

Relationship of Stroke Risk and Hearing Loss in African Americans

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Abstract

Objective: To evaluate the relationships among measures of stroke risk and hearing in an African-American cardiovascular study cohort

Study design: Cross-Sectional Study

Methods: The relationships between stroke risk profiles and hearing of 1,107 individuals were assessed. Pure-tone averages (PTA's) were constructed representing different frequency regions of hearing (i.e., PTA4= 500, 1000, 2000 & 4000 Hz; PTA low= 250 & 500 Hz; PTA mid= 1000 and 2000 Hz; and PTA high= 4000 & 8000 Hz). Gamma regression analyses were performed for each PTA given as a continuous variable with change in stroke risk score. Logistic regression analyses, presented as odds ratios, were performed with "hearing loss" defined as any PTA > 25 dB hearing level.

Results: Single unit increases of stroke risk percentage were found to be predictive of increases in all PTA threshold levels in gamma regression analyses. One of the most robust relationships was observed between stroke risk and the PTA high (RR=1.022, C.I.=1.019, 1.026, p<0.001), of the worse ear, such that for every unit increase in stroke risk percentage, PTA high increases by 2.2%. Similar relationships were observed between these variables in logistic regression analyses. For each 1 unit increase in stroke risk percentage, there are 10% higher odds of hearing loss (OR=1.10, C.I.=1.078, 1.113, p<0.001). For all analyses, the relationship between stroke risk and hearing loss was greater for the PTA high compared to all other PTAs.

Conclusion: Our study provides evidence that as stroke risk increases the measure of hearing loss also increases, most notably for the high frequency regions of hearing; the clinical significance of this relationship cannot be estimated given the nature of the cross-sectional study design.

Introduction

Stroke is a leading cause of morbidity and mortality in the U.S. and leads to many devastating symptoms¹. Auditory dysfunction in patients with strokes has been well described and ranges from central to peripheral deficits². One study found that patient with sudden sensorineural hearing loss have a 1.64 time greater risk of developing a stroke over a five year period than a control group with normal hearing³. Another study observed that patients with moderate to severe hearing loss had a significantly higher likelihood of reporting previous stroke⁴. Exact mechanisms to these findings still have not been elucidated.

The cochlea's vasculature is quite complex, although it is supplied by a single end artery, and is thus highly vulnerable to decreased blood flow and microvascular pathologies⁵. There is increasing evidence reporting associations between cardiovascular disease and its risk factors with hearing loss⁶⁻⁷. Hearing loss has also been associated with other micro-ischemic pathologies such as retinopathy and chronic kidney disease⁸⁻⁹. There are however no other studies looking at the relationship of stroke and its risk factors to hearing loss.

The atherosclerotic cardiovascular disease (ASCVD) risk estimator is a tool used to estimate a patient's 10-year risk of developing stroke or myocardial infarction¹⁰. Risk factors used include age, hypertension, hypertension treatment, diabetes, smoking status, and total & HDL cholesterol. In order to investigate the relationship of stroke and hearing loss we analyzed the ASCVD risk and hearing loss as measured by pure-tone audiometry obtained from an ancillary study of the Jackson Heart Study, a heterogeneously all-African American cohort.

Discussion

Our results show a likely strong relationship to stroke risk and hearing loss, most notably in the high frequencies. However, a cause-and-effect relation cannot be inferred from this association. The ASCVD profile was used to represent a disease process of microvascular pathology, although the relationship to hearing loss may be more strongly related to the ASVD risk factors than the disease process itself. Future research will focus on assessing independent relationship of stroke risk profile variables to hearing loss.

Table 1. Participant demographics and risk factors

Characteristics	Mean(sd) or n(%)
Participants	n = 1,107
Age	60.4 (9.7)
Male Sex	341 (30.8%)
Systolic BP	125.1 (16.2)
BP Medication	680 (61.4%)
Total Cholesterol	197.3 (40.7)
HDL Cholesterol	54.3 (15.2)
Statin Medication	304 (27.5%)
Diabetes	269 (24.3%)
Smoker	112 (10.1%)
Low Risk	315 (28.5%)
Medium Risk	134 (12.1%)
High Risk	658 (59.4%)

