HEARING AND VISUAL IMPAIRMENT AMONG PUBLIC PRIMARY SCHOOL PUPILS IN IBADAN NORTH LOCAL GOVERNMENT AREA, NIGERIA

BY

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DEDICATION

To my awesome creator, GOD

To my dear parents, Engr. & Mrs E.I. Oridupa

To the one who loves me, Oladapo Adetunji

To our loved ones, Olatunji & Olatola

ABSTRACT

Hearing and visual impairment are disabling conditions limiting communication and social connectivity. These can negatively affect school performance, cognitive and emotional status of children. Few studies have been done to assess hearing and vision among school children in Nigeria. This study was designed to determine the prevalence of hearing and visual impairment among pupils in public primary schools in Ibadan North Local Government Area (LGA) of Oyo State, Nigeria.

A cross-sectional survey was conducted among public primary school pupils in Ibadan North LGA. Using a three-stage sampling technique, 300 pupils aged 6-14 years were selected from six out of 74 schools located in six of the 12 wards in the LGA. Data on pupils' socio-demographic characteristics were collected with interviewer administered questionnaire. Screening audiometer was used for audiologic evaluation. Pure Tone Audiometry (PTA) averages greater than 30 dB HL was classified as hearing impairment. Snellen's "E" chart was used to determine visual acuity. Visual acuity reading from 6/24 to 6/60 was classified as visual impairment. Descriptive statistics and Chi square test were used for data analysis at p=0.05.

Mean age of participants was 9.7±2.1years and 53.0% were females. The mean PTA for the right ear was 24.2±4.9 dB HL and 24.3±4.7 dB HL for the left ear. Overall prevalence of hearing impairment was 14.0% [right ear (4.3%), left ear (4.0%) and both ears (5.7%)]. Prevalence of hearing impairment among pupils aged 6-8 years was 7.7% (right ear 2.0%, left ear 2.7%, both ears 3.0%); 9-11 years was 4.6% (right ear 1.3%, left ear 1.3%, both ears 2.0%) and 12-14 years was 1.7% (right ear 1.0%, left ear 0.0% both ears 0.7%). Prevalence of hearing impairment in males (14.2%) and females (13.2%) were not significantly different. Hearing impairment was significantly higher among children less than 10 years (23.7%) compared to those aged 10 years and above (6.1%). Of the affected pupils, 14.3% reported having difficulty in hearing and 5% had previous ear examination. Prevalence of visual impairment was 6.4% (right eye 1.7%, left eye 0.0%, both eyes 4.7%). Prevalence of visual impairment among pupils aged 6-8 years was 3.0% (right eye 1.3%, left eye 0.0%, both eyes 1.7%); 9-11 years was 2.3% in both eyes and 12-14 years was 1.0% in both eyes. Females (9.4%) had a higher prevalence of visual impairment

compared with males (2.8%). Prevalence of visual impairment did not vary significantly for the different age groups; 8.9% for those less than 10 years and 4.2% for 10years and above. Among those with visual impairment 38.9% reported difficulty seeing and 11.1% had previous eye examination. Both hearing and visual impairments were present in 1.0% of the pupils (females 0.7% and males 0.3%).

The burden of hearing and visual impairment was high among school children in Ibadan North LGA. This highlights the need to emphasize routine screening services in public schools as part of the school health programme in order to enhance early detection.

Key words: Hearing impairment, Visual impairment, Primary school pupils, Pure Tone Audiometry.

Word counts: 486

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CERTIFICATION

I hereby, certify that this research was carried out by Mrs Olubukola O. ADETUNJI in the Institute of Child Health, Faculty of Public Health, College of Medicine, University of Ibadan, under my supervision.

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LIST OF ABBREVIATIONS

WHO	World Health Organization
VA	Visual Acuity
VD	Visual Diameter
SHP	School Health Programme
LGA	Local Government Area
IBNLGA	Ibadan North Local Government Area
dB HL	Decibel Hearing Level
dB	Decibel
kHz	Kilo Hertz
NHANES	National Health And Nutritional Examination Survey
JCIH	Joint Committee on Infant Hearing
BMI	Body Mass Index
NHIS	National Health Interview Survey
NSHP	National School Health Policy
NPC	National Population Commission
SPSS	Statistical Package for the Social Sciences

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CHAPTER ONE

INTRODUCTION

1.1 Background

The World Health Organization (WHO) in 1948, in its preamble to its constitution, defined health as a state of complete physical, mental and social wellbeing and not merely the absence of disease and infirmity. This statement was later amplified to include the ability to lead a "socially and economically productive life" (WHO, 1978). Also, the General Assembly of the United Nations adopted on 20th November, 1959, the Declaration of the Rights of the Child. These include the right to enjoy the benefits of social security including nutrition, housing and medical care; right to free education, full opportunity for play and recreation, and special care if handicapped. Also, the right to learn to be a useful member of the society and to develop in a healthy and normal manner and in conditions of freedom and dignity; and the right to enjoy all rights regardless of race, colour, sex, religion, national or social origin.

Hearing impairment is the most frequent sensory deficit in human population and it is one of the major challenges limiting the health of children worldwide. The consequences of hearing impairment include inability to interpret speech sounds often producing a reduced ability to communicate, delay in language acquisition, economic and educational disadvantage, social isolation and stigmatization (Murray, 1996). Ideally, all cases of hearing impairment should be detected early, enabling prompt provision of treatment and rehabilitation in order to lessen the period of auditory deprivation (McCormic, 1997), but in reality, this is not always the case especially in resource poor countries like Nigeria.

Childhood hearing loss is a widespread problem with significant impact because it is an invisible condition resulting in communication problems that can ultimately interfere with learning and social development. Academic delays occur in children with mild hearing loss as early as first grade, and in later grades, two to three years academic delays

are commonly reported. While many children who receive good speech language stimulation catch up to their peers, those children without sufficient intervention from teachers and families, and those with sensorineural hearing loss usually do not (Nelson, 2009).

Most congenital and childhood onset hearing impairment occurs as sequelae to various causes which include: infections in pregnancy (rubella, syphilis), premature birth, perinatal/postnatal complications, neonatal jaundice, childhood infections (meningitis, measles, mumps, chronic ear infections), use of ototoxic drugs, injury to the head or ear, wax/foreign body blocking the ear canal and excessive noise (WHO, 2010).

Another major challenge to child health globally is visual impairment which is also recognized as an important problem in Nigeria (WHO, 2009; Faderin and Ajaiyeoba, 2001; Kehinde et al, 2005 and Ajaiyeoba et al, 2007). The years of early development make the child particularly vulnerable to visual disorders, especially if the normal development of the eye is affected by occurrence of disease. This has been documented by Frick and Foster (2003) that it may have a devastating impact on the child's psychological and physical development and abilities. Also, low vision and blindness have been associated with considerable disability and excess mortality, resulting into heavy socio-economic consequences.

Children with poor vision may be considered by their teachers to be poor students and both teachers and parents may subsequently lower their expectations of the child's performance (Avences and Mersheld, 1990). So also, poor vision and the inability to read materials written on the board can have a serious impact on a child's participation and learning in class with resultant consequences such as: lost educational and employment opportunities; lost economic gain for the individual and the family, and impaired quality of life (WHO, 2008). This impaired ability may also affect the child's behaviour (Newcomb and Marshall, 1990).

It has been observed that the prevalence and causes of visual impairment in children depends on geographic regions, socio-economic development, the status of the primary health care, and the eye care services available. In low income countries, it has been

observed that: corneal scars due to measles, ophthalmia neonatorium and other infections; malnutrition with vitamin A deficiency and harmful traditional eye remedies are major causes of childhood blindness (Rudanka, 2007).

It is imperative to know that a study of the pattern of ocular diseases in children is very important because while some eye conditions are just causes of ocular morbidity, others invariably lead to blindness. Also, while some conditions such as refractive errors and cataract are treatable, others like measles and vitamin A deficiency are largely preventable (WHO, 1999).

In Nigeria, surveys on the pattern of eye diseases among children carried out in various parts of the country have indicated that refractive errors, conjunctivitis, corneal scaring and injuries were some of the most common eye conditions affecting Nigerian children as reported by Kehinde et al, 2005; and also Ajaiyeoba et al, 2007.

In Nigeria, routine/periodic medical examination of school children, which is designed to detect problems that require medical attention, is important. The medical examination also provides the opportunity of discussing with parents and teachers the health problems and needs of the children. It includes, among others, screening for defects of hearing and sight. Thereafter, the medical examination findings will also ascertain the activities that a child can partake in (Lucas and Gilles, 2003).

School Health Programme (SHP) is the composite procedures and activities designed to protect and promote the well-being of students and school personnel. The main objectives of the SHP are to obtain a rapid and sustained improvement in the health of the school children, to ensure that children from pre-school age to adolescents are in optimum health at all times so that they can attain physical and intellectual potentials, as well as maximal moral and emotional benefits, from health providers, teachers and the school environment (Okeahialam, 2003). These can only be achieved through procedures and activities organized in: health services, healthful environment and health education.

The SHP comprises of five components, three of which are school health services, school health education and healthful school environment. The school health services deal with health appraisals, control of communicable diseases, detection of non-communicable

diseases, record keeping, supervision of health of school children and personnel. School health education provides a formal classroom opportunity for passing on information concerning knowledge, habits, attitudes, practices and conduct that pertain to individual or group health. Healthful school environment deals with conditions within the school that are most conducive to optimal physical, mental and emotional health, safety of pupils, satisfactory relationships among pupils, teachers, administrators as well as for rest, relaxation and recreation(Akani et al, 2001).

The WHO in its Global School Health Initiative, seeks to increase the number of schools that can be called health promoting schools, through implementing policies and practices that respects an individual's well-being and dignity, and provides multiple opportunities for success. Implementation of an effective school health programme will therefore make all schools, [Nigerian schools inclusive], a health promoting school that constantly strengthens its capacity as a healthy setting for living, learning and working by fostering health and learning, with all the measures at its disposal, in order to provide multiple opportunities for successful outcomes of the school children (Anderson and Creswell, 1980).

1.2 Conceptual Clarification

Hearing impairment includes a range of difficulties with hearing including deafness. It ranges from mild to profound and some people may be able to hear certain frequencies but not others, so that increased loudness does not necessarily result in greater clarity. Thus, the effect of hearing loss to individuals varies and is usually dependent on the degree of hearing loss. A person with a mild loss may have no difficulty hearing in quiet one-to-one situations, but may have problems in groups, where there is a background noise, or where the sound comes from a distance. A person with a moderate hearing loss may hear normal conversation only very faintly and will have difficulty understanding speech sounds at distance greater than one meter; high speech sounds such as S, F, P, T, K may be difficult to detect and they are likely to hear little in open spaces. A person with severe hearing loss may be unable to hear a normal speaking voice and even at very close range speech sound will not be clear, although, they may understand vowel sounds if they are loud enough. A person with profound loss may have no awareness of loud

sound in their immediate environment, and will not be able to hear normal speaking voices (Phaneendra Raoa et al, 2002).

There are three types of hearing loss namely conductive hearing loss, sensorineural hearing loss and mixed hearing loss. Conductive hearing losses are caused by diseases or obstruction in the outer or middle ear which usually affect all frequencies of hearing evenly and do not result in severe hearing losses. A person with a conductive hearing loss usually is able to use a hearing aid well or can be helped medically or surgically. Sensorineural hearing loss result from damages to the delicate sensory hair cells of the inner ear or the nerves which supply it and which can range from mild to profound. They often affect the person's ability to hear certain frequencies more than others. Thus, even with amplification to increase sound level, a person with a sensorineural hearing loss may perceive distorted sound level, sometimes making the successful use of a hearing aid impossible. A mixed hearing loss refers to a combination of conductive loss and sensorineural loss and means that a problem occurs in both the outer or middle and the inner ear. In addition, a central hearing loss results from damage or impairment to the nerves or nuclei of the central nervous system, either in the pathways to the brain or in the brain itself (Phaneendra Raoa, 2002).

The Individuals with Disabilities Education Act defined hearing impairment as "an impairment in hearing, whether permanent or fluctuating, that adversely affects a person or child's educational performance", while deafness is defined as "hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification". Furthermore, pure-tone averages can be classified into the following hearing loss categories: slight (16-25 dB HL), mild (26-40 dB HL), moderate (41-70 dB HL), severe (71-90 dB HL), and profound (> 90 dB HL). Hearing impairment can otherwise be classified as sensorineural if the air-bone gap is < 15 dB, conductive if the air-bone gap is > 15 dB and mixed if the air-bone gap was > 15 dB with elevated bone conduction threshold > 15 dB (Mathers et al, 2003).

Concerning vision, the categories of visual impairment in the International Classification of Diseases range from low vision to blindness and are based on the measurements of visual acuity (VA) and visual diameter (VD). These are: moderate visual impairment

(WHO 1: VA < 6/18-6/60), severe visual impairment (WHO 2: VA < 6/60-3/60), profound visual impairment (WHO 3: VA < 3/60-1/60, VD < 20 degrees ≥ 10 degrees), near total blindness (WHO 4: VA < 1/60-light perception, VD < 10 degrees), total blindness (WHO 5: VA- no light perception, VD- 0 degrees) and unknown degree of blindness (WHO 9: VA- unknown, VD- unknown). They are majorly classified into two: low vision (WHO categories 1-2) and blindness (WHO categories 3-5, 9) [WHO, 1973].

In general terms, congenital impairment is an impairment that is recognized at birth or that is believed to have been present since birth; progressive impairment is an impairment that may manifest itself at birth or postnatally and worsens over time; late onset impairment is an impairment that first manifests itself postnatally and cannot be attributed to an identifiable exogenous cause while acquired impairment is an impairment that first manifests itself postnatally and can be attributed to an identifiable exogenous cause (Fortnum et al, 2001).

1.3 Operational definitions

Hearing impairment was defined using WHO's definition of disabling hearing impairment in children under the age of 15 years, as a permanent unaided hearing threshold level in the better ear of 31decibels or greater pure tone average using audiometry for four frequencies 0.5, 1, 2 and 4 kHz (WHO, 2007).

Visual impairment was defined using the International Classification of Disease range of low vision to unknown degree of blindness expressed as visual acuity of less than 6/18 to unknown visual acuity (Mathers et al, 2003).

Body Mass Index (BMI) was assessed using the Centre for Disease Control and Prevention BMI chart for children aged 2-20 years classified as underweight (less than the 5th percentile), healthy weight (5th percentile to less than the 85th percentile), overweight (85th to less than the 95th percentile) and obese (equal to or greater than the 95th percentile). This was done separately for both male and female pupils (CDC, 2002).

1.4 Problem Statement

School age children constitutes a substantial fraction of the world's population, accounting for 24% of the population of the less developed world and about 15% of the industrialized world (Shariff et al, 2000). Nigeria has a population of 140,003,542 (male: 71,709,859; female: 68,293,683), as reported by the National Population Commission (NPC) in 2006, out of which 64% of the population live in the rural areas while about 36% live in the urban areas. About 70% of the population is under the age of 30 years while those under 15 years make up 44%. Children of school age, from pre-school to secondary school; a period during which the child is undergoing rapid physical and mental development, constitute about 23% of the population of the average Nigerian community (Akani et al, 2000). Akani et al (2000) also stated that not only are school age children a much larger proportion of the total population in the less developed than industrialized countries, but their numbers are also growing at a substantial rate.

WHO estimates that globally the number of people with hearing loss, on the hearing loss scale > 40 dB HL, has more than doubled from 120 million in 1995 to at least 278 million in 2005, thus making the condition the most prevalent sensory deficit. Permanent hearing loss can occur at any age but about 25% of the burden is of childhood onset (WHO, 2006). Using a lower scale of < 40 dB HL, there was an estimated 588 million persons with hearing loss globally, with childhood onset hearing loss accounting for an estimated 249 million (42.3%) of the affected persons (Mathers et al, 2003).

It was also estimated globally that the prevalence of childhood onset hearing loss according to the spectrum of the disease was: mild or greater at ≥ 26 dB HL was 175 million (males-89 million, females-86 million); moderate or greater at ≥ 41 dB HL was 62 million (males-31 million, females-31 million); severe or greater at ≥ 61 dB HL was 6 million (males-3 million, females-3 million) and profound at ≥ 81 dB HL was 6 million (males-3 million, females-3 million) [Mathers et al, 2003].

Routine screening for hearing impairment in childhood is now widespread in industrial countries. Also, universal newborn hearing screening is promoted in developed countries as an early detection strategy for permanent congenital and early-onset hearing loss.

However, most developing countries do not currently have screening programmes for hearing impairment (Gell, 1992).

In Nigeria, the early detection and management of hearing problems is relatively rare, thus precluding the determination of possible aetiological factors for the observed abnormalities. The paucity of up-to-date and representative epidemiological data on hearing disorders in Nigeria has been observed as undermining the effective advocacy for prevention initiatives. Furthermore, poor public awareness, inadequate relevant facilities and the lack of early routine or systematic screening programmes for childhood hearing loss in hospitals, schools and communities are major known contributory factors (Olusanya et al, 2008).

In 2009, the WHO estimated that about 314 million people were visually impaired worldwide; out of this 45 million people were blind. Visual impairment was in addition found not to be evenly distributed throughout the world with about 87% of the world's visually impaired living in developing countries, while approximately 85% of all visual impairment was reported to be avoidable globally. It was stated that correction of refractive errors, which is a common cause of visual impairment, could give normal vision to more than 12 million children between the ages of 5-15 years.

Although vision is very important to people of all ages, it is more so in children as it has a key role in their mental, physical and psychological development. Most of adult blindness is easily treatable but visual morbidity in children, if not detected and prevented in time leads to a permanent disability in which the child has to bear the scourge of the disability for the years to come (Nepal et al, 2003).

