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PREVALENCE AND FACTORS ASSOCIATED WITH HEARING IMPAIRMENT AMONG PUPILS AGED 5 TO 15 YEARS IN MOSHI, TANZANIA. A CROSS SECTIONAL STUDY

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Abstract

Background: Hearing impairment (HI) is estimated to adversely affect about 32millions children worldwide. The condition has serious implications in child ‘s development in speech, learning, and academic achievements. Studies on prevalence and risk factors for HI are limited in North Tanzania. This study aimed at determining the current burden of HI as well as its predictors.

Methodology: A cross sectional survey of 240 pupils aged 5 to 15 years from six randomly selected public primary schools in Moshi rural. Pupils whose parents did not consent and those known to have hearing loss were excluded. Clinical otologic assessment and audiometry screening was carried to all participants. Hearing of more than 30 dB was regarded as hearing impairment. Odds ratios with 95% confidence intervals for an association between the selected risk factors and hearing impairment were estimated using multiple regression models. A p-value of <0.05 was considered statistically significant.

Results: Prevalence of hearing impairment was 37.8%. The dominant type of hearing loss was conductive and the commonest cause being wax impaction (68%), otitis media with effusion (30%) and chronic suppurative otitis media (19%).

Conclusion: The prevalence of hearing impairment was significantly high compared to other developing countries and the independent risk factors were male gender, low income, wax impaction, otitis media with effusion and chronic suppurative otitis media. The study calls upon more efforts to the health professionals on hearing screening methods as well as community sensitization on importance of adhering to otological healthcare.

Introduction

The WHO defined hearing loss as a loss of greater than 30decibals in the better hearing ear and has estimated that the world population has hearing loss of 5% of which 9% of the victims are children while Sub Saharan Africa recording a prevalence of 1.9% in children (WHO, 2014). Hearing Loss was also defined as per age categories as a loss of pure-tone average >20 dB for 6- to 18-years old and ≥26 dB for 19-year old and above population (Feder K, 2016).

The ear consists of three parts; the outer ear (auricle and external auditory canal (EAC)), the middle ear and the inner ear. The outer and middle ear components are responsible for transmitting and transforming acoustic energy into mechanical energy whilst the inner ear converts this mechanical energy to neural energy that the brain interprets.

The World Health Organization (WHO) have shown, low- and middle-income countries to have prevalence of hearing loss of more than 80%. Hearing loss is divided into conductive, sensorineural and mixed hearing loss and can be either unilateral or bilateral (Sallavaci S, 2016). Hearing loss has also been categorized as normal hearing (0-25 dB), mild HL (26-40dB), moderate(41-40dB), Moderate to severe (56-70dB), Severe HL (71-90dB) and profound (greater than 90dB) (with this category speech and language deteriorate) (WHO, 2018).

Despite its prevalence and burden HL has not received enough attention yet (Stevens A *et al* 2016)

A study done by Olusanya *et al* 2006 postulated that income of individuals with HL in the third world is estimated to be 40-45% less than the hearing population in developed countries (Olusanya B *et al* 2006). Causes of hearing loss in children can be classified into 3 groups: prenatal (Genetic causes such as Tunner ‘s syndrome, Melnick needle syndrome, infections, TORCHES), perinatal, or post-natal (Low birth weight, exposure to ototoxic drugs, wax impaction, neonatal meningitis, anoxia, and hyperbilirubinemia, prolonged exposure to noise environment, OME, COM, AOM and HIV).

Hearing impairment among pupils remains unnoticed till when presents with delayed speech and milestone and poor school performance hence early screening has positive effect. It also has psychosocial impact to the children if not intervened early. Current interventions only focus on deaf children by the presence of deaf schools leaving aside children with mild hearing loss of whom are mixed with normal hearing children predisposing them to poor performance without knowing the real cause of the unsatisfactory school performance to the teachers and the parents.

Materials and Methods

Study design

A school based analytical cross- sectional study design. This study was conducted in Moshi District in Kilimanjaro Region with 250 government and 23 private schools. This study included pupils aged 5 to 15 years of age, school children aged 5 to 15 years at school by the time of survey**.** Pupils whose parents did not consent and pupils known to have hearing disorder were excluded.

Data collection

Data were collected through interviews using questionnaires and hearing screening carried out by trained research team. The examination commenced with outer ear examination and otoscopic examination of outer (EAC) and middle ear of both ears.

