Afr. J. Med. med. Sci. (2016) **45,** 413-420

Prevalence, pattern and predictors of hearing loss among rural school-age children in Ogun State, Nigeria

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Abstract

Background: Hearing loss is one of the commonest and most neglected disabilities in developing countries. However, most of these are preventable with early detection through screening and appropriate interventions.

Methods: We determined the prevalence, pattern and predictors of hearing loss in school aged children in selected rural communities in Ogun state, Nigeria, using a cross sectional study design. A multistage cluster sampling technique was used to select 305 pupils from 6 randomly selected primary schools. Semi-structured interviewer administered questionnaires and a calibrated Amplivox 240 diagnostic audiometer were used for data collection. Multiple logistic regression analysis was used to determine the risk factors.

Results: The prevalence of bilateral hearing losswas 19.6% while unilateral hearing loss was 11.8% on the left side and 7.9% on the right.Low frequency hearing lossconstituted the commoner type of hearing loss with [54(64.3%)] occurring on the right and [69 (71.1%)] on the left. Logistic regression analysis revealed that history of ear discharge (OR= 2.80, 95% CI= 1.23-6.38: p=0.006), ear injury (OR= 2.28, 95% CI= 1.09-4.74: p=0.028), head trauma (OR= 4.54, 95% CI= 1.97-10.44: p<0.001), noise exposure (OR= 2.74, 95% CI= 1.45 5.17: p=0.002) were significantly associated with hearing loss.

Conclusion: Hearing loss is prevalent among the school-aged children in the rural communities of Ogun state with mild low frequency hearing loss being the commonest pattern. Age, ear infection and discharge, trauma and loud noise exposure were significant predictors. It is recommended that school-aged children should have routine hearing evaluation to identify those with hearing loss and then referred for appropriate hearing rehabilitation or treatment.

Keywords: *Prevalence, Pattern, Predictors, Hearing Loss, School-Age Children, Pure Tone Audiometry.*

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Résumé

Contexte: La perte auditive est l'une des incapacités les plus fréquentes et les plus négligées dans les pays en voie de développement. Cependant, la plupart deceux-ci sont évitables avec une détection tôt par le dépistage et des interventions appropriées.

Méthodes: Nous avons déterminé la prévalence, le profil et les prédicteurs de la perte auditive chez des enfants d'âge scolaire dans des communautés rurales sélectionnées dans l'état d'Ogun, au Nigéria, à l'aide d'une étude transversale. Une technique d'échantillonnage à plusieurs étapes a été utilisée pour sélectionner 305 élèves dans 6 écolessélectionnées aléatoirement. Des questionnaires semi-structurés et un audiomètre de diagnostic calibré Amplivox 240 ont été utilisés pour la collecte des données. Une analyse de régression logistique multiple a été utilisée pour déterminer les facteurs de risque.

Résultats: La prévalence de la perte auditive bilatérale était de 19,6%, tandis que la perte auditive unilatérale était de 11,8% du côté gauche et de 7,9% du côté droit. La perte auditive de fréquencefaible constituait le type le plus commun de perte auditive avec [54 (64,3%)] sur lecôté droit et [69 (71,1%)] sur lecôté gauche. L'analyse de régression logistique a révélé que les antécédents de décharge dans l'oreille (OR = 2,80, IC 95% = 1,23-6,38: p = 0,006), traumatisme del'oreille (OR = 2,28, IC 95% = 1,09-4,74: p = 0,028),traumatisme de la tête(OR = 4,54, IC 95% = 1,97-10,44: p <0,001), l'exposition au bruit (OR = 2,74, IC 95% = 1,45 5,17: p = 0,002) était significativement associée à la perte auditive.

