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ORIGINAL RESEARCH

# Racial-Ethnic Differences in Word Fluency and Auditory Comprehension Among Persons With Poststroke Aphasia

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**Abstract**

**Objectives:** To examine aphasia outcomes and to determine whether the observed language profiles vary by race-ethnicity.

**Design:** Retrospective cross-sectional study using a convenience sample of persons of with aphasia (PWA) obtained from AphasiaBank, a database designed for the study of aphasia outcomes.

**Setting:** Aphasia research laboratories.

**Participants:** PWA (N=381; 339 white and 42 black individuals).

**Interventions:** Not applicable.

**Main Outcome Measures:** Western Aphasia Battery−Revised (WAB-R) total scale score (Aphasia Quotient) and subtest scores were analyzed for racial-ethnic differences. The WAB-R is a comprehensive assessment of communication function designed to evaluate PWA in the areas of spontaneous speech, auditory comprehension, repetition, and naming in addition to reading, writing, apraxia, and constructional, visuospatial, and calculation skills.

**Results:** In univariate comparisons, black PWA exhibited lower word fluency (5.7 vs 7.6; $P=.004$), auditory word comprehension (49.0 vs 53.0; $P=.021$), and comprehension of sequential commands (44.2 vs 52.2; $P=.012$) when compared with white PWA. In multivariate comparisons, adjusted for age and years of education, black PWA exhibited lower word fluency (5.5 vs 7.6; $P=.015$), auditory word recognition (49.3 vs 53.3; $P=.02$), and comprehension of sequential commands (43.7 vs 53.2; $P=.017$) when compared with white PWA.

**Conclusions:** This study identified racial-ethnic differences in word fluency and auditory comprehension ability among PWA. Both skills are critical to effective communication, and racial-ethnic differences in outcomes must be considered in treatment approaches designed to improve overall communication ability.

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Racial-ethnic differences have been reported consistently in stroke-related outcomes.[1-7] Although the incidence of stroke has been decreasing among white Americans, a similar decline has not been observed in black Americans.[8] Blacks are also more likely to experience more severe strokes and at a younger age.[1] Consequently, studies show that blacks experience higher levels of disability compared with whites on traditional measures of poststroke disability such as the FIM.[2] Greater levels of disability have been observed among blacks on other measures of poststroke function including the Barthel Index, Modified Rankin Scale, Stroke Impact Scale, and a questionnaire used to measure performance in activities of daily living and instrumental activities of daily living.[3,4]

Three recent reports[5-7] including large samples of stroke survivors have highlighted racial disparities in poststroke rehabilitation outcomes. Ellis et al[5] completed a systematic review that included 17 studies involving over 429,000 stroke survivors and found that blacks were less likely to achieve the same outcomes as whites after the completion of rehabilitation. A second study by Ottenbacher et al[6] including 161,692 patients from the Uniform Data System for Medical Rehabilitation found that blacks and other minorities had lower admission and discharge functional status compared with whites. A third study[7] of over 1000 stroke

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survivors completing community-based inpatient rehabilitation also found that blacks were less likely to achieve the same functional improvement at discharge as whites. To date, it is unclear why racial-ethnic differences exist in poststroke outcomes. Reduced access to care has been traditionally used as an explanatory factor; however, it does not fully explain the observed differences.[9,10]

Despite reports of racial-ethnic differences in stroke-related outcomes, the same association has not been studied or reported in persons with aphasia (PWA). Aphasia is a poststroke condition that is diagnosed in approximately 180,000 individuals in the United States annually.[11] Aphasia is characterized by deficits in listening comprehension, oral expression, reading, and writing that can result in significant communication limitations even in its mildest form.[12] Additionally, aphasia contributes to the overall economic and societal burden of stroke because it is an independent predictor of longer and more costly hospital stays as well as poorer overall stroke-related outcomes.[13,14] To date, it is also unclear whether PWA experience racial-ethnic differences in poststroke aphasia outcomes in concordance with other aspects of poststroke disability (motor, sensory, cognitive, and functional outcomes) that have been reported previously.[4,5] The objective of this study was to examine whether poststroke aphasia language performance varies by race-ethnicity.

