EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Myocardial infarction symptom recognition by the lay public: the role of gender and ethnicity

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Study objective: To find out if gender and ethnicity are associated with acute myocardial infarction (AMI) symptom recognition and the recommendation of enlisting emergency medical services.
Design: In an experiment, a random sample of the public was provided a scenario of a person experiencing symptoms of AMI; the gender of the character (male, female, or indeterminate) was manipulated.
Setting: Vancouver, Canada
Participants: 976 people from a population based random sample of 3419 people, 40 years of age and older, participated in a telephone survey given in English, Cantonese, Mandarin, and Punjabi.
Main results: 78% of the respondents identified the symptoms as heart related. Unadjusted analyses showed that ethnicity, education, income, and AMI knowledge were significantly associated with symptom recognition (Chinese respondents were least likely to identify the symptoms as heart related). Thirty seven per cent recommended calling emergency services, which was associated with symptom recognition, ethnicity (Chinese respondents were least likely to make the recommendation), AMI knowledge, having an immediate family member with AMI, and having talked with a health professional about the signs and symptoms of AMI. Neither the gender of the respondent nor of the affected person in the scenario was associated with symptom recognition.
Conclusions: Heart health education must be targeted to and tailored for ethnic communities. Health professionals must discuss the signs and symptoms of AMI, and the correct course of action, with their patients.

Early intervention is crucial to successful treatment of acute myocardial infarction (AMI). Reperfusion therapy delivered within 12 hours of symptom onset has dramatically improved short and long term prognosis,[1–4] although the morbidity and mortality rates associated with AMI remain significant. Reducing ischaemic times by shortening the interval from symptom onset to start of reperfusion therapy reduces infarct size.[5] Important advances have been made in reducing the interval from first medical contact to delivery of reperfusion therapy. Conversely, few gains have been made that reduce patient delay before medical contact. Moreover, a substantial fraction of AMI patients fail to seek any emergent medical attention.[6] The realisation of optimal outcomes requires, at minimum, interventions that encourage early symptom recognition by the public and rapid medical contact.[7 8] Designing such interventions requires a better understanding of factors that contribute to patient related delays.

Median delay times range from two to over five hours,[9 10] and as many as 50% of patients admitted to hospital with AMI call their general practitioner first, rather than emergency services (that is, 9-1-1), thereby lengthening the time to treatment.[11] In Canada, in 1998, the average time from onset of cardiac symptoms to hospital admission was 2.6 hours.[12] By 2001, this had not improved substantially; two cardiac referral centres reported the median time from onset of chest discomfort to arrival at the emergency department (ED) to be 2.1 hours—25% of patients had an interval of more than 5.3 hours, and only 31% arrived by ambulance.[13]

Many factors have been associated with treatment seeking delay, but the research findings are contradictory. Symptom characteristics (severity and suddenness of chest pain), sociodemographics (age, gender, ethnicity, socioeconomic status), health status (diabetes, previous AMI, comorbidities), and patient behaviour (need to consult with friends/family) have been associated, although not consistently, with "delay times".[14–19]

Conflicting findings have been reported with regard to gender and treatment delay times. Some researchers have found no gender differences,[20–23] yet others have reported that women delay treatment longer than do men.[17 24 25] Researchers also have focused on whether there are ethnic differences in symptom recognition. Having seen that South Asian people in the UK have greater treatment delays than Europeans, Chaturvedi *et al* examined whether there were differences in ethnic groups' interpretations of and probable responses to symptoms of AMI.[26] They found no apparent differences in Hindus', Sikhs', and Europeans' ability to identify the pain described in a case study as cardiac in origin, although South Asians were "more anxious" about the problem and were more likely than Europeans to report that they would seek immediate care.[26]

We further developed the ideas of Chaturvedi *et al* by exposing a random sample of the public to a hypothetical scenario of a person experiencing symptoms suggestive of AMI. Using an experimental design, we manipulated the gender identity of the person in the scenario to find out if the gender of the respondent, or of the affected person in the scenario, was associated with lay assessments. We also investigated whether ethnicity was associated with symptom recognition. Our final objective was to determine the factors associated with the recommendation of enacting 9-1-1 services.

METHODS

Sample

Data for this study were derived from a telephone survey of a random sample of men and women (n = 3419), 40 years of age and older, and living in the Greater Vancouver area of British Columbia (BC), Canada. People of Chinese and South Asian origin form the two largest visible minority populations in the city, making up 70% of all visible minority groups.[27] In the 2001 census, 17.4% of people of all ages identified their ethnic origin as Chinese (partially or fully) and 8.4% identified as South Asian.

The sample was obtained from the population based BC Ministry of Health Services Client Registry Database. The registry includes the name, date of birth, sex, address, and telephone number of all insured residents.[28] To be listed in the client registry, residents must have lived in BC for at least three months and applied for the Medical Services Plan; military and Royal Canadian Mounted Police personnel are excluded. Because private basic health insurance is not available the registry provides comprehensive coverage of the population. None the less, the potential for error does exist because people change residence or die (the registry routinely updates the list). Others have found that people over 40 years of age are most likely to have correct information in the client database, which may result because of frequent medical visits and hence regular updates to the registry.[28]

Approval for accessing the list 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, respectively. The study conforms to the principles embodied in the Declaration of Helsinki and the Canadian Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

Data collection

The study was conducted in English, Cantonese, Mandarin, and Punjabi. A letter introducing the study and describing how the names and addresses were obtained, together with a consent form, were mailed to all randomly selected persons. All persons received the letter in English and those with names that suggested that they possibly were Chinese or South Asian also received a translated copy in the appropriate language. Recipients were invited to return their signed consent forms in enclosed pre-addressed stamped envelopes or to contact the researchers by telephone, fax, or email. If the recipient did not contact the research office, one reminder telephone call was made. Scripted messages were left on answering machines. Calling occurred from 8 am to 9 pm on weekdays, from 10 am to 9 pm on Saturdays, and from 11 am to 6 pm on Sundays, unless a participant requested contact outside those hours. Up to 15 call backs to those who consented were attempted at different times of the day and week.[29 30] The data were collected between September 2003 and July 2004.

