

Ethnocultural Minorities in Cardiac Rehab

Cardiac Rehabilitation Outcomes by Ethnocultural Background: Results from the Canadian Cardiac Rehab Registry

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Abstract

Background: Clinical practice guidelines recommend cardiovascular rehabilitation (CR) for patients with cardiovascular disease (CVD). Patients of diverse ethnocultural backgrounds are under-represented among participants, and hence little is known about their outcomes. The objectives of this study were to compare CR utilization, cardiovascular risk factor reduction (blood pressure, lipids, anthropometrics), and functional capacity between white and ethnocultural minority patients participating in CR across Canada.

Methods: The study was a retrospective, observational cohort study. Data came from the Canadian Cardiac Rehab Registry (CCRR). Ethnocultural minority participants ($n > 25$) were propensity-matched to white participants based on sociodemographic and clinical characteristics. CR outcomes were compared.

Results: 3848 (53.8%) participants in the CCRR had an ethnocultural background reported. Whites ($n=3630$), South Asians ($n=26$), Southeast Asians ($n=45$), and Arab/West Asians ($n=37$) had sufficient representation to be analyzed. 364 (97.1%) participants in the matched sample completed a discharge assessment. Southeast Asian participants adhered to (96.5%, $p=.02$) and completed (88.2%, $p=0.02$) CR more often than white (90.2% and 55.6%, respectively) participants. Southeast Asian participants had better diastolic blood pressure ($p=0.002$) at CR discharge than matched white participants. No other differences in outcomes or functional capacity were observed.

Conclusions: Ethnocultural minorities make up a small proportion of CR participants in Canada. However, when they do participate, they achieve similar CR outcomes to white

participants. CR programs should seek to ensure ethnoculturally-diverse patients are equally referred to their programs, and ensure their programs are culturally-sensitive to the needs of preponderant ethnocultural groups in their catchment areas.

Condensed Abstract:

Cardiac rehabilitation (CR) utilization, risk factors and functional capacity between white and ethnocultural minority patients participating in the Canadian CR Registry were compared. Southeast Asian participants adhered to and completed CR more often, and had better diastolic blood pressure than white participants. No other differences were observed.

Introduction

Cardiovascular disease (CVD) is the leading cause of mortality in the world(1). In Canada, CVD is among the leading causes of mortality, accounting for 29% of all deaths in 2008(2). Conservative estimates report 1.3 million Canadians are living with CVD(3). Canadians who identify as South Asian or Aboriginal suffer from even higher rates of CVD mortality compared with Canadians originating from Europe(4,5). Specifically, South Asian Canadians experience CVD at younger ages and suffer higher mortality(6,7).

Clinical practice guidelines recommend cardiovascular rehabilitation (CR) for patients with CVD(8). CR programs achieve secondary prevention through delivery of exercise, patient education and risk reduction. Participation results in lower mortality, morbidity, and improvements in exercise capacity, risk factor control, and quality of life(9). A dose-response association between CR adherence and mortality has been established(10).

Despite the benefits, it is well documented that many patients do not access CR, with only approximately 40% of eligible patients enrolling(11). Patients of diverse ethnocultural backgrounds are particularly under-represented among participants. For instance, among Medicare beneficiaries in the United States, only 7.8% of nonwhites, as compared with 19.6% of whites, use any CR after myocardial infarction or coronary bypass surgery(12). In Canada, despite our great ethnocultural diversity, and while there are some non-representative data to suggest similar disparities exist(13), little is known about the representation of ethnocultural minorities in CR programs. Regardless, it appears the ethnocultural minorities are less likely to be referred to CR(15), and when they are referred, are less likely to enroll, adhere and complete CR(16). Paradoxically then, ethnocultural

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minorities are often in greater need for CR due to adverse risk factor profiles and poorer outcomes, yet are less likely to access it(17).

Due to lower access among ethnocultural minorities, there is little data on CR outcomes in these ethnocultural minorities. Limited data from outside Canada suggests that where minority patients do access CR programs, they have poorer outcomes than their white counterparts. For example, African Americans improved less than white Americans in terms of cardiovascular endurance, physical activity levels, body composition and cholesterol upon completing the same CR programs(18). Thus, evaluating outcomes of CR for ethnocultural minorities has recently been established as a priority by the Canadian and American Associations of CR(14). This is particularly important in Canada as there are no studies to our knowledge assessing improvements in outcomes with CR participation among ethnocultural minorities, or comparing CR outcomes among ethnocultural minorities versus whites. Notwithstanding the universal healthcare system in Canada, ethnocultural disparities in health and healthcare have been commonly observed.

Given there are few to no reports of the access to, and benefits achieved among ethnocultural minorities through CR participation in Canada, the objectives of the current study were to compare: (1) CR utilization, (2) cardiovascular risk factor reduction (i.e., lipids, blood pressure and anthropometrics), and (3) functional capacity improvements (i.e. exercise capacity), between white and ethnocultural minority CR patients.

Methods

The study was retrospective, with an observational cohort design.

Data Source

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The Canadian Cardiac Rehab Registry (CCRR) is an online database developed by the Canadian Association of Cardiovascular Prevention and Rehabilitation (CACPR).

Further details regarding the CCRR have been reported elsewhere(19).

Data were collected at participants' CR intake and discharge assessments in accordance with a data dictionary (<http://www.cacpr.ca/resources/registry.cfm>) and entered to the CCRR (<https://registry.cacr.ca/>) by CR staff. Programs are to provide data on all patients consecutively.

Currently, there are 17 CR programs across Canada participating in the CCRR: ten participating sites from New Brunswick, five from Ontario and one each from Nova Scotia and British Columbia. Each participating program offers CR in accordance with Canadian CR guidelines(20); however, there is some variation in terms of the professions represented on staff, and the frequency and duration of the exercise sessions. Each site was responsible to solicit approval from the local research ethics board before contributing data to the CCRR as applicable.