In this study a swollen, warm, discharge and tender pinna/EAC was considered to be otitis externa whilst fungal infection was diagnosed based on fungal spores in the EAC. Chronic suppurative otitis media (CSOM) was diagnosed based on the presence of mucopurulent discharge through a perforated tympanic membrane of more than 3 weeks duration.

Data analysis

Analysis was performed using Statistical Package for Social Science (SPSS) version 20. Descriptive statistics procedures were performed to summarize data using frequencies and percentages for categorical variables. Both unadjusted and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for factors associated with hearing impairment were estimated in a multiple logistic regression model. A p-value of <0.05 was considered statistically significant.

Results

This study included a total of 240 study participants. The mean (SD) age of the study participants was 9.5 (2.2) years. Majority of the study participants 153 (63.8%) had age < 10 years, 125 (52.1%) were females, 141 (58.8%) were residing in rural areas, 118 (49.1%) their parents were self employed, 74 (30.8%) their parents earn between 50,000 to 100,000/= per month, 143 (59.6%) their parents age range between 20 to 40 years of age, 87 (36.3%) were single, 115 (47.9%) their parents had primary education, 155 (64.6%) were taken care by their mothers, 154 (64.2%) had ≥ 5 family size, 128 (53.3%) were insured. This is shown on **Table 1**

Table 1 : Social economic characteristics of the study participants (n=240)

Characteristics	**n (%)**
Age (years) (mean (SD)	9.5 (2.2)
Age (years)	
< 11	153 (63.8)
≥ 11	87 (36.2)
Sex	
Male	115 (47.9)
Female	125 (52.1)
Residence	
Rural	141 (58.8)
Urban	99 (41.2)
Parent employment status	
Employed	21 (8.8)
Not employed	101 (42.1)
Self employed	118 (49.1)
Income per month	
< 101,000/=	130 (54.2)
≥ 101,000	110 (45.8)
Parent age	
< 20	42 (17.5)
20 – 40	143 (59.6)
> 40	55 (22.9)
Marital status	
Married	84 (35.0)
Single	87 (36.3)
Divorce	38 (15.8)
Widow	31 (12.9)
Parent education	
Primary	115 (47.9)
Secondary	106 (44.2)
College	19 (7.9)
Caretaker	
Father	85 (35.4)
Mother	155 (64.6)
Family size	
< 5	86 (35.8)
≥ 5	154 (64.2)
Insurance	
No	112 (46.7)
Yes	128 (53.3)

Clinical characteristics of the study participants (n=240)

Of the study participants, (69.6%) were delivered vaginally, (14.2%) were delivered outside hospital, (25.0%) had ear pain, (2.9%) had auricle malformation, (2.1%) had EAC inflammation, (28.3%) had EAC wax, (1.7%) had EAC foreign body, (2.5%) had EEC otorrhoea, (2.2%) had EEC fungi (7.9%) had ED perforation, (17.9%) had ED dullness or retraction, (12.5%) had ED red or bulging and (70.4%) had normal ED. This is shown on **Table 2** hereunder.

Table 2 : Clinical characteristics of the study participants (n=240)

Characteristics	**n (%)**
Mode of delivery	
SVD	167 (69.6)
C/S	53 (22.1)
Vacuum	20 (8.3)
Place of delivery	
Hospital	206 (85.8)
Home	34 (14.2)
Ear pain	
No	180 (75.0)
Yes	60 (25.0)
Auricle malformation	
No	233 (97.1)
Yes	7 (2.9)
EEC inflammation	
No	235 (97.9)
Yes	5 (2.1)
EEC wax	
No	172 (71.7)
Yes	68 (28.3)
EEC foreign body	
No	236 (98.3)
Yes	4 (1.7)
EEC Otorrhoea	
No	234 (97.5)
Yes	6 (2.5)
EEC fungi	
No	225 (93.8)
Yes	15 (6.2)
ED perforation	
No	221 (92.1)
Yes	19 (7.9)
Ed dullness / retraction	
No	197 (82.1)
Yes	43 (17.9)
ED red and bulging	
No	210 (87.5)
Yes	30 (12.5)
ED Normal	
No	71 (29.6)
Yes	169 (70.4)

Prevalence of hearing loss

The prevalence of hearing loss was 38.7%.

Types of hearing loss

Among those with hearing loss (93) Most of them (66.7%) had conductive hearing loss type followed by mixed (22.5%) and (10.8%) had sensory neural hearing loss. This is shown on Figure 1.

