HHS Public Access

Author manuscript

Neuroepidemiology. Author manuscript; available in PMC 2022 May 19.

Published in final edited form as:

Neuroepidemiology. 2021 ; 55(3): 245–252. doi:10.1159/000516343.

Stroke and heart attack symptoms recognition in older US adults by cognitive impairment status

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Abstract

Introduction: Cognitive impairment may make stroke and heart attack symptoms recognition difficult, potentially resulting in treatment delays for those with these cardiovascular diseases (CVDs). Despite cognitive impairment affecting large numbers of older US adults who are also at increased risk for stroke and heart attack, little is known about stroke and heart attack symptoms recognition in this population. As a result, this study sought to determine the impact of cognitive impairment on stroke and heart attack symptoms recognition among older US adults.

Methods: Using the 2014 and 2017 National Health Interview Surveys, we compared stroke and heart attack symptoms recognition levels in US adults ≥65 years with cognitive impairment and those without cognitive impairment. Estimates of stroke and heart attack symptoms recognition adjusted for CVD related factors were assessed by cognitive impairment status. We also conducted analyses stratified by living arrangement and stroke and heart attack history for individuals with and without cognitive impairment.

Results: US adults ≥65 years with cognitive impairment were observed to respectively be 3.0–6.7% and 1.6–4.9% less likely to recognize an individual stroke and heart attack symptom than similarly aged individuals without cognitive impairment. Recognition of all five stroke/heart attack symptoms was also lower among those with cognitive impairment with this group being 9.7% less

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Author Contributions

All authors have contributed significantly and all authors are in agreement with the content of the manuscript. Phoebe Tran originated the idea and the study design. Lam Tran ran the data analyses and interpreted results. All authors contributed in writing the manuscript.

Statements

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Statement of Ethics

Research involving human participants and/or animals:

This article does not contain any studies with human participants or animals performed by any of the authors. The NHIS data used in this study is a secondary publicly available data source that has been completely anonymized and released for public use by the United States Centers for Disease Control and Prevention (CDC).

Informed consent:

This article is exempt from needing informed consent as no human participants were involved in the study and the data used has been completely anonymized and approved for public use by the United States Centers for Disease Control and Prevention (CDC).

Data Access:

Data used in this study is publicly available and can be found at the United States Centers for Disease Control and Prevention's (CDC) website: https://www.cdc.gov/nchs/nhis/index.htm.

likely to recognize all stroke symptoms and 6.7% less likely to recognize all five heart attack symptoms compared to people without cognitive impairment. Following adjustment, individuals with cognitive impairment continued to have slightly lower recognition of certain individual stroke and heart attack symptoms as well as of all five symptoms of these conditions (stroke OR: 0.70 (95% CI: 0.58–0.85); heart attack OR: 0.88 (95% CI: 0.75, 1.03) than those without cognitive impairment. For individuals with cognitive impairment, living with others was linked with slightly better recognition of all individual stroke symptoms and heart attack history with better recognition of all individual heart attack symptoms.

Conclusions: Additional work is needed to address the challenge of improving recognition levels for specific stroke and heart attack symptoms in older US adults with cognitive impairment and especially for members of this group that live alone.

Keywords

stroke; heart attack; cognitive impairment; symptoms recognition; epidemiology

Introduction

In the United States, cardiovascular diseases (CVDs) such as stroke and heart attack are leading causes of morbidity and mortality with these two conditions resulting in 795,000 and 735,000 hospitalizations respectively each year [1–3]. For adults ≥65 years who are at elevated risk of CVD, stroke and heart attack symptoms recognition has been highlighted by the American Heart Association as a critical factor in timely receipt of treatment and improved outcomes for these particular diseases [4–6]. However, cognitive impairment which affects around 11.7% of Americans ≥65 years may hinder recognition of stroke and heart attack symptoms and particularly for US seniors with cognitive impairment who live alone can prevent receipt of time sensitive stroke and heart attack treatment [7, 8].

Despite more than 33% of US adults ≥65 years with cognitive impairment having experienced a stroke or heart attack, little is known about recognition of stroke and heart attack symptoms in these individuals [8]. Although previous studies on stroke and heart attack symptoms recognition in the US has included older adults, this research has not examined the influence of cognitive impairment on symptom recognition and how recognition levels differ by cognitive impairment status [9–13]. In this national study, we compared recognition of stroke and heart attack symptoms between US adults ≥65 years with and without cognitive impairment by cognitive impairment. We then ascertained estimates of symptoms recognition adjusted for CVD related factors by cognitive impairment status.