Questionnaire

Certified translators translated the questionnaire into Punjabi, Mandarin, and Cantonese, which was validated through back translation. Interviewers were fluent in these languages and conducted the interviews. Respondents' ability to recognise symptoms of AMI was assessed through the use of a case scenario adapted from the work of Chaturvedi *et al* (see box 1).[26] The respondents were randomly assigned to one of three versions of the case scenario, in which the fictional character was either male, female, or no gender was indicated (the name was gender ambiguous). Participants were asked what they believed could be causing the character's pain. They were then asked to indicate on a five point scale, with 1 being ''not at all concerned'' and 5 being ''extremely concerned,'' how concerned the fictional character should be about the pain. The case scenario was then further developed with the character experiencing nausea and shortness of breath; the respondents were again asked what the character should do, and to indicate, of the actions mentioned, which one was most important. The responses were scored according to whether the respondent identified a heart related problem and whether calling 9-1-1 was mentioned.

Personality characteristics such as neuroticism may be associated with treatment seeking[18]; accordingly we included an assessment of respondents' neuroticism (the tendency toward negative emotionality, instability, or inability to cope). We incorporated two facets of the neuroticism domain (anxiety and vulnerability) of the revised NEO personality inventory (NEO-PIR).[31] The anxiety facet assesses if people are apprehensive, fearful, and prone to worry. The vulnerability facet is assessed within the context of stress and whether people are unable to cope with stress, and become dependent, hopeless, or panicked when facing emergency situations. These facets have shown acceptable internal consistency (coefficient α range from 0.77 to 0.78). Although we did not use the entire inventory, the five factor model of personality has been supported with principal components factor analysis. The neuroticism facets are strongly correlated with the Eysenck personality inventory; anxiety is correlated with the state-trait personality inventory and the profile of mood states.[32] The publisher of the NEO provided English and Chinese versions of the questionnaire;

Box 1 Case scenario*

- I am going to read a short story and then ask you some questions. There are no right or wrong answers, only your opinion matters to us.
- *Konia is 55 years old [is a 55 year old woman/is a 55 year old man] and has generally good health, but is overweight and doesn't do much exercise. Konia's grandchildren have come to visit. That evening, one of the grandchildren has a headache. Konia starts carrying the child up the stairs to the bedroom. Suddenly Konia feels a pain in the chest. The pain is so bad that Konia feels a bit sick and has to put the child down. After about five minutes, the pain wears off and Konia feels fine. Konia has had this pain once before, following a large meal.*
- What do you think could be causing the pain? Is there anything else?
- Now, I would like you to try and put a number to it. On a scale from 1, 1 being 'not at all concerned' to 5, 5 being 'extremely concerned,' how concerned should Konia be about the pain?
- *Konia now feels nauseated (nauseous) and out of breath.*
- What should Konia do? Is there anything else? Of all the things you just mentioned, which do you think is the most important thing Konia should do?
- If you were Konia, what would be the first thing you would do?
- What is the most likely cause of Konia's symptoms?

*Adapted from Chaturvedi *et al*.[26]

certified translators developed a Punjabi version of the scale. The NEO has been used widely in cross-cultural research and various translations, including Chinese, have been shown to replicate the factor structure seen in North American data.[33 34]

The respondents' knowledge of AMI symptomatology was determined by asking whether they, a relative, or a friend had ever had an AMI and whether they had ever discussed the signs and symptoms with a health professional. An AMI knowledge score was computed on the basis of respondents' answers to eight questions, derived from Meischke *et al* and Wyatt and Ratner (see table 1).[35–37] The correct responses were summed for a possible score ranging from 0 to 8.

The questionnaire also obtained sociodemographic data (that is, age, gender, education, ethnicity, birthplace, language(s) used, years spent in Canada, total household income, living arrangements). Ethnicity, determined in a manner similar to that used in the 2001 Canadian census, was defined as the ethnic or cultural group to which the respondents' ancestors belonged, their ''roots,'' and was not necessarily the same as their citizenship status or nationality.[38] The question posed was, ''Most people in Canada describe themselves as Canadian first but also identify themselves based on their background or the nationality of their ancestors. What would you say is your main ethnic background? (for example, First Nations, Punjabi, Scottish, French, Korean, Chinese, etc).'' Multiple responses were accepted. Respondents also were asked: whether they were born in Canada; if not, in which country they were born; how long they lived in Canada; their first language spoken; the language spoken most often at home; and the language in which they usually read newspapers.

Four groups were formed on the basis of respondents' ethnicity, language in which they completed the survey, birthplace, and first language: (a) Chinese not born in Canada (n = 148), (b) South Asian (the term used by the local community to unify several groups including Hindus and Sikhs and who share common cultural practices[39]) not born in Canada (n = 67), (c) neither Chinese nor South Asian and not born in Canada (n = 221), and (d) born in Canada (n = 540).

