HHS Public Access

Author manuscript

Top Stroke Rehabil. Author manuscript; available in PMC 2024 July 01.

Published in final edited form as:

Top Stroke Rehabil. 2023 July ; 30(5): 448–458. doi:10.1080/10749357.2022.2070363.

Incidence of Post-Stroke Depression Symptoms and Potential Risk Factors in Adults with Aphasia in a Comprehensive Stroke Center

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Abstract

Introduction: Depression may be a frequent sequela after stroke, however, its incidence has rarely been reported. The likelihood of post-stroke depression (PSD) may relate to individual factors including the presence of aphasia, which also complicates PSD diagnosis. The current study's purpose was to investigate the incidence of PSD symptoms in adults with aphasia, compare it to the incidence of PSD symptoms in adults without aphasia, and to identify potential risk factors for developing PSD in adults with aphasia.

Method: Incidence proportions and relative risk were calculated using data compiled from 970 patient records at an urban tertiary care academic institution and comprehensive stroke center throughout the year of 2019. Focusing exclusively on adults with aphasia, the selected variables of age, gender, race, and aphasia severity were used to conduct logistic regression analyses to explore potential risk factors contributing to the development of PSD.

Results: Adults with aphasia were 7.408 times more likely to exhibit PSD symptoms than adults without aphasia. Logistic regression controlling for the presence of aphasia showed a significant relationship between aphasia severity and post-stroke depression symptoms. Adults with aphasia were 2.06 times more likely to experience post-stroke depression symptoms with every 1-point increase in aphasia severity.

Conclusions: These findings align with earlier evidence identifying aphasia as a risk factor for experiencing PSD symptoms and also suggest aphasia severity is proportionate to the risk. This highlights the need for early identification of PSD symptoms in persons with aphasia in order to provide timely interventions.

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COI: None.

Keywords

aphasia; post-stroke depression; incidence; risk factors; Patient Health Questionnaire

Introduction

Reports suggest that post-stroke depression (PSD) affects at least one out of every three stroke survivors worldwide.[1] This mood disorder presents with manifold symptoms and is most often defined using specific criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).[2-5] Unlike major depressive disorder, PSD is strongly associated with both greater cognitive impairment and some form of physical disability, and is directly attributable to a specific cause.[3] Regardless of its underlying etiology, PSD can be disabling[6-7] and remains challenging to identify.[7] Because the likelihood of developing PSD relates to individual biological, psychological, and psychosocial factors, specific risk factors for developing PSD are a challenge to pinpoint and have therefore been neither adequately nor consistently reported. Furthermore, determining prevalence and incidence rates for PSD is hindered by a lack of consistent measures of depression and timing of measures across studies, as well as criteria that frequently exclude persons with aphasia,[8] thereby creating a scenario in which this group is under-represented among research cohorts. Such under-representation is concerning given aphasia affects one in three stroke survivors.[9-10]

Multiple studies have attempted to identify risk factors for developing PSD in the general stroke population, although agreement across studies remains scant. Most notably, biological considerations include vascular complications,[4,11] number of stroke lesions,[12] location of stroke,[13] serum lipid profiles,[14] season of the year,[15] hypertension,[4,12] and lifestyle habits.[4] Psychosocial considerations include poor or outright lack of social support,[11-12,16] with relationship problems making PSD three times as likely to develop.[11] Comorbid cognitive dysfunction is a psychological risk factor for both PSD[12] and its accompanying suicidal ideation.[17] The risk is higher among those with a familial history of mood disorders,[13] and among those who have previously taken antidepressant medication.[16] Importantly, additional potential risk factors for PSD might include age, gender, ethnicity, race, and the amount of time post-stroke. Earlier studies indicate a greater likelihood of developing PSD when stroke occurs at a younger age,[18-19] and a significantly greater prevalence of PSD among women than men.[20-21] By focusing on racial-ethnic groups, Fei et al. concluded that the prevalence of PSD was significantly higher among Latino groups than non-Latino groups.[16] Several studies investigating race as a risk factor for PSD indicate non-Hispanic whites are most likely to be diagnosed soon after experiencing a stroke,[22-23] but one claims there is no significant association between race and PSD in the chronic post-stroke stage.[22]

