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RACIAL DISPARITIES IN KNOWLEDGE OF STROKE AND HEART ATTACK RISK FACTORS AND WARNING SIGNS AMONG MICHIGAN ADULTS

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Objective: To describe the level of knowledge regarding risk factors and warning signs for stroke and heart attack among White and African American adults in Michigan and to quantify racial disparities.

Methods: Knowledge of stroke and heart attack risk factors and warning signs was assessed by using data from the 2004 Michigan Behavioral Risk Factor Survey. Prevalence estimates of knowledge were generated, and statistical differences in knowledge between Whites and African Americans were assessed. Adequate knowledge was defined as knowing 3 correct warning signs or risk factors. Logistic regression models were used to quantify the racial disparity in knowledge while controlling for potential confounding.

Results: Whites had substantially higher levels of adequate knowledge of risk factors (stroke: 31.6% vs 13.8%; heart attack: 52.6% vs 24.3%) and warning signs (stroke: 30.0% vs 17.2%; heart attack: 29.3% vs 13.8%) compared with African Americans (all observed differences were significant at $P < .05$). The odds of adequate knowledge of risk factors (stroke: adjusted odds ratio [AOR] 2.9; heart attack: AOR 3.4) and warning signs (stroke: AOR 2.0; heart attack: AOR 2.4) were significantly higher for Whites than for African Americans.

Conclusion: A strong racial disparity in the knowledge of stroke and heart attack risk factors and warning signs exists among Michigan adults. Communitywide public education programs in conjunction with targeted interventions for at-risk populations are necessary to produce meaningful improvements in the awareness of stroke and heart attack risk factors and warning signs among Michigan adults. (*Ethn Dis*. 2009;19:128–134)

Key Words: Stroke, Heart Attack, Risk Factors, Warning Signs, Awareness, Race, Disparity

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INTRODUCTION

Heart disease and stroke are the first and third leading causes of death, respectively, in both Michigan and the United States.[1,2] As a result of the high disease prevalence and the contribution of modifiable risk factors, increasing public awareness of stroke and heart attack risk factors and warning signs is a public health priority.[3,4] Furthermore, addressing racial and ethnic disparities in knowledge of stroke and heart attack risk has become an emerging priority.[5,6] During the past 10 years, several researchers have investigated the knowledge of stroke and heart attack risk factors and warning signs in adult populations.[7-17] The results of these studies indicate that public awareness of stroke and heart attack risk factors and warning signs is inadequate.

Only a few studies have investigated racial disparities in the knowledge of stroke and heart attack risk factors and warning signs, and all of them have concluded that knowledge was lower among African Americans than among other racial groups.[8,9,11-12] The aim of our study was to use the most recent data available in Michigan to describe the knowledge level of stroke and heart attack risk factors and warning signs and to quantify any racial disparities in knowledge, while accounting for other demographic variables.

METHODS

Data Source

The Behavioral Risk Factor Surveillance System (BRFSS) is composed of annual, state-level, random-digit-dialed telephone surveys of adults conducted in cooperation with the Centers for Disease Control and Prevention.[18] The purpose of this surveillance system is to provide population-level estimates of health behaviors, as well as knowledge and awareness of risk factors and disease.

Four open-ended questions on knowledge of stroke and heart attack risk factors and warning signs were added to the 2004 Michigan Behavioral Risk Factor Survey (MiBRFS). Up to 3 responses per question were recorded. Respondents were first asked, "Please remember that a stroke and a heart attack are different. A heart attack affects the blood vessels supplying the heart, while a stroke affects the blood vessels supplying the brain. From anything you may have heard or read, what do you think are the 3 most important risk factors for stroke, that is, things that make it more likely that someone will have a stroke?" Respondents were then asked, "From anything you might have read or heard, what do you think are the 3 most important signs of a stroke?"