Methods

Study data

We extracted data from the Family, Person, and Sample Adult files of the 2014 and 2017 National Health Interview Surveys (NHIS), the most recent survey years with stroke and heart attack symptoms recognition information [14]. The NHIS is a national level survey that covers all 50 states and the District of Columbia [14]. It has been conducted annually

since 1957 by the Census Bureau for the National Center for Health Statistics (NCHS), an agency under the umbrella of the Centers for Disease Control and Prevention [14]. Potential survey participants are noninstitutionalized adults and children that reside in households that have been randomly selected for participation in the NHIS [14]. Individuals that choose to participate in the NHIS are administered the survey in person by trained personnel [14]. The survey consists of a series of questions meant to collect information on a participant's sociodemographic background, existing medical conditions, access to healthcare, and health literacy [14]. To ensure that NHIS data is representative of the general US population, clustered sampling of households in addition to survey weighting is carried out in the dataset [14]. Obtaining further IRB approval and informed consent from our respective institutions is not needed when NHIS data is used in research as the NCHS has already obtained IRB approval and informed consent for the NHIS surveys in addition to the surveys being completely deidentified and anonymized [14]. NHIS datasets and accompanying survey documentation are made publicly available by the NCHS and can be found online at their website: https://www.cdc.gov/nchs/nhis/nhis_questionnaires.htm [14].

Individuals ≥65 years with information on their cognitive impairment status and stroke and heart attack symptoms recognition were included in the study. This particular age group was selected because individuals ≥65 years face both an increased risk of stroke and heart attack as well as cognitive impairment [4–6]. We give a brief overview here of the NHIS data processing carried out in the study with full details provided in the online supplementary files. Following the example of prior studies that looked at cognitive impairment using NHIS data, cognitive impairment status was determined through responses to the question, "Are you limited in any way because of difficulty remembering or because you experience periods of confusion?" with people responding "Yes" considered to have cognitive impairment and those responding "No" considered to not have cognitive impairment [15, 16].

To assess recognition of stroke and heart attack symptoms, we used NHIS questions on stroke ("Which of the following would you say are the symptoms that someone may be having a stroke?") and heart attack symptoms knowledge ("Which of the following would you say are the symptoms that someone may be having a heart attack?") [17]. NHIS participants were asked these two questions for common 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; severe headache with no known cause) and heart attack symptoms (jaw, neck, or back pain; feeling weak, lightheaded, or faint; chest pain or discomfort; pain or discomfort in arms or shoulder; shortness of breath) [17]. We present estimates where "Don't know" responses to the stroke and heart attack recognition questions are classified as "Missing" as they are more conservative. Analyses where "Don't know" responses to these questions are classified as "No" (provided in Online Supplementary Tables 3a–b) would lead to poor recognition levels being overestimated as some "Don't know" responses may have resulted from an individual misunderstanding the question and not because they did not recognize a particular stroke/heart attack symptom.

From literature on stroke and heart attacks, we identified sociodemographic factors in NHIS data known to be associated with these cardiovascular diseases [4–6]. These factors were age, sex, race, % of poverty line (a surrogate measure of household income), and education. They were then included in analyses as part of the adjustment process.

There was also interest in the impact of living arrangement and CVD history on symptoms recognition in older US adults with cognitive impairment. Poorer symptoms recognition may be more life-threatening for those who live alone and having a prior CVD event could improve future symptoms recognition. Thus, we also obtained information on living arrangement and stroke and heart attack history from the NHIS in order to conduct analyses stratified by these variables.

Statistical analyses

We calculated the survey-weighted distribution of sociodemographic characteristics for people with cognitive impairment and those without cognitive impairment. Survey-weighted levels of stroke and heart attack symptoms recognition were ascertained by cognitive impairment status. A separate logistic regression model was created in order to obtain adjusted estimates of recognition of each stroke and heart attack symptom as well as recognition of all five stroke and all five heart attack symptoms. Survey weights were used in the models to ensure that adjusted estimates are nationally representative. Model covariates included cognitive impairment status, age, sex, race, % of poverty line, and education. Survey weighted estimates of symptoms recognition stratified by living arrangement and stroke and heart attack history were also determined for those with and without cognitive impairment. In order to carry out statistical testing, Wald-tests were conducted at $\alpha=0.05$. Statistical analyses were performed in R Version 4.0 [18].

