CHAPTER ONE

INTRODUCTION

1:1 PREAMBLE

"Children are always the only future the human race has"

William Saroyan

"As long as the world has children beauty will never cease to be"

George Howard

Children are in the dependent class of the society hence the adult population needs to be constantly conscious of the need to nurture a healthy future generation. Childhood is a fundamental stage and its influence extends into adult life. With the background of inadequate health care delivery services, poverty, ignorance, beliefs, it is imperative for a continuous renewal and sustenance of interest and passion for childhood ocular health. Childhood ocular health is very important and can never be over emphasized.

Children eyes are not literarily small adult eyes, as the causes and strategies to control childhood and adult ocular morbidities are dissimilar. A delay in the treatment of childhood ocular pathology can lead to permanent visual impairment and possible mortality.[1] The Millennium Development Goal (MDG) [2] of reducing childhood mortality thus would be relevant in combating childhood blindness. Quite worrisome is the fact that a visually impaired child has many years ahead to cope with the disability with untoward negative implications for educational and social development.[3]

Visual impairment and blindness constitute important health problems. Severe visual impairment and blindness are serious disabilities and impose enormous limitations on the affected individuals. It is even more important among affected children because of long blind years ahead in his or her life. The time lived with the disability and the associated economic losses during the years have been expressed as disability adjusted life year (DALY). The cost of visual disability is quite enormous and is expressed in dollars per blind years.[4]

1:2 CHILDREN

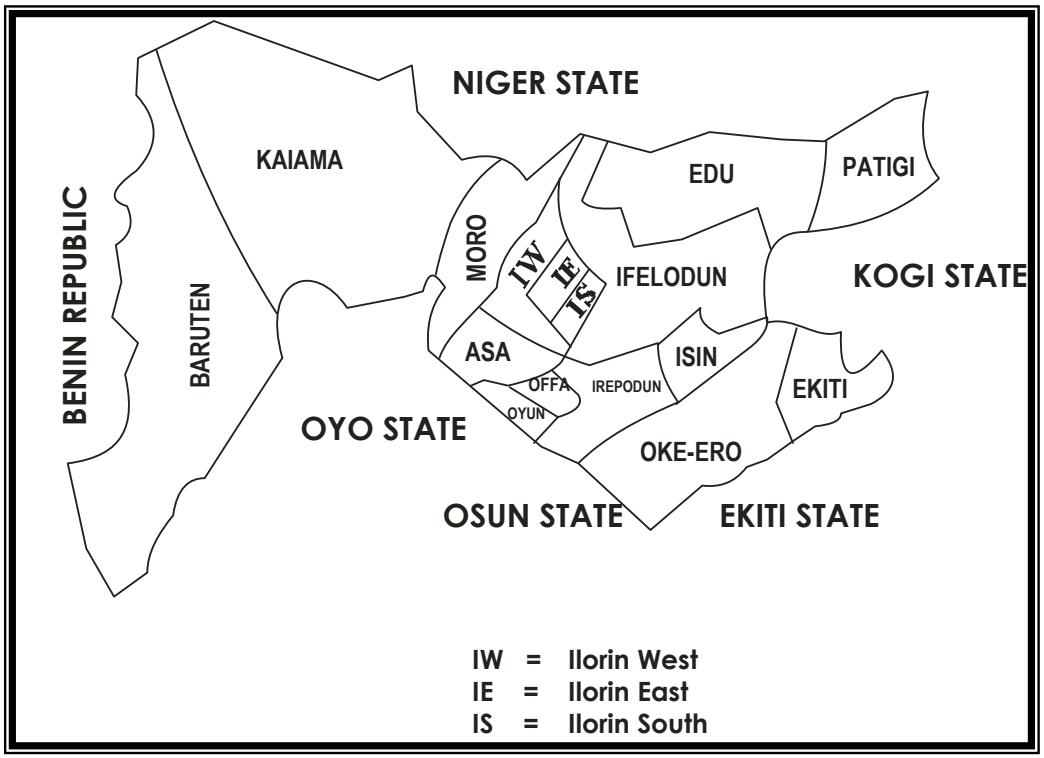
According to the International Convention for the Rights of the Children (ICRC), a child is an active social subject with rights, a person in the process of growing, whose evolutive capacity must be respected and protected. The article 1 of the convention affirms: " for the effects of the present convention, a child is understood to be a human being aged under 18 years old, unless, in accordance with any applicable law, he / she is considered to have come of age''.[5] However, for this study children are defined as individuals aged less than 16 years.

Childhood period has been subdivided into 4: the newborn / neonate (first 28 days of life), the infants (the first year of life), the preschool-age child (1-4 years) and the school children (5-15 years).[6] Tropical countries usually have predominantly young populations, about half of which are children.[6] Children constitute about 45% of Nigerian population.[7] School children constitute significant percentage of the over-all children population and their ocular well being is vital to societal development.

1:3 BACKGROUND OF THE STUDY AREA

Kwara State is one of the 36 states of Nigeria located in the North Central geopolitical zone with Ilorin as its capital city. It has 16 Administrative Local Government Areas (LGAs) with an estimated population (projection from 1991 census[8], using growth rate of 2.83%) of 2.4 million and a landmass area of 32,500 square kilometers. It shares boundary with Oyo, Osun and Ekiti States to the south, Kogi State to the east, Niger State to the north and an international boundary with the Benin republic to the west.[9] (Figure1).

Fig 1: Map of Kwara State showing Local Government Areas and Boundary States



1:3:1: Ilorin: Local Government Areas & Location

Ilorin has three LGAs viz Ilorin West, Ilorin East and Ilorin South.

Ilorin is located between latitudes 08^0 $29^{'}$ 17" and 08^0 $23^{'}$ 23" N as well as between longitudes 04^0 $33^{'}$ 53" and 04^0 $28^{'}$ 35" E.[10]

1:3:2: Climate:

The vegetation of Ilorin is savannah type with daily mean temperature of 21.4 - 31.6^0C (1991 – 1995), daily relative humidity percentage of 72.6 (1991 – 1995 at 0900 GMT %). Ilorin experiences the rainy and dry seasons yearly. The rainy season extends from March / April to October and dry season between November and March.[11] The dry season is associated with high temperature, dry wind and dust. Harmattan cold weather caused by northeast trade wind is usually experienced during the dry period of the year. The two seasons are not without implications for ocular health. Ocular morbidities like allergic conjunctivitis and epidemic keratoconjunctivitis among others could be weather related while trachoma thrives in dry, dusty and dirty environment.[12-14]

1:3:3: Population, People & Economy:

The estimated population of Ilorin (projection from 1991 census figure) is 606,533 and about 168,934 (i.e. 27%) of this are children between the ages of 6 and 12 years.[8, 15] Ilorin has rich cultural diversity and apart from being home to the Yorubas, Fulanis, and Hausas, it hosts the Nupes, Barubas, Ebiras and Igbos among others. The people are involved in activities like farming (arable crops and livestock), cloth weaving (Aso Oke), Islamic evangelical works, trading / business, technical services, and civil / public service. Like in most parts of Nigeria, the average citizen in Ilorin lives below poverty line. This has implications for ocular health as affordability of eye health care

services is compromised with resultant neglect of treatable ocular conditions and / or resort to application of unorthodox but affordable medication. The situation is worse in dependent age groups such as children.[11]

1:3:4: Health Facilities:

Ilorin has many health facilities such as a Federal government owned teaching hospital, State owned health facilities, Local government health facilities and more than 100 privately owned health facilities. Of these, the ophthalmic department of the teaching hospital, the 3 of the State owned health facilities and about 10 privately owned health facilities offer ophthalmic services at different levels of sophistication.[11] It is also of note that ocular health also receives attention from Non Governmental Organizations (NGOs) such as Sight Savers International, religious organizations, Diamond bank, Lions club, Orbis International among others.[9]

1:3:5: Schools:

Ilorin has a Federal university, a private university, a State owned polytechnic and a college of education, some Federal and State owned secondary schools, as well as government and private owned primary schools. In the register of Kwara State Universal Basic Education Board (KSUBEB) as at July 2005, there were 78, 61 and 45 primary schools in Ilorin East, West and South Local Government Areas respectively. There is a State owned school for the handicapped in Ilorin, which provides vocational training for persons with disabilities such as incurably blind pupils, the deaf and dumb among others.[16] To the best of the author's knowledge there is yet to be a comprehensive eye

screening / school eye health programme for pupils in Ilorin as may have obtained elsewhere. The number of the visually disabled children in the school for the handicapped might be the tip of an iceberg as observation in the eye clinic of University of Ilorin Teaching Hospital (UITH) shows that some pupils across the conventional schools in Ilorin are having visual impairment, severe visual impairment, low vision or blindness. Many of these pupils are yet undetected, unaware of their problem or could not access available eye care services either because of ignorance and / or poverty.

1:3:6: Primary schools enrolment:

There were about 1,209 primary schools, 14,356 primary school teachers, 332,510 primary school pupils enrolment and pupil teacher ratio of 19 (national average 44) in Kwara state in 2003.[17] The total number of primary school pupils enrolment in Ilorin in the record of KSUBEB as at July 2005 was 166,105 comprising of 81,752 males and 84,353 females.

1:4 DEFINITION OF HEALTH

Good health is basic to human welfare and a fundamental prerequisite for social and economic development.[18] Health is a priceless commodity and has been defined by World Health Organisation (WHO) as a state of complete, physical, mental and social well being and not merely the absence of disease or infirmity. It is a fundamental human right and the attainment of the highest possible level of health and is a most important worldwide social goal whose realization requires the action of many other social and economic sectors in

addition to the health sector.[19] Globally, studies have shown that eye diseases and blindness constitute significant health problem.[20-25]

1:5 DEFINITIONS OF BLINDNESS, VISUAL IMPAIRMENT AND LOW VISION

According to WHO[5], an individual is blind if the corrected Visual Acuity (VA) in the better eye is less than 3/60 or if the visual field is less than 10^0 around the point of fixation. A severely visual impaired individual is one whose best corrected VA in the better eye is less than 6/60, but equal to or better than 3/60. Visual impairment refers to corrected VA in the better eye of less than 6/18, but equal to or better than 6/60. An individual with normal vision is one whose VA is 6/18 or better. Individual with low vision has impairment of visual function even after treatment and / or standard refractive correction, and has a visual acuity of < 6/18 to Light Perception (PL), or a visual field of $< 10^0$ from the point of fixation, but uses, or is potentially able to use vision for planning and / or execution of a task. The classification of vision by WHO is as shown in Table 1.

