Knowledge of "Heart Attack" Symptoms in a Canadian Urban Community

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Abstract

Background: Temporal delays in myocardial infarction (MI) treatment have been addressed through patient and physician education, innovations in prehospital fibrinolysis, and improvements to emergency medical services, yet the most significant contributor to delayed treatment is the patient's ability to recognize and respond to symptoms.

Purpose: To determine whether public health education campaigns have achieved their desired reach by ensuring that all segments of the population recognize the symptoms of MI ("heart attack").

Methods: 976 men and women, 40+ years of age, randomly selected from Metro Vancouver, Canada completed a telephone survey in English, Punjabi, Mandarin, or Cantonese. Respondents' knowledge of MI symptoms was assessed; 10 "correct symptoms" were considered to be: chest pain/pressure/tightness/discomfort, arm pain, shortness of breath, nausea/indigestion, sweating/clamminess, shoulder/back pain, dizziness/faintness/light headedness, jaw pain, weakness, and uneasiness/panic/anxiety.

Results: 3.2% of the sample could not identify any correct symptoms and 53.3% were able to describe 3+ symptoms. Significant associations were found between the number of correct symptoms and gender, ethnicity, education, exposure to health professional counseling, and worry about having a heart attack. The least number of correct symptoms were reported by: men (incidence rate ratio (IRR) = 0.87; 95% confidence interval (95% CI): 0.81–0.95), Chinese-Canadian participants (IRR = 0.73; 95% CI: 0.65–0.83; relative to European-Canadian born participants), those with less than high school education (IRR = 0.78; 95% CI: 0.66–0.92; relative to those with more than high school), those with no health professional counseling (IRR = 0.92; 95% CI: 0.84–1.00), and those who did not worry "at all" about having a heart attack (IRR = 0.89; 95% CI: 0.80–0.98; relative to those who worried sometimes/often/almost all the time).

Conclusions: The participants were not well informed about the symptoms of heart attack. It will be challenging to educate the public sufficiently to reduce the time between the onset of symptoms and initiation of treatment for MI.

Keywords: health knowledge, myocardial infarction, health education, ethnic groups, Canada

Introduction

About 65,000 Canadians are hospitalized each year for acute myocardial infarction (MI; "heart attacks") accounting for more than 540,000 patient days (Canadian Institute for Health Information 2002) and producing an age- and sex-standardized hospitalization rate, for MI, of 253.8 per 100,000 population (Hall et al. 2003). The age-standardized mortality rate for MI, in 2004, was 44.7 per 100,000 population (Statistics Canada 2007). The Canadian Institute for Health Information recently reported that about 11% of patients admitted to hospital with a first-occurrence MI die in hospital within 30 days, and of those who die, 61% die within four days of admission (Canadian Institute for Health Information 2006).

It has been well established that timely access to emergency health services is associated with MI survival (Barbagelata et al. 2007). Revascularization with either percutaneous coronary intervention or

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thrombolytic therapy, the most important recommended treatment for ST-elevation MI, is most effective when given shortly after the onset of symptoms (Jacobs et al. 2007). Luca et al. (2008) suggested that, ideally, reperfusion should be accomplished within two hours of symptom onset. This recommendation arises because patients treated within two hours have a lower 30-day mortality rate, reduced myocardial infarction size, and thus better likelihood of preserving left ventricular function (Brodie et al. 1998; Liem et al. 1998; Asseburg et al. 2007).

Temporal delays in treatment have been addressed through patient and physician education, innovations in prehospital fibrinolysis and other adjustments to emergency medical services (Welsh et al. 2005), yet the most significant contributor to delayed treatment remains the patient's ability to recognize and respond to the symptoms of MI (Bett et al. 2005). Hallmark symptoms of MI are believed to include intense chest pain of greater than 20 minutes duration often accompanied by pain radiating to the left arm or the jaw. Other symptoms may include weakness, shortness of breath, anxiety, nausea, and syncope (Topol, 1998; Antman, 2001). When chest pain is not dominant, patients may be confused about the nature and severity of their symptoms and thus may postpone treatment seeking (Johansson et al. 2004).

The Heart and Stroke Foundation of Canada, on its website, describes the "warning signals" of heart attack as "sudden discomfort or pain that does not go away with rest; pain that may be in the chest, neck, jaw, shoulder, arms or back; pain that may feel like burning, squeezing, heaviness, tightness, or pressure; in women, pain may be more vague; chest pain or discomfort that is brought on with exertion and goes away with rest; shortness of breath (difficulty breathing); nausea (indigestion or vomiting); sweating (cool, clammy skin); and fear (anxiety or denial)" (Heart and Stroke Foundation 2008). The website advises that people experiencing these symptoms should immediately call 9-1-1, stop all activity, take nitroglycerin if prescribed, take ASA, and rest comfortably while awaiting emergency medical services.

