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Contribution of Patient and Physician Factors to Cardiac Rehabilitation Enrollment: A Prospective Multi-Level Study

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Abstract

Background—Cardiac rehabilitation (CR) is an established means of reducing mortality, yet is grossly under-utilized. This is due to both health system and patient-level factors, issues which have yet to be investigated concurrently. This study utilized a hierarchical design to examine physician and patient-level factors affecting verified CR enrollment.

Design—A prospective multi-site study, using a multi-level design of 1490 CAD outpatients nested within 97 Ontario cardiology practices (mean 15 per cardiologist).

Methods—Cardiologists completed a survey regarding CR attitudes. Outpatients were surveyed prospectively to assess factors affecting CR enrollment. Patients were mailed a follow-up survey 9 months later to self-report CR enrollment. This was verified with 40 CR sites.

Results—550 (43.4%) outpatients were referred, and 469 (37.0%) enrolled in CR. In mixed logistic regression analyses, factors affecting verified CR Enrollment were greater strength of physician endorsement (p=.005), shorter distance to CR (p=.001), being married (p=.01), and fewer perceived CR barriers (p=.03).

Conclusion—Both physician and patient factors play a part in CR enrollment. Patient CR barriers should be addressed during referral discussions, and reasons why physicians fail to uniformly endorse CR explored. Because distance to CR was related to patient enrollment patterns, greater access to home-based CR services should be provided.

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Keywords

Cardiac Rehabilitation; Coronary Artery Disease; Enrollment; Physician Factors; Patient Factors

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in the developed world [1]. Secondary preventive efforts such as cardiac rehabilitation (CR) can greatly reduce this burden. CR is an evidence-based outpatient program of structured exercise, education, psychosocial support, and risk reduction. Among other benefits, evidence from Cochrane systematic reviews as well as meta-analyses [2–4] demonstrate that CR reduces mortality by approximately 25%.

Unfortunately however, CR is grossly under-utilized. Rates of CR participation are approximately 15–20% in North America, Europe and Australia [5–9]. CR is under-used even in those clinical situations where clinical practice guidelines indicate that it will improve prognosis, and perhaps delay or prevent the use of expensive procedures [4,10]. Because under-use represents inferior quality of care, it is essential that factors related to the lack of CR referral are explored.

The process of moving patients through the cardiac care system from acute care to CR involves actions on behalf of healthcare providers, and also on behalf of patients. The CR enrollment process is dependent upon patients being informed about CR by a healthcare provider, and then the referred patient must attend an intake assessment, and ultimately participate in the program. The literature examining physician-level variables affecting CR utilization is lacking [11,12], while the literature examining patient variables affecting CR enrollment is abundant [6,7,13–17]. To date however, there has been no research examining the contribution of physician and patient-level factors to sub-optimal CR enrollment using a multi-level approach. The objective of this study was to concurrently investigate the contribution of physician and patient-level factors to CR enrollment in a broad sample of cardiologists and their patients.

METHODS

Design and Procedure

This was a prospective study, using a multi-level design of outpatients nested within cardiologists' practices. Upon receiving ethics approval from participating institutions, a sample of cardiologists was generated through a national physician registry, CMD Online (www.mdselect.com), and basic sociodemographic data were extracted. Consenting cardiologists completed a survey assessing their CR attitudes. They were also visited by a research assistant to extract a consecutive sample of approximately 20 each of their recent coronary artery disease (CAD) outpatients who were eligible for CR. With informed consent by the patients, basic clinical data were recorded from their charts, and they were mailed a self-report survey assessing factors affecting healthcare utilization. Nine months later, participants were mailed a second follow-up survey assessing self-reported CR enrollment.

Patient postal codes and CR site postal codes were used to compute distance in kilometers and total drive time between participant's home and the closest CR site using Geographic Information Systems. Forty CR sites to which participants reported enrollment were contacted for verification. Analyses ensued in 2007.

Participants

Ninety-seven cardiologists consented to participate. Inclusion criteria consisted of having a non-pediatric practice, location in a major centre in the Windsor to Ottawa corridor of Ontario, Canada to ensure proximity to CR, and actively treating CAD outpatients. Table 1 displays the characteristics of participating cardiologists.

