Original Article

Factors Contributing to Cardiac Rehabilitation Uptake Among Patients with Coronary Artery Disease in Thailand: A Nationwide Cross-Sectional Study

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ABSTRACT

Objectives: This study aimed to identify factors contributing to cardiac rehabilitation (CR) uptake among patients with coronary artery disease (CAD) in Thailand.

Study design: A descriptive survey study

Setting: Data collection took place at an urban and a rural hospital.

Subjects: Patients were eligible for the study if they had been referred for CR by the medical staff during their in-patient stay.

Methods: Data were collected from June 2018 to July 2019. Patients with CAD attending either the urban or the rural hospital completed the Cardiac Rehabilitation Barriers Scale (CRBS) questionnaire which surveyed barriers to CR uptake.

Results: The mean age of the 138 respondents was 64 years with 68.8% aged 60 or older; 70% were male, and 67.4% were CR attendees. Patients aged 60-69 were found to have the highest uptake of CR. Rural patients with CAD differed from those from urban areas in having a lower level of education (X^2 (2, n = 67) = 14.58, p = 0.001, *phi*= 0.466) and lower family income (X^2 (2, n = 67) = 9.60, p = 0.008, *phi* = 0.379). Rural patients with fewer years of formal education and those who were farmers were less likely to attend CR. Rural patients reported more barriers to CR than did urban participants. The main barriers to CR uptake for rural patients were distance from and transportation to the clinic.

Conclusions: While the existing CR hospital-based programs in Thailand may be appropriate for urban patients with CAD, they are less useful for patients living in rural areas. Existing CR programs should be modified to include more nuanced approaches to CR suitable for rural patients.

Keywords: rehabilitation, cardiac rehabilitation, secondary prevention, cardiovascular diseases, barrier, attendance

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Introduction

Coronary artery disease (CAD), also referred to as coronary heart disease (CHD), is mainly caused by coronary atherosclerosis, which results from the coronary arterial wall response to an inflammatory process.[1] CAD is the leading cause of death globally, with annual mortality from CAD approximately 9.1 million worldwide,[2] which is almost a half the total number of deaths (18.6 million) in 2019 from cardiovascular diseases (CVD).[2] Globally, it is estimated that in 2019, 197.2 million people were living with CAD, and that the number of people with CAD increased by 103.5% from 1990 to 2019.[2]

Although CAD mortality in Western countries has dropped dramatically in recent decades as a result of greater emphasis on primary prevention and the improvement of diagnosis and treatment of CAD, developing countries continue to present challenges for public health.[3] In Thailand, the Ministry of Public Health (MOPH) reported CAD mortality of 20,786 for the year 2019,[4] making it the major cause of death among the Thai population. There were 337,441 hospital admissions due to CAD in 2019.[4] According to a report by Kiatchoosakun, Sutra, and Thepsuthammarat (2012),[5] CAD represents the highest disease burden for Thais. The authors also reported that CAD impacts not only patients' quality of life, but also affects the national budget and the healthcare system.

Currently, there are a number of standardized approaches for the prevention or treatment of CAD, e.g., pharmacology therapy, coronary revascularization (Percutaneous Coronary Intervention (PCI) and Coronary Artery Bypass Grafting (CABG).[6] Primary prevention for CAD is defined as prevention of the first occurrence of CAD and includes the assessment and management of cardiovascular risk factors such as maintaining a desirable body weight, eating healthy food, exercising regularly, and not smoking.[7] Secondary prevention, an essential part of contemporary care of patients with

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CVD, refers to healthcare designed to prevent recurrence of cardiovascular events, e.g., heart attack or stroke and complications of CVD in patients diagnosed with CVD. Such prevention involves medical care, modification of behavioral risk factors, psychosocial care, education, and support for self-management, all of which need to be delivered in a variety of settings.[8]

Cardiac rehabilitation (CR) is recommended worldwide as a secondary prevention for patients with CAD, as it improves cardiovascular health outcomes.[9,10] CR has been defined as "the sum of activities required to influence favorably the underlying cause of the disease, as well as to provide the best possible physical, mental and social conditions, so that patients may by their own efforts preserve, or resume when lost, as normal a place as possible in the life of the community."[11]

There is extensive evidence supporting the effectiveness of CR: restoring and maintaining physical functioning of the heart, a significant reduction in morbidity and mortality from cardiac causes, better psychosocial well-being, and improved quality of life.[10,12]

As a result of the effectiveness of CR, it is now recognized in evidenced based guidelines for patients with CAD. The European Society of Cardiology,[13] the American Heart Association, and the American College of Cardiology[7] have all given CR a Class I recommendation, the highest level of recommendation for specific treatments, meaning that there is evidence that CR is beneficial, useful and effective for patients with CAD.

Although the benefits of CR are considerable, CR uptake overall is poor worldwide, with reported rates of attendance at CR sessions by patients recommended to attend ranging from 20% to 50% internationally.[13, 14] Many factors contribute to CR uptake and adherence, including demographic variables, psychological factors, medical conditions, access to programs, and sociocultural factors.[15,16] In Thailand, the CR uptake rate is low, with estimates that only approximately 18.3% of eligible patients attend.[17] However, little is known about the reasons for the poor patient uptake at CR programs in Thailand. The present study aimed to identify factors contributing to low CR uptake among patients with CAD in Thailand as the healthcare system differs from those of most Western countries and because cultural and religious beliefs strongly influence people's lives and health.

