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Five-year Trend in Awareness of Heart Attack and Stroke:

An Analysis of 2005 and 2009 Behavioral Risk Factor Surveillance Survey Data

INTRODUCTION

Heart attack (also called acute myocardial infarction, AMI) and stroke are the leading causes of death in both men and women in the United Statesⁱ. Among U.S. adults ≥ 18 years of age, about 600,000 Americans die from heart disease and more than 133,000 Americans die from stroke every yearⁱ. Because of the high incidence and prevalence of heart attack and stroke, these two diseases in total cost the United States more than \$100 billion each year and stroke alone costs an estimated \$38.6 billionⁱⁱ.

Seeking prompt help after early symptom onset is important to receive prompt medical care and improve outcomes^{iii,iv}. Many studies have demonstrated the correlation between delayed patient presentation in hospital and the lack of knowledge about symptoms and signs for heart attack and stroke. It is critical to have optimal recognition and timely management of heart attack and stroke for the reduction of patient delay in seeking acute medical care.

Similar to men, heart disease is the leading cause of death in women in the United States and stroke ranks 3rd among all the causes of death in women. However, there are substantial gender differences in incidence, prevalence, symptoms, subtypes, severity and case-fatality of heart disease and stroke. For example, although both heart attack and stroke are more common in men, women have more severe outcomes and higher case-fatality^{v,vi}. The presence of chest pain/ discomfort is the most commonly recognized symptom of heart attack, however, women are more likely than men to present without chest pain and have some atypical symptoms (e.g. pain in jaw, neck and back). Although, the overall mortality rates for coronary heart disease have declined steadily since 1968^{vii}, recent statistics among young women show that CHD mortality rates have been increasing on average of 1.3% per year between 1997 and 2002^{viii}. Uncertainty still remains in the level of awareness of early warning symptoms among women. All these evidence underscores the importance to target women for educational campaigns to increase knowledge about symptoms for heart disease and stroke. Especially for young women, it is important to use national campaigns to increase awareness of heart attack

and stroke symptoms because of their higher mortality risk and atypical symptom profile compared to men at the same age^{v,vi,viii}.

Ongoing national public awareness campaigns, including AHA's Go Red For Women, NHLBI's Heart Truth, and the U.S. Department of Health and Human Services Office on Women's Health's Make the Call, Don't Miss a Beat, are all aimed at increasing awareness about heart disease and heart attack symptoms in all women. In 2004, American Heart Association (AHA) published first evidence-based guidelines for preventing CVD in women. In the same year, *The Red Dress*, which is a centerpiece of *The Heart Truth* and a red alert reminding women to take action to protect their heart health, became the national symbol of heart disease in women. Both initiatives aimed to raise awareness in women population and to reduce gender disparities. It is important to evaluate the effect of these campaigns by assessing the public knowledge short after or around the time many of these campaigns were being introduced. So in this study, we analyzed 2005 to 2009 data from the Behavioral Risk Factor Surveillance System (BRFSS) to assess the potential influence of these initiatives on women before the establishment of an HHS coordinating committee on women's health in 2010. Our primary objective was to study the effect of national campaigns on public awareness of heart attack and stroke in nationally representative, non-institutionalized samples over time. If there was a great increase from 2005 to 2009, the secondary objective was to describe the patterns by age and sex subgroups.

MATERIALS AND METHODS

Data Source

We used data from Behavioral Risk Factor Surveillance System (BRFSS) 2005 and 2009. The plan and operations of BRFSS has been described in detail elsewhere^{ix}. Briefly, the BRFSS is a cross-sectional, population-based, random-digit-dialed telephone survey of the noninstitutionalized U.S. population aged ≥ 18 years old. BRFSS is conducted by the Centers for Disease Control and Prevention (CDC) to collect data on health-risk behaviors and use of preventive health services related to the leading causes of death and disability in the United States. With the use of sampling weights, annual survey presents statistics that are representative for all 50 states, DC, Puerto Rico, the U.S. Virgin Islands, 145 selected metropolitan statistical areas (MMSAs), and 234 corresponding counties.