As previously noted, clearly identifying risk factors for developing PSD is hindered by excluding persons with aphasia. Aphasia is a language disorder affecting a person's ability to comprehend and express verbal messages to varying degrees[24] and is a consequence of acquired cerebral lesions.[25] Most depression scales depend on a person's ability to communicate.[8,26] Consequently, most studies investigating the prevalence of PSD state the presence of aphasia as an exclusion criterion due to the potential confounds participants'

difficulties communicating may introduce.[2, 5,17, 27-29] One systematic review found that less than half of the included studies used an appropriately adapted diagnostic tool to identify depression in persons experiencing aphasia.[10] Additionally, reports of potential risk factors for developing PSD specifically among persons with aphasia are conflicting, with some studies incorporating factors such as age, years of education,[30] and time since onset,[31] and others claiming there is no correlation between those.[32] Additional risk factors may include type of aphasia[30] and specific co-occurring personality traits.[32]

As a consequence of excluding persons with aphasia from PSD studies, little is known about the incidence of PSD among groups living with aphasia. Baseline measurements in one study indicated that 47.5% of participants living with aphasia were dealing with PSD, whereas were only 29.1% of the participants living without aphasia.[26] Additionally, Kauhanen et al. found 58% of their sample with aphasia had minor depression and 12% had major depression 3 months after stroke with a change in occurrence one year after stroke (minor depression at 25% and major depression at 35%).[31] This suggests that aphasia itself may be a risk factor for developing PSD as others have suggested.[26,33] Given that the presence of PSD among groups of stroke patients significantly increases mortality rates,[34-35] with PSD contributing to a 35-fold increase in the likelihood of stroke-related death,[36] it is imperative that a better understanding of the incidence of PSD in persons with aphasia occurs. Importantly, assessing PSD symptoms in the acute care setting in persons with aphasia will allow intervention for this mood disorder to occur sooner in the rehabilitation process. Several studies delay assessment for PSD symptoms until one or more months post-stroke[2,5,11,17,37,] with few addressing PSD symptoms in the acute recovery phase.[4,13,14]

The current study seeks to explore the incidence of PSD symptoms in adults with aphasia in a comprehensive stroke center and identify potential risk factors for developing this mental health disorder. Specifically, the research questions are:

1. What is the incidence of PSD symptoms in adults with aphasia in a comprehensive stroke center?
1. How does this incidence of PSD symptoms compare to patients who are post-stroke without aphasia in the same comprehensive stroke center?
2. What are the risk factors for PSD symptoms in adults with aphasia in a comprehensive stroke center?

Based on varying reports of the overall prevalence of PSD in the general stroke population (approximately 20-65%), it is hypothesized that the incidence of PSD symptoms in adults with aphasia will be higher than the incidence of PSD symptoms in adults without aphasia. This study will explore other potential risk factors, including age, gender, race, selected comorbidities, and aphasia severity. Based on the review of previous literature, it is hypothesized that younger age, female gender, non-white race, selected comorbidities, and aphasia severity will each be a risk factor.

Method

IRB approval for this study was obtained through Georgia State University's Office of Research Integrity under the determination that it would not be classified as research with human subjects. Permission to access electronic medical records was obtained through a hospital's IRB and research oversight committee in concordance with hospital policy. This manuscript conforms to STROBE Guidelines.[38-39]

Participants

Records were from patients seen at an urban tertiary care academic institution and comprehensive stroke center throughout the 2019 calendar year. A total of 1,095 deidentified records were extracted. Records of cases with conditions mimicking stroke (intracranial bleeding, epileptic seizures, etc., n = 114) and records with no reported depression scores (n = 11) were excluded, leaving a total of 970 records of patients with ischemic stroke that were included for analysis. The selected data from each record detailed a patient's medical history (indicating conditions such as dyslipidaemia, hypertension, diabetes mellitus, previous stroke, etc.), any noted previously prescribed antidepressants (as an index of pre-stroke depression diagnosis), antidepressants prescribed at discharge, aphasia score, depression score, gender, age, race, and ethnicity. Aphasia scores and depression scores were recorded from tests administered within one week following stroke and prior to hospital discharge.

