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Hearing Impairment in a Semi-urban Community in North-Western Nigeria

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Abstract: Population based studies to measure the burden of hearing impairment are scarce in sub-Saharan Africa due largely to lack of allocation of resources. This study aims to report the prevalence and possible causes of hearing impairment in a semi-urban community. A cross-sectional community based survey using the World Health Organization Ear and Hearing disorders survey protocol was conducted in 2013. Adults and children hearing assessment was conducted via Pure-tone audiometry for air conduction thresholds at 0.5-4kHz with otoscopy. Ambient noise level was at 45dB. A total of 91 participants were tested with a hearing loss prevalence of 29(31.9%). Fifty three (58.2%) were females, population age range was 5-60years, with a mean age of 14.13years (SD: 13.51). Ear diseases were a major contributor to hearing loss 61(67.0%) affecting 5-14year old age-group, followed by unknown causes 19(20.9%). Other major causes of hearing impairment in this cohort were infectious diseases 8(8.8%), genetic conditions 2 (2.2%) and non-infectious conditions 1(1.1%) respectively. There was a significant difference in mean audiometric thresholds for the right and left ears respectively. The prevalence of hearing impairment in this community may indeed be quite high and calls for concerted efforts by relevant authorities to reduce the burden in our communities.

Keywords: Prevalence, Hearing Loss, Causes, Community, Audiometry

1. Introduction

Population based studies to measure the burden of hearing impairment are scarce in sub-Saharan Africa due largely to lack of political will and allocation of resources. Majority of hearing loss and its sequelae can be prevented or avoided, such as speech, language and communication problems on one hand, and social withdrawal and depression on the other. Hearing loss and ear diseases are generally neglected problems among children and adults in most low and middle income countries. Congenital and/or child-onset hearing loss is also a concern as many can be found among children with certain risk factors such as: low birth weight, low socio-economic status, overcrowding, lack of hygiene, respiratory tract infections, among others [1]. Adult onset hearing loss is

hypothesized to represents the second highest percentage of contributors to the total years lived with disability (YLD) [2]. Therefore, the need for preventive measures, early diagnosis and intervention, as well as knowledge about the magnitude of hearing loss, cannot be overemphasized. It is hoped that such data, when generated will help guide policies and programmes in affected areas.

The World Health Organization (WHO) estimates that about 360 million people worldwide have disabling hearing loss (328 million adults and 32 million children). It also defined "disabling" hearing impairment as a permanent unaided hearing loss – in the better ear and averaged over frequencies of 0.5, 1, 2 and 4 kilohertz (kHz) – of more than of 40 dB in adults and 30 dB in children. The burden of disabling hearing impairment among both children and the elderly is thought to be greatest in the Asian Pacific area, southern Asia and sub-Saharan Africa [3].

The WHO Global Burden of Disease (GBD) hearing loss expert group is saddled with the responsibility of producing cause-specific estimates of global mortality, disease burden and risk factors for hearing impairment. This group recommends that repeated studies of hearing impairment prevalence are needed in order to generate more accurate estimates of trends in hearing impairment [4].

In Nigeria, there are few and scattered studies from different geopolitical zones, however, there are no community based studies indicating the prevalence of hearing loss in the Northern axis of the country. Most studies are essentially hospital based, ranging from the report by Stephen and Abraham during a retrospective review of patient records in a tertiary centre, with 5.8% prevalence in North central region to the report by Kodiya et al. of 26.2% prevalence in the North western region [5, 6]. All of which may not reflect the true picture, while a few are community-based but were studies done among children only in the highly metropolitan city of Lagos [7, 8]. However, Pascolini and Smith published a compilation of epidemiological studies, in which estimates of hearing loss prevalence following the Ear and Hearing disorders survey protocol for Nigeria was 6.2% from their target population [9].

Traditionally, hearing loss is categorized as conductive, sensorineural or mixed, ranging in severity from mild to profound. Genetically, more than 50% of severe/profound childhood deafness is genetic, with 75-80% recessive and 20% dominant [10, 11]. Similarly, deafness can be associated with syndromes (groups of signs and symptoms that occur together and characterise a particular abnormality) presenting as syndromic deafness (30%) or non-syndromic deafness (70%) [12].

However, in field surveys this categorization of hearing loss from mild to profound is based on the audiometric pure tone average for air conduction. Therefore, in order to estimate prevalence one requires self-reported and/or perceived hearing impairment with subsequent screening via audiometry, without initial otoscopy. This will then give the point prevalence of hearing impairment of the community under survey.