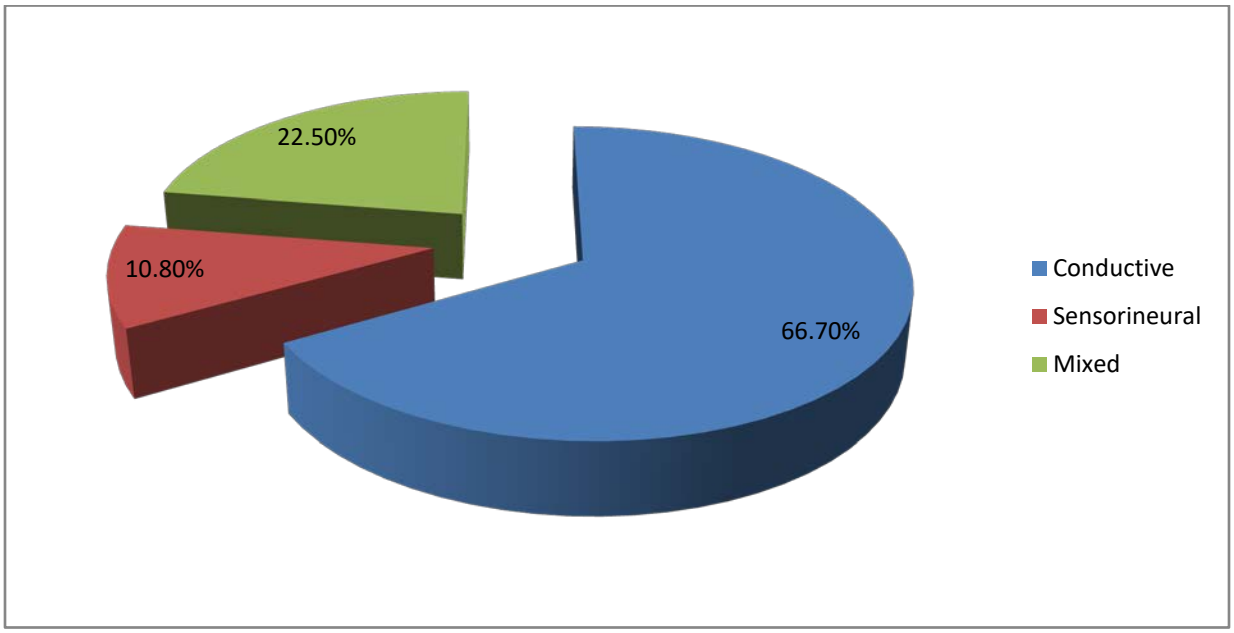

Figure 1 : Types of hearing loss (n=93)

Social economic factors associated with hearing loss

Sex (OR=0.75, 95% CI: 0.47 – 0.87), income per month (OR=0.71, 95% CI: 0.65 – 0.86), caretaker (OR=0.5, 95% CI: 0.29 – 0.86), family size (OR=1.93, 95% CI: 1.09 – 3.39) and insurance (OR=0.65, 95% CI: 0.46 – 0.73) were significantly associated with hearing loss. This is shown on **Table 3**.

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Table 3 : Social economic factors associated with hearing loss (n=240)