Materials

As part of a larger stroke protocol, aphasia scores were gathered prior to hospital discharge using Item 9 (Best Language) from the National Institute of Health's Stroke Scale.[40] Depression scores were determined using the PHQ-2.[41] Both the NIHSS and PHQ-2 are validated instruments which are readily used as part of standard measurements and are easily administered by health professionals with minimal training in primary and comprehensive stroke centers.[42-44]

NIHSS—With use of Item 9 from the NIHSS in hospital settings, patients are first shown its Cookie Theft Picture and are asked to describe the scene. They are then shown a picture of six objects (a glove, a key, a cactus, a feather, a chair, and a hammock) and are asked to name each of them. Lastly, patients are shown a list of five sentences and are asked to read each of them aloud. Calculated scores range from 0 to 3, with 0 indicating no aphasia, 1 indicating mild-to-moderate aphasia, 2 indicating severe aphasia, and 3 indicating mute, global aphasia. The NIHSS can detect aphasia and can be used as a screening tool to identify aphasia with high specificity and good sensitivity.[45]

PHQ-2—Early screening for depression is now recommended for inpatients with stroke.[42,44] One measure commonly used to detect the presence of depression is the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 consists of nine questions taken directly from the full Patient Health Questionnaire in use throughout clinical settings.[46] Further modifications made to address both difficulties communicating with respondents and the constraints of time-limited settings have produced the Patient Health Questionnaire-2

(PHQ-2), which is made up using only the first two questions found within the PHQ-9 focusing on the presence of anhedonia or depressed mood.[41] Construct and criterion validity of the PHQ-2 have been determined through the concurrent use of other valid measures both in detecting and in monitoring changes in levels of depression.[47] To our knowledge, there are no validation studies of the PHQ-2 in individuals with aphasia, however, Turner et al.[48] determined the PHQ-2 to be the most useful single screen in a heterogeneous sample of participants with stroke, and notably did not exclude persons with aphasia in that study. Additionally, the PHQ-2 has been determined to be valid for use in detecting depression symptoms occurring with other conditions such as migraine,[49] postpartum depression,[50] and brain tumours.[51] The PHQ-2 has been shown to be feasible for use in acute inpatient settings.[43,52]

Screening for PSD symptoms was administered in concordance with inpatient service protocol by nursing staff trained in PHQ-2 assessment. Using a four-point Likert scale, respondents were asked to indicate, throughout the previous two weeks, how often they had been bothered by a) “little interest or pleasure in doing things” or b) “feeling down, depressed, or hopeless.” Scores obtained ranged from 0 to 6, with a score of 3 being a cut-off indicating the presence of depression symptoms. These depression assessments were performed by nursing staff during their shift within the first week post-stroke. For patients with aphasia or unable to participate due to other conditions, scores were obtained with assistance of family members and caregivers at bedside and likely represent an estimation. The purpose of this procedure was to screen patients for possible depressive symptoms but not diagnose depression. Therefore, when depression symptoms were noted, the nursing staff notified the patient’s primary provider to request further evaluation and possible treatment.