Some common causes of hearing impairment are Measles, Meningitis, Mumps, Ear infections, Ototoxicity, Age-related hearing loss, Noise-induced, trauma, Hereditary/Genetic causes to mention but a few. It is reasonable to assume that infective causes would be prevalent in Northern Nigeria due to its poverty and literacy level; inherited causes (due largely to consanguinity) as well as lying along the meningitis belt. The meningitis belt is a large zone that cuts across central and western Africa, with meningococcal meningitis, being the most prevalent cause of meningitis and with sequelae of severe to profound hearing impairment.

During the WHO 2000 survey for hearing loss estimates, it was reported that prevalence of hearing impairment in the Southern African region of Madagascar was as high as 29.9% [9]. Hearing impairment varies in many regions of the world according to age, sex, causation and availability of appropriate health care. It is estimated that in sub-Saharan Africa, disabling hearing loss in children < 15years for both sexes is about 1.9%, while for adults it is 7.4% and 5.5% for males and females respectively [3]. In East Africa, the prevalence of disabling hearing was 11.7% and 10.2% for adults and children respectively [13]. Similarly, during a primary school survey in Zimbabwe a disabling hearing impairment prevalence of 0.9% was reported [14]. We must appreciate however that, results from population surveys using the WHO Protocol will usually provide reliable data on prevalences and this would not have the biases of school or clinic-based studies.

Against this background, during the annual international ear care day, we attempted to survey a semi-urban settlement called Kumbotso in Kano, using a fixed facility approach with the comprehensive health centre as the outpost. It is one of the 44 Local government areas of Kano state, this state is the most populous in Nigeria (with an estimated population of 9,383,682 - according to the 2006 census). Kumbotso community has an area of 158 km^2 and a population of 295,979 according to the 2006 census.

This study therefore, aims to report the prevalence and causes of hearing impairment in this semi-urban community.

2. Methodology

A cross-sectional community based survey, using the (WHO) Ear and Hearing disorders survey questionnaire, was conducted in 2013 during the annual international ear care day. The protocol involved conducting a hearing impairment/Ear diseases survey from a randomly-selected community, for all participants above 5years of age. Consenting consecutive subjects were tested for hearing loss, by audiometry, and then examined for the presence of other ear diseases (via otoscopy) and to diagnose the cause of the hearing loss [9].

Audiometric thresholds were established separately for the left and right ear of each subject respectively and the better ear threshold recorded. Hearing assessment was conducted via Pure-tone audiometry for air conduction thresholds at

0.5-4kHz. The Pure Tone Average (PTA) is the average value at these frequencies based on hearing threshold scores of the subjects' better ear. Hearing testing was performed by trained Audiometricians, after which otoscopy was then carried out by the ENT (Ear Nose & Throat) trainees/specialists.

An Amplivox audiometer AD 229B with Amplivox Audiocups noise-excluding headset calibrated prior to the testing day was used and a biological check was performed on the day itself. Ambient noise level during testing was kept at or below 40dB at all times prior to each testing (sound level meter SL-4010, Lutron Electronics). For reproducibility, each measurement was repeated three (3) times from different angles. An average of three (3) readings were calculated, using different corners of the testing room and the average taken as the sound level prior to each testing in dB (A). Random validation checks were conducted by testing and comparing a few participants with abnormal and normal audiometric and otoscopic findings respectively with a gold standard.

Eight persons refused testing but allowed otoscopy, 5 for reasons unrelated to the procedure and the remaining 3 due to fear of the audio-device. These were not included in the overall sample size. No person was noticed/observed to be a hearing aid-user.

Ethical clearance was obtained from the Ethics Committee of Local government council, thereafter, the study was carried out after the local chief (Hakimi) and his council gave consent/permission to collect information and data while marking the international Ear care day as well as offering free hearing healthcare advice and services. Then information was passed to all indigenes via town-crier, jingles, radio to all indigenes with ear/hearing related problems to assemble at the health facility.

All participants gave their informed consent to participate in the study which conformed to the Code of Ethics of the World Medical Association (2013-Declaration of Helsinki).

2.1. Sample Size Determination

This was calculated using the formula below

$$n = \frac{(Z_{1-a})^2 \times \rho(1-\rho)}{d^2}$$

Where, n = the minimum sample size

Z_{1-a} = the standard normal deviate at 95% confidence level (1.96)

ρ = 6.2% (the proportion of the target population estimated to have hearing impairment in Nigeria) [9]

d = the desired precision of the estimate (0.05).