The aim of our study was to use the most recent data available in Michigan to describe the knowledge level of stroke and heart attack risk factors and warning signs…

Using a similar question structure, respondents were then asked for the 3 most important risk factors and warning signs for heart attack. Responses were coded as correct, incorrect, or neither based on a previously developed criteria.[14] Correct risk factor responses were further coded as modifiable or nonmodifiable.

For both stroke and heart attack, correct risk factor responses included hypertension, smoking, diet, overweight, physical inactivity, high cholesterol, cardiovascular disease, diabetes, heredity, age, race, and sex.[19-22] Stress was categorized as incorrect, and alcohol consumption was classified as neither correct nor incorrect because moderate drinking was not differentiated from overconsumption.

For stroke, correct warning signs were defined according to the 5 standard definitions used by the American Stroke Association: sudden numbness or weakness; sudden confusion or trouble speaking or understanding speech; sudden trouble seeing; sudden trouble walking, dizziness, or loss of balance; and sudden severe headache.[23] Loss of consciousness was classified as neither correct nor incorrect. For heart attack, pain or discomfort in the chest, pain or discomfort in other areas of the upper body, shortness of breath, nausea, lightheadedness, and sweating were considered correct warning signs.[24] Fainting and increased or irregular heartbeat were considered neither correct nor incorrect.

Statistical Analysis

All statistical analyses were performed by using SUDAAN version 8.0 (RTI International, Research Triangle Park, NC) to account for the complex survey design. Data were weighted to account for the probability of selection and poststratified to the Michigan adult population by age, race, and sex. Prevalence estimates and 95% confidence intervals (CIs) were generated by racial group (Whites and African Americans) for all outcomes of interest, which included individual risk factors and warning signs, number of correct responses, and the prevalence of adequate knowledge (defined as reporting 3 correct risk factors or warning signs). The prevalence of adequate knowledge was also examined by age, sex, education, and household income. To assess differences between the 2 racial groups, absolute differences in prevalence estimates were calculated, and χ^2 tests were used to assess significant differences ($P < .05$). Four multivariate logistic regressions were generated; adequate knowledge was the dependent variable, race was the independent variable, and age, sex, education, and household income were included as potential confounding variables.

RESULTS

A total of 4790 MiBRFS respondents were asked the questions regarding stroke and heart attack risk factors and warning signs. The response rate for the 2004 MiBRFS was 48.4%.[25]

Risk Factors

The individual stroke risk factor with the highest level of reported knowledge (as measured by response frequency) among both Whites and African Americans was hypertension at 33.2% and 33.7%, respectively (Table 1). The reported risk factor with the next highest prevalence was smoking among Whites and diet among African Americans. For heart attack, Whites most frequently reported overweight/obesity as a risk factor (42.0%), while African Americans most frequently reported diet (42.8%). The next most frequently reported heart attack risk factor was smoking for Whites and physical inactivity for African Americans. Most stroke and heart attack risk factors were reported more frequently by Whites than African Americans. Smoking had the largest racial disparity in reporting for both stroke (absolute difference 18.5%) and heart attack (absolute difference 19.7%) (Table 1). African Americans more frequently reported diet as a risk factor for both stroke and heart attack than did Whites. On the other hand, Whites reported overweight/obesity as a risk factor more often than did African Americans. In addition, stress, an incorrect risk factor response, was reported more frequently by African Americans than by Whites.

The distributions of the number of correct risk factors for both stroke and heart attack differed significantly by race (Figure 1). For both stroke and heart attack, a higher proportion of African Americans reported no correct risk factors compared with Whites (stroke: 28.7% vs 19.8%; heart attack: 19.9% vs 7.3%), and a lower proportion reported 3 correct risk factors compared with Whites (stroke: 13.8% vs 31.6%; heart attack: 24.3% vs 52.6%).

Warning Signs

Table 2 indicates that the most frequently reported warning sign of stroke for both Whites and African Americans was any weakness or numbness. Two warning signs—confusion or trouble speaking or understanding speech and trouble seeing—were reported significantly more often by Whites than by African Americans.