For this study, we evaluated a range of expressive language and receptive language skills. We used total scale scores and subtest scores from the Western Aphasia Battery—Revised (WAB-R).[15] We hypothesized that black PWA would exhibit greater deficits primarily on measures of auditory comprehension when compared with white PWA. Our hypothesis was based on previous reports that have suggested that auditory processes are "almost always"[16(p108)] impaired in aphasia because of the dependence of language on the auditory system.[16] While syntactic impairments, lexical retrieval problems, and paraphasic errors, among others, may be some of the most obvious signs of aphasia, auditory processing impairments are recognized as a primary deficit in aphasia and have been linked to concomitant problems in verbal expression.[17] As well, the greater the auditory comprehension problems in aphasia, the more debilitating they are to overall communication ability.[18]

# Methods

## Data source

This study was submitted to the institutional review board for approval and determined to be exempt from further review. Data for this project were obtained from AphasiaBank, a database designed for the study of aphasia outcomes.[19] AphasiaBank was established in 2007 and funded by the National Institutes of Health, National Institute of Deafness and Communication Disorders.[19] AphasiaBank was developed to offer aphasia researchers a large shared database of clinical and aphasia data from PWA and individuals without aphasia.[19] Researchers involved in the study of aphasia upload data to AphasiaBank based on a standard AphasiaBank protocol that includes (1) speech samples, (2) picture descriptions, (3) story narratives, (4) procedural discourse samples, and (5) standardized test results (Boston Naming Test, Verb Naming Test, WAB-R, etc).

***List of abbreviations:***

| | |
|---|---|
| **AQ** | **Aphasia Quotient** |
| **CI** | **confidence interval** |
| **MANCOVA** | **multivariate analysis of covariance** |
| **PWA** | **persons with aphasia** |
| **WAB-R** | **Western Aphasia Battery—Revised** |

## Data sample

A sample of PWA available in the AphasiaBank database was used for this study. Demographic and clinical data available for each participant include age at time of assessment, sex, race, years of education, occupation, aphasia etiology, duration of aphasia, aphasia type, and medical diagnosis. The race-ethnicity of participants included in the AphasiaBank were defined as white, African American, and Hispanic. Whereas the ethnic label of African American is used in AphasiaBank, the term non-Hispanic black is used more frequently in the general stroke literature. Therefore, we will refer to African Americans as non-Hispanic blacks (blacks) to maintain consistency with the literature reported in the background. Finally, because of the limited sample of Hispanic PWA, we completed comparisons between whites and blacks only.

## Outcome measures

The primary aphasia outcomes of interest in this study were derived from the WAB-R.[15] The WAB-R is a comprehensive assessment of communication function designed to evaluate PWA. The WAB-R includes subtests of spontaneous speech, comprehension, repetition, and naming that are used to calculate a composite Aphasia Quotient (AQ) that characterizes the individual's auditory-verbal communication ability and severity of aphasia. The AQ scores range from 0 to 100, with lower scores indicating greater language deficits. The WAB-R AQ and subtest scores served as outcome measures for the study.

## Aphasia type and severity

Aphasia type was identified in AphasiaBank using the WAB-R.[15] Patients were classified as having 1 of the following types of aphasia: anomic, Broca, Wernicke, global, conduction aphasia, transcortical (motor, sensory, isolation), and other. Aphasia severity was graded based on the work of Pedersen et al[20] where WAB-R AQ scores between 0 and 31.2 indicate severe aphasia, scores between 31.3 and 62.5 indicate moderate aphasia, scores between 62.6 and 93.7 indicate slight (mild) aphasia, and those between 93.8 and 100 suggest no aphasia.

