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Risk Factors of Hearing Impairment among Lower Primary School Children in Port Harcourt

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Abstract

Background: Hearing impairment among lower primary school children is common especially in the Sub Saharan Africa. Some host related and environmental factors can influence its development. The factors may vary depending on the environment of the child and circumstances that surround the child's birth and neonatal history. The aim of this study was to determine the risk factors associated with hearing impairment among lower primary school children as seen in Port Harcourt, Nigeria.

Methodology: Hearing assessment was carried out in lower primary school children in Port Harcourt City between January 10th and May 21st, 2010. A multi-staged sampling technique was used to recruit pupils from lower primary schools for the study. A total of 802 school children, consisting of 405 (50.5%) males and 397 (49.5%) females, were screened for hearing impairment using pure tone audiometry. The data of each child screened was entered into forms provided by the researchers. The data was then entered into the database of a software package designed for collection, completion and reporting, the EPI_INFO (version 6) and SPSS11.0 statistical packages for epidemiology. The age and sex distribution of the study population; the social class; the prevalence of hearing impairment in relation to age, sex, social class; the risk factors of hearing impairment and its relationship with hearing impairment were determined from the data collected. These data were presented as charts and tables in simple proportions, and comparisons of sub groups carried out with chi square test. Statistical significance at 95% confidence interval was p value < 0.05.

Results: A total of 802 pupils were screened. The number of pupils was almost equally distributed in all the age groups; 281 pupils (35.0%) were between 5-7 years whereas 253 pupils (31.6%) were > 10 years. There were 405 males (50.5%) and 397 (49.5%) females, giving a male: female ratio of 1.02:1. Majority of the pupils were from social class III (268 pupils, 33.4%). The prevalence of hearing impairment in lower primary school children in Port Harcourt was found to be 29.4%. Of the 236 pupils with hearing impairment 76 pupils (52%) had Conductive Hearing Loss (CHL), 35 (24%) had Mixed Hearing loss (MHL) and 35 (24%) had Sensorineural Hearing Loss (SNHL). Of the 236 pupils with hearing loss, 128 (54.1%) had unilateral hearing loss while 108 (45.9%) had bilateral hearing loss.

Hearing impairment was significantly more prevalent (32.8%) among children in the older age group (>10 years) than in children 5-7 years of age (24.2%). Females had a significantly higher prevalence (34.0%) than males (24.9%), p=0.003. Hearing impairment was most prevalent among children from the social class V (43.5%) and least in class I and II (27.0%), the difference however, was not statistically significant (p=0.138).

Conductive hearing loss was the most common type of hearing impairment seen amongst these children (52.0%). Majority (58.9%) of the children had slight hearing impairment (16-25 dB HL). Bilateral hearing loss was seen in 54.1% of the children with hearing impairment while 32.8% had unilateral hearing loss of the various identified risk factors, history of neonatal fever (24.6%), ear pain (23.7%) and neonatal convulsions (11.4%) were significantly associated with hearing impairment (p<0.050).

Conclusion: This study had shown that the female gender, older age group > 10years, neonatal jaundice, otalgia and neonatal convulsions are risk factors for hearing impairment among lower primary school children in Port Harcourt.

Keywords: Hearing impairment; Risk factors; Lower primary school children; Conductive hearing loss; Sensorinueral hearing loss; Pure tone audiometry

Abbreviations: CHL: Conductive Hearing Loss; MHL: Mixed Hearing Loss; SNHL: Sensorineural Hearing Loss; PHL: Peripheral Hearing Loss; CSOM: Chronic Suppurative Otitis Media; MMR: Measles, Mumps, Rubella vaccines; UPTH: University of Port Harcourt Teaching hospital; OME: Otitis Media with Effusion

Introduction

Hearing impairment is defined as a full or partial decrease in the ability to detect or understand sounds [1]. It can be classified based on site of the lesion- peripheral or central. Peripheral hearing loss (PHL) results from dysfunction in the transmission of sound through the external or middle ear or by abnormal transduction of sound energy into neural activity in the inner ear and the 8th nerve [2]. PHL can be conductive hearing loss (CHL), sensorineural hearing loss (SNHL) or mixed.

CHL occurs when sound transmission is physically impeded in the external and/or middle ear [2,3]. SNHL occurs as a result of damage to (or maldevelopment of) structures in the inner ear [2,4]. When CHL occurs with SNHL it is said to be of mixed type [5]. Auditory deficits originating along the central auditory nervous system pathways from the proximal 8th nerve to the cerebral cortex are generally considered central (or retrocochlear) hearing losses [2,6].