Study Sample

BRFSS offers an optional heart attack and stroke module, with questions about recognitions and response to typical and atypical warning signs and symptoms. In 2005, 14 states conducted this optional module and in 2009, 19 states conducted this module. In this study, we limited our analyses to states that completed the heart attack and stroke module in both 2005 and 2009. Based on this inclusion criterion, we identified 9 states (Alabama, Florida, Louisiana, Minnesota, Mississippi, Missouri, Montana, Virginia, West Virginia) and the DC district that completed the heart attack and stroke module in both 2005 and 2009 (Figure 1). We further excluded 6,474 participants who missed at least one question among all 13 questions in heart attack and stroke module. This resulted in a final sample of 109,164 BRFSS participants (42,281 in 2005 and 66,883 in 2009) for analysis.

Measurements

The BRFSS heart attack and stroke module included 13 questions to assess knowledge of early warning signs and symptoms of heart attack and stroke. Of these 13 questions, 6 were on knowledge of heart attack, 6 were on knowledge of stroke, and 1 question asked about the first aid choice to either heart attack or stroke early warning signs and symptoms (i.e. If you thought someone was having a heart attack or a stroke, what is the first thing you would do?).

Respondents were asked if the following were warning signs of a heart attack: pain or discomfort in the jaw, neck, or back; feeling weak, lightheaded, or faint; chest pain or discomfort; pain or discomfort in the arms or shoulders; shortness of breath. An incorrect sign of heart attack (i.e., sudden trouble seeing in one or both eyes) was included to examine the possibility that respondents would answer “yes” for all the symptoms. Similarly, respondents were asked if the following were warning signs of stroke: sudden confusion or trouble speaking; sudden numbness or weakness of face, arm, or leg, especially on one side; sudden trouble seeing in one or both eyes; sudden trouble walking, dizziness, or loss of balance; or sudden, severe headache with no known cause. An incorrect sign of stroke (i.e., chest pain or discomfort) was also included to examine the possibility that respondents would answer “yes” for all the symptoms.

The primary study outcomes were the correct identification of all 5 correct heart attack warning symptoms and correct identification of all 5 correct stroke warning symptoms. The two incorrect signs were reverse-coded and incorporated into two additional overall indicators. These two additional indicators represented the proportion of correct identification of all 6 heart attack warning symptoms and the proportion of correct identification of all 6 stroke warning symptoms. We also examined the 12 heart attack and stroke questions separately: respondents were identified as “aware” of each of the 6 heart attack and 6 stroke symptoms if they answered correctly to the question about that symptom. Another study outcome was the percentage of being aware to call 911 as the first thing to do when seeing someone having heart attack or stroke.

The total 9 states and DC district included in this study all conducted the core demographics modules. Data from these modules included demographic characteristics, medical history and well-recognized risk factors for heart attack and stroke. Demographic data included patient age (continuous and categorical 18-34, 35-54, 55-64, 65+), sex, race/ ethnicity (non-Hispanic White, non-Hispanic Black, or other), education (< 12 years, high school graduate or G.E.D, or at least some college or above), marital status (binary, single, or not single), household income (less than \$25,000, \$25,000 to less than \$50,000, \$50,000 or more, or missing), and health insurance status (with health insurance coverage or without health insurance coverage). Medical history included whether the patient had a history of angina/ coronary heart disease, cardiovascular heart attack and stroke. Well-recognized risk factors included data about whether a patient had diabetes, hypertension, or high cholesterol, BMI (<18.5 underweight, 18.5-24.9 normal weight, 25.0-29.9 overweight, or 30.0 and above obese), smoking status (current smoker, former smoker, or nonsmoker), alcohol consumption (heavy drinker, moderate drinker, or nondrinker), and physical activity (insufficient physical activity, sufficient physical activity, or no physical activity). We also calculated the total number of risk factors (0, 1, 2, 3, or 4 and above) as a composite indicator of heart attack and stroke burden. The following 7 conditions were included in this calculation: diabetes, hypertension, high cholesterol, obese, current smoker, heavy drinker, insufficient/ no physical activity. In summing the number of risk factors, participants with at least one missing values were

treated as missing; less than 5% of participants had one or more risk factors with missing values.