Participants

Participants enter CR following acute coronary syndrome, coronary artery bypass graft surgery +/- valve repair/replacement, angina pectoris, stable heart failure, percutaneous coronary intervention, and heart or heart/lung transplants, among other indications(9). All participants in the CCRR for whom their ethnocultural background was recorded were included. Only ethnocultural groups with a sample size of at least 25 were included, to ensure sufficient discharge data were available for analysis.

Measures

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The independent variable was ethnocultural background. In accordance with Statistics Canada(21), the options for ethnocultural background on the CCRR include: Aboriginal, Arab/West Asian, Black, Chinese, Filipino, Japanese, Korean, Latin American, South Asian, Southeast Asian, White and Other. The term “ethnocultural minority” describes people of a “culturally and linguistically-diverse background”(22), where culture consists of a system of values, norms, and beliefs that shape an individual’s day-to-day experiences and behavior(23). For the purposes of the present study, ethnocultural minorities will consist of CR participants that self-identify as an ethnocultural background that is not white.

As per the CCRR data dictionary, sociodemographic data were collected. These are generally recorded during an intake interview. Clinical characteristics were also collected from medical charts and the CR intake assessment, including: referral diagnosis/event, comorbidities, and cardiovascular risk factors.

CR utilization was also captured, namely adherence to the program (i.e., proportion of prescribed exercise sessions that were completed), and whether CR was completed (i.e., participant undertook discharge assessment; yes/no). CR outcome measures were assessed at intake and discharge. The following risk indicator values were assessed: systolic blood pressure (SBP), diastolic blood pressure (DBP), lipid profile (i.e., total cholesterol, triglycerides, high-density lipoprotein [HDL], low-density lipoprotein [LDL]), and anthropometric indicators (waist circumference and body mass index [BMI]).

Participants were further classified as to whether they met clinically-recommended thresholds for these risk indicators. Targets for risk factor control were 2.0 mmol/L for LDL(24), 2.3 mmol/L for triglycerides, 4 mmol/L for total cholesterol, and 30 kg/m² for BMI for all participants(25). The HDL threshold was 1.0 mmol/L for men, and 1.3 mmol/L for

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women. SBP and DBP thresholds were 140 mmHg and 90 mmHg, respectively for patients without diabetes(26). For patients with diabetes, SBP and DBP thresholds were 130 mmHg and 80 mmHg respectively(26). Waist circumference thresholds were ethnicity-specific to better estimate the risk of metabolic syndrome and cardiovascular risk(27). Specifically, the thresholds were 102 cm and 88 cm for white and Arab/West Asian males and females, respectively(27). For South Asians and Southeast Asians, waist circumference thresholds were 90 cm and 80 cm for males and females, respectively(27).

Finally, peak exercise capacity is recorded from a graded exercise stress test pre and post-program. As per the data dictionary, these tests are to be symptom-limited, maximal tests using a standardized protocol. A half metabolic equivalent of task (MET) increase in functional capacity is associated with mortality reductions(28,29).

Statistical Analysis

Statistical analysis was performed using RStudio version 2.15.0 (Boston, MA). Frequencies of each ethnocultural group were calculated. Descriptive statistics (including frequencies and percentages or means and standard deviations) of the sociodemographic and clinical characteristics of participants were computed for participants in each selected ethnocultural group. The normality of the distribution of continuous variables was assessed with the Kolmogorov-Smirnov test. Characteristics of participants in each ethnocultural minority group were compared to the white participants using either t-test, Fisher's exact test, or the chi-square, as applicable. Moreover, sociodemographic and clinical characteristics of unmatched participants who completed a CR discharge assessment versus those who were lost to follow-up were performed using t-test or chi-square analyses, as appropriate.

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Each participant in the ethnocultural minority group was matched to a white participant using Propensity Score Matching in the *R* Package, MatchIt (Boston, MA). Matching was performed using the optimal matching method, which attempts to minimize the overall distance between all matched pairs(30,31). Participants were matched based on sociodemographic and clinical characteristics where significant differences were observed in the above analyses. Missing data elements were estimated using multiple imputation to match groups(32). To assess match quality, sociodemographic and clinical characteristics of matched participants from each ethnocultural minority group were compared to matched white participants, using either t-test, Fisher's exact test, or the chi-square, as applicable.

To test the first objective, Wilcoxon Rank-Sum tests were performed to compare program adherence between the matched ethnocultural minority versus white participants. Chi-square tests were computed to compare program completion between the matched ethnocultural minority versus white participants.

To evaluate the impact of ethnocultural background on CR outcomes, a regression function was fitted with the discharge outcome as the dependent variable, and the intake value and ethnocultural group as the independent variables. When comparing CR outcomes between white and ethnocultural minority participants, missing elements were not imputed. Only those participants for whom the outcome was documented were included.

Results

Participant Characteristics

At the time of the study, 7154 participants were included in the CCRR. For 3848 (53.8%) participants, ethnocultural background was reported. The frequency of each is displayed in Table 1. White/Caucasians, South Asians (i.e., Pakistani, East Indian,

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Bangladeshi, Sri Lankan), Southeast Asians (i.e., Cambodian, Indonesian, Loatian, Vietnamese) and Arab/West Asians (i.e., Armenian, Egyptian, Iranian, Lebanese, Moroccan, Afghani) were sufficiently represented in the CCRR to be analyzed.

Table 2 displays participants' pre-CR sociodemographic and clinical characteristics by ethnocultural background. As shown, Arab/West Asian participants were significantly younger, more educated, more often married, employed, and had diabetes more often than white participants. South Asian participants were significantly younger, more often employed, more often had a family history of CVD, were diabetic and had a higher BMI than white participants. Finally, Southeast Asian participants were significantly younger, more often male, employed, less often hypertensive, with a significantly lower body mass index and waist circumference, and blood pressure than white participants.

