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State level correlations between high heart attack and stroke symptomology knowledge scores and CVD risk factors and mortality rates

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ABSTRACT

Introduction: In 2008, cardiovascular disease (CVD) accounted for one in three deaths in the United States. Epidemiological analyses suggest that two or more risk factors are the indicator of high risk and/or poor CVD outcomes. Knowledge of heart attack and stroke symptomology has been the focus of much research based on the assumption that accurate identification of an event is critical to reducing time to treatment. There is a paucity of research showing a clear association between knowledge of heart attack and stroke symptomology, risk factors, and mortality rates. In this study, we hypothesized that high stroke and heart attack symptomology knowledge scores would correspond to lower stroke or CVD mortality rankings as well as to a lower prevalence of two or more CVD risk factors. Methods: State was the unit of analysis used to examine data from two different sources and combined into a customized database. The first source was a multiyear Behavioral Risk Factor Surveillance Survey (BRFSS) heart attack and stroke symptom knowledge module database. CVD and stroke mortality data used came from the American Heart Association's (AHA) 2012 Heart Disease and Stroke Statistics Update. Spearman's Rho was the test statistic. Results: A moderate negative correlation was found between high heart attack and stroke symptom knowledge scores and the percentage of adults with two or more CVD or stroke risk factors. Likewise, a similar correlation resulted from the two variables, high heart attack and stroke symptoms knowledge score and CVD mortality rank. Conclusions: This study demonstrated a significant relationship between high heart attack and stroke symptom knowledge and lower CVD mortality rates and lower prevalence of two or more CVD risk factors at the state level. Our findings suggest that it is important to continue education efforts regarding heart attack and stroke symptom knowledge. Pharmacists are one group of health care providers who could enhance the needed public health education efforts.

Keywords: Knowledge of Heart Attack and Stroke Symptomology; CVD Risk Factors; Stroke Mortality; CVD Mortality

1. INTRODUCTION

Cardiovascular disease (CVD) accounted for one in three deaths in the United States in 2008 [1]. CVD encompasses numerous disease states, with heart attacks and strokes being among the most notable. Heart disease is the number one cause of death [2], while stroke is the leading cause of long-term adult disability [3]. In the United States, the total cost(s) of cardiovascular disease in 2010 were estimated to be $444 billion [4]. In 2010, approximately one of every six dollars spent on health care in this country was for the treatment of CVD. Since CVD is age-prevalent, the economic impact on the US health care system will become even greater as the population ages [4].

The known modifiable risk factors for CVD are: hypertension, smoking, dyslipidemia, diabetes, physical inactivity, and obesity [1]. Because CVD is multifactorial in nature, identifying risk factors allows health care providers to assist an individual to mitigate the chance of

CVD morbidity and mortality. These risk factors can be used to calculate a person's potential risk for a CVD event (heart attack or stroke). In particular, the Framingham Risk Score [5] is a screening tool that helps predict the 10-year risk of a person having an event and is utilized to determine the course of treatment of the modifiable risk factors. Epidemiological data suggest that two or more risk factors are an indicator of high risk and/or poor CVD outcomes [6].

Knowledge of heart attack and stroke symptomology has been the focus of much research based on the assumption that accurate identification of an event is critical to reducing time to treatment [7]. It is well established that early treatment for both heart attack and stroke is critical in lowering the risk for poor outcomes [8] and preserving quality of life [9,10].

A number of studies have been conducted in order to ascertain specific populations of US adults with knowledge deficits in the areas of first responder action as well as heart attack and stroke symptomology [7,11-15]. It is believed that by identifying these populations of adults, better public health campaigns can be aimed at enhancing knowledge [11-15]. However, there is a paucity of research showing a clear association between knowledge of heart attack and stroke symptomology, risk factors, and mortality rates.