Hearing impairment can also be classified based on severity of the hearing loss [7,8], taken as the better ear average for four frequencies (0.5, 1, 2, and 4kHz), the degree of hearing loss may range from slight (16-25 dB HL), mild (26-40 dB HL), moderate (41-70 dB HL), severe (71-95 dB HL), to profound (>95 dB HL) [7-10]. It may be unilateral or bilateral [2,11]. Studies have shown that more than one third of children with unilateral hearing loss fail one or more grades in school [11,12]. On the other hand, bilateral hearing loss has been shown to affect the acquisition of language skills [11].

The causes of hearing loss may be organic or inorganic, and may present as congenital or acquired conditions [2,3]. CHL is the most common type in children. It is mostly acquired and mainly due to otitis media with effusion (OME) [2,3,13]. Congenital genetic disorders which cause CHL with deafness presenting at birth include Down's syndrome, Crouzon's disease, Achondroplasia, Marfan's and Pierre Robbins syndrome [3]. In a study done by Balkany et al, 40% of children with Down's syndrome had conductive hearing loss [14]. Congenital genetic disorders which cause deafness appearing later in childhood include osteogenesis imperfect, otosclerosis cystic fibrosis, immotile cilia syndrome and cleft palate [2]. Acquired disorders causing CHL include inflammatory conditions such as otitis externa, acute suppurative otitis media, chronic suppurative otitis media (CSOM) and varius forms of OME. Other acquired causes include foreign body, wax (impacted cerumen) and trauma- both direct (fracture of petrous temporal bone, tympanic membrane perforation by foreign body) and indirect (following a slap to the face, an explosion or barotrauma) [3], head injuries, a blow to the ear canal, sudden impact with water, blast injuries or the insertion of pointed instruments into the ear canal can lead to perforation of the tympanic membrane [12]. A study done by Chan reported that 50% of serious penetrating injuries of the tympanic membrane were due to parental use of a cotton-tipped swab [12].

The causes of SNHL include hair cell destruction from noise, disease or ototoxic agents; cochlear malformation, perilymphatic fistula of the round or oval window; and lesions of the acoustic division of the 8th nerve [2,15,16]. The most common infectious cause of congenital SNHL is cytomegalovirus. The infection occurs in 1/100 newborns in the USA [2]. Other causes include toxoplasmosis, syphilis and rubella, all of which may cause delayed onset SNHL, months to years after birth [2,4]. Post natal infectious causes include group B streptococcal sepsis in newborns, bacterial meningitis, mumps, rubella and rubeola [4]. Deafness occurs in about one-third of children with rubella [3] prior to the introduction of Hib vaccine, meningitis was the most common cause of acquired hearing loss with deafness occurring in about 10% of children with bacterial meningitis [12].

Congenital genetic causes presenting with deafness which present at birth include Down's syndrome, Klippel-Feil syndrome, Turner's syndrome, Fanconi's syndrome and congenital hypothyroidism (cretinism) [6]. Alport's syndrome, Renal tubular acidosis and Refsum's disease present with deafness appearing in childhood [2,3]. Non-genetic congenital causes include infections (such as cytomegalovirus and herpes simplex), ototoxic drugs (aminoglycosides), metabolic causes (such as maternal diabetes) and foetal alcohol syndrome [3]. About one-third of children with foetal alcohol syndrome were found to have bilateral SNHL [17]. Perinatal causes of SNHL include hypoxia, hyperbilirubinaemia, preterm delivery and low birth weight [11,18]. Severe hyperbilirubinaemia is a strong risk factor for SNHL [3,11].

Acquired disorders causing SNHL include infections such as mumps, measles, herpes simplex, varicella-zoster and influenza virus (as complications of otitis media). Viral labyrinthitis, meningitis, Reye's syndrome, immunization (Tetanus, MMR vaccines have been implicated), trauma and ototoxic drugs e.g Aminoglycosides, loop diuretics have also being implicated [3]. Other causes include diabetes mellitus and neoplastic disease e.g Acoustic neuroma, leukaemia [3]. Congenital disorders causing mixed hearing loss with deafness occurring in childhood include osteopetrosis, Langerhan's cell histiocytosis and mucopolysaccharidosis. Acquired disorders causing mixed hearing loss may include infections such as meningitis [3].

The causes of central hearing loss include tumours, demyelinating disease of the 8th nerve, cerebellopontine angle and central auditory processing disorders [2]. Non-organic (psychogenic) deafness/hearing impairment is classified into functional (hysterical) deafness, malingering and organic deafness associated with psychogenic overlay. Functional deafness is apparent deafness in the absence of a pathologic process affecting the auditory pathway. It is responsible for about 5% of all audiology clinic attendance [3]. It may be a reaction to stress, especially when the child is not doing well at school and the parents expectations are unrealistically high. It may also be associated with other psychologic disturbances such as mutism,

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tremors, aggressive or withdrawn behaviour. In this condition, the child's hearing is usually better than the audiogram would suggest [3].