Of the 2486 consecutive CAD outpatients mailed, 1490 consented to participate and 413 were ineligible (72% response rate). This represents a mean of 15.3 patients per cardiologist. CAD diagnosis was confirmed through chart abstraction based on standard criteria of detailed history, focused physical examination, diagnostic ECG changes (i.e., Q waves, and/or ST-T segment changes), and/or troponin levels above the 99th percentile of normal. Patients who had undergone percutaneous coronary interventions (PCIs), coronary artery bypass surgery, or concurrent valve repair were also eligible. Patients were eligible for the study if they were seen by their cardiologist in an outpatient setting between 2004 and 2006. Reasons for ineligibility were as follows: lack of English language proficiency (n =145; 35.1%), could not locate the patient (n=86; 20.8%), no CAD diagnosis (n=41; 9.9%), orthopedic, neuromuscular, cognitive or vision impairment (n=37; 9.0%), expired (n=34; 1.4%), non-recent index event or treatment (n =18; 4.4%), ineligibility for CR based on Canadian guidelines [18], previous attendance at CR (n=5; 1.2%), non-dysphoric psychiatric conditions (n=3; 0.7%), and other reasons (e.g. moved out of the country; n=34; 8.2%).

Measures

CR enrollment by patients was assessed via self-report in the follow-up survey, and verified with the CR site as attendance at an intake appointment (yes/no).

Environmental (i.e., physician-level variables) and individual factors (i.e., patient-level variables) affecting CR enrollment were assessed in accordance with Andersen's Behavioral Model of Healthcare Utilization [19] (see Figure 1). Physician-level factors included sociodemographic variables such as sex, graduation year and location of medical school (Ontario, Canada, international). These factors were extracted from the online physician database. In the physician survey, physicians were asked to estimate their weekly patient volume. They were also asked to rate their attitudes toward CR and barriers (including health system barriers) through investigator-generated items [12]. Nineteen Likert-type items were rated on a scale from 'strongly agree' to 'strongly disagree'.

Patient-level factors affecting CR enrollment incorporated into the surveys were those shown in the literature to be related to CR [20,21] and are again in accordance with Andersen's Model [19] (Figure 1). Andersen conceptualizes the patient-level factors as: (1) characteristics predisposing utilization, (2) characteristics enabling utilization, and (3) need. Predisposing factors exist prior to the onset of illness and describe the inclination of individuals to use health services. Enabling factors are the barriers and facilitators to the use of health services. Need factors are the objective and subjective aspects of the decision to use health services. The CR-relevant factors in each category are outlined below, and were assessed in the baseline survey unless otherwise indicated.

Predisposing Factors—Sociodemographic data included age, sex, ethnocultural background (open-ended and forced choice), work status, level of education, and gross annual family income. Two “yes/no” response items were created to assess participants’ past exercise habits (“Did you exercise to the point of getting short of breath on a regular basis (as an adult) prior to your cardiac event?”) and comorbidities that might interfere with an exercise regime (“Do you have any other medical conditions that would prevent you from exercising?”).

The Beck Depression Inventory-II (BDI-II) [22,23] was used to assess depressive symptoms. It is a reliable and well-validated 21-item scale that uses a forced-choice 4-alternative response format. It has been widely used in the general population and in populations with long-term illness, including cardiac problems [24–30]. Higher scores reflect greater depressive symptomatology, with scores >10 reflecting mild to severe symptomatology.

Enabling Factors—The sociodemographic characteristics of marital status and living arrangements were assessed in the baseline survey. Investigator-generated items assessed in the follow-up survey included the type of referring physician (cardiac specialist vs. other), the strength of provider CR endorsement (rated from 1 ‘not at all strongly’ to 5 ‘very strongly’), and the number of visits to a cardiac specialist and primary care physician in the intervening 9 months.

Actual distance and travel time to CR were computed. Participants’ homes and CR sites in Southern Ontario were mapped by postal code, to generate distances in kilometers and drive time in minutes to the closest CR site. The list of CR sites was based on the Canadian Association of CR, CR Network of Ontario, and Canadian CR Foundation directories, and those identified by participants in the survey. CR sites in the Southern Ontario corridor were cross-referenced with patient postal codes using Geographic Information Systems.

Nineteen investigator-generated items [20] assessing patient facilitators and barriers to CR enrollment were administered in the follow-up survey. Sample items included perceived distance, time constraints, and having exercise equipment at home. Responses were made on a 5-point Likert-type scale from ‘strongly disagree’ to ‘strongly agree’. The internal consistency was α=0.92, and nearly all of these variables were significantly related to enrollment. Therefore, a total score was computed.