Importantly, ocular diseases leading to visual impairment and blindness are still rampant among students in Nigeria. Since most of these diseases are largely avoidable (preventable or treatable) early recognition and prompt treatment of these diseases by regular screening of children would reduce unnecessary visual impairment and blindness so that they can attain their full potential in the course of their education (Ajaiyeoba et al, 2007). Gilbert and Foster (2001) highlighted the fact that reducing visual impairment in children poses particular challenges which are different from the challenges of

controlling adult blindness because children are born with an immature visual system, and for normal visual development to occur, they need clear focused images to be transmitted to the higher visual centres. However, since failure of normal visual maturation cannot be corrected in adult life, there is therefore, a level of urgency about treating childhood eye diseases.

The magnitude of visual impairment is worsened by lack of awareness and recognition of the implications of the problem at personal and family level as well as at community and public health level (WHO, 2008).

Little is known about the prevalence and public health importance of eye diseases among school age children in developing countries. In addition, no national preschool or school eye screening programme exists in most countries in sub-Saharan Africa including Nigeria (Wedner et al, 2000).

1.5 Rationale for the study

The health of school children deserves special attention, and in order to derive the maximum benefit from the educational programme, the child must be healthy physically, mentally and emotionally (Lucas, 2003). For every Nigerian child, quality education, apart from providing the opportunity of reading, writing and learning, has the capacity to foster development, to encourage critical thinking, awaken talents and empower the individual. However, this is only possible within the frame work of optimum health care of the child from the uterine period to adolescence (Okeahialam, 2003).

This study was therefore carried out to assess the prevalence of hearing and visual impairment among public primary school pupils in Ibadan North Local Government Area of Nigeria so that the magnitude of their public health importance can be ascertained. This would also stand as a platform of advocacy for early detection programmes of hearing and visual impairment, and other important early onset/childhood impairments in our hospitals, schools and communities, in order to facilitate early management schemes for the various identified conditions. This is important because the earlier impairment occurs in a child the greater the impact it has on the child's overall development and the earlier the impairment is identified and managed appropriately, the lesser the

consequences on the quality of life of the child. Thus, if undetected or untreated, childhood impairments can have substantial long-term implications for the quality of life of the children, their family and the society at large. The findings of this study would also bring to the attention of the three tiers of government, the ministries of health and education, the non-governmental organizations, parents and other stake holders the: health, educational, psychological, and socio-economic implication of these conditions and necessitate adequate programmes on prevention, early detection and prompt assisted intervention.

1.6 Research Questions

1. How many of the public primary school pupils in Ibadan North Local Government Area (IBNLGA) have hearing impairment?
2. How many of the public primary school pupils in IBNLGA have visual impairment?
3. What are the factors that can be associated with hearing impairment among public primary school pupils in IBNLGA?
4. What are the factors that can be associated with visual impairment among public primary school pupils in IBNLGA?

1.7 Hypothesis

1. There is no significant relationship between the age of the pupils in IBNLGA and the prevalence of hearing impairment.
2. There is no significant relationship between the age of the pupils in IBNLGA and the prevalence of visual impairment.
3. There is no significant relationship between sex of the pupils in IBNLGA and the prevalence of hearing impairment.
4. There is no significant relationship between sex of the pupils in IBNLGA and the prevalence of visual impairment.
5. There is no significant relationship between nutritional status of the pupils in IBNLGA and the prevalence of hearing impairment.

6. There is no significant relationship between nutritional status of the pupils in IBNLGA and the prevalence of visual impairment.

1.8 Objectives

1.8.1 General Objectives

To determine the prevalence of hearing and visual impairment among public primary school pupils in IBNLGA.

1.8.2 Specific Objectives

These specific objectives were to:

1. Determine the prevalence of hearing impairment among public primary school pupils in IBNLGA.
2. Determine the prevalence of visual impairment among public primary school pupils in IBNLGA.
3. Identify factors associated with hearing impairment among public primary school pupils in IBNLGA.
4. Identify factors associated with visual impairment among public primary school pupils in IBNLGA.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

It is universally recognized that the health of school children deserves special attention because school age is a period during which the child is undergoing rapid physical, mental, emotional and intellectual development. The school environment provides a unique opportunity for safeguarding the health of the school children today and thus ensuring the health of the adults of tomorrow. Importantly, many of these school children who are survivors in an environment of high childhood mortality still bear the sequalae of these diseases such as malnutrition resulting in vitamin A deficiency complicated by corneal scarring thereby resulting into visual impairment or measles infection complicated by hearing impairment. Also, these children relate with children other than their close relatives and immediate neighbours which makes them susceptible to contacting infections (Lucas and Gilles, 2003).

The major causes of morbidity among school age children can be broadly classified into two which are communicable and non communicable. Communicable causes includes: parasitic infections (malaria), viral infections (chicken-pox, mumps), bacterial infections (gastroenteritis, tetanus), helminthic infestation (hookworm, pinworm, tapeworm); respiratory tract infections; ear infections, eye infections, tonsilopharyngitis, sinusitis; skin conditions (ring worm, scabies) and dental infections. Non communicable causes include the following: anaemia secondary to sickle cell disease, malnutrition, hook worm infestation or chronic disease; dental anomalies; accidents and falls; in addition to hearing impairment and visual impairment (Obionu, 2007).

2.2 Hearing impairment

2.2.1 Definition of hearing impairment

The WHO's definition of disabling hearing impairment in children under the age of 15 years is described as a permanent unaided hearing threshold level in the better ear of 31decibels or greater pure tone average using audiometry for four frequencies 0.5, 1, 2 and 4 kHz (WHO, 2007). Pure-tone averages can also be classified into the following hearing loss categories: slight (16-25 dB HL), mild (26-40 dB HL), moderate (41-70 dB HL), severe (71-90 dB HL), and profound (>90 dB HL). Hearing impairment can further be classified as sensorineural if the air-bone gap is < 15 dB, conductive if the air-bone gap is > 15 dB and mixed if the air-bone gap is > 15 dB with elevated bone conduction threshold (> 15 dB) [Mathers et al, 2003].

2.2.2 Epidemiology of hearing impairment

Globally WHO, (2000) estimates that there are about 588 million persons with hearing loss while childhood onset hearing loss accounted for an estimated 249 million (42.3%) of the affected persons. Prevalence of hearing loss according to the spectrum of disease for childhood onset hearing loss were as follows: mild or greater hearing loss at ≥ 26 dB HL was 175 million (70.3%), moderate or greater hearing loss at ≥ 41 dB HL was 62 million (24.9%), severe or greater hearing loss at ≥ 61 dB HL was 6 million (2.4%) and profound hearing loss at ≥ 81 dB HL was 6 million (2.4%) [Mathers et al, 2003].

Hearing loss is much more common in developing countries and it is estimated that two out of three of the world's hearing impaired are in developing countries. The reasons include absence of regular screening programmes for ear diseases, poverty, malnutrition, ignorance and paucity of accessible health care (Jacob et al, 1997). The view that childhood hearing impairment is commonest in low socio-economic classes has become conventional wisdom because of the impact of poor hygienic conditions, low immunization rate and misuse of ototoxic medications (Olusanya et al, 2004).

In the United States, audiometric screening was carried out using a national population based cross-sectional survey with an in-person interview and audiometric testing to

describe the prevalence of hearing loss by socio-demographic characteristic among 6,166 children aged 6-19 years in elementary, middle and high school. The study revealed that a total of 14.9% of the children had low-frequency or high-frequency hearing loss of at least 16 dB HL, 7.1% had low-frequency hearing loss of at least 16 dB HL and 12.7% had high frequency hearing loss of at least 16 dB HL. Most of the hearing loss was unilateral and slight in severity (16-25 dB HL). Of those with measured hearing loss, 10.8% were reported to have current hearing loss during the interview (Niskar et al, 1998).

Barclay, (2010) carried out another study in the United States to compare the prevalence of hearing loss from 2005-2006 with figures from 1988-1994. This study involved the use of cross-sectional analysis which utilized the United States representative demographic and audiometric data from 2,928 participants aged 12-19 years, in the Third National Health and Nutrition Examination Survey (NHANES) 1988-1994, and from 1,771 of such participants in NHANES 2005-2006. The investigators audiometrically determined the prevalence of hearing loss in participants and categorized it as unilateral or bilateral for low frequency (0.5, 1 and 2 kHz) or high frequency (3, 4, 6 and 8 kHz). On the basis of hearing sensitivity in the worse ear, hearing loss was also categorized as slight loss (> 15-25 dB HL) and mild or greater loss (≥ 25 dB HL). Comparison of the two surveys conducted by Niskar et al (1998) and Barclay (2010) revealed that in 1988-1994, the prevalence of any hearing loss was 14.9% which rose significantly by 31% to 19.5% in 2005-2006. Most of the hearing loss was slight in both time periods, but the prevalence of mild or worse hearing loss was significantly higher by 77% in 2005-2006 than in 1988-1994 ($p=0.001$). The odds of hearing loss were significantly greater in participants from families below the federal poverty threshold (23.6%; 95% CI, 18.5%-28.7%) than in participants from families above the federal poverty threshold (18.4%; 95% CI, 13.6%-23.2%). It also showed that girls were significantly less likely than boys to have hearing loss. The methodology of these studies precludes the determination of causality of hearing impairment and the prevalence of hearing loss could have been underestimated because children whose hearing aids could not be removed, who could not tolerate ear phones, or who had cochlear implants were not tested. In addition, it does not explain the

reason(s) for the increased prevalence observed or identify the potential modifiable risk factor(s) to prevent the development of hearing loss in these children.

Fortnum et al, (2001) conducted a retrospective questionnaire-based total ascertainment study among 17,000 children born from 1980-1995, resident in the United kingdom in 1998, with permanent childhood hearing impairment (hearing level in the better ear > 40 dB HL averaged over 0.5, 1, 2, and 4 kHz). Information was collected through sources in the health and education services for hearing impaired children, in order to determine the prevalence of permanent childhood hearing loss in the United Kingdom and implications for universal neonatal hearing screening. The main outcome measures of the study were number of cases with date of birth and severity of impairment converted to prevalence of each annual birth cohort (cases/1000 live births) and adjusted for under ascertainment. The study revealed that the prevalence of hearing loss observed at > 40 dB HL rose from 0.91/1000 for 3 year olds to 1.65/1000 for children aged 9-16 years. Adjustment for under ascertainment increased the estimate to 1.07/1000 and 2.05/1000 respectively. Thus, it was stated that relative to the current yields of universal neonatal hearing screening in the United Kingdom, which are close to 1/1000 live births, 50-90% more children are diagnosed with permanent childhood hearing impairment by the age of 9 years as prevalence increases with increasing age. Here, the study used data/notification from hospital, community clinic and education services for hearing impaired children, and employed capture and recapture analysis to adjust for under ascertainment. Nevertheless, this was not a true representative of the general population because not all cases were captured and some information might have been lost over time. Another limitation of their study was that it did not identify cases that had not been confirmed and missed those with slight/mild hearing loss.

In Malaysia, Elango et al (1991) conducted a cross-sectional study among 1,307 randomly selected primary school children, to determine the prevalence of hearing loss and ear disorders among Malaysian school children. The children were examined with otoscope and pure tone audiometer, and examination findings revealed that 5.8% were hearing impaired at a hearing loss level > 40 dB HL. About seven percent of the children had middle ear disorder of which 54.7% had chronic suppurative otitis media. In this

study, there was no association between the presence of middle ear disorder and hearing affectation. In another cross-sectional study, Prasansuk (2000) determined the prevalence of hearing impairment among school children from two different communities in Thailand with hearing loss level defined as > 40 dB HL in the better ear. The study findings revealed that 3.9% out of 10,242 urban school children in Bangkok had hearing impairment, while 6.1% out of a total of 2,153 rural school children had hearing impairment. In this study, there were no established factors or risks associated with hearing impairment and the reason for the difference in the prevalence of hearing impairment among rural and urban school children was not indicated.

In the rural areas of coastal South India, and adopting the WHO guidelines, a study was carried out by Phaneendra Raoa et al (2002) to determine the prevalence and causes of hearing impairment and among children of school entry age. A total of 855 children were examined using a portable Pure Tone Audiometer and otoscope to determine children with hearing impairment. Children identified with impaired hearing were re-examined to find out the type of impairment. In addition, mothers of all these children were interviewed in their homes in order to obtain details of socio-economic status, family history and history of consanguinity. The findings of the study revealed the following: 11.9% were detected as having hearing impairment and conductive hearing impairment was predominantly observed (81.6%), impacted wax was found to be the most common cause of hearing impairment (86.3%) among these children and the prevalence was significantly lower among children belonging to high socio-economic status (p=0.0036). The study was limited to school entrants thus the association between differing age groups and hearing impairment could not be ascertained.

Studies conducted in Africa show large variations in the prevalence of hearing impairment. In the Northern Africa region, Hatcher et al, (1995) carried out a pilot study for a clinical trial of simple treatments for chronic suppurative otitis media in 5,368 school children, from 57 randomly selected primary schools in Kiambu District, Kenya. Simple otoscopy was performed by clinical officers with specialty training in otorhinolaryngology and audiometric test was performed by trained nurses using a hand held field audiometer. Microbiological specimens were obtained from children with

chronic suppurative otitis media for further analysis. It was found that 5.6% of the children had hearing impairment > 30 dB HL in one or both ears while 2.2% of the children had bilateral hearing impairment. In addition, 8.6% had wax obstructing the tympanic membrane, 1.4% had at least one perforated tympanic membrane and 1.1% had chronic suppurative otitis media. The most common causative organisms for the chronic suppurative otitis media found in the children were *Pseudomonas* spp. (34%), *Proteus* spp. (34%) and *Eschericia coli* (19%). There was a significant relationship between hearing impairment and both chronic suppurative otitis media and wax impactation (Hatcher et al, 1995). This study identified two risk factors associated with hearing impairment however, being cross-sectional in design causality could not be established.

In Tanzania, a study was carried out by Minja and Machemba, (1996) among 802 primary school children aged 6-10 years from both rural and urban Dar es Salaam, to determine the prevalence of otitis media, hearing impairment and cerumen impaction. Examination was by otoscopy and pure tone audiometry. Ear disease was found in 27.7% of the children as follows: 15.7% had cerumen impaction [rural-20.45% and urban-14.8%, not statistically significant], 8.7% had sensorinueral hearing loss [rural-14.1% and urban-7.7%, statistically significant ($p<0.001$)] and 2.6% had chronic suppurative otitis media [rural-9.44% and urban-1.3%, statistically significant ($p<0.005$)]. The low prevalence of chronic suppurative otitis media among the urban school children was ascribed to better medical services which facilitated early diagnosis and treatment of acute otitis media. However, the study did not establish an associated risk factor(s) for the increased prevalence of sensorineural hearing loss among the rural dwellers.

In Swaziland, a survey was carried out by Swart et al (1994) among a representative sample of Grade 1 school children to determine the prevalence of ear and hearing disorder. The study demonstrated that 16.8% of the children had ear disorders and the most common disorder was impacted wax, with a prevalence rate of 74/1000. Middle ear disorders were also common and the prevalence rate for children with active middle ear disease was 30/1000 with 17/1000 having a hearing loss; and for children with inactive middle ear disease, the prevalence was 21/1000 with 5/1000 having a hearing loss. The prevalence rate of sensorineural hearing loss was 8/1000 children. It was stated in this

study that improved treatment of acute otitis media was important to reduce the sequelae of the disorder, which, has deleterious effect on hearing and impairs educational achievement once the children enrol at school.

Studies conducted in West African have also given varied results. Seely et al (1995) conducted a community screening programme to identify and evaluate hearing impairment in a population based sample of children aged 5-15 years in a rural community in the Eastern province of Sierra Leone. Risk factor analysis was performed in 1,184 children and an equal number of matched controls. Hearing impairment determined according to the WHO definition revealed that 9.1% of children had mild or greater hearing loss while the prevalence of bilateral profound hearing loss was 4.0/1000. The risk factor most strongly associated with hearing loss was a history of otorrhoea persisting longer than one month.

In Nigeria, Olusanya et al (2000), after a study carried out on the hearing profile of Nigerian school children, reported that school age children were rarely screened for hearing impairment during routine clinical examination and most school health authorities made no provision for audiometric assessment. The lack of screening was attributed to low awareness of the consequences of mild hearing loss among parents, school authorities and health care providers. Also, the overwhelming burden of prevailing communicable diseases on the available/limited resources in the country further diverts attention away from auditory screening. In addition, while children with moderate to profound hearing loss > 40 dB HL may be detected through initial parental suspicion, those with slight/mild hearing loss 16-40 dB HL are unlikely to be detected because the handicap is associated more with receptive rather than expressive linguistic skills.

Studies conducted in Nigeria on hearing impairment between 1986-2001, as reported by Olusanya et al, 2005, revealed that the prevalence of hearing impairment defined as > 20 dB HL after audiometry among 1,544 mainstream school children aged 5-21 years by Boison (1986,) was 13.5%; the prevalence of hearing loss defined as > 20 dB HL after otoscopy and audiometry among 292 mainstream school children aged 6-7years by Ogisi and Amu (1990) was 9.2% and Olusanya et al (2000) otoscopy, audiometry and tympanoscopy reported a prevalence of hearing loss defined as > 15 dB HL 13.9%

among 359 mainstream school children aged 4.5-10.9 years. 4) In a Household National Ear Care Programme survey carried out in 2001 among 3,820 children aged 5-14 years, the prevalence of hearing loss was 13.4% when defined as > 25 dB HL and 6.7% when defined as > 40 dB HL.

In the afore-mentioned study carried out by Olusanya et al (2000), 359 primary school entrants in Lagos State, with average age of 6.7 years, were examined following parental interviews, by otoscopy, pure tone audiometric screening (frequency 0.5-4kHz) and tympanometry to evaluate the presence and pattern of hearing impairment among the pupils. At the end of the examinations, it was revealed that 13.9% of the pupils were suffering from hearing loss. Among these, 8.9% experienced mild hearing loss (26-40 dB HL) while 2.8% and 0.8% were suffering from both moderate (41-70 dB HL) and severe (71-90 dB HL) hearing losses respectively; 36% had conductive hearing loss, 24% had sensorineural hearing loss while 40% showed signs of mixed hearing loss. While 19.4% of the examined children reported hearing loss, parents or teachers had observed signs of hearing loss in only 2% of the children.