In a study of the general public in 17 US states and the Virgin Islands, Greenlund et al. (2004) found that most survey respondents (95%) identified chest pain or discomfort as an MI symptom. Other symptoms less frequently identified included arm or shoulder pain or discomfort (89%); shortness of breath (87%); jaw, neck or back pain (51%); and weakness, light headedness and faintness (65%). Several factors were associated with MI symptom recognition, including gender (men were less likely to identify jaw, neck or back pain), "race" (white respondents were more likely to know that jaw, neck, and back pain, weakness and light headedness, and arm or shoulder pain or discomfort were symptoms), age (middle-aged respondents were better informed than younger or older respondents), and education. About 92% of the participants recognized three or more MI symptoms, and only 1% did not recognize any symptoms.

Similarly, the baseline assessment for the Rapid Early Action for Coronary Treatment (REACT) community trial, completed in 20 US communities, found that adults aged 18 years and older could report 2.9 correct heart attack symptoms, on average (Goff et al. 1998). Non-Hispanic white respondents were found to report relatively more correct symptoms compared with other racial/ethnic groups, as were better educated and higher-income respondents. Following an 18-month educational intervention, respondents residing in the communities in which the intervention was delivered were able to report 3.2 symptoms, on average, which was assessed to be a modest improvement by the investigators. Hispanic and non-Hispanic black people and those with lower income, the subgroups with limited knowledge at baseline, benefited most from the intervention (Goff et al. 2004).

In light of the extensive public health education campaigns sponsored by the Heart and Stroke Foundation of Canada, and others, and because of the vital importance to the prognosis of patients, we sought to determine the knowledge of MI symptoms possessed by a representative sample of adults, living in Metro Vancouver, Canada, obtained via a telephone-administered survey. In addition to identifying the average number of symptoms that respondents could correctly identify, we determined whether knowledge of heart attack symptoms is associated with socio-demographic factors, personal history of a heart attack, worry about having a heart attack, and perceived risk of having a heart attack. Researchers have noted that there are demographic differences, including ethnic and socioeconomic, in pre-hospital delay (Goff et al. 1999). In light of the ethnic diversity in Vancouver, we sought to determine whether the public health education campaigns have achieved

their desired reach by ensuring that all segments of the population recognize the symptoms of heart attack.

Methods

Selection and description of participants

Men and women (N = 3,419), 40 years of age and older, living in Metro Vancouver, Canada, were randomly selected from the population-based Ministry of Health Services, Client Registry Database. The client registry includes the name, date of birth, sex, address, and telephone number of all health insured residents (Krenten-Boaretto et al. 2003). To be listed in the registry, residents must have lived in the province for at least 3 months and have applied for health insurance coverage.

Data collection

An introductory letter containing information regarding how their name and address were obtained and a consent form were mailed to all randomly selected individuals. Recipients were asked to return their signed consent forms in enclosed self-addressed stamped envelopes or to contact the research office by telephone, fax, or email, if they wanted to participate. Follow-up telephone calls (up to 15 attempts at different times of the day and week) were made if no contact was received (Dillman, 2000).

People of Chinese and South Asian descent form two of the largest ethnic groups in Metro Vancouver, making up 70% of all "visible minority" groups (Statistics Canada 2004). In the 2001 Census, 17.4% of individuals of all ages identified their ethnic origin as Chinese (partially or fully) and 8.4% identified as South Asian; thus we administered the questionnaire in four languages to ensure representation of these ethnic groups. The questionnaire was translated from English into Punjabi and Chinese (Mandarin and Cantonese) and then back-translated to ensure validity. Interviewers, fluent in these languages, conducted the interviews.

Instrument

Respondents' knowledge of MI symptoms was assessed by the question: "What do you think people experience or feel when they have a heart attack?" Participants were encouraged to give comprehensive responses by a follow-up question, "Anything else?" Ten "correct symptoms," based on a review of the literature, were considered to be: chest pain/pressure/tightness/discomfort, arm pain, shortness of breath, nausea/indigestion, sweating/clamminess, shoulder/back pain, dizziness/faintness/light headedness, jaw pain, weakness, and uneasiness/panic/anxiety (Topol, 1998; Antman, 2001; Heart and Stroke Foundation 2008). Reported symptoms that have not been identified as classical MI symptoms were classified as "other" and considered incorrect.

