Awareness of Warning Symptoms of Heart Disease and Stroke: Results of a Follow-up Study of the Chinese Canadian Cardiovascular Health Project

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Abstract

Background

Our original pilot study in 2008 demonstrated a poor degree of awareness of heart disease and stroke among Chinese Canadians, warranting an updated survey of their knowledge. We sought to determine the current degree of

knowledge of cardiovascular disease, including stroke, among ethnic Chinese residents of Canada.

Methods

A 35-question online survey was conducted in the fall of 2017 among 1001 Chinese Canadians (aged ≥ 18 years) in the greater Toronto area (n = 501) and Vancouver (n = 500). Knowledge of heart disease and stroke, such as signs and symptoms of stroke and heart attack, health habits, and initial response to a cardiovascular emergency were assessed.

Results

A total of 52.0% of the respondents were female, and 46.3% were aged <45 years. A total of 40.1% spoke Cantonese, and 23.7% spoke Mandarin; 79.5% were immigrants, and 31% had lived in Canada < 10 years. A total of 85% identified at least one heart attack symptom, and 80% identified at least one stroke symptom; 86.2% indicated that they would call 911 if experiencing a heart attack or stroke. Internet use was positively associated with the ability to identify a greater number of heart attack and stroke symptoms, compared to the number among non–Internet users ($P < 0.001$). Women were 14% more likely to overlook gender as a risk factor for cardiovascular disease (CVD).

Conclusions

This study found that in 2017, compared to 2008, awareness of symptoms of heart disease and stroke improved among Chinese Canadians residing in Toronto and Vancouver.

Résumé

Contexte

Dans le cadre d'une première étude pilote menée en 2008, nous avions montré que les Canadiens d'origine chinoise connaissaient si mal les maladies cœur et l'accident vasculaire cérébral (AVC) qu'une enquête de suivi de leurs connaissances s'imposait. Nous avons donc entrepris d'évaluer les connaissances actuelles des maladies cardiovasculaires, y compris l'AVC, chez les résidents canadiens d'origine chinoise.

Méthodologie

Un sondage en ligne comprenant 35 questions a été effectué à l'automne 2017 auprès de 1 001 Canadiens d'origine chinoise (âgés de 18 ans ou plus) de la région du Grand Toronto (n = 501) et de Vancouver (n = 500). Les connaissances relatives aux maladies cœur et à l'AVC,

notamment les signes et symptômes d'AVC et de crise cardiaque, les saines habitudes de vie et la première chose à faire en cas d'urgence cardiovasculaire, ont été évaluées.

Résultats

Au total, 52,0 % des répondants étaient des femmes, et 46,3 % étaient âgés de moins de 45 ans; 40,1 % parlaient cantonnais et 23,7 %, mandarin; 79,5 % étaient des immigrants, et 31 % vivaient au Canada depuis moins de 10 ans. Au total, 85 % des répondants connaissaient au moins un symptôme de crise cardiaque et 80 %, au moins un symptôme d'AVC; 86,2 % ont indiqué qu'ils composeraient le 9-1-1 s'ils subissaient une crise cardiaque ou un AVC. Les répondants qui utilisaient l'Internet étaient capables de reconnaître un plus grand nombre de symptômes de crise cardiaque et d'AVC que les répondants qui n'utilisaient pas l'Internet ($p < 0,001$). Les femmes avaient 14 % plus de chances de ne pas tenir compte du sexe comme facteur de risque de maladie cardiovasculaire.

Conclusions

L'étude a révélé qu'en 2017, comparativement à 2008, la connaissance des symptômes de maladie cœur et d'AVC s'est améliorée chez les Canadiens d'origine chinoise vivant à Toronto et à Vancouver.

The ethnic Chinese population in Canada has increased dramatically in recent decades, rising from 486,300 in 2006, around the time of our pilot study, to 1.59 million in 2016, around the time of the current study, accounting for 20.55% of the visible minorities (Chinese, Asians, Blacks, South Asians, etc) in Canada.[1] In spite of their significant presence, ethnic Chinese have been poorly represented in studies among Canadians assessing their general medical knowledge, let alone their knowledge of heart attacks and strokes.

Although ethnic Chinese have the lowest prevalence of heart attacks and stroke among ethnic groups, Chinese Canadians, compared with Caucasian ethnicity, carries a higher risk of type 2 diabetes and is associated with physical inactivity, both of which are risk factors strongly associated with development of CVD, including stroke.[1] Thus, given that ethnic Chinese need to prevent and manage their risk factors of type 2 diabetes and physical inactivity, determining their awareness of cardiovascular and stroke risk factors is important.