Table 1: World Health Organisation (WHO) classification of vision[19]

Corrected visual acuity in the better eye	Classification
6/6 – 6/18	Normal Vision
< 6/18 – 6/60	Visual Impairment
< 6/60 – 3/60	Severe Visual Impairment
< 6/18– PL	Low Vision
< 3/60 – NPL	Blind

CHAPTER TWO

LITERATURE REVIEW

2:1 GLOBAL SITUATION OF EYE HEALTH IN CHILDREN

Eye diseases in children constitute major reasons for ophthalmic consultation.[29] Many studies across the globe have confirmed the contribution of childhood eye diseases to the global ocular morbidity and mortality.[26, 30-33] Globally there are about 1.5 million blind children (and many more with visual impairment) and about 85% live in Africa and Asia.[33-35] It is quite worrisome that one child somewhere in the world goes blind every 10 seconds.[4]

Globally, childhood blindness accounts for about 70 million blind-person years and is the second largest cause of blind person years following cataract. About one third of the total economic cost of blindness is thought to be due to childhood blindness.[33]

The prevalence of blindness in childhood varies with the region of the world, socioeconomic development and accessibility of high quality health care services.[35] In the industrialized countries, the prevalence of blindness in 0-15 years old is 0.2 – 0.4/1000 but in the middle economy such as Latin America, the prevalence is about 0.4 – 0.6/1000 and 1.1/1000 children in the least developed countries of the world such as parts of Africa and Asia.[32]

The major causes of childhood blindness vary from region to region. In West Africa and south India (the least developed countries studied), cornea scarring and phthisis bulbi mainly caused by Vitamin A deficiency (VAD) and measles are the main causes. In developed economy retinal disease, with 18%

due to retinopathy of prematurity (ROP) is responsible while in the middle economy such as Thailand and the Philippines the main causes are mixed with almost a quarter of children being blind from corneal scarring and 20% from retinal conditions, 11% of which was due to ROP.[29,34]

Various local[12, 13, 26, 29, 36-39] and international [30, 40] surveys of children ocular health have indicated the magnitude of eye diseases and the importance of ocular survey among children. In a cohort study of 14,907 English[41] children (in 1970) aged 10 years, the prevalence of blindness was 0.4/1000. In China[41], a similar study among age group 5-15 year in 1998 - 1999 showed a prevalence of blindness (defined in the study as VA $\leq$ 6/60) 0.7/1000. In India[42] 5.1% of school children had visual impairment (defined as VA < 6/12 in the study). In cambodia[43], the survey of schools for the blind showed that cornea scarring from Vitamin A Deficiency (VAD), congenital cataract, high refractive errors and degenerative retinal disease were the common causes of blindness and low vision. About 1% of Cambodian school children had refractive errors.

In Africa, a survey of children in schools and in the community in Botswana[44] showed that 1.5% of children aged 5-15 years had VA < 6/18 in the better eye due to refractive error. A study in Malawi[41] (1983) at the Lower Shire valley, a region where VAD is a significant health problem, showed a prevalence of blindness of 1.1/1000 among children aged < 6 year.

Across Nigeria, studies by various workers have highlighted the pattern and prevalence of eye diseases in children. In an institutional based analysis of eye diseases in Nigerian children, Akinsola at Lagos University Teaching

Hospital (LUTH) reported conjunctival disease as the commonest (30.6%) childhood eye disease, followed by refractive error (26.3%), eye injuries (7.1%) and eyelid diseases (5.3%). Other ocular morbidities reported in the study include neuro-ophthalmological conditions (5.3%), squints (4.5%), cataract (4.2%), corneal diseases (3.5%), congenital abnormalities (2.7%) and retinal diseases (1.4%).[45]

In a similar study at Jos University Teaching Hospital (JUTH), Morgan also reported conjunctiva diseases as the commonest (40.8%) followed by trauma (22.4%), refractive errors (15.3%) and corneal diseases (4.7%).[36] Others include cataracts (3.6%), glaucoma (1.8%), congenital abnormalities (1.8%) and squints (1.6%). Mohammed, in another hospital based study in Kaduna, found allergic eye diseases to be the commonest (22.6%) followed by infections (21.4%) and trauma (17%).[46]

Various community-based studies have also confirmed eye disease among children. Nwosu, in a study of childhood eye diseases in Anambra State, reported vernal conjunctivitis as the commonest (13.1%) childhood eye morbidities followed by refractive error (3.1%), purulent conjunctivitis (1.7%), blepharitis (0.4%), stye (0.4%) and cataract (0.4%). Other childhood ocular morbidities found in the study include corneal opacity (0.4%), strabismus (0.4%), colour vision defect (0.4%), oculocutaneous albinism (0.2%) and retinal detachment (0.2%).[29] A similar study by Okosa among secondary school students in Enugu showed a prevalence of ocular morbidity of 21.2% and the major causes in the study include: vernal conjunctivitis (15.1%),

ametropia (8.7%), accommodative deficiency (3.5%) and convergence deficiency (2.3%).[47]

Ugochukwu, in a survey of eye diseases among primary school children in Nkanu West Local Government Area of Enugu State, reported a prevalence of ocular disorders of 12.3%. Among the 20 different ocular disorders reported, vernal conjunctivitis (49.3%) and refractive error (30.3%) were the most common.[13] In a vision screening of primary school pupils at Mainland Local Government Area of Lagos State, Balogun reported prevalence of ocular morbidity of 21.0% with refractive error (8.7%) being the leading cause of visual impairment. Other ocular morbidities found in the study include allergic conjunctivitis (6%), blepharitis (0.3%), infective conjunctivitis (0.8%), ptosis (0.3%) and (0.1%) each of cataract, chalazion, corneal foreign body, corneal phlycten, molluscum contagiosum of eyelid and colour defect.[48]

In a recent survey of ocular disease among 1144 school children in Ilesa, Osun Starte, Isawumi reported a prevalence of ocular morbidity of (15.5%) with vernal conjunctivitis (2.4%) being the commonest followed by refractive error (5.8%), ptosis (0.3%), stye (0.3%), chalazion (0.1%), pseudopterygium (0.2%) and non trachomatous infective conjunctivitis (0.2%).[12]

In a community-based survey of blindness and ocular morbidities in Kwara state, Mahmoud and associates reported an over-all blindness prevalence of 3.4%, while the prevalence for low vision was 8.6%. Children constituted 54% of the population examined. There was a lone case of

childhood blindness, which appeared to have resulted from ophthalmia neonatorum.[49]

2:2 PATTERN OF OCULAR MORBIDITY AMONG SCHOOL AGE CHILDREN

2:2:1: Eyelid Diseases:

The protective function of the eyelids on the globe is so vital such that the globe can barely maintain its integrity without the eyelids. Various ocular surveys have reported eyelid diseases among the children. In separate hospital based studies, each of Akinsola[45] and Mohammed[46] reported prevalence of 5.3% in Lagos University Teaching Hospital (LUTH) and Guinness Eye Centre of Ahmadu Bello Teaching Hospital (ABUTH), Kaduna respectively.

Chalazion (Internal Hordeolum) is a chronic granulomatous inflammation of the meibomian gland.[50] In Enugu, Ugochukwu reported prevalence of 0.6% among school children.[13] In Ilesa, Isawumi reported a prevalence of 0.1% among school pupils.[12]

Stye (External Hordeolum) is an acute staphylococcal abscess of a lash follicle and associated gland of Zeis or Moll which usually affects children.[50] Various workers such as Balogun[48] (0.2%), Ugochukwu[13] (0.3%) and Isawumi[12] (0.3%) have reported stye among school children. In a community-based study in Anambra State, Nwosu reported a prevalence of 0.4%.[29]

Blepharoptosis is abnormally low position of upper eyelid and may be congenital or acquired. It can cause amblyopia in children especially when severe and uncorrected.[52] Prevalence of 0.3% each has been reported by both Balogun[48] and Isawumi[12] in ocular health surveys among school children.

Moluscum Contagiosum is a form of skin infection caused by a Pox virus, which typically affects otherwise healthy children.[51] Moluscum contagiosum of eyelid may be a manifestation of HIV/AIDS infection in children.[52, 53]

Blepharitis is one of the ocular morbidities reported in various studies of eye disease in children. In Enugu Ugochukwu[13] found a prevalence of 0.3%, and in Anambra Nwosu[29] reported a prevalence of 0.4%.

2:2:2: Conjunctival Diseases:

The conjunctiva because of its contiguity to the cornea contributes to, and assists in the maintenance of a healthy cornea and consequently the visual status of the eye. The conjunctiva is quite frequently implicated in diseases because it is exposed to all types of exogenous irritants and infections.[50]

Conjunctivitis: This is the most common eye disease worldwide.[50] It is commonly of two types – infective and allergic.

Allergic Conjunctivitis: Allergic or hypersensitivity reactions of the conjunctiva are not uncommon. They may be immediate (humoral) as seen in hay fever, acute or, sub acute conjunctivitis and vernal conjunctivitis or delayed (cellular) as found in phlyctenular conjunctivitis. In various studies by Abiose[54] and associates, Nwosu[29], Okosa[47], Ugochukwu[13], and Isawumi[12] vernal conjunctivitis was reported to be the commonest ocular morbidity among children. In Tanzania, a comparative study among school children showed a low prevalence of vernal conjunctivitis (0.36%).[55]

Nwosu found that the preponderance of vernal conjunctivitis correlated with the most frequent eye disease symptoms such as itching and sandy

sensation with tearing in the children.[29] Male dominance has been reported by Abiose[56], Majekodunmi[57], Nwosu[29] and Dahan and Appel[58] in their different studies. Osuntokun and Olurin[59] as well as Calbert[60] reported mixed limbal and palpebral vernal conjunctivitis as the most frequent form. However, Majekodunmi reported tarsal form as the most common.[57]

Vernal conjunctivitis does not usually lead to blindness. However, Hall and Shillo reported that up to 10% (and may be higher in hotter climates) of patients develop corneal ulcer which may lead to visual loss due to cornea changes.[61] Poor vision may also be due to poor management of vernal conjunctivitis especially following excessive scratching, abuse of steroid application (in self medication) and use of harmful traditional eye medication.[13] Mohammed reported bilateral blindness in a nine year old girl resulting from vernal conjunctivitis.[46] Vernal conjunctivitis has been linked with school absenteeism among school children.[13, 37, 62]

Vernal conjunctivitis is usually chronic, recurrent, seasonal or continuous throughout the year.[48, 58, 59] Seasonal exacerbations have been identified by Isawumi[12] and Ugochukwu[13] in their studies. Seasonal exacerbations are usual[46] and there may be history of atopy (but not always) among Africans.[56] On the other hand, seasonal hay fever conjunctivitis and perennial allergic conjunctivitis are usually associated with atopy.[46] Common associated atopic conditions include asthma, allergic rhinitis and eczema.[12]

Allergic conjunctivitis such as giant papillary conjunctivitis is uncommon just as the causative agent – use of contact lens – is uncommon in children in Nigeria.[46]

Infective Conjunctivitis: A wide variety of aetiological agents: bacteria, virus and fungi can cause infection in the conjunctiva.[50] Isawumi reported 2 cases (0.2%) of non-trachomatous infective conjunctivitis among school children in Ilesa, Osun state. [12] In a similar study Ugochukwu[13] reported 1.2% in Nkanu West LGA of Enugu state. Balogun[48] reported a prevalence of 0.8% for infective conjunctivitis among primary school children in Mainland Local Government Area of Lagos State. In India Desai and colleagues reported a prevalence of 28% for trachoma.[63] Pharyngo conjunctivitis fever caused by adenovirus 2, 4 and 7 primarily affects children and appears in epidemic form.[51]

