Patient Education and Counseling 117 (2023) 107972

Contents lists available at ScienceDirect

Patient Education and Counseling

journal homepage: www.journals.elsevier.com/patient-education-and-counseling

Changes in disease-related knowledge and educational needs of patients with coronary heart disease over a six-month period between hospital discharge and follow-up

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ARTICLE INFO

Keywords:
Educational needs
Heart disease
Health literacy
Health knowledge
Patient education
Self-care

ABSTRACT

Objective: To describe changes in the disease-related knowledge and educational needs of individuals with coronary heart disease (CHD).
Methods: Patients hospitalized for CHD answered questionnaires about disease-related knowledge (Coronary Artery Disease Education Questionnaire—short version (CADE-Q-SV), score 0–20), educational needs (investigator–designed questions), health literacy (Short version of the European Health Literacy Survey Questionnaire (HLS-EU-Q16)), self-care (Self-Care of Coronary Heart Disease Inventory version (SC-CHDI)), and physical activity (Leisure-time Physical Activity Questionnaire) at discharge (T1) and six months later (T2).
Results: Participants' (N = 308; mean [M] age=65.5 years [SD=8.7]; 81.5% male) knowledge scores increased from M= 13.8 (SD=3.2) to M= 14.8 (SD=2.8) ($p < 0.001$). At T1, educational level, age, health literacy, smoking, and self-care maintenance explained 14.5% of knowledge variability. At T2, these variables plus lack of awareness of CHD diagnosis explained 20.3% of the variability. Substantial educational needs were reported at both time points, although 89% received predischarge education.
Conclusion: The patients' educational needs were unfulfilled despite an increase in disease-related knowledge over time. Improved evidence-based patient education and follow-ups that address diagnosis, treatment, and self-care are needed.
Practice Implications: Healthcare professionals can improve care of patients with CHD by providing focused patient education, prioritizing "need-to-know" topics and considering patients' health literacy.

1. Introduction

Heart disease is the leading cause of death in Europe [1] and worldwide [2], with coronary heart disease (CHD) being the most prevalent [1,3]. CHD risk factors are greatly lifestyle related, including smoking, high blood pressure, dyslipidemia, and diabetes mellitus [4]. Individuals with CHD are at high risk of recurrent events and mortality [5], which can be lowered with improvements in lifestyle-related risk factors [6,7]. However, a large proportion of individuals do not prioritize risk factor management or achieve the recommended changes [8]. Patient education is an important factor in enhancing patient outcomes [9,10] and a recommended element of comprehensive multidisciplinary cardiac rehabilitation and prevention programs [4].

Patient education is the "process of assisting consumers of health care to learn how to incorporate health-related behaviors (knowledge, skills, and/or attitudes) into everyday life with the purpose of achieving

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https://doi.org/10.1016/j.pec.2023.107972
Received 31 May 2023; Received in revised form 21 August 2023; Accepted 5 September 2023
Available online 6 September 2023

the goal of optimal health" (Bastable, 2023, p. 699) [11]. Patient education is required when preparing CHD patients for necessary self-care, which Riegel et al. (2012) [12] defined as a naturalistic decision-making process that addresses the prevention and management of chronic illness, with self-care maintenance, monitoring, and management as its core elements. Patient education is an effective method of increasing patient knowledge and facilitating successful lifestyle changes [10,13,14], and CHD patients who receive comprehensive education experience greater control over the disease, and fewer negative emotions toward their illness [15], and better health-related quality of life. Thus, patient education and support for lifestyle changes are integral parts of comprehensive CHD treatment [4,10]. Health literacy is associated with health behavior [10], and cardiac patients with low health literacy face more problems in implementing lifestyle changes compared to patients with high health literacy [16]. Therefore, it is important to consider patients' personal health literacy levels—that is, "the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others" [17].

Patients with CHD tend to have insufficient disease-related knowledge [15,18,19]; their educational needs are underestimated and somewhat unmet [15,19,20]. Evidence also suggests that healthcare professionals often do not assess [21] or attend to their patients' educational needs [15]. The literature shows that patients with CHD have diverse [19–21] and significant educational needs [15,21,22], including psychosocial education [19–23], information about the disease [19,20,23] and the associated risk factors, medications [19–24], cardiac anatomy, and physical activity requirements. These needs vary over time [19,21–23,25], and studies have reported that healthcare professionals and patients prioritize information differently and may have varying views on the importance of specific learning needs [22]. This incongruence perception between patients and health professionals can result in the educational needs of patients being unmet, ultimately leading to ineffective education. Therefore, patient education should be an evidence-based, patient-centered [20,23,26], interactive process focused on the patient's priorities and desired behaviors [26].

The literature on education for cardiac patients at the time of hospital discharge is scarce. More knowledge is needed on whether and how the educational needs and disease-related knowledge of patients with CHD change over time, as this could inform the development and provision of effective patient education. Therefore, the aim of this study was to describe the changes in the disease-related knowledge and educational needs of individuals with CHD over a six-month period.