Conclusion: La perte auditive est répandue chez les enfants d'âge scolaire dans les communautés rurales d'Ogun, avec la perte auditive légère étant l'affection la plus fréquente. L'âge, l'infection et ladécharge de l'oreille, le traumatisme et l'exposition au bruit élevé étaient des prédicteurs significatifs. Il est recommandé aux enfants d'âge scolaire d'effectuer une évaluation auditive de routine afin d'identifier ceux qui souffrent de déficience auditive et de les référer pour une réhabilitation ou un traitement appropriéde l'ouïe.

Mots-clés: *Prévalence, Profil, Prédicteurs, Perte auditive, Enfants d'âge scolaire, Audiométrie à tonalité pure*

Introduction

Hearing loss (HL) is one of the commonest but neglected disabilities because of its gradual onset, often painless and physically invisible nature [1 - 3].Globally, an estimated 32 million children have hearing loss and majority of them are from South East Asia and sub Saharan Africa [4]. Children who have hearing disability have greater learning and language difficulties than children with normal hearing [5]. In Nigeria, the reported prevalence of hearing loss in school children range from 13.9% - 58.9% [6-8]. Children with hearing disability constitute the largest number of children requiring special services [3].

Hearing loss is usually classified into conductive and sensori-neural with former affecting low speech frequencies while the latter affects the high speech frequencies [9,10]. The causes of conductive hearing loss include impacted cerumen auris, foreign body, edema of the auditory canal, and otitis media [11-13]. Noise, birth asphyxia, ototoxic drugs, measles, mumps, rubella, tetanus, congenital syphilis as well as genetic factors are among the many possible causes of sensorineural hearing loss among children [14].

Regular hearing screening can help identify children with hearing loss and the associated risk factors. Generally many of these factors are preventable even in resource-limited settings and the provision of timely interventions can limit further loss[15].In many developed countries audiometric examinations at different speech frequencies are routinely performed on children especially in school settings [16].This is hardly done in the developing countries which bear a greater burden of the disability. The pure tone audiometer is the gold standard for hear screening in school children [17].In Nigeria, routine screening of school children for hearing disability have been given very little attention because of lack of resources, poor public attention, lack of screening facilities and programmes [3, 18].Importantly, there is also a dearth of local evidence to inform public health interventions regarding hearing loss with the population. The few studies that have assessed the prevalence and pattern of hearing loss in Nigeria have been in the urban areas [18 -20]. Little audiological assessment of school aged children has been carried out inrural areas of Nigeria. The school setting provides a viable platform for performing hearing screening in resource –constraint settings. Therefore, this study determined the prevalence, pattern and predictors of hearing loss among school-aged children in selected rural areas of Ogun state, Nigeria.

Materials and methods

This was a cross-sectional study that investigated 305 school-aged children at"Obafemi Owode" Local Government Area (OOLGA), Ogun State using a multistage cluster sampling technique.OOLGA is a rural community made up of clusters of villages with minimal infrastructure and social amenities. And the main stay of the economy is subsistence farming, trading in farm produce and artisan work. First, "Obafemi" one of the three political zones in (OOLGA) was purposively selected. Thereafter, two out of four educational zones in Obafemi (Ajebo and Ogunmakin) were purposively selected. Three schools were randomly selected from each of Ajebo and Ogunmakin educational zones. Finally,all the pupils in primary 3-6 who gave their assent were recruited for the study. Informedconsent was obtained from the parents of the participating pupils. Ethical approval was sought from the UCH/UI Research Ethical Review committee and a written approval was obtained from the Ogun State Universal Basic Education Board before the commencement of the study.

Data collection

Data were collected with Semi-structured interviewer-administered questionnaires and a calibrated Amplivox 240 diagnostic audio meter. Semi-structured interview administered questionnaires were used to obtain information on demographic data, parents characteristicsand risk factors of hearing loss**.**

Audiometric Measures

Each child was assessed using an electricity-powered screening audiometer (Amplivox 240) and their threshold recorded in the audiogram accordingly. Sound-excluding headphones were used with the audiometer. Those with ear discharge had it cleaned before the test was performed. Audiometric evaluation was obtained for each ear at frequencies between 500 and 8000Hz and, the intensity varied from -10dB to 120dB in 5dB steps. Pure tone Audiometric Measures: audiometric measurements were performed in both ears with a standard, calibrated clinical audiometer (Amplivox model 260, Amplivox Ltd, Oxford, United Kingdom) with TDH