The most frequently reported warning sign for heart attack by both Whites and African Americans was pain or discomfort in the chest (Table 3). Although most participants in both groups reported this warning sign,

Table 1. Knowledge of individual stroke and heart attack risk factors by race, 2004 Michigan Behavioral Risk Factor Surveillance System

	Stroke*			Heart Attack†		
	Whites % (95% CI)	African Americans % (95% CI)	Difference (χ^2 P value)	Whites % (95% CI)	African Americans % (95% CI)	Difference (χ^2 P value)
Correct responses: (modifiable)						
Hypertension	33.2 (31.6-34.8)	33.7 (28.6-39.1)	-.5 (.85)	22.8 (21.3-24.3)	22.8 (18.3-28.2)	0 (.98)
Smoking	29.5 (27.9-31.1)	11.0 (7.9-15.0)	+18.5 (<.01)‡	38.2 (36.5-40.0)	18.5 (14.6-23.3)	+19.7 (<.01)‡
Diet	25.9 (24.3-27.5)	33.1 (27.8-38.9)	-7.2 (.02)‡	36.6 (34.8-38.3)	42.8 (37.2-48.6)	-6.2 (.04)‡
Overweight	20.9 (19.6-22.3)	11.8 (8.7-15.7)	+9.1 (<.01)‡	42.0 (40.3-43.7)	22.8 (18.4-27.7)	+19.2 (<.01)‡
Physical inactivity	19.1 (17.7-20.5)	14.9 (11.2-19.6)	+4.2 (.06)	32.5 (30.8-34.2)	25.2 (20.4-30.7)	+7.3 (.01)‡
High cholesterol	14.0 (12.8-15.3)	8.0 (5.4-11.7)	+6.0 (<.01)‡	27.0 (25.5-28.6)	13.5 (10.2-17.6)	+13.5 (<.01)‡
CVD	7.3 (6.4-8.2)	4.6 (2.7-7.6)	+2.7 (.04)‡	3.6 (3.0-4.3)	6.3 (4.1-9.6)	-2.7 (.06)
Diabetes	3.3 (2.8-3.9)	3.7 (2.2-6.1)	-.4 (.68)	2.3 (1.9-2.9)	2.5 (1.3-4.9)	-.2 (.86)
Correct responses: (nonmodifiable)						
Heredity	14.0 (12.9-15.3)	6.0 (3.7-9.6)	+8.0 (<.01)‡	21.2 (19.8-22.7)	9.3 (6.3-13.5)	+11.9 (<.01)‡
Age	5.4 (4.6-6.3)	1.8 (.7-4.6)	+3.6 (<.01)‡	2.1 (1.6-2.7)	1.4 (0.5-3.7)	+.7 (.35)
Race	.1 (0-.2)	.5 (.1-2.2)	-.4 (.27)	0 (0-.1)	.1 (0-.9)	-.1 (.51)
Sex	.2 (.1-.5)	0	+.2 (.02)‡	.5 (.3-.8)	0	+.5 (<.01)‡
Incorrect responses						
Stress	17.5 (16.2-18.9)	33.6 (28.3-39.3)	-16.1 (<.01)‡	18.2 (16.9-19.6)	25.3 (20.5-30.7)	-7.1 (.01)‡
Miscellaneous	10.8 (9.7-12.1)	13.2 (9.8-17.7)	-2.4 (.25)	9.8 (8.8-10.9)	16.1 (12.3-20.8)	-6.3 (<.01)‡
Neither						
Alcohol	5.4 (4.7-6.3)	5.9 (3.8-9.1)	-.5 (.71)	5.5 (4.7-6.4)	5.5 (3.6-8.5)	0 (.99)

CI = confidence interval, CVD = cardiovascular disease.

* Responses to ''From anything you may have heard or read, what do you think are the 3 most important risk factors for stroke, that is, things that make it more likely that someone will have a stroke?'' Up to 3 responses were recorded.