Procedure

Selected data were compiled into a spreadsheet using Microsoft Excel. Patients’ responses to Item 9 from the NIHSS were used to assign and record a score indicating aphasia severity. An additional column was created in the spreadsheet to categorize cases as either having aphasia or having no aphasia. For the purpose of this study, the depression scores obtained using the PHQ-2 were dummy coded to create a dichotomous variable, with 1 assigned to indicate the presence of depression and 0 assigned to indicate the absence of depression. The spreadsheet was cleaned and imported to create a dataframe in R Studio (version 1.2.5001). Descriptive statistics were gathered using tables before the dataframe was sliced into two different groups, with one representing adults with aphasia and the other representing adults without aphasia. The incidence proportions of PSD symptoms were calculated among each group and were then combined to calculate the relative risk of developing PSD symptoms with aphasia. Incidence proportions indicate the rate of emerging cases of a specific condition within a specified population over a given period of time,[53] while relative risk compares the rate at which a condition affects persons who have been exposed to a potential cause to the rate at which the same condition affects persons who have not.[54]

The incidence proportions of PSD symptoms in adults with aphasia were calculated by dividing the number of positive screens for PSD symptoms by the total number of adults with aphasia. Incidence proportions of PSD symptoms in adults without aphasia were calculated by dividing the number of positive screens of PSD symptoms by the total number of adults without aphasia using R Studio. Relative risk was calculated using MedCalc for Windows, version 19.5.3 (MedCalc Software, Ostend, Belgium).

Focusing exclusively on the group representing adults with aphasia, logistic regression analyses were conducted to explore potential risk factors contributing to the presence of PSD symptoms in adults with aphasia ($\alpha = .05$). Specifically, separate models explored whether the likelihood that an adult with aphasia in the acute care setting would exhibit PSD symptoms was related to age, gender, race, or aphasia severity. Selected comorbidities (obesity; history of drug or alcohol abuse; previous stroke or transient ischemic attack; coronary artery disease or prior myocardial infarction; dyslipidaemia; diabetes mellitus; atrial fibrillation; history of smoking; hypertension; history of depression indicated by previously prescribed antidepressants; see Table 1) were initially included in the analyses, however, no significant relationships were found to exist in any of the models, therefore those analyses were excluded from the results. It was not possible to analyze stroke location as defined by arterial supply because, of the aphasia cases in this data set (n = 406), an overwhelming majority (n = 253) presented with ischemic stroke classified as “other” (see Table 2). This is because, in those cases, strokes were either not observed during MRI done within the first week of admission or were multifocal in nature.

Results

Descriptive Statistics

Patients’ ages ranged from 19 to 112 years (M = 64.67, SD = 14.925). Forty-six percent of patients identified as female, while 54% identified as male. Regarding race, less than 1% identified as American Indian or Alaskan Native, 1% identified as Asian, 60% identified as Black or African American, less than 1% identified as Native Hawaiian or Pacific Islander, 28% identified as White, and approximately 10% remained unidentified. Among the 406 patients who presented with aphasia, 111 were showing mild-to-moderate aphasia, 107 were showing severe aphasia, and 188 were showing mute, global aphasia. Five hundred sixty-four patients did not have aphasia. One hundred seventy-six patients with aphasia had positive screens for PSD symptoms and 33 patients without aphasia had positive screens for PSD symptoms. Of the entire sample, 42% presented with aphasia, and 22% with PSD symptoms (see Table 3).

Incidence Proportions and Relative Risk

The incidence proportion of PSD symptoms in adults with aphasia was 43.3% while the incidence proportion of PSD symptoms in adults without aphasia was 5.8% over the course of one calendar year (2019) in an acute care setting (see Figure 1). Relative risk showed that adults with aphasia are 7.408 times more likely to exhibit PSD symptoms than adults without aphasia (95% CI: 5.2249 – 10.5057, $p < 0.001$).

Post-stroke Depression Symptoms and Aphasia

No significant relationships were found to exist between age and PSD symptoms ($p = 0.935$), gender and PSD symptoms ($p = 0.889$), or race and PSD symptoms ($p = 0.980$). A significant relationship, however, was found between aphasia severity and PSD symptoms ($p < .001$), with patients 2.06 (OR) times more likely to experience PSD symptoms with every 1-point increase in aphasia severity (95% CI: 1.605 – 2.678).