Overall, 3304 (88.4%) participants completed a CR discharge assessment. Sociodemographic and clinical characteristics were compared between the retained sample and those lost to follow-up. As shown in Table 3, retained participants were significantly more often male, married, had a family history of CVD and had a percutaneous coronary intervention or coronary artery bypass graft surgery as a referral indication, compared with those lost to follow-up.

Propensity Score Matching

The following variables were used for matching purposes: sex, age, educational attainment, employment status, marital status, smoking status, diabetes status, hypertension, family history of CVD, and hyperlipidemia. There were insufficient data to include program adherence and completion in the propensity score matching.

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The pre-CR matched sample was comprised of 184 participants, of which 92 (50.0%) were White, 38 (20.7%) were Southeast Asian, 30(16.3%) were Arab/West Asian, and 24 (13.0%) were South Asian. To assess match quality, sociodemographic and clinical characteristics of the matched participants were compared for each ethnocultural minority group versus whites (Table 4). Participants were very similar, with significant p-values for only 10 out of 66 characteristics following matching.

A total of 364 (97.1%) participants in the matched sample completed a CR discharge assessment. Of these, 40 (11.0%) were Southeast Asian, 30 (8.2%) were Arab/West Asian, and 25 (6.9%) were South Asian.

CR Utilization by Ethnocultural Background

Table 5 shows CR program adherence and completion. Participants were prescribed a median of 18 sessions, and completed a median of 13 sessions.

CR utilization by ethnocultural background in the unmatched and matched samples is also shown in Table 5. Matched Southeast Asian participants adhered to a significantly greater proportion of prescribed CR sessions than their white counterparts. No other significant differences in program adherence were observed. CR program completion is also shown, overall and in the matched samples. No comparison between white and South Asian participants could be made as data on program completion was only available for three South Asian participants. Southeast Asian participants more often completed CR than their white counterparts, whether tested in either the matched or unmatched sample. No difference between Arab/West Asian and white participants was observed.

CR Outcomes by Ethnocultural Background

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The percentage of matched participants not meeting cardiac risk indicator thresholds at CR discharge by ethnocultural background are summarized in Table 6. Arab/West Asian and South Asian participants more often met the BMI guideline than their white counterparts. Moreover, 48 (60.8%) white, 10 (38.4%) Arab/West Asian, 7 (29.2%) South Asian, and 17 (48.6%) Southeast Asian participants achieved at least a ½ MET increase in their functional capacity from pre to post-CR.

Table 7 shows the change in risk indicator values and functional capacity from pre to post-program by ethnocultural background. Regression models with ethnocultural background and CR intake value as the independent variables and CR outcomes at discharge as dependent variables were computed, with adjustment. Results are also shown in Table 7. Southeast Asian participants had lower diastolic blood pressure (64.7 mmHg) at CR discharge than their white counterparts (73.3 mmHg). No other significant differences were observed.

Discussion

Canadian CR programs are comprised of predominantly white patients, with ethnocultural minorities being largely underrepresented. In 2006, 16.2% of the population in Canada were considered visible minorities (33), but only 5.7% of CCRR patients were minorities. Of note, very few Aboriginal or Black patients were represented in CR (0.2% and 0.5%, respectively), despite each group comprising roughly 4% of the Canadian population(33) and experiencing a higher burden of CVD(5,18). The overall findings generally suggest that patients of Southeast Asian ethnocultural backgrounds may adhere to CR to a greater degree than their white counterparts once they enrol. CR outcomes achieved were largely similar regardless of ethnocultural background. All ethnocultural groups achieved at least a half MET increase in functional capacity through CR participation.

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The clinical presentation of the ethnocultural minority patients in relation to their white counterparts was consistent with what has been observed in the literature. In particular, South Asian and Arab/West Asian patients had a greater risk factor burden than white patients, with the opposite observed in Southeast Asian patients(34,35). Clearly the former two groups should be more represented in CR. The differences in the sociodemographic characteristics by ethnocultural background, specifically age, education level and marital status were also consistent with what has been reported in the literature(6,7).

Despite literature showing ethnocultural minorities have poorer CR adherence(16,17) surprisingly it was found that Southeast Asians were more likely to complete CR than white patients. There has been little research on Southeast Asian patients in CR, and hence this finding warrants replication.

Very few differences in outcomes were observed between the ethnocultural minority and white patients, suggesting as expected that ethnocultural minority patients achieve similar outcomes as their white counterparts. The only differences observed was between Southeast Asian and white patients; Southeast Asian patients had significantly lower diastolic blood pressure post-CR. There were also trends towards more Southeast Asian patients meeting the BMI, waist circumference and HDL targets compared with whites at discharge. Typically, when included in studies, Southeast Asians have been grouped into a larger 'Asian' group (35) (36). Asian participants have been shown to have lower disease burden, specifically lower rates of hypertension, hypercholesterolemia and BMI than patients of other ethnocultural backgrounds (35). Perhaps the improved diastolic blood pressure, lipids, BMI and waist circumference can be attributed to ethnocultural-specific trends of lower disease burden. Furthermore, the Southeast Asian group was the largest of the ethnocultural groups, with 45

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patients. The larger sample size may explain why differences in CR outcomes were observed, whereas they were not in the other ethnocultural groups with smaller sample sizes. The American and British Associations of CR also have CR registries(36,37) with much larger sample sizes. It would be of interest to test for ethnocultural differences in outcomes with these larger samples.

Reasons for these utilization disparities require understanding. CR referral is the first requirement to gain access to CR, and unfortunately ethnocultural minorities are less likely to be referred than their white counterparts(15,38). Once referred, barriers reported by ethnocultural minorities are often linguistic, cultural and socioeconomic in nature(14). For the subset of ethnocultural minorities that take part in CR, different cultural beliefs about the severity of their disease, social support, self-efficacy in managing their chronic disease and other factors may lead to different adherence patterns and outcomes compared with white patients (39). Barriers to CR participation among ethnocultural minorities at the patient, program and health-system level are reviewed elsewhere(14).