Exposure to people who had incurred heart attacks was determined with the questions, "Have you ever had a heart attack?" and "Has anyone in your immediate family (such as your spouse, parents, siblings, children) ever had a heart attack?" The latter question was also posed in relation to "other relatives or close friends." Perceived risk of future heart attack was determined with the question, "What do you think your risk is of having a heart attack in the next 10 years compared with other people your age and sex: much lower than average, lower than average, average, higher than average, or much higher than average?" Worry about having a heart attack was assessed with the question, "How often do you worry about having a heart attack: not at all, rarely, sometimes, often, or almost all the time?" Respondents also were asked, "Has your doctor or another health-care provider such as a nurse or health educator ever talked to you about the signs and symptoms of a heart attack?"

The questionnaire also included socio-demographic items (i.e. age, gender, education, total annual household income, ethnicity, country of birth, language first spoken, language in which news is obtained, and years in Canada). We classified the respondents as "Chinese" immigrants if they were born in a country other than Canada, and spoke Chinese as their first language or self-identified as Chinese. Similarly, those classified as South Asian were immigrants to Canada who spoke Punjabi or Hindi as their first language, or self-identified as Punjabi. The remaining respondents were divided into those born in Canada and those born in other countries (of European origin). Three cases were excluded from the analyses; they were all born in Canada, spoke Chinese as their first language, identified as Chinese, and functioned entirely in English.

Data analysis

The bivariate relationships between the outcome variables (the mean number of correctly reported symptoms and the relative frequencies of specific reported symptoms) and the predictor variables (gender, ethnicity, age, education, income, exposure to heart attack, health professional education about symptoms, worry about heart attack, and perceived personal risk) were examined with analysis of variance and chi-square analysis, as appropriate. Post hoc multiple mean comparisons were completed with Scheffe's test unless the test of homogeneity of variance was significant, and then a Games-Howell test was conducted. The Games-Howell test does not assume homogeneity of variances, takes into account unequal group sizes, and performs well when cell sizes are very small; it is based on Welch's correction to the degrees of freedom and uses the studentized range statistic (Stoline, 1981; Field, 2005).

Multivariate Poisson regression analysis (used for count data) was conducted with the number of correctly reported symptoms regressed on the predictors explored in the bivariate analyses. Multiple imputation, a recommended approach for dealing with missing data, was used for the regression analysis because some participants (n = 185; 19%) did not provide their annual household income (Schafer and Olsen, 1998). The program S-Plus was used for the multiple imputation (Schimert et al. 2001). The statistical program SPSS (Version 15.0) was used for all other analyses.

Sponsor role

This research was supported by an operating grant from the Canadian Institutes of Health Research. The supporting agency had no role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; nor in the decision to submit the report for publication.

Ethics approval

Approval for accessing the Ministry of Health Services Client Registry Database and conducting the study was received from the Ministry of Health's Confidentiality Agreement: Security Provisions for Personal Information in Individual Identifiable Form and from the University of British Columbia's Behavioural Research Ethics Board.

Results

Of the 3,419 names selected from the registry, 976 (28.5%) people completed the survey, and 759 (22.2%) refused to participate. The remaining 1,684 (49.3%) people were ineligible or could not be contacted because of wrong or out-of-service numbers, relocation, language use other than the four offered, death, or an unknown reason. Two response rates were calculated: a minimum response rate of 28.5% (the number of completed interviews divided by the number of interviews plus the number of refusals plus all cases of unknown eligibility) and a maximum response rate of 56.3% (the number of completed interviews divided by the number of interviews plus the refusals; this eliminated those who had died, were known to not meet the eligibility criteria, and those with no contact for whom eligibility could not be determined).

Socio-demographic characteristics of the survey participants are compared with the characteristics of the larger population in Vancouver, Census Metropolitan Area in Table 1. The sample characteristics are similar to those of the population with the exception of education and income. The sample contained too few individuals with less than high school education and reported annual household income of less than $20,000. Additional socio-demographic information about the participants is provided in Ratner et al. (2006).

About three percent (3.2%) of the sample could not identify any heart attack symptoms and 53.3% were able to describe three or more correct symptoms (the maximum number mentioned was 7 of a possible 10). Table 2 shows the mean number of correctly reported symptoms stratified by socio-demographic and contextual factors. Women reported more correct symptoms than did men. Participants of European origin who were born in Canada identified more correct symptoms, and participants born in China reported significantly fewer correct symptoms, compared with all other participants. Participants in the 40–49 year age group mentioned significantly more correct symptoms than did participants 60 years of age and older, and participants with higher levels of education and income reported relatively more correct symptoms. People who had been exposed to victims of heart attack (including self), had had health professional education about the symptoms, or who worried about having a heart attack were better able to report correct symptoms. People who reported that they

Table 1. Sample and population characteristics.

