



Research Paper

Cardiovascular risk factors and hearing loss among adults in a tertiary center of Northwestern Nigeria



Stephen Semen Yikawe ^{a,*}, Kufre Robert Iseh ^a,
Anas Ahmad Sabir ^b, Mfon Ime Inoh ^a, Joseph Hassan Solomon ^a,
Nasiru Aliyu ^a

^a Department of Otolaryngology, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

^b Department of Internal Medicine, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

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KEYWORDS

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Abstract *Objective:* To assess the effect of cardiovascular risk factors on hearing impairment.

Methods: This was a cross sectional study conducted in Usmanu Danfodiyo University Teaching Hospital, Sokoto. A pretested questionnaire was used to obtain information about the biodata and medical history of participants after which, they were examined and had their hearing thresholds measured.

Results: In this study, total of 220 participants were recruited. Within these participants, 112 (55.5%) were females, while 98 (44.5%) were males. The average age of the participants was (45.24 ± 12.21) years. The mean of pure tone average among the participants was (19.15 ± 9.28) dB HL. Thirty-six (16.4%) of the participants had some degree of hearing loss. Besides, 30 of them (13.6%) had hypertension, while 23 (10.5%) presented with diabetes mellitus. In addition, 43 participants (19.5%) had BMI (body mass index) that was ≥25 kg/m². Also, 9 out of the 220 participants (4.1%) had a history of cigarette smoking. Our studies indicated that hypertension, diabetes mellitus, BMI of ≥25 kg/m², and aging were significantly associated with the risk of hearing loss. In contrast, cigarette smoking and sex were not associated with the hearing loss.

* Corresponding author. Department of Otolaryngology, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Sokoto State, Nigeria.

E-mail address: syikawe@gmail.com (S.S. Yikawe).

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Conclusion: This study showed that hypertension, diabetes mellitus, aging, and higher BMI were associated with increase risk of hearing loss.

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Introduction

According to the standards from World Health Organization (WHO), a patient with hearing loss is defined as a person who is not able to hear at a threshold of 25 dB or better in both ears.¹ Ear disease and hearing impairment are neglected public health problems in developing countries.² However, eighty percent of deaf and hearing impaired people live in low to middle income countries, 50% of which are avoidable through prevention, early diagnosis, and management.^{1,3,4}

Prevalence of hearing loss increases with age and it is higher among males than females.² Globally the prevalence of hearing impairment ≥ 35 dB HL for individuals aged 15 years and above is 12.2% for males and 9.8% for females.² The prevalence of mild hearing impairment is 22.7% for adult males and 19% for adult females.² A population based survey done by Nwawolo et al (unpublished data), which included 8975 respondents in Akwa-Ibom, Benue, and Katsina of Nigeria showed a prevalence of mild hearing impairment of 8.3% in persons > 4 years, and the prevalence of disabling hearing impairment of 6.2%.⁴

Cardiovascular risk factors like diabetes mellitus, hypertension, cigarette smoking, obesity, and hyperlipidemia have been indicated to be associated with hearing loss in various studies,⁵ though the mechanisms are still under debate.⁶ Hearing thresholds are higher in diabetics at every frequency when compared with non-diabetics, particularly at higher frequency. The symmetric sensorineural hearing loss has been observed within these patients,^{7,8} which could be due to microangiopathy of the inner ear or neuropathy of the cochlear nerve.⁹ The pattern of high frequency sensorineural hearing loss is also observed among hypertensive patients.¹⁰ Decreased blood supply to the stria vascularis due to vasoconstriction has been observed among hypertensive patients.¹⁰ High vascular pressure may cause hemorrhage into the inner ear causing progressive or sudden sensorineural hearing loss.¹¹ Cigarette smoke contains nicotine and carbon monoxide. Nicotine causes vasospasm and reduces blood supply to the inner ear, while carbon monoxide reduces the capacity of blood to deliver oxygen to the cochlear.^{12,13} Obesity along with other cardiovascular risk factors compromises the function of the stria vascularis by reducing its blood supply.⁵ Higher body mass index (BMI) has been demonstrated to be associated with risk of hearing impairment,^{14–16} which could be reduced with increased physical exercise.⁵ This study intends to assess the effects of cardiovascular risk factors on hearing impairment among adults in a tertiary hospital.