This study is not without limitations. Chiefly, just over half of patients in the CCRR had an ethnocultural background recorded. Therefore the estimated rates of ethnocultural minority representation in CR observed in the present study should be interpreted with caution.

Second, missing data in the CCRR limits the interpretation of the study. Third, small sample sizes means tests to detect differences between ethnocultural groups may have been under-powered and thus true differences not identified. Moreover, many ethnocultural groups were not included in the analyses due to small numbers, further limiting our

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understanding of the diverse and varying impact of ethnocultural background on CR in Canada.

Fourth, multiple comparisons were undertaken, increasing the potential of error. Finally, while optimal methods were applied to match the ethnocultural samples, there were some measured differences observed nevertheless, and there may be some unmeasured differences at play as well. These may introduce alternative explanations for the findings.

In conclusion, ethnocultural minorities make up a disproportionately small percentage of CR participants in Canada, and present with some different clinical features when compared to white patients. Contrary to previous research suggesting that ethnocultural minority patients are less likely to adhere to CR, patients of Southeast Asian ethnocultural backgrounds were found to adhere to CR to a greater degree than their white counterparts once they enrol. Ethnocultural minority participants in CR largely achieve comparable outcomes to their white counterparts. Patients of all ethnocultural groups achieved at least a half MET increase in functional capacity through program participation.

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References:

- (1) Roth GA, Forouzanfar MH, Moran AE, Barber R, Nguyen G, Feigin VL, et al. Demographic and epidemiologic drivers of global cardiovascular mortality. *N Engl J Med* 2015 Apr 2;372(14):1333-1341.
- (2) Statistics Canada. Mortality, summary list of causes 2008. 2011.
- (3) Public Health Agency of Canada. Tracking heart disease and stroke in Canada. 2009.
- (4) Anand SS, Yusuf S, Vuksan V, Devanese S, Teo KK, Montague PA, et al. Differences in risk factors, atherosclerosis, and cardiovascular disease between ethnic groups in Canada: the Study of Health Assessment and Risk in Ethnic groups (SHARE). *Lancet* 2000 Jul 22;356(9226):279-284.
- (5) Anand SS, Yusuf S, Jacobs R, Davis AD, Yi Q, Gerstein H, et al. Risk factors, atherosclerosis, and cardiovascular disease among Aboriginal people in Canada: the Study of Health Assessment and Risk Evaluation in Aboriginal Peoples (SHARE-AP). *Lancet* 2001 Oct 6;358(9288):1147-1153.
- (6) Raghavan R, Rahme E, Nedjar H, Huynh T. Long-term prognosis of south Asians following acute coronary syndromes. *Can J Cardiol* 2008 Jul;24(7):585-587.
- (7) Sheth T, Nair C, Nargundkar M, Anand S, Yusuf S. Cardiovascular and cancer mortality among Canadians of European, south Asian and Chinese origin from 1979 to 1993: an analysis of 1.2 million deaths. *CMAJ* 1999 Jul 27;161(2):132-138.
- (8) Smith SC, Jr, Benjamin EJ, Bonow RO, Braun LT, Creager MA, Franklin BA, et al. AHA/ACCF secondary prevention and risk reduction therapy for patients with coronary and other atherosclerotic vascular disease: 2011 update: a guideline from the American Heart Association and American College of Cardiology Foundation endorsed by the World Heart Federation and the Preventive Cardiovascular Nurses Association. *J Am Coll Cardiol* 2011 Nov 29;58(23):2432-2446.
- (9) Wenger NK. Current status of cardiac rehabilitation. *J Am Coll Cardiol* 2008 Apr 29;51(17):1619-1631.
- (10) Martin BJ, Hauer T, Arena R, Austford LD, Galbraith PD, Lewin AM, et al. Cardiac rehabilitation attendance and outcomes in coronary artery disease patients. *Circulation* 2012 Aug 7;126(6):677-687.
- (11) Samayoa L, Grace SL, Gravely S, Scott LB, Marzolini S, Colella TJ. Sex differences in cardiac rehabilitation enrollment: a meta-analysis. *Can J Cardiol* 2014 Jul;30(7):793-800.
- (12) Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation* 2007 Oct 9;116(15):1653-1662.
- (13) Gupta M, Doobay AV, Singh N, Anand SS, Raja F, Mawji F, et al. Risk factors, hospital management and outcomes after acute myocardial infarction in South Asian Canadians and matched control subjects. *CMAJ* 2002 Mar 19;166(6):717-722.