In this same study, middle ear abnormalities were noted in 20.9% of the study population, of which 18.7% had otitis media with effusion. Impacted cerumen documented in 52.6% of the children was the most common disorder which showed significant association with hearing loss and school performance. Tympanic membrane abnormalities were observed in 40.1% of the children while 1.3% showed abnormal tympanograms (Olusanya et al, 2000). This study limited its population to only school entrants; hence findings cannot be generalized to all children. Furthermore it could not explore association between differing age and the prevalence of hearing impairment and if the presence of abnormal tympanogram was associated with hearing impairment.

Lasisi et al (2006) conducted a hospital based study to assess the challenges in the management of childhood sensorineural hearing loss in Sub-Saharan Africa, Nigeria, with a review of children presenting at the Otolaryngology out-patient clinic in the University College Hospital, Ibadan, Nigeria. Sensorineural hearing loss was found in 103 children giving a hospital prevalence rate of 14% out of which about 60% of them had educationally significant hearing loss at presentation. Among these children, access

to hearing aid was poor as only 12.5% of them could afford it while the rest were managed by deaf training. Genetic factors accounted for 25% of the sensorineural hearing loss, followed by measles infection 13% and meningitis 8%. It was expressed that the evaluation of the hearing impaired child which attempts to determine the aetiology, the degree of hearing loss, and intervention to aid speech and language remains a challenge to practicing otolaryngologists, especially in the developing countries as 85-90% of causes of hearing losses were never discovered leading to delayed intervention and irreversible effects. Some limitations of this study are that it was hospital based and assessed only sensorineural hearing loss excluding both conductive hearing loss and mixed hearing loss. In addition, it is not a true representative of the burden of hearing impairment in the population.

2.2.3 Factors associated with hearing impairment

Hearing plays an important role in communication, speech, language development and learning, and even a small amount of hearing loss can have profound negative effects on speech, language comprehension, communication, classroom learning and social development (Bess et al, 1998). Speech development, social variables and emotional variables are highly related to language development which is positively and significantly affected by the age of identification of hearing loss and age of initiation into intervention services (Yoshinaga-Itano, 2003).

Hearing impairment could be hereditary. If one or both parents or a relative is born deaf, there is a higher risk that a child will be born deaf. Pre, peri and post natal causes of hearing impairment include premature birth, birth asphyxia, infections in pregnancy (rubella, syphilis), inappropriate use of ototoxic drugs during pregnancy and at birth, and jaundice. Childhood causes include infectious diseases such as meningitis, measles, mumps and chronic ear infections leading to hearing loss mostly in childhood, but also later in life, use of ototoxic drugs including some antibiotics (gentamicin), and anti-malaria (quinine) which can damage the inner ear. In addition, head injury or injury to the ear and wax or foreign bodies blocking the ear canal can cause hearing loss at any age. Excessive noise, including working with noisy machinery, exposure to loud music or

other loud noises, such as gunfire or explosions, can damage the inner ear and weaken hearing ability. Also as people age, accumulated exposure to noise and other factors may lead to deafness or hearing impairment (WHO, 2010).

Reported risk factors for Permanent Congenital and Early onset Hearing Loss in Nigeria according to the Joint Committee on Infant Hearing (JCIH) were: family history of hearing loss in childhood, birth asphyxia, prematurity < 1500g, prenatal infections, meningitis, ototoxicity, hyperbilirubinaemia, cranio-facial anomalies and syndromes associated with hearing loss. Other factors were: congenital malaria, high fever with or without seizures, neonatal sepsis, young maternal age, prolonged/obstructed labour, prolonged rupture of membrane, consanguinity, birth trauma, low birth weight and small for gestational age (JCIH, 2007).

In the study carried out to determine the predictors of hearing impairment among children in Nigeria by Olusanya et al (2004), six audiologic factors associated with hearing loss were foreign bodies in the ear canals, impacted cerumen, dull tympanic membrane, perforated ear drum, otitis media and enlarged nasal turbinate. Hearing loss was predominantly slight/mild and bilateral among children in this study. This finding suggested that the hearing impaired children would not have been detected during routine clinical examination without a systematic audiologic screening. Impacted cerumen and otitis media were important predictors of hearing loss in this population and when a universal audiometric screening cannot be implemented, selective screening or referral based screening on identified risk factors would facilitate the detection of a significant proportion of hearing impaired children for appropriate and timely intervention. This may explain the reason behind the inclusion of routine and systematic hearing screening in well established child health surveillance programme (Olusanya et al, 2004).

The study carried out to determine the predictors of hearing impairment among school children in Nigeria demonstrated that hearing loss in school going children cannot be readily detected during routine clinical examination without a systematic audiologic screening. (Olusanya et al, 2004).

2.2.4 Hearing impairment prevention/intervention

Today, children with hearing loss have more opportunities than ever before to use audition and to achieve age-appropriate spoken language and academic outcomes. Several factors are driving these new outcomes including: universal newborn hearing screening and early diagnosis of hearing loss, immediate fitting of advanced hearing technology, and enrollment in appropriate early intervention services (Houston and Caraway, 2010). Importantly, early identification before significant handicap accrues, offers the best opportunity for initiating effective remediation and rehabilitation if its long term consequences are to be prevented (Mohd khari, 2005).

The problems involved in implementing screening programmes in developing and industrial countries are very different and in selecting screening procedures for a particular population the following factors have to be taken into consideration: the environmental test conditions, the availability of resources for equipment and the training of testers, the local attitudes towards disability, the level of hearing impairment that may cause handicaps, and the major types of pathology causing hearing impairment. There is also an urgent need to develop reliable and simple screening procedures for infants and children, before the age of two years and at school entry. No screening should however be implemented until appropriate follow-up services are available (Gell, 1992).

Hearing impairment among school children in the developing world has also been widely reported as a significant health problem since mainstream schools are auditory-verbal environment; thus, hearing impairment has adverse consequences on educational attainment. Therefore, hearing screening at school entry had been proposed for the early detection and rehabilitation of hearing impaired school children in developing world (Mcpherson, 1990 and Gell, 1992).

Bess, Dudd-Murphy and Parker (1998) stated that even a small amount of hearing loss can have profound negative effects on speech, language comprehension, communication, classroom learning, and social development. Thus, children with mild to moderate hearing loss without proper intervention on average do not perform as well in schools as

children with no hearing loss and this gap in academic achievements widens as students progress through school.

When assessing the hearing status of children, different methods may be employed to seek similar information which includes: to identify and qualify any hearing impairment, to localize the site of any pathological process and to assess any resulting hearing disability. The hearing thresholds are identified wherever possible by age appropriate behavioural techniques. It is important to note that hearing assessment is only one aspect in the overall care of children with hearing problems, and if hearing problem is found, investigations into the cause will be needed followed by appropriate management and rehabilitation (Bellman and Vamiasegram, 1997).

Kemper and Downs (2000), and Cunningham and Cox (2003) observed that most children with congenital hearing loss have hearing impairment at birth and are potentially identifiable by newborn and infant screening. However, some congenital hearing loss may not be evident until later in childhood and studies have shown that improved outcomes for children with congenital impairment are associated with confirmation and intervention by six months of age.

The benefit of universal newborn hearing screening for children with permanent hearing impairment is that early identification is associated with better expressive and receptive language, speech, social and emotional development. It was also observed that children who are identified before the age of 6 months show substantial benefit in the first five years of life, and there is some evidence that early enrolment in intervention programmes is associated with better outcomes (Moeller, 2000). Fortnum et al (2009) in addition stated that paediatric audiology services must have the capacity to achieve early identification and confirmation of additional cases since not all hearing impairments manifest themselves at birth, and screening programmes must be complemented by services that can confirm and manage cases where impairment first shows itself postnatally.

In recognition of the complementary value of implementing both primary and secondary prevention measures for hearing loss, the World Health Assembly passed a resolution in

1995 urging member states to: 1) Ensure primary prevention through immunization, genetic counseling and improved antenatal and perinatal care which may help to address some environmental causes; but this has limited impact on genetic or hereditary aetiologies. 2) Ensure screening using transient evoked otoacoustic emission and automated auditory brainstem responses before hospital discharge. 3) Have an audiologic programme which has the comprehensive function of neonatal and infant hearing screening, accompanied with subsidized hearing aid services, hearing rehabilitation and surgery. 4) Ensure screening audiometric test and otological examination conducted by school health medical officers regularly to enable detection of most of the cases with hearing loss and middle ear disorders (WHO, 1995).

Efforts to address the high incidence of hearing loss in Nigeria like many developing countries are currently limited to primary prevention through immunization, improved birthing practices/conditions and on going public health education. However, the expanded programme on immunization (EPI) in Nigeria excludes mumps, rubella and meningitis which are notable risk factors for hearing loss. Despite all efforts, however, immunization coverage is not optimal especially in some Northern parts of Nigeria. Also important is improved birthing practices/conditions which include provision of trained birth attendants, emergency obstetric care and steps aimed at discovering unsupervised home delivery to minimize the incidence of risk factors for hearing loss. However, the standard of maternal and child health care across the country is poor and is unlikely to develop to a level that significantly curtails the incidence of avoidable hearing loss. So also, congenital hearing loss which is attributable to heredity, congenital abnormalities or genetic factors and adventitious hearing loss is also associated with poor living condition which persists in our environment (Olusanya et al, 2005).

Children with hearing loss require more favorable conditions which entails an improvement in signal-to-noise ratio of 12-15 dB than do other children in order to achieve the same word recognition i.e. the teacher's voice must be heard by an additional 12 dB or 15 dB above the noise level in order for children with hearing loss to understand as well as other children in the same room. These more favorable listening conditions cannot be achieved through children's use of hearing aids alone. Traditional hearing aids

place the microphone on the child's ear, and these amplify both the signal (the teachers voice), and the noise (the children's chatter) equally. Instead, more favorable listening conditions may be achieved by providing amplification of signal selectively. Teachers can improve the signal-to-noise ratio by wearing wireless microphones, with the voice signal transmitted through personal FM systems to individual children wearing FM receivers, or by transmitting the signal through classroom FM amplification systems to speakers around the room. These systems improve children's understanding by amplifying the teacher's voice selectively, thereby, resulting in a desirable positive signal-to-noise ratio. Additional benefit can be gained through architectural changes that result in reduced noise and reverberation in the classroom, such as tiles, carpets, and drapes (Nelson, 2009).

It is important to note that children with hearing loss look like all other children, but they understandably experience frustration while trying to learn in unfavorable conditions. Some succeed in spite of the conditions; however, others may become poor readers, poor mathematics students, or develop behavioural problems. Still, the good news is that secondary problems associated with hearing can be minimized by early identification of the loss and by maximizing communication in the child's environment (Nelson, 2009).

2.3 Visual impairment

2.3.1 Definition of visual impairment

The WHO's definition of visual impairment in terms of presenting vision as defined by the visual acuity in the better eye are: moderate visual impairment (VA < 6/18-6/60), severe visual impairment (VA < 6/60-3/60), profound visual impairment (VA < 3/60-1/60), near total blindness (VA < 1/60-light perception), total blindness (VA - no light perception) and unknown degree of blindness (WHO, 1973).

2.3.2 Epidemiology of visual impairment

The WHO estimated that there were in excess of 161 million people worldwide in 2002 with visual impairment (VA < 6/18 in the better eye), accounting for 2.4% of the world's population, including 37 million with blindness (VA < 3/60) in the better eye and 124

million having low vision (VA < 6/18-3/60). Visual impairment survey carried out in the six WHO sub regions revealed the number of persons visually impaired in descending order as thus: South-East Asia Region- 45.083 million, Western Pacific Region- 41.793 million, Africa Region- 26.778 million, East Mediterranean Region- 16.469 million, Region of the Americas- 15.535 million and European Region- 15.521 million (Pascolini, 2004). It demonstrated that the burden of visual impairment was not distributed uniformly throughout the world and the least developed regions carried the largest share. Visual impairment was also unequally distributed across age groups with prevalence increasing with increasing age. A distribution imbalance was also found with regards to gender globally with females having a significant higher risk of having visual impairment than males as evidenced by the female:male ratios ranging from 1.5-2.2:1. The ratios of people with low vision to those with blindness, by sub region, ranged from 2.4-5.8 with a median value of 3.7 and an estimated 1.4 million blind children below the age of 15 years (Pascolini et al, 2004).

When the definition was expanded to include uncorrected refractive error, it was estimated that 259 million people were visually impaired (Wong et al, 2006). It was also estimated in 2004 that 12.8 million children in the age group of 5-15 years were visually impaired from uncorrected or inadequately corrected refractive errors, at a global prevalence of 0.96% with the highest prevalence reported in urban and highly developed areas in South-East Asia and in China (WHO, 2008).

A 2004 WHO report estimated that worldwide, about 314 million people were visually impaired out of which 45 million people were blind. It was estimated that globally 12.8 million children aged 5-15 years were visually impaired from uncorrected or inadequately corrected refractive errors at a global prevalence of 0.96% (WHO, 2008); and an estimated 1.4 million children below the age of 15 years were blind (WHO, 2009).

The WHO, in its report in 2004 stated that for the age group 5-15 years, the prevalence of visual impairment from uncorrected refractive error in some regions appeared to be higher in urban areas than in the rural areas despite the reported better access to services. This was attributed to a higher incidence of myopia in these populations. It was also suggested that there may be a direct cause-effect relationship between increased access to

education and myopia, bearing in mind that other secular changes could be contributing factors. In this age group, the prevalence of myopia reported in the studies that used the same definitions and cut-off levels ranges from 3%-35%, hypermetropia from 0.4%-17% and astigmatism from 2.2%-34% depending on the region and on the urban/rural setting.

Childhood blindness remains a significant problem globally as stated by the WHO in 2009 which estimated that 1.4 million blind children below age 15 years will live in blindness for many years. In addition, more than 12 million children aged 5-15 years were visually impaired because of uncorrected refractive errors (near-sightedness, far-sightedness or astigmatism); conditions that could be easily diagnosed and corrected with glasses, contact lenses or refractive surgery.

In the United States, a study was carried out to determine the prevalence of visual impairment and blindness among 12,524 children aged less than 18 years using the National Health Interview Survey (NHIS) in which information was collected from a parent or other knowledgeable adult in the family. The prevalence of reported visual impairment and blindness was 2.5%. The prevalence was significantly lower for children less than 6 years (1.0%) than for children aged 6-17 years (3.3%). Children whose families were below the federal poverty level were nearly twice as likely to be visually impaired compared with children from families whose income was ≥ 200% of the poverty level (Cotch et al, 2005). The limitation of this study was that the proxy reported visual impairment may differ from measured visual impairment; and also, the interviewed parent or family member might not have complete information on the nature and extent of the child's condition.

In Sao Paulo, Brazil a study was carried out to determine the prevalence and causes of visual impairment in low income school children in which 2,441 children aged 11-14 years were selected by randomized cluster sampling. The examination included visual acuity testing, ocular motility and examination of the external eye, anterior segment and media. The prevalence of uncorrected, presenting and best corrected visual acuity ≤ 6/12 in the better eye was 4.82%, 2.67% and 0.41% respectively. Refractive error was a cause in 76.8% of children with visual impairment in one or both eyes, amblyopia (11.4%), retinal disorders (5.9%), other causes (2.7%) and unexplained causes (7.7%). The girls

had poorer vision in the better eye compared with the boys. Out of the overall prevalence of visual impairment of 9%; 2.3% had visual impairment in the right eye only, 1.9% had visual impairment in the left eye only while 4.8% had visual impairment in both eyes. With uncorrected visual impairment, 4.8% of the children had visual acuity 6/12 or worse in the better eye. With presenting visual acuity, 2.7% remained visually impaired while 0.41% had visual impairment with correction (Salomao et al, 2008). A limitation of this study was that the sample of public school children might not necessarily be representative of all children living in the study area and there was no explanation given for the higher prevalence observed among the girls.

In Australia, a population based cross-sectional study was carried out to describe the distribution of visual acuity and the causes of visual loss in a representative sample of 1,738 predominantly 6 year old children. Visual acuity was measured in both eyes before and after pin-hole correction and with spectacles if worn. Cyclopegic autorefraction and detailed dilated fundus examination were performed. The findings of this study revealed the prevalence of uncorrected visual impairment defined as $\leq$ 6/12 in the better eye of 1.3% and in the worse eye of 4.1%. The prevalence was higher in girls than boys and among children of lower socio-economic status. Refractive error was the most frequent cause accounting for 69.0%, followed by amblyopia (22.5%) while astigmatism was the commonest refractive error causing visual impairment (Robaei et al, 2005). A limitation of this study was that a wide age range of children were not included hence precluding the association of visual impairment with increasing age; and the association between the observed higher prevalence among girls was not investigated.

In a district of Western Turkey, a cross sectional vision screening study was carried out among children in primary schools with mean age 10.52 ± 2.28 years, ranging between 6-17 years. The prevalence of visual impairment defined as VA < 6/12 was 1.7% in the better eye. There was a female predominance at female:male ratio 2.4:1.0 ($p< 0.05$). Also in the study, children older than 10 years had a higher frequency of presenting visual impairment than children younger than 10 years 1.7% and 1.6% respectively; however no statistically significant difference was found between the two age groups (Unsal et al,

2009). This study did not assess the association between grade levels, socio-economic status and the occurrence of visual impairment among the participants.

Nepal et al (2003) carried out a study in Kathmandu, Nepal involving the examination of 1,100 pupils aged 5-16 years in three clusters of government schools to determine the prevalence of ocular morbidity. A complete eye examination was given to all the children including slit lamp examination, fundus evaluation and retinoscopy, and subjective refraction. Ocular morbidity was detected in 11% of the children and 97% of these causes were preventable or treatable. Refractive error was a major cause of visual impairment and accounted for a total of 8.1% of cases i.e. 5.4% for visual acuity 6/9-6/18, 2.1% for visual acuity 6/24-6/60 and 0.6% for visual acuity < 6/60. Other ocular morbidity identified were strabismus (1.6%), traumatic eye injuries (0.5%), xerophthalmia (0.36%), and congenital abnormalities (0.36%). The cluster sampling method utilized in this study yields low precision because many first stage units would have been excluded.