39 headphones fitted to audiocups to further attenuate ambient environmental sound. In this study, children with pure tone average measured at frequencies 500Hz, 1000Hz, 2000Hz and 4000Hz of unaided hearing threshold of >25dBHL in the better ear is considered as hearing impaired. Hearing threshold value of 26 – 40dBHL is mild hearing loss, 41 – 60dBHL is moderate hearing loss, 61 – 80dBHL is severe hearing loss and >80dBHL is profound hearing loss. Participants were categorised into low frequencies (4000Hz and below) and high frequencies (>4000Hz) hearing loss.

Table 1: Socio-demographic characteristics of respondents

Characteristics	Frequency (n=305)	Percentages (%)
Age groups (years		
Less than 10	79	25.9
10-12	158	51.8
13-15	68	22.3
Gender		
Males	172	56.4
Females	133	43.6
Ethnicity		
Yoruba	249	81.6
Ibo	25	8.2
Hausa	9	3.0
Other	22	7.2
Religion		
Christianity	186	61.0
Islam	108	39.0
Father's education		
None	26	8.5
Primary	105	34.4
Secondary	141	46.2
Tertiary	33	10.8
Mother's education		
None	32	10.5
Primary	121	39.7
Secondary	123	40.3
Tertiary	29	9.5
Father's occupation		
Farmer	142	46.6
Trader	11	3.6
Artisan	80	26.2
Civil servant	13	4.3
Others	59	19.3
Mother's occupation		
Farmer	74	10.5
Trader	141	46.2
Artisan	45	14.8
Civil servant	13	4.3
Others	32	9.5

Data analysis

The outcome variable was hearing loss and the independent variables included socio-economic, medical and environmental factors.Analysis was done using descriptive statistics (frequency, percentage, mean, and standard deviation). Chi-square test was carried out to explore the association between hearing loss and the independent risk factors. The variables that were significant on bivariate analysis was further tested with multiple logistic regression which was used adjusted odds ratios and their 95% confidence intervals.

Results

The age of the pupils was 10.95±1.98 and 56.4% were males, 81.6% were Yorubas and61.0% were Christians. The fathers of the pupils were mostly farmers (46.6%) and artisans (26.2%) while their mothers were mainly traders (46.2%) and farmers (24.3%). The distribution of the pupils by their class was as follows, 112 (40.0%) in primary 3, 86 (28.2%) in primary 4,51 (16.7%) in primary 5 and 46 (15.1%) in primary 6.