Furthermore, the demographics within Canada's ethnic Chinese population has shifted toward greater numbers of immigrants from mainland China, with a total of 85% from mainland China vs 6.3% from Hong Kong in 2011. This change coincides with the 90% decline since 1997 in the proportion of Hong Kong immigrants residing in Canada—from 23,975 to 2443.

Based on the 2008 pilot study, we previously concluded that Chinese Canadians had a poor level of awareness of the signs and symptoms of heart attacks and strokes. The purpose of the current study is to obtain an update on the status of their awareness, given the many changes that have occurred within the Chinese Canadian community over the intervening decade. This 2017 study and the 2008 pilot study both contribute to the collective effort known as the Chinese Canadian Cardiovascular Health Project, which is conducted by researchers and clinicians of the Chinese Canadian Heart and Brain Association (CCHABA).

Methods

Study population

The Apex Research Company was recruited to carry out the survey, and they sourced the study's 1001 participants from an online market research study panel of ethnic Canadians, named the Ethnic Voice Accord, which manages its lists of members by curating them for marketing research. This study's source of respondents differs from that used in the 2008 pilot study, in which a sampling company randomly selected telephone number listings from Toronto and Vancouver that matched Cantonese and Mandarin surnames.

The cohort size of 1001 was selected because it was similar that of the 2008 pilot study of 1004. Panelists whose profile information, such as age, gender, and ethnicity, matched the study's selection criteria were sent standard recruitment materials asking if they wanted to participate in the study. Selection criteria consisted of the following: being aged ≥ 18 years and having Chinese parents or grandparents. These criteria were the same as those used in the 2008 pilot study to define "ethnic Chinese." In order to eliminate potential bias from knowledge associated with medical-related occupations not reflective of the general populous, the criteria excluded panelists employed by a hospital or clinic, health care institution, pharmaceutical company, or a market research firm. In addition, panelists who had household members employed in these work settings were excluded. During the induction process for becoming a panelist, respondents agreed to the Canadian Ethnic Online Panel's voluntary consent agreement and its terms and conditions.

The online survey was conducted in the language chosen by the respondents, of either English, traditional Chinese, or simplified Chinese, to accommodate immigrants from mainland China. Traditional Chinese is used mainly in Hong Kong and Taiwan, whereas simplified Chinese is used mainly in mainland China (People's Republic of China). Respondents were informed that all responses would be kept confidential and that the investigators were studying

lifestyle, health knowledge, and cardiovascular health issues among Chinese Canadians. We obtained research approval from the Veritas institutional review board for this study.

Questionnaire

A 35-question online survey was created for use in the present study, provided in the English (see Supplemental Appendix S1), traditional Chinese, or simplified Chinese. It consisted of 3 sections of dichotomous, multiple-choice, rank order, and open-ended questions. The first section screened the respondents based on their citizenship status and ethnic background. Respondents were then asked to indicate their spoken language and citizenship status. The second section queried each respondent's knowledge of factors and symptoms associated with heart attack and stroke. The warning symptoms for heart attack and stroke were obtained from the website and brochures of the Heart and Stroke Foundation of Canada and the American Heart Association.[7] Respondents were tested on their ability to recognize and appreciate risk factors and symptoms of heart attack and stroke by ranking them on a scale of "strongly agree" to "strongly disagree," by agreeing or disagreeing with statements, and by indicating the type and duration of exercise they participate in. The third section inquired about the respondents' demographics, such as their gender, age, education and employment status, and

the social media sites they used frequently to obtain health information.

Statistical analysis

IBM SPSS (version 25) was used for statistical analysis. Ordinal variables were reported as median and interquartile ranges, whereas count variables (n) were reported as percentages. Nonparametric Mann-Whitney *U* tests were used to compare differences between 2 groups; Kruskal-Wallis tests were used for 3 groups. The nonparametric Spearman rho or the Kendall tau-b correlation coefficient was used to assess relationships between ordinal variables. Statistical significance was set at $P < 0.05$.

To determine the independent association between subjects' demographics and knowledge, a multivariable logistic regression analysis was conducted with these predictor variables: age group, years lived in Canada, main language spoken at home, and education level.