2. Methods

This longitudinal study was conducted in 2017–2019 as a part of the KRANS study of lifestyles, risk factor management, and self-care among individuals with CHD. Patients with diagnosed CHD were invited to participate at hospital discharge after a cardiac event (T1) and six months later (T2). Data were collected using self-administered questionnaires and from medical records.

2.1. Participants and setting

All patients (18–79 years old) admitted to two of the largest hospitals in Iceland—Landspitali, which is the National University Hospital of Iceland, and Akureyri Hospital—due to acute coronary syndrome (ACS), percutaneous coronary intervention (PCI), or coronary artery bypass grafting surgery (CABG) were eligible for this study. Landspitali, is the only PCI and CABG center in Iceland, and most patients with ACS are admitted to one of the aforementioned hospitals. Therefore, the majority of this patient group in Iceland had a chance of being recruited.

At discharge, all cardiac patients in Iceland are offered an appointment with a cardiologist as a standard procedure. Those living in the vicinity of Landspitali and Akureyri Hospital are offered follow-ups at a nurse-led secondary prevention clinic. Comprehensive cardiac rehabilitation is available only for selected patients at one center in Iceland, Reykjalundur Rehabilitation, where rehabilitation is an individualized, multifaceted intervention designed to optimize physical, psychological, and social health and well-being. The program involves exercise training, education, and counseling on the necessary lifestyle changes for risk factor management, and it generally starts about 4–8 weeks after hospital discharge following a cardiac event [27]. Other patients may be referred to an outpatient nurse-led clinic for psychoeducational care, an outpatient hospital for physical therapy, a private physical therapy clinic, or a combination of these.

Individuals unable to understand or speak Icelandic and those with documented cognitive deficits that hindered their ability to participate were excluded from the study. A total of 446 patients met the inclusion criteria and consented to participate in the study at hospital discharge. During the six-month follow-up, 373 patients answered the questionnaires. Although an a priori power analysis was not conducted for this part of the KRANS study, a post hoc power analysis using J power for a paired T-test revealed that, considering two-sided criteria for the detection of a Type I error rate of $\alpha = 0.05$, a minimal sample size of 199 was needed for an effect size of $\delta \geq 0.2$ with a probability greater than 0.8. The estimated probability for a sample size of 308 was $> 90\%$ to detect an effect size of 0.2.

2.2. Measures

2.2.1. Disease-related knowledge

An Icelandic version of the Coronary Artery Disease Education Questionnaire—short version (CADE-Q-SV) [28] was used to measure disease-related knowledge. The instrument consists of 20 questions and statements across five domains: medical condition, risk factors, exercise, nutrition, and psychosocial risk. The response options are "true," "false," and "I do not know." Each correct answer gets one point, whereas the other two are assigned zero points. The scores for each domain range from 0 to 4, for a total score of 0–20 points. The psychometric properties of the questionnaire were found to be sufficient based on the intra-class correlation coefficient and internal consistency, with a Cronbach's alpha of 0.76–0.94 for each domain and > 0.70 for the whole questionnaire. Differences in the criterion validity scores according to educational level ($p < 0.001$) and length of cardiac rehabilitation ($p < 0.005$) were found [28].

With permission from the author, the CADE-Q-SV was translated from English to Icelandic via cognitive interviewing [29]. The questionnaire was administered to healthcare professionals ($n = 8$) and patients ($n = 6$) in a cardiac rehabilitation center, and cognitive interviews were subsequently conducted. The CADE-Q-SV was then further adapted to the Icelandic language and culture [30]. Cronbach's alpha for the present study was 0.74.

2.2.2. Educational needs

Based on the known risk factors, recommended lifestyle [31], and important elements of patient education [21,24] for CHD patients, the research group developed 15 questions to evaluate patients' educational needs. The questions were categorized into the same five domains as those in the CADEQ-Q-SV. The response options were on a four-point scale (1 = no need; 4 = very high need). At hospital discharge, the participants were asked whether they had received education from healthcare professionals during their hospital stay (yes or no), how well their educational needs were met before discharge (very well, mostly, to a little extent, or not at all), who provided them with patient education, and what educational materials were used (multiple choice).

2.2.3. Health literacy

Health literacy was measured using the short version of the European Health Literacy Survey Questionnaire (HLS-EU-Q16), a 16-item questionnaire that yields a sum score of 0–16, with higher scores indicating

better health literacy. Specifically, the scores are categorized as inadequate (0−8), problematic (9−12), or sufficient (13−16) [32].

2.2.4. Self-care

Self-care was measured using the Self-Care of Coronary Heart Disease Inventory version 2.2 (SC-CHDI), which consists of 22 items and three subscales for self-care maintenance, self-care management, and confidence. For each subscale, a standardized score (0−100) is calculated, with higher scores indicating greater self-care or confidence levels [33].