In this study, we were interested in examining whether or not US whose adults had high knowledge scores regarding heart attack and stroke symptoms also had a correspondingly lower prevalence of CVD risk factors and lower CVD and stroke mortality rates. We hypothesized that high stroke and heart attack symptomology knowledge scores would correspond to lower stroke or CVD mortality rankings as well as to a lower prevalence of two or more CVD risk factors.

2. METHODS

Two data sources were used for this study: a multiyear Behavioral Risk Factor Surveillance Survey (BRFSS) heart attack and stroke module database and the CVD and stroke mortality data from the American Heart Association (AHA) 2012 Heart Disease and Stroke Statistics Update. Bivariate techniques were used to analyze the data.

BRFSS data are collected using a random-digit dial telephone survey targeting adults 18 - 99 years of age. These data are collected under the guidance of the Centers for Disease Control and Prevention (CDC) in collaboration with all US States and most US territories. Once collected, BRFSS data are weighted such that they are representative of the non-institutional US population by surveyed State. The data are cross-sectional and are focused on health risk factors and behaviors. A detailed description of the survey design and sampling procedures can be found elsewhere [16].

Data from the BRFSS optional module on heart attack and stroke were used in these analyses. Because different States used this module in different years, we merged 2005, 2007, and 2009 data to include as many States and territories as possible. In 2005, 14 States, the District of Columbia and United States Virgin Islands (USVI) included a module in their BRFSS surveys regarding knowledge of symptoms of heart attack and stroke. In 2007, 13 States, the District of Columbia and the USVI included the module. In 2009, it was included by 19 States and the District of Columbia. Data from 25 States, the USVI, and the District of Columbia were used in these analyses. If a State used the module more than once, only the data from the most recent year were used. For the years in question, the BRFSS heart and stroke module included 13 questions focused on ascertaining knowledge of early symptoms of heart attack and stroke. Of these 13 questions, six were on knowledge of stroke symptoms, six were on knowledge of heart attack symptoms, and one question was on proper first response to either stroke or heart attack (see **Table 1**).

Respondents were asked if the following were warning signs of stroke: sudden confusion; trouble speaking or understanding; sudden numbness or weakness of face, arm, or leg; sudden trouble seeing in one or both eyes; sudden trouble walking, dizziness, or loss of balance or coordination; or sudden, severe headache with no known cause. An incorrect sign (*i.e.*, sudden chest pain) was included to examine the possibility that respondents would answer "yes" for all the symptoms. Likewise, 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. As was the case with stroke symptoms, an incorrect sign (*i.e.*, trouble seeing in one or both eyes) was included to examine the possibility that respondents would answer "yes" for all the symptoms.

We chose to group the questions for heart attack and stroke symptomology together for analysis because these disorders are both vascular events that require the need for prompt recognition of symptoms and pre-hospital action by either the patient or bystanders. Any costly public health campaign will likely need to address both these vascular diseases together, and strokes are often referred to as "brain attacks," as many aspects of early stroke management mimic heart attack management [17, 18].

For analysis we computed a Heart Attack and Stroke Knowledge Score for each respondent. Correct answers received one point and were categorized according to the following scale: low score 0 - 5 points, midrange score 6

Table 1. Heart Attack and stroke symptomology knowledge questions with % incorrect and correct responses US adults by geographic locale 2005, 2007 and 2009 behavioral risk factor surveillance data.