Analyses

The statistical package SPSS (SPSS, Chicago, 2003) was used for all data analyses. Differences in proportions and means were tested with χ^2, Kruskal-Wallis, and Mann-Whitney tests. Multivariate logistic regression analysis was used to assess the relations between the predictors and two outcome variables: (a) recognition of a heart related problem in the case scenario and (b) mentioned calling 9-1-1. A binary response of ''yes'' or ''no'' was recorded for both outcome variables. The set of predictors included the scenario character's gender (male, female, or indeterminate), the anxiety and vulnerability scores, sociodemographic factors (age, gender, education, ethnicity, income group, living arrangement), history of AMI either personally, in the family, or among friends, whether a health professional had ever discussed AMI symptoms, and the AMI knowledge score.

Table 1 Acute myocardial infarction knowledge test*

Question	Answer
A heart attack means that the heart has stopped beating	False
Most people who suffer a heart attack die right away	False
The symptoms of a heart attack are always sudden and severe	False
The symptoms of a heart attack can be mild and can take days to develop	True
Paramedics are trained to begin treatment for a heart attack before transferring the person to the hospital	True
If a person is having a heart attack it does not really matter how quickly they seek medical help	False
A woman is much less likely to have a heart attack than a man	False
A heart attack always causes severe chest pain	False

*Adapted from Meischke *et al* and Wyatt and Ratner.[35–37]

Diagnostics steps were performed on the models as recommended by Hosmer and Lemeshow[40]: (a) all continuous and ordinal variables in the multivariable models were assessed for conformity to a linear gradient; (b) all independent variables in the models were tested for multicollinearity; (c) all plausible two way interactions were assessed; (d) goodness of fit was appraised; and (e) influential observations were inspected. We defined $p<0.05$ as significant.

Nineteen per cent of the participants did not disclose their household income; therefore, to reduce bias, three methods of handling missing data were used: (a) conventional listwise deletion of cases with missing data, (b) multiple imputation of values for missing data, and (c) imputation of missing income data with the median household income of the participants' neighbourhood (census enumeration area). Multiple imputation was performed using the statistical program Amelia (Aptech Systems, Maple Valley, Washington).[41 42] Multiple imputation is a valid and robust procedure when dealing with missing data from a mixed (continuous and categorical) dataset.[42 43] The set of covariates, and other variables predictive of those covariates, were used to impute five complete sets of data. Logistic regression analysis was completed, as described above, for each dataset and the estimated coefficients were averaged across the five datasets. Standard errors were calculated using the formulas provided by Rubin.[44] The third approach to the treatment of missing income data involved the imputation of the median household income for the respondent's neighbourhood (census tract) obtained from the Canadian census (2001) using postal codes.[45] A census tract is defined as a small area within a large urban centre (population >50 000) that usually has a population size between 2500 and 8000.

RESULTS

Of the 3419 names selected from the client registry, 976 people completed the survey, and 759 refused to participate. The remaining 1684 people were found to be ineligible or could not be contacted (39% were ''wrong'' or fax numbers; 26% were numbers not in service; 25% could not be contacted; 5% no longer lived in the sampling area; 4% spoke languages other than those provided; and 1% had died); the minimum response rate was 28.5% (defined as the number of completed interviews divided by the number of interviews plus the number of non-interviews (refusals) plus all cases of unknown eligibility).[47] The maximum response rate was 56.3% (defined as the number of completed interviews divided by the number of interviews plus the refusals; this eliminates those who had died, were known to not meet the eligibility criteria, and those cases with no contact for whom eligibility could not be determined). Of the 976 respondents, 296 (30.3%) completed a case scenario with the character referred to as a woman, 342 (35.0%) had the ''male'' version, and 338 (34.6%) did not have the character's gender made explicit.

Table 2 provides the characteristics of the respondents. Among those classified as ''Chinese'' not born in Canada, 89.2% and 10.8% described their ethnic origin as Chinese or Taiwanese, respectively; all were born in Asia (Hong Kong, India, the People's Republic of China, Taiwan, Cambodia, Indonesia, Macau, Malaysia, the Philippines, Singapore, and Vietnam); 24.3% completed the survey in English; 11.5% most often spoke English at home; and of the 87.2% that read newspapers, 37.3% read English language newspapers. They