2.2.5. Level of physical activity

Patients' physical activity levels were assessed using an adapted version of the Leisure-time Physical Activity Questionnaire [34]. The questionnaire is used to estimate occupational and leisure-time physical activity in various large populations [35]. The questionnaire items focus on exercise levels in the past three months and have four response options: mostly sedentary, light physical activity, exercise with moderate effort, and regular vigorous physical activity several times a week.

2.2.6. Background and demographics

Background information on age, gender, marital status, residency (rural or urban), admission diagnosis, prior hospitalization for CHD, and length of hospital stay were collected from the participants' hospital records. The patients also answered questions about their education, income sufficiency, rehabilitation, dietary changes since hospital discharge, and goals for lifestyle changes. Smoking was self-reported at T1, and self-reported data and breath carbon monoxide measurements (ppm) using a smokerlyzer were obtained at T2. Smoking was defined as self-reported smoking and/or breath carbon monoxide exceeding 10 ppm. The participants were also asked if they had coronary heart disease (yes or no) to determine diagnosis awareness.

2.3. Data analysis

Statistical analyses were conducted using standard software packages (IBM SPSS statistics v28 and Jamovi v2.3.18). Only participants who answered at least 18 of the 20 items (maximum 10% missing items) of the CADE-Q-SV at both time points (T1 and T2) were included in this analysis (N = 308). Differences in the means between T1 and T2 for the CADEC-Q-SV total scale and subscales were analyzed using paired t-tests. The difference in the proportion of correct responses on the CADEC-Q-SV at T1 and T2 and the differences in patients' educational needs were analyzed using McNemar's test for paired nominal data. To analyze patients' educational needs, the response categories were collapsed into a dichotomous variable (no need / little need vs. much need / very much need) for each question. Association between the educational needs and background variables were analyzed using the chi-square independence test. For this analysis, the three health literacy categories; inadequate, problematic and sufficient were collapsed into a dichotomous variable (insufficient (scores 0–12) vs. sufficient (scores 13–16). To test for mean differences in the independent groups, a Student t-test (for equal variances), a Welch t-test (for unequal variances), an ANOVA, or a Kruskal–Wallis ANOVA was performed. The relationships between the scales were measured using the Pearson or Spearman correlation coefficient. The statistical significance for all the analyses was set at $p < 0.05$.

2.4. Ethics

The study and the cognitive interviews in the translation process were approved by the National Bioethics Committee for Medical Research Ethics (17–159 and 17–088) and hospital authorities. The study conformed to the principles in the Declaration of Helsinki [36], and all data were treated in accordance with existing regulations to protect the patients' privacy. The patients received both verbal and written information about the study before providing their informed consent.

3. Results

The participants' (N = 308) demographics are presented in Table 1. The average age was 65.5 years (range 35–80, SD=8.7), and 81.5% were male. There was no significant difference between the mean ages of the men and women ($p = 0.076$). Six months after discharge, 37.7% had completed their cardiac or general rehabilitation following the cardiac incidence, and 24.6% were in rehabilitation. The average length of hospital stay was three days (range 0–31, SD=4.9), with 51% staying one day or less.

At hospital discharge, 17.6% of the participants were active smokers, compared to 10.5% at the six-month follow-up. Physical activity improved over the six-month period: 27.1% reported being moderately or vigorously physically active at T1 compared to 43.5% at T2. At T2, 84.0% reported to have changed their diet, and about half had set a goal for lifestyle changes however, 9.7% (n = 28) said they did not have CHD, (Table 2).

3.1. Knowledge

The average total knowledge score increased from 13.8 (SD=3.2) at T1 to 14.8 (SD=2.8) at T2 (mean difference: 1.1, $p < 0.001$). At T1, 47.1% of the participants scored ≥ 15 or ≥ 75% of the scores correct compared to 62.3% participants at T2. The scores for each domain and the differences between the time points are presented in Table 3. There was a significant increase in knowledge in all domains between T1 and T2, except in the nutrition domain ($p = 0.108$), which obtained the highest score domain at both time points. The participants' knowledge levels were the lowest in the psychosocial risk domain at both time points, and the greatest knowledge increase between T1 and T2 was in the exercise domain (mean difference: 0.4, $p < 0.001$). At both time points, the highest proportions of correct answers were for statements regarding the ways to control blood pressure (item 12; (T1 = 95.1%, T2 = 97.1%, $p = 0.157$) and modifiable risk factors (item 2; (T1 = 94.1%, T2 = 98.1% $p = 0.005$). The lowest scores at both time points were for statements related to the effects of statin medication (item 11; (T1 = 3.3%, T2 = 5.5%, $p = 0.108$) and cholesterol control (item 16; T1 = 26.3%, T2 = 39.9%, $p < 0.001$), (see Appendix I).