	Hearing loss				
	No n (%) 147 (61.3)	Yes n (%) 93 (38.7)	Total n (%)	OR (95% CI)	p-value
Age (years)					
< 11	93 (63.3)	60 (64.5)	153 (63.8)	Ref	
≥ 11	54 (36.7)	33 (35.5)	87 (36.2)	0.95 (0.55 ; 1.63)	0.844
Sex					
Male	74 (50.3)	41 (44.1)	115 (47.9)	Ref	
Female	73 (49.7)	52 (55.9)	125 (52.1)	0.75 (0.47 ; 0.87)	0.015
Residence					
Rural	83 (56.5)	58 (62.4)	141 (58.8)	Ref	
Urban	64 (43.5)	35 (37.6)	99 (41.2)	0.78 (0.46 ; 1.33)	0.366
Parent employment					
Employed	13 (8.8)	8 (8.6)	21 (8.8)	Ref	
Not employed	63 (42.9)	38 (40.9)	101 (42.1)	0.98 (0.37 ; 2.58)	0.968
Self employed	71 (48.3)	47 (50.5)	118 (49.1)	1.08 (0.41 ; 2.79)	0.881
Income per month					
< 101,000/=	81 (55.1)	49 (52.7)	130 (54.2)	Ref	
≥ 101,000/=	66 (44.9)	44 (47.3)	110 (45.8)	0.71 (0.65 ; 0 .86)	0.014
Parent age					
< 20	23 (15.7)	19 (20.4)	42 (17.5)	Ref	
20 – 40	93 (63.3)	50 (53.8)	143 (59.6)	0.65 (0.32 ; 1.31)	0.228
> 40	31 (21.1)	24 (25.8)	55 (22.9)	0.94 (0.42 ; 2.10)	0.875
Marital status					
Married	55 (37.4)	29 (31.2)	84 (35.0)	Ref	
Single	52 (35.4)	35 (37.6)	87 (36.3)	1.28 (0.69 ; 2.38)	0.441
Divorce	21 (14.3)	17 (18.3)	38 (15.8)	1.54 (0.70 ; 3.36)	0.282
Widow	19 (12.9)	12 (12.9)	31 (12.9)	1.19 (0.51 ; 2.81)	0.678
Parent education					
Primary	73 (49.7)	42 (45.2)	115 (47.9)	Ref	
Secondary	61 (41.5)	45 (48.4)	106 (44.2)	1.28 (0.75 ; 2.20)	0.368
College	13 (8.8)	6 (6.4)	19 (7.9)	0.80 (0.28 ; 2.27)	0.678
Caretaker					
Father	43 (29.3)	42 (45.2)	85 (35.4)	Ref	
Mother	104 (70.7)	51 (54.8)	155 (64.6)	0.50 (0.29 ; 0.86)	0.013
Family size					
< 5	61 (41.5)	25 (26.9)	86 (35.8)	Ref	
≥ 5	86 (58.5)	68 (73.1)	154 (64.2)	1.93 (1.09 ; 3.39)	0.022
Insurance					
No	69 (46.9)	43 (46.2)	112 (46.7)	Ref	
Yes	78 (53.1)	50 (53.8)	128 (53.3)	0.65 (0.46 ; 0.73)	0.017

Clinical factors associated with hearing loss

EAC wax (OR=1.27, 95% CI: 1.07 – 2.22), ED perforation (OR=3.82, 95% CI: 1.39 – 10.44), ED dullness / retraction (OR=2.09, 95% CI: 1.07 – 4.06) and ED red and bulging (OR=3.75, 95% CI: 1.67 – 8.44) were significantly associated with hearing loss. This is shown on **Table 4.**

Table 4 : Clinical factors associated with hearing loss (n=240)

	Hearing loss				
	No	Yes			
	n (%)	n (%)	Total		
	147 (61.3)	93 (38.7)	n (%)	OR (95% CI)	p-value
Mode of delivery					
SVD	97 (65.9)	70 (75.3)	167 (69.6)	Ref	
C/S	36 (24.5)	17 (18.3)	53 (22.1)	0.65 (0.34 ; 1.26)	0.203
Vacuum	14 (9.5)	6 (6.5)	20 (8.3)	0.59 (0.22 ; 1.62)	0.309
Place of delivery					
Hospital	123 (83.7)	83 (89.3)	206 (85.8)	Ref	
Home	24 (16.3)	10 (10.7)	34 (14.2)	0.62 (0.28 ; 1.36)	0.231
Ear pain					
No	113 (76.9)	67 (72.1)	180 (75.0)	Ref	
Yes	34 (23.1)	26 (27.9)	60 (25.0)	1.29 (0.71 ; 2.33)	0.401
Auricle malformation					
No	143 (97.3)	90 (96.8)	233 (97.1)	Ref	
Yes	4 (2.7)	3 (3.2)	7 (2.9)	1.19 (0.26 ; 5.45)	0.821
EEC inflammation					
No	146 (99.3)	89 (95.7)	235 (97.9)	Ref	
Yes	1 (0.7)	4 (4.3)	5 (2.1)	6.56 (0.72 ; 9.64)	0.095
EEC wax					
No	108 (73.5)	64 (68.8)	172 (71.7)	Ref	
Yes	39 (26.5)	29 (31.2)	68 (28.3)	1.27 (1.07 ; 2.22)	0.006
EEC foreighn body					
No	146 (99.3)	90 (96.8)	236 (98.3)	Ref	
Yes	1 (0.7)	3 (3.2)	4 (1.7)	4.87 (0.49 ; 4.75)	0.173
EEC Otorrhoea					
No	145 (98.6)	89 (95.7)	234 (97.5)	Ref	
Yes	2 (1.4)	4 (4.3)	6 (2.5)	3.26 (0.58 ; 8.16)	0.178
EEC fungi					
No	140 (95.2)	85 (91.4)	225 (93.8)	Ref	
Yes	7 (4.8)	8 (8.6)	15 (6.2)	1.88 (0.66 ; 5.38)	0.238
ED perforation					
No	141 (95.9)	80 (86.1)	221 (92.1)	Ref	
Yes	6 (4.1)	13 (13.9)	19 (7.9)	3.82 (1.39 ; 10.44)	0.009
ED dullness / retraction					
No	127 (86.4)	70 (75.3)	197 (82.1)	Ref	
Yes	20 (13.6)	23 (24.7)	43 (17.9)	2.09 (1.07 ; 4.06)	0.031
ED red and bulging					
No	137 (93.2)	73 (78.5)	210 (87.5)	Ref	
Yes	10 (6.8)	20 (21.5)	30 (12.5)	3.75 (1.67 ; 8.44)	0.001
ED Normal					
No	38 (25.9)	33 (35.5)	71 (29.6)	Ref	
Yes	109 (74.1)	60 (64.5)	169 (70.4)	0.63 (0.36 ; 1.11)	0.112