Materials and methods

Study design

This was a tertiary institution based cross sectional study among patients attending the general outpatient and medical outpatient departments of Usmanu Danfodiyo University Teaching Hospital Sokoto, conducted between December 2015 and April 2016. Institutional ethical approval was obtained and informed consent was taken before patients were recruited into the study.

The inclusion criterion of this study was adults that attended the General and Medical outpatient clinics of Usmanu Danfodiyo University Teaching Hospital, Sokoto, participants with a history of ear surgery performed in the past, exposure to loud sounds, recently use of ototoxic drugs, and ear diseases were excluded from the study.

Medical history and risk factor assessment

A pretested interviewer administered questionnaire was used to obtain information about biodata and medical history of participants. Diabetes mellitus and hypertension were considered as risk factors in participants whose diagnosis was made by a physician. Cigarette smoking was considered as a risk factor in participants that had smoked 20 pack years or more. BMI was calculated by dividing the weight in kg by the square of the height in meters. A BMI of 25 kg/m² and higher was considered as a risk factor. Participants had general physical examination including weight and height measurements. Weight was taken after participants removed shoes, bulky clothing, and emptied their pockets. They were instructed not to touch any object and to keep their feet on the center of the platform. Height was measured after participants removed shoes, caps, and headscarves. They were instructed to stand with the back as erect as possible, looking straight ahead. Height was measured by lowering the height indicator until it firmly touched the crown of the head with sufficient pressure to compress the hair.

Pure tone audiometry

Participants had examination of their ears done (any obstructing wax observed during otoscopy was removed). They then had their hearing thresholds measured using the Modified Hughson–Westlake method with a diagnostic audiometer (Oscilla SM 960 – D, diagnostic memory audiometer, Denmark) in a sound isolated room which satisfied the criteria of ISO – 8253 – 1. Average of audiometric

hearing threshold at 500, 1000, 2000 and 4000 Hz for both air and bone conduction was determined, this was taken to be the pure tone average for both air and bone conduction. This was categorized in accordance to the WHO grades of hearing impairment as follows: normal hearing (<25 dB), mild hearing loss (26–40 dB), moderate hearing loss (41–60 dB), severe hearing loss (61–80 dB), profound hearing loss (81 dB or greater).¹⁷

Data analysis

Data analysis was done using statistical package for the social sciences version 21 (IBM – SPSS Inc., Chicago, IL). *Chi-square* test was used to determine the relationship between categorical variables and *t* test was used to determine the relationship between quantitative variables. Multivariate analysis was done to test for association between variables. Data was presented using tables. Level of significance was set at $P < 0.05$.

Results

A total of 220 patients were recruited for the study among which, one hundred and twenty two (55.5%) were females while 98 (44.5%) were males (Table 1). The average age of participants was (45.24 ± 12.21) years with ages ranging from 22 to 87 years. The mean age among participants with hearing loss was (60.19 ± 9.87) years, while the mean age among participants that had normal hearing thresholds was (42.32 ± 10.36) years ($P = 0.000$). The mean pure tone average among participants was (19.15 ± 9.28) dB. Thirty-six (16.4%) of the participants had some degree of hearing loss, while the other 184 (83.6%) participants had normal hearing. Within the hearing loss participants, twenty-eight (12.7%) had mild hearing loss, while 8 (3.6%) of them had moderate hearing loss. Higher degrees of hearing loss were not observed among participants in this study.

Out of the 220 participants enrolled into the study, 30 (13.6%) had hypertension, 23 (10.5%) had diabetes mellitus. Forty-three (19.5%) of the participants had BMI of ≥ 25 kg/m², while nine (4.1%) had a history of cigarette smoking.