Educating the public about the causes, effects, treatment and preventive measures of hearing impairment helps in reducing the prevalence of hearing disorders in children [19,20]. Genetic counseling should be provided for families at risk of genetic disorders such as Down's syndrome and Marfans syndrome [3]. Appropriate paediatric care helps in preventing many causes of hearing deficits. Erythroblastosis foetalis is prevented by the use or Rhesus (D) immunoglobulin, and hyperbilirubinaemia controlled by phototherapy and exchange transfusions [11,21].

Immunizations, such as MMR (Measles, Mumps, Rubella vaccines) and Pneumococcal vaccine, effectively prevents hearing loss from intrauterine and acquired infections [11]. Aminoglycosides and diuretics (especially in combination) are potentially ototoxic, and when used, serum levels must be monitored carefully especially in premature infants and in patients with renal insufficiency [11]. Reduction of exposure to loud noise (such as loud music from personal stereos, television sets, fire crackers, lawn-mowers, motorcycles, jet engines etc) in the child's environment prevents high-frequency hearing loss [12,22,23]. Teaching children not to ever stick objects such as toothpicks, matchsticks or even cotton swabs in their ears to remove wax reduces the risk of tympanic membrane perforation and subsequent hearing loss [22] Prompt and adequate treatment of infections (such as meningitis, respiratory tract infections and ear infections) reduces complications that lead to hearing loss [2].

The earlier the detection and rehabilitation of children with hearing impairment, the better the outcome [4,7,24,25]. A survey involving nine European countries showed that 90% of children with hearing impairment were not diagnosed by their first birthday and as many as 50% were not detected until 3 years of age [26]. Similarly, in the United States of America the average age of identification of deaf children was 3 years of age [27]. These findings therefore, encourage screening at birth to enhance early detection and prevention of hearing impairment. There is a dearth of literature on the risk factors associated with hearing impairment amongst lower primary school children in our setting. This study therefore, determined the risk factors associated with hearing impairment among lower primary school children as seen in Port Harcourt, Nigeria.

Methodology

Study area

The study area is Port Harcourt City, the capital of Rivers State of Nigeria. It is located in the South-South geo-political zone of Nigeria. It was carved out of the former Eastern Region in 1967 by the Federal Government of Nigeria and is part of the Niger-Delta Basin. Rivers State covers a land area of 12,910 km2. Port Harcourt City is one of 23 local government areas of Rivers State. It is divided into 3 main school districts: Township, Diobu and Trans Amadi. There are a total of 139 primary schools in PHC.

Ethical Consideration

Ethical clearance was obtained from the Ethics Committee of the University of Port Harcourt Teaching hospital (UPTH). The Rivers State Ministry of Education and the head teachers of the recruited schools were notified and permission obtained from them to carry out the study. Informed consent was also obtained from parents/guardian of the children.

Study Population

These were primary school children (primary 1, 2 and 3). Data obtained from Rivers State Ministry of Education showed that as at 2005/2006, the estimated student population in primary 1, 2 and 3 in PHC was 70000 pupils. There was an average of 200 pupils per class in the public schools, and 100 per class in the private schools.

Inclusion Criteria

a) Children in primary 1, 2 and 3.

b) Those whose parents gave consent.

Exclusion Criteria

a) Children in special schools for the handicapped.

b) Children whose parents refused consent.

Sample Size

Sample size was calculated using the formula[52]:

$$n = \frac{pq}{(e/1.96)^2}$$

Where n= minimal sample size required

p=expected prevalence of hearing impairment (13.9% in Lagos) [5]

q=100-p

e=margin of error tolerated (2.5%)

Thus n=13.9 x (100- 13.9)= 1196.79

(2.5/1.96)2 1.63

=734.23

Approximated to 740.

Thus the minimum sample size used was 740 lower primary school children.

Sampling Method

Multistage sampling technique was used to select pupils for the study. A list of all the primary schools in PHC obtained from the Rivers State Ministry of education with their student population formed the sample frame.

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a) STAGE 1 (Distribution into the 3 school districts of PHC)

The 139 primary schools listed were shared into the 3 school districts of Port Harcourt:

Diobu-67, Township- 52, and Trans Amadi- 20. This translated to a ratio of 3: 2.5: 1.

b) STAGE 2 (selection of pupils)

At each selected school, 20 pupils were selected by simple random sampling from each class of primary 1, 2 and 3, and recruited for the study.

Study Procedure

This study was carried out within two school terms from January 10th, 2010 to May 21st, 2010. Notification and permission for the study was obtained from the head teachers of the selected schools. Each school was visited before the commencement of the study. This was used for introduction and familiarization of the investigator and her assistants with the principals, teachers and pupils. The nature and the purpose of the study were explained to them. The head teachers were enthusiastic and agreed to the investigator being present at their Parent-Teacher Association meetings. This forum afforded the researcher the opportunity to educate the parents on the study and facilitated the process of obtaining consent from them. It was also used as a forum for clarifying any misunderstanding concerning the work. The parents were excited about the study and willingly gave consent for their children's /ward's participation.