Another study was carried out to assess the prevalence of visual impairment among secondary school children of upper-middle socio-economic status in Kathmandu for comparison with rural Jhapa District. It involved a random selection of 4,282 children from 130 classes in 43 private secondary private schools in Kathmandu. Examinations included visual acuity testing, ocular motility evaluation, cycloplegic refraction, and examination of the external eye, anterior segment, media and fundus. The overall prevalence of uncorrected, presenting and best-corrected visual impairment ≤ 6/12 in the better eye was 18.6%, 9.1% and 0.86% respectively. Refractive error was a cause of visual impairment in 93.3% of children with uncorrected visual impairment, amblyopia (1.8%), retinal disorders (1.3%), other causes (0.3%), and unexplained causes (4.4%). Visual impairment with myopia among the children ranged from 10.9% in 10 year olds to 27.3% in 15 year olds in urban Kathmandu, compared to 0.5% in 10 year old to 3.0% in 15 year olds in rural Jhapa District. The prevalence of visual impairment was associated with higher grade level, female gender, higher parental level of education and parental spectacle usage but the reasons for these occurrence were not demonstrated (Sapkota et al, 2008).

Mingguang He et al (2004) carried out a study to assess the prevalence of refractive error and visual impairment among school age children in Guanzhou, a metropolitan area of Southern China. Random selection of geographically defined clusters was used to identify 4,364 school aged children between 5-15 years. Children in 22 clusters were enumerated through a door-to-door survey and examined in 71 schools and 19 community facilities. The examination included visual acuity measurements, ocular mobility evaluation, retinoscopy, and autorefraction under cyclopegia; and examination of the external eye, anterior segment, media and fundus. The prevalence of uncorrected, presenting, and best-corrected visual acuity 6/12 or worse in the better eye was 22.3%, 10.3% and 0.62% respectively. Refractive error was the cause in 94.9%, amblyopia in 1.9%, other causes in 0.4% and unexplained causes in the remaining 2.8%. In this study, females had a significant higher risk than males but the reason for this was not ascertained.

In a cross-sectional study conducted by Mingguang He et al (2007) to determine the prevalence of refractive error and visual impairment in 2,454 junior high school children aged 13-17 years in a rural area of Southern China. The examination included visual acuity testing, ocular motility evaluation, cyclopegic autorefraction; and examination of the external eye, anterior segment,media and fundus. The prevalence of uncorrected, presenting and best-corrected visual acuity $\leq$ 6/12 in the better eye was 27.0%, 16.6% and 0.46% respectively. Refractive error was the cause in 97.1% of eyes with reduced vision, amblyopia (0.81%), other causes (0.67%) and unexplained causes (1.4%). It was observed in this study that the prevalence of visual impairment increased with: increasing age, higher grade level, female gender, attending school in the urban centre and high parental education; but the reasons for this was not exposited.

A cross-sectional school based study was carried out in Xichang in which rural secondary school students were selected through random cluster sampling to determine the prevalence of visual disability, visual function and myopia. A total of 1,892 rural Chinese secondary school children with mean age 14.7±0.8 years (range of 11.4-17.1 years) were identified and their visual acuity, cycloplegic autorefraction with refinement and self reported visual function were assessed. The proportion of children with uncorrected,

presenting and best-corrected visual disability ≤ 6/12 in the better eye was 41.2%, 19.3% and 0.5% respectively. The girls had significantly more presenting visual disability and myopia than boys (Congdon et al, 2008). A limitation of the Asian studies above mentioned was that necessary causal inferences could not be established because they were cross-sectional.

In Africa, some studies have assessed the vision of children. A study was carried out by Wedner et al (2000) to determine the prevalence of eye diseases in primary school children in Mwanza Region, a rural area of Tanzania. It was reported that among the primary school pupils aged 7-19 years identified, the prevalence of visual impairment was 1.7% out of which 0.7% had bilateral visual impairment while 1.0% had unilateral visual impairment. Significantly, refractive errors causing visual acuity less than 6/12 accounted for 1.0%, strabismus (0.5%), and amblyopia (0.2%). Among the children, 5.5% had active trachoma, 5.3% reported night blindness, 0.6% had Bitot's spots and 0.8% had corneal scars.

Also in Mwanza city, a study on the prevalence of myopia in secondary school students and the need for a national screening programme was conducted. In this study, poor eye sight was defined as visual acuity less than 6/12 and the presence of other eye diseases were determined. A total of 2,511 secondary school children aged 11-27 years were examined and visual impairment was present in 6.9% of the students of which 5% had bilateral visual impairment while unilateral visual impairment was present in 2% of the students. Also, 6.1% of the students had significant refractive errors with myopia being the leading refractive error (5.6%), followed by amblyopia (0.4%) and strabismus (0.2%). Visual impairment in this study was significantly higher among females, in the age group 11-13 years and among those who had a family history of sibling(s) wearing glasses. However, this research focused on secondary school students only thereby not precluding information on visual impairment among younger primary school children (Wedner et al, 2002).

In another study carried out by Kingo and Ndawi (2009) among 400 primary school children aged between 6-17 years in Kibaha district in Tanzania, a Snellen's chart was used to measure visual acuity of children with visual impairment, using the WHO

category of low vision defined as presenting visual acuity of at least 3/60 but less than 6/18 in the better eye. The study revealed that 9.5% of the primary school children had low vision and the causes of low vision among the affected children were: congenital anomalies (65%) of which retinopathies were the most contributing conditions to low vision, refractive error (31%) and corneal scar (4%). The low vision due to retinopathies among the study participants was opined as likely to have been contributed to by high childhood malnutrition. The prevalence of visual impairment was statistically higher ($p<0.05$) among those aged 12-17 years (87%) than among 6-11 years (13%). The prevalence of visual impairment among females (68%) was statistically higher than among males (32%) and majority (90%) of the cases had binocular visual impairment

Kassa and Alene, (2000) carried out a cross-sectional survey in which simple random sampling technique was used to select 1,134 pre-school and school children aged 5-15 years (mean age 10.5 years) in Debark and Kola Diba towns of Northwestern Ethiopia. Snellen's chart was used to assess the visual acuity of the participants. The prevalence of visual problem in general was 8.2% while visual impairment among the school children, determined as visual acuity less than 6/12 in either or both eyes was 7.6% while 2.6% of children had a visual acuity of less than 6/18 in the better eye due to refractive error. As the age of the children increased from 5 to15 years, the risk of developing refractive error was observed to be increasing significantly. A higher level of education also showed a significant association with the presence of refractive error. There was no statistically significant difference between sex and the prevalence rate of visual problem. The limitation of the study is that it did not further investigate the causes and risk factors associated with visual problem among the study participants.

In a South African study, a random selection of physically defined clusters were used to identify a sample of 4,890 school aged African children, 5-15 years, in the Durban Area to assess the prevalence of visual impairment and refractive error. They were examined in temporary facilities which involved visual acuity measurements, ocular motility evaluation, retinoscopy and autorefraction under cyclopegia. The prevalence of uncorrected, presenting and best-corrected visual acuity of less than 6/12 or worse in the better eye was 1.4%, 1.2% and 0.32% respectively. Refractive error was the cause in

63.6% of visual impairment, amblyopia (7.3%), retinal disorders (9.9%), corneal opacity (3.7%), other causes (3.1%) and unexplained causes in remaining 12.0%. There was an observed upward trend increase in the prevalence of myopia with increasing age. (Naidoo et al, 2003). In addition, a prospective study of visual impairment and spectacle compliance was carried out by Congdon et al, 2008 in South Africa to determine the association between refractive cut-offs for spectacle provision and visual improvement among school aged children between 6-19 years, receiving free spectacles in a programme supported by Helen Keller International. In this study 9.5% of the children were detected to have visual impairment among which 65% were girls. However, in these studies, there were no exposition given for the observed increase in the prevalence of visual impairment with increasing age and the female gender.

A few published studies that assessed visual problems among school aged children in Nigeria showed that ocular disorders and visual impairment are common occurrences in this population (Faderin and Ajaiyeoba, 2001, Kehinde et al, 2005 and Ajaiyeoba et al, 2007). In a cross-sectional study carried out to find the pattern of eye disorders affecting primary school children in Kaduna metropolis, 2,397 pupils from primary one to primary six, aged 5-18 years, were selected through random sampling method and examined. Pre-designed school screening formats were distributed to the various class teachers after they were taught to assess visual acuity using Snellen's charts. All pupils with visual acuity less than 6/6 were double-checked by a resident ophthalmologist through visual acuity testing with a pin-hole, and on referral to the clinic they had refraction done with a streak retinoscopy. The study revealed that 17.6% of pupils had an eye disorder and 1.7% had visual acuity < 6/18. Allergic conjunctivitis (14.5%) and infective conjunctivitis (1.4%) were the commonest ocular disorders (Kehinde et al, 2005).

In South-Western Nigeria, Faderin and Ajaiyeoba (2001) carried out a study to determine the prevalence of refractive error defined as visual acuity < 6/9 in primary school children in Bonny Camp, Lagos State. A total of 919 pupils aged 6-15 years, from two primary schools (a private and a public school) were selected using stratified random sampling method and subsequently examined. The findings revealed that 7.3% of the children had visual impairment and more girls (56%) presented with refractive errors than boys (44%).

In this study, the differences in findings between the private and public primary school children were not highlighted.

Ajaiyeoba et al (2007) also conducted a cross-sectional study in Ilesa East Local Government Area of Osun State, South-Western Nigeria to determine the prevalence and causes of eye diseases and visual impairment among primary and secondary school students. Using a multistage random sampling method, 1,144 students with age range between 4-24 years were selected; and examined with Snellen's pictorial or illiterate 'E' chart, pin-hole, refraction and Sussex vision test. Among the students, 15.5% had ocular diseases and 5.8% had visual acuity < 6/18 while two students were blind having bilateral corneal scars with a prevalence of 0.17%. Conjuctival disorder (51.4%) and refractive error (37.3%) were the most common ocular diseases reported. There was a significant female preponderance in the distribution of ocular disorder among the students giving a female to male ratio of 2:1. The father's occupational status, which is an index of socio-economic status, showed an inverse relationship to the occurrence of ocular diseases among the students.

2.3.3 Factors associated with visual impairment

The prevalence and causes of visual impairment in children depends on geographic regions, socio-economic development, the status of primary health care, and the eye services available (Gilbert and Foster, 2001). The WHO and the International Agency for the Prevention of Blindness stated the main avoidable causes of childhood blindness as: corneal scaring in Africa and poorer countries in Asia, cataract globally, glaucoma globally, retinopathy of prematurity in high and middle income countries and some cities in Asia, refractive errors globally but particularly in South-East Asia, and from untreated causes globally (WHO, 2009).

Sirkka-Liisa (2007) stated that childhood blindness is still a major problem in developing countries, where over 80% of the blind diseases were principally preventable or curable. He listed the major causes of blindness in developing countries as cataract, trachoma, onchocerciasis and xerophthalmia; followed by measles, congenital rubella, prematurity, and inherited syndromes. He expressed his opinion that simple hygienic measures,

dietary education and vitamin A distribution could eradicate a large proportion of visual problems. He also suggested antiseptics and antibiotics usage for the prevention of ophthalmia neoniatorium and immunization programme for measles and rubella. He advocated that attention is needed to be paid to the structures of health care services and training of multidisciplinary teams, health education, screening to promote early referrals, and adequate follow-up.

A longitudinal birth cohort study titled 'Are there inequities in the utilization of childhood eye-care services in relation to socio-economic status" was carried out in the Avon Longitudinal Study of Parent and Children which involved 8,271 participants who were seen at age seven years. The children attended a research clinic at around seven years of age, where they underwent comprehensive eye examination with an orthoptist testing monocular visual acuity, ocular alignment and autorefraction. They were examined and details of family history of eye conditions, vision problems and contact with eye services were obtained. The prevalence of eye conditions was higher in the lower social class compared with the highest social class, and children from lower socio-economic groups were less likely to see an eye-care specialist or to use screening services. The differences in the trends between socio-economic groups, eye conditions and utilization of services suggested inequitable access to services. (Majeed et al, 2008). The limitation of this study was that a single birth cohort from a similarly defined geographic area was used.

Hall and Elliman (2003) in their report also acknowledged the gap in the care received by children from low socio-economic backgrounds compared with children from high socio-economic background. Following this observation, they therefore not only called for set referral pathways for vision problems in childhood, but also recommended universal screening at school entry as opposed to pre-school, as this results in better coverage. It was further stated that if this was achieved, it would ensure that more children have access to optimum eye care at the initial contact and subsequently irrespective of their socio-economic background.

In Tanzania, Wedner et al (2002) observed that there was an association with the presence of visual impairment among children with a family history of siblings wearing

glasses, and an association was also observed in Nepal by Sapkota et al (2008) with the presence of visual impairment among children with a family history of parental glasses usage. In the studies carried out in China and Nepal by Mingguang He (2007) and Sapkota et al (2008) respectively, both reported an observed higher prevalence of visual impairment among children with high parental education.

In addition, there is a general truth that as age increases from preschool to early adolescence, an increasing number of children who would manifest visual impairment will be observed (Sandford-Smith, 1997 and Murphy, 2000).

2.3.4 Visual impairment prevention/intervention

In developed countries such as the United States of America and the United Kingdom, screening for eye diseases in preschool and school children is done routinely. Stewart-Brown and Brewer (1986) reported that as far back as the nineteenth century in the United Kingdom, almost all children with important visual problems would have been detected before school entry and by the age of 8 years only 1.7% would not have been screened for eye diseases. In addition, eye services are easily accessible and the majority of children with eye problems consult without requiring referral by other health professional (Jewell et al, 1994).

The declaration of the Oxford 2007 International Conference: Vision for Children in the Developing World, A New Way Forward, estimated that at least 180 million school age children in the developing world could benefit from vision correction. However, majority of these children do not have access to an affordable eye examination or a pair of eye glasses. In their report, three barriers to optimum eye care in developing countries were identified which are: 1) Insufficient number of eye care professionals and equipments. 2) Inadequate supply and delivery of eye glasses. 3) The consideration of vision corrections as a low priority because poor vision is a chronic condition, whereas other prevailing issues such as food shortages or malaria pose more immediate problems.

In view of the expanding investments in global education initiatives which are leading to record numbers of school entrants, the prevalence of visual impairment is also increasing. Thus, uncorrected vision in children is likely to reduce the benefit of these investments

and as such, is a significant hindrance to the attainment of "Education for All" and the education related "Millennium Developmental Goals".

Following a study conducted by Nepal et al (2003) among school children in Nepal, it was advocated that a school eye screening cum intervention programme i.e. prevention, promotion and treatment programme; with periodic evaluation will be appropriate to reduce ocular morbidity in school children in developing countries as most of the eye diseases found were preventable or treatable. In addition, following vision screening of pre-school children in Jeddah, Saudi Arabia, it was further recommended that vision screening should be carried out as part of a periodic health examination even for pre-school children considering that vision screening was cost effective, highly sensitive, acceptable and easy to administer (Bardisiri and Binsadiq, 2002). Congdon et al (2008) in their own opinion stated that the provision of spectacles, which is a non-invasive and inexpensive intervention, is potentially capable of improving the visual function of a large number of school age children.

Following the study carried out by Kingo and Ndawi (2009) among school children in Tanzania, it was observed that there was need for an early detection of the possible causes of visual impairment and provision of appropriate treatment to reduce the condition among school children in Africa. In their own conclusion they highlighted the need for all the tiers of the health management team to establish school eye screening programme for early detection and treatment, and that it was equally important to strengthen advocacy programme targeting school children, teachers and care givers on the public health importance of visual impairment.

In the study carried out by Ajaiyeoba et al (2007) on the pattern of eye diseases and visual impairment among students in South-Western Nigeria, it was observed that eye diseases were common. Therefore, eye examination for all new intakes and regular screening in both public and private primary and secondary schools in Nigeria was advocated. It was also suggested that wearing of corrective glasses should be emphasized for children with refractive errors. This is particularly important among primary school pupils so that they can utilize their visual endowment during learning process at this early formative stage of life (Faderin and Ajaiyeoba, 2001).

A major hurdle to sustainable and reliable screening programme is the cost of personnel to perform the screening. Thus, teachers seems to be ideal candidates to perform basic vision screening in school based programme because they are readily available and are experienced in interacting with children. A study was carried out on the strategies to improve the accuracy of vision measurement by teachers among rural Chinese secondary school children in order to assess and improve the accuracy of lay screeners compared with vision professionals in detecting visual impairment in school children. After brief training, 32 teachers and a team of vision professionals independently measured vision in 1,892 children in Xichang. Teachers in the school setting in rural China achieved good accuracy of greater than 90% sensitivity, specificity, positive and negative predictive values in the detection of uncorrected visual impairment after brief training (Abhishe et al, 2008).

Similarly, a study was carried out among primary school children aged between 7-19 years in a rural area of Tanzania to determine whether teachers could successfully provide the first component of a school eye screening service. Using visual acuity less than 6/12, the findings of the study revealed that the simple screening done by teachers correctly identified 80% with 91% specificity (Wedner et al, 2000). In addition, after the findings of the school eye health study that was carried out in Kaduna, Nigeria; it was suggested that primary health care workers may also be utilized for school eye health screening (Kehinde et al, 2005).

A study was also carried out to estimate the cost and effects of alternative strategies for annual screening of school children for visual impairment and the provision of spectacles for children with refractive errors in different WHO sub regions in Africa, Asia, America and Europe. The outcome measures were life years adjusted for disability (DALY), costs of screening and provision of spectacles, and follow-up for six different screening strategies, and cost-effectiveness in international dollars per DALY averted. It was revealed at the end of the study that screening of school children for refractive errors was economically attractive in all regions of the world (Baltussen et al, 2009).