Table 2 Characteristics of study sample

Characteristics	Total (n = 976)	Men (n = 427)	Women (n = 549)	Mann-Whitney p value	χ^2 p value
Personal					
Ethnicity (n (%))					
Born in Canada	540 (55.3)	234 (54.8)	306 (55.7)		
Not born in Canada (not Chinese/South Asian)	221 (22.6)	100 (23.4)	121 (22.0)		
South Asian (not born in Canada)	67 (6.9)	26 (6.1)	41 (7.5)		
Chinese (not born in Canada)	148 (15.2)	67 (15.7)	81 (14.8)		0.79
Age (years) (mean (SD))	55.5 (11.1)	56.6 (11.1)	54.7 (11.1)	<0.01	
Education (n (%))					
<High school	92 (9.5)	45 (10.6)	47 (8.6)		
High school	243 (25.0)	100 (23.5)	143 (26.2)		
College/diploma/certificate/incomplete university	342 (35.2)	134 (31.5)	208 (38.2)		
Baccalaureate or higher	294 (30.3)	147 (34.5)	147 (27.0)		0.03
Total household income (n (%))					
\$0–\$19999	77 (9.7)	26 (7.0)	51 (12.1)		
\$20000–\$39999	150 (19.0)	64 (17.3)	86 (20.4)		
\$40000–\$59999	168 (21.2)	69 (18.7)	99 (23.5)		
\$60000–\$79999	118 (14.9)	64 (17.3)	54 (12.8)		
\$80000–\$99999	107 (13.5)	54 (14.6)	53 (12.6)		
\$100000+	171 (21.6)	92 (24.9)	79 (18.7)		0.01
Lives alone (n (%))	167 (17.1)	57 (13.3)	110 (20.1)		<0.01
Anxiety score (mean (SD))	13.4 (5.2)	12.3 (5.0)	14.3 (5.1)	<0.001	
Vulnerability score (mean (SD))	9.1 (3.9)	8.5 (3.9)	9.6 (3.9)	<0.001	
Case scenario version (n (%))					
Male character	342 (35.0)	133 (31.1)	209 (38.1)		
Female character	296 (30.3)	125 (29.3)	171 (31.1)		
Gender indeterminate character	338 (34.6)	169 (39.6)	169 (30.8)		0.01
AMI					
Had an AMI (n (%))	51 (5.3)	29 (6.8)	22 (4.0)		0.06
Immediate family member with AMI (n (%))	420 (43.3)	169 (39.8)	251 (46.0)		0.05
Another relative/close friend with AMI (n (%))	519 (53.5)	226 (53.3)	293 (53.6)		0.94
Discussed the signs and symptoms of AMI with health professional (n (%))	301 (30.9)	152 (35.6)	149 (27.2)		<0.01
AMI knowledge score (mean (SD))	6.6 (1.5)	6.6 (1.5)	6.6 (1.6)	0.60	

had resided in Canada between 1 and 49 years (mean = 15.4 years; SD = 10.8).

Among the South Asian respondents not born in Canada, 91.0% described their ethnic origin as Punjabi, Sikh, Hindi, Indian, East Indian, or Gujarati (the language of west central India), and the others (9.0%) described themselves as South East Asian, Pakistani, Fijian, or Canadian; all were born in Egypt, Fiji, India, Malaysia, Pakistan, Singapore, Sri Lanka, Tanzania, or Uganda; 50.7% completed the survey in English; 22.4% most often spoke English at home; and of the 71.6% that read newspapers, 53.7% read English language newspapers. They had resided in Canada between 2 and 51 years (mean = 21.0 years; SD = 10.8).

Those classified as ‘‘born in Canada’’ described their ethnic origin as including Canadian (44.3%), British (23.1%), Scottish (14.8%), Irish (8.9%), or other origins (8.9%); all completed the survey in English; 99.6% most often spoke English at home; and of the 88% that read newspapers, 87.8% read English language newspapers.

The fourth group, those neither Chinese nor South Asian, and who were born outside of Canada, described their ethnic origins as including Canadian (25.3%), British (20.4%), German (7.7%), Filipino (7.7%), other western European (25.8%), or other roots (13.1%); they were born in western Europe (51.6%), Eastern Europe (11.8%), the Philippines (8.1%), the United States of America (5.9%), South Africa (4.5%), or elsewhere (18.1%) including Africa, Asia, Australia, the Caribbean, the Middle East, New Zealand, and South America; all completed the survey in English; 78.3% most often spoke English at home; and of the 84.6% that read newspapers, 82.8% read English language newspapers. They had resided in Canada between 2 and 85 years (mean = 33.2; SD = 15.8).

One half of the participants reported incomes of more than \$60 000 annually and more than one half (65.5%) had attained greater than high school education. The 2001 census data for this population show that 27.5% of people have less than a high school education (compared with 9.5% in this sample) and that the median total household income is about \$50 000–\$59 999 per annum.

Only 5.3% of the respondents reported having had an AMI, but over 70% had either a relative or a close friend who had had an AMI (table 2). There was no significant difference between the number of men and women who had had an AMI or who had a family member or friend who had had an AMI; however, men were more likely than women to report that health professionals had discussed the signs and symptoms of AMI with them.

Table 3 shows the statistically significant gender specific bivariate relations between ethnic status and the other covariates. The male participants did not differ in terms of their age (p = 0.10), anxiety scores (p = 0.06), or whether they had had an AMI (p = 0.48) across the four ethnic groupings. There were significant ethnic differences in the men’s educational attainment, income, whether they lived alone, their vulnerability scores, whether an immediate family member or other relative had had an AMI, whether they had discussed the signs and symptoms of AMI with a health professional, their AMI knowledge score, and the version of the case scenario they were given. The female participants differed in age, education, income, whether they lived alone, vulnerability, whether an immediate family member or other relative had had an AMI, whether they had discussed the signs and symptoms of AMI with a health professional, and their AMI knowledge score, across the four ethnic groupings. There were no significant differences in the women’s versions of the case scenario (p = 0.81), anxiety scores (p = 0.32), or whether they had had an AMI (p = 0.62), across the ethnic groups.