Thus, n = 90 participants

To account for 5% drop-out rate = 95 Expected participants.

2.2. Data Management

Data was analysed using IBM SPSS (version 21, for windows) with descriptive statistics to examine demographic data and Audiometric values at different frequencies. Chi square was used to find relationships for categorical variables and non-parametric analysis (2 tailed-Wilcoxon signed rank test) was used to compare mean and differences in audiometric thresholds values for right and left ears. The non-parametric test was also used to test if asymmetry between the right and left audiometric thresholds as a measure of hearing acuity did not occur by chance. $P<0.05$ was used for evaluating statistical significance (95% Confidence interval).

3. Results

A total of 91 subjects (0.031% of total population) were seen and tested with a hearing loss prevalence of 29 (31.9%). Fifty three (58.2%) were females and 38 (41.8%) males, giving a female preponderance (female: male; 1.4:1). Population age range was 5 – 60 years, with a mean age of 14.13years (SD: 13.51) table 1.

Disabling hearing loss (DHL) accounted for an overall prevalence of 13.2%, and a differential adult (≥41dB) and childhood (≥31dB) onset of disabling hearing loss prevalence for males, females and for both sexes 5.3%, 18.9% and 10.6% respectively.

Pure tone audiometric testing among participants revealed mean audiometric hearing thresholds in the better ear of 31.04dBHL (SD: 18.09) and audiometric range of 10dBHL to 83.75dBHL. Median Audiometric thresholds were 28dB and 30dB for the right and left ears respectively. A (2-tailed) Wilcoxon signed-rank test revealed a statistically significant difference in median audiometric thresholds for the right and left ear respectively ($Z = -2.32$, $P = 0.020$).

The major causes of hearing impairment recorded in this community were Ear diseases 35 (38.5%), Unknown causes 15(16.5%), infectious diseases 10(11.0%), genetic conditions 3 (3.3%) table 2. Chi square analysis did not reveal a significant relationship between age group and sex with diseases causing hearing impairment ($P > .05$). To test or compare the differences of the proportions of various diseases causing hearing loss, differed significantly using a chi-squared, one-variable test ($P < .001$).

Ear diseases were also noted to have contributed greatly to hearing impairment especially among children with the highest contributor being chronic suppurative otitis media 35(38.5%), followed by wax 19 (20.9%), otitis media with effusion 10 (11.0%), acute otitis media 7 (7.7%), otitis externa 6 (6.6%), and foreign body 2 (2.2%). Twelve subjects (13.2%) did not have any ear disease. No significant relationship between ear diseases and sex or age group could be established ($P>0.05$). Figure 1.

During the survey a total of 87 (95.6%) of the participants required some kind of intervention while 4 (4.4%) did not need. A variety of interventions were offered to the participants such as Medication 41(45.1, %), Hearing Aids 6 (6.6%), Surgery referral 2 (2.2%), Combination of interventions 42 (46.2%).

Table 1. *Demographic and severity of hearing loss pattern among participants.*

S/no	Variable	Frequency	%
	Sex		
1.	Male	38	41.8
	Female	53	58.2
	Age (years)		
2.	5-14	58	63.7
	15-60	33	36.3
	3.Grade of Hearing loss		
	No hearing loss [0-25]dB	62	68.1
	Slight hearing loss [26-40]dB	17	18.7
	Moderate hearing loss [41-60]dB	6	6.6
	Severe hearing loss [61-80]dB	5	5.5
	Profound hearing loss [81dB +]	1	1.1
	Total	91	100

Table 2. *Major causes of hearing impairment observed among the age-groups.*

Cause of Ear disease/hearing impairment			
	Age-groups (years)		Total
	5-14	15-60	
Normal ear/normal hearing	19 (32.8%)	9 (27.3%)	28 (30.8%)
Ear disease	27 (46.6%)	8 (24.2%)	35 (38.5%)
Infectious diseases	4 (6.9%)	6 (18.2%)	10 (11.0%)
Genetic conditions	1 (1.7%)	2 (6.1%)	3 (3.3%)
Undetermined	7 (12.1%)	8 (24.2%)	15 (16.5%)
Total	58(100.0%)	33(100.0%)	91(100.0%)

(Fisher's Exact 0.012)