† Responses to ''From anything you may have heard or read, what do you think are the 3 most important risk factors for a heart attack, that is, things that make it more likely that someone will have a heart attack?'' Up to 3 responses were recorded.

‡ Significant at $P<.05$.

Whites reported it more frequently than did African Americans. In addition, more Whites reported that pain or discomfort in other areas of the upper body was with a warning sign than did African Americans.

The distributions of number of correct warning signs for both stroke and heart attack significantly differed by race (Figure 1). A higher proportion of African Americans were unable to report any correct warning signs (stroke: 25.8% vs 15.7%; heart attack: 17.9% vs. 6.6%) and a lower proportion of African Americans reported three correct warning signs compared to Whites (stroke: 17.2% vs 30.0%; heart attack: 13.8% vs 29.3%).

Adequate Knowledge of Risk Factors and Warning Signs

Comparisons of unadjusted estimates of adequate knowledge (defined as reporting 3 correct responses) of stroke and heart attack risk factors and warning signs showed that adequate knowledge was higher among middle-aged adults, those living in households with incomes ≥$50,000, and those with higher levels of education (all $P < .001$). Adequate knowledge of both stroke and heart attack warning signs were higher among women than men (stroke: $P < .001$; heart attack: $P = .001$), but adequate knowledge of risk factors was similar by sex (stroke: $P = .20$; heart attack: $P = .41$).

Results from four multivariate logistic regressions, with adequate knowledge as the dependent variable, demonstrated that even after accounting for age, sex, education, and household income, race remained a significant predictor of adequate knowledge. The adjusted odds ratios (AOR) for adequate risk factor knowledge were ≈3 times higher for Whites than for African Americans (stroke: AOR 2.9 [95% CI 2.0-4.2]; heart attack: AOR 3.4 [95% CI 2.5-4.6]), and at least twice as high for adequate warning sign knowledge (stroke: AOR 2.0 [95% CI 1.4-2.9]; heart attack: AOR 2.4 [95% CI 1.7-3.4]). Analyses were replicated for respondents from the Detroit metropolitan statistical area (an area in which different racial groups have similar access to certified stroke centers), and similar odds of adequate knowledge were found (stroke risk factors: AOR 2.81 [95% CI 1.78-4.44]; stroke warning signs: AOR 2.14 [95% CI 1.35-3.78]; heart attack risk factors: AOR 3.42 [95% CI 2.33-5.00]; heart attack warning signs: AOR 2.44 [95% CI 1.59-3.73]). Further analysis also indicated that the Hispanic population in Michigan reported lower levels of adequate knowledge when compared to Whites, especially for stroke