Characteristics	Number of respondents (N = 973)	Prevalence (%)	
		Survey sample	Vancouver, CMA Census[1]
Gender			
Women	548	56.3	52.4[2]
Men	425	43.7	47.6[2]
Ethnicity			
European (born in Canada)	536	55.1	49.8[3,4]
European (not born in Canada)	221	22.7	NA
South Asian	67	6.9	5.9[3,4]
Chinese	149	15.3	16.3[3,4]
Age (years)			
40-49	369	37.9	37.1[2]
50–59	290	29.8	27.1[2]
60+	314	32.3	35.7[2]
Education			
<High school	92	9.5	27.7[2,3]
High school	243	25.0	20.2[2,3]
>High school	633	65.0	52.2[2,3]
Refused or missing	5	0.5	NA
Annual household income			
< $20,000	77	7.9	18.5[3,5]
$20,000–$39,999	150	15.4	21.2[3,5]
$40,000–$59,999	167	17.2	19.1[3,5]
$60,000–$79,999	116	11.9	14.5[3,5]
$80,000+	278	28.6	26.6[3,5]
Refused, do not know, or missing	185	19.0	NA
Exposure to heart attack (personal/family/friends)	690	70.9	NA
Health professional education about symptoms	301	30.9	NA
Worry about heart attack			
Not at all	486	49.9	NA
Rarely	243	25.0	NA
Sometimes/often/almost all the time	243	24.9	NA
Perceived personal risk			
Lower than average	476	48.9	NA
Average	320	32.9	NA
Higher than average	154	15.9	NA

[1]2001 Census data for Vancouver Census Metropolitan Area (CMA).
[2]Population aged 40 years and older.
[3]From a random sample of 20% of the Census data.
[4]Population aged 45 years and older.
[5]Population aged 15 years and older.

Table 2. Mean number of correctly reported heart attack symptoms by sociodemographic and contextual factors.

Characteristic	Mean number of correctly reported symptoms (95% C.I.)	F (df), *p* post hoc comparisons
Total sample (n = 973)	2.75 (2.66–2.84)	
Gender		10.77 (971,1), $p = 0.001$
Women (1)	2.88 (2.75–3.01)	Group 1 > 2
Men (2)	2.58 (2.47–2.70)	
Ethnicity		24.60 (969,3), $p < 0.001$[a]
European (Canadian born) (1)	3.03 (2.91–3.15)	Group 1 > 2, 3, 4
European (Not Canadian born) (2)	2.66 (2.48–2.83)	Group 2 > 4
South Asian (3)	2.49 (2.19–2.79)	Group 3 > 4
Chinese (4)	1.99 (1.81–2.18)	
Age (years)		4.05 (970,2), $p = 0.018$
40–49 (1)	2.86 (2.72–3.01)	Group 1 > 3
50–59 (2)	2.80 (2.63–2.96)	
60+ (3)	2.57 (2.42–2.72)	
Education		29.50 (965,2), $p < 0.001$[a]
<High School (1)	2.01 (1.77–2.25)	Group 1 < 2, 3
High School (2)	2.44 (2.29–2.59)	Group 2 < 3
>High School (3)	2.98 (2.87–3.10)	
Annual household income		6.09 (967,5), $p < 0.001$
<$20,000 (1)	2.31 (2.04–2.59)	Group 1 < 5
$20,000–$39,999 (2)	2.41 (2.21–2.60)	Group 2 < 5
$40,000–$59,999 (3)	2.77 (2.54–3.00)	
$60,000–$79,999 (4)	2.95 (2.68–3.22)	
$80,000+ (5)	3.01 (2.85–3.18)	
Not reported (6)	2.67 (2.47–2.87)	
Exposure to heart attack (personal/ family/friends)		22.36 (962,1), $p < 0.001$
Yes (1)	2.89 (2.78–2.99)	Group 1 > 2
No (2)	2.42 (2.26–2.58)	
Health professional education about symptoms		17.04 (969,1), $p < 0.001$
Yes (1)	3.02 (2.86–3.18)	Group 1 > 2
No (2)	2.63 (2.52–2.73)	
Worry about heart attack		9.55 (969,2), $p < 0.001$
Not at all (1)	2.56 (2.44–2.68)	Group 1 < 2, 3
Rarely (2)	2.91 (2.73–3.09)	
Sometimes/often/almost all the time (3)	2.98 (2.80–3.15)	
Perceived personal risk		8.26 (967,3), $p < 0.001$
Lower than average (1)	2.77 (2.64–2.90)	Group 1 > 4
Average (2)	2.77 (2.62–2.92)	Group 2 > 4
Higher than average (3)	2.86 (2.66–3.05)	Group 3 > 4
Don't know (4)	1.29 (0.81–1.77)	

[a]Significant test of homogeneity of variance; Games-Howell post hoc test used.

did not know their personal risk of heart attack reported significantly fewer correct symptoms.