Epidemic keratoconjunctivitis caused by adenovirus 5, 6, 19 and 37 occurs in epidemics. Acute haemorrhagic conjunctivitis (Apollo conjunctivitis) is caused by enterovirus 70 and affects all age groups but mostly seen in the young.[50] Chlamydia trachomatis serotypes A, B, and C causes conjunctivitis in children.[51] Trachoma has been associated with overcrowding, abundant fly population, unsanitary conditions, paucity of water, and low personal hygiene.[14] Chronic recurrent infections of trachoma lead to complications such as trichiasis, cornea opacity and subsequently to visual impairment.[13, 14]

2:2:3: Corneal Diseases:

Cornea integrity is important for visual function of the eye. In children many factors such as nutritional deficiency especially, vitamin A deficiency, infection, trauma, harmful tradition eye medication contribute to cornea ulceration, scarring, cornea opacity and blindness. Faal elegantly illustrated this as the 'funnel of childhood blindness'.[64]

Infective Keratitis: Diseases of the cornea are extremely serious as they often interfere with its transparency, leading to permanent visual impairment.[50] Infective agents such as bacteria, virus, fungi, onchocerciasis, and protozoa can infect cornea.[51- 65] Cornea infection is a known cause of cornea scarring. Surveys of blind schools in Africa have shown that corneal scarring causes up to 75% of blindness in children; about half of those children give a history of measles occurring shortly before they become blind.[66]

Corneal and Vitamin A Deficiency: Vitamin A is vital to the maintenance of healthy epithelium, and is important to the body's ability to resist infections.[3] Globally, about 231,000 children are blind from conditions leading to corneal scarring. The single most common cause is Vitamin A Deficiency (VAD).[3] In Ibadan, Akinyinka[67] and colleagues reported prevalence of VAD in 6.3% and 7.8% of well-nourished and malnourished children respectively. Vitamin A deficiency occurs clinically and of public health significance if serum level of retinol is less than 10ug/dl among greater than 5% of population.[67]

In Nigeria the prevalence of xerophthalmia among children according to the United National Children's Fund survey showed 47.6% (Kaduna State),

20% (Benue State) and 37.5% (Oyo State).[68] In a study conducted in 1993 involving 2,905 children between ages 6 months to 71 months across Nigeria the National prevalence of xerophthalmia was 1.2%.[69] Hence, Nigeria is one of the countries classified as having clinical xerophthalmia. As a National policy to prevent VAD among Nigerian children Vitamin A supplement has been incorporated into National Programme on Immunisation (NPI).[70]

Vitamin A is found in locally available food items such as green leafy vegetables, carrot, palm oil, eggs and meat. Vitamin A deficiency is commonly seen among preschool age children but the effect of its complication such as corneal scarring and visual impairment can be seen among school age children.

2:2:4: Refractive Error:

Refractive error is the dioptric condition of the eye in which parallel rays of light from infinity come to a focus not on the retina when accommodation is at rest and is due to an anatomical condition of the eye.[51] Refractive errors are a very important cause of poor eye sight world wide and its correction is one of the priority areas of the WHO initiative 'Vision 2020'.[27]

A population based cross sectional survey of refractive errors in children aged 5 to 15 years showed that more than 9% of rural Chinese, 2% of rural Nepalese and 7% of urban children would benefit from spectacle correction.[27, 71-73] Studies showed that prevalence of myopia among children in urban areas of India[74, 75], Taiwan[76], Tibetian[77] children living in Nepal and Oman[78] is greater than their rural children counterparts. Studies have shown higher prevalence of refractive error among children in urban settings than in rural

settings.[74-78] In Tanzania a study among secondary school children found that 6.1% had refractive errors.[79]

Community and schoolchildren ocular health surveys showed refractive errors to be a significant cause of ocular morbidity in Nigeria. Nwosu reported a prevalence of 3.1% in Anambra State, and the study showed refractive error as the most common ocular morbidity after vernal conjunctivitis.[29] Ologban reported a prevalence of 42.1% among students in the Wesley School for the Deaf, Lagos and being the commonest of all ocular morbidities in the study.[80] Okosa reported a prevalence of 8.7% in a secondary school survey in Enugu.[47] Balogun[48] reported in Lagos Mainland LGA, a prevalence of 8.7% and Isawumi[12] reported 5.8% among primary school children in Ilesa East LGA of Osun State.

Most neonates are hypermetropic and this decreases with age and as the eye enlarges. The refractive status at 5 years of age is predictive for the refractive status in later life as the eye growth has stabilized by then. Hence, a child with slight hypermetropia (up to 1.5D) at five is likely to end up emmetropic in later life. Those with higher degree of hypermetropia are likely to stay hypermetropic and those that are emmetropic or myopic at this age are likely to become myopic. Myopia most often develops between the ages of 10 and 14 years, particularly around the period of body growth spurt associated with puberty, and stabilises by the late teens or early twenties. The younger the age at onset of myopia, the more severe will be the final refractive error.[81]

Astigmatism and hypermetropia are inherited disorders. Myopia is caused by a combination of hereditary and environmental factors. Risk factors that have been found to be associated with myopias in different cultures are age, socioeconomic status, education, Asian ethnicity and a family history of myopia. Exposure to near work, such as reading has been the most consistent environmental factor that has been linked to the development of myopia.[81]

Poor eyesight due to uncorrected refractive errors has a negative impact on academic and professional achievement, and it increases the likelihood of trauma and social isolation.[27] Poor vision and inability to read materials written on the black board can have a serious impact on a child's participation and learning in class and this can adversely affect the child's education, occupation and socio-economic status for life.[82] Various studies in Nigeria and Britain showed that vision screening help in early detection of uncorrected refractive errors.[26, 82, 83, 84]

WHO[85] recommends that in children 15 years and below, significant refractive error should be bilateral visual acuity (VA) less than 6/12 and this should improve with standard correction. Different authors within Nigeria had used differing working definition for refractive errors. Nkaga and Dolin[84] used VA < 6/6, Faderin and Ajaiyeoba[26] VA < 6/9, Isawumi[12] VA < 6/9, Balogun[48] VA < 6/12, with the VA improving with pin hole test / standard correction

2:2:5: Cataract:

Cataract is any opacity in the lens or its capsule.[51] Cataract is one of the main treatable causes of blindness in children accounting for 3-39% of all

causes. It affects an estimated 170,000 children worldwide. Childhood cataract may be genetic, or be due to congenital syndromes, metabolic disorders or traumatic.[69] Dawodu and Dawodu reported 4 cases of congenital cataract at Otibhor Okhae Teaching Hospital, Irrua, Edo State among children whose ages range between 4 and 12 years.[86]

In a survey of eye health of school children in Ilesa, Isawumi[12] reported cataract prevalence of 0.2%, while Morgan[36] reported a prevalence of 3.6% among children at Jos University Teaching Hospital. In another hospital-based study, Akinsola reported cataract prevalence among children attending eye clinic at Lagos University Teaching Hospital as 4.2%.[45] Nwosu reported a prevalence of 0.4% among children in a community based study in Anambra State.[29]

The uptake of cataract surgery in children is low in developing countries because of reasons such as late detection; lack of awareness, or beliefs of parents; inadequate surgical facilities for children; lack of paediatric anaesthesia; insufficient trained surgeons and support staff; and high costs of surgery and transportation.[67]

2:2:6: Glaucoma:

A group of eye diseases that have in common a characteristic optic neuropathy with associated visual field loss for which intraocular pressure is one of the primary risk factors.[87] Glaucoma is uncommon in children, an incidence of 1 in 10,000 births occurs among Caucasian, and 65% of patients are males. Most cases of primary congenital glaucoma are sporadic and in

about 10% inheritance is autosomal recessive with incomplete penetrance.[52] In a survey of blind school in Benin City, Dawodu and Ejegi reported a prevalence of 7.1% for congenital glaucoma.[88] Adefule-Ositelu reported bilateral congenital buphthalmos in siblings of same mother in a polygamous set up.[89] The cases reported by Adefule-Ositelu showed recessive pattern of inheritance.

Genetic defects thought to be responsible for specific glaucoma have been identified and described in some families. Primary congenital glaucoma is designated with GLC3 and the three loci have been recognized as GLC3A, GLC3B and GLC3C. GLC3A has Mendelian Inheritance in Man (MIM) 231300, Gene CYP1B1 and chromosome 2P22-P21. GLC3B has MIM 600975 and Chromosome 1P36.2–P36.1.[90]

Juvenile Primary Open Angle Glaucoma (JPOAG) typically affects teenagers but onset at three year of life has been reported. It is autosomal dominant with high penetrance (80-100%) by age 20 and a family with autosomal recessive has been described. The genes have been found at 2 loci, GLC1A and GLC1E. GLC1A has MIM 137750, gene Myocilin (MYOC or TIGR), and chromosome 1q24–q25.2. GLC1E has MIM 602432 and chromosome 10P14–P15. Other chromosomes in families with POAG include chromosomes 2 (GLC1B), 3 (GLC1C), and 8 (GLC1D). Also GLC2 has been assigned to closed-angle glaucoma.[90]

2:2:7: Ocular Injuries:

Accidents do not just happen, they are caused.[91] Ocular injuries do occur among school children mostly when left unsupervised during play or when fighting among themselves.[91-95] The nature and the outcome of ocular injury vary. The outcome of ocular injury may be mild, moderate or severe visual impairment or blindness involving one or both eyes.[96-97]

Eye injury may be caused by a foreign body, blunt or non-penetrating and penetrating injuries. Broomstick, sharp objects, toys and explosives among other agents have been implicated in ocular injuries.[92, 97] Studies on ocular injuries showed various prevalence rates among children. Umeh[95] reported prevalence of 35% within 6-10 years age group in Enugu while in Ile-Ife[39] the prevalence among age group 10-14 years was 31.6%. Meda and associates reported a prevalence of 25.8% among school children / student in Burkina Faso.[98]

2:2:8: Neoplasia:

Neoplasia is found in different age groups but some are commonly found among children. Ocular tumour especially malignant ones can lead to blindness. Retinoblastoma is the commonest childhood intraocular tumour and can cause unilateral or bilateral blindness. It usually presents around the first 3 years of life and very rare thereafter. A more commonly used estimates is 1 case of retinoblastoma per 18,000 – 30,000 live births depending on the country.[51, 99]

Ochichia and Ekanem, in a histopathological review of orbito-ocular biopsies at University of Calabar teaching hospital, over 10 years period, found that age distribution exhibited bimodal pattern with the larger peak in the first decade and second peak at fifth decade of life. In that review, Burkitt's lymphoma was the commonest orbito-ocular tumour accounting for 18.5% cases, and mean age at diagnosis being 7-9 years. The prevalence of retinoblastoma, the commonest intraocular tumour in the study was 13% and the mean age at diagnosis was 3-7 years.[100]

Optic nerve glioma is an uncommon orbital tumour found predominantly in children under the age of ten years. Arigbabu and associates reported a case of optic nerve glioma in a 6-year-old boy in Lagos. The boy presented with visual impairment (VA = 6/36).[101]