The Exercise Benefits/Barriers Scale (EBBS) was used to determine respondent’s health beliefs concerning participation in exercise [31]. The EBBS is a 43-item instrument that uses a 4-point Likert scale with responses ranging from 4 (strongly agree) to 1 (strongly disagree). Mean benefit and barrier scores were computed.

The ENRICHD Social Support Inventory (ESSI) [32] is a 7-item measure developed and validated in a cardiac randomized controlled trial. It includes items regarding structural, tangible and emotional aspects of support found to be predictive of outcome in cardiac patients.

The Illness Perception Questionnaire (IPQ-R) [33] was incorporated to assess cognitive representations of cardiovascular disease. The personal control subscale of the IPQ-R was incorporated as an enabling factor. All items were scored on a 5-point Likert-type scale. A mean subscale score was computed, with higher scores denoting greater perceived control.

Need Factors—The following IPQ-R [33] subscales were included as need factors: the timeline (acute/chronic), timeline cyclical or episodic, consequences, and treatment cure/controllability. All items are scored on a 5-point Likert-type scale, which ranges from strongly disagree to strongly agree. Mean subscale scores were computed with higher scores denoting greater endorsement of the given construct.

Clinical indicators of perceived need included CCS [18] class as available, and cardiac risk factors (i.e., diabetes, body mass index, smoking, family history, hypertension). These variables were extracted from clinical charts where available, and risk factor data were supplemented with patient self-report if missing.

The Duke Activity Status Index (DASI) [34] is a brief 12-item, self-administered survey to determine functional capacity. Participants were asked about their ability to perform common activities of daily living, such as personal care, ambulation, household tasks, sexual function, and recreational activities, which are each associated with specific metabolic equivalents (METs). This valid and common tool correlates highly with peak oxygen uptake [35].

The Physical Activity Scale for the Elderly (PASE) [36] is a brief and reliable instrument to assess physical activity in epidemiological studies of persons age 65 years and older. PASE comprises self-reported occupational, household, and leisure activities during a one-week period.

Statistical Analyses

The following analyses were conducted using SPSS 15.0 [37]. A descriptive examination of self-reported and verified CR enrollment was performed. Bivariate screening based on CR enrollment was performed on the physician and patient-level variables using chi-squares and t-tests as appropriate. This was performed to enable variable selection for an adjusted model based on theoretical (i.e., Andersen's model) and empirical (i.e., $p<.1$) criteria. Significant variables were screened for multicollinearity, and in some cases decisions were made to exclude variables from the model. For instance, CR distance and travel time were highly correlated, and given the greater t value for distance, it was chosen for inclusion in the model. Similarly, exercise barriers and benefits were highly correlated, and benefits were chosen for inclusion. With regard to illness perceptions, the timeline cyclical, consequences (trend only) and cure/controllability subscales were highly correlated, and the latter subscales were excluded. Finally, with regard to physician items assessing CR attitudes, items 16, 17 and 18 were highly correlated (see Table 4). A principal components analysis was undertaken of all 19 variables, and these three items loaded highly (<.8) on one factor which explained the greatest degree of variance. A variable was computed based on the mean score on these 3 items. Overall checks of statistical assumptions also revealed the distance to CR variable to be highly skewed, and therefore rank of distance was entered into the model. Finally, mixed logistic regression analysis predicting verified CR enrollment was conducted using R [38,39], which takes into account the clustering of patients within physicians.

RESULTS

Respondent Characteristics

Of the 1490 consenting patient participants, 1268 were retained at the nine-month assessment and 86 were ineligible (retention rate = 1268/(1490–86) = 90.3%). Reasons for ineligibility were as follows: unable to reach/incorrect contact information (n=37; 43.0%), expired (n=24; 27.9%), new onset of an orthopedic, neuromuscular, cognitive, psychiatric or vision impairment (n=6; 7.0%), and other reasons (n=19; 22.1%) such as too ill to participate or moved out of the province/country. Characteristics of participants and those who refused or were ineligible at follow-up are summarized in Table 2.

Self-Reported and Verified CR Enrollment and Participation

Five hundred and ninety three (46.8%) patients indicated that they enrolled in CR at one of 40 sites, and 534 (42.1%) reported participating in the program. Patients reported attending a mean of 84.6±25.68% of the prescribed CR sessions, and reported a mean travel time of 24.1±17.7 minutes to CR. GIS data revealed a mean CR travel time of 27.60±64.62 minutes from home to the closest site with a mean distance of 23.55±71.09 kilometers for all patients regardless of CR enrollment.