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- (14) Midence L, Mola A, Terzic CM, Thomas RJ, Grace SL. Ethnocultural diversity in cardiac rehabilitation. *J Cardiopulm Rehabil Prev* 2014 Nov-Dec;34(6):437-444.
- (15) Gregory PC, LaVeist TA, Simpson C. Racial disparities in access to cardiac rehabilitation. *Am J Phys Med Rehabil* 2006 Sep;85(9):705-710.
- (16) Prince DZ, Sobolev M, Gao J, Taub CC. Racial disparities in cardiac rehabilitation initiation and the effect on survival. *PM R* 2014 Jun;6(6):486-492.
- (17) Banerjee AT, Grace SL, Thomas SG, Faulkner G. Cultural factors facilitating cardiac rehabilitation participation among Canadian South Asians: a qualitative study. *Heart Lung* 2010 Nov-Dec;39(6):494-503.
- (18) Sanderson BK, Mirza S, Fry R, Allison JJ, Bittner V. Secondary prevention outcomes among black and white cardiac rehabilitation patients. *Am Heart J* 2007 Jun;153(6):980-986.
- (19) Grace SL, Parsons TL, Duhamel TA, Somanader DS, Suskin N. The quality of cardiac rehabilitation in Canada: a report of the Canadian Cardiac Rehab Registry. *Can J Cardiol* 2014 Nov;30(11):1452-1455.
- (20) Stone JA, Arthur HM, Suskin N editors. *Guidelines for Cardiac Rehabilitation and Cardiovascular Disease Prevention: Translating Knowledge into Action*. 3rd ed. Winnipeg, MB: Canadian Association of Cardiac Rehabilitation; 2009.
- (21) Statistics Canada. Classification of population group. 2009; Available at: <http://www.statcan.gc.ca/eng/concepts/definitions/ethnicity01>. Accessed May 1st, 2015, 2015.
- (22) Haghshenas A, Davidson PM. Quality service delivery in cardiac rehabilitation: cross-cultural challenges in an Australian setting. *Qual Prim Care* 2011;19(4):215-221.
- (23) Hofstede G. *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*. 2nd ed. Thousand Oaks, CA: Sage Publications; 2001.
- (24) Anderson TJ, Gregoire J, Hegele RA, Couture P, Mancini GB, McPherson R, et al. 2012 update of the Canadian Cardiovascular Society guidelines for the diagnosis and treatment of dyslipidemia for the prevention of cardiovascular disease in the adult. *Can J Cardiol* 2013 Feb;29(2):151-167.
- (25) Obesity: preventing and managing the global epidemic. Report of a WHO consultation. *World Health Organization Technical Report Series* 2000(894):1-253.
- (26) Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, Jr, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 2003 Dec;42(6):1206-1252.
- (27) Alberti KG, Zimmet P, Shaw J, IDF Epidemiology Task Force Consensus Group. The metabolic syndrome--a new worldwide definition. *Lancet* 2005 Sep 24-30;366(9491):1059-1062.

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(28) Kavanagh T, Mertens DJ, Hamm LF, Beyene J, Kennedy J, Corey P, et al. Prediction of long-term prognosis in 12 169 men referred for cardiac rehabilitation. *Circulation* 2002 Aug 6;106(6):666-671.

(29) Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE. Exercise capacity and mortality among men referred for exercise testing. *N Engl J Med* 2002 Mar 14;346(11):793-801.

(30) Ho D, Imai K, King G, Stuart E. Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis* 2007;15(3):199-236.

(31) Ho D, Imai K, King G, Stuart E. Matchit: Nonparametric Preprocessing for Parametric Causal Inference. 2011; Available at: <http://gking.harvard.edu/matchit/>. Accessed May 1st, 2015.

(32) King G, Honaker J, Joseph A, Scheve K. Analyzing incomplete political science data: An alternative algorithm for multiple imputation. *American Political Science Review* 2001;95(1):49-69.

(33) Statistics Canada. Visible minority population, by province and territory (2006 Census) . September 11, 2009; Available at: <http://www.statcan.gc.ca/tables-tableaux/sum-som/101/cst01/demo52a-eng.htm>. Accessed 09/11, 2015.

(34) Davis TM, Coleman RL, Holman RR, UKPDS Group. Ethnicity and long-term vascular outcomes in Type 2 diabetes: a prospective observational study (UKPDS 83). *Diabet Med* 2014 Feb;31(2):200-207.

(35) Lopez JM, Bailey RA, Rupnow MF, Annunziata K. Characterization of type 2 diabetes mellitus burden by age and ethnic groups based on a nationwide survey. *Clin Ther* 2014 Apr 1;36(4):494-506.

(36) National Audit of Cardiac Rehabilitation. Available at: <http://www.cardiacrehabilitation.org.uk/nacr/index.htm>. Accessed May 10, 2015.

(37) AACVPR Outpatient Cardiac Rehabilitation Data Registry. 2015; Available at: <https://www.aacvpr.org/Resources/OutpatientDataRegistries/OutpatientCardiacRehabDataRegistry/tabid/422/Default.aspx>. Accessed May 10, 2015.

(38) Brown TM, Hernandez AF, Bittner V, Cannon CP, Ellrodt G, Liang L, et al. Predictors of cardiac rehabilitation referral in coronary artery disease patients: findings from the American Heart Association's Get With The Guidelines Program. *J Am Coll Cardiol* 2009 Aug 4;54(6):515-521.

(39) Daly J, Sindone AP, Thompson DR, Hancock K, Chang E, Davidson P. Barriers to participation in and adherence to cardiac rehabilitation programs: a critical literature review. *Prog Cardiovasc Nurs* 2002 Winter;17(1):8-17.

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Table 1. Ethnocultural background of participants in the Canadian Cardiac Rehab Registry

	Frequency (n)	Percentage (%)
White	3630	94.3
Southeast Asian	45	1.2
Arab/West Asian	37	1.0
South Asian	26	0.7
Black	20	0.5
Latin American	15	0.4
Chinese	11	0.3
Aboriginal	9	0.2
Filipino	9	0.2
Japanese	3	0.1
Korean	2	0.1
Other	41	1.1
Total	3848	100

Table 2. Pre-CR sociodemographic and clinical characteristics of white, Arab/ West Asian, South Asian, and Southeast Asian participants.