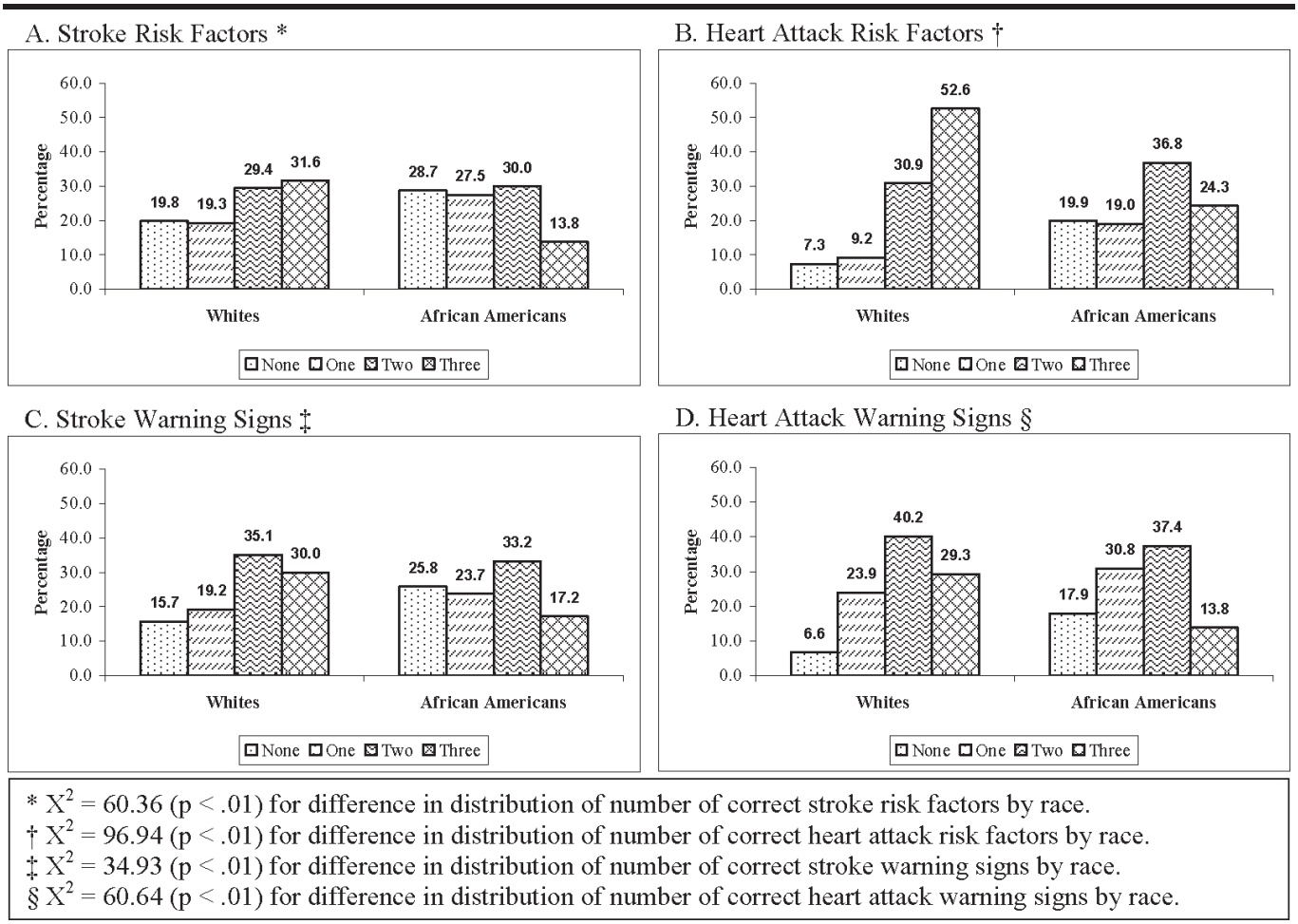

Fig 1. Based on data from the 2004 Michigan BRFS, percent distributions of the number of correct responses for stroke risk factors (A), heart attack risk factors (B), stroke warning signs (C), and heart attack warning signs (D) stratified by race

Table 2. Knowledge of individual stroke warning signs* by race, 2004 Michigan Behavioral Risk Factor Surveillance System

Warning signs	Whites % (95% CI)	African Americans % (95% CI)	Absolute % Difference (χ^2 p-value)
Correct responses			
Any weakness or numbness	66.6 (64.9-68.3)	63.1 (57.5-68.4)	+3.5 (.24)
Confusion or trouble speaking or understanding speech	50.0 (48.2-51.8)	32.5 (27.2-38.1)	+17.5 (<.01)†
Trouble seeing	24.7 (23.2-26.2)	16.7 (12.9-21.5)	+8.0 (<.01)†
Trouble walking, dizziness, or loss of balance	15.6 (14.4-17.0)	13.6 (9.9-18.3)	+2.0 (.36)
Severe headache	10.3 (9.3-11.4)	9.0 (6.4-12.4)	+1.3 (.39)
Incorrect responses			
Shortness of breath	3.8 (3.1-4.6)	7.1 (4.5-11.1)	-3.3 (.05)
Pain in chest or arm	4.5 (3.8-5.3)	3.8 (2.3-6.2)	+.7 (.51)
Miscellaneous	13.8 (12.6-15.1)	19.2 (15.1-24.0)	-5.4 (.02)†
Neither			
Loss of consciousness	8.4 (7.4-9.4)	5.1 (3.1-8.1)	+3.3 (.01)†

CI = confidence interval.
* Responses to ''From anything you may have heard or read, what do you think are the 3 most important signs or symptoms of a stroke?'' Up to 3 responses were recorded.
† Significant at $P<.05$.