The percentages of respondents who reported specific heart attack symptoms, stratified by socio-demographic characteristics, are presented in Tables 3 and 4. More men than women identified chest pain, tightness, pressure or discomfort as a heart attack symptom (OR = 1.60; 95% CI: 1.12–2.28). In contrast, women were more likely than were men to report nausea/indigestion (OR = 1.87; 95% CI: 1.42–2.46), shoulder/back pain (OR = 2.39; 95% CI: 1.52–3.75), jaw pain (OR = 5.12; 95% CI: 2.40–10.93), and uneasiness, panic, or anxiety (OR = 1.49; 95% CI: 1.00–2.22) as symptoms of a heart attack.

Ethnicity was associated with reporting 8 of the 10 identified symptoms, namely chest pain, arm pain, shortness of breath, nausea, sweating, shoulder pain, dizziness, and jaw pain (Table 3). Chinese participants were less likely to report these symptoms than were European-Canadian born participants, with the exception of dizziness (28.9% vs 18.3%). Only one in four South Asian participants (25.4%), in contrast with about one half of those of European and Chinese origin, correctly identified shortness of breath as a symptom of heart attack. Similarly, only 13.4% of the South Asian participants reported nausea, whereas 43.3% of those born in Canada did. South Asian participants were more likely to report shoulder or back pain than were participants from the other groups.

Age was associated with reporting some of the correct symptoms. Younger people were more likely to mention shortness of breath, nausea, and dizziness than were people 60 years of age or older. Participants in the older age group were more likely to mention sweating than were younger participants.

As the participants' education increased, so did their likelihood of reporting chest pain or discomfort, shortness of breath, nausea or indigestion, sweating or clamminess, and dizziness or light headedness as symptoms of heart attack (Table 4). Similarly, there was a positive association between income and the reporting of arm pain and nausea or indigestion.

Among the many incorrect symptoms mentioned (i.e. choking, blurred vision, temperature change, anger) those most likely to report loss of consciousness as a symptom were people of Chinese origin (15.1%) compared with about 4% of people in each of the other 3 ethnic groups ($\chi^2_{(3)}$ = 27.22, p < 0.001). People in the lowest income bracket were more likely to report loss of consciousness as

a symptom (14.3% of participants with <\$20,000 per annum compared with about 6.5% of those in the other income groups; $\chi^2_{(4)}$ = 10.60, p = 0.03).

Table 5 provides the relative frequency of reported symptoms of heart attack in relation to exposure to heart attacks through their personal, family, or friends' histories, exposure to health professional education, worry about heart attack, and perceived heart attack risk. Participants who knew someone who had had a heart attack or who had had one themselves were more likely to mention shortness of breath (OR = 1.49; 95% CI: 1.12–1.97), nausea or indigestion (OR = 1.39; 95% CI: 1.02–1.88), sweating or clamminess (OR = 2.08; 95% CI: 1.3–3.31), and shoulder or back pain (OR = 1.78; 95% CI: 1.07–2.97).

Exposure to health professional education was positively associated with the likelihood of reporting the following symptoms: arm pain (OR = 1.38; 95% CI: 1.05–1.83), sweating or clamminess (OR = 1.56; 95% CI: 1.08–2.26), shoulder or back pain (OR = 1.65; 95% CI: 1.09–2.49), jaw pain (OR = 1.95; 95% 1.14–3.34), and weakness (OR = 1.75; 95% CI: 1.09–2.81).

Reporting no worry at all about heart attacks was associated with lesser likelihood of reporting some symptoms, including shortness of breath, nausea or indigestion, sweating or clamminess, shoulder or back pain, and dizziness or light headedness. Similarly, those who reported that their risk of heart attack was lower than average were less likely to report shoulder or back pain as a symptom.

Table 6 provides the results of the Poisson regression of the number of correct symptoms reported on the predictors examined in the bivariate analyses. Significant associations were found between the number of correct symptoms reported and gender, ethnicity, education, exposure to health professional education, and worry about having a heart attack. The multivariate analysis reveals that the respondents who reported the least number of correct symptoms were: male, reported their ethnic background as Chinese, had less than a high school education, reported no health professional education about symptoms, and had "no worry at all" about having a heart attack.

Discussion

The goal of this study was to assess the reach of public health education campaigns that are aimed at reducing the time from initial onset of symptoms to diagnosis and treatment of MI. Overall the public

Ratner et al

Table 3. Relative frequency of reported symptoms of a heart attack by socio-demographic characteristics.