Results

Our study included 12,630 people (Table 1). Cognitive impairment was found to affect about 7.8% of the study population. US adults with cognitive impairment tended to be older, female, poorer, have lower educational attainment, live alone, and have a history of stroke and heart attack when compared to their peers without cognitive impairment.

Older US adults with cognitive impairment were 3.0–6.7% less likely to be able to recognize an individual stroke symptom than similarly aged individuals without cognitive impairment, with this difference being even larger (9.7%) when knowledge of all five stroke symptoms was considered (Table 2). We noted that the smallest and largest difference in recognition by cognitive impairment status was for the symptom that people had the second highest (sudden confusion or trouble speaking: 91.9%, 94.9%) and second lowest (severe headache with no known cause: 77.8%, 84.5%) overall recognition of respectively. After adjustment, we observed that individuals with cognitive impairment had significantly lower odds of being able to recognize sudden trouble seeing in one or both eyes (OR: 0.74, 95% CI: 0.59, 0.93); sudden trouble walking, dizziness, or loss of balance (OR: 0.73, 95% CI: 0.56, 0.96); severe headache with no known cause (OR: 0.71, 95% CI: 0.59, 0.87), and all five stroke symptoms (OR: 0.70, 95% CI: 0.58, 0.85) in addition to having slightly lower nonsignificant odds of being able to recognize sudden confusion or trouble speaking (OR: 0.85, 95% CI: 0.62,

1.16); and sudden numbness or weakness of face, arm, or leg, especially on one side (OR: 0.81, 95% CI: 0.59, 1.12) compared to those without cognitive impairment (Table 3).

For heart attack symptoms recognition, US adults ≥65 years with cognitive impairment had lower levels of recognition of all individual heart attack symptoms and all five heart attack symptoms than those without cognitive impairment, with the difference between the two groups ranging from 1.6–4.9% for each individual symptom and being 6.7% for all heart attack symptoms (Table 2). The smallest and largest difference in heart attack symptoms recognition by cognitive impairment status was found for the symptom people had the most recognition of (chest pain or discomfort: 90.3%, 91.9%) and least recognition of (jaw, neck, or back pain: 69.8%, 74.7%). When we adjusted for sociodemographic factors, people with cognitive impairment had slightly lower nonsignificant odds of recognizing jaw, neck, or back pain (OR: 0.93, 95% CI: 0.79, 1.11) and pain or discomfort in arms or shoulder (OR: 0.88, 95% CI: 0.71, 1.10) as well as of all five heart attack symptoms (OR: 0.88, 95% CI: 0.75, 1.03) compared to those without cognitive impairment (Table 3).

Stratified analyses are presented in the online supplementary tables. Compared to individuals with cognitive impairment who lived alone, those with cognitive impairment who lived with others had slightly higher recognition of all individual stroke symptoms (0.3–3.0%) but not all individual heart attack symptoms (online supplementary Tables 1a and 1b). Heart attack history was linked with higher recognition of all individual heart attack symptoms (1.2–11.9%) among people with cognitive impairment while stroke symptoms recognition patterns by stroke history were inconsistent in this group (online supplementary Tables 2a and 2b).

Discussion

In this study, we assessed national levels of stroke and heart attack symptoms recognition in US adults ≥65 years by cognitive impairment status. Individuals with cognitive impairment were found to have lower recognition of all individual stroke and heart attack symptoms and all five stroke/heart attack symptoms compared to those without cognitive impairment. After adjustment, this disparity in recognition by cognitive impairment status still persisted for certain individual stroke and heart attack symptoms and all five symptoms of these two conditions.

As there is a lack of available information on the impact of cognitive impairment on US stroke and heart attack symptoms recognition, we compare our findings with results from existing studies that have examined stroke and heart attack symptoms recognition in Americans ≥65 years as a whole regardless of their cognitive impairment status [9–13]. The majority of these studies look at recognition of all five stroke/heart attack symptoms rather than recognition of individual stroke/heart attack symptoms [10–13]. Patel et al., 2019 found a 14.4% increase in recognition of all five stroke symptoms between 2009–2014 in US adults ≥65 years while Patel et al., 2018 noted a 10.8% increase in recognition of all five heart attack symptoms in this population between 2008 and 2014 [10, 13]. Additionally, although Fang et al. reported that 57.4% of US adults ≥65 years who participated in the 2017 NHIS recognized all five heart attack symptoms, Mahajan et al. observed within this same

dataset that people ≥65 years had lower odds of being able to recognize all five heart attack symptoms than those <65 years [10, 12].