In a five-year review of ultrasound evaluation of orbito-ocular tumours in Ilorin by Nzeh and colleagues, more than 75% of the cases reviewed were seen in less than 15 year old children. These tumours included retinoblastoma, orbital sarcoma, Burkitt's lymphoma and dermoid cyst.[102]

2:2:9: Haemoglobinopathies:

Haemoglobinopathies are a recognized cause of retinopathy[14] and potentially visual impairing and blinding condition especially in cases of proliferative sickle cell retinopathies. This has been reported in school age children of 10-14 years.[103] In Jamaica proliferative sickle cell retinopathy (PSR) has been reported in 32% of HbSC and 6% of HbSS subjects.[104] In

Nigeria, a PSR prevalence of 6% has been reported in a cohort of predominantly HbSS patient.[103]

2:2:10: Colour Vision Defects:

Colour vision is subserved by 3 different cones cells, each coding for the red, the green and the blue colour. It can be congenital or acquired. Between 7% and 8% of males and 0.5% females in the general population have congenital colour defect with 5% males and 0.3% females having red-green colour defects. Blue colour defect is very rare. The red-green colour gene is carried on X chromosome and blue gene on chromosome 7. Acquired colour defects are seen in retina and optic nerve diseases.[105-107]

Colour vision defects in school children could affect children performance and can also limit individual choice of career such as aeroplane pilot and driving.[108] Many workers outside and within Nigeria have reported different prevalence of colour vision defect. Desai[64] and associates and Swansen and Everett[109] reported 2.9% and 1.9% respectively. On the other hand Adams[110] and associates using single plate Farnsworth F-2 test reported 7.3% in boys and 0.9% in girls while Pokorny[111] and colleagues reported 7.8% in males and 0.5% in females using Ishiara chart. In Nigeria, survey of childhood ocular health showed colour vision defects prevalence of 3.9%, 0.4% and 0.1% in Jos[38], Anambra[29] and Lagos[48] respectively.

Colour vision screening is vital for counseling in the choice of career and in the diagnosis of retinal and optic nerve morbidities.

2:2:11: Strabismus:

This can be manifest or latent. It is a potential cause of asthenopia, visual impairment (amblyopia) and of cosmetic importance. Balogun, in vision screening among primary school children in the Mainland Local Government Area of Lagos state reported prevalence of manifest and latent squint as 0.2% and 1.4% respectively. [48] Yoloye, reported prevalence of squint as 1% with exotropia being commoner than esotropia (5:2).[112] Squint, when detected and treated early reduces the burden of amblyopia in children and cosmetic embarrassment.

2:2:12: Amblyopia:

This refers to a developmental defect of spatial vision and the major symptom being loss of visual acuity.[113] It may be unilateral or bilateral and the vision is reduced to 6/12 or worse.[106] Amblyopia can be strabismic, isoametropic, anisometropic and deprivative.[114] Amblyopia affects 2-4 % of the general population in North America and 2 - 2.5 % in the United Kingdom (UK).[106, 113, 115] Amblyopia is the single most common form of monocular vision impairment in the first 4 decades of life and among the major three causes of monocular visual loss between 18 to 85 years of life in North America.[113, 115]

Although there is no identifiable organic pathologic condition in the eye(s) / optic nerves, the development of amblyopia requires an immature visual system and the presence of one or more amblyogenic factors.[115] Amblyogenic factors such as refractive errors, anisometropia, strabismus and

media opacity have been reported in surveys of ocular health among school children.[12, 13, 48]

The 'critical' or 'sensitive' period (interval of reversibility) of visual development varies with the type of amblyopia.[115] With appropriate and timely intervention, amblyopia can be prevented or reversed during the critical period and beyond this period, it is irreversible.[114] Although, sensitive period almost always occur before the age of seven years[116], but the treatment may still be possible throughout the school age years in anisometropic amblyopia.[52] Amblyopia thus can be prevented through appropriate ocular health survey of school children by early detection of potential amblyogenic factors and prompt treatment.

2:2:13: Other Ocular Disorders:

Chorioretinitis: In a study of visual impairment among school children in Jos, Onyekwe reported a prevalence of 1.4% among a cohort of 2,146 school pupils / students.[38] Both toxoplasmosis and onchocerciasis were among the possible aetiological factor responsible for the chorioretinitis in the study. Syphilis[52], sickle cell disease[117], contusive and penetrating ocular injuries have also been reported as aetiological agents for chorioretinitis.[118-119]

Optic Atrophy: Onyekwe reported a prevalence of 1.4% among school children in Jos.[38] Majority of the cases in the study were male who had history of previous ocular trauma.

Malingering: This is a functional vision loss or ocular hysteria. In a hospital-based study, Majekodunmi reported a prevalence of 13% among children seen

in the eye clinic in Lagos.[120] Onyekwe reported a prevalence of 0.7% among school children in Jos.[38] All the affected children were females and possible emotional stress of adolescent was suspected as the causative factor in the study.

Others: Onyekwe also reported 2 cases of uveitis in 6 – 10 years old males and 2 cases of macula hole in males following ocular trauma with associated visual impairment in one of them. Others were 2 cases of oculocutaneous albinism in a female and a male, a case of retinitis pigmentosa as well as congenital microphthalmia and amblyopia each with a prevalence of 0.2%.[38]

2:3 JUSTIFICATION FOR THE STUDY

"*The function of the eye is vision, and the purpose in studying the epidemiology of eye disease in different populations is to promote normal vision, to preserve healthy eyes and to prevent blindness*" **Gordon J Johnson and Allen Foster**

The school age is very important for detecting a number of ocular morbidities as the pupil most probably is being visually challenged in a sustained manner for the first time in life because of school work. Also, many ocular problems that are amenable to interventional measures are detected through vision screening of selected population such as school children.[26-28]

Children visual well being ranks among the top priorities of "Vision 2020: The Right to Sight".[5] Regrettably, there is paucity of data on prevalence of blindness and visual impairment among children in Nigeria, more especially in Kwara State.

A study of ocular health status in Ilorin will further enrich the current body of knowledge and also reveal any peculiarity for this area. Individual children will benefit by detection and treatment of any ocular disease present. The study will not only provide a base line data necessary for comparison with similar studies conducted elsewhere but, will assist planner(s) in the provision of adequate eye care delivery to the children in Ilorin, Kwara State, Nigeria.

CHAPTER THREE

AIM AND OBJECTIVES

3:1 AIM

To determine the ocular health status of primary school children in Ilorin, Nigeria.

3:2 SPECIFIC OBJECTIVES

- To determine the prevalence of ocular morbidity among primary school children in Ilorin.
- To determine common eye complaints among primary school children in Ilorin.
- To determine eye diseases treatment practices at the family level of primary school children in Ilorin.
- To determine the parents' perceptions of importance of good eyesight (normal vision) among school children in Ilorin.

CHAPTER FOUR

MATERIALS AND METHODS

4:1 STUDY DESIGN

This was a cross-sectional study carried out over 7 months period from July 2005 to January 2006 in 10 randomly selected day primary schools within Ilorin metropolis. One thousand three hundred and ninety three pupils from the selected schools were studied.

4:2 THE SURVEY POPULATION

This consisted of all the primary school children within Ilorin metropolis. The population was approximately 166,000 as at July 2005.

4:3 PRE-SURVEY PERIOD

4:3:1 Advocacy at the Kwara State Universal Basic Education Board (KSUBEB) Secretariat:

This was done to convey the objectives and importance of this study to the KSUBEB with a view to gaining support and permission to carry out this study among primary schools children in Ilorin. The Board provided the necessary support for the study: supplied relevant information on primary school education in Ilorin, sent letters to relevant Local Education Authorities (LEAs) to allow the study to hold in the selected primary schools under their jurisdiction and issued a covering letter to the author (Appendix V).

4:3:2 First stage random sampling:

This involved the use of generated random numbers to select 10 primary schools from a list of 184 primary schools within Ilorin metropolis. This

comprising 78 schools (Ilorin South), 45 schools (Ilorin East) and 61 schools (Ilorin West). The number of schools surveyed in each LGAs include 3 (Ilorin South), 3 (Ilorin East) and 4 (Ilorin West). The list of the selected schools is shown in Table 3.

4:3:3 Advocacy at the selected schools:

At this stage, activities such as discussion with the selected school authorities on the objectives and benefits of the study, permission to carry out the study among the pupils as well as co-operation and support of entire school community throughout the study period were sought. Also accomplished was the training of the volunteers among the teachers on how to determine the pupils' visual acuity using E chart and collection of data on number of classes, arms, and the number of pupils in each class among others. The proforma (Appendix II) containing sections on pupils' parents consent, pupils' socio-demographic data and other relevant information on pupils' ocular health were explained to the head teachers and class teachers for subsequent distribution to parents through the selected pupils. The findings from a pilot study, which was carried out in one of the selected schools to validate the proforma during this stage, were useful in the final format of the proforma. The pilot study also revealed that all sighted pupils comprehend E chart compared to alphabetical Snellen chart as some pupils could not identify alphabets correctly. Hence, illiterate E chart was used to train volunteer teachers in visual acuity determination.

4:4 THE SAMPLE SIZE

The sample size of one thousand three hundred and ninety three pupils studied was calculated as below. The sample size is related to the survey population, prevalence rate of ocular condition being studied, p; degree of accuracy, d; and confidence level, z.[121] In this study, author determined the minimal sample size using the power equation:

$$n = Z^2pq/d^2$$

Where:

n = the desired sample size (since primary schoolchildren population in Ilorin was more than 10, 000)

Z = the standard normal deviate, author used 1.96 which corresponds to the 95% confidence level.

P = the proportion (prevalence) of the children population estimated to have visual problem.

The prevalence of ocular pathology among schoolchildren from previous studies in Nigeria included:

1. Yoloye[112] (Ibadan) - 14.40%
2. Onyekwe[38] (Jos) - 19.30%
3. Balogun[48] (Lagos) - 21.00%
4. Ugochukwu[13] (Enugu) - 12.32%
5. Isawumi[12] (Ilesa) - 15.47%

Average 17%

Thus:

p = 0.17

q = 1.0 – p = 0.83

d = Degree of accuracy, which was set at 2% (i.e. 0.02)

Thus $n = \frac{(1.96)^2 \times 0.17 \times 0.83}{(0.02)^2}$

$= 1{,}355$

4:5 FINAL STAGE OF RANDOM SAMPLING

Using the calculated minimal sample size as well as the number of pupils in each class as a guide, a predetermined number of 30 pupils was randomly selected for the study from the arms of each class. Through the assistance of class teachers, all available pupils in all the arms of a particular class were assembled and each pupil was asked to pick a numbered wrapped paper. The pupils who picked the first 30 numbers were selected from each

class for the study and thus a total number of 180 pupils from each school and an overall 1800 from 10 schools. Each selected pupils was given a letter containing information about the study (Appendix I) as well as a proforma (Appendix II) containing sections on parents' consent, pupils' socio-demographic data and information on pupils' eye health to take home to their parents for completion and return the same to the class teacher. The author subsequently sorted out returned proforma based on parent / guardian consent and proper completion of other sections ahead of the day of survey. All the pupils that had all or nearly all the sections of proforma (consent inclusive) properly completed were subsequently examined.