Method

Design

This was an urban and rural center cross sectional study.

Participants

The population consisted of patients diagnosed with CAD who were eligible to attend a CR program based on the current guidelines in Thailand.[18] Patients were eligible to participate in the study if they had been referred for CR by the medical staff during their in-patient stay. A question regarding their intention to attend future CR (yes/no/waiting) was asked. Patients waiting to attend their first CR session were excluded from the study as they may or may not actually attend CR.

The majority of patients with CAD were undergoing coronary artery bypass grafting or percutaneous coronary intervention, or were patients with CAD who had developed heart failure.

Data collection

All recruited patients had been discharged after their initial admission and were returning to outpatient clinics between 2018 and 2019 at either the urban hospital or the rural hospital. Data collection took place between June 2018 and July 2019. Patients were excluded if they had a documented cognitive impairment. Participants were recruited in the outpatient clinic using a convenience sampling approach. The researcher presented the self-administered survey questionnaires after providing a verbal explanation of the survey tool. Once completed, the survey questionnaires were retained in a sealed box to ensure anonymity.

Ethical considerations

The study protocol was approved by the Human Research Ethics Committees of University of Queensland (approval number 2017001672), the urban hospital (reference number MURA2018/339 and protocol number ID 05-61-24), and the rural hospital (reference number HE621143).The study conforms to the Helsinki Declaration. All participants gave written consent to participate in the study.

Table 1. Overview of the phase two CR program delivery in a rural and an urban hospitals

Phase 2 Intensive physical and aerobic exercise (walking, running, cycling) as circuit conditioning delivered in the outpatient CR center.
Three programs are available and the number of sessions were determined by the risk of the patients including
Program 1: high risks= 18 sessions (6-9 weeks), 2-3 times a week
Program 2: moderate risks= 10 sessions (3-5 weeks), 2-3 times a week
Program 3: low risks= 12 sessions, monthly
60 minutes duration each session
Content of the session: warm up (10-15 minutes), exercising (15-30 minutes), and cool down
Educational activities 2–3 times per week
Psychological counselling
The CR programs are standardized and based on international guidelines; therefore, deliver the same benefits across different sites.

CR, cardiac rehabilitation

Questionnaire

The questionnaire consisted of one question ("yes/no/waiting") to determine if the participant was currently attending phase II CR plus 14 demographic questions and a Thai language version of the Cardiac Rehabilitation Barriers Scale (CRBS) questionnaire. The researchers obtained permission to use the CRBS questionnaire from the authors.[19] The CRBS was chosen because it has been used to identify multidimensional barriers to CR uptake as reported in literature reviews. It was practical for the purpose of the present study, and the reliability and validity of the questionnaire had previously been demonstrated.[19,20]

The CRBS questionnaire is comprised of four subscales with a total of 21 items rated on a five point Likert type scale, ranging from 1=strongly disagree to 5=strongly agree. Higher scores represent stronger barriers to CR participation or adherence. The CRBS consists of perceived need for CR/healthcare factors (nine items), logistical factors (five items), conflicts with work schedule/time (three items), and comorbidities/functional status (four items).[19] For the present study, the CRBS questionnaire was translated into Thai and the face validity of the translation was determined by a panel of experts and a back-translation approach combined with a bilingual test.[21] The back-translation technique allows detection and correction of discrepancies between source- and target language versions, while a bilingual test can evaluate an instrument's clarity, comprehensiveness, appropriateness, and cultural relevance with future subjects.[21] The CRBS back-translation process was performed by two qualified bilingual translators, both having a NATTI (National Accreditation Authority for Translators and Interpreters) certificate. The original version of the CRBS was initially forward-translated from English into Thai. Then, the CRBS Thai version was back-translated blindly into an English version.

Once the translation process was completed, the two versions in English were compared and evaluated by the researcher. The researcher and the translators reviewed the source version and the back-translation of the CRBS for equivalences, and adapted them to the most fitting meaning in Thai. The version was reviewed for linguistic and cultural quality by the researcher and the translators.[21] Discrepancies were resolved by consensus to achieve conceptual equivalence with the original questionnaire.

An expert panel then conducted a face validity check of the CRBS to determine whether the language was considered to be appropriate for Thai people and to assess the questionnaire language for clarity. Then, the translated CRBS was sent to experts to ensure the appropriateness of the language based on Thai local information, context, and culture.[22]

A cardiologist, a cardiac surgeon, a cardiac rehabilitation physician, and two clinical nurses who specialize in CR were chosen as the experts in this study as they are responsible for referring patients to CR programs as well as providing ongoing care and management to patients diagnosed with CAD. During face validation, all experts recommended that "my doctor" in item CRBS[16] should be modified to "my cardiologist" and "cardiac surgeons" or "cardiac rehabilitation doctors" as appropriate. Aside from this item, the experts found the length, readability, and clarity of the translated CRBS satisfactory.