Forty CR centers within the province of Ontario were contacted to verify self-reported enrollment. Verification was received for 657 (97.6%) patients. Of the 593 patients who self-reported enrollment, this was verified for 469 (79.1%) patients, such that 85.3% of those referred enrolled in CR. Where CR enrollment could not be verified, we relied upon self-report data. Overall, 37.0% of participants enrolled in CR. Verified patient attendance across all centers was 80.75±31.27% of prescribed sessions.

Multi-Level Factors Related to CR Enrollment

Tables 3 and 4 display the patient and physician scores by verified CR enrollment. In bivariate analyses, the following patient-level factors were related to CR enrollment: younger age, employment, greater education, greater family income, fewer comorbid conditions which affect ability to exercise, less depressive symptoms, closer distance and travel time to CR, being married or common-law (trend), greater exercise benefits and fewer barriers, greater perceived personal control over cardiac illness, referral by a cardiac specialist (trend), perceived strength of provider endorsement, fewer CR barriers, greater functional status, and the illness perceptions of cure/controllability, timeline cyclical and illness consequences (trend). In bivariate analyses, the following physician-level attitudinal items were related to CR enrollment: intentions to refer, and the composite mean of items 16, 17 and 18 which represent positive perceptions of CR. The mixed logistic regression

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analysis shown in Table 5 revealed the following variables to be related to CR enrollment: shorter distance to CR, greater strength of physician CR endorsement, being married, and patient perceptions of fewer CR barriers, with a trend for greater functional status and perceived exercise benefits.

DISCUSSION

There have been few multi-level studies assessing medical practice and health service use variation, and even fewer studies examining rehabilitation, or CR specifically. The present study has been the first to concurrently examine a comprehensive list of multi-level factors affecting CR enrollment in a broad sample of CAD outpatients and their cardiologists, in a theoretically-based and hierarchical manner. Although overall results confirm those presented in the literature to date [13,14,40,41], findings strongly demonstrate how factors at multiple levels interact in CR enrollment patterns. Overall, according to Andersen's Behavioral Model of Healthcare Utilization [19], environment-level and patient-level enabling factors were central to CR enrollment in the adjusted model.

Similar to our results, previous research has consistently identified the importance of physician endorsement in CR utilization [41–43]. Whether this lack of endorsement is due to time constraints during healthcare visits, negative physician perceptions of CR, or perception that other healthcare providers should provide such endorsement is unknown. A recent RCT however shows that physician CR endorsement is not effective in written format when compared to no endorsement [44], thus given our findings studies of verbal physician endorsement should be pursued. While there has been much discussion of this issue in the literature, interventions are needed to ensure physician CR endorsement to patients. Increasing awareness among physicians regarding the importance of their CR endorsement should be pursued, given that advice by physicians is more likely to be heeded than advice from other healthcare providers. Such endorsement could be included in cardiac care maps for example.

Enabling factors are those which serve as barriers or facilitators to CR enrollment. Factors identified in this study were marital status, CR barriers, and distance to CR. Previous research has identified these factors as important in CR utilization [40,41]. Having spousal support for instance has been shown to positively affect CR participation, and involving including spouses in referral discussions, or enlisting the support of adult children where patients do not have a partner [45] could promote greater CR enrollment.

Patient's CR barriers were related to enrollment. These barriers include transportation issues, time constraints due to family or work responsibilities, exercise in one's home or community, comorbidities, and perceiving exercise as tiring or painful for example. Healthcare providers should work with patients to identify and address these common barriers and facilitators during CR discussions. For instance, securing alternate means of transportation, identifying CR programs with evening classes, and discussion of the individualized nature of exercise prescriptions based on a patient's abilities, comorbidities and preferences may increase CR enrollment.