Respondents were defined as being "knowledgeable" if they provided more than 3 correct myocardial infarction symptoms and more than 3 correct stroke symptoms, and chose to call 911 in response to occurrence of a myocardial infarction or stroke.

Results

Demographics

The online survey was conducted in the fall of 2017, among 1001 ethnic Chinese (aged ≥ 18 years) in the greater Toronto area (n = 501) and Vancouver (n = 500). A total of 52% of respondents were women; 46.3% of respondents were aged < 45 years. A majority of 79.5% were immigrants, of which 35.6% were born in mainland China, 29.8% in Hong Kong, and 20.5% in Canada. A total of 69.3% of the respondents attained a university degree or a higher level of education; with 65% reporting an annual household income > $50,000 and only 7.8% with an income < $25,000. A total of 5.4% of respondents had a history of coronary artery disease, and 7.4% had a history of stroke. A comprehensive summary of the respondents' demographics is listed in Table 1.

Table 1Demographics of participants in current 2017 study and pilot 2008 study

⁎ 2017 study n = 1001); 2008 study n = 1004.

† Remainder percentages correspond to respondents who have opted not to disclose their income.

‡ These 2008 metrics were included, since they are incompatible with those of the current 2017 study.

Knowledge of heart disease and stroke

Figure 1 shows Chinese Canadians' awareness of individual

risk factors of coronary artery disease (n = 1001). In addition, 56.7% of men and 42.9% of women were able to identify gender as a risk factor for coronary artery disease ($P < 0.001$; with the "don't know" category merged with "incorrect" category).

Figure 1Knowledge of the risk factors for coronary artery disease (n = 1001).

Figure 2 shows perceived level of risk from Chinese ethnicity for CVD, including stroke-related diseases, relative to that of the general Canadian population (n = 1001).

Figure 2Chinese ethnicity as a risk factor for development of cardiovascular diseases including stroke (n = 1001).

Figure 3 shows Chinese Canadians' awareness of individual symptoms of heart attack (n = 1001).

Figure 3Knowledge of heart attack symptoms (n = 1001).

Figure 4 shows Chinese Canadians' awareness of individual symptoms of stroke (n = 1001).

Figure 4Knowledge of stroke symptoms (n = 1001).

Figure 5 shows Chinese Canadians' knowledge of heart disease and stroke facts, which was tested by their ability to identify statements as being true or false (n = 1001).

Figure 5Statements about coronary artery disease and stroke (n = 1001).

The vast majority of respondents knew to call 911 (86.2%) when a CVD event occurs.

Factors influencing knowledge of heart

attack and stroke symptoms

The number of correct heart attack symptoms provided by the respondents was positively correlated with the number of correct stroke symptoms provided (Kendall tau-b correlation coefficient 0.646, $P < 0.001$).

Internet use, as defined by the choice of the Internet as a health information resource, was positively associated with a greater number of correct heart attack symptoms (Q) (median = 4; Q1 = 3; Q3 = 5) than that provided by non–Internet users (median = 2; Q1 = 1; Q3 = 3; $P < 0.001$). Likewise, Internet use was positively associated with a greater number of correct stroke symptoms (median = 4; Q1 = 3; Q3 = 5) than that provided by non–Internet users (median = 2; Q1 = 1; Q3 = 3; $P < 0.001$).

Speaking Mandarin was positively associated with a greater number of correct heart attack symptoms (median = 4; Q1 = 3; Q3 = 5) than that provided by Cantonese speakers (median = 3; Q1 = 2; Q3 = 5; $P < 0.001$). However, Mandarin speakers provided a similar number of correct stroke symptoms (median = 4; Q1 = 3; Q3 = 5) compared with Cantonese speakers (median = 4; Q1 = 3; Q3 = 5).

Overall, 280 of the respondents were classified as "knowledgeable". In multivariable analysis, respondents' age group ($P = 0.001$), how long they had been living in Canada ($P = 0.001$), language spoken at home ($P = 0.011$), and education level ($P = 0.001$) were independently associated

with knowledge.

Health habits

A total of 62% of the respondents exercised regularly, defined as exercising for at least 20 minutes at least 3 times per week. Most exercise sessions lasted 20 to 30 minutes (46.9%) or 30 minutes to 1 hour (39.5%). The most popular exercise activity was “walking” (79.1%). The most common reason for not exercising regularly was being “busy” (29.7%) or “lazy” (24.7%). A total of 14.0% of the respondents reported being current smokers; of those that did not report current smoking, 1.1% of them had smoked in the past. Approximately half of the current smokers had smoked for 1–5 years.