## Statistical analysis

Baseline demographic and aphasia outcomes were described for the complete sample. Comparisons between the 2 racial-ethnic groups (whites and blacks) were completed for all continuous variables using independent samples *t* tests and Pearson chi-square statistics for categorical variables. To compare racial-ethnic differences in language performance, the total scale WAB-R AQ and WAB-R subtests were compared using independent samples *t* tests. For statistically significant group differences (racial-ethnic) in aphasia outcomes (WAB-R scores), multivariate analysis of covariance (MANCOVA) was completed with race group (white vs black) as the independent factor and

WAB-R AQ and subtest scores as the dependent factors, controlling for age and education. All statistical analyses were completed using SPSS 22.[a]

## Results

AphasiaBank contains data for 444 PWA (397 whites, 47 blacks) who were evaluated between 2008 and 2015. After excluding all PWA who did not have WAB-R scores, a final sample of 381 patients (339 whites, 42 blacks) was available for racial comparisons. Characteristics of the sample are shown in table 1. The mean age of the PWA in the sample was 62.8 years, the mean years of education was 15.5 years, and the mean duration of aphasia was 5.4 years. Racial-ethnic differences were observed in mean age ($P<.001$) and years of education ($P<.001$). Sixty-one percent of the sample were men, 88% were right-handed, 94% were born in the United States, 11% exhibited dysarthria, and 37% exhibited apraxia of speech. The largest percentages of the sample were diagnosed with anomic aphasia (32.7%) and Broca aphasia (30.7%). Approximately 60% of the sample exhibited mild aphasia and 26% moderate aphasia. No racial-ethnic differences were observed in aphasia type, duration of aphasia, or aphasia severity.

### Aphasia outcomes

Table 2 shows the racial-ethnic comparisons of aphasia outcomes. The mean WAB-R AQ for the sample was 69.2/100. No racial-ethnic differences were observed in WAB-R AQ. In univariate comparisons of the WAB-R subtest scores, blacks had lower word fluency scores compared with whites (5.7 vs 7.6; $P=.004$). Blacks also had lower auditory word recognition scores (49.0 vs 53.5; $P=.02$) and lower scores for comprehension of sequential commands (44.2 vs 53.2; $P=.01$) than whites. Racial-ethnic differences were not observed in the remaining subtest scores.

### Post hoc analysis excluding individuals with WAB-R AQ scores >93.8

The sample included 24 individuals (23 white, 1 black) who exhibited WAB-R AQ scores >93.8 indicating no aphasia. We included these individuals in the initial analyses because they originally had a diagnosis of aphasia, and the scores reported here represented their abilities at the time of testing. WAB-R AQ scores can fluctuate a few points even when assessed within the same week, and many individuals with scores >93.8 continue to complain of subtle comprehension problems and anomia. Nonetheless, we completed post hoc analyses excluding these participants. No differences were observed in WAB-R AQ scores between the 2 groups; however, differences in word fluency, auditory word recognition, and sequential commands were found.

The MANCOVA was completed with race group (whites vs blacks) as the independent factor and WAB-R word fluency, auditory word recognition, and sequential commands as dependent variables. The MANCOVA was adjusted for the covariates