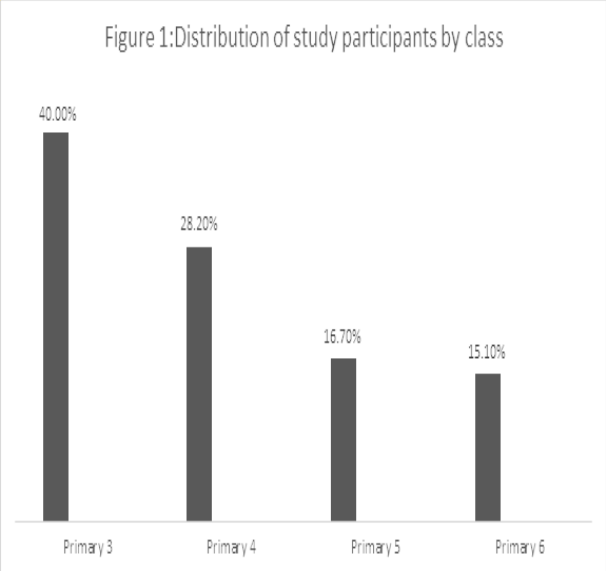
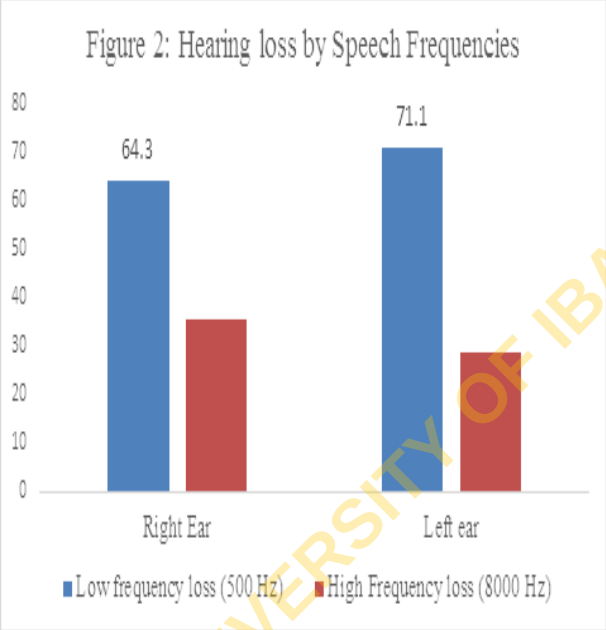


Table 2 shows that majority of the students examined had normal hearing function in both ears (72.5% % in the right ear and 68.2% in the left ear).The prevalence of bilateral hearing loss was 60(19.7%), unilateral hearing loss was 37 (12.1%) and 24 (7.9%) on the left and right ears respectively. Low frequency hearing loss constitutes [54(64.3%)] and [69(71.1%)] in the right and left ears respectively (Figure 2).

The adjusted odd ratios and 95% confidence intervals of the predictors of hearing loss in the left

Table 2: Pattern of hearing loss in the right and left ears

Hearing loss categories	Right ear		Left ear	
Normal hearing (-10 to 24dB)	221	72.5	208	68.2
Mild hearing loss(26 to 40dB)	84	27.5	96	31.5
Moderate hearing loss(41 to 70dB)	-	-	1	0.3
Severe hearing	-	-	-	-
Profound hearing loss(>95dB)	-	-	-	-
Total	305	100%	305	100%



and right ears were presented in tables 3 and 4.The significant predictors of hearing loss in the right ear were age: (OR=0.395, 95% CI= 0.23 – 0.68, P<0.001); past history of ear discharge (OR=2.80, 95% CI= 1.23-6.38, P=0.014), head injury (OR=4.54, 95% CI= 1.97-10.44, P<0.001), measles (OR=11.26, 95% CI= 4.79-26.49, P<0.001and noise (OR=8.32, 95% CI= 3.99-17.38, P<0.001) had independent effects on hearing loss and were statistically significant.

On the other hand, the significant predictors of hearing loss on the right were: previous history of ear discharge (OR=2.72, 95% CI= 1.33-5.56, P=0.006), ear injury (OR=2.28, 95% CI=1.09-4.74, P=0.03), head injury (OR=3.62, 95% CI= 1.79 – 7.32, P<0.001), meningitis (OR=26.52, 95% CI=10.52-66.86, P<0.001) and noise (OR=2.74, 95% CI= 1.45-5.17, P=0.002) had significant and independent effects on hearing loss.

Discussion

The overall prevalence of hearing loss among the school-aged children in the selected rural communities in Ogun state Nigeria was 39.7%. This is higher than the prevalence of 13.8% reported by Olusanya and his colleagues among school-aged children in Lagos [18].The reason for this difference is unknown but it is possible that the availability of ear health facility, routine hearing evaluation for school entrants and hearing rehabilitation services in the urban region must have contributed to the lower prevalence rate.This could imply that school-aged children in rural communities in Nigeria may be at higher risk for hearing loss compared with urban dwellers. Also,the prevalence appears to be higher than what had been reported among the school aged

Table 3: Adjusted odd ratios and 95% CI of the predictors of hearing loss in the left ear