The knowledge score differences based on background factors are presented in Table 1. A post hoc multiple comparison test indicated that those who had completed rehabilitation at T1 had significantly higher knowledge scores than those who were currently in rehabilitation, those who had dropped out of rehabilitation, and those who had not attended rehabilitation ($p = 0.015$). Further, patients who acknowledged having CHD had higher knowledge scores (M=15.2, SD=2.5) than those who denied having the disease (M=13.4, SD=3.6) at T2 ($p = 0.019$).

A stepwise multiple regression analysis was used to test whether the observed or known demographic and risk factors significantly predicted the participants' knowledge scores. Variables that yielded significant differences in the univariate analysis or correlations in the bivariate analysis (see Tables 1 and 2) were incorporated into the regression model and tested. Tables 4 and 5 present the regression models for T1 and T2, respectively, with the coefficients having a p-value ≤ 0.05. Education ($\beta = 0.166, p = 0.003$), age ($\beta = -0.125, p = 0.030$), self-care maintenance ($\beta = 0.146$, $p = 0.014$), health literacy ($\beta = 0.197$, $p < 0.001$), and smoking ($\beta = -0.153, p = 0.010$) accounted for 14.5% of the variability in knowledge scores at T1 (R^2 =0.160, F(5277)= 10.543, $p < 0.001$) (Table 4). At T2, education ($\beta = 0.194$, $p < 0.001$), age ($\beta = -0.220, p < 0.001$), self-care maintenance ($\beta = 0.135, p = 0.027$), health literacy ($\beta = 0.150$, $p = 0.010$), smoking ($\beta = -0.130$, $p = 0.027$), and diagnosis awareness ($\beta = 0.182$, $p = 0.001$) accounted for 20.3% of the variability in disease-related knowledge (R^2 =0.203, F(6257)= 12.170, $p < 0.001$) (Table 5).

Table 1
Participants demographics and CADEQ-Q-SV scores at hospital discharge and six months later.

		CADEQ-Q-SV scores					
		Hospital discharge (T1)		Six-month follow-up (T2)		Difference (T2-T1)	
Variables	n (%)	Mean (SD)	*p*	Mean (SD)	*p*	Mean [95% CI]	*p*
Gender			0.229		0.295		
Men	251 (81.5)	13.9 (3.3)		14.9 (3.3)		1.0 [0.70–1.37]	< 0.001
Women	57 (18.5)	13.3 (3.1)		14.5 (2.5)		1.2 [0.48–1.87]	0.001
Marital status			0.870		0.259		
Married/cohabiting	230 (74.7)	13.8 (3.0)		14.7(2.7)		0.9 [0.60–1.30]	< 0.001
Single/divorced/widow(er)	78 (25.3)	13.7 (3.8)		15.1 (3.1)		1.4 [0.78–2.07]	< 0.001
Residency			0.076		0.501		
Urban	218 (70.8)	14.0 (3.3)		14.9 (2.8)		0.9 [0.55–1.28]	< 0.001
Rural	90(29.2)	13.3 (2.9)		14.8 (2.7)		1.4 [0.88–1.92]	< 0.001
Prior CHD hospitalization			0.219		0.812		
Yes	133 (43.2)	14.0 (3.1)		14.9 (2.8)		0.8 [0.42–1.27]	< 0.001
No	175 (56.8)	13.6 (3.3)		14.8 (2.8)		1.2 [0.80–1.64]	< 0.001
Admission diagnosis			0.049		0.290		
ACS	29 (9.4)	13.7 (3.5)		14.3 (3.3)		0.6 [− 0.55–1.80]	0.288
STEMI	63 (20.5)	13.7 (3.4)		15.5 (2.4)		1.7 [1.08–2.38]	< 0.001
Non-STEMI	49 (15.9)	13.8 (3.0)		14.8 (2.2)		1.0 [0.40–1.69]	0.002
Elective PCI	137 (44.5)	14.2 (3.5)		14.8 (2.8)		0.6 [0.22–1.06]	0.003
Elective CABG	30 (9.7)	12.0 (3.5)		14.0 (3.5)		2.0 [0.71–3.29]	0.003
Admission type			0.039		0.431		
Acute admission	161 (52.3)	13.5 (3.3)		14.8 (2.9)		1.3 [0.91–1.77]	< 0.001
Elective admission	147 (47.7)	14.1 (3.1)		14.8 (2.7)		0.7 [0.33–1.16]	< 0.001
Level of education			<0.001		<0.001		
Primary education (≤9 years)	90 (30.1)	13.1 (3.2)		14.3 (2.8)		1.2 [0.56–1.80]	< 0.001
Secondary education	140 (53.2)	13.4 (3.3)		14.6 (3.0)		1.2 [0.74–1.62]	< 0.001
University education	69 (23.1)	15.2 (2.7)		15.9 (2.2)		0.7 [0.10–1.23]	0.021
Sufficient income			<0.001		0.094		
Always, has savings	168 (42.1)	14.5 (2.6)		15.3 (2.3)		0.8 [0.46–1.14]	< 0.001
Rarely	85 (29.1)	12.9 (3.5)		14.1 (3.3)		1.2 [0.56–1.91]	< 0.001
Seldom	27 (9.2)	12.9 (2.9)		14.5 (3.1)		1.6 [0.40–2.80]	0.011
Never	12 (4.1)	12.4 (3.5)		15.5 (2.0)		3.1 [1.52–4.65]	0.001
Disease awareness			<0.001		0.019		
Yes	261 (90.3)	14.2 (3.0)		15.2 (2.5)		0.9 [0.63–1.26]	0.012
No	28 (9.7)	11.8 (2.8)		13.4 (3.6)		1.61 [0.38–2.83]	< 0.001
Rehabilitation			0.087		0.015		
Yes, completed rehabilitation	89 (37.7)	14.2 (3.3)		15.6 (2.5)		1.4 [0.82–1.99]	< 0.001
Yes, still in rehabilitation	58 (24.6)	14.0 (3.6)		14.7 (2.8)		0.6 [1.38–1.72]	0.091
Yes, but dropped out	35 (14.8)	13.8 (2.9)		14.3 (2.8)		0.5 [− 0.356–1.34]	0.254
No	54 (22.9)	13.2 (2.9)		14.7 (2.5)		1.5 [0.867–2.21]	< 0.001
Age	r = −0.125		0.028	r = −0.229	<0.001		
Self-care maintenance	r = 0224		<0.001	r = 0.256	<0.001		
Self-care management	r = 0.036		0.548	r = 0.131	0.048		
Self-care confidence	r = 0.182		<0.001	r = 0.102	0.081		
Health literacy	r = 0.214		<0.001	r = 0.229	<0.001		
Days in hospital	r = −0.094		0.098	r = 0.005	0.927		