4:6 RESOURCES

4:6:1 Human:

The personnel utilized in carrying out this study included: trainee Ophthalmologist (the author), 2 Ophthalmologists (supervisors), a statistician, trained volunteer school teachers, other school staff and a photographer

4:6:2 Materials:

The materials used in carrying out this study included: stationeries, proforma, pen torches, tape rule, pointing stick, Snellen E chart, trial frame, pin hole, occluder, near vision chart, Ishiara colour plates, direct ophthalmoscope (Welch Allyn), Perkins applanation tonometer, digital camera batteries and tropicamide 0.5% guttae.

4:7 THE SURVEY

The period of the study was between 9.30 a.m and 1.30 p.m each day and ocular examination of the selected pupils took place in a classroom lit by daylight. The presence of the class teacher ensured the co-operation of the pupils with the examination process.

Ocular examination started with visual acuity (VA) determination by trained volunteer teachers and crosschecked by author in doubtful cases as well as in cases of VA less than 6/9. This was done using the Illiterate 'E' chart, which was hung on the wall at 6m (as measured with a tape rule), away from the pupil. Illiterate E chart was preferred and used for VA determination, as all concerned pupils comprehended it unlike the alphabetical Snellen chart, which challenged the poor literate of some pupils. Each eye was tested separately. Pin hole test was done by trained teachers for pupils with VA $\leq$ 6/9. Near vision was also checked by trained teachers using near vision chart.

The author took relevant ocular history of the pupils where necessary and carried out additional ocular examinations specified below (Appendix III). The colour vision defect was checked by the author using Ishiara colour plates, which was placed at a reading distance to the pupil. With the aid of the pen torch the eyelids, the conjunctiva, the cornea, the anterior chamber, the iris and the pupil of each eye were examined separately for each respondent pupil by the author. Hirschberg test and cover-uncover test were also carried out for pupils with strabismus by the author. With the aid of direct ophthalmoscope author examined the posterior segment of the eyes of each pupil in a darkened

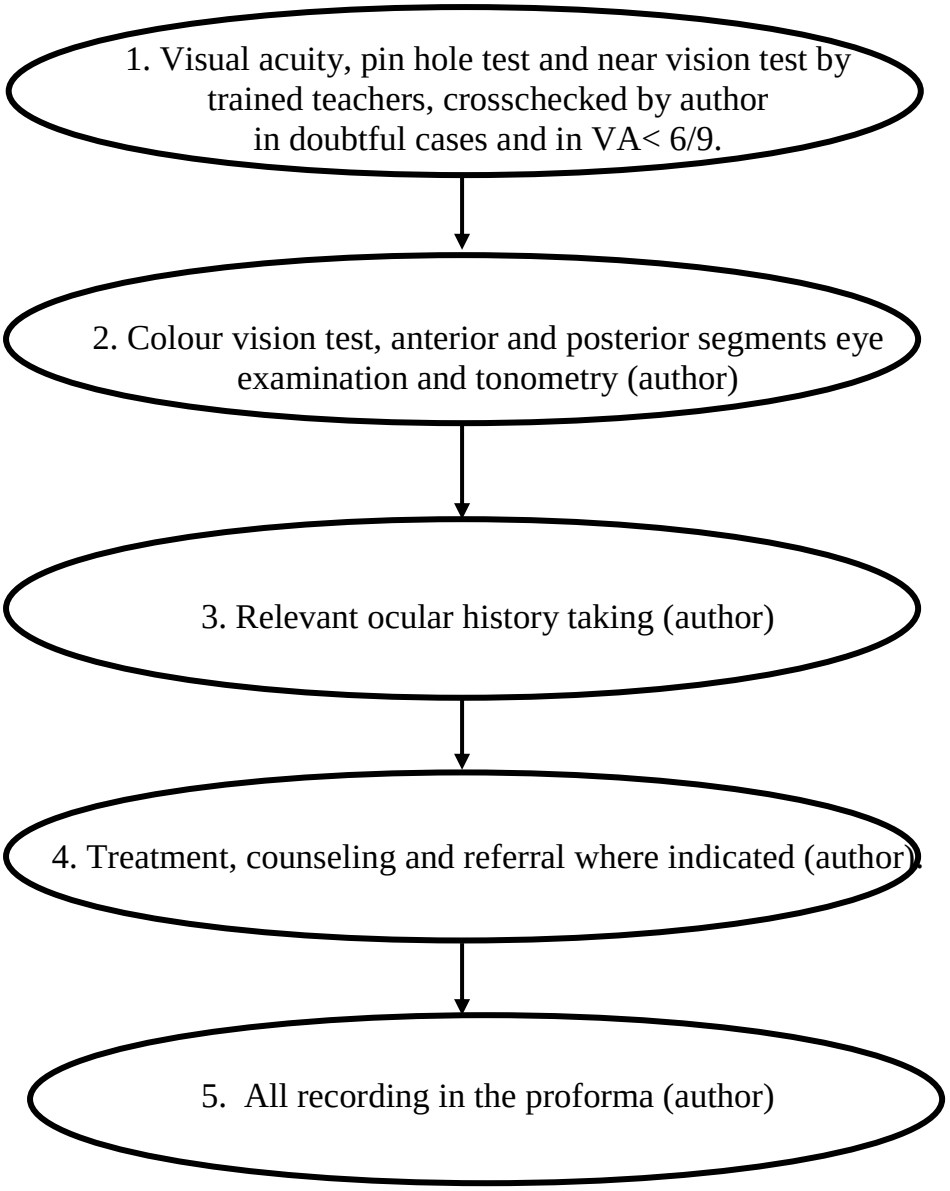
corner of the classroom (ensured by closing few windows). The eye was dilated with 0.5% tropicamide drops whenever mydriasis was required for fundoscopy.

The intra ocular pressure was checked with a Perkins applanation tonometer in pupils whose ocular findings suggested glaucoma. Glaucoma was diagnosed based on cup disc ratio of $\geq$ 0.6 with or without cup disc asymmetry of fellow eyes and intraocular pressure of > 20mmHg. Confrontation visual field test to detect visual field defects was inconclusive. Standard perimetry to detect visual field defects could not be carried out on the field. Eyes with cup disc ratio of $\geq$ 0.4 with or without cup disc asymmetry of fellow eyes however having intraocular pressure of < 20mmHg were diagnosed as glaucoma suspect.

Amblyopia was diagnosed based on presence of amblyogenic factors (such as strabismus and refractive error) and reduced VA with or without improvement with pin hole test. Additionally, single optotype VA test and refraction were also performed on these pupils at eye clinic of UITH, Ilorin.

Ophthalmic morbidities detected were managed as appropriate by prescription of antihistamine in cases of allergic conjunctivitis, antibiotics eye drops in ocular infection, appropriate referral (Appendix IV) were made where necessary and parents were sent for where necessary for counseling on pupils' ocular health. The photographer assisted in taking some clinical photographs as shown in survey activities in Appendix VIII. Ethical approval and written consent were taken from relevant authority and parents / guardians / pupils respectively prior to survey activity (detail as in 4:15).

4:8 FLOW CHART OF THE SURVEY ACTIVITY



4:9 POST SURVEY VISITS

These were carried out to fill in inadvertent gaps during survey activities, to confirm / clarify some information in doubtful cases, for advocacy to encourage identified pupils with ocular pathology to report in the eye clinic for management and to express appreciation to the school communities.

4:10 INCLUSION CRITERIA

All selected pupils in the selected primary schools registered by Ilorin Local Government Educational Authorities (ILGEAs) who were not having exclusion criteria.

4:11 EXCLUSION CRITERIA

1. Any school not selected by the first stage random sampling.
2. Any school pupil not in the selected schools by first stage random sampling.
3. Selected school pupils who were of age 16 year and above.
4. Selected pupils whose parent / guardian did not give consent for their participation in the study.
5. Any selected school pupil who was very unco-operative with the examination process.
6. Pupils whose parents / guardians failed to complete relevant sections of the proforma.
7. Pupils who participated in the pilot study.

4:12 STUDY DEFINITIONS

4:12:1 SOCIO-ECONOMIC CLASS OF PUPILS' PARENTS

This was derived from the parents' occupation and earning capacity as well as the sophistication of pupils' school. Elsewhere parents' educational level and number of individuals sleeping in a room may be used.

High socio-economic class: doctors, engineers, lawyers, tertiary institution lecturers, senior civil / public officers, business executives, political office holders.

Medium socio-economic class: teachers, nurses, police (middle cadre), military personnel (middle cadre), medium scale business concern, some artisans (drivers, fashion designers, motor mechanics)

Low socio-economic class: public servants below level 5, pensioners, farmers, petty traders, majority of artisans (vulcanisers, shoe repairers)

Indeterminable: Housewife, students, aged.

4:12:2 DIAGNOSIS

Both anatomical and aetiological approaches were adopted: where multiple ocular pathologies were observed the principal / primary pathology was used as diagnosis. Thus, the pupil with presumed congenital ocular toxoplasmosis who had associated strabismus was diagnosed as presumed congenital ocular toxoplasmosis. Otherwise, where primary multiple pathologies co-exist the one that is most curable / preventable was used.

4:12:3 REFRACTIVE ERROR

This was based on visual acuity of 6/9 or less which improved with pin hole test as previously reported by Isawumi[12] in Ilesa and Ugochukwu[13] in Enugu in their separate surveys of ocular eye health among pupils.

4:13 ETHICAL APPROVAL / CONSENT

Ethical approval to carry out the research was obtained from the University of Ilorin Teaching Hospital ethical review committee (Appendix VI). The Faculty of Ophthalmology, National Postgraduate Medical College of Nigeria approved the title of the study (Appendix VII). General approval was obtained from the Kwara State Universal Basic Education Board (KSUBEB) and the school authorities of each of the selected schools. Written informed consent allowing each pupil to participate in the study was obtained from the parent / guardian of each pupil (Appendix II).

4:14 DATA COLLECTION, ENTRY AND ANALYSIS

Data was collected using the proforma (Appendices II & III) while data entry and analysis was done with Statistical Package for Social Scientist (SPSS) version 12.0.1. Analysis was done using simple frequency proportions and chi square test for significance. Statistical significance difference was taken at the level of $p < 0.05$. Microsoft Office Excel 2003 was employed to prepare most statistical charts. CorelDraw 11 software was employed to prepare the plates in Appendix VIII.

CHAPTER FIVE

RESULTS

5:1 DEMOGRAPHY

One thousand three hundred and ninety three pupils were examined. There were 689 (49.4%) males and 704 (50.6%) females giving a male to female ratio of nearly 1:1. The age range was between 4 and 15 years. The mean and modal ages were 10.16 $\pm$ 2.5 and 10 respectively. The modal age group being 10-12 years (Table 2).

Table 2: Age group and Sex distribution of pupils

Age group (years)	Number of males (%)	Number of females (%)	Total (%)
4 - 6	53 (3.8)	55 (4.0)	108 (7.8)
7 - 9	228 (16.4)	223 (16.0)	451 (32.4)
10 - 12	275 (19.7)	299 (21.5)	574 (41.2)
13 – 15	133 (9.5)	127 (9.1)	260 (18.6)
Total	689 (49.4)	704 (50.6)	1393 (100.0)

5:2 THE SCHOOLS

Table 3 shows the 10 selected day primary schools and the numbers of pupils studied in the different schools and classes.