Variables	Categories	OR	95% CI	P-value
Ever had ear discharge	Yes	2.724	1.33 – 5.56	0.006
	No (Ref)	1		
Ear injury	Yes	2.28	1.09 – 4.74	0.028
	No (Ref)	1		
Head injury	Yes	3.62	1.79 – 7.32	<0.001
	No (Ref)	1		
Measles	Yes	0.893	0.410 – 1.94	0.775
	No (Ref)	1		
Meningitis	Yes	26.521	10.521-66.85	<0.001
	No (Ref)	1		
Noise	Yes	2.74	1.45 – 5.17	0.002
	No (Ref)	1		

Table 4: Adjusted Odd Ratios and 95% CI of the Predictors of Hearing loss in the right ear

Variables	Categories	OR	95% CI	P-value
Age (years)	Less than 10	0.395	0.228-0.682	0.001
	>=10 (Ref)	1		
Current ear discharge	Yes	3.788	0.582-24.655	0.163
	No (Ref)	1		
History of ear discharge	Yes	2.800	1.230-6.376	0.014
	No (Ref)	1		
Ear injury	Yes	1.612	0.705-3.682	0.258
	No (Ref)	1		
Head injury	Yes	4.540	1.973-10.443	<0.001
	No (Ref)	1		
Measles	Yes	11.259	4.785-26.493	<0.001
	No (Ref)	1		
Meningitis	Yes	26.521	10.521-66.855	0.175
	No (Ref)	1		
Mumps	Yes	1.374	0.656-2.880	0.399
	No (Ref)	1		
Noise	Yes	8.322	3.985-17.376	<0.001
	No (Ref)	1		

children in other parts of Africa such as Egypt, [20,21] Uganda [22] and Zimbabwe [23].

In contrast, the prevalence reported bya study in Malaysia [24] was similar to this present finding. In more advanced countries like the United States, the estimated prevalence of hearing loss in school-aged children ranged from 10 to 15 per 1,000 for mild bilateral hearing loss and 30 to 56 per 1,000 for unilateral hearing loss [14].The reasons for these variations may be due to differences in hearing test methodology and the risk factors (environmental and genetic) of hearing loss in these countries. Nevertheless, it is important that school-aged children in Nigeria are publicly educated on ear health and risk factors for hearing loss. There should be routine hearing screening for school entrants to identify and refer those with hearing disability promptly for rehabilitation or treatment. This will reduce burden of hearing loss on the children with positive effect on their academic performance.

The study revealed that 7.9% and 12.1% had right and left mild unilateral hearing loss respectively. This is in consonance with other studies from Africa [18-23, 25].Usually, mild hearing loss may be unnoticed especially in children with excellent perceptual abilities and good coping skills. In addition, because of the gradual nature of mild hearing loss, over time, the affected children might have developed adaptive mechanism such that their neighbours do not easily notice the disability. Nevertheless, communication defects with lower scholastic achievement has been reported in some children with mild hearing loss [24].

The effect of unilateral hearing loss on academic performance of the school-aged children was not investigated in this study. Low frequency hearing loss was the commonest type of hearing loss in this study constituting 54(44.6%) and 69(57.0%) in the right and left ears respectively. The finding of this research is similar to that of Olusanya et al [19]. Most people with low frequency hearing loss are still able to hear sounds, take part in conversations and tend to understand speech [27]. In addition, many of them are able to cope and progress well in their academic pursuits hence the unreported hearing disability.

Age has been found to have independent effect on hearing loss. In this study, children with age 10 years and above have significantly increased odds of developing hearing loss compared with those less than 10. This is in agreement with the findings of Josef et al who reported that there is higher prevalence of hearing loss among teenagers aged 12-19 years [31].The explanation may be that children 10 years and older are likely to be exposed to a high level of noise compared with those in the lower age group.