Discussion

The purpose of this study was to assess the incidence of PSD symptoms in adults with aphasia, compare it to the incidence of PSD symptoms in adults without aphasia, and to identify risk factors for PSD symptoms in adults with aphasia. Overall, the results indicate that the incidence proportion of PSD symptoms in adults with aphasia is much higher than in adults post-stroke without aphasia. The results are comparable to those reported in earlier studies that recruited participants much later following stroke (see Wang, et al., 2018), but lower than other reports.[13] This study was unique in its focus on persons with aphasia in a comprehensive stroke center; the presence of aphasia was not an exclusion criterion, and the PHQ-2 was administered immediately following stroke occurrence.

When controlling for the presence of aphasia, findings indicate that the potential risk factors of age, gender, race, and selected comorbidities shared no significant relationship with PSD symptoms. Curiously, this is different than the findings of earlier work focused on PSD.[2,4-5,12,16,18-21,23] In this study, only aphasia severity shared a significant relation with PSD symptoms. This finding not only aligns with earlier evidence indicating the presence of aphasia is a risk factor for PSD, but also suggests aphasia severity is proportionate to the risk.

Depression is a multi-dimensional disorder[55-57] which is not fully captured within the PHQ-2. It is also possible for both incidence of aphasia and incidence of PSD to change across stages of post-stroke recovery.[13,30] A more longitudinal study incorporating these and other factors across acute, sub-acute, and chronic stages of post-stroke recovery could yield a more robust understanding of this condition. For example, because other cognitive impairments occurring pre- and/or post-stroke were not assessed in this population, those impairments could be factors incorporated into future research designs.

The clinical implications of these findings are related to the treatment for PSD in persons with aphasia. Because the determinant depression scores were obtained before hospital discharge following recovery from stroke, more immediate referrals to the appropriate services could be possible. Unfortunately, while mental health professionals may know what aphasia is, not many have the experience to provide services to persons living with aphasia.[58] This study's results showed that with greater severity of aphasia comes an increasing likelihood of contending with PSD symptoms. Consequently, many of the needed counselling services are unavailable, and with inadequate psychological support, the symptoms of PSD are likely exacerbated,[59] thus fueling a vicious and draining cycle. The current findings underscore the critical need to address PSD symptoms in persons with aphasia.

Limitations

A limitation of this study involved the restricted availability of information regarding specific stroke lesion site. As noted earlier, many of the stroke lesion locations were undetermined, therefore an analysis of lesion location as a risk factor could not be analyzed. Given evidence that lesion location may be a risk factor for PSD in the general stroke population,[60] such information could have contributed to our understanding of risk factors for PSD symptoms in the acute recovery stage. Perhaps studying a larger sample that has been stratified based on stroke lesion sites could yield this information. Relatedly, lesion laterality was not reported in this study. Right hemispheric stroke lesions may also potentially and possibly indirectly affect depression scores due to patients' challenges comprehending questions addressing emotional states.[61-62] At least one study, however, suggests that the risk of developing PSD is proportional to the number of stroke lesions,[12] and with advances in neuroimaging, more studies exploring risk factors focus on the laterality of stroke lesions. Mitchell et al. conducted a meta-analysis and inferred that the risk of developing PSD was higher following a stroke occurring in the left hemisphere of the brain.[13] Nonetheless, there is still some controversy. While additional studies have arrived at similar conclusions,[12] some claim the laterality of lesions shares no relationship with the risk.[4,17] Another limitation involved under-representation of certain groups in the analyses. Although age was normally distributed and two genders each made up approximately half of the sample, other genders were not recorded, and race was more varying. From a total of 970 cases, only two identified as Native Hawaiian or Pacific Islander, only three identified as American Indian or Alaskan Native, and only 13 identified as Asian, each making up no more than 1% of the sample. Furthermore, demographics such as socioeconomic status, primary language, and levels of education were unavailable and could be confounding.[63]