Table 3: Distribution of pupils by school and class

	Class						
School	I	II	III	IV	V	VI	Total
Adeta A	25	29	28	23	26	24	155
Adeta B	23	22	22	22	25	24	138
Oke Aluko	26	27	26	26	24	24	153
Ipata	25	22	26	23	24	25	145
Baptist	20	24	22	24	23	22	135
Dada	20	23	21	24	23	23	134
Solagberu	22	21	21	23	25	26	138
Ajoke	22	21	22	24	20	24	133
Barakat	23	24	21	22	19	23	132
Five-ways	21	20	25	22	20	22	130
Total	227	233	234	233	229	237	1393

5:3 THE OCULAR MORBIDITIES

Two hundred and seventy seven of 1393 pupils had ocular pathology giving a prevalence of 19.9. Table 4 gives the breakdown of the diagnostic groups of ocular pathologies in pupils.

Table 4: Ocular pathologies among study pupils

Diagnosis group	Frequency (prevalence) n =1393	Male	Female
Refractive error	**96 (6.9)**	**49**	**47**
Allergic: vernal conjunctivitis	**93 (6.7)**	**60**	**33**
Genetic / congenital / developmental	**39 (2.8)**	**21**	**18**
Defective colour vision	17 (1.2)	8	9
Strabismus	5 (0.4)	2	3
Amblyopia	5 (0.4)	3	2
Blepharoptosis	4 (0.3)	1	3
Oculocutaneous albinism	2 (0.1)	2	0
Persistent hyaloid artery	2 (0.1)	2	0
Maculopathy	1 (0.1)	0	1
Eyelash ptosis	1 (0.1)	1	0
Optic nerve atrophy	1 (0.1)	1	0
Non proliferative sickle cell retinopathy	1 (0.1)	1	0
Glaucoma / glaucoma suspect	**20 (1.4)**	**11**	**9**
Glaucoma	3 (0.2)	2	1
Glaucoma suspect	17 (1.2)	9	8
Ocular infection	**18 (1.3)**	**9**	**9**
Infective conjunctivitis	10 (0.7)	7	3
Post measles leucoma / phthisis	2 (0.1)	0	2
Eyelid infections	3 (0.2)	1	2
Dacryocystitis	1 (0.1)	0	1
Presumed ocular toxoplasmosis	2 (0.1)	1	1
Ocular trauma	**11 (0.8)**	**8**	**3**
Lid ecchymosis / bruise / laceration	4 (0.3)	3	1
Phthisis bulbi	2 (0.1)	1	1
Subconjunctival haemorrhage	1 (0.1)	1	0
Hyphema	1 (0.1)	1	0
Couching	1 (0.1)	1	0
Optic nerve atrophy	1 (0.1)	1	0
Retinal detachment	1 (0.1)	0	1
Total	**277 (19.9)**	**158**	**119**

5:3:1 The pupils' Visual Acuity (VA)

Table 5 shows distribution of pupils eyes' VA based on WHO categorisation of vision. Most eyes [2735 (98.1%)] of pupils had VA of 6/18 or better (normal vision). However, the VA of 10 (0.4%) eyes of the pupils though, believed to be seeing was indeterminable due to their poor co-operation to VA test. Forty of the eyes had VA between < 6/18 and Perception of Light (PL) (low vision).

Table 5: Distribution of pupils eyes' VA based on WHO categorization.

Visual Acuity	No of eyes (%)	WHO category
≥ 6/18	2735 (98.1)	Normal vision
< 6/18 - 6/60	28 (1.0)	Visual impairment
< 6/60 - 3/60	2 (0.1)	Severe visual impairment
< 3/60 – NPL	11 (0.4)	Blind
Indeterminable	10 (0.4)	
Total	2786 (100.0)	

5:3:2 Refractive Error:

This was the commonest [96 of 1393 (6.9%) pupils] ocular disorder found among pupils in this study (Table 4). Included were pupils with VA of 6/9 or less but improved on pin hole test. Table 6 shows the distribution of unaided VA of 214 eyes with VA $\leq$ 6/9 and their outcome on pin hole test.

Table 6: Distribution of unaided VA of 214 eyes with VA $\leq$ 6/9 and their outcome on pin hole test.

Distribution of unaided VA in 214 eyes with VA $\leq$ 6/9		Outcome of pin hole test of 214 eyes with VA $\leq$ 6/9		
VA	No of eyes (%)	Improved (%)	Not improved (%)	Worse (%)
6/9	120 (56.1)			
6/12	32 (15.0)			
6/18	21 (9.8)			
6/24	10 (4.7)	192 (89.7)	13 (6.1)	9 (4.2)
6/36	15 (7.0)			
6/60	3 (1.4)			
<6/60	13 (6.1)			
Total	214 (100.0)	214 (100.0)		

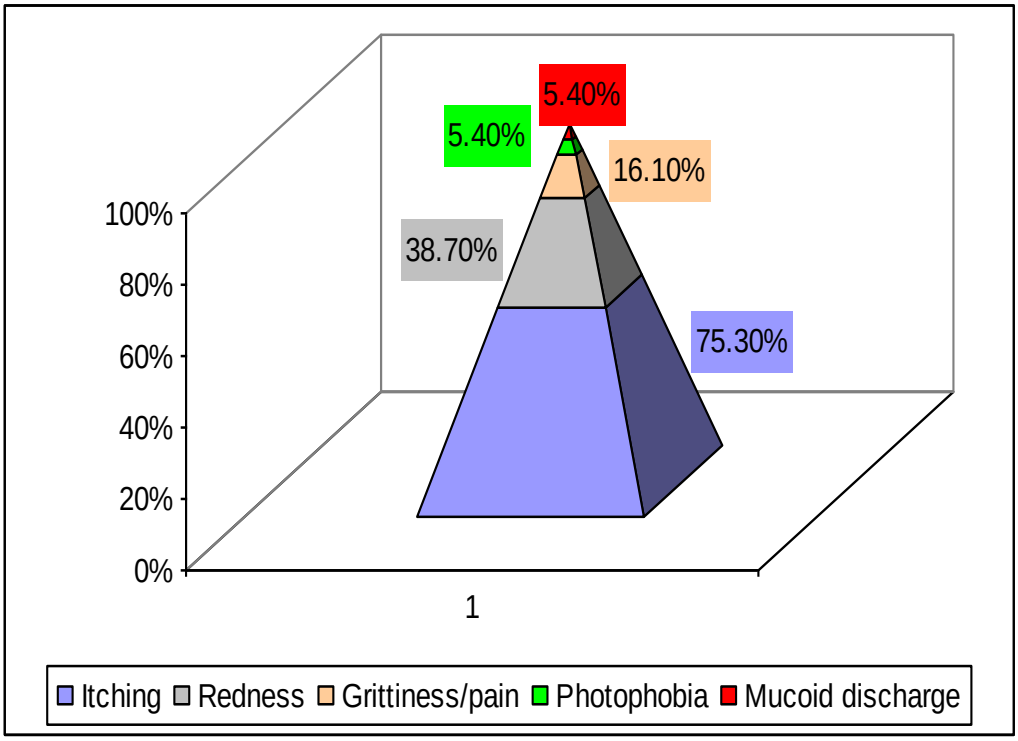
The sex distribution of the 96 pupils with refractive error included 49 (51%) males and 47 (49%) females with a male to female ratio of nearly 1:1 however, 8 (8.3%) of them had family history of refractive errors among their first degree relatives. The asthenopic symptoms of eye pains / discomfort were noted in 24 (25%) while 15 (15.6%) pupils reported blurred vision for distance. In addition, other symptoms of photophobia 5 (5.2%) and lacrimation 5 (5.2%) were elicited. Fifty one (53%) of the 96 pupils (47% defaulted) with refractive error eventually honoured referral letter for refraction in the eye clinic of University of Ilorin Teaching Hospital.

5:3:3: Allergic conjunctivitis:

This was next to refractive error in magnitude with 93 of 1393 (6.7%) pupils having vernal conjunctivitis (Table 4). There were 60 (65%) males and 33 (35%) females with male to female ratio of 1.8:1. Eighteen (19.40%) pupils had family history of ocular itching among their first-degree relatives.

The main complaints of the pupils who had vernal conjunctivitis included ocular itching, 70 (75.30%); redness of eyes, 36 (38.70%); ocular gritty sensation / pain, 15 (16.10%); photophobia, 5 (5.40%) and mucoid eye discharge, 5 (5.40%) (Figure 2). The number of pupils with their respective unaided VA included 76 (81.70%), 6/6 or better; 16 (17.20%), 6/9 and 1 (1.10%), 6/12.

Figure 2: Eye complaints among pupils with vernal conjunctivitis



5:3:4: Genetic / congenital / developmental ocular conditions:

This group included 39 of 1393 (2.8%) pupils comprising 21 (53.9%) males and 18 (46.1%) females (Table 4). Among this group of ocular disorders, 17 of 1393 (1.2%) pupils comprised 8 males (47.1%) and 9 females (52.9%) had congenital defective colour vision. Their ages were between 9 and 15 year with VA of 6/9 or better. Also, 5 of 1393 (0.4%) pupils comprising 3 females (60.0%) and 2 males (40.0%) had strabismus. Three (60.0%) were alternating exotropia and 2 (40.0%) were alternating esotropia. All the five pupils with strabismus had ocular deviations ranging between 15^0 and 30^0. There was history of ocular deviations in the mothers of 2 (40.0%) of the pupils. All of the

5 (100.0%) pupils had VA of 6/6 or better and their ages ranged between 7 and 10 years.

Another identified disorder was amblyopia in 5 (0.4%) of 1393 pupils comprising 3 males (60.0%) and 2 females (40.0%) between ages 8 and 15 years. Two (40.0%) of them had strabismic amblyopia (the mother of one of them had squint), 2 (40.0%) were isoametropic amblyopia, and 1 (20.0%) was anisoametropic amblyopia. Three of the pupils (60.0%) had improved VA between 1 and 2 lines on single optotype VA test while 2 (40.0%) had no improvement. However, none had significant improvement with refraction. Amblyopia accounted for 3 (17.7%), 1 (50.0%) and 1 (33.3%) of all causes of bilateral visual impairment (BVI), bilateral severe visual impairment (BSVI) and unilateral visual impairment (UVI) respectively. Mild congenital blepharoptosis was identified among 4 pupils comprising 3 females and a male whose ages ranged between 5 and 12 years. All had VA of 6/6.

There were 2 boys of ages 10 and 12 years who had oculocutaneous albinism**.** Both had visual impairment ($6/18^{-2}$ in both eyes in one and 6/36 in both eyes in the other), horizontal nystagmus, iris hypochromia and tessellated fundi. Other ocular disorders in this group included idiopathic eyelash ptosis in a 6-year-old boy who had downward displacement of eyelashes. However, other ocular findings were essentially normal. Persistent hyaloid arteries were found in 2 boys of ages 12 and 13 years, however other ocular findings in them were essentially normal.