Discussion

A total number of 240 pupils aged 5 to 15 years from 5 selected primary schools in Moshi rural were randomly selected The mean age of the study participants was 9.5 (2.2) years The total number of boys examined were 125 (52.1%) whilst 115 (47.9%) girls were examined, bringing the gender ratio to almost 1:1. The prevalence of HI in this study is higher than what was found in some sub-Saharan African countries such as Nigeria (13.9%), Rwanda (13.3%), and Mozambique (5%).This noted varying prevalence could be a consequence of different methodologies and definitions of HI used.

The most common ear diseases observed in this study were impacted cerumen 28.3%, which was mostly bilateral. This was followed by OME (12.5%), ETD (17.9%), CSOM (7.9%). Wax impaction in this study could have been the most common ear disease because in the majority of cases it is asymptomatic and a coincidental finding. Wax impaction was noted to be a common ear disease amongst school children in Nigeria (52.6%) Southeast India (53.8%), and Kathmandu valley (60.6%).

CSOM, OME and ED were statistically significant associated with hearing impairment. CSOM had a significant association with hearing impairment. Children with CSOM were at a higher risk of developing hearing impairment compared to those without CSOM. The odds of developing hearing impairment in children with CSOM was about four times higher [OR = 3.82 (1.39: 10.44)] than that of children without CSOM, otitis media with effusion had two times odds of developing hearing loss than those children without OME OR=2(1.07:4.06) and Eustachian tube dysfunction had four folds higher odds (OR =3.75(1.67-8.44) of developing hearing loss compared with those children with intact Eustachian tube.

The prevalence rate of OME in this study was 12.5%, which is slightly lower than that of Saudi Arabia and Chile at 13.8% and 10% respectively. Factors such as creumen impaction with one fold increase in hearing impairment, OME with two times fold increase in HI, tympanic membrane perforation with three times fold increase in HI and CSOM also with three folds increase in HI, which were statistically significant OR= 1.27 (1.07 ; 2.22), OR= 2.09 (1.07 ; 4.06),OR= 3.82 (1.39 ; 10.44), OR=3.82 (1.39 ; 10.44) respectively as also supported by other researchers in Madagascar, Zambia, Uganda and Tanzania.

Factors such as family size, family income per month, possession of insurance also been shown to have contributory effect to hearing impairment as evidenced by the study done in Malawi which also showed similar findings. Among these ,only family size, male gender, insurance cover and low income was statistically significant with the OR=1.93(1.09: 3.39).Those children from the family size with more than five members had 2 folds odds increase in hearing impairment compared with those coming from the family with few members OR=1.93 (1.09 ; 3.39),Male children had one folds increase in HI compared to females OR=0.75 (0.47 ; 0.87),insured

children had lower risk of HI compared with the non-insured OR=0.65 (0.46 ; 0.73),low income also contributes more to HI compared with the high income families OR=0.71 (0.65 ; 0 .86) which concurs with the studies done in Kenya and Uganda.

Conclusion

The prevalence of hearing loss in primary school children in Moshi Rural district is significantly high compared to other locations in low income countries. The most common type of HI was conductive hearing loss. Among the ear condition associated with hearing loss, Wax impaction led in the population understudy followed by CSOM and this study also showed male predominance in developing hearing impairment.

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