A study was carried out by Lemmerstrand et al (1995) titled “Screening for Ocular Dysfunction in Children: approaching a common programme”, and the recommendations

made after the study include: 1) Careful inspection of the eyes in the neonatal period and examination of the red reflex with ophthalmoscope. 2) Children at high risk for ocular and visual disorder i.e. those born prematurely before 32 weeks of age, or with genetic diseases, hearing deficit and/or neurological and mental disorders, should be examined at the appropriate age by an ophthalmologist. 3) All staff of paediatric departments and child health care centres should be familiar with the visual development of the normal baby and should be alerted to the various symptoms and signs which first warn that there may be a visual deficit. 4) A screening test of monocular visual acuity in 4 year old children can be performed and the screening test should be repeated during the first grade of school, and at regular intervals during the school years. 5) Children that screen positively should be seen by ophthalmologists and in some cases by orthoptists, without undue delay for diagnosis and treatment.

The American Academy of Ophthalmology, and the American Association of Pediatric Ophthalmology and Strabismus also recommended that children should be examined for eye problems in four stages: in the newborn nursery, at age six months, age three years , and age five years and older (Simon and Kaw, 2001).

The "Vision 2020-Right to Sight" which is a global initiative of the WHO and the International Agency for the Prevention of Blindness, for the elimination of avoidable causes of blindness, in 1999 stated as part of its strategies the promotion of school eye health programmes by ensuring that school children undergo a simple vision screening examination with provision of spectacles to those who will benefit. The objectives of Vision 2020 include: to promote programmes that reduce corneal scarring and visual loss from vitamin A deficiency and measles; to implement interventions against harmful traditional practices, neonatal conjunctivitis and eye injuries; to provide services to treat children with cataract, glaucoma, retinopathy of prematurity and corneal ulcer or scarring; to provide optical services for children with refractive errors, for instance in school eye-health programmes; and to provide services for children with low vision.

The strategy of Vision 2020 for the control of blindness in children includes among its overall targets the following: 1) To see that all school children have a simple vision

screening examination and that glasses are provided to all who have a significant refractive error. Furthermore, this service should be incorporated into the school health programme. 2) Ensure that all secondary level eye clinics have facilities to provide appropriate glasses for children with significant refractive errors. 3) Provide training so that there will be at least one refractionist per 100,000 people. 4) Ensure the development of low-cost, high quality, low-vision devices which should be widely available even in low income countries. 5) At the secondary level, strengthen diagnosis and management of less complex cases. 6) At the tertiary level, provide specialist training and services for the management of surgically remediable visual loss from cataract, congenital glaucoma and corneal scarring, including long term follow up. 7) Provide each child eye-care centre with a well-trained team (e.g. paediatric or child-centred ophthalmologist, optometrist, anaesthetist, counsellor, low-vision therapist, mid-level personnel), appropriate equipment and infrastructure and access to consumables for infants and children (e.g. small spectacle frames, high-power intraocular lenses).

The global and local burden of visual impairment warrants the urgent implementation of the following fundamental policies: Screening of children for refractive errors should be conducted at community level and integrated into school health programmes, accompanied by education and awareness campaigns to ensure that the corrections are used and cultural barriers to compliance are addressed and removed. As the cost of refractive corrections is still high compared with the personal and family resources in many regions, corrections must be accessible and affordable for people of all ages. Eye-care personnel should be trained in refraction techniques. Training and information programmes should also be designed for teachers and school health-care workers. Reliable and affordable equipment for refractive assessments should be developed. Refraction services need to be integrated with eye-care systems and included as a part of cataract surgery services. Impairment from uncorrected refractive errors, provision of refractive services and outcomes of the provisions should be monitored at national level to identify communities in need and evaluate the most cost-effective interventions (WHO, 2008).

The problem is so prevalent that it does not only interfere with the children's ability to attend classes and study, but also creates grave social consequences. Teachers who do not realize the plight of these children, for example, accuse them persistently. Unsympathetic classmates also pester them and laugh at them in the classrooms as well as in playgrounds. Even their parents and siblings undermine and discourage these visually impaired children (Taylor, 2000). Similarly, Kingo and Ndawi (2009) stated that poor vision and the inability to read material written on the blackboard can have a serious impact on a child's participation and learning in class and this can adversely affect a child's education, occupation and socio-economic status for life.

2.4 Intervention measures

In Nigeria, screening among children is essential because children less than 15 years make up 44% of the total population (NPC, 2006), while school children constitute about 23% of the average Nigerian community (Akani, 2000). School age children are very important because they are a captive population and are relatively accessible to intervention that facilitates easy and early assistance to any child with impairment/disorder (Wormald, 1998). In recognition of this, many countries have instituted a school health programme.

Screening is an intervention which involves the use of rapidly applied tests, examinations or other procedures in testing for information or disease in an unsuspecting individual or population. Its purpose is to detect person(s) likely to have, or at risk of developing a disease of interest and the hope that early diagnosis gained with subsequent treatment will favorably alter the natural history of the disease in a significant proportion of those identified as positive. The goals of prevention are to promote health, preserve health, restore health and to minimize distress when health is impaired. Generally, intervention defined as an attempt to interrupt the usual sequence in the development of disease can be achieved through five modes which are: health promotion, specific protection, early diagnosis and treatment, disability limitation and rehabilitation (Park, 2005).

There are four levels of prevention namely: 1) Primordial prevention which is the prevention of the emergence or development of risk factors in a population through

individual and mass education. 2) Primary prevention which is intervention in the pre-pathogenesis phase of a disease through measures designed to promote health, well-being and quality of life or by specific intervention and protective measures. 3) Secondary prevention involves actions that halts the progress of a disease at its incipient stage and prevents complications through screening tests, case finding programmes and adequate treatment. It can provide at once both secondary prevention for the infected individuals and primary prevention for their potential contacts. 4) Tertiary prevention which adopts all measures available to reduce or limit impairments and disabilities, minimize distress and promote adjustment to progression of disease. When defects or disabilities are established, rehabilitation which includes psychological, vocational and medical play preventive role (Park, 2005).

The earliest recorded organized efforts to improve the health of the school child as reported by Anderson and Creswell (1980) were made in Europe. In 1790, Bavaria in Germany provided free lunches. In 1833, France enacted a law holding public schools responsible for the health of school children and this later included the inspection of schools by physicians. The First World War sensitized American educators and the public to the health needs of school children. It was discovered that 34% of the examined draftees had adverse physical, mental and emotional conditions. This raised the question of whether or not, the school could have prevented or corrected many of the observed conditions by conserving or improving the health of the children. Great emphasis was subsequently placed on the health of the school child. In 1944, during the Second World War, 4 million out of 13 million recruits aged between 18 and 37 years were found to be unfit for military service. The existing SHP was therefore adjudged a failure. Thereafter, the efforts that followed have culminated in the present status of the school health in Europe and America.

Historically, Oduntan (1972) reported that a school health service (SHS) was started in Nigeria in 1928 by Dr. Isaac Ladipo Oluwole, the first African medical officer of health in Lagos State, where he introduced a medical service that could cater for school children and the first medical inspection of school children in Ibadan was carried out in 1929. A scheme was proposed that entrusted school inspection to medical officers with special

training in that field and included a thrice a year examination of school children throughout their school years, for detecting early any derailment from well-being with prompt treatment and follow up. Lucas and Gilles (2004) also stated that the school health programme must include some mechanism for finding children with various disabilities, assess them and place them in the most appropriate institution if special care is indicated.

The administration of the SHP involves all tiers of government in policy development, policy translation and manpower development and in day to day implementation and supervision. It also involves deliberate enlightenment of the key policy makers and implementation in the legislative, executive and judicial arms of the government; and its evaluation which includes monitoring of implementation of components and assessing how effective they are in achieving the objectives of the programme (Merenu, 2006).

The Nigerian National School Health Policy has a vision of promoting health of learners to achieve Education for All and Health for All in Nigeria. Its mission is to put in place adequate facilities, resources and programme, this will guarantee physical and mental health, social wellbeing, and the safety and security of the school community which will promote the learning outcome of the children. The scope of the SHP includes 1) Healthful School Environment. 2) School Feeding Services. 3) Skill-based Health Education. 4) School Health Services and 5) School, Home and Community Relationships (NSHP, 2006).

School Health Services are preventive and curative services provided for the promotion of the health status of learners and staff. It includes pre-entry medical screening; routine health screening/examination; school health records, sick bay, First Aid and referral services. It also provides advisory and counseling services for the school community and parents. The personnel include Medical Doctors, School Nurses, Health Educators, Environmental Health Officers, School Guidance Counselors, Community Health Workers, Dieticians, Nutritionist, School Teachers and Social Workers (NSHP, 2006).

School Feeding Services are aimed at providing an adequate meal a day to all children enrolled in schools nationwide and to improve the nutritional status of school children thereby enhancing their comprehension and learning abilities (NSHP, 2006).

However, it was opined by Fajewonyomi and Afolabi, (1993) that school health services in Nigeria had solely been limited to administering first aid to injured students in schools and consideration was not given to other relevant aspects of the school health programme including screening for disabilities for which the expertise of a number of professionals were needed.

Early screening that identifies any disability which may impair learning and normal school activities is important globally especially in developing countries like Nigeria, where many children of school age are survivors in an environment of high perinatal, neonatal, infant and under five mortality rates. Hence, every child should undergo a clinical examination prior to registration at each academic level (Okeahialam, 2003). In addition, any child with identified case of impairment should be managed appropriately because screening is justifiable only if a remedy for a screened disorder is available (Olusanyal et al, 2005).

In view of the global awareness of the importance of non-communicable disease conditions, it has necessitated emphasis on addressing the issue of non-communicable diseases because of its various consequences on the quality of life of the individuals involved. These include: developmental, emotional/psychological, educational and socio-economic effects; and the effects of non-communicable diseases on the individual's family, the immediate community and the society as a whole. Notably important is the interplay between communicable and non-communicable diseases in which some non-communicable conditions occur as a result of an infective agent, for example otitis media and hearing impairment; chlamydia infection and visual impairment.

CHAPTER THREE

METHODOLOGY

3.1 Study design

The study was a descriptive cross-sectional survey. Public primary school pupils were recruited and surveyed at single visit.

3.2 Study site

Ibadan North Local Government Area (IBNLGA), one of the 11 Local Government Areas in Ibadan the capital city of Oyo State, which was selected through balloting, was created by the Federal Military Government of Nigeria on the 27th of September 1991. It is bounded in the North by Akinyele LGA; in the West by Ido, Ibadan South-West and Ibadan South-East LGAs and bounded in the East by Ibadan North-East and Lagelu LGAs. Its Headquarters is located at Agodi.

IBNLGA has a total population of 308,119. The male population was 152,608 while the female population was 155,511 (NPC, 2006). IBNLGA consists of multiethnic nationalities, predominantly dominated by the Yorubas. It comprises of 12 Wards and has six Zonal Offices. Majority of the population are in the private sector and are mainly traders and artisans, while a good number are civil servants.

3.3 Study population

The Ibadan North Local Government Education Authority has 74 public primary schools. The total number of public primary school pupils in IBNLGA was 49,425 (Males: 24,700 and Females: 24,725) which was the highest total enrolment in the 33 LGAs of Oyo State (State Universal Primary Education Board, 2010/2011 Pupils' Enrolment Summary Sheet).

3.4 Inclusion criteria

Pupils from Primary two to Primary six who assented to participate in the study after parental consent in the selected public primary schools in IBNLGA were included in the study.

3.5 Exclusion criteria

Pupils ears were examined prior to recruitment and pupils with clinical evidence of either otitis media or impacted wax on otoscopy were excluded from the study.

3.6 Sample size determination

The minimum sample size to be studied was obtained from the statistical formula for estimating single proportion as shown below

$$n = \frac{z^2pq}{d^2}$$

Where

n = minimum sample size

z = standard normal deviate usually set at 1.96 which corresponds to the 95% confidence level

p = proportion of the target population estimated to have hearing impairment at 13.9% (Olusanya et al, 2000) was used.

q = 1- 0.139 = 0.861

d = degree of accuracy (level of precision) taken as 4%

$$n = \frac{1.96^2 \times 0.139 \times 0.861}{(0.0016)} = 287.35$$

This figure was approximated to 300 primary school pupils.

3.7 Sampling technique

A two-stage sampling technique was used to select 300 public primary school pupils from six out of the 74 public primary schools located in IBNLGA. The two-stage sampling technique used for selecting the study respondents consist of:

Stage 1: Six schools were selected by systematic sampling using the following sampling fraction

74/6 ≈12, therefore every 12^{th} school was selected from the list of schools under IBNLGA.

Stage 2: Ten pupils were selected by systematic sampling from each of classes two-six, thus 50 pupils were selected from each of the six schools.

3.8 Methods and instruments for data collection

3.8.1 Instruments

Interviewer administrated questionnaire was used to obtain information from the participants. The questionnaire was in four sections which addressed the objectives of the study. Section A had questions on child demographic characteristics, Section B had questions on family characteristics, Section C had questions on clinical assessment and Section D was for physical examination findings.

The questionnaire was translated to Yoruba and back translated to English to ensure consistency in meaning. A pre-test was conducted at Lagelu LGA. The flow of questions was modified and ambiguous questions were corrected following the pre-test. Each questionnaire took an average of twenty minutes to administer.

Audiologic instruments used were otoscope and screening audiometer.

Visual assessment was carried out using Snellen's E chart.

The weight and height measurements were taken, using a standardized SECA 786, UK weighing scale with standiometer, in kilograms to one decimal place and in meters to one decimal place respectively. The Body Mass Index was calculated with the formula weight divided by $height^2$.

3.8.2 Data collection procedure

Quantitative method of data collection was used. The procedures were explained to the pupils and they were made to feel at ease prior to the commencement of the screening exercise. The questionnaires were filled for the participants by the whole research team comprising of: the researcher (a medical personnel), an audiometrist and two research assistants who were undergraduates.

The general physical appearance of the respondents were assessed based on the status of their hair, skin, finger nails and toe nails, on the presence or absence of evidence of infection and also on thier level of cleanliness.

The mouth was assessed for the following: cleanliness of the teeth and tongue; presence of dental plaques or dental carries and presence of sores in the mouth including the tongue. Those with evidence of dental plaques or dental caries, mouth sores and dirty tongues were assessed as having poor oral hygiene.

The respondents were asked to take off their shoes and socks while the weight and height measurements were taken. The weight was measured with a duly calibrated and standardized weighing scale in kilogrammes approximated to one decimal space, while the height measurement was done with a standiometer in meters approximated to one decimal space by the research assistants. The weight and height measurements were recorded for each pupil and converted to nutritional indices using the Body Mass Index chart for age and sex.

The ear canals were examined with an otoscope by the medical personnel.

Audiometric screening test was performed by the audiometrist in a room located in the quietest section in each of the six schools using a duly calibrated Pure-Tone Screening Audiometer with ear phones and audiocups for extra attenuation. Tests were carried out only when the sound level reading from the sound level meter was less than 45dBA. The audiometric test was applied to each ear at frequencies 0.5, 1.0, 2.0 and 4.0 kHz and the pure tone averages for each ear was calculated from the audiogram and recorded.

Visual acquity test was carried out using Snellen's E chart placed at a distance of 6 meters in a well illuminated area by the medical personnel. Both eyes were tested separately with the right eye tested first, while the non tested eye was covered with a hand held occluder.

3.9 Data management

Pure Tone Audiometry averages greater than 30 dB HL in four frequencies (0.5, 1.0, 2.0 and 4.0 kHz) was classified as hearing impairment. Visual acuity reading less than 6/18 was classified as visual impairment. The Body Mass Index (BMI) was assessed using the Centre for Disease Control chart for children aged 2-20 years and classified as: underweight (less than the 5th percentile), healthy weight (5th percentile to less than the 85th percentile), overweight (85th to less than the 95th percentile) and obese (equal to or greater than the 95th percentile). This was done separately for both male and female pupils.

On completion of each data collection exercise, the questionnaires were collated and inspected daily for completeness; in order to detect and promptly correct errors, and also to ensure that each questionnaire was properly filled. Serial numbers were given to the questionnaires for easy identification. Data was entered into the computer using the Statistical Package for the Social Sciences (SPSS) Version 15 software and cleaned. Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) Version 15. Descriptive statistics: frequency, proportions, means and standard deviations were used to summarize variables and inferential statistics: Chi Square Tests (Pearson Chi Square test and Fisher's Exact Test) were used to test the associations between hearing impairment, visual impairment, socio-demographic characteristics and Body Mass Index.

3.10 Ethical considerations

Ethical approval was obtained from The Joint UI/UCH Institutional Ethics Review Committee and Oyo State Ethical Review Committee. Advocacy visit was paid to the headmistress/headmaster of the selected schools during which the purpose and objectives of the study were discussed, and their cooperation ascertained. The study followed the

standard ethical principles guiding the use of human participants in research. The principles are:

Informed Consent

Parental consent forms in both English and Yoruba, which included the contact number of the principal investigator, were given to parents/guardians through the selected pupils in order to allow them to participate. In addition, the contact numbers of the parents/guardians were collected for further explanation where applicable. Informed consent was obtained from the parents/guardians on behalf of the selected participants after the purpose of the study had been explained to them, they understood and voluntarily agreed to allow their child/ward to participate. Assent to participate in the study was also obtained from the selected pupils after their parents/guardians had given their consent.

Confidentiality of data

Participants were interviewed and examined at secluded side rooms. Serial numbers and not names of participants were used to maintain confidentiality. The participants were assured that their information would be kept confidential. Information on the system was password-protected and accessible to the principal investigator and data analyst. Confidentiality was observed throughout and after the study.

Non-maleficence (non-harmful) to participants

The participants in this study were not harmed in any way because the two procedures were non-invasive.

Right of decline/withdrawal from the study without loss of benefits

The participants were assured that they were free to decide not to participate or choose to discontinue at any point during the process of the research, and that they would not suffer any consequences based on their decision if they chose not to participate.