Data handling

To review data across commonly accepted categories used by the National Economic and Social Development Board, and Ministry of Education, age and education were collapsed into categorical variables as shown in Table 2.

Employment status was also collapsed into four categories, consistent with the main categories of employment status among the Thai population. The distance patients travelled from their home to CR settings in Thailand was grouped into three categories (Table 2).

Data analysis

Data were entered into SPSS version 21.0 (IBM SPSS software) for statistical analysis. For purposes of comparison, "attendees" was defined as individuals who had attended one or more rehabilitation sessions, and "non-attendees" as those who had been invited to attend but did not do so. The Chi-square test for independence was used to detect the relationship between categorical variables (sociodemographic characteristics and CR attendance) at both hospitals and within each hospital. Post hoc tests were conducted using Chi-square tests when appropriate. The independent samples t-test was used to compare the mean scores of continuous variables. Statistical significance was set at 0.05 for all tests in the analysis with two sided *p* values.

Results

Demographic Characteristics

Of the 180 patients who were approached, 138 met the eligibility criteria. A total of 71 participants from the urban hospital, and 67 participants from the rural hospital were

Table 2. Categories for collapsed continuous and categorical variables

Variable	Category (coding)
Age (years)	< 60 (1) 60-69 (2) ≥ 70 (3)
Educational level	< 6 years (1) 6-12 years (2) More than 12 years or tertiary (3)
Employment status	Employed (1) Unemployed (2) Retired (3) Farmer (4)
Distance from patients' homes (kilometer)	≤ 100 (1) > 100, but ≤ 200 (2) > 200 (3)

included. Of the participants, 95 were CR attendees and 43 were CR non-attendees. The average age of the participants was 64 years (range 41-88). Of the participants, 96% were Thai and 4% were Lao. There were more males (70%) than females (30%). Almost 95% of the participants were Buddhist, with 3% and 2% of the participants Christian and Muslim, respectively.

The demographics of the participants are shown in Table 3. The majority of the participants were 60 years or older, married, and had a moderate family income. Approximately half of the participants had a tertiary educational and almost 20% were farmers. Approximately 10% said they had to travel a long distance from their home to the CR location. CR attendees had a higher educational level, employment rate, and family income compared to CR non-attendees.

At the urban hospital (Table 4), there was no statistically significant association between any of the demographic variables and CR attendance among patients with CAD. However, at the rural hospital (Table 5), a Chi-square test for independence indicated that there were significant differences in educational level (X^2 (2, n = 67) = 14.58, p = 0.001, *phi* = 0.466), employment status (X^2 (3, n = 67) = 10.25, p = 0.017, *phi* = 0.391), and family income (X^2 (2, n= 67) = 9.60, p = 0.008, *phi* = 0.379) with CR attendance among patients with CAD. Post hoc comparisons revealed that patients with fewer years of education and those who were farmers were less

Table 3. Demographics of CR Attendees and CR Non-Attendees (n = 138)

Demographic variables	Total (n = 138)	CR attendees (n = 95)	CR non-attendees (n = 43)	*p*-value[a]
Age (years)				0.101
< 60	43 (31.2)	31 (32.6)	12 (27.9)	
60-69	54 (39.1)	41 (43.2)	13 (30.2)	
≥ 70	41 (29.7)	23 (24.2)	18 (41.9)	
Educational level (years)				< 0.001
< 6	42 (30.4)	18 (18.9)	24 (55.8)	
6-12	23 (16.7)	19 (20.0)	4 (9.3)	
Tertiary or more than 12	73 (52.9)	58 (61.1)	15 (34.9)	
Marital status				0.492
Single	5 (3.6)	4 (4.2)	1 (2.3)	
Married	110 (79.7)	75 (79.0)	35 (81.4)	
Widowed	19 (13.8)	12 (12.6)	7 (16.3)	
Divorced	4 (2.9)	4 (4.2)	0	
Employment status				0.001
Employed	41 (29.7)	32 (33.7)	9 (20.9)	
Unemployed	28 (20.3)	19 (20.0)	9 (20.9)	
Retired	42 (30.4)	34 (35.8)	8 (18.6)	
Farmer	27 (19.6)	10 (10.5)	17 (39.5)	
Family income a month (Thai baht)				0.046
< 10,000	17 (12.3)	9 (9.5)	8 (18.6)	
10,000-20,000	36 (26.1)	21 (22.1)	15 (34.9)	
> 20,000	85 (61.6)	65 (68.4)	20 (46.5)	
Health insurance				0.076
Universal health coverage scheme	44 (31.9)	24 (25.3)	20 (46.5)	
Civil servant medical benefit scheme	71 (51.4)	52 (54.7)	19 (44.1)	
Social security scheme	11 (8.0)	9 (9.5)	2 (4.7)	
Voluntary payment	12 (8.7)	10 (10.5)	2 (4.7)	
CR cost per session (Thai baht)				0.958
< 1,000	52 (37.7)	36 (37.9)	16 (37.2)	
1,000-2,000	56 (40.6)	39 (41.0)	17 (39.5)	
≥ 2,000	30 (21.7)	20 (21.1)	10 (23.3)	
Distance from patients' homes to CR (kilometers)				0.609
≤ 100	72 (52.2)	52 (54.7)	20 (46.5)	
> 100, but ≤ 200	48 (34.8)	32 (33.7)	16 (37.2)	
> 200	18 (13.0)	11 (11.6)	7 (16.3)	
Time travelling from patients' homes to CR (minutes)				0.192
≤ 60	64 (46.4)	49 (51.6)	15 (34.9)	
≥ 90, but ≤ 180	55 (39.9)	34 (35.8)	21 (48.8)	
≥ 200, but ≤ 300	17 (12.3)	10 (10.5)	7 (16.3)	
> 300, but ≤ 360	2 (1.4)	2 (2.1)	0	