	White/ Caucasian n=3630, 94.3%		Arab/ West Asian n=37, 1.0%		p	South Asian n=26, 0.7%		p	Southeast Asian n=45, 1.2%		p
Sociodemographic											
Age [†]	64.3	10.9	59.7	10.3	0.011	57.9	11.2	0.003	60.5	10.6	0.023
Sex (% male)	2470	68.1	26	70.3	0.698	21	80.8	0.050	36	81.8	0.006
Education (% some post-secondary +)	495	20.8	9	56.3	0.002	1	33.3	NA	5	23.8	0.945
Employment Status (% working part or full time)	1102	35.3	18	60.0	0.009	18	78.3	<0.001	19	52.8	0.045
Marital status (% married or common-law)	2681	79.0	28	82.4	0.794	23	92.0	0.140	33	84.6	0.513
Clinical											
<u>Cardiovascular Risk Factors</u>											
Family History of CVD (%)	2127	68.6	21	75.0	0.305	17	89.5	<0.001	26	74.3	0.310*
Current smoker (% yes)	2323	67.8	22	59.5	0.133	18	78.3	0.153*	31	73.8	0.287*

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Hypertension (%)	2434	69.1	22	61.1	0.149	15	57.7	0.079	24	58.5	0.042
Hyperlipidemia (%)	2605	73.8	25	69.4	0.406	17	65.4	0.172	28	68.3	0.263
Diabetes (%)	932	34.5	15	71.4	<0.001	7	87.5	<0.001	10	40.0	0.420
<u>Referral event/indication</u>											
PCI	695	25.0	7	36.8	0.732	1	20.0	1.000*	8	30.8	1.000*
ACS	758	27.3	4	21.1	0.616*	1	20.0	1.000*	9	34.6	0.564
CABG	359	12.9	2	10.5	1.000*	1	20.0	0.500	4	15.4	0.767*
<u>Disease severity</u>											
<u>Risk Indicators[†]</u>											
BMI (kg/m ²)	30.1	6.3	29.3	4.2	0.434	26.6	2.5	0.009	27.4	6.2	0.010
WC (cm)	105.1	15.2	103.8	14.0	0.710	98.2	6.9	0.081	97.6	15.9	0.005
LDL (mmol/L)	2.3	1.0	2.3	1.2	0.841	2.5	1.5	0.707	2.3	1.0	0.960
HDL (mmol/L)	1.2	0.4	1.1	0.4	0.424	1.0	0.2	0.309	1.2	0.3	0.962
TG (mmol/L)	1.7	1.0	2.1	1.3	0.110	1.9	1.1	0.660	1.4	0.7	0.140

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TC (mmol/L)	4.2	1.2	4.1	1.3	0.750	4.2	1.5	0.930	4.0	1.3	0.420
SBP (mmHg)	123.2	17.3	121.7	17.0	0.607	119.5	13.2	0.292	115.1	16.3	0.002
DBP (mmHg)	71.8	10.4	70.3	8.8	0.407	70.8	9.2	0.639	67.4	8.3	0.006
<u>Exercise Capacity[†]</u>											
Peak METs	6.6	2.7	6.9	2.8	0.466	7.5	2.8	0.068	6.6	2.2	0.840

* denotes where p-values were calculated using a Fischer Exact test in lieu of a Chi-Square test due to small sample size.

NA=not applicable, for very small groups where a p value could not be determined.

[†] denotes a variable that is continuous and hence mean and standard deviation are reported.

ACS=acute coronary syndrome, BMI = body mass index, CABG = coronary artery bypass graft surgery, CR = cardiac rehabilitation, CVD = cardiovascular disease, DBP = diastolic blood pressure, HDL = high density lipoprotein, LDL= low density lipoprotein, METs = metabolic equivalent of task, PCI = percutaneous coronary intervention, SBP = systolic blood pressure, TC = total cholesterol, TG = triglycerides, WC = waist circumference.

Table 3 Pre-CR sociodemographic and clinical characteristics of unmatched patients in selected ethnocultural groups by retention status, N=3738

	Completed CR Discharge Assessment n=3304, 88.4%	Lost to Follow-Up n=434, 11.6%	p
<i>Sociodemographic</i>			
Age [†]	64.4±10.8	62.5±11.5	0.001
Sex (% male)	2227 (69.0%)	277 (63.8%)	0.035
Education (% some post-secondary)	419 (20.8%)	91 (22.2%)	0.583
Employment Status (% working part or full-time)	1020 (35.7%)	137 (38.1%)	0.421
Marital Status (% married or common-law)	2441 (79.8%)	324 (75.2%)	0.031
<i>Clinical</i>			
<u>Referral indications</u>			
PCI	655 (25.7%)	56 (20.1%)	0.001
ACS	675 (26.5%)	97 (34.8%)	0.162
CABG	337 (13.2%)	29 (10.4%)	0.040
<u>Cardiovascular risk factors</u>			
Family History of CVD (%)	1925 (69.6%)	266 (63.8%)	0.020
Current smoker	2080 (66.9%)	314 (75.5%)	0.001
Hypertension (%)	2200 (68.6%)	295 (70.2%)	0.532

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Hyperlipidemia (%)	2351 (73.1%)	324 (77.5%)	0.064
Diabetes (%)	835(35.8%)	129 (30.1%)	0.056
<u>Risk Indicators</u> [†]			
BMI (kg/m ²)	29.9±5.9	32.2±8.7	<0.001
WC (cm)	104.6±15.0	108.7±16.8	0.001
LDL (mmol/L)	2.3±1.0	2.4±1.1	0.120
HDL (mmol/L)	1.2±0.4	1.2±0.4	0.996
TG (mmol/L)	1.7±1.1	1.8±1.3	0.058
TC (mmol/L)	4.2±1.3	4.3±1.3	0.057
SBP (mmHg)	123.0±17.1	124.2±18.5	0.274
DBP (mmHg)	71.6±10.3	71.9±11.1	0.541
<u>Exercise Capacity</u> [†]			
Peak METs	6.5±2.7	7.2±2.6	<0.001

[†] denotes a variable that is continuous and hence mean and standard deviation are reported.

ACS=acute coronary syndrome, BMI = body mass index, CABG = coronary artery bypass graft surgery, CR = cardiac rehabilitation, CVD = cardiovascular disease, DBP = diastolic blood pressure, HDL = high density lipoprotein, LDL= low density lipoprotein, METs = metabolic equivalent of task, PCI = percutaneous coronary intervention, SBP = systolic blood pressure, TC = total cholesterol, TG = triglycerides, WC = waist circumference.