Pupils in the selected classes were given pre-tested questionnaire (Appendix 1) for their parents to fill and return the following week. Those for whom informed consent was obtained were recruited for the study.

Appendix I:

Questionnaire

a) Child's History

Name-

Date of birth- (Dd/M/Yr) Age- (years)

Sex: M/F

Home address (not P.O. Box) :

Phone no:

b) Pregnancy history

Any rash? Yes No

Fever? Yes No

Any other problems?

Duration of pregnancy in months: Normal/Premature

If premature, what was the duration of the pregnancy?

c) Delivery (Birth)

Normal (vertex) delivery Yes No

Breech (buttocks) delivery Yes No

Caeserean section (C/S) Yes No

-Emergency C/S

-Elective (planned) C/S

Labour lasted more than 24 hours? Yes No

Difficult delivery? Yes No

Place of birth

What was the birth weight? (Kilograms)

Did the child cry well immediately after birth?

What problems did he/she have after birth?

-Jaundice? Yes No

-Convulsion? Yes No

-Fever? Yes No

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At what age did he/she smile?

At what age did he/she sit without support?

At what age did he/she crawl?

At what age did he/she walk without help?

At what age did he/she speak?

Has he/she had any illness, accidents or operations? Yes No

If yes, list the problems and the age at which they occurred:

Problem Age

1.

2.

3.

4.

Has he/she ever had?

Ear pain? Yes No

Ear discharge? Yes No

Difficulty in hearing? Yes No

Difficulty speaking or being understood? Yes No

Others

d) Family history

Father's occupation:

Mother's occupation:

Parent's educational attainment:

Father Mother

No formal education

Primary 6

Basic 9/Junior Secondary School Class 3

West African School certificate/SSCE

Teacher Training College

Technical Education, OND/HND

University Degree

Any family history of deafness (hearing impairment/loss)? Yes No

Training and standardization of Survey Team

Five post-internship doctors were used as research assistants. They were trained on proper administration of the questionnaire. The training was done by the researchers. Individual performance of the assistants was crosschecked and found to be reliable by the researchers.

Pilot study

A pilot study was carried out on 20 primary school pupils in a different local government area (Obio-Akpo) 6 weeks before the main study. This was to ascertain the workability of the study methods and improve on areas where there were likely to be shortcomings.

a) Field work: At the schools, the pupils whose parents gave informed consent were assembled in the classrooms/ school hall depending on which facility was made available by the school authorities. One of the researchers then introduced members of her team to the pupils and teachers and gave a 10 minute interactive talk on simple ear care to gain their attention and confidence. She went further to demonstrate the screening process to the pupils.

The pupils were divided into groups of 5 for weight and height measurements and general physical examination carried out by the research assistants. After this, every child had an otoscopic examination and a complete ear, nose and throat evaluation done by the researchers following the guidelines published by Ijaduola [28]. Pupils with an abnormality or the presence of wax were be re-examined by the ENT Surgeon and the wax removed.

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The ear drums were then classified as abnormal if there was perforation, retraction or scarring.

The pupils were then taken to the quietest location in the school for audiometry. The school library was used for this. The ambient noise was measured with a sound level meter and if found to be acceptable (< 50 dB) [9,29]. The calibrated pure tone audiometer used (Madsen 1004) had a noise-reducing headset providing extra attenuation of about 25dB to outside noise thus bringing the ambient noise further within the acceptable range. The tests tones were presented to each child at the various tests frequencies (0.5, 1.0, 2.0 and 4.0 kHz) at an intensity level of 20dB and each ear tested separately. The child was instructed to listen carefully and raise the appropriate hand each time he or she heard the tone.

The children were encouraged to view the test as a game to reduce anxiety. The child was considered to have failed the test, and thus be hearing impaired, if he failed to respond to any of the frequencies tested in at least one ear. Such children were then screened again using the special head set for bone conduction. The various tests frequencies were once again presented using the pure tone audiometer. When both air and bone conduction were within normal limits (<15 dB HL) and equal, hearing is normal. Where both air and bone conduction are abnormal (>15dB HL) but equal, the child has sensorineural hearing loss (SNHL). Where bone conduction is normal but air conduction is > or= by 15 dB HL, the child has conductive hearing loss (CHL). Where both air and bone conduction are abnormal and unequal, the child has mixed hearing loss (MHL). Children who failed the audiometric test were subsequently referred to the University of Port Harcourt Teaching Hospital to see an Otorhinolaryngologist for further audiological assessment and expert management.