Distance and drive time to CR can be viewed as either an environmental/health system level issue or a patient enabling factor. CR siting decisions have generally not been made on the basis of a thorough analysis of regional need, but generally emerge through local CR champions such as physicians. This has resulted in CR service maldistribution [10]. Moreover, patients who reside in rural areas invariably face geographic barriers to healthcare utilization such as CR [46]. Results show that patients take geography into consideration when making enrollment decisions. Promotion of home-based CR services for patients with geographic barriers should be more widely advocated to ensure universal access to CR services. This mode of CR service delivery has been shown to be efficacious, safe and cost-effective [47,48]. Patient-level predisposing and need factors were unrelated to CR enrollment in the hierarchical model. This is both encouraging and disconcerting. With regard to predisposing factors, the fact that characteristics such as sex and ethnocultural background were unrelated to CR enrollment suggests that we are overcoming inequalities in CR enrollment. On the contrary, while all eligible patients should be referred for CR universally as recommended in clinical practice guidelines [18], the fact that need factors such as disease severity and risk factor status were unrelated to CR enrollment is disheartening. Both objective and subjective (i.e., illness perceptions) indicators of need were incorporated into the study, and in adjusted analyses there was only a trend for a difference in CR enrollment by activity status. In fact, the trend showed that participants with greater need or those with a lower activity status were significantly less likely to enroll in CR. Use of risk factor burden and disease severity information could ensure CR access to cardiac patients who need it most. However, all patients in the sample had verified indications for CR, and thus ‘needed’ such services.

While comprehensive reviews of patient-level factors affecting CR enrollment can be found in the literature [13,14,40,41], this research shows that we can no longer focus solely on the patient level without examining the broader issues affecting CR at the physician and health system level. Moreover, while there have been calls in the literature to develop means to overcome under-utilization of CR services, few interventions have been developed, tested or implemented, particularly at the physician level [49]. Our group has demonstrated the potential of automatic referral in doubling rates of CR utilization [20,50]. However, automatic referral generally precludes physician endorsement of CR to patients, and thus means to further optimize CR enrollment must be explored.

Caution is warranted when interpreting these results, most notably due to threats to generalizibility. Retained participants were more likely to be older, married, white, higher income and with higher activity status than non-participants. Moreover, results may not be generalizable to other health care systems, particularly those where CR services are not covered. Replication is warranted.

CONCLUSIONS

This study has concurrently examined physician and patient factors affecting CR enrollment. CR enrollment is associated with greater physician endorsement of CR, being married, shorter distance to CR and fewer barriers. Results suggest that enrollment is not related to disease severity or rehabilitation need. Health system, physician and patient factors play a role in patient enrollment decisions, and thus multi-level interventions are needed to optimize CR enrollment, and ultimately cardiac health.

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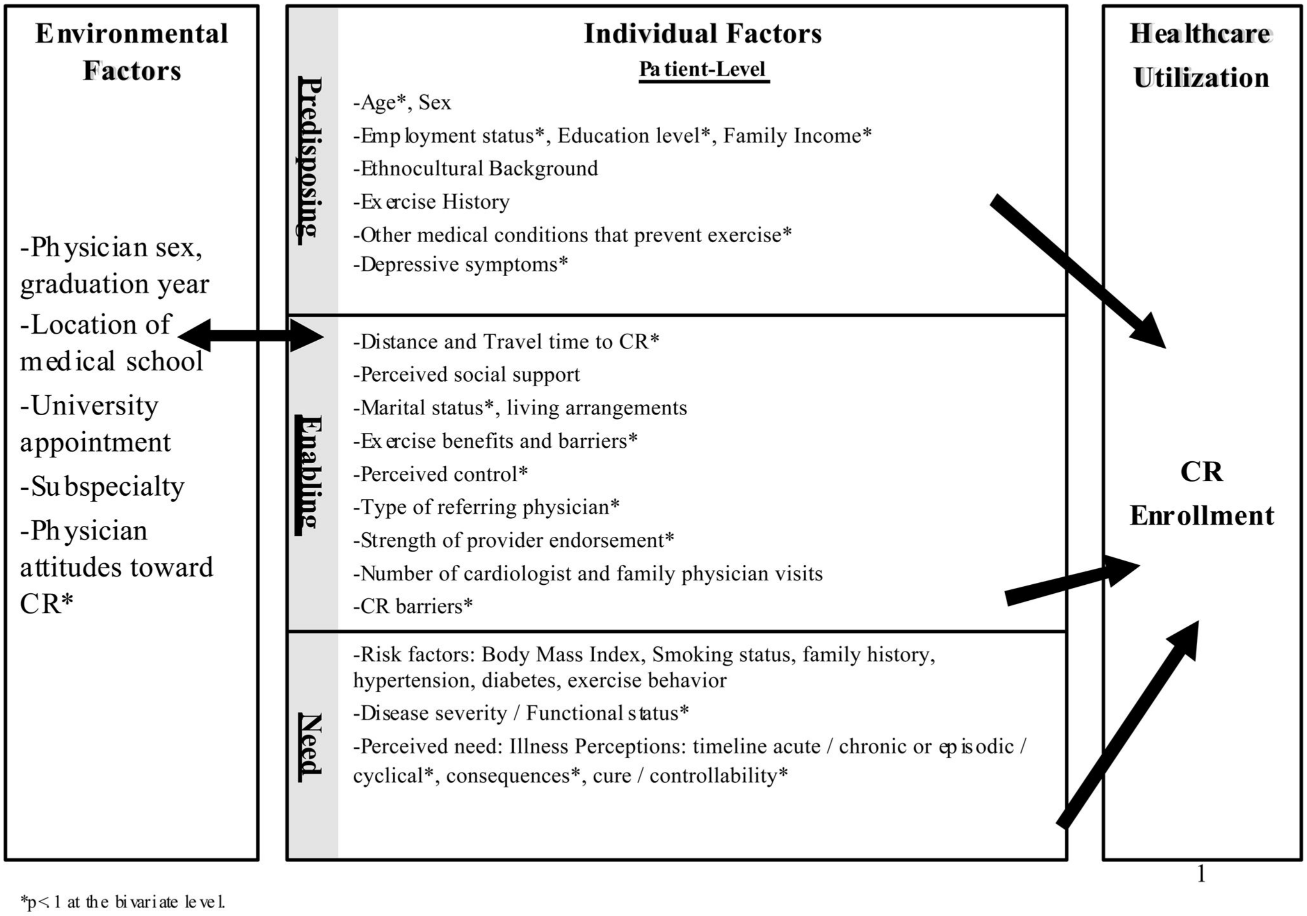