Table 4. Pre-CR sociodemographic and clinical characteristics of matched White/Caucasian, Southeast Asian and West Asian participants in the Canadian Cardiac Rehab Registry

	White	Arab/ West Asian	p*	White	South Asian	p*	White	Southeast Asian	p*
	n=30	n=30		n=24	n=24		n=38	n=38	
<i>Sociodemographic</i>									
Sex (% male)	18 (60.0%)	22 (73.3%)	0.411	20 (83.3%)	20 (83.3%)	1.000*	28 (73.7%)	29 (78.4%)	0.837
Age (mean ± SD)	60.3±9.1	59.0±10.0	0.608	59.1±9.4	56.7±10.5	0.407	61.2±12.0	60.9±10.8	0.930
Education (% some post-secondary +)	19 (67.9%)	5 (45.5%)	0.683	5 (33.3%)	0 (0.0%)	NA	5 (14.3%)	3 (17.7%)	1.000*
Employment Status (% full or part-time)	14 (56.0%)	16 (64.0%)	0.773	11 (61.1%)	17 (81.0%)	0.310*	23 (65.7%)	16 (51.6%)	0.362
Marital status (% married or common-law)	20 (66.7%)	22 (81.5%)	0.333	23 (95.8%)	21 (91.3%)	0.970*	29 (82.9%)	26 (81.3%)	1.000
<i>Clinical</i>									
<i>Referral indication</i>									
PCI	1 (4.0%)	3 (30.0%)	0.061*	2 (15.4%)	0 (0.0%)	1.000*	3 (9.1%)	1 (6.7%)	1.000*
ACS	11 (44.0%)	3 (30.0%)	0.704*	2 (15.4%)	0 (0.0%)	1.000*	13 (39.4%)	7 (46.7%)	0.875
CABG	3 (12.0%)	1 (10.0%)	1.000*	4 (30.8%)	1 (50.0%)	1.000*	7 (21.2%)	3 (20.0%)	1.000

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<i>Cardiovascular risk factors</i>									
Family History of CVD (%)	25 (89.3%)	20 (86.3%)	1.000*	20 (95.2%)	17 (94.4%)	1.000	26 (72.2%)	22 (73.3%)	1.000
Current smoker (%)	23 (85.2%)	18 (60.0%)	0.043*	20 (95.2%)	16 (76.2%)	0.186	31 (88.6%)	28 (77.8%)	0.370*
Hypertension (%)	21 (72.5%)	19 (65.5%)	0.777	14 (58.3%)	13 (54.2%)	1.000*	28 (73.7%)	20 (57.1%)	0.215
Hyperlipidemia (%)	25 (83.3%)	20 (69.0%)	0.321	16 (66.7%)	15 (62.5%)	1.000*	26 (70.3%)	23 (65.7%)	0.872
Diabetes (%)	19 (65.5%)	11 (73.3%)	0.738*	17 (94.4%)	5 (83.3%)	1.000*	8 (22.9%)	5 (26.3%)	1.000
<i>CR Intake Measures[†]</i>									
BMI (kg/m ²)	31.7±6.3	28.5±3.6	0.021	31.9±5.7	26.6±2.5	<0.001	30.4±5.0	27.0±6.0	0.016
WC (cm)	110.9±13.5	101.2±13.1	0.022	111.3±14.0	98.2±6.9	0.001	110.4±13.5	96.3±14.9	<0.001
LDL (mmol/L)	2.2±0.8	2.0±1.1	0.672	1.8±0.8	2.6±1.6	0.404	2.3±1.0	2.3±0.9	0.866
HDL (mmol/L)	1.1±0.3	1.0±0.3	0.188	1.0±0.2	1.0±0.2	0.498	1.1±0.3	1.2±0.3	0.440
TG (mmol/L)	1.8±1.0	2.3±1.4	0.220	1.7±0.9	1.8±1.2	0.829	1.8±0.9	1.3±0.7	0.025
TC (mmol/L)	4.1±1.0	4.1±1.3	0.935	3.6±1.0	4.2±1.7	0.526	4.3±1.1	4.0±1.3	0.400
SBP (mmHg)	122.7±18.4	122.0±17.9	0.887	124.5±16.0	119.5±13.2	0.247	125.7±14.5	115.0±16.9	0.004
DBP (mmHg)	71.4±9.6	69.5±9.2	0.436	75.3±8.5	70.8±9.2	0.086	74.0±11.4	67.0±8.4	0.003
<i>Exercise capacity</i>									
Peak METs [†]	7.0±2.1	6.9±2.9	0.933	8.2±2.6	7.7±2.7	0.483	7.8±2.9	6.6±2.3	0.054

* denotes where p-values were calculated using a Fischer Exact test in lieu of a Chi-Square test due to small sample size.

ACS=acute coronary syndrome, BMI = body mass index, CABG = coronary artery bypass graft surgery, CR = cardiac rehabilitation, CVD = cardiovascular disease, DBP = diastolic blood pressure, HDL = high density lipoprotein, LDL= low density lipoprotein, METs = metabolic equivalent of task, PCI = percutaneous coronary intervention, SBP = systolic blood pressure, TC = total cholesterol, TG = triglycerides, WC = waist circumference.

Table 5. Program utilization among ethnocultural minorities compared with White/Caucasians

Unmatched	Program Adherence*			Program Completion		
	Mean	SD	p	n	%	p
White	84.6	23.7	NA	1990	48.2	NA
Arab/West Asian	71.6	42.4	0.712	13	53.8	0.901
South Asian	95.5	7.9	0.441	3	66.7	NA
Southeast Asian	87.8	24.2	0.108	20	75.0	0.031
Total	84.6	23.9	NA	2026	48.6	NA
Matched						
White	90.2	14.3	NA	189	55.6	NA
Arab/West Asian	93.1	13.1	0.475	10	70.0	0.568
South Asian	95.5	7.9	0.612	3	66.7	NA
Southeast Asian	96.5	10.0	0.024	17	88.2	0.018
Total	90.3	13.9	NA	219	58.9	NA

*percentage of prescribed sessions completed. Only includes patients for whom there is information on the number of exercise sessions prescribed, and the number completed. SD = standard deviation, NA = not applicable.