Symptom	Total (N = 973)	Gender		Ethnicity				Age (years)		
		Women (n = 548)	Men (n = 425)	European (Canadian Born) (n = 536)	European (Not Canadian Born) (n = 221)	South Asian (n = 67)	Chinese (n = 149)	40–49 (n = 369)	50–59 (n = 290)	60+ (n = 314)
	%	%	%	%	%	%	%	%	%	%
Chest pain, tightness, pressure or discomfort	**83.6**	80.8*	87.1*	86.0*	83.3*	82.1*	75.8*	86.2	81.4	82.5
Arm pain	34.9	37.0	32.2	43.7*	33.5*	37.3*	4.7*	32.0	37.9	35.7
Shortness of breath	51.3	50.7	52.0	55.6*	51.6*	25.4*	47.0*	57.5*	51.4*	43.9*
Nausea or indigestion	33.8	39.8*	26.1*	43.3*	27.1*	13.4*	18.8*	36.9*	39.7*	24.8*
Sweating or clamminess	14.3	14.4	14.1	16.4*	13.6*	14.9*	7.4*	11.1*	13.1*	19.1*
Shoulder or back pain	11.0	14.4*	6.6*	12.1*	11.3*	23.9*	0.7*	8.4	11.0	14.0
Dizziness, faintness or light headedness	20.0	20.1	20.0	18.3*	19.0*	17.9*	28.9*	25.7*	19.7*	13.7*
Jaw pain	5.9	8.9*	1.9*	7.1*	5.9*	7.5*a	0.7*	4.9	7.2	5.7
Weakness	7.9	7.5	8.5	8.0	7.2	7.5	8.7	8.9	6.2	8.3
Uneasiness panic, or anxiety	12.2	14.1*	9.9*	12.5	13.1	19.4	6.7	14.9	12.1	9.2

*Pearson Chi-Square $p < 0.05$.
aCaution, expected cell count <5.

Table 4. Relative frequency of reported symptoms of a heart attack by socio-economic status.

Symptom	Education			Annual household income ($CAD)				
	<High School (n = 92)	High School (n = 243)	>High School (n = 633)	<20,000 (n = 77)	20,000– 39,999 (n = 150)	40,000– 59,999 (n = 167)	60,000– 79,999 (n = 116)	80,000+ (n = 278)
	%	%	%	%	%	%	%	%
Chest pain, tightness, pressure or discomfort	75.0*	78.2*	86.9*	80.5	80.0	81.4	85.3	88.1
Arm pain	29.3	31.7	37.1	23.4*	27.3*	33.5*	32.8*	42.8*
Shortness of breath	34.8*	40.7*	58.1*	45.5	50.7	50.3	59.5	54.7
Nausea or indigestion	12.0*	29.6*	38.7*	18.2*	25.3*	32.3*	38.8*	46.8*
Sweating or clamminess	7.6*	11.9*	16.1*	10.4	10.0	17.4	19.0	12.9
Shoulder or back pain	9.8	8.2	12.3	14.3	6.7	12.0	7.8	10.8
Dizziness, faintness or light headedness	9.8*	21.0*	21.3*	14.3	21.3	19.8	20.7	20.9
Jaw pain	3.3	4.1	7.0	6.5*a	1.3*	10.2*	5.2*	5.4*
Weakness	7.6	6.2	8.7	6.5	10.0	7.8	7.8	7.2
Uneasiness, panic, or anxiety	12.0	12.3	12.2	11.7	8.0	12.0	18.1	11.9

*Pearson Chi-Square $p < 0.05$.
aCaution, expected cell count < 5.

in this community were not well informed about the symptoms of heart attack, other than chest pain. Chest pain and shortness of breath were reported as symptoms by 84% and 51% of the participants, respectively. Other symptoms including arm pain, nausea, sweating, jaw pain, and weakness were reported by fewer than 35% of the participants. Key socio-demographic and contextual factors were associated with the participants' knowledge of symptoms. Women could identify more symptoms than could men, although they were less likely to mention chest pain (the only symptom that men were more likely to mention). Those who were economically and educationally more privileged, and younger adults, were more likely to identify correctly the classic symptoms. Chinese immigrants, in particular, were found to lack knowledge of heart attack symptoms; one in four did not identify chest pain as a symptom. Contextual factors including knowing someone who has had a heart attack and having been counseled by health professionals about the symptoms were key predictors of people's knowledge. Having received health professional counseling about the symptoms of heart attack was associated with identifying five of the less commonly recognized symptoms (i.e. arm pain, sweating/clamminess, shoulder/back pain, jaw pain, and weakness). Reporting being worried about a heart attack was more strongly associated with knowledge of symptoms than was perceived personal risk.

The above results are based on a sample of residents in one urban setting who were enrolled in the provincial health insurance plan. The extent to which residents do not enroll in the plan is unknown, but is likely to occur most commonly in those who are poor, those with mental illness, or those marginalized in other ways including because they lack English fluency or are illiterate. An additional limitation is the single urban setting in which the study took place. It is very likely that other communities in Canada, particularly those that are suburban, rural, or remote, and which have different ethnic compositions, have different levels of awareness related to heart attack symptoms.