Data Entry

The data of each child screened was entered into the forms provided (Appendix II) by the research assistants and crosschecked by the researcher. The data was then entered into the database of a software package designed for collection, completion and reporting, the EPI_INFO (version 6) statistical package for epidemiology.

Appendix II:

Findings

a) Physical Examination:

General:

Height: (metres) Weight: (Kilograms)

b) ENT profile:

Rhinorrhoea Yes No

Enlarged turbinates Yes No

Engorged turbinates Yes No

Enlarged tonsils Yes No

Pre-Auricular sinus Yes No

Others

External Ear Profile:

c) Otoscopy:

Cerumen Yes No

Debris Yes No

Foreign body Yes No

Mucoid discharge Yes No

Normal Yes No

Tympanic Membrane Findings:

Dull Yes No

Hyperaemia Yes No

Perforation Yes No

Scar Yes No

Retracted/Bulging Yes No

Normal Yes No

d) Audiometry:

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Frequency (kHz) Hearing threshold (dB)-left ear Hearing threshold-right ear

0.5

1

2

4

Pure tone average in worse ear:

Passed test (<15dB): Failed test (>15dB):

Degree of hearing loss, if any:

-Slight (16-25 dB HL)

-Mild (26-40 dB HL)

-Moderate (41-70 dB HL)

-Severe (71-95 dB HL)

- Profound (>95 dB HL)

Data analysis: Data from the study was analyzed using the computer program EPI-INFO (VERSION 6) and SPSS11.0. The age and sex distribution of the study population; the social class; the prevalence of hearing impairment in relation to age, sex, social class and school type; the risk factors of hearing impairment and its relationship with school performance were determined from the data collected. These data were presented as charts, graphs and tables in simple proportions, and comparisons of sub groups carried out with chi square test. Statistical significance at 95% confidence interval was p value < 0.05.

Results

Age and Sex Distribution of the Study Population

The age and sex distribution of the study population is shown in Table 1. The number of pupils was almost equally distributed in all the age groups; 281 pupils (35.0%) were between 5-7 years whereas 253 pupils (31.6%) were > 10 years. There were 405 males (50.5%) and 397 (49.5%) females, giving a male: female ratio of 1.02:1.

Table 1: Age and Sex Distribution of Study Population.

Age group (years)	Males (%)	Females (%)	Total number (%)
5-7	144(51.25)	137(48.8)	281(35.0)
8-10	133(49.6)	135(50.4)	268(33.4)
>10	128(50.6)	125(49.4)	253(31.6)
Total	405(50.5)	397(49.5)	802(100.0)

Social Class of the Study Population

The social class of the study population is as shown in Table 2. Majority of the pupils were from social class III (268 pupils, 33.4%) and class II (222 pupils, 27.7%). Social class V had the least number of pupils (23, 2.9%). Forty-eight pupils (6.0%) were not classified as not enough information was provided by their parents/guardians.

Table 2: Social Class of the Study Population.

Social class	Total (%)
I	74 (9.2)
II	222 (27.7)
III	268 (33.4)
IV	167 (20.8)
V	23 (2.9)
Unclassified	48 (6.0)
Total	802 (100.0)

Prevalence of Hearing Impairment

The prevalence of hearing impairment in lower primary school children in PHC is illustrated in Figure 1. Of the 802 children screened, 566(70.6%) passed the screening test whereas 236 (29.4%) failed the screening test. The prevalence of hearing impairment in lower primary school children in PHC is 29.4%.

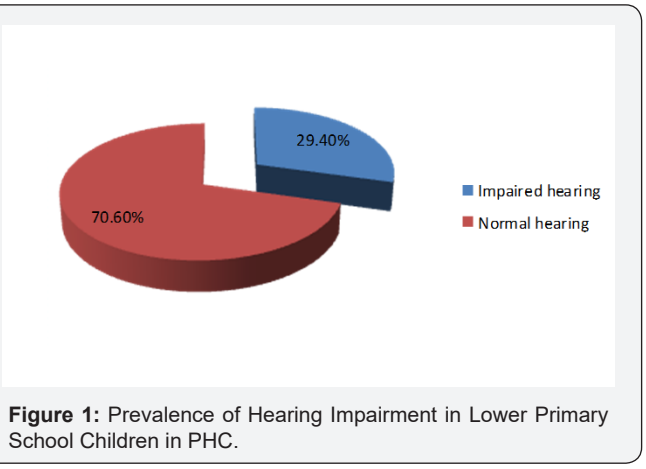

Figure 1: Prevalence of Hearing Impairment in Lower Primary School Children in PHC.

Age Specific Prevalence of Hearing Impairment

Table 3 compares the number of children with hearing impairment and normal hearing to the total population within

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the different age groups. The highest prevalence of hearing impairment was seen amongst those > 10 years of age. The least prevalence was seen among pupils aged 5-7 years. These differences were statistically significant (X^2 =5.765, p=0.027).