Table 6. Percentage of patients not meeting cardiac risk indicator thresholds in matched, retained samples post-CR.

	White	Arab/West Asian	p	White	South Asian	p	White	South east Asian	p
	%	%		%	%		%	%	
SBP >140mmHg [‡]	26.7	26.7	1.000	37.5	16.7	0.193*	23.7	10.5	0.222*
DBP >90mmHg [‡]	3.3	13.3	0.353*	8.3	4.2	1.000*	5.3	2.6	1.000*
HDL <1.0mmol/L, 1.3mmol/L [†]	50.0	41.7	1.000	60.0	40.0	1.000*	92.3	53.8	0.073*
LDL >2.0mmol/L	20.0	10.0	1.000	50.0	0.0	0.429*	38.5	38.5	1.000*
TG >2.3mmol/L	25.0	33.3	1.000*	20.0	40.0	1.000*	15.4	7.7	1.000*
TC >4mmol/L	30.8	38.5	1.000*	20.0	20.0	1.000*	23.1	23.1	1.000*
BMI >30kg/m ²	55.2	24.1	0.032	50.0	9.1	0.007*	46.9	21.9	0.065
WC ^{†, §}	88.2	52.9	0.057*	80.0	86.7	1.000*	60.0	70.0	0.588

* denotes where p-values were calculated using a Fischer Exact test in lieu of a Chi-Square test due to small sample size.

† denotes a different threshold used for female patients (i.e., 1.3).

§ denotes a different threshold used for ethnocultural background. For white and Arab/West Asian participants, 102cm and 88cm for male and female patients, respectively were used. For Southeast Asian and South Asian participants, 90cm (male) and 80cm (female) were used.

‡For patients with diabetes, the systolic and diastolic blood pressure thresholds were 130 mmHg and 80 mmHg respectively.

BMI = body mass index, WC = waist circumference, HDL = high density lipoprotein, LDL= low density lipoprotein, TG = triglycerides, TC = total cholesterol, SBP = systolic blood pressure, DBP = diastolic blood pressure

Table 7. Mean change (\pm standard deviation) in CR outcomes from pre to post-CR in matched retained samples by ethnocultural background, and results of linear regression models of CR outcomes by ethnocultural background

	Arab/ West Asian				South Asian				Southeast Asian			
	Change (White)	Change (Minority)	n†	p*	Change (White)	Change (Minority)	n†	p*	Change (White)	Change (Minority)	n†	p*
Risk Indicators												
SBP (mmHg)	-1.2 \pm 14.2	-0.5 \pm 6.0	30	0.817	1.6 \pm 14.7	-0.6 \pm 7.2	24	0.163	-1.1 \pm 15.3	-1.2 \pm 15.1	38	0.100
DBP (mmHg)	-1.2 \pm 9.3	-0.2 \pm 4.7	30	1.000	-3.2 \pm 13.3	0.9 \pm 3.5	24	0.508	-0.7 \pm 12.3	-2.3 \pm 10.0	38	0.002§
TC (mmol/L)	-0.5 \pm 0.8	-0.5 \pm 1.2	13	0.576	0.1 \pm 0.4	-0.4 \pm 0.9	5	0.322	-0.4 \pm 1.0	-0.2 \pm 1.2	13	0.652
TG (mmol/L)	-0.2 \pm 0.6	-0.2 \pm 0.5	12	0.976	0.0 \pm 0.3	0.0 \pm 0.4	5	0.939	-0.4 \pm 0.4	-0.2 \pm 0.7	13	0.669
HDL (mmol/L)	0.0 \pm 0.2	0.0 \pm 0.1	12	0.890	0.0 \pm 0.1	0.0 \pm 0.1	5	0.636	0.3 \pm 0.6	0.0 \pm 0.3	13	0.151
LDL (mmol/L)	-0.1 \pm 0.6	-0.4 \pm 1.0	10	0.436	-0.5 \pm 0.9	-0.5 \pm 0.9	4	0.282	-0.2 \pm 0.7	-0.3 \pm 0.7	13	0.702
BMI (kg/m ²)	0.04 \pm 1.4	-0.04 \pm 0.9	29	0.659	-0.5 \pm 1.2	0.0 \pm 0.4	22	0.164	-0.1 \pm 1.2	0.2 \pm 1.6	32	0.723
WC (cm)	-1.8 \pm 4.4	-1.6 \pm 5.0	17	0.588	-2.3 \pm 3.7	-0.6 \pm 1.8	15	0.160	-3.4 \pm 4.2	-0.7 \pm 3.1	30	0.069
Functional Capacity												

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Peak METs	0.9±1.4	0.8±1.2	26	0.744	1.1±1.5	0.6±1.1	24	0.332	1.6±1.8	1.1±1.4	35	0.231
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NOTE: linear regression models were adjusted for age, sex, education, marital status, employment status, smoking status, hypertension, and family history of cardiac disease. Independent variables were ethnocultural background and pre-CR values.

*The p-value shown is for ethnocultural background as an independent variable.

†the number of matched white and ethnocultural minority participants.

§p<.05 for overall linear regression model.

BMI = body mass index, CR = cardiac rehabilitation, DBP = diastolic blood pressure, HDL = high density lipoprotein, LDL= low density lipoprotein, METs = metabolic equivalent of task, SBP = systolic blood pressure, TC = total cholesterol, TG = triglycerides, WC = waist circumference.