Table 5. Relative frequency of reported symptoms of a heart attack by exposure to heart attack, health professional education, worry and perceived personal risk.

Symptom	Exposure to heart attack (personal/family/friends)		Health professional education about symptoms		Worry about heart attack			Perceived personal risk of heart attack		
	Yes (n = 690)	No (n = 274)	Yes (n = 301)	No (n = 670)	Not at all (n = 486)	Rarely (n = 243)	Sometimes/ often/almost all the time (n = 243)	Lower than average (n = 476)	Average (n = 320)	Higher than average (n = 154)
	%	%	%	%	%	%	%	%	%	%
Chest pain, tightness, pressure or discomfort	84.6	81.0	85.7	82.5	82.3	84.8	84.8	85.5	81.9	86.4
Arm pain	36.5	31.4	40.2*	32.7*	34.4	33.7	37.4	33.4	36.6	39.6
Shortness of breath	54.1*	44.2*	53.5	50.1	47.5*	57.2*	53.1*	54.0	50.0	51.3
Nausea or indigestion	35.9*	28.8*	37.5	32.2	30.2*	35.8*	39.1*	36.6	33.4	29.9
Sweating or clamminess	16.7*	8.8*	18.3*	12.5*	10.1*	16.5*	20.6*	12.2	16.9	17.5
Shoulder or back pain	12.3*	7.3*	14.6*	9.4*	8.2*	12.3*	14.8*	8.2*	13.4*	14.9*
Dizziness, faintness or light headedness	20.7	18.2	18.9	20.4	17.3*	25.1*	20.6*	20.8	21.9	14.9
Jaw pain	6.8	3.6	8.6*	4.6*	4.9	6.6	7.0	5.0	5.9	8.4
Weakness	8.4	6.6	11.0*	6.6*	7.8	8.6	7.4	8.0	6.9	9.7
Uneasiness, panic, or anxiety	12.5	12.0	14.0	11.5	13.0	10.3	12.8	13.2	10.3	13.0

*Pearson Chi-Square *p* < 0.05.

A strength of this study is that the questions related to heart attacks were open-ended, thereby removing the chance for bias (i.e. participants were not prompted). In addition, we obtained a good response rate for a telephone-based survey and we were able to capture a relatively representative sample of residents, including those whose first language was not English and who are often omitted from community-based research because of language barriers.

The findings suggest that particular groups have not received adequate education about common symptoms of heart attack; most troubling, some of these groups' baseline risk is relatively higher than that of the general public. The incidence of heart attack is known to increase progressively with age (Rich, 2006). Only 44% of the participants over the age of 60 years mentioned shortness of breath and about 25% mentioned nausea or indigestion as possible symptoms. Yet, Then et al. (2001) noted that as patients age, men in particular, the presenting clinical manifestations of a heart attack become increasingly "atypical" (complaints of indigestion, epigastric or abdominal pain, shortness of breath, back or jaw pain, nausea, vomiting or malaise).

The Chinese community, the largest ethnic community in Metro Vancouver, is a group in particular need of health education intervention. A recent study conducted in Beijing also noted that the Chinese public's knowledge of heart attack symptoms is deficient (Zhang et al. 2007). Zhang et al. (2007) reported that only 64% of Beijing's adult residents reported chest pain or discomfort as a heart attack symptom. Culturally and linguistically appropriate health education efforts to increase knowledge need to be targeted to this ethnic community.

It would appear that women have been significantly and somewhat erroneously influenced by several public awareness campaigns and the popular literature that describes women's symptoms of heart attack as different from those of men (Anonymous 2005). For example, Graham (2005) wrote, in "Good Housekeeping," a popular women's magazine, that, for women, "chest pain may not be the most prominent symptom—or even a symptom at all. Heart attacks often start with only mild discomfort hours for days, or even weeks before the actual event. This malaise may not serve as an alert." Indeed, in a list of symptoms provided in the article, chest pain was not included. An unintended consequence of these sex-specific health awareness campaigns is that women experiencing chest pain may rule out the possibility

Table 6. Poisson regression of the number of correctly reported heart attack symptoms on socio-demographic and contextual factors.