Table 3. Knowledge of individual heart attack warning signs* by race, 2004 Michigan Behavioral Risk Factor Surveillance System

Warning signs	Whites % (95% CI)	African Americans % (95% CI)	Absolute % Difference (χ^2 P value)
Correct responses			
Pain or discomfort in the chest	79.9 (78.4-81.3)	66.6 (60.9-71.8)	+13.3 (<.01)†
Pain or discomfort in other areas of the upper body	42.7 (40.9-44.4)	18.3 (14.5-22.9)	+24.4 (<.01)†
Shortness of breath	39.9 (38.2-41.7)	35.6 (30.3-41.4)	+4.3 (.15)
Other signs, eg, nausea, lightheadedness, sweating	23.8 (22.3-25.3)	21.6 (17.2-26.7)	+2.2 (.39)
Incorrect responses			
Numbness	25.7 (24.2-27.3)	24.2 (19.6-29.5)	+1.5 (.56)
Pain, unspecified	8.8 (7.8-9.9)	10.9 (7.8-15.2)	-2.1 (.28)
Miscellaneous	8.8 (7.8-9.9)	10.6 (7.7-14.4)	-1.8 (.32)
Neither, such as fainting or increased/irregular heart beat	6.9 (6.1-7.8)	7.8 (5.1-11.6)	-.9 (.61)

CI = confidence interval.

* Responses to ''From anything you may have heard or read, what do you think are the 3 most important signs or symptoms of a heart attack?'' Up to 3 responses were recorded.

† Significant at $P<.05$.

and heart attack warning signs (stroke warning signs: AOR .63 [95% CI .34-1.15]; heart attack warning signs: AOR .60 [95% CI .34-1.08]).

DISCUSSION

The results of this study indicate that adults in Michigan have a relatively low knowledge of the risk factors for both stroke and heart attack, and African Americans report a substantially lower number of correct risk factors than do Whites. The results also indicate a lack of knowledge of stroke and heart attack warning signs for all Michigan adults. Large racial disparities exist in the knowledge of 2 of the 5 stroke warning signs (ie, confusion or trouble speaking or understanding speech and trouble seeing) and 2 of the 4 heart attack warning signs (ie, pain or discomfort in the chest and pain or discomfort in other areas of the upper body). After accounting for the effects of age, sex, education level, and household income, race remained a significant predictor of adequate knowledge for stroke and heart attack risk factors and warning signs among Michigan adults. In each of the 4 models (stroke risk factors, heart attack risk factors, stroke warning signs, and heart attack warning signs), the odds of adequate knowledge were 2-3 times higher for Whites than for African Americans. Additional analyses found similar odds of adequate knowledge in the Detroit metropolitan statistical area and also indicated that Michigan's Hispanic population reported lower levels of adequate knowledge when compared with Whites: a finding that was also reported among veterans at the national level.[15]

Our findings are based on data from open-ended questions, a method that we believe provides a better measure of actionable knowledge. In general, closed-ended questions result in higher levels of reported knowledge of individual warning signs and risk factors. For example, in a previous study, 90.2% of Whites and 80.8% of African Americans reported being aware of ''confusion or trouble speaking or understanding speech'' as a stroke warning sign when a closed-ended question was used, while only 50.0% of Whites and 32.5% of African Americans reported this warning sign in our study.[9] A similar situation exists with heart attack warning signs. For example, a previous study found that 89.1% of Whites and 73.0% of African Americans reported being aware of ''pain or discomfort in other areas of the upper body'' as a heart attack warning sign when a closed-ended question was used, while only 42.7% of Whites and 18.3% of African Americans reported this warning sign in our study.[12]