Diabetes mellitus, hypertension, BMI of ≥ 25 kg/m², and age of ≥ 50 years were found to be associated with increase

prevalence of hearing loss ($P < 0.05$, Table 1). In contrast, cigarette smoking was not significantly related with increase prevalence of hearing loss based on our studies ($P > 0.05$, Table 1).

BMI of ≥ 25 kg/m², presence of diabetes mellitus, and hypertension were observed to be predictors of hearing loss among participants after multivariate analysis ($P < 0.05$, Table 2). Participants with a BMI of ≥ 25 kg/m² and diabetics had increased odds of having hearing loss (odds ratio 2.8, 95% confidence interval (CI) 1.2–6.8 and odds ratio 4.2, 95% CI 2.6–6.9 respectively, Table 2). However, aging, 50-year-old and above, was not observed to be a predictor of hearing loss ($P > 0.05$, Table 2).

Discussion

In this study, the prevalence of hearing loss was 16.4%, with 12.7% having mild degree of hearing loss and 3.6% having moderate degree of hearing loss. This result agrees with a study conducted by Nwawolo et al (unpublished data) in three states of Nigeria where they observed a prevalence of mild hearing loss of 8.3% among participants > 4 years.⁴ Lin et al¹⁸ however observed a prevalence of hearing loss of 63.1% among the 717 participants that were enrolled in their study. Their study was conducted among older adults, aged 70 years and above. Thus, the high prevalence of hearing loss that observed could have been due to age

Table 2 Multivariate analysis of risk factors of hearing loss among participants.

Variable	<i>P</i> value	Odds ratio	95% confidence interval
BMI (≥ 25 kg/m ² vs < 25 kg/m ²)	0.019	2.8	1.2–3.7
Age (≥ 50 years vs < 50 years)	0.108	2.0	0.9–4.7
DM status (Diabetic vs Non-diabetic)	0.000	4.2	2.6–6.9
Hypertension status (Yes vs No)	0.024	3.1	1.1–4.2

Table 1 Risk factors of hearing loss among participants [case (%)].

Variable		Normal Hearing (<i>n</i> = 184)	Hearing loss (<i>n</i> = 36)	χ^2	<i>P</i>
Sex	Males	81 (82.7)	17 (17.3)	0.125	0.724
	Females	103 (84.4)	19 (15.6)		
Diabetes mellitus status	Diabetics	11 (47.8)	12 (52.2)	24.067	0.000
	Non-diabetics	173 (87.8)	24 (12.2)		
Hypertension status	Hypertensives	19 (63.3)	11 (36.7)	10.463	0.001
	Non-hypertensives	165 (86.8)	25 (13.2)		
Cigarette smoking	Yes	6 (66.7)	3 (33.3)	1.974	0.160
	No	178 (84.4)	33 (15.6)		
Body mass index	≥ 25 kg/m ²	30 (69.8)	13 (30.2)	7.512	0.006
	< 25 kg/m ²	154 (87.0)	23 (16.0)		
Age	≥ 50 years	43 (71.7)	17 (28.3)	8.637	0.003
	< 50 years	141 (88.1)	19 (11.9)		

related hearing loss among their participants.¹⁸ This study observed the mean age among participants with hearing loss to be (60.19 ± 9.87) years, and (42.32 ± 10.36) years among participants that had normal hearing thresholds. Age was associated with increased risk of hearing loss in this study. This is in agreement with a study conducted by Dawes et al¹² who reported that age is a significant risk factor for hearing impairment. Starck et al¹³ also reported age to be the most significant risk factor for sensorineural hearing loss among the 370 participants they assessed.

However, further multivariate analysis including age, hypertension, diabetes mellitus status, BMI, indicated age was not a predictor of hearing loss. This is in agreement with findings by Agrawal et al,¹¹ who studied participants in the National health nutrition examination survey (NHANES) from 1999 to 2002 in the USA. They observed that age did not have any significant effect on the risk of hearing impairment after further analysis. Lin et al¹⁸ however reported increase in age and male sex as factors strongly associated with hearing loss after multivariate analysis. The older a participant is, the more risk factors of hearing loss he/she is exposed to. Thus, although age was not observed to be a predictor of hearing loss in this study, the older participants might have had higher hearing threshold due to exposures to other risk factors of hearing loss.