Survey Question (Correct Response)		Percent Total US
Do you think pain or discomfort in the jaw, neck, or back are symptoms of a heart attack? (Yes)	Incorrect Answer	46.0
	Correct Answer	54.0
Do you think feeling weak, lightheaded, or faint are symptoms of a heart attack? (Yes)	Incorrect Answer	36.8
	Correct Answer	63.2
Do you think chest pain or discomfort are symptoms for a heart attack? (Yes)	Incorrect Answer	7.3
	Correct Answer	92.7
Do you think sudden trouble seeing in one or both eyes is a symptom of a heart attack? (No)	Incorrect Answer	57.8
	Correct Answer	42.2
Do you think pain or discomfort in the arms or shoulders are symptoms of a heart attack? (Yes)	Incorrect Answer	13.5
	Correct Answer	86.5
Do you think shortness of breath is a symptom of a heart attack? (Yes)	Incorrect Answer	15.1
	Correct Answer	84.9
Do you think sudden confusion or trouble speaking are symptoms of a stroke? (Yes)	Incorrect Answer	10.3
	Correct Answer	89.7
Do you think sudden numbness or weakness of face, arm, or leg, especially on one side are symptoms of a stroke? (Yes)	Incorrect Answer	6.2
	Correct Answer	93.8
Do you think sudden trouble seeing in one or both eyes is a symptom of a stroke? (Yes)	Incorrect Answer	28.1
	Correct Answer	71.9
Do you think sudden chest pain or discomfort are symptoms of a stroke? (No)	Incorrect Answer	59.7
	Correct Answer	40.3
Do you think sudden trouble walking, dizziness, or loss of balance are symptoms of a stroke? (Yes)	Incorrect Answer	14.6
	Correct Answer	85.4
Do you think severe headache with no known cause is a symptom of a stroke? (Yes)	Incorrect Answer	38.9
	Correct Answer	61.1
If you thought someone was having a heart attack or a stroke, what is the first thing you would do? (call 911)	Incorrect Answer	13.1
	Correct Answer	86.9

- 9 points and high score 10 - 13 points. Although this scale, like most, is somewhat arbitrary, we based the cut points on the actual range (0 - 13) derived from responses. This scale served the purpose of allowing for the standardized comparison of knowledge levels.

The variable risk factor was computed by ascertaining whether or not respondents had two or more modifiable CVD risk factors from the following: hypertension, smoking, dyslipidemia, diabetes, physical inactivity, and obesity. From this list, hypertension, dyslipidemia, and diabetes were all determined from questions asking the respondents if a health care provider had ever told them that they had the condition in question. Level of physical activity was calculated by combining other variables assessing physical activity level by: 1) whether or not a person was getting recommended levels of moderate physical activity, and 2) whether or not a person was getting recommended levels of vigorous physical activity. People who reported getting recommended levels of either moderate or vigorous physical activity were coded as getting at least recommended levels of moderate physical activity. Recommended levels of moderate physical activity were defined as moderate-intensity activities such as brisk walking for at least 30 minutes per day, at least five days a week. Respondents getting less than moderate levels of physical activity were coded as physically inactive. Obesity was determined by calculating BMI from the respondents' self-reported height and weight. All respondents with a BMI >/= 30 were considered obese.

The CVD and stroke mortality data that we used came from the American Heart Association's (AHA) 2012 Heart Disease and Stroke Statistics Update [1]. These data were 2005 to 2007 mortality data. We used the CVD mortality rate by State as a proxy for heart attack mortality rate [1]. The data on CVD and stroke mortality were

ranked from highest to lowest by State. We ranked the prevalence of high composite knowledge score by State. Hence, the number 1 rank for knowledge went to the State with the lowest composite knowledge score. Likewise, we ranked the prevalence of two or more modifiable CVD risk factors by State with the number 1 ranking going to the state with the lowest prevalence of risk factors. Because the knowledge data we used was based on the 26 States and territories that included the optional BRFSS module on heart attack and stroke symptom knowledge, we could only use 26 States in our ranking of all the other data. The prevalences (percentages) were converted to rankings 1 through 26 for each variable (percentage of adults with high heart attack and stroke symptom knowledge score, two or more CVD or stroke risk factors, CVD mortality, and stroke mortality).