Additionally, the PHQ-2 screens for depressive symptoms within the previous two weeks; administration of the PHQ-2 in the current study occurred within the first week post-stroke onset. Without information regarding history of depression, we cannot rule out the possibility that depressive symptoms were present in the weeks preceding the stroke, or at other points in the participants' histories. This limits our ability to say with certainty that the stroke caused the depressive symptoms that were reported, however, it does not limit the implications of our study, which address the critical issue of depressive symptoms after stroke in persons with aphasia who are often excluded from studies of PSD. Furthermore, there is no gold standard for assessment of depressive symptoms in persons with aphasia.[8,30] As noted earlier, the PHQ-2 is used in acute care settings and is valid in multiple clinical populations.[42-44] Recently, Walter explored an aphasia friendly version of the PHQ-8 with promising results for its use in identifying depressive symptoms.[64] Although it is unknown whether the PHQ-2 is valid in persons with aphasia, its brevity is attractive for this population during the acute post-stroke stage. Further investigation into the psychometric properties of various versions of the PHQ when applied to persons with aphasia, as well as into using caregivers as proxies, will continue to advance the accuracy of PSD diagnosis in this population.

Fourth, although a recent study supports the use of the NIHSS in detecting aphasia, it is possible that a more comprehensive assessment such as the Western Aphasia Battery

would provide a more specific diagnosis, especially when distinguishing mild or moderate aphasias.[65-66] Use of the NIHSS in an acute stroke center is a standard of care, thus the procedure used in the current study reflects the typical procedure used to provide services to patients. The detection of aphasia is preliminary to treatment.

Future Directions

The current study focused on PSD symptoms, their risk factors, and the presence of aphasia in the acute care setting. Future studies should include longitudinal designs to explore the progression, resolution, or stability of PSD and how this course affects incidence rates. Additionally, the methods used to assess PSD symptoms in this study were part of a standard stroke assessment protocol and were constrained by the realities of an acute care setting. As explained earlier, the PHQ-2 is the ideal tool for use in this time-limited setting with individuals who may have difficulty communicating. If researchers seek to include what is learned in an acute care setting as part of longitudinal studies in the future, then, depending on settings and time constraints, lengthier validated screening tools could be utilized.

Conclusions

This study indicates that adults with aphasia are over seven times more likely to screen positive for PSD symptoms than adults without aphasia in an acute care setting, and with greater aphasia severity comes an increasing likelihood of experiencing PSD symptoms. Other variables including age, gender, and race were not identified as risk factors. Overall, these findings highlight the critical need for addressing PSD symptoms in persons with aphasia. Findings highlight the importance of screening for depression in PSD, especially in those with severe aphasia, and making appropriate referrals for treatment and services.

Funding sources:

VMD is supported by the National Institutes of Health (AG054046-04).