Table 3 All explanatory variables by gender specific ethnic status

Characteristics	Born in Canada	Not born in Canada (not Chinese/South Asian)	South Asian (not born in Canada)	Chinese (not born in Canada)	Kruskal Wallis p value	χ^2 p value
Men (n = 426)						
Personal						
Education (n (%))						
<High school	19 (8.2)	8 (8.0)	12 (46.2)*	6 (9.0)		
High school	55 (23.6)	22 (22.0)	7 (26.9)	16 (23.9)		
College/diploma/certificate/incomplete university	85 (36.5)	33 (33.0)	2 (7.7)	14 (20.9)		
Baccalaureate or higher	74 (31.8)	37 (37.0)	5 (19.2)	31 (46.3)		<0.001
Total household income (n (%))						
\$0–\$19999	8 (3.8)	7 (8.0)	1 (9.1)*	10 (17.2)		
\$20000–\$39999	33 (15.6)	17 (19.3)	3 (27.3)*	11 (19.0)		
\$40000–\$59999	40 (18.9)	10 (11.4)	2 (18.2)*	17 (29.3)		
\$60000–\$79999	38 (17.9)	18 (20.5)	2 (18.2)*	6 (10.3)		
\$80000–\$99999	33 (15.6)	15 (17.0)	1 (9.1)*	5 (8.6)		
\$100000+	60 (28.3)	21 (23.9)	2 (18.2)*	9 (15.5)		0.03
Lives alone (n (%))	40 (17.1)	14 (14.0)	2 (7.7)*	1 (1.5)		<0.01
Vulnerability score (mean (SD))	7.8 (4.1)	8.5 (3.6)	9.7 (3.7)	10.0 (2.9)	<0.001	
Case scenario version (n (%))						
Male character	74 (31.6)	31 (31.0)	9 (34.6)	19 (28.4)		
Female character	78 (33.3)	22 (22.0)	2 (7.7)	23 (34.3)		
Gender indeterminate character	82 (35.0)	47 (47.0)	15 (57.7)	25 (37.3)		0.04
AMI						
Immediate family member with AMI (n (%))	114 (49.1)	37 (37.0)	9 (34.6)	9 (13.4)		<0.001
Another relative/close friend with AMI (n (%))	139 (59.7)	52 (52.0)	9 (34.6)	26 (40.0)		<.01
Discussed the signs and symptoms of AMI with health professional (n (%))	97 (41.5)	36 (36.0)	7 (26.9)	12 (17.9)		<0.01
AMI knowledge score (mean (SD))	7.2 (1.0)	6.5 (1.5)	4.5 (1.4)	5.3 (1.6)	<0.001	
Women (n = 549)						
Personal						
Age (mean (SD))	54.7 (11.4)	56.7 (11.6)	54.4 (10.1)	51.7 (9.1)	0.02	
Education (n (%))						
< High school	14 (4.6)	6 (5.0)	13 (32.5)*	14 (17.5)		
High school	74 (24.3)	29 (24.0)	13 (32.5)	27 (33.8)		
College/diploma/certificate/incomplete university	131 (43.1)	52 (43.0)	7 (17.5)	18 (22.5)		
Baccalaureate or higher	85 (28.0)	34 (28.1)	7 (17.5)	21 (26.3)		<0.001
Total household income (n (%))						
\$0–\$19999	22 (8.9)	14 (14.3)	4 (23.5)*	11 (18.0)		
\$20000–\$39999	41 (16.7)	21 (21.4)	2 (11.8)*	22 (36.1)		
\$40000–\$59999	55 (22.4)	26 (26.5)	5 (29.4)*	13 (21.3)		
\$60000–\$79999	36 (14.6)	12 (12.2)	1 (5.9)*	5 (8.2)		
\$80000–\$99999	31 (12.6)	13 (13.3)	2 (11.8)*	7 (11.5)		
\$100000+	61 (24.8)	12 (12.2)	3 (17.6)*	3 (4.9)		<0.01
Lives alone (n (%))	75 (24.7)	27 (22.3)	4 (9.8)	4 (4.9)		<0.001
Vulnerability score (mean (SD))	9.0 (3.9)	9.4 (3.8)	11.1 (3.2)	11.5 (3.7)	<0.001	
AMI						
Immediate family member with AMI (n (%))	154 (50.7)	54 (45.0)	18 (43.9)	25 (30.9)		0.02
Another relative/close friend with AMI (n (%))	185 (60.7)	58 (48.3)	17 (41.5)	33 (40.7)		<0.01
Discussed the signs and symptoms of AMI with health professional (n (%))	84 (27.5)	45 (37.5)	11 (26.8)	9 (11.1)		<0.01
AMI knowledge score (mean (SD))	7.2 (1.0)	6.4 (1.6)	4.3 (2.1)	5.5 (1.4)	<0.001	

*Caution: expected cell count less than 5.

Table 4 shows the bivariate relation between each of the covariates and the two outcome variables. After being presented with the first part of the case scenario, 762 (78.1%) participants indicated that the symptoms could be heart related. Without controlling for the other covariates, ethnicity, education, income, and the AMI knowledge score were all found to be significantly associated with the recognition of the symptoms. After being presented the full case scenario, 359 (36.8%) people responded that they would call 9-1-1. The mention of calling 9-1-1 was significantly associated with recognition of the symptoms as heart related, ethnicity, whether the respondent had an immediate family member who had had an AMI, whether they had talked with a health professional about the signs and symptoms of AMI, and the AMI knowledge score.

Table 5 provides the logistic regression model (with multiple imputation of values for missing data) for heart symptom recognition. All three methods of handling missing data showed that income and the AMI knowledge score were significant predictors of recognising the case scenario symptoms. For each one point increase in the knowledge score, respondents were 1.4 times more likely to recognise the symptoms as heart related. Respondents reporting total household incomes of \$80 000 to \$99 999 were 2.7 times more likely than the lowest income group to recognise the symptoms.