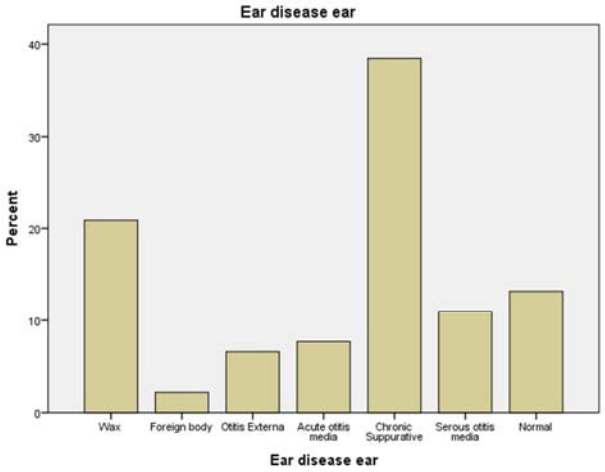

Figure 1. *Profile of ear diseases recorded in the community during the survey.*

4. Discussion

Population based studies to survey hearing impairments are scarce in Nigeria. According to WHO estimates following a survey in 2000, this country had a hearing loss prevalence of 6.2%, since then accurate national estimates of hearing loss prevalence have been lacking. With the estimate from our study we may posit that reported prevalence of hearing impairment has increased tremendously within a span of 12years. In the course of this survey, hearing loss prevalence was 29 (31.9%), signifying that approximately one in 3 persons among the participants had a hearing loss. Hearing loss was proportionally higher in children between the ages of 5-14 years compared to the adults' ≥15years of age. There were more female participants than males (table 1) and we recorded a "disabling hearing loss" (≥41dB) prevalence of 13.2%

Our prevalence (31.9%) is almost the same as estimated in Madagascar (29.9%) [9] but twice the prevalence recorded in Egypt (16.0%) some years ago, during a national household survey to estimate the prevalence of hearing impairment [15]. Although, 4000 individuals across six randomly selected districts were used as opposed to a single district in our survey. While they did not record any difference in hearing loss prevalence among sexes, there were significant differences between the age groups and districts, those ≥65 years had the highest prevalence (49.3%). In contrast to our study, younger persons had proportionally higher prevalence compared to adults, this is probably due to the fact that in our setting 'most' of the adults had to go to the farms, market or their place of work to earn their keep as bread winners.

Global estimates according to the GBD expert group for children (5–14 years) in sub-Saharan Africa was 1.9% in 2011 [4], while our study revealed a prevalence of 10.6%. We must note however that audiometry in this setting and with a lack of sound –proof booth can be unreliable especially in this age-group as they are easily distracted as well. This figure is ten times the global estimate, adding credence to the fact that the already poor educational level of these children may be far much worse than was previously predicted. That is, probably more students in our cohort may potentially have problems with ability to communicate, economic and educational disadvantage and a predisposition to depression. A review by some Authors in Southwestern Nigeria also reiterates that permanent childhood hearing loss is a significant health problem and its detection through screening is feasible in target populations [16]. Dunmade et al. in a retrospective study in Ilorin, also reported a high proportion of hearing loss (28.7%) among children 1-3years of age in their study group also substantiating our claim of a huge burden mostly among children [17].

Similarly, GBD estimates for adults (≥15years) in sub-Saharan Africa was 15.7%, with a male prevalence of 12.2% and female 9.8%. Comparatively, adult males in our survey had a prevalence of 5.3% and females 18.9%. This signifies a possible higher feminine preponderance in this community due primarily to a higher female participation, we may hypothesize that this could be remotely due to associated chemically induced hearing loss, mostly among the womenfolk (table 1). This is because in this community, vocational trading for women most often involves the use of chemicals for soap-making and dyeing, agreeably this may be speculative. Some other studies have also reported more women than men with hearing losses as probably more women were tested [4, 18]. Conversely, in a study by Olusanya et al. among spice-grinders from an urban community in southwest Nigeria, looking at Noise induced hearing reported 62.5% of the sample with mild to moderate

losses. Again here, we dare to say that spice-grinding is a female dominated profession.

Regarding DHL, our prevalence of 13.2% is high as well, compared to similar studies from other developing countries with values of 5.2%, 5.4%, 7%, and 11.7% in Latin America and East Africa [13, 19-21]. The reason for this high value in our case may not be unconnected to higher female participation contrary to common belief that females are not usually allowed out in this environment or that most are in purdah. This is equally quite encouraging considering recent terrorist insurgencies and community sentiments regarding allowing strangers/unfamiliar faces into their environment.