Statistical Analysis

All statistical analyses were performed using SAS (SAS Institute, Inc., Cary, North Carolina). Data were weighted according to BRFSS analytical guidelines. The weighting methodology adjusts for bias that may arise from total nonresponse to examination. Descriptive statistics of respondent demographics, medical history and well-recognized risk factors were presented as weighted proportions. Categorical demographic variables were analyzed and compared by data collection year (2005 and 2009) by using the χ^2 test, and continuous variable (i.e. age) was compared by using the Student t test. Statistical significance was set at $p < 0.05$. No adjustments were made for multiple comparisons and statistical tests.

Descriptive statistics were also displayed by the proportions of correct recognition of 5 correct symptoms of heart attack or stroke, 6 symptoms (including incorrect symptom) of heart attack or stroke, 6 individual heart attack symptoms and 6 individual stroke symptoms for year 2005 and year 2009. The relative change in knowledge between 2005 and 2009 was calculated by the following formula: increase rate (2005-2009) = $((\text{percentage 2009} - \text{percentage 2005}) / \text{percentage 2005}) \times 100\%$.

If there was a “great” change in the awareness of individual heart attack and stroke symptom over time, further age and sex subgroup analysis would be performed to examine patterns within subgroups. The cutting point to define “great” was set as 10.0%. Within an age or gender subgroup, descriptive statistics were presented as the proportions of correct recognition of 5 correct symptoms of heart attack or stroke, 6 symptoms (including incorrect symptom) of heart attack or stroke, and 6 individual heart attack symptoms and 6 individual stroke symptoms for both year 2005 and year 2009. Age subgroup analysis was also performed within each sex subgroup. Increase rates were calculated using the same method described above.

RESULTS

Characteristics of Respondents

The unweighted sample size for the population of interest in year 2005 and year 2009 was 109,164 (42,281 in 2005 and 66,883 in 2009). For analysis, these data were weighted

to represent 74,436,947 (36,540,597 in 2005 and 37,896,350 in 2009) noninstitutionalized Americans aged ≥ 18 years old. The demographic characteristics of the respondents were listed in Table 1 by year. The data indicated that approximately half of the respondents were women in each year (52.0% for year 2005 and 51.9% for year 2009). Participants in year 2009 were significantly older, more likely to be Black, and had higher education level and household income. The prevalence of several risk factors increased from 2005 to 2009, including diabetes, hypertension, high cholesterol, and obesity. However, there were also decreases in the proportion of current smokers and heavy drinkers. Approximately half of the respondents had insufficient physical activity in both years. The composite indicator of heart attack and stroke burden indicated an increased burden over time: more respondents reported 4 or more than 4 risk factors for heart attack and stroke. As for medical history, the proportions of previous angina/coronary heart disease slightly decreased between 2005 and 2009, while the prevalence of previous cardiovascular disease, and stroke were consistent over time. Respondents with history in these three diseases took a small proportion of all respondents.

Overall Heart Attack and Stroke Knowledge

Table 2 described the proportions of correct answers to heart attack and stroke symptoms for all respondents. Symptoms were ranked by recognition rate in 2005, and the symptom in the first row represented the symptom with the highest proportion of correct answer. More than 80.0% of respondents could correctly name the 3 most commonly recognized (table 2) heart attack symptoms and 3 most commonly recognized stroke symptoms in both years. More than 90.0% of respondents could correctly identify chest pain or discomfort as a valid heart attack symptom in both years (92.6% in 2005 and 92.8% in 2009). Similarly, more than 90.0% of respondents could correctly identify sudden numbness or weakness of face, arm, or leg, especially on one side as a correct symptom for stroke in both years (92.9% in 2005 and 94.5% in 2009). However, less than 40% of respondents could distinguish the incorrect sudden trouble seeing in one or both eyes symptom from other 5 correct heart attack symptoms in both years. Similarly, only 38.8% of respondents in 2005 and 39.6% in 2009 could recognize chest pain or discomfort as the incorrect stroke symptom. Despite of the high recognition rate for individual heart attack and stroke correct symptoms, when we took all 5 correct heart attack symptoms or