In the logistic regression model for mentioning 9-1-1 as a response to the scenario, heart symptom recognition and ethnicity were found to be significant (regardless of how missing data were handled) (table 6). The participants who recognised the symptoms were 2.9 times more likely to mention 9-1-1 than those who did not. Also, those born outside of Canada and neither Chinese nor South Asian were 1.4 times more likely to mention 9-1-1 than those born in Canada. Chinese participants were 45% less likely to mention 9-1-1 than those born in Canada. Participants who were

Table 4 Heart symptom recognition and calling 9-1-1 by personal characteristics and AMI experience

Variables	Recognised case scenario symptoms as heart related (n = 762)	Did not recognise case scenario symptoms as heart related (n = 214)	Mentioned calling 9-1-1 as a response to the symptoms (n = 359)	Did not mention calling 9-1-1 as a response to the symptoms (n = 617)
Recognised case scenario symptoms as heart related (n (%))			**316 (88.0)**	**446 (72.3)**
Case scenario version (n (%))				
Male character	274 (36.0)	68 (31.8)	133 (37.0)	209 (33.9)
Female character	228 (29.9)	68 (31.8)	105 (29.2)	191 (31.0)
Gender indeterminate character	260 (34.1)	78 (36.4)	121 (33.7)	217 (35.2)
Ethnicity (n (%))				
Born in Canada	**451 (59.2)**	**89 (41.6)**	**207 (57.7)**	**331 (54.0)**
Not born in Canada (not Chinese/South Asian)	**160 (21.0)**	**61 (28.5)**	**93 (25.9)**	**128 (20.7)**
South Asian (not born in Canada)	**42 (5.5)**	**25 (11.7)**	**30 (8.4)**	**37 (6.0)**
Chinese (not born in Canada)	**109 (14.3)**	**39 (18.2)**	**29 (8.1)**	**119 (19.3)**
Gender of respondent (n (%))				
Male	338 (44.4)	89 (41.6)	149 (41.5)	278 (45.1)
Female	424 (55.6)	125 (58.4)	210 (58.5)	339 (54.9)
Age (mean (SD))	55.1 (10.9)	55.2 (11.7)	54.6 (10.6)	55.4 (11.3)
Lives alone (n (%))	124 (16.3)	43 (20.1)	64 (17.8)	103 (16.7)
Education (n (%))				
< High school	**65 (8.6)**	**27 (12.7)**	26 (7.3)	66 (10.8)
High school complete	**179 (23.6)**	**64 (30.0)**	90 (25.1)	153 (25.0)
College/diploma/certificate/incomplete university	**271 (35.8)**	**71 (33.3)**	141 (39.4)	201 (32.8)
Baccalaureate or higher	**243 (32.1)**	**51 (23.9)**	101 (28.2)	193 (31.5)
Total household income (n (%))				
\$0–\$19999	**52 (8.4)**	**25 (14.5)**	19 (6.6)	58 (11.5)
\$20000–\$39999	**108 (17.5)**	**42 (24.2)**	51 (17.7)	99 (19.7)
\$40000–\$59999	**127 (20.6)**	**41 (23.7)**	62 (21.5)	106 (21.1)
\$60000–\$79999	**91 (14.7)**	**27 (15.6)**	46 (16.0)	72 (14.3)
\$80000–\$99999	**95 (15.4)**	**12 (6.9)**	48 (16.7)	59 (11.7)
\$100000+	**145 (23.5)**	**26 (15.0)**	62 (21.5)	109 (21.7)
Anxiety score (mean (SD))	13.3 (5.2)	13.9 (4.8)	13.4 (5.3)	13.4 (5.0)
Vulnerability score (mean (SD))	8.9 (3.9)	9.6 (4.1)	8.9 (3.9)	9.2 (4.0)
Had an AMI (n (%))	43 (5.7)	8 (3.8)	18 (5.1)	33 (5.4)
Immediate family member with AMI (n (%))	340 (44.9)	80 (37.6)	**173 (48.6)**	**247 (40.2)**
Another relative/close friend with AMI (n (%))	414 (54.6)	105 (49.3)	202 (56.4)	317 (51.7)
Discussed the signs and symptoms of AMI with health professional (n (%))	236 (31.1)	65 (30.4)	**127 (35.4)**	**174 (28.3)**
AMI knowledge score (mean (SD))	**6.8 (1.4)**	**6.0 (1.7)**	**6.8 (1.4)**	**6.5 (1.5)**

Bold results refer to significance of $p<0.05$.

South Asian were more than twice as likely to mention 9-1-1 compared with respondents born in Canada.

DISCUSSION

The findings of this study provide important insights into the lay public's capacity to recognise symptoms suggestive of AMI and their likelihood of activating emergency health services. Despite the fact that 71% of this urban sample reported that they, or a relative or close friend, had had an AMI, and 78% recognised the symptoms in the hypothetical case scenario, only 37% reported that 9-1-1 services should be engaged. We did not find gender differences in the respondents' capacity to identify the symptoms (whether the respondent was male or female or whether the affected person in the case scenario was male or female) or likelihood of recommending the enlistment of 9-1-1 services.

In Canada, there has been considerable effort made, especially by the Heart and Stroke Foundation, to educate the public about the risk of AMI, particularly in women, which may account for the lack of gender differences in this sample. None the less, men were 1.5 times more likely than women to report that they had discussed the signs and symptoms of AMI with a health professional. Although the general public has developed a better understanding of who is at risk for AMI, and the symptoms associated with it, health professionals seem to be slower to revise the outdated image of the AMI patient as an older man. Mosca *et al* found that fewer than one in five American physicians knew that women were at significant risk for cardiovascular disease mortality and that there were important gender disparities in the recommendations physicians provided for preventive care.[47]

Those with limited general knowledge of AMI were least able to distinguish AMI symptoms. Bivariate analyses showed that people who identified themselves as Chinese, had lower education, and had lower income tended to fail to recognise the symptoms. Multivariate analyses narrowed the predictors to income and AMI knowledge and suggested that ethnicity was significantly confounded by knowledge; that is, the Chinese respondents lacked general knowledge about AMI.