Characteristics	Incidence rate ratio	95% Confidence interval
Gender (referent: men)	1.14	1.06–1.24
Ethnicity (referent: European (Canadian born))		
European (not Canadian born)	0.89	0.81–0.98
South Asian	0.97	0.85–1.10
Chinese	0.73	0.65–0.83
Age (years) (referent: 40–49)		
50–59	0.95	0.87–1.05
60+	0.98	0.88–1.08
Education (referent: <high school)		
High school	1.08	0.91–1.29
>High school	1.29	1.08–1.53
Annual household income, $CAD (referent: <20,000)		
20,000–39,999	1.02	0.85–1.22
40,000–59,999	1.10	0.94–1.29
60,000–79,999	1.12	0.92–1.37
80,000+	1.14	0.97–1.34
Exposure to heart attack (personal/family/friend) (referent: no)	1.09	0.99–1.19
Health professional education about symptoms (referent: no)	1.09	1.00–1.18
Worry about heart attack (referent: not at all)		
Rarely	1.07	0.98–1.18
Sometimes/Often/ Almost all time	1.13	1.02–1.25
Perceived personal risk (referent: lower than average)		
Average	1.01	0.92–1.10
Higher than average	0.97	0.86–1.09

that they are having a heart attack and may delay their treatment seeking. Indeed, in a review of studies that examined gender-specific heart attack symptom expression, Canto et al. (2007) concluded that gender-specific health messages about expected symptoms are not warranted.

Sheifer et al. (2000) reported that socioeconomic status independently predicted the amount of time

elapsed between the onset of symptoms and patients' hospital arrival. Our findings that income and education are associated with symptom recognition may explain their results, at least in part. Health literacy, the capacity to acquire, process, and comprehend health-related information, is associated with many health outcomes, including hospitalization rates and mortality, and is most notably limited in the elderly, those with minimal annual income, and limited education (Baker et al. 2002; Baker et al. 2007).

Studies of this kind have been undertaken in many places. Although these studies are not directly comparable because the age ranges and health status of the participants, the assessments of knowledge, and the groupings of symptoms varied, there are some noteworthy differences. For example, although there were gender difference found in this sample, with women being more likely to mention four of the ten symptoms, and less likely to mention chest pain, compared with men, Tullmann and Dracup (2005), in a sample of 65-year-olds with a history of coronary heart disease in a rural area of California, found that the only gender difference was associated with mention of jaw pain (women were more likely to know that jaw pain can be a symptom). Overall, their participants were more knowledgeable than were ours. Similarly, Goff et al. (2004) reported that 18 months after the REACT trial, in the USA, 70.9% of their intervention participants could report at least 3 correct symptoms, yet only 53.3% of our sample could do so. Our participants' knowledge was very comparable with that found among residents of Melbourne and other areas of Victoria, Australia (Smith et al. 2002); in both studies women were able to report more symptoms than were men and people whose first language was English were more knowledgeable.

It will be challenging to educate the public sufficiently to reduce the time between the onset of symptoms and initiation of treatment for MI, which depends greatly on the ability to recognize the symptoms. The Rapid Early Action for Coronary Treatment Study, a large community-based intervention designed to educate the public in 10 communities, found that, despite a multi-component education program, the time from symptom onset to hospital arrival was not reduced, although activation of the emergency medical services systems was significantly increased (Luepker et al. 2000). In Sweden, however, researchers were able to reduce the average time to presentation by almost 60 minutes following a broad public education campaign (Blohm et al. 1996). Meischke et al.

(2004) concluded that small- and large-scale interventions have produced modest results, at best, and that face-to-face contact with highly credible communicators may be an important element in any strategy. Alonzo and Reynolds (1997) suggested that the disappointing results of various community interventions may have arisen because many of the evaluated campaigns have been "one-offs" that cannot achieve sustained behavior change. They cautioned, however, that repeated interventions may serve to "normalize information meant to arouse" people, and thus their effects may be mitigated.

Healthcare providers have an important role to play; those individuals who received health professional counseling were able to describe more correct symptoms of MI. Unfortunately, only 31% of the sample reported having received such education. Primary care providers, in particular, can encourage their patients "to act fast" even in the face of uncertainty. As Zapka et al. (2000) pointed out, primary care providers can educate their patients about their risk, the nature and possible vagueness or variability of symptoms, the importance of rapid action, the value of emergency medical services, and the unnecessary delay associated with seeking advice or confirmation from their primary care provider at the time of symptom onset. Such education, in the primary care setting, could have substantial influence in Canada, particularly because the vast majority of Canadians (86% in 2003) have a *regular* medical doctor (Statistics Canada 2004).

People's ability to recognize symptoms and to take appropriate action is fundamental to positive outcomes following coronary events. Interventions to raise awareness of heart attack symptoms, particularly with ethnic and lower income groups are needed. Educational efforts, resources, and supports should be targeted to healthcare professionals, especially primary care providers. Further research into effective strategies to disseminate information is essential. Knowledge alone, however, is likely insufficient to prompt action. This is a complex, multifactorial problem; studies to better understand the other factors that lead to action are required.

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