all 5 stroke symptoms into consideration, less than 40% of respondents could correctly recognize all 5 heart attack symptoms and less than 50% of respondents could correctly recognize all 5 stroke symptoms. Compared to the comparatively low correct recognition rates of all 5 correct heart attack or all 5 correct stroke symptoms, recognition rates further dropped after taking the correct identification of the incorrect heart attack or stroke symptom into consideration (31.6% vs 11.7% for heart attack in 2005, 37.5% vs 13.5% for heart attack in 2009, 45.5% vs 20.0% for stroke in 2005, and 50.7% vs 22.3% for stroke in 2009). When asked what they would do first if they thought someone else was experiencing signs of a heart attack, more than 86% of respondents reported that they would call 9-1-1 and proportions were consistent in both years.

Among all the respondents, awareness of both typical (e.g. chest pain or discomfort) and atypical (e.g. pain or discomfort in the jaw, neck, or back) symptoms was greater in 2009 compared to 2005. However, the increases were not “great” in most symptoms: increase rates were less than 10.0%, which did not meet the cutting point set before. Only one symptom showed an increase greater than 10.0% among all 12 symptoms from 2005 to 2009, and this was an atypical symptom for heart attack: pain or discomfort in the jaw, neck, or back. 47.4% of respondents correctly recognized this symptom in 2005 and 55.8% of respondents correctly recognized this symptom in 2009, with an increase rate equaling 17.8%.

Age and Sex Subgroup Analysis

Table 3 presented the proportions of correctly recognizing pain or discomfort in the jaw, neck, or back as a heart attack symptom in different age and sex subgroups. Women had better awareness of this atypical symptom compared to men in year 2005 and 2009, and had a greater increase in awareness between 2005 and 2009 compared to men (18.7% vs 16.5%). For different age groups, younger population (i.e. 18 to 34 years old and 35 to 54 years old) had consistently greater proportions of correct recognition compared to older population (i.e. 55 to 64 years old and 65 years old and over). The youngest population reported the greatest increase rate (22.1%), while the oldest population reported the lowest increase rate (12.9%).

For age subgroup analysis within each sex subgroup, women aged 18 to 34 years old showed the largest increase rate among all 8 subgroups. The increase rate for this

subgroup was 29.1%, which was greater than the increase rate for all women (18.7%) and the increase rate for the whole young population (22.1%).

DISCUSSION

Our result indicated that the overall knowledge of early warning signs and symptoms of heart attack and stroke was still not ideal. This result was consistent with previous studies^{x,xii,xiii} and recent published data from the National Health Interview Survey^{xiv}. Over 90% of people can correctly name at least one symptom, but only half can correctly name all 5 stroke symptoms and about 1/3 can correctly name all 5 heart attack symptoms. Symptoms with lower awareness in 2005 remained low recognition rates in 2009, especially the atypical symptoms (e.g. pain or discomfort in the jaw, neck, or back among heart attack symptoms, and sudden, severe headache with no known cause among stroke symptoms). Most symptoms did not show a great increase in awareness between 2005 and 2009. Even though the recognition rate of atypical symptom pain or discomfort in the jaw, neck, or back increased significantly from 47.4% to 55.8%, the proportion was still low compared to other typical heart attack symptoms, including chest pain or discomfort. All these results suggested that there is still room for the improvement of knowledge. Mosca et al. found a similar result in American Heart Association survey that over the past 15 years, there had been improvement in the recognition of atypical heart attack symptoms, but overall, awareness remained quite low^{xv} and more efforts were needed to improve awareness.

Our study indicated better heart attack knowledge improvement compared to stroke knowledge improvement, and this finding was consistent in all demographic subgroups. A greater proportion of respondents (increase rate was 18.7%) could correctly recognize all 5 correct heart attack symptoms from 2005 to 2009. The increased knowledge of heart attack was most prominent for pain or discomfort in the jaw, neck, or back (increase rate was 17.8%). Substantial increases in the correct reporting of this symptom were seen in all demographic subgroups, with the greatest increase in women aged 18 to 34 (increase rate was 29.1%).