3.2. Educational needs

Most participants (88.9%) said that they received patient education before hospital discharge, and 80.0% said their educational needs were very well (32.0%) or mostly (48.0%) fulfilled at that time. Nevertheless, most reported a very high or high educational need for each topic, as demonstrated in Fig. 1 At both time points, most participants had educational needs related to the disease (T1 = 73.8%, T2 = 46.1%), treatment (T1 = 78.5%, T2 = 53.4%), symptom management (T1 = 75.3%, T2 = 48.8), and prescribed medication (T1 = 71.4%, T2 = 58.6%), and fewer needed education about smoking and tobacco use (T1 = 16.5%, T2 = 13.3%), and problems with sex life (T1 = 31.8%, T2 = 25.8). However, a sub-analysis of smoking participants showed that 36.0% (n = 18, T1) and 46.9% (n = 15, T2) had a high or very high need for education about smoking and tobacco use. Educational needs on all topics decreased over time (Fig. 1) but did not differ based on background factors.

After Bonferroni's adjustment for multiple comparisons, associations between insufficient health literacy and greater educational need was observed for education about vegetable and fruit consumption at T1 (X^2 =11.7, df=1, $p = 0.009$), response to symptoms (X^2 =10.1; df=1, $p = 0.03$), physical activity and exercise (X^2 =10.0; df=1, $p = 0.03$), problems with sex life (X^2 =10.0; df=1, $p < 0.001$), sugar consumption (X^2 =9.3; df=1, $p = 0.045$), saturated fat consumption (X^2 =13.5; df=1, $p = 0.004$), fatty fish consumption (X^2 =19.1; df=1, $p = 0.002$), and salt consumption (X^2 =19.1; df=1, $p < 0.001$) at T2 (see Appendix II). No associations were observed for the other variables, namely gender, education level, marital status, income, residency (urban vs. rural) or rehabilitation participation, after Bonferroni's adjustment.

Most participants received information from healthcare professionals (96.4%) and/or healthcare institutions (88.5%) and fewer through media (43.8%) or patient associations (22.8%). Brochures (89.4%) were the most commonly used educational materials, followed by webpages (56.5%) and television (44.8%).

4. Discussion and Conclusion

4.1. Discussion

In this study, the disease-related knowledge of patients with CHD was explored at hospital discharge and six months later. The main findings showed that despite a significant increase in knowledge, patients had substantial unfilled educational needs at T2. Knowledge levels at hospital discharge were comparable to previous reports at hospital

Table 2
Participants' lifestyle characteristics and CADEQ-Q-SV scores at hospital discharge and six months later.