In this study we defined adequate knowledge by using a composite measure that required correct responses for each of 3 response opportunities. When comparing composite measures of adequate knowledge across question types, the differences in reported knowledge were less pronounced. For example, adequate knowledge of heart attack warning signs using a 5-component indicator was reported for 34.3% of Whites and 18.8% of African Americans,[12] which is comparable with the 29.3% of Whites and 13.8% of African Americans who were classified as having adequate knowledge in our study. Three previous studies also found race to be a significant predictor of adequate knowledge through the use of multivariate logistic regression models (in each study Whites were twice as likely to report adequate knowledge compared with African Americans).[7,10,16] This result was confirmed in our study. Overall, the racial disparity in knowledge was persistent regardless of question structure.

Michigan, like elsewhere in the United States, is in great need of sustained stroke and heart attack public health education programs that focus on increasing the knowledge of the entire

[In Michigan], large racial disparities exist in the knowledge of 2 of the 5 stroke warning signs and 2 of the 4 heart attack warning signs.

population and providing additional assistance to certain high-risk groups. This lack of knowledge may mean that people with poor knowledge do not take the preventive measures necessary for proper risk factor control or seek treatment in a timely manner because of poor warning sign recognition. Several different approaches could be implemented to increase knowledge of stroke and heart attack risk factors and warning signs, as well as decrease the racial disparity in this knowledge. To improve public awareness of stroke and heart attack risk factors and warning signs, a multifaceted approach consisting of community-oriented education initiatives (eg faith-based programs), professional conferences focusing on patient education, quality improvement efforts in hospitals, and continuous mass-media advertising (print, radio, and television) should be implemented.[7,13,26-28] In addition, education efforts focusing on high-risk groups could also be used in attempts to increase stroke and heart attack knowledge through programs specifically tailored to these groups.[29,30] Although increasing the general public's knowledge of stroke and heart attack risk factors and warning signs and decreasing the racial disparity in this knowledge are initial steps, increases in stroke and heart attack knowledge as a result of community-based education do not necessarily lead to reductions in prehospital delay.[4]

The results of this study could provide a platform for the development of more targeted educational messages. For example, this study indicates that some of the largest racial disparities in knowledge of stroke and heart attack risk factors exist within the smoking, high cholesterol, and stress risk factor categories. In addition to providing the public with general risk factor information, public education programs may be improved by placing further emphasis on the areas of greatest need. This approach would hold true for warning sign education efforts as well. For instance, this study indicates that the main warning signs for both stroke (eg, any weakness or numbness) and heart attack (eg, pain or discomfort in the chest) are reported at high levels, so in addition to developing educational programs around all warning signs, it would be beneficial to focus further educational efforts on those warning signs about which awareness is low and disparity is high. In addition, educational messages on stroke and heart attack risk factors and warning signs must be culturally competent, thus increasing their effectiveness in minority groups at highest risk of stroke and heart attack.[7,13,26-28]

A strength of this study is that it uses a large, representative, population-based sample. This study also gains strength through the use of an open-ended question structure. The limitations of this study include those commonly associated with telephone surveys, which include possible noncoverage bias (exclusion of people who live in cell phone-only households and those who do not live in private residences) and nonresponse bias (eg, BRFSS responses rates are normally ≈50%).[18] Although these sources of error have the potential to affect our estimates, it is unlikely that they have significantly affected our conclusions because the questions used in this study are not questions that tend to exhibit noncoverage bias and because the magnitude of the disparities found was large.[31]

In summary, this study emphasizes the need for further improvements in awareness of stroke and heart attack risk factors and warning signs among Michigan adults, especially among African Americans. Communitywide public education programs in conjunction with targeted education efforts that focus on at-risk populations (eg, African Americans and Hispanics) are necessary to produce meaningful improvements in the awareness of stroke and heart attack risk factors and warning signs among Michigan adults.

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