The ability to correctly recognize warning signs and symptoms for heart attack and stroke is one of the major determinants of delay time to treatment^{xvi,xvii}, and Healthy People 2020 objectives include increasing public awareness of these symptoms. Greater

delay time to treatment correlates directly with higher heart attack mortality^{xviii}. Similarly, for ischemic stroke patients, thrombolytic therapy within 3 hours of symptom onset decreases risk of permanent disability^{xix}. However, most heart attack or stroke patients could not arrive to get proper treatment within recommended timeframe^{xx,xxi}. Moreover, studies have found that women were more likely to have longer delays than men^{vi}, with a median difference in duration of prehospital delay ranging from 0.3 to 3.7 hours. Evidence from previous studies also indicated that women were more likely to report atypical symptoms compared to men. To the degree that symptom recognition accounts for gender difference in prehospital delay, increasing knowledge about heart attack and stroke symptoms in women is an important step in assuring equal and timely access to appropriate medical care for this population. Young women admitted to the hospital with a heart attack were reported to have more atypical symptoms (e.g. pain or discomfort in the jaw, neck, or back) and had greater in-hospital mortality compared to men of the same age^{xxii}. Furthermore, despite of the overall decrease in coronary heart disease (CHD) mortality rate, mortality rate among young women has been increasing on average by 1.3% annually^{viii}. Young women presenting without chest pain also had greater in hospital mortality than age-matched men, and these sex differences decreased or even reversed with advancing age^{xxiii}. All these evidence underscores the need to educate women about heart attack and stroke symptoms, in particular, to raise awareness of the symptoms of heart attack and stroke among younger women. In our study, we found the only significant increase was in the awareness of the heart attack atypical symptom among young women, which may be a positive sign of the nationwide efforts put on women, especially young women, to increase awareness of heart disease and heart attack signs and symptoms.

There are several limitations in this study. First, this study was a telephone-based survey focusing on English-speaking population, so the results may not be generalizable to all individuals. Second, we limited the analysis to states that included the optional heart attack and stroke module in both years and these states are concentrated on eastern and middle parts of the U.S. So the results may not represent the awareness level of all Americans. Third, this was a cross-sectional study and the assessment of awareness is based on self-reporting results. We found that when taking the recognition of incorrect

symptoms into account, the proportion of respondents that could correctly recognize all symptoms dropped dramatically. So there may be an over-estimation of the overall awareness level, people might answer “yes” for all the listed symptoms.

Knowledge about warning symptoms is only the first and early step to prevent heart attack and stroke. Subsequent steps including pre-hospital care seeking action are also required for successful early intervention. This study primarily focused on the early recognition phase, however, good knowledge about warning signs and symptoms can, to some extent, trigger patients’ initiating action steps. Our study found that women had better knowledge of both typical and atypical heart attack symptoms compared to men, however, previous study has also found that women were more likely to have longer delays than men^{xxiv}. This may suggest that although people have the correct knowledge of symptoms, they still do not act on the knowledge. More studies are still needed to understand the barriers and factors that women facing to act on the recognition of having heart attack and stroke. Additionally, we found that in both 2005 and 2009, a large proportion (nearly 90%) of respondents correctly recognized of calling 911 in response to someone having acute symptoms and figures were substantial in all demographic groups. Despite of the fact that vast majority of respondents know that they should call 911 for symptoms, they are still not able to identify all the correct symptoms for heart attack and stroke. Subsequent steps are needed to fix the gap and improve the chance of prompt medical care by calling 911 for others.

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Table 1. Selected Characteristics of Participants ≥ 18 Years of Age Responding to the Heart and Stroke Module: 2005 and 2009 Behavioral Risk Factor Surveillance Survey Data