Table 3: Age Specific Prevalence of Hearing Impairment.

Age group (years)	Normal hearing (%)	Impaired hearing (%)	Total (%)
5-7	213 (75.8)	68 (24 .2)	281 (100)
8-10	183 (68.3)	85 (31.7)	268 (100)
>10	170 (67.2)	83 (32.8)	253 (100)
Total	566 (70.6)	236 (29.4)	802 (100)

Sex Specific Prevalence of Hearing Impairment

Of the 236 children with hearing impairment, 101(42.8%) were males while 135 (57.2%) were females. The prevalence of hearing impairment was higher in females (34.0%) than in males (24.9%) as shown in Table 4 below. The gender difference was statistically significant (X^2=7.936, p=0.003).

Table 4: Sex Specific Prevalence of Hearing Impairment.

Gender	Normal hearing (%)	Impaired hearing (%)	Total (%)
Male	304 (75.1)	101 (24.9)	405 (100)
Female	262 (66.0)	135 (34.0)	397 (100)
Total	566 (70.6)	236 (29.4)	802 (100)

Prevalence of Hearing Impairment according to Social Class

Table 5: Prevalence of Hearing Impairment according to Social Class.

Social class	Normal hearing (%)	Impaired hearing (%)	Total (%)
I	54 (73.0)	20 (27.0)	74 (100.0)
II	162 (73.0)	60 (27.0)	222 (100.0)
III	192 (71.6)	76 (28.4)	268 (100.0)
IV	111 (66.5)	56 (33.5)	167 (100.0)
V	13 (56.5)	10 (43.5)	23 (100.0)
Unclassified	34 (70.8)	14 (29.2)	48 (100.0)
Total	566 (70.6)	236 (29.4)	802 (100.0)

The prevalence of hearing impairment according to social class is as shown in Table 5. The prevalence of hearing impairment was highest among children in social class V (43.5%) followed by those in social class IV (33.5%). The prevalence of hearing impairment was lowest amongst those in social class II and I (27.0%). This difference was however not statistically significant (X^2 =1.369, p=0.138).

Types of Hearing Impairment

Of the 236 pupils with hearing impairment (hearing loss), 76 pupils (52%) had Conductive Hearing Loss (CHL), 35 (24%) had Mixed Hearing loss (MHL) and 35 (24%) had Sensorineural Hearing Loss (SNHL). This is shown in Figure 2 below.

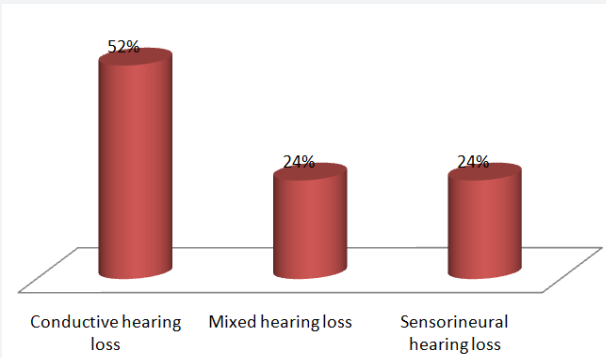

Figure 2: Types of Hearing impairment.

The Severity of Hearing impairment

Table 6: The Severity of Hearing impairment.

Severity of hearing impairment	Number of pupils (%)
Slight(16-25dB HL)	139 (58.9)
Mild (26-40 dB HL)	84 (35.6)
Moderate (41-70 dB HL)	12 (5.1)
Severe (71-95 dB HL)	1 (0.4)
Profound (dB HL)	0 (0.0)
Total	236 (100)

Table 7: Risk Factors Associated with Hearing Impairment.

Risk factors	Normal hearing (%)	Impaired hearing (%)	X^2	P value
Emergency C/S	62 (11)	35 (14.8)	2.354	0.080
Prolonged labour	85 (15.0)	47 (19.9)	2.905	0.056
Cried poorly at birth	41 (7.2)	13 (5.5)	0.799	0.233
Low birth weight	20 (5.8)	8 (7.1)	0.274	0.372
NNJ	75 (13.3)	31 (13.1)	0.002	0.533
Neonatal convulsion	32 (5.7)	27 (11.4)	8.184	0.004*
Neonatal fever	73 (12.9)	58 (24.6)	16.623	0.000*
Ear pain	90 (15.9)	56 (23.7)	6.854	0.007*
Ear discharge	51 (9.0)	31 (13.1)	3.084	0.054

The severity of hearing impairment (hearing loss) is shown in Tables 6 & 7. Of the 236 pupils with hearing impairment, majority-139 (58.9%) had slight hearing impairment. Eighty-four pupils (35.6%) had mild, 12 (5.1%) had moderate, and 1 (0.4%) had severe hearing impairment. None had profound hearing impairment.