Beneficence to participants

The parents/guardians of those identified with either hearing impairment or visual impairment were invited over to the school through the respondents and with the assistance of the teachers and also through the aid of the headmistress/headmaster. The findings of the screening exercise, its medical importance and implications were explained to them and they were counseled on available interventions. They were then given referral notes to the otorhinolaryngology clinic and ophthalmology clinic as appropriate.

In addition, counseling on good oral hygiene was given to those with poor oral hygiene while those with demonstrable dental caries were referred to the dental clinic.

Findings from this study will be communicated to stake holders especially to the Ministry of Education and the Ministry of Health in Oyo State. Also, the study would have long term benefits on the total health of Nigerian school children with respect to periodic screening and early detection of hearing and visual impairment.

3.11 Duration of study

The administration of the questionnaire, the general physical examination, hearing assessment and visual assessment were carried out within four weeks.

3.12 Limitation of the study

1. The study utilized screening procedures on the field to assess the prevalence of hearing impairment using a screening audiometer and the prevalence of visual impairment using Snellen's E chart, instead of diagnostic procedures which requires more comprehensive evaluations, thus the impairments could not be categorized.

2. The diversity of the definitions of both hearing and visual impairment, and the use of different criteria caused difficulties in direct comparism with findings of some researches and estimation of the burden of these problems.

3. It was not possible to assess the socio-economic status of the respondents' family due to inadequate information on parental level of education, job description/cadre and income. The respondents were too young to provide these demographic information.

CHAPTER FOUR

RESULTS

4.1 Section A: Socio-demographic characteristics of respondents and their general physical examination

Table 4.1 shows the socio-demographic characteristics of the 300 pupils involved in the study. The age of participants ranged from 6 to 14 years with a mean of 9.7 ± 2.1 years. Most of the participants (51.7%) fell in the 9-11 years age group followed by 27.7% between the 6-8 years age group and then 20.7% between the 12-14 years age group. The distribution of the participants by sex revealed that females were in the majority, at 53.0%. The predominant ethnic group was Yoruba (87.3%), followed by Igbo (31.0%), Hausa (3.0%) and others comprising of Edo and Tiv (1.3%). The distribution of participants by their religious affiliation indicated that the participants were predominantly from Christian homes (62.3%) while others were from Muslims homes. The predominant occupations of the fathers were manual skilled labour (52.0%) while the mothers were predominantly involved in unskilled labour (70.1%).

The participants had no pre-entrance medical evaluation and were not periodically examined while in school.

The general physical examination findings of the pupils revealed that 10% had poor general physical appearance while 26.7% of the pupils had poor oral hygiene.

Table 4.2 shows the family characteristics of the pupils. Majority of the pupils 81.0% were from a monogamous family type. Slightly more than half of the pupils (53.3%) came from families with two to four children. Pupils that were third born were the majority (27.3%) while the least were pupils who were beyond fourth born (15.7%).

Table 4.1: Socio-demographic characteristics of 300 pupils in Ibadan North Local Government Area

Socio-demographic characteristics	Frequency=300 (%)
6-8	83 (27.7)
9-11	155 (51.7)
12-14	62 (20.7)
Sex	
Male	141 (47.0)
Female	159 (53.0)
Tribe	
Yoruba	262 (87.3)
Igbo	31 (10.3)
Hausa	3 (1.0)
Edo/Tiv	4 (1.3)
Religion	
Christianity	187 (62.3)
Islam	113 (37.7)
Occupation of Father	
Professional labour	69 (23.0)
Manual/Skilled labour	156 (52.0)
Unskilled labour	75 (25.0)
Occupation of Mother	
Professional labour	25 (8.3)
Manual/Skilled labour	63 (21.0)
Unskilled labour	212 (70.7)

Table 4.2: Family characteristics of 300 pupils in Ibadan North Local Government Area

Family characteristics	Frequency=300 (%)
Family Type	
Monogamous	243 (81.0)
Polygamous	57 (19.0)
Number of children in the family	
1	3 (1.0)
2-4	160 (53.3)
>4	137 (45.7)
Birth order of pupils	
1st	50 (16.7)
2nd	65 (21.7)
3rd	82 (27.3)
4th	56 (18.7)
>4th	47 (15.7)

4.2 Section B: Prevalence and patterns of hearing impairment among respondents

All the pupils were asked about a history of ear and hearing problems. The external ears were examined using an otoscope and the pure tone audiometry average for each ear was taken after examination with a screening audiometer.

Table 4.3 shows the prevalence of hearing impairment in at least one ear at PTA average > 30 dB HL among the pupils which was 14.0% (right ear only 31.0%, left ear only 28.6%, both ears 40.4%). Among pupils who had hearing impairment, those who reported difficulty in hearing were 14.3% while five percent of them had previous ear examinations.

Table 4.4 shows the age specific prevalence of hearing impairment in at least one ear among the 300 pupils examined. The prevalence of hearing impairment in at least one ear was highest among pupils 6-8 aged years and lowest among pupils aged 12-14 years at 27.7% and 8.0% respectively.

The sex specific prevalence of hearing impairment among the male and female participants was 14.2% and 13.8% respectively. Ear affectations by sex are as shown in table 4.5.

The proportions of participants who had a history of ear problems are as shown in table 4.6 below. Overall, only 3.3% of the pupils had previous ear examination while 7.7% had a recent history of ear treatment.

Table 4.3: Prevalence of hearing impairment among 300 pupils in Ibadan North Local Government Area

Hearing impairment in at least one ear	Frequency=42 (%)
Right ear only	13 (31.0)
Left ear only	12 (28.6)
Both ears	17 (40.4)
Total	42 (100.0)

Table 4.4: Grouped age specific prevalence of hearing impairment among 300 pupils in Ibadan North Local Government Area

Age group of pupils (Years)	Hearing impairment in at least one ear Frequency=300 (%)	
	Present	Absent
6-8	23 (27.7)	60 (72.3)
9-11	14 (9.0)	141 (91.0)
12-14	5 (8.0)	57 (92.0)
Total	42 (14.0)	258 (86.0)

Table 4.5: Sex specific prevalence of hearing impairment among 300 pupils in Ibadan North Local Government Area

Sex of pupils	Hearing impairment in at least one ear Frequency=300 (%)	
	Present	Absent
Male	20 (14.2)	121 (85.8)
Female	22 (13.8)	137 (86.2)
Total	42 (14.0)	258 (86.0)

Table 4.6: Proportion of pupils with history of an ear problem in Ibadan North Local Government Area

History of ear problem	Frequency=300 (%)	
	Yes	No
Do you have difficulty with hearing?	12 (4.0)	288 (96.0)
Do you ask people to repeat themselves when speaking?	15 (5.0)	285 (95.0)
Do you have ear pain?	16 (5.3)	284 (94.7)
Do you have ear discharge?	0 (0.0)	300 (100)
Do you hear ringing sound in your ear?	7 (2.3)	293 (97.3)

Table 4.7 shows the factors associated with hearing impairment. Hearing impairment was significantly higher among those less than 10 years (23.7%) compared with those 10 years and above (6.1%) [p<0.0001]. Hearing impairment was also significantly higher among pupils born into families with less than or equal to four total number of children (17.8%) than those from families with greater than four children (9.5%) [p=0.039]. In addition, hearing impairment was significantly higher among pupils from monogamous family type (16.0%) than those from a polygamous family type (5.3%) [p=0.035]. Hearing impairment was found in 14.2% of male pupils and 13.8% of female pupils without significant difference. There was no significant association between the presence of hearing impairment in pupils and parental occupation (fathers at p=0.236 and mothers at p=0.307). Hearing impairment was co-existent in 15.8% of pupils with visual impairment and 35.7% of pupils with abnormal body mass index without statistical significance.

Table 4.7: Factors associated with hearing impairment among 300 pupils in Ibadan North Local Government Area

Variable	Hearing Impairment in at least one ear Frequency=300 (%)		Chi Square Test	P-Value
	Present	Absent		
Age				
< 10 years	32 (23.7)	103 (76.3)		
≥ 10 years	10 (6.1)	155 (93.9)	19.196	<0.0001*
Sex				
Male	20 (14.2)	121 (85.8)		
Female	22 (13.8)	137 (86.2)	0.008	0.931
Total number of children				
≤ 4	29 (17.8)	134 (82.2)		
> 4	13 (9.5)	124 (90.5)	4.262	0.039*
Visual Impairment				
Present	3 (15.8)	16 (84.2)		
Absent	39 (13.9)	242 (86.1)	0.054	0.816
Family Type				
Monogamous	39 (16.0)	204 (84.0)		
Polygamous	3 (5.3)	54 (94.7)	4.461	0.035*
Occupation of father				
Professional labour	7 (10.1)	62 (89.9)		
Manual/Skilled labour	27 (17.3)	129 (82.7)		
Unskilled labour	8 (10.8)	67 (89.2)	2.886	0.236
Occupation of mother				
Professional/Skilled labour	6 (24.0)	19 (76.0)		
Manual/Skilled labour	9 (14.3)	54 (85.7)		
Unskilled labour	27 (12.7)	185 (83.7)	2.362	0.307
Body Mass Index				
Healthy weight	27 (64.3)	173 (67.1)		
Underweight	15 (35.7)	85 (32.9)	0.125	0.724

***Statistically significant

4.3 Section C: Prevalence and patterns of visual impairment among respondents

The pupils were asked about a history of eye and visual problems prior to visual acuity assessment of each eye carried out in a well illuminated room using a Snellen's chart.

In all, 6.3% of the pupils examined had visual impairment (VA < 6/18) in at least one eye in this pattern: right eye only 26.3%, left eye only 0.0%, and both eyes 73.7% as shown in table 4.8 below. Among pupils with visual impairment, 38.9% reported having difficulty with seeing, 11.1% had previous eye examination while 0.3% used a pair of recommended glasses.

The prevalence of visual impairment in at least one eye was highest among pupils aged 6-8 years at 10.8% and lowest among pupils aged 12-14 years with a prevalence of 4.8% as shown in Table 4.9.

The prevalence of visual impairment among the pupils increased with increasing class from primary two to primary six as follows: 0.7%, 0.7%, 1.3%, 1.7% and 2.0% respectively.

The sex specific prevalence of visual impairment in at least one eye among the male and female participants was 2.8% and 9.4% respectively. Eye affectations by sex are as shown in table 4.10.

The proportions of participants who had a history of eye problems are as shown in table 4.11 below. In addition, 3.0% of the pupils had previous eye examination, 10.3% had previous eye treatment and only one pupil (0.3%) was using a pair of recommended glasses.

Table 4.8: Prevalence of visual impairment among 300 pupils in Ibadan North Local Government Area

Visual impairment in at least one eye	Frequency=19 (%)
Right eye only	5 (26.3)
Left eye only	0 (0.0)
Both eyes	14 (73.7)
Total	19 (100.0)

Table 4.9: Grouped age specific prevalence of visual impairment among 300 pupils in Ibadan North Local Government Area

Age group of pupils (Years)	Visual impairment in at least one eye Frequency=300 (%)	
	Present	Absent
6-8	9 (10.8)	74 (89.2)
9-11	7 (4.5)	148 (95.5)
12-14	3 (4.8)	59 (95.2)
Total	19 (6.3)	281 (93.7)

Table 4.10: Sex specific prevalence of visual impairment among 300 pupils in Ibadan North Local Government Area

Sex of pupils	Visual impairment in at least one eye Frequency=300 (%)	
	Present	Absent
Male	4 (2.8)	137 (97.3)
Female	15 (9.4)	144 (90.6)
Total	19 (6.3)	281 (93.7)

Table 4.11: Proportion of pupils with history of an eye problem in Ibadan North Local Government Area

History of eye problem	Frequency=300 (%)	
	Yes	No
Do you have any problem seeing?	60 (20.0)	240 (80.0)
Do you have any difficulty seeing far objects?	52 (17.3)	248 (82.7)
Do you have any difficulty seeing near objects?	3 (1.0)	297 (99.0)
Do you have any difficulty reading?	25 (8.3)	275 (91.7)
Do you squeeze your eyes to read?	17 (5.7)	283 (94.3)
Do you use recommended glasses?	1 (0.3)	299 (99.7)
Is your eye paining you?	1 (0.3)	299 (99.7)
Do you have eye discharge?	12 (4.0)	288 (96.0)
Is your eye(s) red?	19 (6.3)	281 (93.7)
Is your eye(s) itchy?	7 (2.3)	293 (97.7)

Table 4.12 shows the factors associated with visual impairment. Visual impairment was significantly higher among females (9.4%) than males (2.8%) [p=0.019]. The prevalence of visual impairment was 8.9% for those less than 10 years and 4.2% for those 10 years and above which did not vary significantly.

Visual impairment was present in 7.0% of pupils from a monogamous family type and 3.5% from a polygamous family type without significant difference. There was no significant association between the presence of visual impairment in the pupils and the occupation of either the father (p=0.904) or the mother (p=0.443).

Visual impairment was co-existent in 7.1% of pupils who were hearing impaired and 31.6% of pupils with abnormal body mass index without statistical significance at p=0.816 and p=0.867 respectively.

Table 4.12: Factors associated with visual impairment among 300 pupils in Ibadan North Local Government Area

Variable	Visual Impairment in at least one eye Frequency=300 (%)		Chi Square Test	P-Value
	Present	Absent		
Age				
< 10 years	12 (8.9)	123 (91.1)		
≥ 10 years	7 (4.2)	158 (95.8)	2.702	0.100
Sex				
Male	4 (2.8)	137 (97.2)		
Female	15(9.4)	144 (90.6)	5.483	0.019*
Total number of children				
≤ 4	13 (8.0)	150 (92.0)		
> 4	6 (4.4)	131 (95.6)	1.622	0.203
Hearing Impairment				
Present	3 (7.1)	39 (92.9)		
Absent	16 (6.2)	242 (93.8)	0.054	0.816
Family Type				
Monogamous	17 (7.0)	226 (93.0)		
Polygamous	2 (3.5)	55 (96.5)	0.946	0.331
Occupation of father				
Professional labour	5 (7.2)	64 (92.8)		
Manual/Skilled labour	9 (5.8)	147 (94.2)		
Unskilled labour	5 (6.8)	70 (93.2)	0.202	0.904
Occupation of mother				
Professional labour	3 (12.0)	22 (88.0)		
Manual/Skilled labour	3 (4.8)	60 (95.2)		
Unskilled labour	13 (6.1)	199 (93.9)	1.630	0.443
Body Mass Index				
Healthy weight	13 (68.4)	187 (66.5)		
Underweight	6 (31.6)	94 (33.5)	0.028	0.867

*Statistically significant

Figure 4.1 shows the percentage distribution by sex of the prevalence of hearing impairment only, visual impairment only and co-existing hearing and visual impairments among the participants. It demonstrated the co-existence of the impairments among 1.0% of the pupils (females-0.7% and males-0.3%).

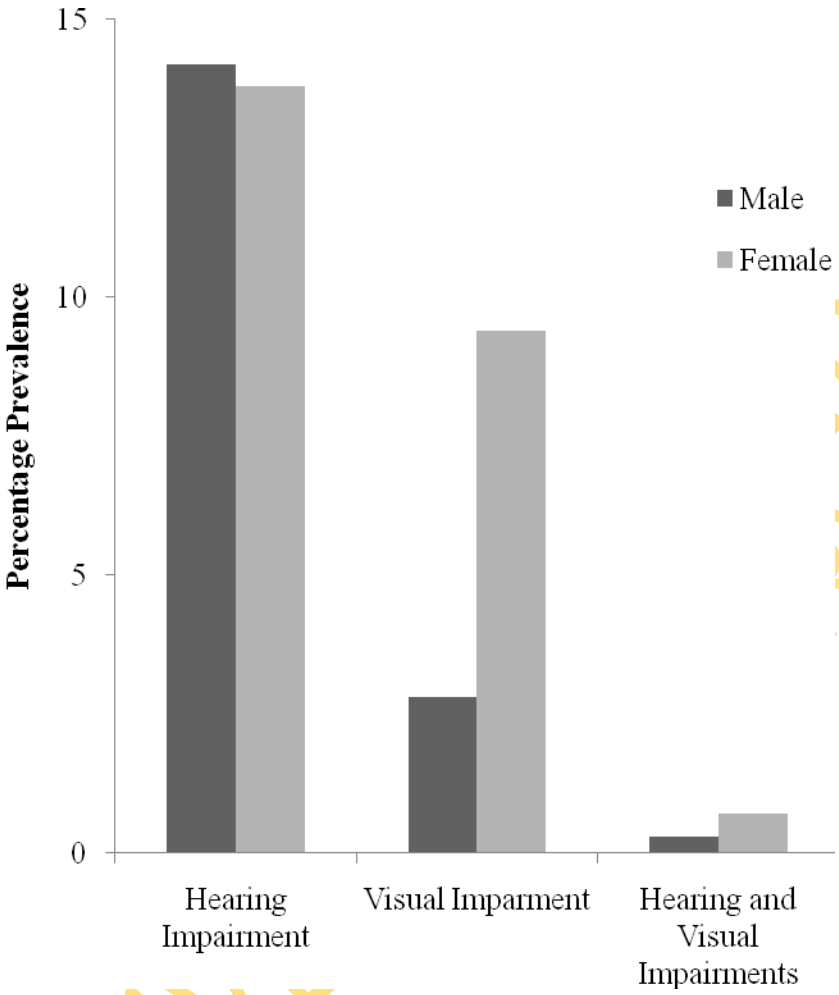

Figure 4.1: Percentage distribution of hearing impairment, visual impairment and co-existing hearing and visual impairments by sex among 300 pupils in Ibadan North Local Government Area

4.4 Section D: Other findings on physical examination of respondents

The Centers for Disease Control and Prevention Body Mass Index classification of the 300 pupils examined is as shown in Table 4.13 below. Majority of the pupils had healthy weight 68.0% (males 49.0%, females 51.0%), 24.7% were underweight (males 44.6%, females 55.4%), 5.3% were overweight (males 31.3%, females 68.7%) while 2.0% were obese (males 50.0%, females 50.0%).