Figure 1.

Andersen's Model Applied to Cardiac Rehabilitation Enrollment

Table 1

Characteristics of participating cardiologists, N=97

Characteristic	N(%)/Mean± SD
Sex (% female)	14 (14.4%)
Graduation year – medical degree (mean ± SD)	1982 ± 8.48
Location of medical school (% Ontario)	55 (57.0%)
University appointment (% yes)	43 (44.0%)
Subspecialty (% internal medicine)	62 (25.6%)
Weekly patient volume (mean ± SD)	46.34±33.48

Table 2

Sociodemographic and clinical characteristics of patient sample at 9-month follow-up, N=1268

Characteristic	Retained Participants (N=1268)	Ineligible (n=86)	Declined (n=138)
Age	67.28 ± 11.16	66.56 ± 13.60	64.46 ± 11.44 *
Sex (% female)	358(28.2)	23(26.7)	43(31.2)
BMI †	27.53 ± 5.39	27.43 ± 5.58	27.61 ± 5.69
Marital status † (%married)	910(72.3) **	52(60.5)	81(60.0)
Ethnocultural background † (% minority)	174(13.7) ***	21(24.4)	37(26.8)
Education † (% >high school)	670(86.1)	38(44.7)	70(52.2)
Family income † (% >= $50,000 CAD per year)	560(48.5) **	26(32.1)	43(37.4)
Work status † (% full-time/part-time)	406(32.3)	27(31.8)	53(39.6)
Systolic BP mm Hg (mean ± SD)	131.15 ± 19.15	136.06 ± 20.82	131.35 ± 19.31
Diastolic BP mm Hg (mean ± SD)	74.50 ± 10.21	77.51 ± 13.19 *	73.23 ± 10.42
Total Cholesterol/ HDL Ratio	4.24 ± 1.21	4.07 ± 1.09	4.15 ±1.18
HDL mmol/L (mean ± SD)	1.22 ± 0.42	1.09 ± 0.29	1.18 ± 0.30
LDL mmol/L (mean ± SD)	2.33 ± 0.93	2.08 ±1.00	2.49 ± 0.91
CCS Angina Class II-IV (%)	262 (20.7)	7 (8.1)	26(18.8)
Multi-vessel Disease (>1 diseased coronary arteries)	365 (28.7)	24(27.9)	34(24.6)
Duke Activity Status Index †	37.23 ± 15.79 ***	29.12 ± 18.64	34.28 ± 16.16
Current or Previous MI	929(73.2)	62(72.1)	105(76.1)
Current or Previous PCI	558(44.0)	37(43.0)	56(40.6)
Current or Previous CABG	360(28.4)	18(21.9)	31(22.5)
Current or Previous HF	177(14.0)	18(20.9)	24(17.4)
Current or Previous Valve repair/replacement	194(15.3)	13(15.1)	27(19.6)

Note: Percentages take into account missing data for some variables.