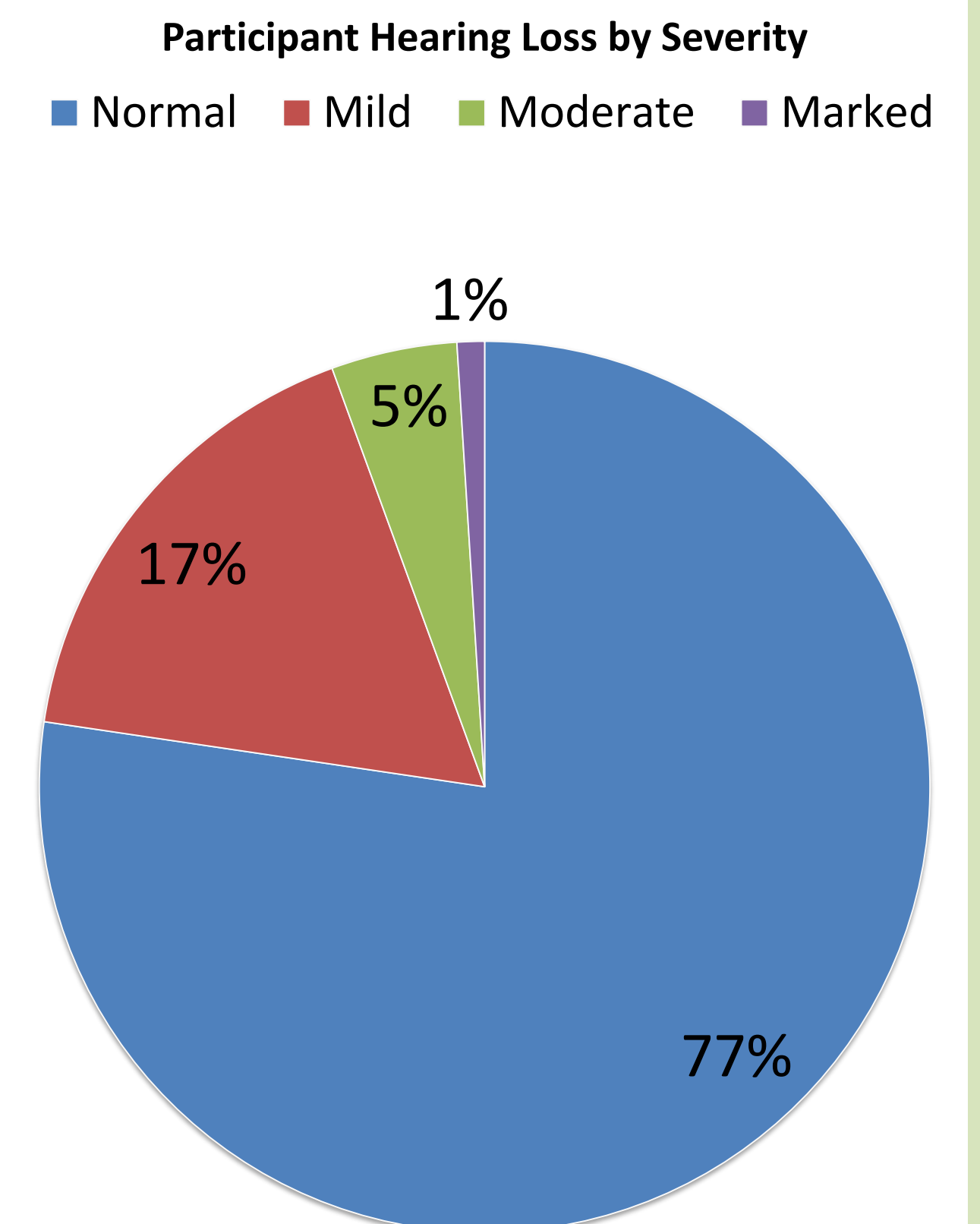


Chart 1. Percentage of participants with hearing loss defined by PTA4: Normal (<25dB), Mild (25-40dB), Moderate (40-70dB), Marked (>70dB)

Table 2. Distribution of participants with hearing loss for stroke risk categories

Stroke Risk Category	Hearing Loss by PTA4 Worse ear n (% participants with HL in that category)
Low Risk	22 (6.98%)
Medium Risk	28 (20.90%)
High Risk	238 (36.17%)

Description: Number of participants with hearing loss defined as PTA4 ≥ 25dB. Stroke risk categories according to cut points in the literature: Low (0-5%), Medium (5-7.5%), and high (≥ 7.5%)

Table 3. Association of stroke risk percentage with hearing loss by gamma regression

Hearing measure outcome	Worse ear
Hearing Loss (PTA4)	1.018 (1.015, 1.021) ***
Hearing Loss (PTA Low)	1.013 (1.01, 1.016) ***
Hearing Loss (PTA Mid)	1.017 (1.015, 1.02) ***
Hearing Loss (PTA High)	1.022 (1.019, 1.026) ***

Description: Association of hearing loss (>25dB HL) to ASCVD risk profile, given as gamma regression coefficients for hearing loss defined as PTA4 (500, 1000, 2000, 4000 Hz), PTA Low (250, 500 Hz), PTA Mid (1000, 2000 Hz), and PTA High (4000, 8000 Hz). *** p<0.001

Table 4. Association of stroke risk percentage with hearing loss by Logistic Regression

Hearing measure outcome	Worse ear
Hearing Loss (PTA4)	1.07 (1.056, 1.085) ***
Hearing Loss (PTA Low)	1.04 (1.027, 1.057) ***
Hearing Loss (PTA Mid)	1.06 (1.047, 1.075) ***
Hearing Loss (PTA High)	1.10 (1.078, 1.113) ***

Description: Association (logistic regression) of hearing loss (>25dB HL) to stroke risk profile, given as odds ratio of hearing loss defined as PTA4 (500, 1000, 2000, 4000 Hz), PTA Low (250, 500 Hz), PTA Mid (1000, 2000 Hz), and PTA High (4000, 8000 Hz). *** p<0.001

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