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Unilateral/ Bilateral Hearing Loss

Of the 236 pupils with hearing loss, 128 (54.1%) had unilateral hearing loss while 108 (45.9%) had bilateral hearing loss (Figure 3). Among those with unilateral hearing loss, 86 (67.2%) had right-sided hearing loss, while 42 (32.8%) had left-sided hearing loss.

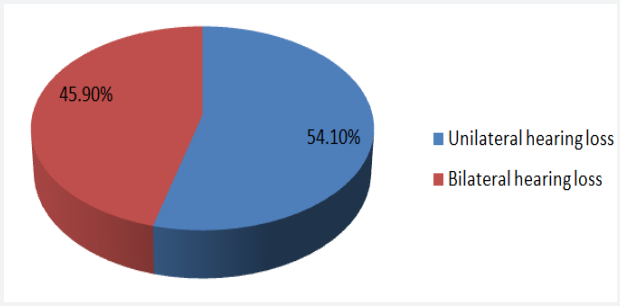

Figure 3: Unilateral / Bilateral Hearing Loss.

Discussion

The factors that contribute to hearing impairement among lower primary school children Worldwide are multifactorial; they vary depending on the environment of the child and circumstances that surround the child's birth and pregnancy history. Our study found the female school child to have a significantly higher sex specific prevalence of hearing impairment (34.0%) than their male counterparts (24.9%). Most studies have suggested that hearing impairment occurred more commonly in boys than girls [30-34]. It has been reported that girls have a shorter stiffer cochlear which provides a more sensitive frequency response [32] and that the hair cells are stiffer and therefore more sensitive in girls than in boys [33]. Traditionally, males have been noted to be more likely to be exposed to loud noises from work machines or firearms, and thus hearing loss. Henderson et al. [35] however, reported that more children of both sexes are listening to very loud music from headphones.

They reported a significant increase in noise induced hearing loss among girls from 12% to 17% when comparing results of studies they had carried out in 1994 and 2006 respectively [35]. Our study also revealed that hearing impairment was most prevalent amongst older children (> 10 years) and least amongst those 5-7 years of age. This was similar to that noted by Olusanya et al. [9]. The higher prevalence observed among older children may be due to noise induced hearing loss which occurs as a result of prolonged exposure to loud noise [36].

Three social classes (III, IV and V) have been reported to constitute 87.9% of a typical urban city population in Nigeria [37]. The prevalence of hearing impairment is highest among those in social class V (43.5%) and noted to reduce with increase in social class (Class I and II-27.0%). Though this difference was not statistically significant, it is comparable to that found in a study done in USA, [8] which reported a higher prevalence of hearing impairment of 0.78% in African-American children than their Caucasian counterparts (0.38%). This difference was attributed to a lower socioeconomic status of the African-American children [8]. This is similar to the findings of the study done by Prescott and Kibel in a poor rural city in South Africa [38]. Besides, it has been reported that hearing loss was more common in children whose mothers were less well educated [39]. This is probably due to the lower socio-economic status and consequently, poorer standard of living, increased risk of recurrent ear infections and reduced access to health care facilities of those in the lower social classes [40].

Conductive Hearing Loss was the most common type of hearing impairment seen among the pupils with hearing impairment in this study (52%).Twenty-four percent had SNHL and 24% had MHL. This is similar to the findings reported by Akinpelu and Amusa in a study done in the Western part of Nigeria, which showed CHL to be the most common type (54%) among primary school children [13]. These findings are also comparable to that reported by Olusanya et al. [9] where 36% of the pupils with hearing impairment had CHL, 24% had SNHL and 40% had MHL. This has also been confirmed by several studies carried out in other countries [6,3,12,40,41]. In fact, it has been established that CHL is the most common type of hearing loss in young children [6,3,13,42]. CHL may result from cerumen blocking the external ear canal, fluid in the middle ear preventing the ear drum from vibrating or a disruption or fixation of bones in the middle ear [43]. Middle ear disease (otitis media) is a leading cause of visits to the paediatrician. Research studies have determined that 50% of children less than 5 years of age will experience a conductive hearing loss [42]. Anderson in 1995 noted that 80% of primary school pupils (4-10 years) suffer from temporary hearing loss (usually CHL) at some time during the school year [42]

Most of the pupils (58.9%) with hearing impairment had slight hearing loss (16-25 dB HL). Only 5.5% had moderate to severe hearing loss. None had profound hearing loss. This finding is comparable to that reported in Tanzania which shows 3.0% of school children had mild to moderate hearing loss while only 0.35% had severe to profound hearing loss [44]. Also in Sierra Leone, 2.58% of children were shown to have mild hearing loss while only 0.65% had moderate hearing loss and 0.5% had severe hearing loss [45]. In Nigeria, in a study which showed the prevalence of hearing loss of 9.3%, only 0.58% and 0.93% of the study population had profound and severe hearing loss respectively [8]. Similarly, slight to mild hearing loss has been shown to be the most common among primary school children [7,9,40]. Children with more severe degrees of hearing impairment were more likely to have been detected earlier and most likely may have been enrolled in special schools for the deaf.