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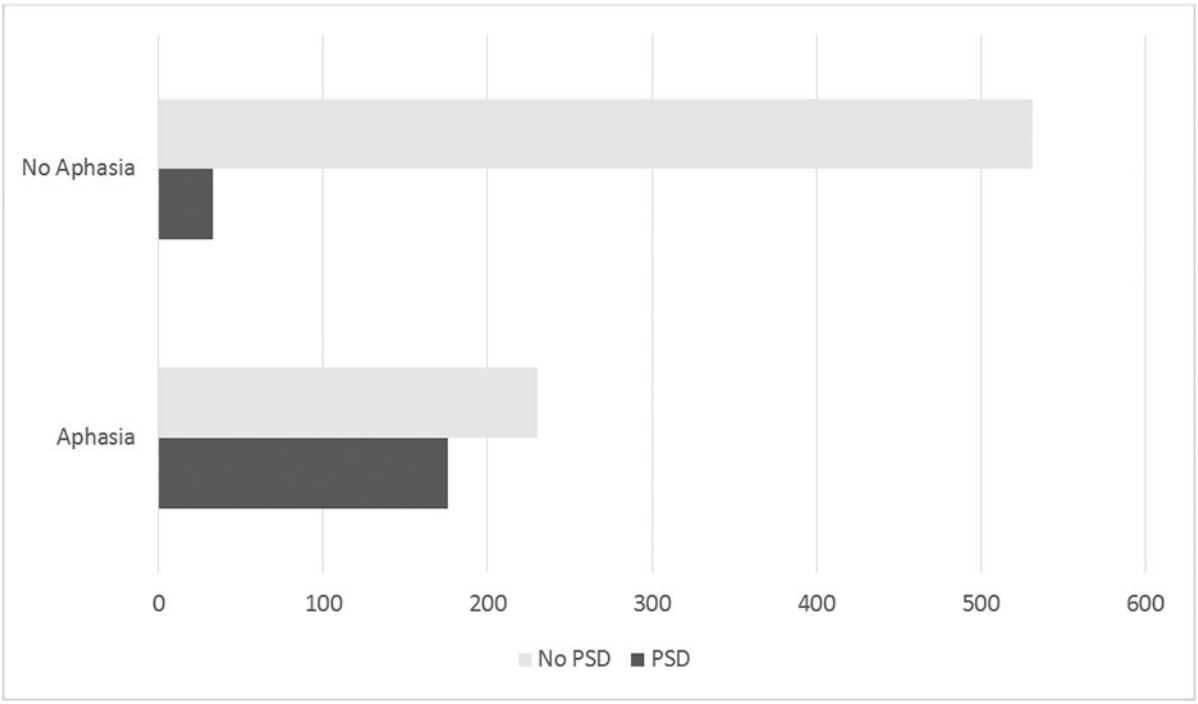

Figure 1. Incidence Proportions of PSD Among Both Persons with and without Aphasia.
Note: Number of cases with no aphasia = 564, number of cases with aphasia = 406, total number of cases = 970.

Table 1.

Selected Comorbidities Among Persons with and without Aphasia.

	Aphasia (n = 406)	No aphasia (n = 564)
Selected Comorbidities		
Obesity	22	34
History of drug or alcohol abuse	42	83
Previous stroke or TIA	119	195
CAD or MI	85	86
Dyslipidaemia	94	148
Diabetes mellitus	137	193
AFib	83	78
History of smoking	109	169
Hypertension	316	438
History of depression	41	39

Note: TIA = transient ischemic attack, CAD = coronary artery disease, MI = myocardial infarction, AFib = atrial fibrillation.

Table 2.

Stroke lesion sites as defined by arterial supply among persons with and without aphasia.

	Aphasia (n = 406)	**No aphasia (n = 564)**
Stroke Lesion Sites		
Basilar artery	6	3
CAB	2	-
Cervical ICA	23	18
Intracranial ICA	3	-
MCA (M1)	95	84
MCA (M2)	20	18
MCA (other)	3	3
Vertebral artery	1	2
Other	253	436

Note: CAB = other cerebral artery branch, ICA = internal carotid artery, MCA = middle cerebral artery.

Table 3.

Descriptive Statistics of Both Persons with and without Aphasia.

	Aphasia (n = 406)	**No aphasia (n = 564)**	**Overall (n = 970)**
Age range in years	23 to 99	19 to 112	19 to 112
Mean age in years (SD)	66.02 (15.140)	63.70 (14.705)	64.67 (14.925)
Gender			
Male	206	315	521
Female	200	249	449
Race			
American Indian/Alaskan Native	1	2	3
Asian	5	8	13
Black or African American	231	352	583
Native Hawaiian/Pacific Islander	0	2	2
White	129	146	275
Undetermined	40	54	94
Aphasia scores			
Mean (SD)	2.190 (0.838)	-	0.916 (1.209)
None (NIHSS Score = 0)	-	564	-
Mild to moderate (NIHSS Score = 1)	111	-	-
Severe (NIHSS Score = 2)	107	-	-
Mute (NIHSS Score = 3)	188	-	-
Post-stroke Depression			
Absent (PHQ ≤ 2)	230	531	761
Present (PHQ >2)	176	33	209

Note: SD = standard deviation, NIHSS = National Institutes of Health Stroke Scale, PHQ = Patient Health Questionnaire.