BMI, Body Mass Index; BP, blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein CCS, Canadian Cardiovascular Society; NYHA, New York Heart Association. MI, Myocardial Infarction; PCI, Percutaneous Coronary Intervention; CABG, Acute Coronary Bypass; HF, Heart Failure.

† denotes data from patient report

* $p < 0.05$,

** p<.01,

*** p<.0001

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Table 3

Patient-Level Factors Associated with Verified Enrollment in a CR Program, N= 1268

	CR Enrollment		t or χ^2 value	p
	Yes 469 (37.0%)	**No** 799 (63.0%)		
Predisposing *				
Age, mean ± SD †	65.68±10.13	68.21±11.62	−3.91	<.001
Sex (% female) †	127(27.1)	231(28.9)	0.49	0.52
Employment status (% FT/PT work)	168(36.2)	238(30.0)	5.20	0.02
Education (% ≥ high school)	280(60.6)	390(49.6)	14.13	<.001
Family income (% ≥$50,000CAD/year)	243(56.5)	317(43.8)	17.49	<.001
Ethnocultural background (% Non-Caucasian)	71(15.1)	103(12.9)	1.26	0.27
Exercise history (%yes)	134(29.2)	211(28.6)	0.06	0.84
Other medical condition(s) that prevents exercise (%yes)	128(27.7)	273(36.7)	10.37	0.001
BDI-II Depressive Symptoms, mean ± SD	8.70±7.60	10.15±8.42	−2.99	0.003
Enabling *				
Distance to closest CR site (GIS)	16.14±23.91	27.91±87.34	−2.85	0.004
Travel time in minutes to closest CR (GIS)	21.12±23.03	31.39±79.23	−2.74	0.006
Social support, mean ± SD (ESSI)	28.31±6.08	28.36±5.94	−0.14	0.89
Marital status (% married)	350(75.3)	560(70.5)	3.29	0.08
Living arrangements (% living with family)	365(78.7)	602(76.0)	1.16	0.29
Exercise benefits, mean ± SD (EBBS)	2.99±0.32	2.87±0.38	5.14	<.001
Exercise barriers, mean ± SD (EBBS)	2.01±0.37	2.12±0.42	−4.43	<.001
Illness perceptions (personal control)	24.15±3.37	22.71±3.97	6.60	<.001
Type of referring physician (% specialist) §	314 (73.0)	46(62.2)	3.64	0.06
Strength of provider CR endorsement, mean ± SD §	3.89±1.09	3.46±1.26	4.33	<.001
Number of cardiologist visits, mean ± SD §	1.65±1.74	1.51±1.85	1.35	0.18
Number of family physician visits, mean ± SD §	4.80±4.02	4.81±4.44	−0.03	0.98
Total CR Barriers, mean ± SD §	2.00±0.91	2.83±0.93	−13.61	<.001

	CR Enrollment		t or χ^2 value	p
	Yes 469 (37.0%)	**No** 799 (63.0%)		
Need[*]				
BMI, mean ± SD	27.34±5.33	27.65±5.42	−0.99	0.32
Smoker (% yes)	40(8.6)	62(7.8)	0.22	0.67
CCS Class II-IV (%)	85(32.4)	117(67.7)	0.96	0.33
Diabetes (%yes)[†]	114(24.4)	203(25.5)	0.19	0.66
Family history CVD (%yes)[†]	301(64.3)	483(61.1)	1.26	0.26
Hypertension (%yes)[†]	284(60.7)	489(61.4)	0.69	0.81
Functional Status (DASI), mean ± SD	301(64.3)	483(61.1)	1.26	0.26
Exercise behavior (PASE), mean ± SD	132.00±81.35	127.67±91.87	0.85	0.41
Illness perceptions, mean ± SD				
Timeline	22.29±5.03	22.37±4.90	−0.27	0.79
Consequences	19.44±4.61	20.36±4.89	−1.76	0.08
Cure/Controllability	18.79±2.77	18.00±3.03	4.64	<.001
Timeline Cyclical	13.98±3.39	13.37±3.44	3.12	0.002

[*] Individual level factors based on Andersen's Behavioral Model of Healthcare Utilization.

[†] denotes data from physician chart report.

[§] Denotes patient self-report data measured at follow-up assessment.

FT, Full-time; PT, Part-time; BDI, Beck Depression Inventory; GIS, Geographic Information Systems; ESSI, Enriched Social Support Inventory; EBBS, Exercise Benefits and Barriers Survey; BMI, Body Mass Index; CCS, Canadian Cardiovascular Society; CVD, Cardiovascular Disease; DASI, Duke Activity Status Index; PASE, Physical Activity Scale for the Elderly.