*Values are presented as number (%); [a]Chi-square test; CR, (cardiac rehabilitation)

A recommended living family income of 313–336 Thai Baht a day is based on the daily minimum wage nationwide (Ministry of Labor, 2020).

likely to attend CR, while patients with higher educational levels and who had a higher family income were more likely to attend CR.

Cardiac Rehabilitation Barriers Scale (CRBS) findings

The criterion validity of the CRBS and of mean scores for CRBS items for both cohorts are presented below.

Criterion Validity of the CRBS

Mean total and subscale CRBS scores for CR attendees and CR non-attendees for both hospitals combined are shown in Table 6. CR attendees and CR non-attendees had the highest mean CRBS subscale for logistical factors. There was a significant difference in the CRBS mean total scores between CR attendance for CR non-attendees (M = 2.60, SD = 0.36) and CR attendees (M = 2.41, SD = 0.52); t (138) = -2.44, p = 0.016, two tailed. The magnitude of the difference in the means (mean difference = -0.19) was small to moderate (eta^2 = 0.04). However, a statistically significant difference in CR attendance was found only for the CRBS healthcare/perceived need subscale for CR non-attendees (M = 2.46, SD = 0.41) and CR attendees (M = 2.21, SD = 0.48); t (138) = -2.96, p = 0.004, two tailed. The magnitude of the difference in the means (mean difference = -0.25) was moderate (eta^2 = 0.06).

Table 4. Demographics of CR Attendees and CR Non-Attendees at the Urban Hospital (n = 71)

Demographic variables	CR attendees (n = 55)	CR non-attendees (n = 16)	p-value[a]
Age (years)			0.290
< 60	14 (25.5)	3 (18.8)	
60-69	22 (40.0)	4 (25.0)	
≥ 70	19 (34.5)	9 (56.2)	
Educational level (years)			0.291
< 6	8 (14.5)	5 (31.3)	
6-12	14 (25.5)	4 (25.0)	
Tertiary or more than 12	33 (60.0)	7 (43.7)	
Marital status			0.741
Single	2 (3.6)	1 (6.25)	
Married	44 (80.0)	14 (87.5)	
Widowed	8 (14.6)	1 (6.25)	
Divorced	1 (1.8)	0	
Employment status			0.535
Employed	14 (25.5)	3 (18.8)	
Unemployed	13 (23.6)	6 (37.5)	
Retired	28 (50.9)	7 (43.7)	
Family income a month (Thai Baht)			0.774
< 10,000	6 (10.9)	1 (6.3)	
10,000-20,000	9 (16.4)	2 (12.5)	
> 20,000	40 (72.7)	13 (81.2)	
Health insurance			0.218
Universal health coverage scheme	12 (21.8)	6 (37.5)	
Civil servant medical benefit scheme	32 (58.2)	10 (62.5)	
Social security scheme	5 (9.1)	0	
Voluntary payment	6 (10.9)	0	
CR cost per session (Thai Baht)			0.713
< 1,000	27 (49.1)	9 (56.2)	
1,000-2,000	16 (29.1)	3 (18.8)	
≥ 2,000	12 (21.8)	4 (25.0)	
Distance from patients' homes to CR (kilometers)			0.185
≤ 100	34 (61.8)	7 (43.8)	
> 100, but ≤ 200	18 (22.7)	6 (37.5)	
> 200	3 (5.5)	3 (18.7)	
Time travelling from patients' homes to CR (minutes)			0.058
≤ 60	33 (60.0)	7 (43.8)	
≥ 90, but ≤ 180	19 (34.6)	6 (37.5)	
≥ 200, but ≤ 300	1 (1.8)	3 (18.7)	
> 300, but ≤ 360	2 (3.6)	0	

*Values are presented as number (%); [a]Chi-square test; CR, cardiac rehabilitation

A recommended living family income of 313–336 Thai Baht a day is based on the daily minimum wage nationwide (Ministry of Labor, 2020).