Asymmetric hearing thresholds were noted among some participants with statistically significant differences for the right and left ears, even though this was noted in the mild hearing loss category. This can lead to problems with hearing in background noise since binaural hearing may have been jeopardized, consequently, the individual may also have real difficulty following and/or taking part in conversations. Does hemispherical dominance (HD) or Auditory/language hemispheric dominance (AHD/LHD) have a role to play? According to Petit et al. [22], the right hemisphere is preferentially engaged in auditory attentiveness. Bearing this in mind, with the findings of Michael et al. [23], that if a person has a hearing difference, the probabilities of using dominant hand–side ear are not different regardless of handedness (53% and 50% for left- and right handedness, respectively; $P = 0.81$). We dared to speculate that perhaps right handedness and an acute sense of hearing in the right ear, may have led to some degree of auditory deprivation for the left ear amongst our participants; this is however, up for further debate and/or research.

Despite the apparent introduction of universal basic education, improvement in immunization uptake and availability of primary and comprehensive health centres in this semi-urban community, it was troubling to observe that avoidable and preventable causes of hearing impairment were still prevalent. Ear diseases still ranked highest (38.5%), Unknown causes (16.5%), infectious diseases (11.0%) such as measles, meningitis and probably rubella (table 2). Involvement/affectation of a first degree relative, a history of consanguinity in a subject adjudged to have hearing loss is considered genetic/hereditary in origin. Genetic causes accounted for about 3.3% in our study while in a Saudi Arabia study it was responsible for less than 2% of cases bearing in mind that consanguinity is prevalent in both our countries [24]. Unknown/undetermined causes accounted for the second commonest cause of hearing impairment (16.5%), this is less than the result reported in the Middle East [25]. A low Literacy level which is common in this environment, perhaps plays a significant role as it affects health-seeking behaviour and personal hygiene, thus patients may be unable to recall the events preceding the hearing loss. Ototoxicity is a well-documented cause of hearing loss, however we did not record any such history, although hawkers of expired drugs were seen marketing their wares freely for minor ailments, tiredness and fatigue (analgesics, antimalarials, etc). Expectedly, ear diseases are the commonest causes of hearing loss and this is corroborated by several studies [26], with perhaps poverty as a contributory factor [25, 27].

Chronic suppurative otitis media (CSOM) followed by cerumen auris accounted for the first and second highest contributors to hearing impairment respectively (figure 1). Similar reports have shown cerumen is way ahead of CSOM as the commonest contributor to hearing loss [28-30], in rural communities such as Kumbotso with poor access to specialty care, unsafe ear care practices and poor health indices, it is not unexpected to find these contributors to hearing impairment.

Our main constraints were limited time duration for the study, small number of participants and perhaps a skewed outcome as compared to having a large-scale demographic population study in which cluster or multi-stage sampling technique will be used. Also the lack of adequate number of personnel for examination and testing with resultant fatigue may also lead to some degree of error in the results. As with most cross sectional studies recall bias is common and population based conclusions may not be entirely accurate. We are also aware that population based comparisons from this study should be interpreted with caution bearing in mind the few limitations highlighted above. This survey was an attempt at community screening using air-conduction testing only without inclusion of bone conduction and tympanometry in the protocol due largely to lack of funds, adequate manpower, equipment and time. Bone conduction and tympanometric testing can help separate those with conductive hearing loss, usually amenable to treatment, from those with permanent or sensorineural hearing loss, with consequent reduction in the overall estimate.

The strength of this survey lies in the determination to sacrifice time and resources to provide some semblance of much needed data in the area of public health aspect of hearing impairment via a community based survey. It suffices to say, that further studies in this area is needed.

Furthermore, in course of this survey about 87(95.6%) of the participants needed one form of intervention or the other. This underscores the number of people requiring ear and hearing care services in this community. Those who could not be treated fully on the field were offered direct referrals in the form of transportation to and fro with preferential treatment at the tertiary centre. Majority required a combination of therapeutic approaches while others had surgical referrals only, medication in the form of wick dressings, and drugs, while those that require a hearing aid were directed to places were relatively reasonably priced ones can be purchased.

5. Conclusion

The prevalence of hearing impairment in this community may indeed be quite high and calls for concerted efforts by relevant authorities to help reduce the burden of hearing loss in our communities. This burden is highest among children with chronic otitis media and wax being the major

contributors to hearing impairment which are largely preventable at primary or community care level. The need for an overdue National survey on hearing impairment cannot be overemphasized given the current risks in our environment.

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