**Table 1** Aphasia sample characteristics

| Characteristics | Total (N=381) | White (n=339) | Black (n=42) | *P* |
|---|---|---|---|---|
| Age (y) | 62.8±12.0 | 63.8±11.6 | 54.7±12.3 | <.001 |
| Education (y)* | 15.5±2.9 | 15.7±2.9 | 14.1±1.9 | <.001 |
| Sex: male | 237 (61.1) | 216 (62.4) | 21 (50.0) | .119 |
| Handedness | | | | |
| Right | 343 (88.4) | 308 (89.0) | 35 (83.3) | .197 |
| Left | 34 (8.8) | 30 (8.7) | 4 (9.5) | |
| Ambidextrous/unknown | 11 (2.8) | 8 (2.3) | 3 (7.1) | |
| Primary language English | 357 (92.0) | 37 (88.1) | 320 (92.5) | .322 |
| Born in U.S. | 365 (94.1) | 325 (93.9) | 40 (95.2) | .122 |
| Aphasia duration (y) | 5.4±4.9 | 5.2±4.7 | 6.6±5.9 | .151 |
| Aphasia type | | | | |
| Anomic | 127 (32.7) | 116 (33.5) | 11 (26.2) | .807 |
| Broca | 119 (30.7) | 101 (29.2) | 18 (42.9) | |
| Wernicke | 25 (6.4) | 23 (6.6) | 2 (4.8) | |
| Global | 21 (5.4) | 19 (5.5) | 2 (4.8) | |
| Conduction | 40 (10.3) | 35 (10.1) | 5 (11.9) | |
| Transcortical | 17 (4.8) | 16 (5.2) | 1 (2.4) | |
| Other | 38 (9.0) | 36 (9.3) | 3 (7.1) | |
| Aphasia severity | | | | .306 |
| Severe | 26 (6.7) | 24 (7.0) | 2 (4.8) | |
| Moderate | 103 (26.6) | 88 (25.5) | 15 (35.7) | |
| Mild | 22 (58.7) | 203 (58.8) | 24 (57.1) | |
| No aphasia | 31 (8.0) | 30 (8.7) | 1 (2.4) | |
| Motor speech disorders | | | | |
| Dysarthria | 44 (11.3) | 35 (10.1) | 9 (21.4) | .033 |
| Apraxia | 143 (36.9) | 129 (37.3) | 14 (33.3) | .181 |

NOTE. Values are mean ± SD, n (%), or as otherwise indicated.
* Education: 12 years = high school education.

**Table 2** Univariate comparisons of WAB-R AQ and subtest scores by race

| Measures | Total (N=381) | White (n=339) | Black (n=42) | *P* |
|---|---|---|---|---|
| WAB-R AQ | 69.2±20.7 | 69.7±21.0 | 65.1±17.6 | .118 |
| Spontaneous speech | | | | |
| Information content | 7.5±2.4 | 7.6±2.4 | 7.3±2.2 | .502 |
| Fluency | 6.0±2.6 | 6.1±2.6 | 5.4±2.4 | .061 |
| Repetition | 64.2±27.7 | 64.4±28.2 | 63.1±22.8 | .739 |
| Naming | | | | |
| Object naming | 43.3±17.6 | 43.3±17.7 | 42.1±17.5 | .648 |
| Word fluency | 7.4±4.9 | 7.6±5.1 | 5.7±3.6 | .004 |
| Sentence completion | 7.8±2.9 | 7.8±2.9 | 7.2±2.8 | .200 |
| Responsive speech | 7.7±3.2 | 7.7±3.2 | 7.1±3.1 | .230 |
| Comprehension | | | | |
| Yes/no | 55.3±5.8 | 55.5±5.9 | 54.4±4.8 | .184 |
| Auditory word recognition | 53.0±9.9 | 53.5±9.6 | 49.0±1.8 | .021 |
| Sequential commands | 52.2±22.5 | 53.2±22.4 | 44.2±21.1 | .012 |

NOTE. Values are mean ± SD or as otherwise indicated.

age and years of education, which were significant in univariate comparisons (table 3). A significant main effect for group (race) was observed for the 3 subtests, controlling for the covariates age and education ($P=.04$). The adjusted means for WAB-R word fluency were lower for blacks (5.5; 95% confidence interval [CI], 3.9−7.1) compared with whites (7.6; 95% CI, 7.1−8.2) ($P=.02$). Similarly, auditory word recognition scores were lower for blacks (49.3; 95% CI, 46.1−52.3) compared with whites (53.3; 95% CI, 52.2−54.4) ($P=.02$). The adjusted means for WAB-R sequential commands were also lower for blacks (43.7; 95% CI, 36.4−51.0) when compared with whites (53.2; 95% CI, 50.8−55.6) ($P=.01$).