Table 5. Demographics of CR attendees and CR non-attendees at the rural hospital (n = 67)

Demographic variables	CR attendees (n = 40)	CR non-attendees (n = 27)	*p*-value[a]
Age (years)			0.059
< 60	17 (42.5)	9 (33.3)	
60-69	19 (47.5)	9 (33.3)	
≥ 70	4 (10.0)	9 (33.3)	
Educational level (years)			0.001
< 6	10 (25.0)[b]	19 (70.4)[c]	
6-12	5 (12.5)[b]	0[b]	
Tertiary or more than 12	25 (62.5)[b]	8 (29.6)[c]	
Marital status			0.173
Single	2 (5.0)	0	
Married	31 (77.5)	21 (77.8)	
Widowed	4 (10.0)	6 (22.2)	
Divorced	3 (7.5)	0	
Employment status			0.017
Employed	18 (45.0)[b]	6 (22.2)[b]	
Unemployed	6 (15.0)[b]	3 (11.1)[b]	
Retired	6 (15.0)[b]	1 (3.7)[b]	
Farmer	10 (25.0)[b]	17 (63.0)[c]	
Family income a month (Thai baht)			0.008
< 10,000	3 (7.5)[b]	7 (25.9)[b]	
10,000-20,000	12 (30.0)[b]	13 (48.2)[b]	
≥ 20,000	25 (62.5)[b]	7 (25.9)[c]	
Health insurance			0.353
Universal health coverage scheme	12 (30.0)	14 (51.9)	
Civil servant medical benefit scheme	20 (50.0)	9 (33.3)	
Social security scheme	4 (10.0)	2 (7.4)	
Voluntary payment	4 (10.0)	2 (7.4)	
CR cost per session (Thai baht)			0.900
< 1,000	9 (22.5)	7 (25.9)	
1,000-2,000	23 (57.5)	14 (51.9)	
> 2,000	8 (20.0)	6 (22.2)	
Distance from patients' homes to CR (kilometers)			0.863
≤ 100	18 (45.0)	13 (48.1)	
> 100, but ≤ 200	14 (35.0)	10 (37.0)	
> 200	8 (20.0)	4 (14.8)	
Time travelling from patients' homes to CR (minutes)			0.342
≤ 60	16 (40.0)	8 (29.6)	
≥ 90, but ≤ 180	15 (37.5)	15 (55.6)	
≥ 200, but ≤ 300	9 (22.5)	4 (14.8)	
> 300, but ≤ 360	0	0	

*Values are presented as number (%); [a]Chi-square test; [bc]Post-hoc tests for Chi-square tests; CR, (cardiac rehabilitation)
A recommended living family income of 313–336 Thai Baht a day is based on the daily minimum wage nationwide (Ministry of Labor, 2020).

Correlation of CRBS Scores and CR Attendance (n=138)

The mean scores of CR attendees were compared to CR non-attendees for each of the CRBS items both overall and for urban and rural hospitals. The most commonly reported barriers for both cohorts were "transportation problems," "distance," and "family responsibilities," followed by CR cost, and a lack of knowledge of CR.

Consistent with the methodology of Shanmugasegaram et al. (2012), an independent samples t-test was conducted to compare the CRBS mean item scores of CR attendees and CR non-attendees (Table 7). There were statistically significant differences in mean item scores for "other health problems," not being contacted by the rehab program with small to moderate effect size. "My doctor did not feel it was necessary" and "taking too long to start the CR program" showed a significant difference in mean item score with moderate to large effect size as shown in Table 7.

CRBS Scores for the urban hospital

The mean scores for CRBS items of CR attendees were compared to scores for CR non-attendees at the urban hospital. "Transportation problems" was the most frequently reported barrier for CR attendees, while "family responsibilities" had the highest CRBS mean score for CR non-attendees. Both CR non-attendees and CR attendees had CRBS mean

Table 6. Comparison of Mean Scores on the CRBS between CR attendees and CR non-attendees (n = 138)

Demographic variables	CR attendees (n = 95)		CR non-attendees (n = 43)		*p*-value[a]
	Mean	SD	Mean	SD	
Scale total	2.41	0.52	2.60	0.36	0.016
Subscales					
Healthcare/perceived need	2.21	0.48	2.46	0.41	0.004
Logistical	2.84	0.88	2.91	0.67	0.635
Work/time conflicts	2.45	0.84	2.67	0.68	0.124
Comorbidities/functional status	2.29	0.72	2.46	0.72	0.207

CRBS, Cardiac Rehabilitation Barriers Scale; CR, cardiac rehabilitation; SD, standard deviation

[a]Independent sample t-tests.

Table 7. CRBS Scores of CR Attendees and CR non-attendees of both hospitals (n = 138)