Table 4.13: Body Mass Index category among 300 pupils in Ibadan North Local Government Area

Body Mass Index	Frequency=300 (%)
Underweight	74 (24.7)
Healthy weight	204 (68.0)
Over weight	16 (5.3)
Obese	6 (2.0)

CHAPTER FIVE

DISCUSSION

5.1 Introduction

This study set out with the aim of assessing the prevalence of hearing and visual impairment among public primary school pupils in IBNLGA. The findings of this study showed that the prevalence of hearing and visual impairments among the 300 primary school pupils examined were high and of public health importance. The prevalence of childhood hearing and visual impairments/disorders in Nigeria are not known. However, reported studies conducted among school children in various parts of the country have revealed a high prevalence of 13.9% and 5.8% for hearing impairment and visual impairment respectively (Olusanya et al, 2000 and Ajaiyeoba et al, 2007).

Hearing and visual impairment are important conditions because of their chronicity and effect on the quality of life. They also have socio-economic effects. However, unlike some other conditions which are infectious and acute and attract a lot of attention in the society such as malaria infection; these disease entities do not receive adequate recognition, consideration and publicity.

5.2 Prevalence of hearing impairment

This study has shown that hearing impairment occurred in 14% of the primary school pupils examined in IBNLGA. This prevalence corroborates previous studies carried out in Nigeria in both school and community population based surveys, in which the reported prevalence of hearing impairment ranged from 6.7% to 13.9%, using varying criteria to define hearing loss with cut offs ranging from > 15 dB HL to > 40 dB HL. For instance, the Household National Ear Care Survey, 2001 reported a prevalence of 13.4% using a cut off of > 25 dB HL and 6.7% using a cut off of > 40 dB HL, while Olusanya et al, 2000 reported a prevalence of 13.9% among school children using a criteria of >15 dB

HL. A hospital based survey of hearing impairment among children presenting at the otorhinolaryngology out-patient clinic also revealed a similar prevalence of 14% (Lasisi et al, 2006). The observed prevalence in this study also reflects the prevalence in other developing countries such as in Southern India where a prevalence of 11.9% was reported for hearing impairment among children of school entry age (Phaneendra Raoa, 2002).

The prevalence of hearing impairment found in this population of school children however varies markedly from what was reported in the United States of America national population based cross-sectional survey carried out among elementary, middle and high school children aged 6-19 years. Using a definition of > 15 dB HL the prevalence of hearing loss was 19.5% between the years 2005-2006 (Barclay, 2010). This higher prevalence in the United States may be attributed to the lower diagnostic criteria used for defining hearing loss.

In this study, 14.3% of the pupils reported having difficulty with hearing while in the study carried out in Lagos, 19.4% of the children reported hearing loss signifying that this complaint is quite common among school children (Olusanya et al, 2000). The findings of these studies highlights the need for an effective screening exercise in order to identify various categories of hearing impairment that could have hitherto been missed or overlooked, and initiate prompt intervention before complications sets in.

Routine ear assessment in children is important to detect early any ear disorder or hearing impairment among the school age population, and initiate prompt management of any identified anomalies in order to achieve a good outcome. The evaluation of a hearing impaired child attempts to determine the aetiology, the degree of hearing loss, and intervention to aid auditory reception, speech and language. Lasisi et al (2005) stated that this has remained a challenge to practicing otolaryngologists, especially in the developing countries, as 85%-90% of the causes of hearing loss were never discovered leading to delayed intervention and irreversible effects. In addition, Olusanya et al (2000) stated that the paucity of up to date and representative epidemiological data on hearing disorder in Nigeria has been observed as undermining the effective advocacy of prevention initiatives.

5.3 Age and hearing impairment

This study revealed that hearing impairment was significantly higher among children less than 10 years (23.7%) compared with those 10 years or greater (6.1%). This was contrary to the findings of the study carried out in the United Kingdom where hearing loss was observed to increase with increasing age (0.91% at three years and 1.65% at 9-16 years of age). The reason for this could not be ascertained and will require further investigation to identify the cause.

5.4 Gender and hearing impairment

There was no statistical association between gender and the occurrence of hearing impairment in this study, which was also observed in the review of other studies except for the study carried out in the United States by Barclay, 2010 which revealed that girls were significantly less likely than boys to have hearing loss. However, there was no reason proffered for either the cause or the association of this finding.

5.5 Prevalence of visual impairment

Compared with this study where the prevalence of visual impairment (VA < 6/18) was 6.3% among the primary school pupils examined in IBNLGA, the prevalence of visual impairment among children aged less than 18 years in the United States through a population based national health interview survey was lower at 2.5% (Cotch et al, 2005). This observed lower prevalence may be due the fact that it was a proxy reported visual impairment which may differ from measured visual impairment, and in addition, the interviewed parent or family member might not have complete information on the nature and extent of a child's condition.

A higher prevalence compared to this was reported by Salomao et al (2008), in their study among school age children between 11-14 years in Brazil which revealed an overall prevalence of 9% (VA ≤ 6/12) with uncorrected, presenting and best corrected visual impairment of 4.82%, 2.67% and 0.41% respectively. This higher prevalence can be attributed to a lower criterion of defining visual impairment at VA ≤ 6/12 compared with VA < 6/18 that was used in this study, the geographic location, and the observation that

the proportion of the children examined was older compared with those examined in this study whose age ranged between 6-14 years.

Conversely, a lower prevalence of visual impairment at 1.3% (VA ≤ 6/12) was reported in the population based cross-sectional study carried out among predominantly six year old Australian children (Robaei et al, 2005). A possible explanation for this may be the younger age of the respondents, which is young, because increased prevalence of visual impairment is usually associated with increasing age (Pascolini, 2004). In addition, a lower prevalence of 1.7% (VA < 6/12) was also reported among primary school children between 6-17 years in Western Turkey by Unsal et al (2009). The reason for this observed prevalence was not highlighted, but it may be due to genetic and/or environmental factors. However, further studies are needed to elucidate the cause of these differences.

The findings of this study revealed that the prevalence of visual impairment was 6.3%. This was comparable to the findings of previous studies carried out in South-Western Nigeria where the prevalence of this study falls within. The prevalence of 5.8% and 7.3% were observed in the studies conducted by Ajaiyeoba et al (2007) among both primary and secondary school students aged 4-24 years in Osun State; and Faderin and Ajaiyeoba (2001) among primary school children aged 6-15 years in Lagos State respectively. This differed from the findings of the study carried out in Kaduna State among primary school children aged 5-18 years with a prevalence of 1.7% (Kehinde et al, 2005). Kehinde et al (2005) expressed that the magnitude of childhood visual disorder in Nigeria was unknown, and observed from the review of literature that refractive error which is a common cause of visual impairment in children was more common among school children in the Southern part of Nigeria than in the Northern part. This was evidenced by the findings of Faderin and Ajaiyeoba (2001); and Ajaiyeoba et al (2007) as opposed to his own findings among Northern children.

The prevalence of visual impairment in this study (6.3%) falls within the observed wide range of 0.5%-9.5% found in various prevalence studies conducted in different regions of Africa. The prevalence of visual impairment was 0.5% (VA < 6/18) among school children aged 5-15 years in Botswana (Murphy, 2006). The prevalence of 1.4%, 1.2%

and 0.32% of uncorrected, presenting and best corrected visual impairment (VA < 6/12) was reported from a cluster sample of school aged children 5-15 years in South Africa (Naidoo et al, 2003). The prevalence of visual impairment (VA < 6/12) was 1.7 % among primary school children aged 7-19 years in Mwanza District, Tanzania (Wedner et al, 2000). The prevalence of visual impairment (VA < 6/12) observed also among secondary school students aged 11-27 years in Mwanza District, Tanzania was 6.9%. The study carried out by Kassa and Alene (2000) among school children aged 5-15 years in North-Western Ethiopia, revealed a prevalence of visual impairment (VA < 6/12) of 7.6%. A higher prevalence of visual impairment, compared with this study, of 9.5 % (VA <6/18) was found among primary school children aged 6-17 years at an urban section of Kibaha District, Tanzania (Kingo and Ndawi, 2009). A similar visual impairment prevalence of 9.5% (VA < 6/18) was reported among school children aged 6-19 years in South Africa (Congdon et al, 2008). The wide range of the prevalence of visual impairment observed in the various studies carried out in these African countries may be due to the different methodology utilized, the varying age groups and the different cut off values of visual acuity to define visual impairment.

The main purpose of screening and surveillance for visual defects throughout childhood is the early detection and treatment of relevant ophthalmic disorders in order to minimize their impact on a developing child (Jugnoo and Dezateux, 1997). Mills (1999) stated that early detection of a visual problem can have educational, behavioural and quality of life benefits. However, because of the detrimental impact visual impairment can have on a child's life, exploration of cost-effective strategies to eliminate or treat causes of visual impairment are warranted (Salomao et al, 2008).

The methods utilized to assess the prevalence of visual impairment among school age children include proxy reported visual impairment in the National Health Interview Survey carried out in the United States by Cotch et al (2005) which could give incomplete information that differs from measured visual impairment. Also, ocular motility evaluation; cycloplegic refraction; examination of the external eye, anterior segment, media and fundus; and retinoscopy were carried out in the other studies which

requires professional skills and gives more accurate findings on diagnosis and causes of visual impairment.

In this study, visual impairment was screened for using Snellen's E chart which is appropriate for assessing visual acuity in children above five years. It is simple because the children are required to tell the direction that the capital letter E is facing either right, left, up or down. It can easily be applied and is effective for screening purposes but not as a diagnostic procedure.

5.6 Age and visual impairment

In this study, visual impairment did not vary significantly for the different age groups less than 10 years and 10 years and greater which was similarly reported in the study carried out in Western Turkey where the prevalence of visual impairment in children aged less than 10 years was 1.7% and those greater than 10 years was 1.6% without statistical difference (Unsal et al, 2009). Findings of this study was contrary to findings demonstrated by some studies which showed an increase in the prevalence of visual impairment with increasing age as documented by various studies carried out in Tanzania by Wedner et al (2002), and Kingo and Ndawi (2009) and also in North-Western Ethiopia by Kassa and Alene (2000).

This study showed an increasing prevalence of visual impairment with increasing Class/Grade levels as evidenced by 0.7% among primary two pupils to 2.0% among primary six pupils. This was similarly found in the studies carried out by Sapkota et al (2008) in Nepal and Mingguang He (2007) among primary school children in Southern China.

5.7 Gender and visual impairment

The findings in this study showed that the prevalence of visual impairment was significantly higher among the female pupils (p=0.019) as similarly demonstrated in the 2004 WHO global estimate which showed a female preponderance. A study carried out in Osun State by Ajaiyeoba et al (2007) also showed a female preponderance with a female:male ratio of 2:1. This was also similar to the findings of visual impairment

predominance among females in studies carried out by Salomao et al (2008) in Sao Paulo, Brazil; Sapkota et al (2008) among Tanzanian children from Kathmandu and Jhapa districts; and also in the study carried out by Unsal et al (2009) among primary school children in Western Turkey.

Schaumberg and Nichols (2006) suggested that the observed global gender inequity with the prevalence of visual impairment, with females having a higher prevalence of some eye diseases, may be linked to an inherent biological predisposition which is either hormonal or immunologic. An example is Dry eye syndrome which is twice to thrice more prevalent in females than males at any given age.

5.8 Co-existing hearing and visual impairments

The observed prevalence of both hearing impairment and visual impairment were notably high in the selected environment (IBNLGA) as evidenced by the result of this study which showed a prevalence of 14% for hearing impairment and 6.3% for visual impairment among primary school aged children respectively. Additional findings on physical examination revealed that 26.7% of the pupils had poor oral hygiene. The parental occupation were found to be mostly manual skilled labour for fathers at 52.0% and unskilled labour for mothers at 70.7% which has implication on socio-economic status with inferred low income and health seeking behavior.

In spite of the high prevalence of both hearing and visual impairment as observed by some authors, and the consequent effects of these conditions among Nigerian children, a sustainable programme on prevention, early detection and management of congenital, early onset and childhood hearing and visual impairment; and appropriate intervention services are not available (Olusanya et al, 2000; Kehinde et al, 2005 and Ajaiyeoba et al, 2007).

This study revealed that one percent of the primary school pupils examined had both hearing and visual impairment co-existing. This signifies double concern for the affected pupils who have to cope with the double affectation viz-a-viz its consequences on their quality of life (educational, intellectual, physical, psychological, and socio-economical) and also its extended effect on the immediate family and the society as a whole.

The review of available published literatures did not show comparable studies that have explored the co-existence of both hearing and visual impairment. This means that additional studies will be required to explore the co-existence of these two common sensory deficits. This further demonstrates that a comprehensive childhood screening exercise to detect sensory deficits and other common childhood disorders should be explored, as opposed to single screening exercise, targeted to a single disorder. This is imperative to identify multiple affectations wherever they exist and to initiate appropriate comprehensive intervention.

5.9 Hearing and visual impairment with nutritional status

The study has also added to literature by demonstrating that school age children did not only suffer from hearing and visual impairment but 24.7% of the school children examined were underweight, while 5.3% were overweight and 2.0% were obese. The prevalence of primary school children in this study that were underweight was higher than the prevalence observed in the study conducted by Akor et al (2010) among primary school entrants in Jos Plataeu where 10.3% were underweight and lower than a prevalence of 61.2% found in the study carried out by Oninla et al (2007) among public primary school children in Osun State. In addition, a study carried out to determine the nutritional status of primary school children from low income households in Kuala Lumpur, Malaysia revealed that 52% were underweight while 5.8% were overweight (Shariff et al, 2000).

The high prevalence of undernutrition, as observed in this study is of public health importance because of the interaction between malnutrition, immunocompromised state and predisposition to infections which can have deleterious effect on the affected child. For example vitamin A deficiency and visual impairment and also hearing impairment resulting from infections such as measles, influenza, mumps and herpes zoster virus.

This study demonstrated that about half of the pupils with visual impairment were underweight compared with children with healthy weight, overweight/obese. This could be explained by the fact that malnourished state especially with deficiency of vitamin A affects the immune system and the healthy growth and development of children including

vision; while vitamin C deficiency increases vulnerability to infections which can be complicated by impaired vision or affect the normal development of the eye.

Attention also needs to be paid to the emerging burden of overnutrition that has been imported into developing countries like Nigeria where we are imbibing western lifestyle and diet fast and exposing ourselves, particularly the children, to being overweight and/or obese thereby predisposing them to the associated health risks. This is evident in this study where 5.3% of the primary school pupils were overweight while 2.0% were obese. The prevalence of overweight observed in this study was similarly demonstrated in the study carried out in Malaysia by Shariff et al (2000) where 5.8% of the primary school pupils were found to be overweight.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study carried out among public primary school pupils in Ibadan North Local Government Area to screen for both hearing and visual impairment demonstrated that at least one out of every seven primary school pupils is hearing impaired while one out of every fifteen primary school pupils is visually impaired. Factors such as age played a role with respect to hearing impairment where the younger age, less than 10 years, about thrice the prevalence among those aged 10 years and above. This can be ascribed to a greater predisposition to infection among younger children with resultant complications on hearing perception. The female sex played a significant role with the occurrence of visual impairment as evidenced by the findings of this study.

This study showed that one out of every four primary school pupils is underweight while one out of every thirteen primary school pupils is overweight/obese. This study also demonstrated the impact of nutritional deficiency where it showed that about half of the pupils with hearing impairment, and also half of those with visual impairment, were underweight.

This study also revealed that pupils were not required to carry out pre-entrance medical examination nor had periodic medical evaluation while in school, thereby resulting in non early detection of hearing and visual impairment among the school children.

There is therefore need for evaluation of school age children for hearing and visual impairments in the study area and Nigeria as a whole. In addition, there is an urgent need for the implementation of routine school-based screening programmes to enhance early detection of impairments, initiate timely intervention and enhance the quality of life of school children.

6.2 Recommendations

Based on the findings of this study the following recommendations were made:

1. Hearing and vision screening programmes in schools should be implemented and children should be screened at pre-entrance and periodically during each academic session with provision of aids for those detected with abnormalities.
2. The Ministry of Education and the Ministry of Health should in collaboration explore and identify effective means of screening school children for hearing and visual impairment through provision of health services and personnel to promote the health of the school community.
3. Teachers should be trained to carry out basic physical assessment of their pupils; and be aware of the medical importance of their findings on general physical appearance, weight and height measurements, and also hearing and visual assessments.
4. Prompt presentation of parents at health facilities at the earliest noticeable onset of ear or eye diseases in their children or wards and compliance to intervention.
5. Promotion of adequate nutrition through health education and promotional activities involving parents, and also through provision of school meal under the school health programme.
6. Proper documentation and record keeping of the hearing, visual and nutritional assessments of school children.
7. Civil Service Organizations, Organized Private Sector and International Development Partners should enhance effective implementation of SHP through their support, financial assistance, provision of standards and technical assistance.
8. Further research is required to determine the national prevalence and burden of hearing and visual impairments in children. In addition, the associated factors and their effects on the quality of life need to be explored in order to develop appropriate interventions.

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APPENDIX 1

INFORMED CONSENT FORM (ENGLISH VERSION)

INFORMED CONSENT FORM

My name is ADETUNJI, Olubukola Omolola, I am a Masters student of the Institute of Child Health, Faculty of Public Health, University of Ibadan, Oyo state. I am screening primary school pupils in Ibadan North local government area in order to know the prevalence of hearing and visual impairments (i.e. ear and eye problems) amongst them. I will need to ask your child/ward some questions and his/her answers will be kept confidential. Your child will be given a number and his/her name will never be used in connection with any information gotten from him/her. The information gotten will be used by the Government and other stake holders to help the hearing and visually impaired children.

During this exercise, medical (physical) examination will be carried out on your child/ward. This will include reading of Snellen's Tumbling E chart from a distance for visual acquity(eye) test and the determination of the level of hearing perception(ear test) will be done using a screening audiometer which is like a head phone. The 2 procedures are non-invasive (safe) and the processes will not cause or predispose your child/ward to any harm or injury.