In regard to studies that have reported actual estimates of recognition of individual CVD symptoms, Fang et al., 2011 found that 56.5% of US adults ≥65 years recognized jaw, neck, or back pain; 50.8% recognized feeling weak, lightheaded, or faint; 85.5% recognized chest pain or discomfort; 81.2% recognized pain or discomfort in arms or shoulder, and 76.9% recognized shortness of breath as a heart attack symptom [9]. However, this study relied on data from over a decade ago which may result in study findings that are not representative of current recognition patterns in older US adults [9]. Our work builds on existing research by presenting contemporary recognition levels of individual CVD symptoms in older US adults in addition to considering the impact of cognitive impairment, a significant health issue in this age group, on stroke and heart attack symptoms recognition.

Low recognition of certain stroke and heart attack symptoms among older US adults with cognitive impairment represents a particular challenge to timely stroke and heart attack treatment in this population. Regardless of our finding that living with others was only linked to moderately better recognition of stroke symptoms among individuals with cognitive impairment, these low recognition levels are especially concerning given that approximately a third of US adults with cognitive impairment live alone. Individuals with cognitive impairment who live alone and do not have caretakers or family members who regularly check in on them may be especially vulnerable in missing key stroke or heart attack symptoms in the early stages of a stroke or heart attack event [19].

Prolonged delays in stroke and heart attack symptoms recognition can lead to individuals being ineligible to receive common cardiovascular treatments [20–23]. In order to receive tissue plasminogen activator for stroke and percutaneous coronary intervention for a heart attack, individuals need to be administered these treatments within three hours and 12 hours respectively after the onset of an event [20–23]. Failure to receive stroke and heart attack treatment in a timely manner is not only associated with an increase in morbidity and mortality but has also been linked with worsening cognitive impairment for those who already have this condition [5, 24, 25]. However, as individuals with cognitive impairment often suffer from confusion, memory loss, and impaired judgement in high stress situations, educational strategies that have previously been used to raise recognition of CVD symptoms may be less effective among this population [4, 6, 26, 27].

The study’s limitations are acknowledged below. Some misclassification in NHIS data is unavoidable owing to the self-reported nature of the survey [14]. However, there is evidence that the amount of misclassification present in the NHIS is minimal with NHIS estimates being comparable to in-person measurements of clinical factors such as BMI as well as demographic factors such as Medicare coverage [28, 29]. Another limitation of the study is the potential for survey participants to view higher stroke and heart attack symptoms recognition as a positive health behavior and overreport recognition as a result of social desirability [30]. This overreporting would contribute to us obtaining higher recognition levels of stroke and heart symptoms than what recognition levels actually are within the study population.

Conclusions

Overall, US adults ≥65 years with cognitive impairment displayed lower recognition of certain stroke and heart attack symptoms than those without cognitive impairment even after accounting for sociodemographic factors. As recognition of CVD symptoms is crucial to receiving timely treatment and improving disease outcomes, additional efforts to develop interventions to raise recognition of CVD symptoms in older US adults with cognitive impairment are needed that take into account the limitations that are inherent to having cognitive impairment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding Sources

The publication costs of this manuscript are covered through funds from F31 AG067720–01.

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Table 1

Characteristics of the study population (n=12,630)