Variables	Hospital discharge (T1)			Six-month follow-up (T2)		
	n (%)	Mean (SD)	*p*	n (%)	Mean (SD)	*p*
Smoking			0.006			0.042
Yes	54 (17.6)	12.4 (4.2)		32 (10.5)	13.9 (3.3)	
No	252 (82.4)	14.1 (2.9)		274 (89.5)	14.9 (2.7)	
Level of physical activity last three months			0.197			0.102
Mostly sedentary/ light physical activity	213 (72.9)	13.65 (3.6)		169 (56.5)	14.6 (2.7)	
Moderate/ vigorous physical activity	79 (27.1)	14.2 (3.0)		130 (43.5)	15.1 (2.6)	
Changed diet since hospital discharge						0.014
Yes				254 (84.0)	15.0 (2.8)	
No				48 (16.0)	13.9 (2.8)	
Goal setting for life-style changes since hospital discharge						0.345
Yes				137 (46.0)	15.2 (2.5)	
No, but I need to make changes				98 (33.0)	14.7 (2.6)	
No				66 (22.0)	14.4 3.5)	

discharge [37] and prior to cardiac rehabilitation in Latin America [38], but were considerably lower than those of patients in Canada [14,39]. Furthermore, studies evaluating patients' disease-related knowledge after completing cardiac rehabilitation have reported similar [38] or higher knowledge scores [39] than those in the present study for participants who completed any type of rehabilitation.

Although knowledge levels improved, only 62.3% of patients scored ≥ 75%, and the results showed a gap in the participants' knowledge about certain aspects of CHD, especially at T1. A systematic review [19] highlighted the extensive and unfilled educational needs of patients with CHD, especially in understanding the disease and its risk factors. This supports our finding that most educational needs are related to cardiac disease and its treatment, symptom management, and medication. Interestingly, one-tenth of the participants in the current study were unaware of having a CHD diagnosis. Denial or skepticism about having a cardiac problem is one of the most reported barriers to treatment [19]. In this context, improved awareness and acceptance of a CHD diagnosis and the presence of a chronic condition could enhance patients' involvement in self-care and lifestyle changes. Healthcare professionals should prioritize education about the nature of the disease and emphasize the importance of a healthy lifestyle and sufficient self-care for the patient's prognosis.

At hospital discharge, the participants simultaneously reported that their educational needs had been fulfilled and that they had substantial educational needs. These conflicting responses may reflect the stressful situation faced by the patients. Over half of them were hospitalized for less than 24 hours, about half were newly diagnosed with CHD, and half had been acutely admitted due to their cardiac illness. Effective patient education must take into consideration both the patient's condition and the environmental factors that can hinder or enable learning. Although discharge education is emphasized in hospitals, patients with CHD have described its limitations, including poor recall and retention of information, and called for opportunities for repeated education [20]. The results of this study highlight the need for providing comprehensive education tailored to patients' individual needs, using different means of delivery across multiple sessions; this approach has been shown to enhance patients' self-care knowledge and self-care performance [40] while meeting the patient's wishes [4]. While discharge education should focus on essential "need-to-know" topics, follow-ups after discharge are important for meeting patients' individual educational needs when they arise and when the patients are motivated to learn. Clinical guidelines for the prevention of cardiovascular disease [4] recommend providing comprehensive, multidisciplinary cardiac

Table 4
Predictors of knowledge (CADE-Q-SV) at hospital discharge.

T1 (N = 274)	B	B.SE	*β*	*t*	*p*
Constant	11.889	2.113		5.626	< 0.001
Education	0.754	0.249	0.172	3.028	0.003
Age in years	-0.047	0.022	-0.127	-2.168	0.031
Self-care maintenance	0.031	0.013	0.145	2.404	0.017
Health literacy	0.230	0.071	0.187	3.223	0.001
Smoking [Yes]	-1.319	0.535	-0.148	-2.446	0.014
R^2	0.151				
Adjusted R^2	0.135				

(F(5268)= 9.50, $p < 0.001$, R2 = 0.135

Table 5
Predictors of knowledge (CADE-Q-SV) six months from hospital discharge.