Variables and factors	% ^{1,2}		p value
	2005 (n=42281)	2009 (n=66883)	
Women	52.0	51.9	0.91
Age, mean (SD)	46.6 (0.15)	47.7 (0.16)	<0.0001
18-34	29.4	25.9	<0.0001
35-54	38.0	39.5	
55-64	14.1	15.4	
65+	18.6	19.2	
Race/ Ethnicity			0.024
Non-Hispanic White	73.5	73.1	
Non-Hispanic Black	13.2	14.4	
Other	13.3	12.6	
Education			<0.0001
< 12 years	11.4	9.4	
High school graduate or G.E.D	30.7	28.7	
At least some college or above	57.9	62.0	
Married	63.5	64.5	0.076
Household income			<0.0001
Less than \$25,000	23.7	22.3	
\$25,000 to less than \$50,000	26.3	23.4	
\$50,000 or more	36.2	41.2	
Missing	13.8	13.1	
With Health Insurance Coverage	83.9	84.6	0.19
Risk Factors			
Diabetes	9.0	10.7	<0.0001
Hypertension	27.7	31.3	<0.0001
High cholesterol	28.8	31.3	<0.0001
Obese (BMI>30)	25.4	28.5	<0.0001
Current smokers	22.0	19.4	<0.0001
Heavy drinkers	5.4	4.7	0.017
Insufficient physical activity	52.2	51.8	0.46
Total			<0.0001
0	17.5	17.5	
1	31.5	29.6	
2	26.2	25.5	
3	15.2	16.2	
4+	9.5	11.2	
Medical History			
Angina/ coronary heart disease	5.2	4.5	0.0019
Cardiovascular heart attack	4.8	4.6	0.21
Stroke	3.0	3.0	0.93

¹All variables are in weighted % or mean (standard error).

²Percentages may not add up to 1 because of rounding.

Table 2. Heart Attack and Stroke Knowledge Questions with Correct Responses: 2005 and 2009 Behavioral Risk Factor Surveillance Survey Data^{1,2}

<i>Survey questions in BRFSS Heart Attack and Stroke Module</i>	Correct answers %		
	2005	2009	Change (%)
Heart attack symptoms (correct answers)			
Chest pain or discomfort (Yes)	92.6	92.8	0.2
Pain or discomfort in the arms or shoulders (Yes)	85.1	86.8	2.1
Shortness of breath (Yes)	85.2	85.5	0.3
Feeling weak, lightheaded, or faint (Yes)	61.6	63.5	3.1
Pain or discomfort in the jaw, neck, or back (Yes)	47.4	55.8	17.8
Sudden trouble seeing in one or both eyes (No)	32.7	36.1	10.0
Recognized all 5 correct heart attack symptoms	31.6	37.5	18.7
Recognized all 6 heart attack symptoms	11.7	13.5	15.6
Stroke symptoms (correct answers)			
Sudden numbness or weakness of face, arm, or leg, especially on one side (Yes)	92.9	94.5	1.7
Sudden confusion or trouble speaking (Yes)	86.5	90.7	4.9
Sudden trouble walking, dizziness, or loss of balance (Yes)	83.6	86.6	3.7
Sudden trouble seeing in one or both eyes (Yes)	68.7	73.7	7.2
Sudden, severe headache with no known cause (Yes)	60.7	63.2	4.1
Chest pain or discomfort (No)	38.8	39.6	2.2
Recognized all 5 correct stroke symptoms	45.5	50.7	11.4
Recognized all 6 stroke symptoms	20.0	22.3	11.4
Responses to heart attack or stroke (correct answer)			
If you thought someone was having a heart attack or a stroke, what is the first thing you would do? (Call 911)	86.0	87.3	1.5

¹ All the percentages were weighted %.

Table 3. Awareness change of Pain or Discomfort in the Jaw, Neck, or Back between 2005 and 2009 by Age and Sex Groups¹

<i>Subgroups</i>	Correct answers %		
	2005	2009	Change (%)
Sex subgroups			
Men	41.0	47.7	16.5
Women	53.3	63.3	18.7
Age subgroups			
18 to 34	34.0	41.4	22.1
35 to 54	49.4	57.4	16.4
55 to 64	60.9	68.9	13.0
65 or over	54.3	61.4	12.9
Sex-age subgroups			
Men 18 to 34	30.7	35.1	14.2
Men 35 to 54	42.4	48.6	14.6
Men 55 to 64	52.5	60.4	14.9
Men 65 or over	46.9	54.6	16.5
Women 18 to 34	37.2	48.0	29.1
Women 35 to 54	56.1	65.8	17.4
Women 55 to 64	68.7	76.6	11.5
Women 65 or over	59.7	66.5	11.5

¹ All the percentages were weighted %.

Figure 1. Optional Heart Attack and Stroke Module Participating States and District