Hearing loss was unilateral in 54.1% of hearing impaired pupils and bilateral in 32.8%. Similarly, Daud et al also reported

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unilateral hearing loss as being more common (61.1%) [41]. This is in contrast to that reported by Olusanya et al. [9] where bilateral hearing loss was reported as being more common [9]. Kiese-Himmel and Schoff [46] also reported bilateral hearing loss as being more common (73%) [46]. Other factors found to be significantly associated with hearing impairment by this study, includes history of neonatal fever (24.6%), ear pain (23.7%) and neonatal convulsions (11.4%). This is comparable to the results obtained by several other studies [3,11,18,47]. Post natal infections (which may present with neonatal fever and/or convulsions) such as group B streptococcal sepsis in the neonates, bacterial meningitis, mumps, rubella and rubeola all cause SNHL [4]. Meningitis is one of the most common causes of acquired hearing loss with deafness occurring in about 10% of children with bacterial meningitis [12].

Furthermore, a study done amongst some children revealed hereditary factors (due to intermarriages of close relatives) damaging medication (quinine), and infections (especially meningitis) as the causative factors of the needlessly high prevalence of hearing impairment [48]. Chronic ear infections are the most common cause of hearing loss among Nigerian children, with as many as one in three children presenting at an otology clinic in our setting, being diagnosed with middle ear infection (one in four of which suffer from hearing loss) [36,37]. Unfortunately, the children often present late at the health facilities with complications such as hearing loss because of poverty. Otitis media with effusion (OME) is more common in children than adults because of their shorter, more horizontal, straighter Eustachian tube (making it easier for bacteria to enter). The tube is floppier and the opening is narrower [49]. Also their relatively immature immune system makes them more susceptible to upper respiratory tract infections and consequently, OME [49]. Trauma (both direct and indirect) is also an important cause of CHL [3,12]. Severe hyperbilirubinaemia is a strong risk factor for SNHL [3,12,40]. Periods of neonatal apnoea and hypoxia strongly predispose to subsequent hearing loss [50]. Low birth weight increases the risk of hearing loss. The growth of the foetus during pregnancy, not the duration of the pregnancy, determines the hearing development [36]. The risk of hearing loss is greater in children weighing less than 1.5kg [36]. Conversely, premature birth has been reported to lead to hearing loss in 5% of cases [39]. These and other associated factors, including preterm delivery, low birth weight and prolonged labour were however, not shown to be significantly associated with hearing impairment by this study [3,11,18,47].

In the classroom, undetected hearing loss is more common than teachers realize. Slight, mild and unilateral hearing loss are not 'loudness' problems per se, but are distortion and clarity problems which negatively impact the speech signal [42]. In these situations, the teachers voice may be audible but not intelligible. Children with these hearing profiles will respond when their name is called, yet will confuse or not discern distinctive sounds needed for reading and language skills [42]. In developed nations, screening starts at birth and children are screened at first entry into school, every year from kindergarten through the 3rd grade, 7th grade, 11th grade and upon grade repetition [11]. However, in most developing countries like Nigeria, provisions for hearing screening in schools are lacking, due to the collapse of the School Health Program in the country. If the present initiatives in enhancing the School Health Program in Nigeria are not improved upon and sustained, the prevalence of hearing impairment in primary school children may continue to rise and the economic and social consequences on the child, family and nation may become worse.

Limitation of the study

Information on most risk factors associated with hearing impairment was based on history and should be taken with caution.

Conclusion

This study had shown that the female gender, older age group > 10years, neonatal jaundice, otalgia and neonatal convulsions are among the risk factors for hearing impairment among lower primary school children in Port Harcourt. However, the prevalence of hearing impairment even though it was found higher among children in lower primary school that belong to social class V was not statistically significant as a cause of hearing impairment.

Recommendations

To curb the menace posed by the risk factors of hearing impairment in lower primary school children in our environment, educating the public about the causes, effects, treatment and preventive measures of hearing impairment becomes imperative. Routine hearing screening should be carried out in school children for early detection of hearing impairment. This should be implemented as an integral part of the school health program and should be repeated annually. Routine Immunization services should be strengthened and new strategies developed to increase coverage. This will help prevent communicable diseases. Lastly, all stake holders should promote exclusive breastfeeding policy and encourage parents to improve personal hygiene, avoid smoking and overcrowding.

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