The factors identified to predispose to hearing loss were ear discharge, head trauma, ear trauma, measles, meningitis and noise. Noise exposure is a well-recognized and probably the most studied environmental factor causing hearing loss [32].The WHO report in 2002 showed that 7% to 21% of hearing loss is attributed to noise exposure [5]. Report has also shown that school children could develop hearing impairment from hazardous noise

exposed to daily in their schooling environments [33]. This could be prevented and hearing salvaged if the source of the noise is withdrawn. Biologically, exposure to high level of noise over time could cause damage to the tiny hair cells in the cochlea, leading to the impedance of effective transmission of sound. In this study, exposure to noise was significantly associated with hearing loss. Generally, exposure to noise seems to have increased in many societies. For example, Smith and his colleagues in the United Kingdom reported that exposure of young people to social noise has tripled since the early 1980s [34].

There is evidence that a significant number of children will participate in one or more potentially high- risk noise behaviours in their lifetime [35-37]. Similarly in the US, Niskar and co-workers documented association of increased noise levels with a rise in noise-induced hearing threshold shift among children aged 6-19 years in the USA [9].This study found that children exposed to noise had statistically significant increased odds of developing hearing loss. Noise induced hearing loss usually results in high frequency hearing loss, which has been well reported among children [38,39].

This study found that ear discharge (otorrhea), a clinical feature of middle ear infection was a statistically significant risk factor for developing hearing loss. This is similar to the findings from other studies which reported that otitis mediaas the commonest cause of childhood hearing loss in developing countries [40-41].This occurs because the diseased middle ear cleft blocks sound from passing from the ear canal to the inner ear where the organ of corti is located. The association between ear discharge and hearing loss has been reported by several authors [40-42].Similarly, ascending infection to the middle ear cleft from upper respiratory tract through Eustachian tube may occur and result in conductive hearing loss. This is due to blockage of the Eustachian tube and collapse in the walls of the middle ear. This degree of hearing loss may be affected by the duration of the ear discharge meaning that the longer theear discharge the greater the deterioration in hearing level.

In this study, individuals with previous history of ear injury had significantly increased odds of developing hearing loss compared with those who reported no injury to the ear. This agrees with the WHO report that injury to the ear leads to hearing loss [43]. Hearing loss can be a sequel of previous head injuries. Hearing loss from head (which includes brain) injuries may be due to a disruption of the membranous portion, disturbance in the microcirculation, or hemorrhage into the fluids of the cochlea [44]. Direct head trauma that is severe enough to cause unconsciousness can causeossicular chain discontinuity and eardrum perforation, and subsequently conductive hearing loss [45]. Munjal *et al* observed a higher prevalence of hearing impairment in the group of patients with closed head injury compared with control group [46].

Infections have been documented as an important cause of hearing loss in developing countries. In this study, individuals who reported history of measles had increased likelihood of developing hearing loss. The finding agrees with other studies, which reported that hearing loss is a known complication of measles infection [45,46].A study conducted in the western area of Sierra Leone in 1991 showed that measles was responsible for 45% of cases of hearing loss. A higher prevalence of 52.9% was seen in the current study.

Studies have shown that Meningitis is a significant risk factor for hearing loss [47- 50]. The individuals who reported history of meningitis in this study also had increased likelihood of developing hearing loss. It is thought that over 30% of bacterial meningitis cases result in some degree of hearing loss from mild impairment to profound deafness. The Gallaudet Research Institute reported that 3.2% of American youth with hearing loss had suffered meningitis; making the infection the second most common cause of hearing loss [51].

In conclusion, this study revealed that the prevalence of hearing loss is high among the school-aged children. Although both high and low frequency hearing loss pattern were identified, mild low frequency hearing loss was the commonest pattern among the participants. It occurred more often with increasing age and the conventional risk factors that are strongly predictive of mild hearing loss. It is recommended that children should have routine hearing evaluation at school entrance to identify early those with hearing loss and then refer them for appropriate hearing rehabilitation or treatment. This will impart positively on their communication skill and improve their academic performance.

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