This study did not observe any significant association between gender and hearing loss. Dawes et al¹² reported similar findings in a population based cross sectional study of 164,770 participants in the UK. Other studies have however observed hearing loss to be worse among men when compared with women.^{2,18}

In this study, 13.6% of participants had hypertension. Hypertension was associated with increased risk of hearing loss (*OR* 3.1; 95% *CI* 1.1–4.2). Agrawal et al¹¹ and Lin et al¹⁹ reported associations between hypertension and the risk of hearing impairment in their studies, both of which were prospective. They however observed higher prevalence of hypertension among their participants (27% in the study conducted by Agrawal et al,¹¹ and 30.8% prevalence in the study conducted by Lin et al¹⁹). Starck et al¹³ further corroborated these findings in their study where they reported that diastolic blood pressure had an effect on hearing impairment. However, Shargorodsky et al⁶ together with other studies did not observe any association between hypertension and the risk of hearing loss, in contrast to the findings of former studies.^{18,20}

In this study, it was observed that 10.5% of participants had diabetes mellitus. Diabetes mellitus was associated with risk of hearing impairment (*OR* 4.2; 95% *CI* 2.6–6.9). This is in agreement with some previous studies.^{11,20} Agrawal et al¹¹ reported an association between diabetes mellitus and hearing impairment (*OR* 2.0; 95% *CI* 1.2–3.2), and they reported a prevalence of diabetes mellitus of 6.9%. Bainbridge observed that two thirds of participants that had diabetes mellitus had high frequency hearing impairment and 26% had low/mid frequency hearing impairment.²⁰ Other authors however did not observe any association between the risk of hearing impairment and diabetes mellitus.^{6,18}

Out of the 220 participants in our study, 19.5% had BMI of ≥25 kg/m². Our results demonstrated that BMI was associated with the increased risk of hearing (*OR* 2.8; 95% *CI*

1.2–3.7). This is in agreement with a study on independent association between BMI, waist circumference, physical activity, and self-reported hearing loss conducted among 68,421 female nurses by a former study.⁵ They reported that higher BMI and larger waist circumference were associated with increased risk of hearing loss.⁵ They also observed that physical activity decreased the risk of hearing impairment among their participants.⁵ Fransen et al¹⁵ also observed that high BMI was associated with hearing loss in a European multicenter study, further corroborating the findings in this study. Shargorodsky did not observe any association between BMI and hearing loss, though they observed that elevated cholesterol was associated with 10% increase in hearing loss.⁶

Cigarette smoking was not associated with increased risk of hearing loss in this study. Only 9 (4.1%) participants reported a history of current or past cigarette smoking of ≥20 pack years. This is in contrast to the findings by several authors.^{6,11,12,21} Dawes et al¹² observed that current smokers were more likely to have hearing loss than non-smokers (*OR* 1.28; 95% *CI* 1.21–1.35), and passive smokers were also more likely to have hearing loss. Nakashima et al²¹ also observed that current smokers showed a significant increase of hearing loss compared with non-smokers. Bainbridge et al²⁰ however did not observe any effect of cigarette smoking on hearing impairment. The findings on the effect of cigarette smoking on hearing impairment among participants in this study may be due to the small number of participants that smoked cigarette.

Conclusion

Cardiovascular risk factors have been observed to affect hearing threshold in several studies. This study observed a 16.4% prevalence of hearing loss among participants. Hypertension, diabetes mellitus, age, and higher BMI were the cardiovascular risk factors associated with hearing impairment. Further multivariate analysis however showed that age was not a predictor of hearing loss in this study. Cigarette smoking was not observed to be associated with hearing impairment in this study. A larger population based study is needed.

Conflict of interest

The authors declare no conflict of interest relevant to this report.

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