Least likely to recommend activating emergency health services were those who failed to recognise the symptoms, those who identified themselves as Chinese, had limited knowledge about AMI, did not have a relative who had had an AMI, and had never talked to a health professional about the signs and symptoms of AMI. These variables were found to confound one another such that the primary predictors of recommending 9-1-1 were: ethnic group and recognition of the symptoms. Those respondents who identified themselves as Chinese and South Asian were about half as likely and more than twice as likely, respectively, to recommend calling 9-1-1 compared with respondents who were born in Canada.

Some potential limitations of the study should be discussed. The participants' responses to the hypothetical scenario may not reflect what their actual behaviour would be in the event of symptoms of AMI. People often fail to act in accordance with their intentions.[48] The bias typically is in the direction of overstatement of one's intentions (for example, "I will call 9-1-1"); thus we may

Table 5 Logistic regression model of predictors of heart symptom recognition (n = 976)†

Variable	Category	Odds ratio (95% CI)
Case scenario version	Female character	1.00
	Male character	1.29 (0.86 to 1.91)
	Gender indeterminate character	1.02 (0.68 to 1.51)
Ethnicity	Born in Canada	1.00
	Not born in Canada (not Chinese/ South Asian)	0.68 (0.45 to 1.03)
	South Asian (not born in Canada)	0.88 (0.44 to 1.74)
	Chinese (not born in Canada)	1.11 (0.64 to 1.92)
Gender of respondent	Female	1.00
	Male	1.01 (0.72 to 1.43)
Age		1.01 (0.99 to 1.02)
Lives alone	No	1.00
	Yes	0.83 (0.52 to 1.33)
Education	<High school	1.00
	High school complete	0.77 (0.41 to 1.43)
	College/diploma/certificate/ incomplete university	0.84 (0.44 to 1.62)
	Baccalaureate or higher	1.11 (0.57 to 2.16)
Total household income	$0–$19999	1.00
	$20000–$39999	1.18 (0.55 to 2.54)
	$40000–$59999	1.27 (0.58 to 2.78)
	$60000–$79999	1.38 (0.56 to 3.40)
	$80000–$99999	2.72 (1.05 to 7.02)*
	$100000+	1.75 (0.72 to 4.28)
Anxiety score		0.99 (0.95 to 1.03)
Vulnerability score		1.01 (0.96 to 1.06)
Had an AMI	No	1.00
	Yes	1.46 (0.63 to 3.42)
Immediate family member with AMI	No	1.00
	Yes	1.17 (0.83 to 1.65)
Another relative/close friend with AMI	No	1.00
	Yes	1.01 (0.72 to 1.42)
Discussed the signs and symptoms of AMI with health professional	No	1.00
	Yes	0.92 (0.64 to 1.32)
AMI knowledge score		1.37 (1.21 to 1.56)*

†Multiple imputation of missing data. *$p<0.05$.

have overestimated the number that would actually execute this behaviour. Furthermore, although the response rate was typical for this type of survey we cannot be certain that those who did not respond were not different, in some important way, from those who did participate. This limitation is offset, however, by the expanded generalisability achieved through the administration of the survey in four languages. It also should be acknowledged that the study sample was somewhat biased in that it was better educated and slightly wealthier, on average, than the population from which it was drawn. The reported coefficients probably underestimate the role of socioeconomic status on peoples' ability to recognise the symptoms of AMI.

We were unable to evaluate the English language proficiency of the respondents despite several questions posed about everyday language use, including reading and listening to the news, language used in the home, and first language used. We found that many respondents who were proficient in English chose to conduct the survey in their first language (anecdotally they indicated that they preferred talking to someone ''like themselves''). Others reported listening to English language news but seemed to have difficulties with English comprehension on the telephone. Although the local community provides multilingual services, including television and radio programming, newspapers, and translation services to provide access to health information (9-1-1 services provide access to a 24 hour, 144 language translation service that is connected in less than one minute), language barriers probably explain some of the differences seen in the groups. There is research evidence that lack of fluency in Canada's official languages is a significant barrier to health promotion programmes and first contact with healthcare providers, and that it is language proficiency, rather than cultural beliefs, values, and practices, that may be the explanation.[49] Further research is required to explore the ethnic factors that may affect knowledge about various conditions and intentions to act when faced with potentially serious symptoms.

Chaturvedi *et al* noted that South Asian people in the United Kingdom had a greater likelihood of seeking immediate health services for AMI symptoms.[26] South Asian immigrants to North America have been noted to have 1.5 to 4.0 times higher coronary heart disease mortality rates than ''indigenous'' populations.[50] This is consistent with the high heart disease mortality rate and disability adjusted life years lost (DALYs) seen in India (1.46 and 20 per 1000 population, respectively).[51] In comparison, China has low prevalence of heart disease (mortality: 0.54 per 1000 and DALYs: 4 per 1000). (The Canadian rates are: mortality of 1.38 per 1000 and DALYs of 5 per 1000.) The heightened risk faced by members of the South Asian community may explain their greater likelihood of calling 9-1-1 in the event of symptoms. On the other hand, Chinese immigrants from Asia may lack awareness about the problems associated with heart disease. Daly *et al* pointed out that as Chinese immigrants to Australia are ''westernised'' their rate of heart disease may increase as they adopt different diets and lifestyles.[52] In 2000, Canadians of Chinese ethnicity were less likely to smoke tobacco, be overweight, and have hypertension and diabetes compared with the overall Canadian population. They were, however, more likely to be physically inactive and to consume less than the recommended daily amounts of fruit and vegetables.[53] There is a pressing need to educate the Chinese community about the risk factors associated with heart disease, the signs and symptoms of AMI, and the importance of timely medical contact. Indeed, in Beijing, China, where AMI is a major cause of death, treatment seeking delay is a noted concern.[54]