Table 4

Physician-Level Factors Associated with Verified Enrollment in a CR Program, N=97

Factors	CR Enrollment		t or χ^2 value	p
	Yes	No		
Sex (% female)	80(17.1)	108(13.5)	2.93	0.87
Graduation year – medical degree (mean ± SD)	1983±8.48	1982±8.52	0.83	0.41
Location of Medical School (%Ontario)	280(59.7)	458(57.3)	0.69	0.41
University appointment (%yes)	217(50.2)	354(46.3)	1.73	0.21
Subspecialty (% Internal Cardiology)	297(63.3)	512(64.1)	0.07	0.81
Mean self-reported patient volume (per week)	46.35±33.04	46.8±33.67	−0.22	0.83
Physician Attitude Items, mean ± SD				
1. Clinical practice guidelines promote referral to CR	1.92±0.92	1.90±0.81	0.50	0.62
2. My colleagues generally refer patients to CR	2.26±0.96	2.24±0.82	0.43	0.66
3. My department/practice generally refers all eligible patients to CR as a standard of care	2.30±1.02	2.32±0.94	−0.44	0.66
4. Reimbursement policies are a financial disincentive to CR referral	2.91±1.25	2.91±1.17	0.07	0.94
5. Follow-up care, including referral, is handled by another healthcare professional	3.44±1.09	3.45±1.05	−0.07	0.94
6. I generally intend to refer patients to CR	1.61±0.73	1.78±0.75	−3.77	<.001
7. I am not familiar with the CR programs in my area	4.58±0.70	4.55±0.75	0.47	0.64
8. I am not familiar with CR sites outside my geographic area	3.18±1.33	3.14±1.34	0.49	0.62
9. There is no standard referral form for CR, making it more effort to refer to sites closest to patients' homes	3.16±1.48	3.13±1.42	0.31	0.76
10. An allied health professional fills out referral forms on my behalf	3.79±1.09	3.72±1.14	1.05	0.29
11. It is inconvenient to make a referral to CR	3.75±1.05	3.69±1.04	0.81	0.42
12. I prefer to manage my patients' secondary prevention myself	3.31±1.13	3.20±1.14	1.65	0.11
13. I have patient education materials in my office that are sufficient for promoting behavioral change	3.88±0.97	3.83±1.03	0.81	0.42
14. I can prescribe an exercise regimen for my patients myself	3.81±1.14	3.74±1.06	1.11	0.27
15. Female cardiac patients generally don't like to exercise	3.99±1.00	3.91±0.99	1.41	0.56
16. I am skeptical about the benefits of CR	4.61±0.56	4.54±0.54	2.08	0.04
17. The available CR program is of poor quality	4.53±0.70	4.40±0.75	2.81	0.005
18. I have had a bad experience with a CR program	4.62±0.64	4.52±0.68	2.51	0.01
19. The CR program does not provide me with patient discharge summaries	4.55±0.71	4.52±0.73	0.23	0.42

* Note: Items were rated on a scale from 1 'strongly agree' to 5 'strongly disagree'.

Table 5

Mixed Logistic Regression Analysis Predicting CR-Verified Enrollment

Predictors	Estimate	Std. Error	p
Physician referral intentions	−0.07	0.27	0.79
Positive physician perceptions of CR	−0.54	0.38	0.15
Employment status	0.36	0.44	0.42
Family income	−0.03	0.41	0.93
Marital status	−1.02	0.40	0.01
Education	−0.06	0.37	0.88
Strength of provider CR endorsement	0.40	0.14	0.01
Other medical condition(s) that prevents exercise	0.05	0.40	0.90
Age	−0.01	0.02	0.61
Depressive Symptoms (BDI-II)	0.00	0.03	0.99
Exercise benefits	−1.06	0.64	0.09
Distance to closest CR site (GIS)	−0.00	0.00	0.001
Illness perceptions (personal control)	−0.01	0.06	0.85
Illness perceptions (timeline cyclical)	0.07	0.06	0.22
Functional Status (DASI)	0.03	0.01	0.08
Type of referring physician	−0.27	0.39	0.49
Total CR Barriers	−0.40	0.19	0.03

CR, Cardiac Rehabilitation; BDI, The Beck Depression Inventory; GIS, Geographic Information Systems; DASI, Duke Activity Status Index.