The most popular sources of health information were “doctors” (75.5%) and the “Internet” (64.4%). The next most used source of health information was “friends/family/relatives” (47.0%). “Facebook” (66.6%; the most widely used social media site), “YouTube” (54.8%), Google+ (16.1%), Instagram (10.2%), and Twitter (9.7%).

Discussion

The current study shows that ethnic Chinese in Canada had an overall good level of awareness of heart attack and stroke symptoms, despite a remaining lack of knowledge of

the highly prevalent risk factors among those of Chinese ethnicity of type 2 diabetes and physical inactivity.

Knowledge of cardiovascular disease and stroke

Gender was predominantly overlooked as a risk factor for CVD, more often by women. Our study found that a 57.1% majority of women either strongly or somewhat disagreed that gender is a risk factor for CVD, whereas a 43.3% minority of men disagreed. This finding suggests that there is a female-specific underestimation of gender's relationship with CVD, possibly due to the notion that CVD is mainly a male disease. Men are as much as 2.5 times more likely to have a myocardial infarction, hence their higher level of awareness. Nevertheless, this notion is misleading because it overemphasizes the effect of gender on CVD prevalence, while ignoring the effect of gender on CVD mortality. Female gender is associated with higher CVD mortality compared with male gender, due to differences such as young women being more likely than men to develop major bleeding complications during hospitalization, postmenopausal women underproducing cardioprotective sex hormones such as estrogen, and women delaying longer than men before seeking medical care. The combination of these female-specific characteristics contributes to the fact that women aged 20–

39 years with ischemic heart disease are 18 times more likely to die of any cause than those without ischemic heart disease, whereas the comparative statistic for men is 11 times, and that women aged 40–54 years with heart failure are 27 times more likely to die of any cause than those of the same age without heart failure, whereas the comparative statistic for men is 16 times. Thus, this finding reveals the specific need to elaborate on gender as a risk factor for CVD, with emphasis on inclusion of female gender as a factor for higher risk of CVD mortality.

With regard to knowledge of heart attack symptoms, participants were more likely to identify localized symptoms, as opposed to nonlocalized symptoms. With the exception of pain radiating down the arms, a majority of participants were unable to identify nonlocalized symptoms such as upset stomach/nausea (20%), pain in the neck/jaw/back/throat (31%), and sweating/clammy skin (42.5%). These findings were also noted in a study conducted in Hong Kong, in which stomachache and neck pain were also some of the most poorly identified heart attack symptoms. These nonspecific symptoms are of particular benefit to be aware of, as they often are present in episodes of silent heart attacks. Therefore, Chinese Canadians will benefit from increased awareness of these nonlocalized symptoms, as this can allow for earlier diagnosis of myocardial damage and thereby help in early disease intervention.

The least-identified stroke symptom was sudden severe

headache (43%), a hallmark symptom of subarachnoid hemorrhage, a result consistent with other studies.[1] A possible reason for the underidentification is the multiple etiologies of headaches, with the commonest type being migraines. Unfortunately, the confusion about headache etiology has led to the misdiagnosis of a staggering 1 in 20 subarachnoid hemorrhage patients at their first assessment in the emergency department. Thus, it is imperative for Chinese Canadians, as well as the general Canadian population, to be aware of the symptoms of subarachnoid hemorrhage, to increase the likelihood of its timely diagnosis and treatment.

Mandarin speakers had an overall greater level of awareness of heart attack symptoms than did Cantonese speakers and an approximately similar level of awareness of stroke symptoms. This finding indicates that while it will be most beneficial to provide more educational material in Mandarin or simplified Chinese, due to increasing numbers of immigrants from mainland China, it is still necessary to provide material that addresses the deficit in awareness of heart attack symptoms in the Cantonese-speaking population.

The statistically significant correlation between knowledge of heart attack and knowledge of stroke suggests that education regarding both heart attack and stroke should be pursued simultaneously. This need is highlighted by the close pathophysiological relationship between the 2—heart

attack is often a risk factor for stroke.
The number of years lived in Canada and both the number of correct heart attack and stroke symptoms identified (0.210 and 0.225 Kendall tau-b correlation coefficients at $P < 0.001$, respectively) had significant positive correlations, which suggests that Chinese Canadians gain greater awareness of heart attacks and strokes the longer they live in Canada. Thus, this finding indicates the need to increase the accessibility of heart attack and stroke education material tailored to Chinese immigrants, given their overall deficit in awareness.