Table 6 Logistic regression model of predictors of calling 9-1-1 (n = 976)†

Variable	Category	Odds ratio (95% CI)
Recognise case scenario symptoms as heart related	No	1.00
	Yes	2.89 (1.96 to 4.26)*
Case scenario version	Female character	1.00
	Male character	1.17 (0.83 to 1.64)
	Gender indeterminate character	0.98 (0.69 to 1.38)
Ethnicity	Born in Canada	1.00
	Not born in Canada (not Chinese/ South Asian)	1.41 (1.00 to 2.00)*
	South Asian (not born in Canada)	2.22 (1.17 to 4.20)*
	Chinese (not born in Canada)	0.55 (0.33 to 0.91)*
Gender of respondent	Female	1.00
	Male	0.88 (0.66 to 1.18)
Age		0.99 (0.98 to 1.01)
Lives alone	No	1.00
	Yes	1.14 (0.76 to 1.70)
Education	<High school	1.00
	High school complete	1.40 (0.77 to 2.54)
	College/diploma/certificate/ incomplete university	1.50 (0.82–2.73)
	Baccalaureate or higher	1.13 (0.61 to 2.09)
Total household income	$0–$19999	1.00
	$20000–$39999	1.40 (0.70 to 2.82)
	$40000–$59999	1.49 (0.76 to 2.90)
	$60000–$79999	1.65 (0.83 to 3.27)
	$80000–$99999	1.86 (0.85 to 4.06)
	$100000+	1.35 (0.67 to 2.68)
Anxiety score		1.01 (0.98 to 1.04)
Vulnerability score		0.99 (0.95 to 1.03)
Had an AMI	No	1.00
	Yes	0.82 (0.45 to 1.56)
Immediate family member with AMI	No	1.00
	Yes	1.25 (0.94 to 1.66)
Another relative/close friend with AMI	No	1.00
	Yes	1.09 (0.82 to 1.45)
Discussed the signs and symptoms of AMI with health professional	No	1.00
	Yes	1.29 (0.95 to 1.74)
AMI knowledge score		1.02 (0.90 to 1.15)

†Multiple imputation of missing data. *p<0.05.

What this paper adds

- Few gains have been made that reduce acute myocardial patients' delay before obtaining medical help. Many factors, including symptom characteristics, sociodemographics, health status, and patient behaviour, have been associated with treatment seeking delay, but the research findings are contradictory.
- Despite the fact that most of this sample knew someone who experienced AMI, and recognised the symptoms of AMI, only 37% recommended that emergency services should be engaged. There were no gender differences in the ability to identify AMI symptoms or the likelihood of commending emergency services. Factors associated with the likelihood of recognising AMI symptoms included ethnicity, education, and income. Factors associated with commending emergency services, in the event of AMI symptoms, were recognition of the symptoms, ethnicity, knowledge about AMI, having a relative with AMI, and having talked to a health professional about AMI symptoms. Directing tailored health education campaigns about AMI to lower socioeconomic groups and targeted ethnic groups may be beneficial. Educational efforts are also required to promote primary care professionals' cardiovascular disease prevention practices.

There is a risk associated with attributing particular characteristics to ethno-cultural groups that are heterogeneous in nature (for example, multiple religions, languages, extent of enculturation, socioeconomics). Descriptions of healthcare practices of particular ethno-cultural groups can be used to "essentialise" or stereotype behaviours in ways that ignore individuality and diversity.[55] None the less, coronary heart disease is unequally distributed in the Canadian population including those in the lower

Policy implications

Many questions about why ethnic differences occur remain unanswered. Possible explanations are that ethnic groups have different perceptions about their AMI risk or have different propensities to access services, possibly because of cultural values (for example, preference for self care, stoicism, or independence), historical experiences (for example, limited or inadequate health care in country of birth), and system barriers (for example, limited translation services, perceived discriminatory practices). Directing targeted health education campaigns about AMI, through such means as media campaigns, to lower socioeconomic groups and the Chinese community may be beneficial. Educational efforts are also required to promote health professionals' preventive care practices, particularly for women and visible minority groups.

socioeconomic strata and particular ethno-cultural groups at highest risk.[56] It has been suggested that factors such as social exclusion contribute to this increased risk; being outside of the "mainstream" culturally and linguistically may place people with particular ethno-cultural backgrounds at a double disadvantage in relation to the added risk of limited opportunity to acquire knowledge about, and to access appropriate courses of action in response to, symptoms of AMI.[57 58]

Possible explanations about why ethnic differences occur are that ethnic groups have different perceptions about their AMI risk or have different propensities to access services, possibly because of cultural values (for example, preference for self care, stoicism, or independence), historical experiences (for example, limited or inadequate health care in country of birth), and system barriers (for example, limited translation services, perceived discriminatory practices). Directing health education campaigns about AMI, through such means as media campaigns, to lower socioeconomic groups and the Chinese community may be beneficial. In addition, as suggested elsewhere,[59] specific tailoring of educational programmes for ethnic groups may be required, particularly for those who do not speak the official languages. Educational efforts are also required to promote health professionals' preventive care practices, particularly for women and visible minority groups.

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