Analysis. Bivariate analysis was conducted to assess whether or not the relationships between high knowledge of heart attack and stroke symptoms score and the three variables: CVD risk factors, CVD mortality rate and stroke mortality rate were statistically significant. Since all of our data could be meaningfully represented as ranked data, we calculated a series of Spearman's Rho correlations. The Spearman's Rho statistic assesses how well the relationship between two variables can be described using a monotonic function (either the variables increase in value together or as one variable value increases the other variable value decreases). A perfect Spearman's correlation of +1 or −1 occurs when each of the variables is a perfect monotone function of the other. The Spearman's correlation coefficient (rs) is defined as the Pearson correlation coefficient (r) between ranked variables.

Alpha was set at 0.05 for all tests of statistical significance. SPSS version 20.0 (SPSS, IBM, Chicago, IL) was used to complete the analyses. Since this was a data only study, human subjects' approval was not necessary.

3. RESULTS

Table 1 displays the percent of incorrect and correct answers for each of the knowledge questions used to compute the heart attack and stroke knowledge score. Three heart attack symptom questions regarding chest pain, pain or discomfort in the arms or shoulders, and shortness of breath all had high percentages of correct responses (>80%). Three of the stroke symptom questions also had high percentage correct answers (confusion, numbness and balance). **Table 2** displays the ranking of the data of the four study variables by State. West Virginia had the highest percentage of adults with high heart attack and stroke symptom knowledge scores; whereas, Oklahoma had the lowest percentage of adults with a high heart attack and stoke symptom knowledge score. Tennessee had the highest percentage of adults with two or more CVD or stroke risk factors and Montana had the lowest percentage of adults with two or more CVD or stroke risk factors. Mississippi had the highest CVD mortality ranking, while Minnesota had the lowest. Lastly, Tennessee had the highest stroke mortality ranking; whereas, Arizona had the lowest stroke mortality rank.

Table 3 displays the results of the bivariate analysis using Spearman's Rho as the test statistic. A moderate negative correlation was found between high heart attack and stroke symptom knowledge scores and the percentage of adults with two or more CVD or stroke risk factors. Likewise, a similar correlation resulted from the two variables, high heart attack and stroke symptoms knowledge score and CVD mortality rank. The correlation between high heart attack and stroke symptom knowledge score and stroke mortality rank was not statistically significant. DISCUSSION

We hypothesized that high stroke and heart attack symptomology knowledge scores would correspond to lower stroke or CVD mortality rankings as well as to a lower prevalence of two or more CVD risk factors. The results of our analyses partially supported our hypotheses. The correlation between high heart attack and stroke symptom knowledge score and stroke mortality rank was not statistically significant.

The Spearman's Rho calculations showed a negative correlation among high heart attack and stoke symptom knowledge scores and low prevalence of two or more CVD risk factors. Hence, US States with higher knowledge scores also had a lower prevalence of adults with two or more risk factors for CVD. Likewise, US States with higher knowledge scores also had correspondingly lower CVD mortality rates. This too, was indicated by there being a negative correlation between high heart attack and stroke symptom knowledge scores and lower CVD mortality rates based on the calculated Spearman's Rho statistic. The correlation was negative because of what high and low rank refers to in each of the variables being examined. For instance, a low rank for knowledge scores references a low or poor knowledge score, however, a low rank for 2 or more CVD risk factors references lower risk which is favorable.

West Virginia produced an interesting finding as it showed the highest attack and stroke symptom knowledge score overall, but had highest rate of heart attack and stroke mortality as well as a high prevalence of adults with 2 or more CVD risk factors. As an outlier, West Virginia may have had a greater influence on the findings than that which other States may have had. These results however, are important because they identify for us at least one place where public health education needs to be directed in a manner that specifically addresses the results we have uncovered.

Table 2. Rank* order of % adult population with high heart attack and stroke symptom knowledge score, two or more CVD Or stroke risk factors, CVD mortality, stroke mortality.