CRBS items	Total (n = 138)	CR attendees (n = 95)	CR non-attendees (n = 43)	MD	*Eta*^{2}	*p*-value[a]
CRBS_01… of distance	3.22±1.30	3.14±1.35	3.42±1.16	-0.28	0.010	0.240
CRBS_02… of cost	2.93±1.20	2.83±1.23	3.16±1.09	-0.33	0.016	0.133
CRBS_03… of transportation problems	3.29±1.23	3.29±1.29	3.28±1.12	0.23	0.000	0.945
CRBS_04… of family responsibilities	2.98±1.10	2.96±1.15	3.02±1.01	0.07	0.000	0.749
CRBS_05… I didn't know about CR	2.80±1.01	2.79±1.08	2.79±1.08	-0.05	0.000	0.798
CRBS_06… I don't need CR	2.42±1.05	2.34±1.11	2.62±0.88	-0.28	0.015	0.147
CRBS_07…I already exercise at home, or in my community	2.68±1.03	2.60±1.07	2.60±1.07	-0.26	0.013	0.171
CRBS_08… severe weather	1.88±1.03	1.98±1.02	1.67±1.04	0.30	0.009	0.109
CRBS_09… I find exercise tiring or painful	2.52±0.94	2.55±0.98	2.47±0.83	0.08	0.001	0.635
CRBS_10… travel	2.49±0.97	2.41±0.99	2.66±0.91	-0.25	0.014	0.174
CRBS_11… of time constraints	2.59±1.07	2.48±1.10	2.84±0.97	-0.35	0.023	0.073
CRBS_12… of work responsibilities	2.47±0.99	2.45±1.03	2.51±0.91	-0.06	0.000	0.747
CRBS_13… I don't have the energy	2.30±0.96	2.22±0.96	2.49±0.94	-0.27	0.017	0.129
CRBS_14… other health problems prevent me from going	2.29±0.87	2.17±0.81	2.56±0.96	-0.39	0.038	0.023
CRBS_15… I am too old	2.26±1.12	2.23±1.13	2.33±1.09	-0.09	0.002	0.648
CRBS_16… my doctor did not feel it was necessary	2.06±0.72	1.94±0.69	2.33±0.71	-0.39	0.062	0.003
CRBS_17… many people with heart problems don't go, and they are fine	2.13±0.70	2.12±0.74	2.16±0.57	-0.05	0.001	0.713
CRBS_18… I can manage my heart problem on my own	2.30±0.93	2.28±0.98	2.33±0.85	-0.05	0.000	0.778
CRBS_19… I think I was referred, but the rehab program didn't contact me	2.10±0.79	1.98±0.73	2.37±0.85	-0.39	0.049	0.010
CRBS_20… it took too long to start the outpatient program after referral	2.03±0.73	1.84±0.61	2.45±0.80	-0.61	0.125	< 0.001
CRBS_21… I prefer to take care of my health alone, not in a group	2.06±0.77	2.01±0.83	2.17±0.62	-0.16	0.008	0.278

[*]Values are presented as mean± standard deviation; [a]Independent sample t-tests; mean difference; Eta^2, eta square

A recommended living family income of 313–336 Thai Baht a day is based on the daily minimum wage nationwide (Ministry of Labor, 2020).

scores of 2.5 or more in five items, and CR non-attendees had higher CRBS means in 10 items. However, only the item, "taking too long to start the CR program after referral," showed a significant difference in mean score between CR attendees and CR non-attendees. The *eta*^{2} statistic (0.12) indicated a moderate to large effect size (Table 8).

CRBS Scores for the Rural Hospital

As shown in Table 9, CR non-attendees had higher mean scores on CRBS items than CR attendees, with the exception of the items related to "transportation problems," "family responsibilities," a lack of knowledge of CR, "severe weather," and "finding exercise tiring or painful." "Distance" was the most frequently reported barrier for CR non-attendees, but the highest reported CRBS mean score for CR attendees was for "transportation problems." CR non-attendees and CR attendees had mean CRBS item scores of 3 or more for distance, cost, and transportation problems.

An independent samples t-test was conducted to compare the CRBS mean item scores for CR attendees and CR non-attendees at the rural hospital (Table 9). There were significant differences in the CRBS item mean scores for "severe weather," "other health problems," "the rehab program didn't contact me," and the preference to "manage my heart problem

Table 8. CRBS Scores of CR Attendees and CR Non-Attendees at the Urban Hospital (n = 71)

CRBS items	CR attendees (n = 55)	CR non-attendees (n = 16)	MD	*Eta*^{2}	*p*-value[a]
CRBS_01… of distance	2.78±1.29	2.94±1.34	-0.16	0.002	0.674
CRBS_02… of cost	2.44±1.05	2.38±0.96	0.06	0.000	0.835
CRBS_03… of transportation problems	3.04±1.26	2.88±1.20	0.16	0.003	0.651
CRBS_04… of family responsibilities	2.82±1.23	3.25±1.18	-0.43	0.021	0.218
CRBS_05… I didn't know about CR	2.65±1.16	2.81±1.11	-0.16	0.003	0.630
CRBS_06… I don't need CR	2.24±1.07	2.19±0.83	0.05	0.000	0.867
CRBS_07… I already exercise at home, or in my community	2.69±1.20	2.94±1.06	-0.25	0.007	0.461
CRBS_08… severe weather	2.36±1.11	2.63±1.15	-0.26	0.009	0.414
CRBS_09… I find exercise tiring or painful	2.29±0.96	2.19±0.91	0.10	0.002	0.702
CRBS_10… travel	2.35±0.93	2.31±0.95	0.03	0.000	0.903
CRBS_11… of time constraints	2.29±1.05	2.25±1.00	0.04	0.000	0.890
CRBS_12… of work responsibilities	2.24±0.96	1.94±0.77	0.30	0.018	0.259
CRBS_13… I don't have the energy	2.13±1.02	2.31±0.95	-0.19	0.006	0.518
CRBS_14… other health problems prevent me from going	2.05±0.83	2.19±1.05	-0.13	0.004	0.596
CRBS_15… I am too old	2.18±1.11	2.00±0.89	0.18	0.006	0.504
CRBS_16… my doctor did not feel it was necessary	1.84±0.76	2.00±0.89	-0.16	0.007	0.471
CRBS_17… many people with heart problems don't go, and they are fine	1.98±0.73	1.81±0.40	0.17	0.011	0.380
CRBS_18… I can manage my heart problem on my own	2.27±1.06	2.13±1.06	0.14	0.003	0.654
CRBS_19… I think I was referred, but the rehab program didn't contact me	1.89±0.74	2.06±0.99	-0.17	0.008	0.453
CRBS_20… it took too long to start the outpatient program after referral	1.80±0.73	2.50±0.97	-0.70	0.124	0.003
CRBS_21… I prefer to take care of my health alone, not in a group	2.13±0.96	2.06±0.68	0.07	0.000	0.803