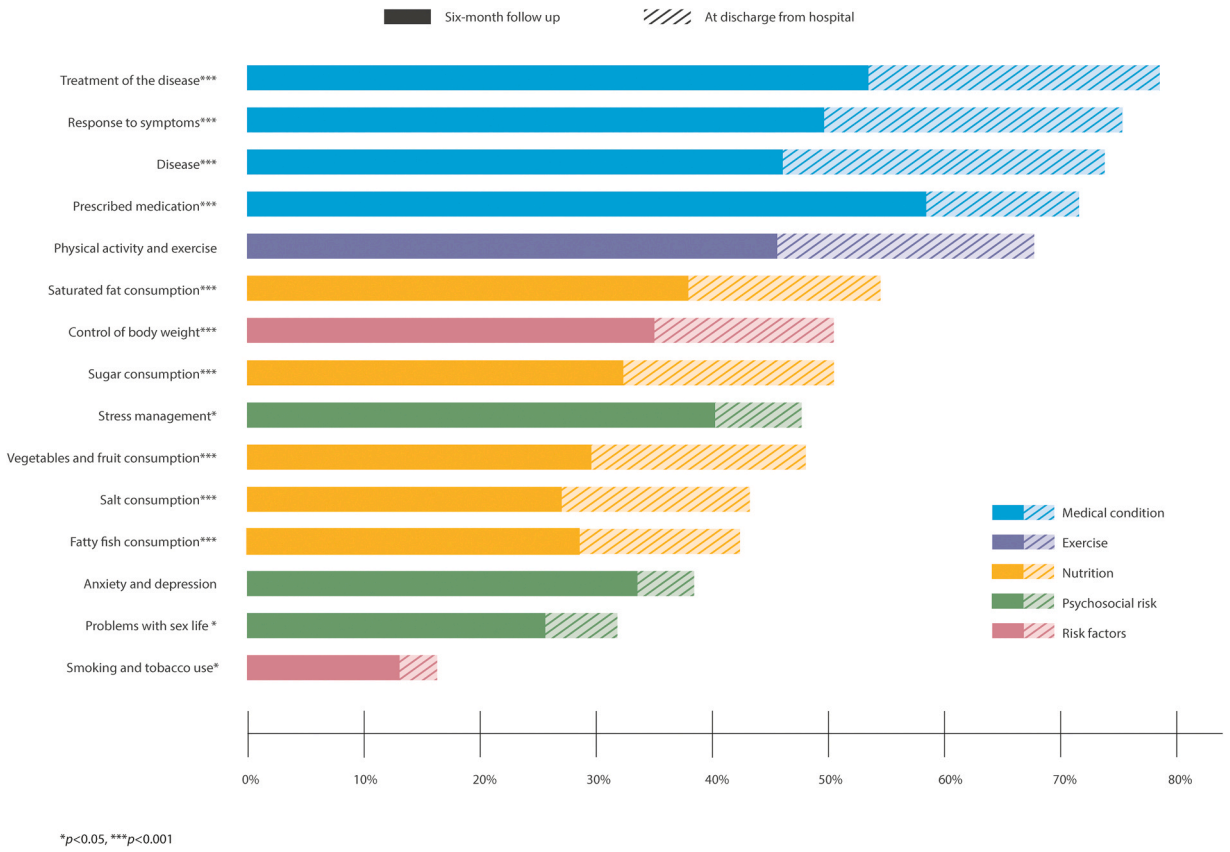
T2 (N = 264)	B	B.SE	*β*	*t*	*p*
Constant	12.116	2.015		6.013	< 0.001
Education	0.412	0.118	0.194	3.481	< 0.001
Age in years	-0.067	0.017	-0.220	-3.891	< 0.001
Self-care maintenance	0.027	0.012	0.135	2.230	0.027
Health literacy	0.155	0.060	0.150	2.583	0.010
Smoking [Yes]	-1.148	0.515	-0.130	-2.227	0.027
Diagnosis awareness [Yes]	1.690	0.517	0.182	3.270	0.001
R^2	0.221				
Adjusted R^2	0.203				

(F(6257)= 12.170, $p < 0.001$, R2 = 0.203)

Table 3
Disease-related knowledge (CADE-Q-SV) at hospital discharge (T1) and six months later (T2) and the increase in knowledge scores between the time points (n = 308).

Domain	N	Mean (SD),		Mean difference	t (df)	*p*	Cohen's d
		T1	T2	T2-T1 [95% CI]			
Nutrition	304	3.2(1.0)	3.3 (0.9)	0.1 [− 0.02, 0.19]	1.61(303)	0.108	0.1
Risk factors	308	2.9 (0.8)	3.1 (0.7)	0.2 [0.08, 0.28]	3.61(307)	< 0.001	0.2
Exercise	296	2.7 (1.1)	3.1 (1.0)	0.4 [0.27, 0.54]	6.01(295)	< 0.001	0.4
Medical	297	2.6 (0.7)	2.7 (0.6)	0.1 [0.05, 0.22]	3.13(296)	0.002	0.2
Psychosocial risk	301	2.4 (1.0)	2.7 (1.0)	0.2 [0.09, 0.34]	3.45(300)	< 0.001	0.2
Total Score	308	13.8 (3.2)	14.8 (2.8)	1.1 [0.76, 1.36]	6.94(307)	< 0.001	0.4

Possible score in each domain 0–4, Possible total score 0–20



*$p<0.05$, ***$p<0.001$

Fig. 1. Proportion of participants with high and very high educational needs at hospital discharge and six months later.

rehabilitation, which includes education, as its effects on patient knowledge and health behaviors are well established [10,13,14,41].

Participants who had completed their rehabilitation had higher knowledge scores than those who were still in rehabilitation, those who had dropped out of rehabilitation, and those who had not attended rehabilitation, although this variable was not significant in our multiple regression analysis. This finding is in line with previous reports [28,42,43]. However, similar to many other European countries, the availability of cardiac rehabilitation programs is suboptimal in Iceland, and rural patients lack support for their psychosocial and educational needs [44]. In the EUROASPIRE V [8] study on lifestyles and their impact on cardiovascular risk factor control in coronary patients across 27 countries, only one-third of the patients had participated in cardiac rehabilitation programs. In contrast, around two-thirds of the participants in the present study had either completed or were active in some form of rehabilitation. These results emphasize the need for new approaches in cardiac programs to increase attendance and overcome the well-known barriers to cardiac rehabilitation [45]. Notably, the COVID-19 pandemic led to the development of telerehabilitation programs without face-to-face contact [46], and it is likely that the lessons learned will be used for the future development of cardiac rehabilitation.