State	Rank* of % Adult Population with High Heart Attack and Stroke Symptom Knowledge Score	Rank* of % Two or More CVD or Stroke Risk Factors	CVD Mortality Rank*	Stroke Mortality Rank*
Arizona	6	6	2	1
Connecticut	13	2	5	2
Florida	15	14	4	3
Minnesota	25	5	1	4
Wyoming	19	3	8	5
Maine	5	9	6	6
DC	2	21	24	7
Montana	22	1	3	8
North Dakota	18	7	9	9
Iowa	20	10	11	10
Wisconsin	21	8	10	11
Virginia	23	11	12	12
Indiana	14	13	15	13
Idaho	16	4	7	14
West Virginia	26	22	20	15
Kentucky	24	15	18	16
Missouri	10	16	17	17
Georgia	8	18	16	18
Louisiana	3	23	21	19
Mississippi	4	25	26	20
North Carolina	17	17	13	21
South Carolina	11	12	14	22
Oklahoma	1	19	23	23
Alabama	7	24	25	24
Arkansas	12	20	19	25
Tennessee	9	26	22	26

*All ranks are lowest (1) to highest (26).

Table 3. Bivariate analysis of heart attack and stroke symptomology knowledge by ranked state data using Spearman's Rho as test statistic.

	% Two or More CVD or Stroke Risk Factors	CVD Mortality Rank	Stroke Mortality Rank
% Adult Population with High Heart Attack and Stroke Symptom Knowledge Score	−0.476*	−0.461*	−0.289**

*Correlation is significant at the 0.01 level (1-tailed); **Correlation is not statistically significant.

We believe that pharmacists can and should play a role —perhaps even taking the lead—in helping to educate US adults about the symptoms of heart attack and stroke. Community pharmacists are easily accessible health care

providers [19,20]. Pharmacist-driven public health related interventions have been successful in multiple communities for a variety of health concerns (e.g., smoking, hypertension, hyperlipidemia, elevated blood glucose) [21-25].

From the practice setting of a community pharmacy, pharmacists' could mount low-cost campaigns to inform their patients about the signs and symptoms of heart attack and stroke. Elements of such a campaign may include: posters, medication counseling, pamphlets and community outreach programs. Furthermore, hospital-based pharmacists could provide community outreach programs that not only provide education on the symptomology of strokes and heart attacks, but also providing information of how to access care if and or when it might be needed. Finally, from the practice setting of primary care clinics, pharmacists could identify high-risk patients by using medical records and provide education during clinic visits. They might also offer group visits for high risk patients in order to provide additional education regarding CVD and heart attack and stroke signs and symptoms.

Study Limitations. Several potential limitations to this study should be noted. First, the BRFSS survey is based on telephone derived data and may be skewed because those who could not be reached by phone could not participate in the survey. Additionally, widespread use of answering machines and caller identification now allow people to filter their phone calls potentially leading to a passive refusal to participate in surveys such as the BRFSS. However, call filtering is beyond the control of survey administrators. Furthermore, persons of lower socioeconomic status may have been excluded because of poorer phone access. However, the vast majority of US residents live in households with telephones, which minimizes this bias. Moreover, US cell phone numbers are now included in the pool of phones contacted for the survey. Nevertheless, study strength is in the use of a national database that included a robust sample of residents weighted to reflect the demographics of the US population by State.

A second limitation is that the survey used close-ended questions, which limit participants' options to fully explain response choices. Nonetheless, the survey questions were worded such that the answer choices covered a wide range of response possibilities. A final potential bias resulted from the languages of the survey—English and Spanish. Individuals who did not speak English or Spanish were excluded from this survey.

Additional biases may have been manifested by the use of CVD mortality rates by State as a proxy for heart attack mortality. Ultimately, CVD encompasses more than heart attacks, however, no heart attack only mortality rate data by State were available.

4. CONCLUSION

This study demonstrated a significant relationship between high heart attack and stroke symptom knowledge and lower CVD mortality rates and lower prevalence of two or more CVD risk factors at the state level. Our findings suggest that it is important to continue education efforts regarding heart attack and stroke symptom knowledge. Pharmacists are one group of health care providers who could enhance the needed public health education efforts.

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