Covariates	Has Cognitive Impairment (n=991)		No cognitive impairment (n=11,639)	
	n	Weighted %[1] (95% Confidence Interval)	n	Weighted % (95% Confidence Interval)
Age				
65–74	371	35.4 (32.4, 38.4)	7110	60.7 (59.8, 61.6)
75–84	340	34.9 (31.9, 37.9)	3416	29.6 (28.8, 30.4)
≥85	280	29.7 (26.9, 32.6)	1113	9.7 (9.2, 10.3)
Sex				
Male	389	38.2 (35.2, 41.2)	4851	41.6 (40.7, 42.5)
Female	602	61.8 (58.8, 64.8)	6788	58.4 (57.5, 59.3)
Race				
White	670	73.3 (70.6, 76.1)	8965	79.1 (78.3, 79.8)
Black	135	11.2 (9.3, 13.2)	1220	9.4 (8.9, 10.0)
Hispanic	121	10.6 (8.7, 12.5)	901	7.5 (7.1, 8.0)
Other Race	65	4.9 (3.5, 6.2)	553	4.0 (3.6, 4.4)
% of Poverty Line (imputed)				
<100%	204	19.8 (17.4, 22.3)	1092	8.9 (8.4, 9.4)
100–199%	292	28.3 (25.5, 31.1)	2691	22.1 (21.3, 22.8)
200–299%	176	18.3 (15.9, 20.7)	2205	18.9 (18.2, 19.6)
300–399%	119	12.7 (10.6, 14.7)	1625	13.9 (13.3, 14.6)
>400%	200	21.0 (18.4, 23.5)	4026	36.2 (35.3, 37.1)
Education				
Less than high school	224	21.1 (18.5, 23.6)	1348	11.0 (10.4, 11.5)
High school graduate	258	26.4 (23.7, 29.2)	2732	23.0 (22.3, 23.8)
Some college	257	27.1 (24.3, 29.8)	3384	28.5 (27.7, 29.3)
College graduate	252	25.4 (22.7, 28.1)	4175	37.5 (36.6, 38.3)
Living arrangement				
Lives alone	499	52.2 (49.0, 55.3)	5468	46.8 (45.9, 47.7)
Lives with others	492	47.8 (44.7, 51.0)	6171	53.2 (52.3, 54.1)
Stroke history				
Had a stroke	224	22.4 (19.8, 25.0)	778	6.8 (6.3, 7.2)
Never had a stroke	767	77.6 (75.0, 80.2)	10861	93.2 (92.8, 93.7)
Heart attack history				
Had a heart attack	146	15.2 (12.9, 17.4)	1021	8.4 (7.9, 8.9)
Never had a heart attack	845	84.8 (82.6, 87.1)	10618	91.6 (91.0, 92.1)

[1]Survey weights in the National Health Interview Survey have been used to obtain the weighted percentages.

Table 2.

Unadjusted Prevalence of stroke and heart attack symptoms recognition in the United States by cognitive impairment status

	Stroke symptom recognition					
	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**	**Severe headache with no known cause**	**All five symptoms**
	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)
Has cognitive impairment	91.9 (90.3, 93.6)	92.5 (90.8, 94.1)	79.4 (76.9, 81.9)	88.5 (86.5, 90.5)	77.8 (75.2, 80.3)	68.2 (65.3, 71.1)
No cognitive impairment	94.9 (94.5, 95.3)	95.6 (95.2, 95.9)	86.4 (85.8, 87.0)	93.2 (92.8, 93.7)	84.5 (83.8, 85.1)	77.9 (77.1, 78.6)
	Heart attack symptom recognition					
	Jaw, neck, or back pain	**Feeling weak, lightheaded, or faint**	**Chest pain or discomfort**	**Pain or discomfort in arms or shoulder**	**Shortness of breath**	**All five symptoms**
	Weighted %[1] (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)	Weighted % (95% Confidence Interval)
Has cognitive impairment	69.8 (66.9, 72.6)	75.5 (72.8, 78.1)	90.3 (88.4, 92.1)	85.0 (82.7, 87.2)	85.1 (82.9, 87.3)	56.5 (53.4, 59.6)
No cognitive impairment	74.7 (73.9, 75.5)	77.5 (76.7, 78.2)	91.9 (91.4, 92.4)	89.6 (89.1, 90.2)	87.1 (86.5, 87.7)	63.2 (62.3, 64.1)

[1]Survey weights in the National Health Interview Survey have been used to obtain the weighted percentages.

Neuroepidemiology. Author manuscript; available in PMC 2022 May 19.

Table 3

Adjusted estimates of stroke and heart attack symptoms recognition by cognitive impairment status

	Stroke symptom recognition					
	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**	**Severe headache with no known cause**	**All five symptoms**
	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)
Cognitive Impairment status (ref: No cognitive impairment)						
Has cognitive impairment	0.85 (0.62, 1.16)	0.81 (0.59, 1.12)	0.74 (0.59, 0.93)	0.73 (0.56, 0.96)	0.71 (0.59, 0.87)	0.70 (0.58, 0.85)
	Heart attack symptom recognition					
	Jaw, neck, or back pain	**Feeling weak, lightheaded, or faint**	**Chest pain or discomfort**	**Pain or discomfort in arms or shoulder**	**Shortness of breath**	**All five symptoms**
	Odds Ratio[1] (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)	Odds Ratio (95% Confidence Interval)
Cognitive Impairment status (ref: No cognitive impairment)						
Has cognitive impairment	0.93 (0.79, 1.11)	1.03 (0.86, 1.24)	1.12 (0.85, 1.48)	0.88 (0.71, 1.10)	1.08 (0.87, 1.34)	0.88 (0.75, 1.03)

[1] Logistic models had NHIS survey weighting applied to them and included cognitive impairment status, age, sex, race, % of poverty line, and education as covariates.