In this study, both the educational and health literacy levels of the patients were found to predict their disease-related knowledge, and smokers had less knowledge than nonsmokers. There were fewer smokers in this study than in the EUROASPIRE study [8], at 10.5% and 19%, respectively, $\geq$ six months from hospital discharge. To our knowledge, the relationship between the smoking status and disease-related knowledge of CHD patients has not been reported before. It was interesting that half of the smokers expressed a need for education about smoking and tobacco use six months after discharge, which can be interpreted as a need for support to quit smoking.

Other studies have similarly demonstrated that low levels of education [28,37,43,47] and health literacy are associated with less knowledge of the disease [16,48,49] and are predictors of cardiac knowledge [50]. The literature indicates that inadequate health literacy is highly prevalent among patients with CHD [48,49,51] and that patients with low health literacy are less likely to attend educational classes, have more difficulties in understanding health-related information, and tend to be uncomfortable asking for explanations [16]. Low health literacy is also associated with decreased self-care [48], adherence [16], quality of life, unfavorable cardiovascular risk factor profiles [51,52], increased hospital readmissions [48,49], and mortality [48]. This suggests that CHD patients with low education and health literacy levels may lack the knowledge required for optimal self-care and lifestyle changes. Therefore, health literacy screening to identify patients in need of special education and support may seem an obvious step and a critical component of patient care. However, researchers have argued that it is simpler and less stigmatizing to focus on clear communication with all patients [53], and implementing the principles of health-literate organizations—that is, healthcare organizations that incorporate health literacy into their care—may be a better solution [54], along with integrated care [55].

The findings of this study emphasize the need to improve the education of patients with CHD by enhancing healthcare professionals' role as educators and integrating comprehensive, person-centered education into patient care. Training for such a role must begin in undergraduate education and continue through postgraduate programs and specialization. Clinical guidelines for patient education practice [26] and the recently published core curriculum for cardiac nurses and allied professionals [56] can support educators and managers in making evidence-based developments to improve patient education.

The main strength of this study was that the majority of the eligible CHD patients in Iceland had a chance of being recruited, and the dropout rate at follow-up was low. Thus, the results are representative of the

patient group. Another strength was the use of standardized questionnaires that are internationally accepted, which enhances the transferability of the study and adds to the empirical research within patient education. We also acknowledge the well-recognized limitations of self-reported surveys, such as social desirability bias, and selection bias.

5. Conclusion

The study results confirm the need for implementing comprehensive educational interventions for patients with CHD. Despite an increase in disease-related knowledge over time, the participants had substantial educational needs six months after hospital discharge. Therefore, improved patient education and follow-ups are needed to address the diagnosis, treatment approaches, and ways of implementing self-care and lifestyle changes. Special attention should be given to elderly patients with low health literacy levels, deficit self-care, and a smoking habit.

5.1. Practice Implications

Patients with CHD need better, more extensive patient education following a cardiac event, but it may be difficult to provide sufficient education within short hospitalization periods when patients' learning capabilities are impaired. Healthcare professionals can improve the care of patients with CHD through comprehensive patient education that is person centered, focused, and based on evidence and patients' educational needs. Further, health literacy levels should be considered, and "need-to-know" topics, such as what the diagnosis and treatment of CHD entails and the essentials of self-care, should be prioritized. Improved care can be provided along with follow-ups after hospitalization, but this may require a reorganization of care pathways.

Funding

The study was supported by the Icelandic Regional Development Institute, Landspitali University Hospital Research Fund, Akureyri Hospital Research Fund, University of Akureyri Research Fund, Icelandic Nursing Association Research Fund, KEA Research Fund, and Akureyri Heart Association.

CRediT authorship contribution statement

Margrét Hrönn Svavarsdóttir: Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization, Resources, Visualization, Writing - original draft, Writing - review & editing. **Eva Halapi:** Validation, Software, Formal analysis, Data curation, Visualization, Writing - review & editing. **Auður Ketilsdóttir**: Conceptualization, Methodolgy, Investigation, Writing - original draft, Writing - review & editing, Resources. **Inga Valborg Ólafsdóttir**: Conceptualization, Methodolgy, Investigation, Writing - review & editing, Resources. **Brynja Ingadottir:** Methodology, Investigation, Funding acquisition, Data curation, Conceptualization, Project administration, Resources, Supervision, Writing - review & editing.

Declaration of Competing Interest

The authors report no competing interest.

Acknowledgments

The authors thank the patients who contributed their time to this study and the nurses who assisted with recruitment and data collection.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2023.107972.

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