Comparison with the 2008 pilot study

An indirect comparison of the current 2017 study with our original 2008 pilot study suggests improvements in heart attack and stroke knowledge within the Chinese Canadian population (Table 2). Firstly, the most dramatic improvement was in their response that they would call 911 in the case of a heart attack or stroke, which increased 63.2% from 2008 (23.0%) to 2017 (86.2%). Additionally, the current participants were engaged more in regular exercise, defined as exercising at least 20 minutes at least 3 times per week, than those of the 2008 study, with a 14.1% increase from 2008 (48.0%) to 2017 (62.1%). However, the different methodologies used complicate a direct comparison between the 2 studies. The telephone survey of 2008

consisted of open-ended questions, whereas the 2017 online survey consisted of multiple-choice questions.

Table 2Responses from current 2017 study and pilot 2008 study

⁎ 2017 study n = 1001; 2008 study n = 1004.

† Expressed as a number of symptoms (*P* < 0.001).

‡ Defined as exercising at least 20 minutes for at least 3 times per week.

The higher level of physical activity of the participants in the current study, compared with that in the 2008 study, may be attributable to the rise in household income of Chinese Canadians. In the 2008 study, 26% of participants had an annual household income < $37,000, whereas only 2% had an income > $112,000, adjusted for inflation. These levels contrast starkly with those in the current 2017 study, in which only 7.8% of participants had an annual household income < $25,000, and 20.6% had an income > $100,000. As indicated by the Pan-Canadian Health Inequalities Data Tool and other Canadian socioeconomic studies, leisure-time physical activity is positively correlated with household income.[,] This finding suggests that the current Chinese Canadian population was able to increase their heart attack and stroke-preventative behaviors as a result of their increased economic freedom.

Health habits

A majority of the participants wrongly believed that exercising 2–3 times per week is directly associated with a lower risk of heart disease and stroke (70%), regardless of factors such as the type and duration of exercise. An effective exercise routine is one that addresses all 3 factors: type, frequency, and duration of exercise.[1] The recommended type of exercise is aerobic, specifically because it improves lipid profiles by increasing high-density lipoprotein levels and has been shown to improve systolic function. Equally, if not more, important is that the specific type of exercise match an individual's desired level of enjoyment and convenience, in order to ensure compliance to an exercise regimen over time. The recommended frequency of exercise is actually 3–5 sessions per week, which should be further increased for those with obesity, dyslipidemia, or poor glucose tolerance. In fact, 2–3 exercise sessions per week is when most coronary artery disease patients begin demonstrating improvements in functional capacity, such as reduced symptoms and decreased heart rate for a given workload. Desirable duration of exercise is slightly more complicated, as it depends on the type of exercise. The general recommended duration of continuous or intermittent aerobic exercise is 20–60 minutes.

Many participants indicated that "walking" was their main form of exercise, which was also found by Dogra et al. to be the preferred type of exercise among older immigrants of

East-Asian descent. The implication is that there should be increased education, targeting in particular the exercise habits of recent immigrants of ethnic Chinese background, with emphasis placed on types of exercise.

Sources for health-related information

The Internet (64%) was one of the most frequently used sources for health information, second only to doctors (76%). In fact, they were the only 2 sources used by more than half of the participants. This finding is consistent with the Statistics Canada report that 70% of Canadians "go online to search for medical information." A comparison revealed that Internet use was positively correlated with greater awareness of myocardial infarction and stroke symptoms, with higher median numbers of correct symptoms than those identified by non–Internet users. Facebook, excluding the WhatsApp owned by Facebook, was the most popular source for health information (67%) among Chinese Canadians. This finding is consistent with the higher level of increased Internet usage by Canadians, with Facebook being the most commonly used social media site. The implication from these findings is that serious consideration should be given to future dissemination of cardiovascular awareness campaigns on social media sites.