An 11-year-old boy with SS haemoglobin had features of non-proliferative sickle cell retinopathy including tortuous conjunctival vessels and silvered wired retinal arterioles. His VA was 6/24 in each eye and VA did not improve with pin hole test. Maculopathy was found in a 12 year old girl who had a VA of 6/36 (RE), 6/60 (LE), reduced VA on pin hole test and macular stippling**.** Optic nerve atrophy with possible genetic aetiology was seen in a 14-year-old boy. He had VA of 6/60 (RE), 6/36 (LE), no improvement in VA with pin hole and bilateral temporal disc pallor with normal intraocular pressure of 12 mmHg in both eyes.

5:3:5: Glaucoma / glaucoma suspect:

This category was found among 20 of 1393 (1.4%) pupils. This included 11 boys (55.0%) and 9 girls (45.0%) with ages ranging between 7 and 13 years. Three pupils (15.0%) had glaucoma and 17 (85.0%) were glaucoma suspect (Table 4). The main findings in glaucoma cases included pale disc with cup to disc ratio ranging between 0.6 – 0.9, nasalised vessels, intraocular pressure between 19 and 30mmHg and VA of 6/6 in 5 eyes and PL in an eye. They were 2 boys (10.0%) and a girl (5%) whose ages were 7, 8 and 13 years.

The remaining 17 (85.0%) pupils (34 eyes) had ocular features characteristic of glaucoma suspect such as cup to disc ratio of 0.4 in 7 eyes (with lamella dots in 4 of the eyes and nasalised vessels in 2 of the eyes), 0.5 in 11 eyes, 0.6 in 13 eyes (with nasalized vessels in 2 of the eyes), and 0.7 in 3 eyes. Another feature was cup to disc asymmetry, which was found in 5 pairs of eyes. The VA among the glaucoma suspect pupils included 6/5 in 8 eyes, 6/6

in 24 eyes and 6/9 in 2 eyes. All the 34 eyes had normal intraocular pressure ranging between 11 and 16mmHg (Table 7). Although there was no history suggestive of glaucoma among their first-degree relatives, however all the pupils were blacks.

Table 7: Ocular findings among seventeen glaucoma suspect pupils

	Clinical features	Number of eyes
1	Visual Acuity (6/5 – 6/9)	34
2	Cup Disc ratio (0.4 – 0.7)	34
3	Lamella dots	4
4	Nasalised vessels	4
5	Cup Disc asymmetry	5 pairs of eyes
6	Intraocular pressure (11 – 16mmHg)	34

5:3:6 Ocular infections:

The ocular infections found among the pupils included infective conjunctivitis among 10 (0.7%) of 1393 pupils. Seven of them were males and 3 were females with age ranging between 5 and 15 years (Table 4). A lone case of epidemic keratoconjunctivitis among them (10.0%) occurred in a 7-year-old girl and had a positive history of contact with her sister and VA of 6/9 in both eyes. One of the pupils had a VA of 6/18 in both eyes however; all others had VA of 6/6.

A lone case (10.0%) of post measles infection right eye (RE) leucoma was found in a 13-year-old girl who had measles infection as an infant. She had a VA of Hand Motion (HM) (RE), 6/5 (LE). History had it that the measles vaccine for unexplained reason was not available in the health centre when it was due in case of this girl with post measles leucoma, however months later when she was about 15 months old she had a febrile illness and bodily rashes.

The mother only noticed the eye lesion few days after admission in a local private health facility. There was also a 12-year-old girl (10.0%) who had left eye phthisis bulbi resulting from measles infection in her early childhood period. She had VA of 6/5 (RE) and NPL (LE).

There was a case (10.0%) of bilateral presumed congenital ocular toxoplasmosis in a 6-year-old boy who had a huge macular scar, VA of Counting Finger (CF) in both eyes and associated nystagmus with esotropia of about 40^0. Others included 1 case (10.0%) each of blepharitis, hordeolum externum, hordeolum internum, dacryocystitis and unilateral presumed toxoplasma scar inferotemporal to the disc and all had normal vision.

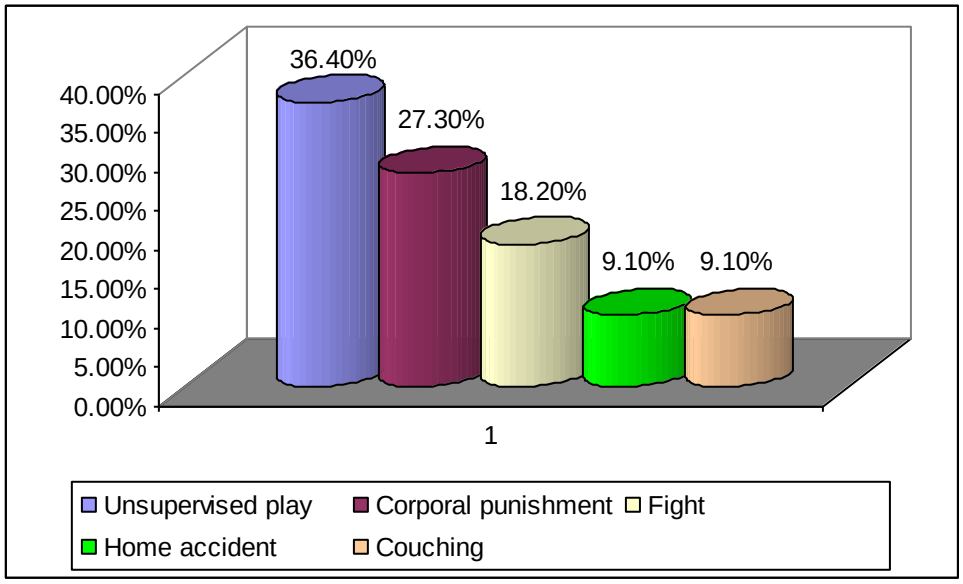
5:3:7 Ocular trauma:

This was found among 11 of 1393 (0.80%) pupils. This included 8 (72.70%) boys and 3 (27.30%) girls (male to female ratio of 2.7:1) and their ages ranged from 5 to 13 years.

The trauma related ocular pathology found among these pupils included 2 cases (18.20%) of unilateral phthisis bulbi with VA of NPL (in the affected eyes) and 6/5 (in the fellow eyes), a case (9.10%) of couched eyes in a 12 year old boy with VA of PL and CF, a case (9.10%) of traumatic retinal detachment in a 12 year old girl with VA of PL (RE), 6/6 (LE), and a case (9.10%) of traumatic hyphema in a 5 year old boy with VA of 6/6 in both eyes. Other trauma cases included 2 of eyelid bruises, one (9.10%) each of eyelid ecchymosis, laceration of the eyelid, subconjunctival haemorrhage and optic nerve atrophy.

The aforementioned traumatic cases occurred as follow: unsupervised play, 4 (36.40%); corporal punishment at school and home, 3 (27.30%); at fight, 2 (18.20%); home accident, 1 (9.10%) and couching, 1 (9.10%) (Figure 3).

Figure 3: Distribution of activities leading to ocular trauma among pupils



Ocular trauma accounted for 5 (16.7%) of all causes of visual impairment and blindness in this study. This included 50%, 50% and 33.3% of the total causes of bilateral blindness (BB); unilateral blindness (UB) and unilateral visual impairment (UVI) respectively.

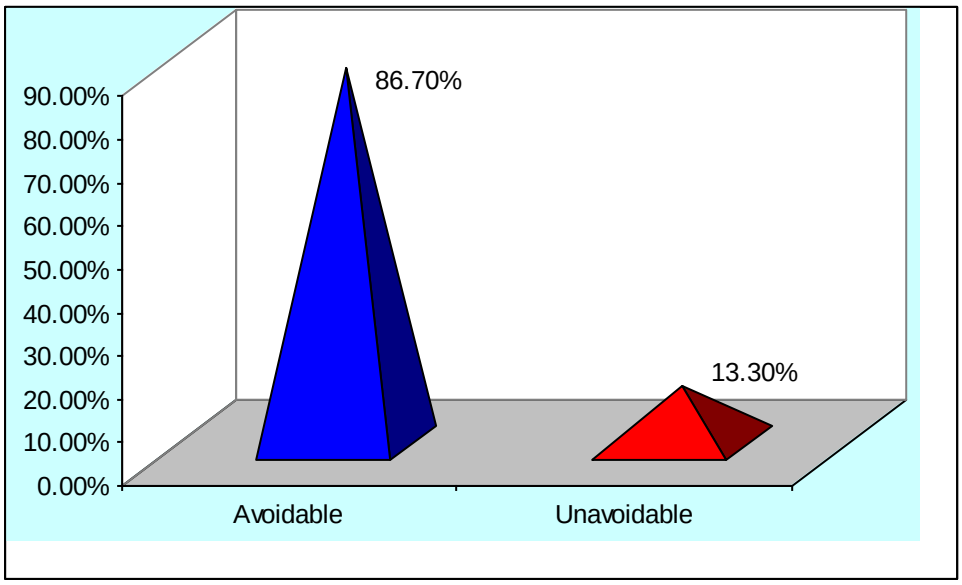
5:3:8 Blindness and visual impairment:

The blindness and visual impairment were observed among 30 (2.2%) out of 1393 pupils. This included 2 (6.7%) pupils with bilateral blindness (BB) caused by presumed congenital ocular toxoplasmosis and couching (trauma); 6 (20.0%) pupils with unilateral blindness (UB) caused by glaucoma [1 (3.3%)], measles [2 (6.7%)] and trauma [3 (10.0%)]; 2 (6.7%) pupils with bilateral

severe visual impairment (BSVI) caused by refractive error [1 (3.3%)] and amblyopia [1 (3.3%)]; 17 (56.6%) pupils with bilateral visual impairment (BVI) caused by refractive error [9 (30.0%)], familiar optic nerve atrophy [1(3.3%)], amblyopia [3 (10.0%)], oculocutaneous albinism [2 (6.7%)], sickle cell retinopathy [1 (3.3%)] and maculopathy [1 (3.3%)]; and 3 (10.0%) pupils with unilateral visual impairment (UVI) caused by refractive error [1 (3.3%)], trauma [1(3.3%)] and amblyopia [1 (3.3%)].

The aforementioned causes of visual impairment and blindness could be categorised as avoidable (preventable and treatable) and unavoidable. These include preventable [toxoplasmosis, measles, sickle cell retinopathy (through genetic counseling), trauma and glaucoma], treatable (refractive error and amblyopia) and unavoidable (maculopathy, familiar optic atrophy and oculocutaneous albinism). The avoidable causes of visual impairment and blindness in this work constituted 86.70% while the remaining 13.30% was unavoidable (Figure 4).