## Discussion

The findings reported here demonstrate racial-ethnic differences in aphasia outcomes related to word fluency and domains of auditory comprehension. Whereas the overall measure of communication function (WAB-R AQ), as well as measure of aphasia type and severity, was similar, black PWA exhibited greater deficits in word fluency, auditory word recognition, and comprehension of sequential commands after controlling for baseline differences in age and education. To our knowledge, this is the first study of racial-ethnic differences in aphasia outcomes. No such evidence has emerged in the study of aphasia, although the general stroke outcomes literature suggests racial-ethnic differences with generally worse outcomes among racial-ethnic minorities. For example, Ottenbacher[6] found that FIM postrehabilitation discharge scores and efficiency scores (FIM score/length of stay) were lower among blacks when compared with whites. Similarly, black stroke survivors reported lower levels of functional independence than white stroke survivors at 1 year despite nonsignificant differences in stroke severity or utilization of rehabilitation services.[4]

The underlying cause of the observed differences in word fluency is not clear. Tests of word fluency are used in research and clinical practice to support diagnoses of language, cognitive impairment, or both.[21] A greater emphasis has emerged regarding race-based norms of tests such as word fluency to ensure racial-ethnic minorities are not misdiagnosed with language and cognitive issues.[22] Studies have shown that nonneurologically impaired blacks score lower on measures of word fluency than similar cohorts of whites.[23] For example, Molrine and Pierce[24] examined racial differences in WAB-R subtests among 48 (24 black, 24 white) non−brain-damaged adults and found that only WAB-R word fluency subtest scores differed between whites and blacks. What is not entirely clear is the clinical relevance of the approximate 2-word difference between the 2 groups that emerged as statistically significant.

The underlying cause of the observed differences in auditory comprehension ability is also unclear. Observed racial-ethnic differences in stroke-related outcomes can be influenced by a wide range of neurologic, sociodemographic, and clinical management factors (differences in amounts of therapy, lack of access to rehabilitation care and referrals to postacute services).[25] Putman et al[25] also proposed potential differences in the postdischarge environments as contributors to racial-ethnic differences in outcomes. They found racial differences in stroke outcomes despite blacks and whites exhibiting similar outcomes and recovery trajectories after participating in inpatient rehabilitation programs. Therefore, identifying the underlying cause of such differences in outcomes and the specific time points in the

**Table 3** Estimated marginal means of multivariate comparisons of WAB-R subtest scores by race

| WAB-R Subtests | White | Black | *P* |
|---|---|---|---|
| Word fluency | 7.6 (7.1−8.2) | 5.5 (3.9−7.1) | .015 |
| Auditory word recognition | 53.3 (52.2−54.4) | 49.3 (46.1−52.3) | .018 |
| Sequential commands | 53.2 (50.8−55.6) | 43.70 (36.4−51.0) | .014 |

NOTE. Values are mean (95% CI) or as otherwise indicated. MANCOVA model controlling for age and years of education.

recovery trajectory where such differences can emerge requires further investigation.

Because the aphasia data reported here all emerged from individuals experiencing a stroke, some consideration must be given to racial differences that have been reported previously in stroke subtypes. Data from the Northern Manhattan Study[26] revealed that higher (age-adjusted) rates of all stroke subtypes existed among blacks when compared with whites. Of significant interest here was the greater proportion of blacks with small vessel disease. It has been hypothesized that greater cognitive impairment exists among individuals with small vessel disease.[27] It is tenable then that the presence of small vessel disease may be an explanatory factor for the greater racial-ethnic differences in specific language impairments after aphasia. More specifically, it is possible, based on this evidence, that blacks may have greater cognitive impairment, in addition to their aphasia, that contributes to the racial-ethnic differences observed.

However, stroke subtype is not necessarily related to aphasia type or severity. Regardless of stroke subtype, the location of a stroke will dictate presence of aphasia, aphasia type, and aphasia severity, since all are determined by which language-related structures or combination of structures are damaged or disrupted. Regardless, future studies should consider whether observed racial differences in stroke subtypes contribute to racial differences in aphasia outcomes.

