing, Reinforcing, and Enabling factors). The model encourages self-help behaviours including creating social support networks. Patients and partners were divided into three groups for education about CAD; patients also attempted to establish social support systems.	Self-help behaviours significantly increased in the intervention group at 2-months compared to the control group ( $p < 0.001$ ).
Sakakibara et al., 2017	10-week ‘Healing Circles’ program via a mobile device. Participants accessed the program when they felt a need to connect with others. Six to nine participants were assigned to the same ‘‘Circle-of-Friends’’ to share information, ask questions and ‘‘Challenge’’ each other in heart healthy tasks.	After 10 weeks of using the intervention, significant improvements in health behaviours, self-monitoring, social support, and social integration (all $p < 0.05$ )
Varaei et al., 2014	Two 1-hour education sessions provided by peers to patients over two consecutive days before CABG surgery. Peers received three training sessions, including communication skills (i.e. non-verbal behaviours, active listening and ability to receive and send clear communication messages). Sessions were held in the hospital.	Cardiac self-efficacy in the intervention group was higher in all three follow-up points (5 days, 4 weeks & 8 months ( $p < 0.001$ )); the intervention group had a lower re-admission rate (10.3% vs 39.3%, $p = 0.011$ )

### *Empowerment for people with low health literacy*

No studies were identified within this category

<i>Improving the interaction between patients and the health system/health professionals</i>		
Bates et al., 2014	Patients and their caregiver received education from the patient educator using the teach-back method. The IG was also assisted by the patient educator to make follow-up appointments 1–2 days prior to the patient's discharge.	30-day readmission rates in the pre- and post-intervention groups were 25.8% and 12.0%, respectively (p=0.02); majority of participants perceived a positive experience of care
Dontje et al., 2013	A Nurse-led group education session reinforced participants' knowledge about treatment options for CAD and defined the Shared Decision-Making (SDM) process. Participants completed an Encounter Planning guide, then scheduled a SDM visit with their provider, and took their Encounter guides as a cue to remind the provider to focus on SDM for CAD.	Post-intervention, patients gained knowledge of options and confidence in participating in shared decision making with providers
Lau-Walker et al., 2016	A Personalised Patient Educational Protocol (PPEP) was used to facilitate nurse-patient interaction. The PPEP has two components: first, patients state their illness beliefs so that nurses can tailor discussion on health behaviour change. The second is designed to get patients to adopt a problem solving approach to management of their symptoms. This structure increases patients' confidence to discuss concerns with clinicians after discharge.	At 3-months, the only improvement was in the Illness Belief component 'Understanding' (p=0.021) and the 'General Health' component of the quality of life survey (p=0.041)
Lee et al., 2019	An electronic-based patient and family education (PFE) system was systemically embedded in the hospital information system for CAD patients, aiming to increase the opportunity for frequent, multifaceted interactions during the PFE process, improving communication between patients and providers.	The intervention group was prescribed more guideline-recommended drugs post-intervention than the control group (39.3% vs 14.5%, p<0.001)



Fors et al., 2015	A patient-centred care approach emphasising the partnership between patients and health professionals. Professionals were specially trained in PCC. Included co-creation of a PCC health plan between patient and health professionals, shared decision-making, collaborative revision of the plan, referral and discharge notes shared with the patient.	At 6-months, general self-efficacy improved more in the intervention group compared with the control group (p=0.026), but no differences were seen between groups on re-hospitalisation or death, return to work or prior activity level
<b><i>Building health literacy capacities of professionals</i></b>		
Shen et al., 2018	A train-the-trainer model where community nurses were trained over 2-days in how to educate CHD patients. Topics included CHD risk factors and management, clinical skills training, health behaviour change, and communication skills. The trained nurses were then sent back to their communities where the intervention consisted of distributing individualised health education prescriptions and brochures, organizing health education lectures, and conducting telephone follow-ups.	Nurses' knowledge and self-efficacy improved (p<0.001), as did intervention group patients' self-management behaviours compared to controls (p<0.001)
<b><i>Facilitating access and appropriate use of health services</i></b>		
Hald et al., 2019	The expanded CR intervention consisted of standard CR and a longer phase II course (extra two weeks), more consultations with CR nurses, and sharing of patient's rehabilitation plan with GP. Phase III is like standard CR but also includes referral to 30min preventive GP consultation, referral to activities in the municipal sector and the Danish Heart Association, and telephone follow up at 2 months.	The intervention group had more annual chronic care consultations than the comparison group at 2- and 5-year follow-up. At 10-year follow-up, no significant differences were seen.

Cao et al., 2017	Three phases: (1) Hospitalization: Patients received a treatment plan and self-care advice from a nurse. Teach-back was used to reinforce understanding.(2) Pre-discharge: Individualized discharge plan developed by the cardiologist, nurse, and patient cooperatively, and teach-back used to confirm understanding. (3) Post-discharge: The discharge plan emailed to community nurse <48 h after discharge. 1-week post-discharge, the family doctor and community nurse made structured telephone calls to the patient.	Both 30- and 90-day re-admission rates were significantly lower in the intervention group compared to the control group (5.1% vs 16.1%, p=0.004; 8.5% vs 20.3%, p= 0.005), respectively
<i>Described as a health literacy intervention by study authors</i>		
Eckman et al., 2012	Two intervention groups: (1) Video (30min) plus printed booklet; (2) printed booklet alone ('Living with CHD- Doing Your Part'). The video showed interviews with patients of varying ethnicity and gender who are struggling to live with CAD as they explain their decisions based on their own preferences and values, and physician experts.	At 3-months, there was a trend towards greater knowledge among the intervention group compared with controls (1.4 vs 0.8, p=0.07); The intervention prompted patients to become more involved in their care
Kripalani et al., 2012	For 1 year, patients received refill reminder postcards, illustrated medication schedules, both interventions, or usual care. The medication schedule group received a visual picture of their medication regime, including dosing instructions in plain language, a colour image of each medication, and an icon to indicate its purpose. A pharmacist met with the patient for 5 minutes to explain the tool. Comprehension was confirmed through teach-back. The reminder postcards group had postcards mailed to their home 25 days after their last medication fill..	Post-intervention medication adherence did not differ significantly across treatments: 31.2 % in usual care, 28.3 % with mailed refill reminders, 34.2 % with illustrated medication schedules, and 36.9 % with both interventions

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Tongpeth et al., 2018	In addition to usual care, the IG received education via the Avatar app on a handheld tablet computer. Topics included heart attack warning signs and action plan, with quizzes The app was developed using the principles of web design for patients with low health literacy. A tablet computer was provided to every IG participant for home use during the -month study period. IG participants also received two follow-up telephone calls, at 1 month and 6 months.	The intervention group had a significant improvement in symptom knowledge, attitudes, and beliefs over the 6-month period ( $p<0.001$ , $p=0.009$ , $p<0.001$ , respectively); and no significant improvement in the usual care group
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Abbreviations: ACS=Acute Coronary Syndrome; BDI=Beck Depression Inventory; CABG=Coronary Artery Bypass Grafts; CR=Cardiac rehabilitation; ED=Emergency Department; FVC=Fruit & vegetable Consumption; heiQ=Health Education Impact Questionnaire; IG=Intervention Group; PA=Physical Activity; SSS=Social Support Scale; UG=Usual Care Group