Awareness of Chinese ethnicity as a risk

factor

The participants largely believed that those of Chinese ethnicity have a higher risk of developing cardiovascular-related conditions, which has been shown to be incorrect. In fact, compared to Caucasians, ethnic Chinese have a lower prevalence of major risk factors for CVD, such as smoking and obesity. Although there is no harm in taking preventative health measures for CVD conditions that ethnic Chinese have a lower risk of developing, their higher risk of developing diabetes should not be underestimated. Our study indicates that only a quarter of the participants believed that ethnic Chinese have a higher risk of developing diabetes (26%), which was also the CVD risk factor least likely to be identified by Hong Kong residents. This finding has very serious negative implications, especially given that type 2 diabetes patients have a "two-to- fourfold [greater] propensity to develop CVD"; thus, a disregard for prevention of diabetes could significantly outweigh the potential benefit conferred by Chinese ethnicity of low risk for hypertension and hypercholesterolemia.

The participants' poor awareness may be due to a lack of ethnicity-directed CVD research and education in Canada. With regard to education at a population-based level, it has been shown that in-depth CVD education can be effectively introduced to those as young as middle-school children—

Toepperwein et al. demonstrated that integration of National Heart, Lung, and Blood Institute research findings into curriculum coincides with education levels.[7] Programs such as the targeted earlier intervention curriculum may therefore be an effective way to introduce CVD-specific knowledge, such as the ethnicity risk factor, to newer generations of Chinese Canadians.

An important point to note is that the overall prevalence of CVD, including stroke among ethnic Chinese, is still lower than that among Caucasians. As discussed in several population studies, this fact may be attributable to the "healthy immigrant effect"—most ethnic Chinese Canadians were found to be healthier than the general Canadian population. Moreover, some studies have shown that the prevalence of diabetes among Chinese Canadians has increased rapidly with longer duration of stay in Canada. In fact, a recent publication by Lam & Chu found that the prevalence of type 2 diabetes was higher in Chinese Canadian adults with ischemic stroke. What this all may suggest is that over time, as ethnic Chinese Canadians live longer in Canada, the prevalence of CVD, including stroke, in this population may become more similar to that in the non-Chinese population, due to acculturation to the Canadian lifestyle. Additionally, diabetes may play a larger role in the development of stroke for ethnic Chinese, as it might for other ethnic groups as well. Thus, further studies should be conducted to determine exactly how diabetes

interacts with environmental factors in the pathogenesis of CVD, including stroke, among Chinese Canadians.

Comparison of knowledge of symptoms of heart attack and stroke with non-Chinese

For heart attack symptoms, the REACT (**R**apid **E**arly **A**ction for **C**oronary **T**reatment) trial, a population survey in the United States, identified 1294 adult respondents in 20 communities and found that 89.7% were able to identify chest pain or discomfort as a symptom of a heart attack, which is very similar to our current finding of 86.8%. Shortness of breath was noted by 50.8% in that study, and in our study, it was noted by 67.8% of participants. Knowledge of arm pain or numbness was found in 67.3% of participants, and in our current study among 57.1%. Their median number of correct heart attack symptoms identified was 3, which is very similar to the mean number of 3.27 in our study. In their multivariable-adjusted model, significantly higher mean numbers of correct symptoms were provided by non-Hispanic whites than by other racial or ethnic groups, younger persons, those with higher socioeconomic status, and those who had previous experience with heart attack. These findings are also very similar to our multivariate analysis indicating that age, length of stay in Canada, educational status, and prior experience with heart attack are important parameters that increase knowledge of

symptoms of heart attack.
For stroke symptoms, the website of the Heart and Stroke Foundation of Canada (www.strokebestpractices.ca) quoted a Norwegian stroke population study conducted in 2014 that found among 287 patients admitted to the hospital with suspected stroke or transient ischemic attack, 43.2% were able to name at least one stroke risk factor, 13.9% could identify 2 factors, and only 1.7% knew 3 factors. A total of 70.7% of patients knew at least one stroke symptom, and 66.6% identified numbness or weakness of the face, arm, or leg; 45.6% identified confusion or trouble speaking or understanding speech, and 42.9% were able to identify both symptoms. In our current study, the respective proportions were 79.7% for weakness or numbness and 78.3% for confusion or impaired speech. The mean number of stroke symptoms identified was 3.07. It should be noted that our study is a general population survey of Chinese Canadians, whereas the Norwegian study is a survey among a stroke population admitted to hospitals and thus contains inherent selection bias.

Limitations

Several limitations warrant further discussion. One limitation is that the questions were formatted as multiple choice, which would increase the number of correct responses due to chance alone. The study needed to have this format

because of the difficulty of interpreting and processing open-ended answers.