[*]Values are presented as mean± standard deviation; [a]Independent sample t-test

CR, cardiac rehabilitation; CRBS, Cardiac Rehabilitation Barriers Scale; MD, mean difference; E*ta*^{2}, eta squared

Table 9. CRBS Scores of CR Attendees and CR Non-Attendees at the Rural Hospital (n = 67)

CRBS items	CR attendees (n = 40)	CR non-attendees (n = 27)	MD	*Eta*^{2}	*p*-value[a]
CRBS_01… of distance	3.63±1.31	3.70±0.95	-0.08	0.001	0.777
CRBS_02… of cost	3.38±1.28	3.63±0.88	-0.26	0.014	0.338
CRBS_03… of transportation problems	3.65±1.25	3.52±1.01	0.13	0.003	0.651
CRBS_04… of family responsibilities	3.15±1.00	2.89±0.89	0.26	0.018	0.278
CRBS_05… I didn't know about CR	2.98±0.95	2.85±0.66	0.12	0.006	0.533
CRBS_06… I don't need CR	2.48±1.15	2.88±0.82	-0.41	0.042	0.096
CRBS_07…I already exercise at home, or in my community	2.48±0.88	2.81±0.83	-0.34	0.037	0.117
CRBS_08… severe weather	1.45±0.55	1.11±0.32	0.34	0.133	0.002
CRBS_09… I find exercise tiring or painful	2.90±0.93	2.63±0.74	0.27	0.024	0.211
CRBS_10… travel	2.50±1.09	2.88±0.83	-0.38	0.033	0.140
CRBS_11… of time constraints	2.75±1.13	3.19±0.79	-0.44	0.050	0.067
CRBS_12… of work responsibilities	2.75±1.06	2.85±0.82	-0.10	0.003	0.659
CRBS_13… I don't have the energy	2.35±0.86	2.59±0.93	-0.24	0.018	0.278
CRBS_14… other health problems prevent me from going	2.33±0.76	2.78±0.85	-0.45	0.074	0.026
CRBS_15… I am too old	2.30±1.18	2.52±1.16	-0.22	0.008	0.456
CRBS_16… my doctor did not feel it was necessary	2.08±0.57	2.52±0.51	-0.44	0.140	0.002
CRBS_17… many people with heart problems don't go, and they are fine	2.30±0.72	2.37±0.57	-0.07	0.003	0.672
CRBS_18… I can manage my heart problem on my own	2.30±0.85	2.44±0.69	-0.14	0.008	0.468
CRBS_19… I think I was referred, but the rehab program didn't contact me	2.10±0.71	2.56±0.69	-0.46	0.094	0.012
CRBS_20… it took too long to start the outpatient program after referral	1.90±0.38	2.42±0.70	-0.52	0.157	0.001
CRBS_21… I prefer to take care of my health alone, not in a group	1.85±0.58	2.23±0.59	-0.38	0.094	0.012

[*]Values are presented as mean± standard deviation; [a]Independent sample t-test.

CR, cardiac rehabilitation; CRBS, Cardiac Rehabilitation Barriers Scale; MD, mean difference; E*ta*^{2}, eta squared

on my own" between CR attendees and CR non-attendees with a moderate to large effect size. However, statistically significant differences were also found with large effect size in the mean item scores for "my doctor did not feel it was necessary" and "it took too long to start the outpatient program after referral."

Distance was the most frequently reported barrier at both hospitals. CR attendees and CR non-attendees at the rural

hospital had higher CRBS mean item scores than those of CR attendees and CR non-attendees at the urban hospital in 18 and 17 items out of 21, respectively. CR non-attendees at the rural hospital had CRBS mean item scores of 2.5 or more in 16 items, while CR non-attendees at the urban hospital had CRBS mean item scores of 2.5 or more for only seven items.

Discussion

The majority of the CR participants in this study were 60 years or older and male.

Patients aged 60-69 had the highest rate of CR attendance, and patients over 70 years had the lowest rate of CR attendance. These results accord with an Australian study where CR attendance rates dropped sharply after 70 years of age among patients with CAD.[23] Contrary to our study, previous research studies have found that CR attendees were younger than non-attendees.[16,24,25] In the Thai context, there are some possible reasons why patients aged 60-69 had a higher rate of CR attendance than those under 60. These could include that the majority of the participants were retired and had more free time to attend CR, they may have had financial security sufficient for costs associated with traveling to CR settings, and they may have had strong family support (almost 80% of CR attendees were married).