Your child is free to refuse to take part in this screening programme. Your child has a right to withdraw at any given time if he/she chooses to.

My contact number is 08038048182 and I'm available for further explanations.

I will greatly appreciate your help in responding to this study.

CONSENT: Now that the study has been explained to me and I fully understand the content of the study process; I am willing to allow my child/ward to take part in the screening exercise.

---------- ----------

Signature/Thumbprint of participant/Date Signature of Interviewer/Date

---

Signature/Thumbprint of Parent or Guardian/Date

APPENDIX 2

INFORMED CONSENT FORM (YORUBA VERSION)

IWE MO FI OWO SI

Oruko mi ni ADETUNJI, Olubukola Omolola. Mo je akeko agba ni isa ibi ti a ti n'koni l'eko imo ilera nipa awon omode ati odo ti Ile iwe giga fasiti ti ilu Ibadan ni ipinle Oyo . Mo n'se iwadi awon omo ile iwe alako-bere ni apa ijoba guusu ti ilu Ibadan; iwadi ati ayewo yi da l'ori bi awon omo akeko yi se n'lo eti won lati gbonran si ati bi won se n'rina pelu oju won si, pelu akiyesi pataki fun awon omo ti iwadi wa ba fi han wa wipe won ni alebu eti ati/tabi oju. Mo ma bere ibeere l'owo awon omo yin, mosi fe fun yi ni idaniloju pe awon idahun si awon ibere yi ko ni di n'kan ti ao polongo fun ara'ye gbo. A o fun omo yin ni nonba ti ao so po mo oruko re gege bi amin ida oni kaluku mo pelu alaye ati iwadi ti aba ri kojo lati mo odo awon omo kookan ti esi iwadi yi ba ti j'eyo. Esi iwadi ati ayewo wa, pelu ohun ti aba ti ri, ni ijoba ati awon isori ti oro naa ba kan yio lo lati pese itoju fun awon omo ti oba ni alebu(tabi arun) eti tabi oju.

Nigbati aba n'se eto yi, ao se ayewo finifini fun awon omo yin. Awon ayewo naa yio je bi ki awon omo ka leta lati ona ti ojin fun ayewo oju, pelu be, ao tun lo ero agbohun s'afefe mojelomiogbo lati se ayewo eti. Awon ayewo yi koni fa ki ase ise abe tabi ki agba eje tabi n'kankan jade ni ara omo yin, eyi si fun yin ni idaju pe ko si ewu Kankan ninu awon eto ayewo ati iwadi yi.

Kii se dandan ki omo yin kopa ninu eto ayewo ati iwadi yi. Omo yin si ni anfani lati so pe ohun ko se ayewo naa mo, koda bi oba ti bere ayewo naa tele.

Ele pe mi si ori ero alagbeka yi, 08038048182, fun alaye s'iwaju si.

Anfani to po ni emaa se fun wa ti eba le fo esi ti o dara si eto ayewo ati iwadi yi. E seun pupo.

MO FI OWO SI: Ni won ba igba ti won ti se alaye eto iwadi ati ayewo yi fun mi ti osi ti yemi daradara, mo fi owo si ki omo mi nipa ninu eto naa.

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Ika tite tabi amin idani mo olukopa/Ojo oni Amin idani mo olubeere/Ojo oni

---

Ika tite tabi amin idani mo obi olukopa/Ojo oni

APPENDIX 3

PUPILS ASSENT FORM (ENGLISH VERSION)

PUPILS ASSENT FORM

I am Dr Adetunji O.O., a postgraduate student of the Institute of Child Health. I want to screen for hearing and vision problems in school children in this area to know how big the problem is.

I will like to ask you some questions, check your weight and height, and also examine your ears and eyes.

I will not hurt you in any way. You do not have to join if you don't want to and you can stop participating whenever you want.

So, would you allow me to ask you some questions and examine you?

Answer:

YES ☐

NO ☐

---------- ----------

Signature/Thumbprint of pupil/Date Signature of Interviewer/Date

APPENDIX 4

PUPILS ASSENT FORM (YORUBA VERSION)

IWE MO FI OWO SI

Oruko mi ni Adetunji O.O. Mo je akeko agba ni isa ibi ti a ti wa n'ko nipa ilera awon omode ni ile iwe giga Fasiti ti ilu Ibadan ni ipinle Oyo. Mo n'se iwadi ati ayewo nipa aisan eti ati oju laarin awon omo akekeo ile iwe akobere ni adugbo ti a wa yi.

Mo fe beere awon ibeere lori bi oti ga si ati bi oti won si. Mo tun fe se ayewo eti ati oju re.

Ko si ewu abi ijamba Kankan ti o le s'ele si o. O si ni anfani lati so pe o o se ayewo naa mo.

Nipa idi ti mo ka s'ile yi, se o ti setan lati dahun awon ibeere ti mo fe bi o, se o si gbami l'aye lati ye eti ati oju re wo?

Idahun

BENI ☐

BEKO ☐

---------- ----------

Amin idani mo/ika tite ti oluko/Ojo oni Amin idani mo ti olubeere/Ojo oni

APPENDIX 5

QUESTIONNAIRE

HEARING AND VISUAL IMPAIRMENT AMONG PUBLIC PRIMARY SCHOOL PUPILS IN IBADAN NORTH LOCAL GOVERNMENT AREA, NIGERIA

Date: _____ Serial number: _____

Section A: Child socio-demographic characteristics

1. Age in years (at last birthday) _____Date of birth _____(dd/mm/yy)

2. Sex: a. Male ( ) b. Female ( )

3. Class:_____

4. Tribe: a. Yoruba ( ), b. Ibo ( ), c. Hausa ( ), d. Others_____

5. Religion: a. Christianity ( ),b. Islam ( ),c. Traditional ( ), d. Others ( )

Section B: Parental characteristics

6. Occupation of father:_____

7. Occupation of mother:_____

8. Type of family: a. Nuclear ( ), b. Extended ( )

9. Family set-up: a. Monogamous ( ), b. Polygamous ( )

10. Number of children in the family :_____

11. Birth order/position of student:_____

Section C: Clinical assessment

Ear

12. Do you have difficulty with hearing? a. Yes ( ) b. No ( )

13. Do you ask people to repeat themselves when speaking? a. Yes ( ) b. No ( )

14. Have you had your ear examined before? a. Yes ( ) b. No ( )

15. If 'Yes' when and why

---

16. Have you had ear treatment before? a. Yes ( ) b. No ( )

17. Do you have ear pain? a. Yes ( ) b. No ( )

18. Do you have ear discharge? a. Yes ( ) b. No ( )

19. Do you hear ringing sound in your ear? a. Yes ( ) b. No ( )

Eye

20. Do you have any problem seeing? a. Yes ( ) b. No ( )

21. Do you have any difficulty seeing far objects? a. Yes ( ) b. No ( )

22. Do you have any difficulty seeing near objects? a. Yes ( ) b. No ( )

23. Do you have any difficulty reading? a. Yes ( ) b. No ( )

24. Do you squeeze your eyes to read? a. Yes ( ) b. No ( )

25. Have you had your eyes examined before? a. Yes ( ) b. No ( )

26. If 'Yes' when and why

---

27. Have you had your eyes treated before? a. Yes ( ) b. No ( )

28. Do you use recommended glasses? a. Yes ( ) b. No ( )

29. Is your eye paining you?? a. Yes ( ) b. No ( )

30. Do you have eye discharge a. Yes ( ) b. No ( )

31. Is your eye(s) red? a. Yes ( ) b. No ( )

32. Is your eye(s) itchy? a. Yes ( ) b. No ( )

33. Did you carry out any medical test before you started school? a. Yes ( ) b. No ( )

34. Do you have medical check-up in school? a. Yes ( ) b. No ( )

Section D: Physical examination

35. General appearance: a. Hygienic ( ) b. Not Hygienic ( )

36. Oral hygiene: a. Good ( ) b. Poor ( )

37. Weight: _____

38. Height: _____

39. Visual acuity of the right eye: _____

40. Visual acuity left eye: _____

41. Pure Tone Audiometry of the right ear: _____

42. Pure Tone Audiometry of the left ear: _____

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)
COLLEGE OF MEDICINE, UNIVERSITY OF IBADAN. IBADAN, NIGERIA.

Director: **Prof. A. Ogunniyi,** B.Sc(Hons), MBChB, FMCP, FWACP, FRCP (Edin), FRCP (Lond)
Tel: **08023038583, 08038094173**
E-mail: **aogunniyi@comui.edu.ng**

UI/UCH EC Registration Number: **NHREC/05/01/2008a**

NOTICE OF EXPEDITED REVIEW AND APPROVAL

Re: Hearing and Visual Impairment among Public Primary School Pupils in Ibadan North Local Government Area, Nigeria

UI/UCH Ethics Committee assigned number: UI/EC/10/0166

Name of Principal Investigator: **Olubukola O. Adetunji**

Address of Principal Investigator: Institute of Child Health,
College of Medicine,
University of Ibadan, Ibadan

Date of receipt of valid application: 12/10/2010

Date of meeting when final determination on ethical approval was made: **N/A**

This is to inform you that the research described in the submitted protocol and other participant information materials have been reviewed and *given expedited approval by the UI/UCH Ethics Committee.*

This approval dates from 21/12/2012 to 20/12/2013. If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the* UI/UCH EC *assigned number and duration of* UI/UCH EC *approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC early in order to obtain renewal of your approval to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. *No changes are permitted in the research without prior approval by the* UI/UCH EC *except in circumstances outlined in the Code. The* UI/UCH EC *reserves the right to conduct compliance visit to your research site without previous notification.*

UI/UCH EC
21 DEC 2012
APPROVED
COLLEGE OF MEDICINE, U.I.

Professor A. Ogunniyi
Director, IAMRAT
Chairman, UI/UCH Ethics Committee
E-mail: uiuchirc@yahoo.com

TELEGRAMS.....

TELEPHONE.....

MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. .....
All communications should be addressed to the Honourable Commissioner quoting
Our Ref. No: AD 13/479/75

Date 4th October, 2010

The Principal Investigator,
Department of Institute of Child Health,
Faculty of Public Health,
College of Medicine,
University of Ibadan,
Ibadan.

Attention: Adetunji Olubukola O.

Ethical Approval for the Implementation of Your Research Proposal in Oyo State.

This acknowledges the receipt of the corrected version of your Research Proposal titled *``Hearing and Visual Impairment Screening among Primary School Pupils in Ibadan North Local Government Area, Nigeria''.*

The Committee has noted your compliance with all the ethical concerns raised in the initial review of the proposal. In the light of this, I am pleased to convey, to you, the approval of the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

Please, note that the committee will monitor, closely, and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of the findings as this will help in policy making in the health sector.

Wishing you all the best

Adepoju

Mrs V.A. Adepoju
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethical Review Committee.

OYO STATE UNIVERSAL BASIC EDUCATION BOARD
PLANNING RESEARCH AND STATISTICS DEPARTMENT
2010 / 2011 PUPILS' ENROLMENT SUMMARY SHEET

S/NO	LGUBEA	PRE -PRIMARY			PRIMARY I			PRIMARY II			PRIMARY III			PRIMARY IV			PRIMARY V			PRIMARY VI			GRAND TOTAL		
		M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
1	AFIJIO	1322	1377	2699	2080	2186	4266	1946	2077	4023	2139	2140	4279	2007	2071	4078	2071	2041	4112	2044	2024	4068	13609	13916	27525
2	AKINYELE	2535	2678	5213	2950	3072	6022	2954	3101	6055	2970	3090	6060	2941	3043	5984	2967	3168	6135	3167	3342	6509	20529	21434	41963
3	ATIBA	1313	1318	2631	2168	2074	4242	2089	2077	4166	2213	2180	4393	2179	2114	4293	2153	2130	4283	2070	2109	4179	14185	14002	28187
4	ATISBO	3843	3112	6955	2378	2558	4936	2353	2529	4882	2362	2458	4820	2166	2529	4695	2176	2402	4578	1911	2176	4087	16189	17764	33953
5	EGBEDA	1935	1936	3871	2387	2397	4784	2458	2520	4978	2605	2760	5365	2770	2731	5501	2788	2817	5605	3189	3504	6693	18118	18839	36957
6	IBADAN NORTH	2305	2197	4502	3407	3253	6660	3483	3814	7297	3668	3764	7432	3856	3862	7718	3836	3995	7831	4214	4423	8637	24700	24725	49425
7	IBADAN NORTH EAST	2078	2012	4090	1904	1901	3805	2088	2080	4168	2176	2233	4409	2363	2382	4745	2360	2386	4746	2565	2605	5170	15649	15631	31280
8	IBADAN NORTH WEST	2569	3068	5637	2450	2805	5255	2817	3063	5880	2697	3183	6080	2901	3231	6132	3056	3300	6356	3217	3548	6765	19808	22104	41912
9	IBADAN SOUTH EAST	1750	1674	3424	1782	1757	3539	2030	1999	4029	2227	2262	4489	2362	2337	4699	2457	2467	4924	2835	2757	5592	15443	15253	30696
10	IBADAN SOUTH WEST	1434	1586	3020	1931	1964	3895	2007	2050	4057	2171	2111	4282	2429	2261	4690	2377	2233	4610	3003	2926	5929	15372	15131	30503
11	IBARAPA CENTRAL	1046	1143	2189	2329	2367	4696	2106	2132	4238	1863	2065	3928	1866	1967	3833	1942	1938	3880	1818	2013	3831	11924	12482	24406
12	IBARAPA EAST	855	952	1807	1370	1412	2782	1349	1335	2684	1308	1334	2642	1310	1326	2636	1299	1309	2608	1148	1210	2358	7784	7926	15710
13	IBARAPA NORTH	990	1027	2017	1629	1676	3305	1560	1600	3160	1578	1640	3218	1515	1587	3102	844	838	1682	1223	1306	2529	9875	10292	20167
14	IDO	1277	1327	2604	1817	1879	3696	1841	1932	3773	1878	1917	3795	1984	1963	3947	1945	1959	3904	2017	2043	4060	11482	11693	23175
15	IREPO	1602	1688	3290	1739	1841	3580	1624	1638	3262	1531	1582	3113	1408	1461	2869	1189	1101	2290	1017	922	1939	10110	10233	20343
16	ISEYIN	1112	1133	2245	3463	3814	7277	3692	3726	7418	3685	3978	7663	3838	3895	7733	3776	3832	7608	3670	3821	7491	22817	23990	46807
17	ITESIWAJU	1994	2172	4166	1959	2591	4550	1906	1982	3888	1767	1971	3738	1731	1886	3617	1728	1781	3509	1482	1615	3097	13224	14293	27517
18	IWAJOWA	1098	1272	2370	1346	1491	2837	1257	1358	2615	1204	1360	2564	1255	1357	2612	1241	1313	2554	1063	1193	2256	7366	8072	15438
19	KAJOLA	1612	1720	3332	1795	2038	3833	1744	1951	3695	1807	2018	3825	1707	1932	3639	1755	1886	3641	1588	1786	3374	11977	13422	25399
20	LAGELU	3025	3163	6188	2816	3196	6012	2861	3019	5880	3007	2992	5999	2862	2972	5834	2859	2953	5812	3008	3120	6128	17443	18262	35705
21	OGBOMOSO NORTH	1825	1816	3641	1801	2070	3871	1945	2043	3988	2064	2201	4265	1984	2144	4128	2061	2190	4251	2025	2229	4254	13705	14747	28452
22	OGBOMOSO SOUTH	1591	1773	3364	1221	1360	2581	1417	1489	2906	1347	1452	2799	1420	1578	2998	1428	1520	2948	1332	1530	2862	9756	10702	20458
23	OGO OLUWA	2766	2948	5714	2188	2350	4538	2210	2301	4511	2058	2183	4241	1975	2102	4077	1963	2021	3984	1793	1951	3744	14947	15847	30794
24	OLORUNSOGO	3810	3628	7438	2698	2783	5481	2234	2188	4422	1979	1976	3955	1634	1648	3282	1369	1350	2719	813	888	1701	10727	10863	21590
25	OLUYOLE	1965	1932	3897	2585	2498	5083	2944	3104	6048	3066	3238	6304	3186	3204	6390	3054	3112	6166	3205	3162	6367	20074	20403	40477
26	ONA ARA	2248	2456	4704	2732	2967	5699	2972	3228	6200	3235	3390	6625	3318	3509	6827	3364	3534	6898	3459	3677	7136	21328	22761	44089
27	OORELOPE	2006	2155	4161	1730	1829	3559	1821	1916	3737	1588	1636	3224	1607	1661	3268	1584	1678	3262	1373	1405	2778	11736	12299	24035
28	ORIIRE	1668	1730	3398	3240	3435	6675	3452	3468	6920	3300	3299	6599	2989	2948	5937	2903	3208	6111	2756	2780	5536	20308	20868	41176
29	OYO EAST	1089	1178	2267	1756	1803	3559	1790	1883	3673	1844	1886	3730	1842	1890	3732	1739	1877	3616	1786	1795	3581	11846	12312	24158
30	OYO WEST	1353	1435	2788	1915	2056	3971	1909	2078	3987	2002	2137	4139	1981	2049	4030	1953	1973	3926	1959	1931	3890	13072	13659	26731
31	SAKI EAST	2005	2398	4403	1360	1649	3009	1378	1571	2949	1388	1677	3065	1325	1470	2795	1291	1397	2688	1018	1159	2177	11010	13459	24469
32	SAKI WEST	2830	3030	5860	2670	2693	5363	2708	2752	5460	2677	2726	5403	2611	2663	5274	2678	2714	5392	2606	2528	5134	18750	19106	37856
33	SURULERE	1575	2081	3656	3724	3874	7598	3120	3333	6453	2866	2917	5783	2613	2857	5470	2474	2628	5102	2083	2374	4457	18445	20064	38509
	GRAND TOTAL	62426	65115	127541	73320	77639	150959	74065	77337	151402	74470	77756	152226	73935	76630	150565	72680	75051	147731	72457	75852	148309	493308	516554	1009862