Another limitation is that the results of this study may be applicable for only Chinese Canadians who are Internet literate and have access to the Internet; it does not account for those who do not use the Internet. Although this limitation can be addressed by offering the survey in alternative formats, such as on paper or by telephone, those traditional formats are becoming less relevant due to increasing levels of Internet accessibility in Canada.

Further, the demographics of the study cannot be absolutely representative of those of the general Chinese Canadian population, due to the inherent biases in cohort selection by online research companies, which favor those with better-than-average education levels and socioeconomic status. Although a striking 69% of this study's cohort reported having a university degree, this percentage is consisten with the 59% of children of Chinese immigrants in Canada that have university degrees, as found in a previous study.

Lastly, the studies used as a comparison with non-Chinese populations were limited to those conducted in the United States, as no similar non-Chinese studies have been conducted in Canada within the past decade.

Conclusion

This study is the first of its kind to examine the effects of changing Chinese Canadian demographics on knowledge within this population of heart disease and stroke. In addition, this study is one of a few recent publications that focus on health-related behaviors of Chinese Canadians. These data suggest that current ethnic Chinese in Canada have a good level of knowledge of the symptoms of heart attack and stroke, yet are still largely unaware of the effects of nonmodifiable risk factors, such as ethnicity and gender. Our findings have important implications regarding the need to develop future health promotion initiatives that focus on ethnicity as a risk factor for heart attack and stroke. In addition, appropriate cardiovascular health information can be further disseminated via social media.

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References

1. Central Intelligence Agency
   Central Intelligence Agency, Langley, Canada2017
2. Government of Canada
   Statistics Canada. Census Profile, 2016 Census Canada [Country] and Canada [Country] [Internet]. Census Profile, 2016 Census - Canada [Country] and Canada [Country].
   (Available at:)
   https://www12.statcan.gc.ca
   (Accessed April 12, 2021)
3. Chiu M.
   Austin P.
   Manuel D.
   Tu J.

Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007.
Can Med Assoc J. 2010; **182**: e301-e310

4. Lee J.W.R.
Brancati F.L.
Yeh H.-C.
Trends in the prevalence of type 2 diabetes in Asians versus Whites.
Diab Care. 2011; **34**: 353-357

5. Statistics Canada. Immigration and Ethnocultural Diversity in Canada. 2016. Available at: url=www12.statcan.gc.ca. Accessed April 21, 2021.

6. Zhang K. (2014). Flows of People and the Canada-China Relationship in the 21st Century. Migration in China and Asia International Perspectives on Migration, 25–50. Acailable at: www.idrc.ca. Accessed April 12, 2021.

7. Chow C.-M.
Chu J.Y.
Tu J.V.
Moe G.W.
Lack of awareness of heart disease and stroke

among Chinese Canadians: results of a pilot study of the Chinese Canadian Cardiovascular Health Project.
Can J Cardiol. 2008; **24**: 623-628

8. Heart and Stroke Foundation of Canada
Heart disease/signs of a heart attack.
(Available at:)
www.heartandstroke.ca/heart/emergency-signs
(Accessed April 12, 2021)

9. American Heart Association
Warning Signs of a Heart Attack.
(Available at:)
https://www.heart.org/en/health-topics/heart-attack/warning-signs-of-a-heart-attack
(Accessed April 12, 2021)

10. Government of Canada
Report from the Canadian Chronic Disease Surveillance System: Heart Disease in Canada, 2018.
(Available at:)
https://www.canada.ca/en/public-health/services/publications/diseases-conditions/report-heart-disease-Canada-2018.html
(Accessed April 12, 2021)

11.

Norris C.
Yip C.
Nerenberg K.
et al.
State of the science in women's cardiovascular disease: a Canadian perspective on the influence of sex and gender.
J Am Heart Assoc. 2020; **9**e015634

12.

Chau P.H.
Moe G.
Lee S.Y.
Woo J.
et al.
Low level of knowledge of heart attack symptoms and inappropriate anticipated treatment-seeking behaviour among older Chinese: a cross-sectional survey.
J Epidemiol Commun Health. 2018; **72**: 645-652

13.

Qureshi W.T.
Zhang Z.-M.
Chang P.P.
et al.
Silent myocardial infarction and long-term risk of heart failure.

J Am Coll Cardiol. 2018; **71**: 1-8

14.

Faiz K.W.
Sundseth A.
Thommessen B.
Rønning O.M.
Patient knowledge on stroke risk factors, symptoms and treatment options.
Vasc Health Risk Manag. 2018; **14**: 37-40

15.