Consistent with other studies, our study found that women were less likely than men to attend CR programs,[16,26] although other studies have reported no significant gender difference in CR uptake when the gender difference in enrolment rates after a referral is taken into account.[27] In the Thai context, women have a crucial role as the caretaker of family members and feel an obligation to feed other family members before joining CR.[28] This may affect the decision of female patients not to attend CR at the hospital. This is supported by studies which show that family commitments for women are a key barrier preventing them from attending CR.[15,29]

Barriers to CR uptake

This study demonstrated that educational level, distance and transportation, work commitments and the farming season, knowledge of CR and its benefits, family responsibilities, and CR costs were the key concerns related to CR uptake among patients with CAD in the Thai context.

Consistent with the findings of several international studies, patients with a higher education level were more likely to attend CR.[16,30] The majority of CR non-attendees at the rural hospital had fewer years of education than those at the urban hospital, reflecting a huge gap in accessing the Thai educational system between the urban and rural areas of the country. This education gap may result in reduced ability of patients in rural areas to access, understand and appraise health information, including information about CR.

In agreement with other international studies undertaken in Europe, Japan and Indonesia, distance to travel for CR was a common barrier to attendance, especially in rural areas.[16,25,31,32,33] In Thailand, the number of CR programs is limited. Throughout the northeast of Thailand, for example, only one CR setting currently provides a CR program which provides for 22 provincial areas of Thailand and the nearby countries of Laos, Cambodia, and Vietnam. The majority of CR rural non-attendees lived more than 100 kilometers from the location of the CR program.

In line with previous studies, our study demonstrated that transportation difficulties, including heavy traffic and lack of parking, have been associated with low CR uptake[16, 31,34] In remote areas of Thailand's northeast, the transportation system is not well developed. Road systems are often inadequate, some patients do not own cars, and public transport is extremely limited. However, transportation is a problem not only for rural people, but is also a barrier for urban dwellers.[35] This could be because of traffic congestion which is common in some urban areas, particularly in Bangkok.

Consistent with the findings of some international studies, an association was found between patients' knowledge of CR and CR uptake.[9,36] This study found that CR attendees, especially younger CR attendees with higher educational levels, had more practical knowledge of CR and its benefits. Despite this knowledge, however, some patients still did not attend CR, possibly because the perceived benefit was not high enough or because the barriers to attendance were too great.

These results are consistent with international studies which have found that some currently employed patients did not attend CR due to work responsibilities.[15,37,38] A novel finding of the present study is the extent to which specific work demands in rural and urban areas differ. At the rural hospital, 63% of CR non-attendees were farmers, which could explain why they did not attend CR during the rice planting or harvesting periods. Rural Thai people are heavily dependent on agriculture as their main source of income.[39] Their farming activities also rely on natural conditions such as weather and seasons.

Urban and rural female patients who did not work outside the home had responsibilities such as cooking for their family members which must be considered before joining CR. These duties led to a reluctance to attend CR programs. This finding accords with that of some international studies that women's decision to attend CR is influenced by their family obligations.[29, 31] This could also be explained culturally, e.g., the Buddhist belief that women and wives play important roles in household duties and as caretakers to support other family members. Thai women live in a patriarchal social structure where they undertake most of the family care.[40] Men or husbands take responsibility as a head of the house to provide the means to feed the family members.[40]

Although the CR program itself was covered by the healthcare system, costs related to CR attendance, including food, parking, transportation, and accommodation, were the responsibility of patients. The finding that cost was a barrier is consistent with previous studies.[15,25,31] However, those studies were conducted in urban settings, where income tends to

higher than in rural populations.[15] In Thailand, patients in both urban and rural areas have similar issues related to CR costs. These CR costs might be linked to the lack of CR facilities located in some provincial areas, resulting in patients having to travel some distance from their home to participate in CR programs.

Study limitations

The findings of this study should be interpreted with caution. First, the study sample was a convenience sample, the study consisted mainly of male Thai participants, and the findings are specific to only two tertiary hospitals in Thailand which may limit the generalizability of the findings. Second, the majority of the participants were elderly, had comorbidities, and had had follow-ups with many different physicians which may have introduced recall bias. However, efforts were made to minimize recall bias by asking patients to recall only shorter periods. Third, data collection took place in two CR settings, although these tertiary CR settings did appear to be the representative of the urban and rural areas of Thailand.

Conclusions

Distance, transportation, and CR costs are the key obstacles affecting patients' decision to attend CR in Thailand. Notably, differences in work commitments in rural and urban areas also affected CR uptake. Men and the elderly were found to be the majority of the CR participants. Most importantly, this study shows that rural participants differ from the urban cohort in some aspects. There may be additional barriers which may not have been identified, so further research with a larger sample may be able to identify factors related to CR uptake among patients with CAD throughout the country. The upshot is there is a need to improve the current CR programs and to create more nuanced approaches to CR for rural and remote populations.

Disclosure

The authors have no conflicts of interest to disclose.

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