Despite our controlling for age, it is notable that the blacks were approximately 9 years younger than the whites. Age, therefore, might still be a contributing factor. Even though atherosclerosis is an underlying cause of stroke in both young and old adults, the relative frequency by which it causes stroke in young adults is significantly different than in older adults.[28] It is tenable that stroke type and younger age may combine to influence aphasia type, severity, and overall aphasia outcomes.

Similarly, additional consideration should be given to the effect of aphasia severity in these comparisons. Despite a lack of statistically significant differences in WAB-R AQ scores, visual inspection of the proportion of individuals at each severity level in these racial-ethnic groups suggests a potentially relevant difference. The proportion of blacks with moderate aphasia was approximately 10% greater than that for whites. Because severity levels range approximately 30 points per severity level, the groups are quite heterogeneous in regards to specific impairments. Therefore, it may be that the greater number of blacks with moderate aphasia accounts for the observed differences in word fluency, auditory word comprehension, and comprehension of sequential commands.

Interestingly, the racial-ethnic differences that were observed parallel previously reported differences in poststroke motor function, sensory function, cognitive function, and overall functional ability.[3-5] Currently, there is a substantial literature related to aphasia treatment outcomes, yet less is known about the effect of different racial-ethnic backgrounds on outcomes across patients.[29] Consequently, some aphasia outcomes may not apply as strongly to different racial-ethnic groups that differ in nonclinical factors (eg, insurance, availability of services, costs of services, access to quality equitable care).[30] As a result, there is concern regarding the relationship between these nonclinical factors and frequently observed disparities in general stroke outcomes, and additional studies are needed to address these issues.

## Study limitations

The findings reported here are interesting, but this study has several limitations. First, although we attempted to control for age and years of education, caution should be exercised when controlling for these factors as covariates. The total sample included here exhibited high levels of education and may not reflect a typical poststroke aphasia population. Years of education is believed to be an inadequate measure of educational attainment, and quality of education may be a more important factor.[31] Further, statistical control for age and education assumes a linear relationship between the covariate and the dependent variable. Similarly, covariance does not account for unmeasured variables that influence test performance.[32] Second, the sample size of blacks was approximately 11% of the total sample. A larger sample may yield different results. Third, the study was a retrospective data analysis which, by nature, has general limitations because the cohort data were collected for purposes other than making racial-ethnic comparisons in outcomes. Fourth, the data emerged from research centers in different regions of the United States. Access to quality care can vary greatly in different regions of the United States and thereby significantly affect clinical outcomes.[33]

# Conclusions

Understanding racial-ethnic differences in stroke and stroke-related conditions such as aphasia is difficult because of the complex interrelationship among factors that both cause stroke and influence outcomes. Access-to-care issues have been frequently identified as a key factor in disparities in outcomes for conditions such as stroke.[10] However, reduced access to care does not consistently explain the nature of racial-ethnic differences in outcomes observed in this study. Greater emphasis has been placed on the "social determinants of health" or the "conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life."[34] Consequently, the social determinants of health should be considered in outcomes research investigating health disparities.[35] Specifically, the field of speech-language pathology should include the racial-ethnic backgrounds of PWA consistently in research studies. In the absence of this basic information, drawing conclusions from samples that are already heterogeneous (age, education, socioeconomic status, social support, aphasia severity, aphasia profiles) becomes even more difficult when factors known to be associated with racial-ethnic differences are excluded. Similarly, clinicians engaged in the care of individuals with aphasia must give consideration to the social determinants of health and their potential contribution to racial-ethnic differences in outcomes when developing and generating treatment plans designed to improve aphasia outcomes. Systematic study of aphasia outcomes will be required to adequately understand the true effect of race/ethnicity on aphasia outcomes. A longitudinal approach should be considered that includes outcomes beyond aphasia impairment scores, functional aphasia scores, and services received. Poststroke aphasia outcome measures should also include measures of the social networks of PWA, which are known to affect poststroke outcomes beyond treatment settings.[36]

## Supplier

a. SPSS 22; IBM Corp.

## Keywords

Aphasia; Blacks; Minority groups; Rehabilitation

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