Patel A.
Fang J.
Gillespie C.
et al.
Awareness of stroke signs and symptoms and calling 9-1-1 among US adults: National Health Interview Survey, 2009 and 2014.
Prev Chron Dis. 2019; **16**: 180564

16.

Vermeulen M.J.
Schull M.J.
Missed diagnosis of subarachnoid hemorrhage in the emergency department.
Stroke. 2007; **38**: 1216-1221

17.

Government of Canada
Health inequalities data tool.

(Available at:)
https://health-infobase.canada.ca/health-inequalities/data-tool/
(Accessed April 12, 2021)

18. Kari J.T.
Pehkonen J.
Hirvensalo M.
et al.
Income and physical activity among adults: evidence from self-reported and pedometer-based physical activity measurements.
Plos One. 2015; **10**e0135651

19. Rhodes R.E.
Janssen I.
Bredin S.S.
Warburton D.E.
Bauman A.
Physical activity: health impact, prevalence, correlates and interventions.
Psychol Health. 2017; **32**: 942-975

20. Canadian Society for Exercise Physiology
Canadian Physical Activity Guidelines. Canadian Society for Exercise Physiology, Ottawa, Canada2019

21.

Yang Y.J.
An overview of current physical activity recommendations in primary care.
Kor J Fam Med. 2019; **40**: 135-142

22.
Patel H.
Alkhawam H.
Madanieh R.
et al.
Aerobic vs anaerobic exercise training effects on the cardiovascular system.
World J Cardiol. 2017; **9**: 134-138

23.
Brubaker P.H.
Ross J.H.
Joo K.C.
Contemporary Approaches to Prescribing Exercise in Coronary Artery Disease Patients.
American Journal of Lifestyle Medicine. 2016; **12**: 130-139

24.
Dogra S.
Meisner B.A.
Ardern C.I.
Variation in mode of physical activity by ethnicity and time since immigration: a cross-sectional analysis.

Int J Behav Nutr Phys Activ. 2010; **7**: 75

25. Tonasker T.
Bartlett G.
Trpkov C.
Health information on the Internet.
Can Fam Physician. 2014; **60**: 407-408

26. Canadian Internet Registration Authority (CIRA). 2019 Canada's Internet Factbook. 2019. CIRA, Vancouver, Canada.

27. Leigh J.A.
Alvarez M.
Rodriguez C.J.
Ethnic minorities and coronary heart disease: an update and future directions.
Curr Atheroscler Rep. 2016; **18**: 9

28. Lee V.W.Y.
Fong F.Y.H.
Cheng F.W.T.
Yan B.P.Y.
Life's simple 7 and cardiovascular disease risk knowledge in Hong Kong.
BMC Cardiovasc Disord. 2019; **19**: 185

29.

Rosa S.D.
Arcidiacono B.
Chiefari E.
et al.
Type 2 diabetes mellitus and cardiovascular disease: genetic and epigenetic links.
Front Endocrinol. 2018; **9**: 2

30.

Toepperwein M.A.
Pruski L.A.
Blalock C.L.
Lemelle O.R.
Lichtenstein M.J.
Getting the word out: teaching middle-school children about cardiovascular disease.
J Clin Lipidol. 2008; **2**: 179-188

31.

Tu J.V.
Chu A.
Rezai M.R.
et al.
Incidence of major cardiovascular events in immigrants to Ontario, Canada.
Circulation. 2015; **132**: 1549-1559

32.

Lam S.

Chu J.Y.
Epidemiology of cerebrovascular diseases among Chinese Canadian adults with type 2 diabetes.
Can J Diabetes. 2018; **42**: 94-99

33.
Goff D.C.
for the REACT Trial
Knowledge of heart attack symptoms in a population survey in the United States.
Arch Intern Med. 1998; **158**: 2329-2338

34.
Sundseth A.
Faiz K.W.
Rønning O.M.
Thommessen B.
Factors related to knowledge of stroke symptoms and risk factors in a Norwegian stroke population.
J Stroke Cerebrovasc Dis. 2014; **23**: 1849-1855

35. Hoogendoorn AW, Daalmans J. Nonresponse in the recruitment of an Internet panel based on probability sampling. Survey Res Meth2009;3:59-72.

36.
Abada T.
Hou F.
Ram B.

Ethnic differences in educational attainment among the children of Canadian immigrants.
Can J Sociol. 2008; **34**

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