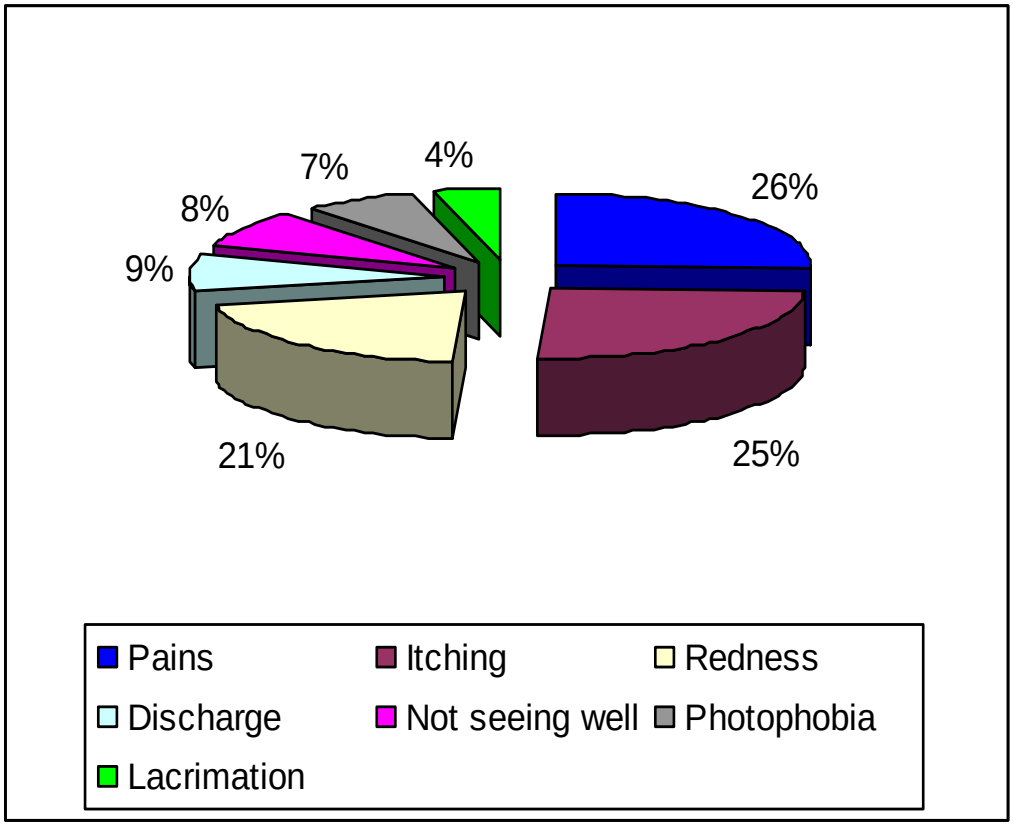
Figure 4: Proportion of avoidable and unavoidable causes of visual impairment and blindness among pupils



5:4 THE COMMON EYE COMPLAINTS AMONG PUPILS

Nine hundred and fourteen of 1393 (66%) pupils' parents indicated pupils' eye complaints. The commonest eye complaints among the pupils included ocular pains, 238 (26%); ocular itching, 226 (25%) and redness of the eyes, 193 (21%). Others were eye discharge, 78 (9%); inability to see well, 75 (8%); photophobia, 67 (7%); and lacrimation, 37 (4%) (Figure 5).

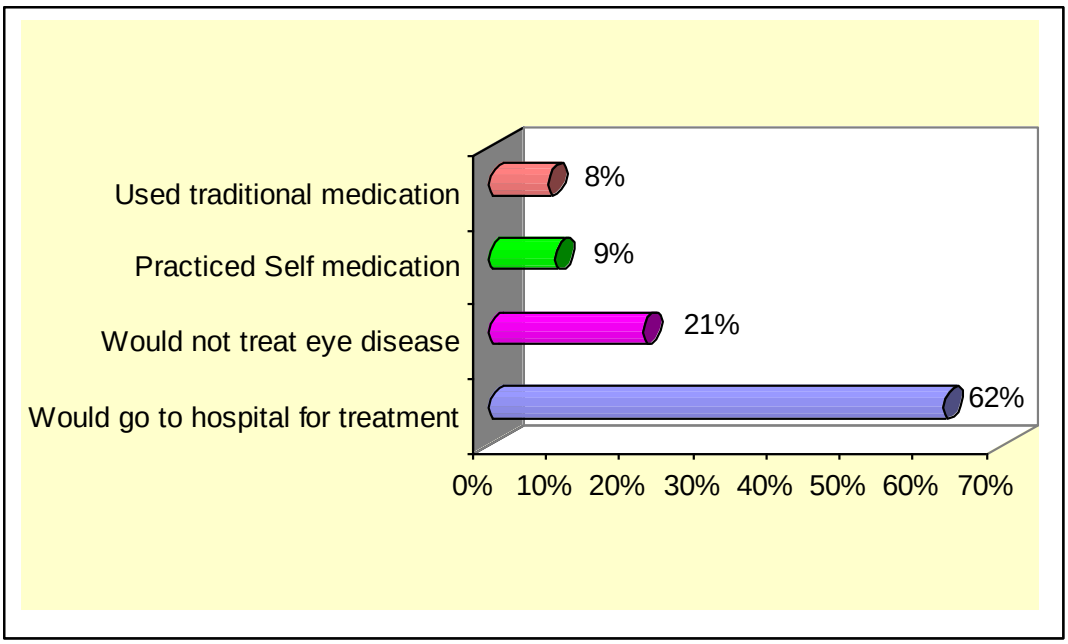
Figure 5: Distribution of eye complaints among pupils



5:5 EYE HEALTH SEEKING BEHAVIOUR OF PUPILS' CAREGIVERS

One thousand and sixty nine of 1393 (77%) pupils' families indicated the ways they took care of eye diseases among family members as follow: 659 (62%) of the families went to the hospital for treatment whenever a family member had eye diseases, 228 (21%) did not treat eye diseases, 99 (9%) practiced self medication by applying drug(s) bought from medicine stores and 83 (8%) treated with traditional medication. There was no statistical significant difference between pupils' eye complaints and the way pupils' families treated eye diseases (p = 0.14) (Figure 6).

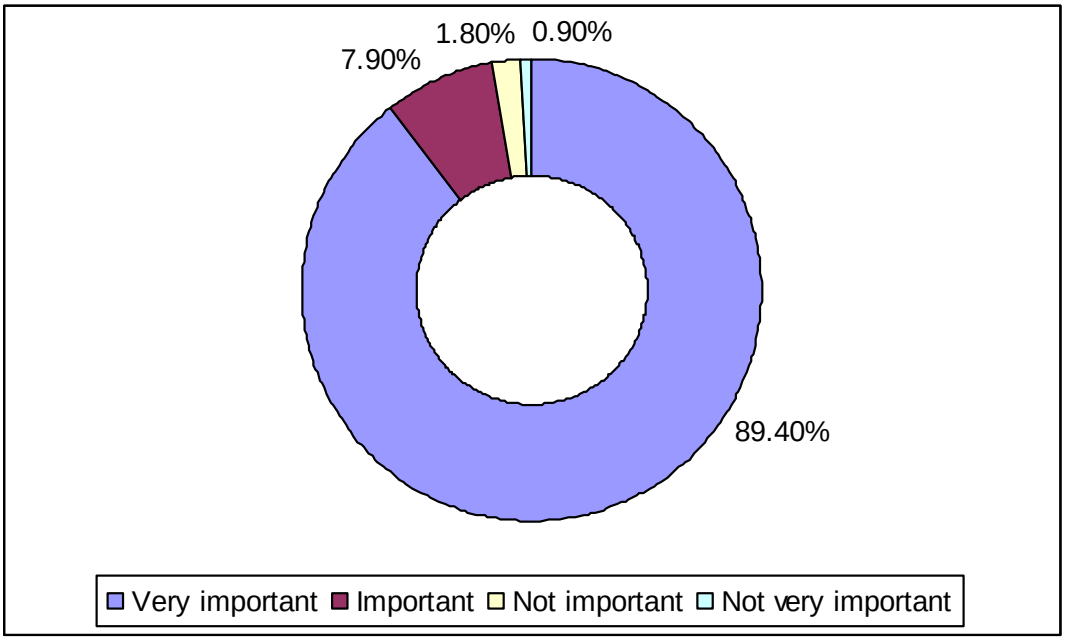
Figure 6: Distribution of eye health seeking behaviour of pupils caregivers



5:6 THE PUPILS' PARENTS' VIEWS ABOUT GOOD EYESIGHT (NORMAL VISION)

The views of 1174 of 1393 (84.20%) pupils' parents about good eyesight were as follow: very important, 1049 (89.40%); important, 93 (7.90%); not important, 21 (1.80%) and not very important, 11 (0.90%) (Figure 7).

Figure 7: Views of pupils' parents about good eyesight (normal vision)



5:7 PUPILS' CAREGIVERS AWARENESS OF AVAILABILITY OF EYE CARE SPECIALISTS

The degree of awareness of one thousand one hundred and ninety two of 1393 (85.50%) pupils' parents about availability of eye care specialists in Ilorin was as follows: the majority 1048 (87.90%) of the parents were aware of the availability of eye care specialists should their services be required. However, 144 (12.10%) of the parents were unaware of them.

5:8 THE OCULAR CONDITIONS AMONG PUPILS' FAMILY MEMBERS

The ocular conditions among 306 of 1393 (220%) pupils' family members included: refractive error, 116 (37.90%); ocular itching, 88 (28.80%); cataract, 38 (12.40%); glaucoma, 29 (9.50%); squint, 12 (3.90%) and Apollo (acute haemorrhagic conjunctivitis), 8 (2.60%). Others were ocular redness, 6 (2.00%); ocular pain, 8 (2.60%) and photophobia, 1 (0.30%).

5:11 THE PUPILS' PARENTS' SOCIO-ECONOMIC CLASS

The socio-economic class distribution of pupils' parents is shown in table 8. There was statistical significant difference between the fathers' and mothers' socio-economic class (p = 0.00).

Table 8: Socio-economic class distribution of pupils' parents.

Socio-economic class	Father	Mother
Low	499 (35.8)	947 (68.0)
Medium	720 (51.7)	335 (24.1)
High	103 (7.4)	16 (1.1)
Unascertainable	71 (5.1)	95 (6.8)
Total	1393 (100.0)	1393 (100.0)

CHAPTER SIX

DISCUSSION

The findings from this study are similar to previous studies[12, 13, 26, 38, 48] of eye health among pupils in many respects. The two most common ocular disorders of refractive error and vernal conjunctivitis among pupils in Nigeria were the same in this study as well. Refractive error was found to be more common than vernal conjunctivitis in this study, this is similar to studies by Onyekwe[38], Nkanga[84], and Ologban.[80] However, Balogun[48], Ugochukwu[13] and Isawumi[12] reported vernal conjunctivitis to be more common than refractive error. Another similarity between this study and other previous ones on eye health of pupils in Nigeria was the fact that causes of visual impairment and blindness were mostly avoidable. These include refractive error, ocular trauma, amblyopia, past measles infection, oculocutaneous albinism, optic atrophy and presumed ocular toxoplasmosis.

The scope of children eye health in this study is enriched by additional information sought. These included pupils' parents' perception of good ocular health (normal vision), the pupils' caregivers awareness of availability of eye care specialists in Ilorin, the health seeking behaviour of pupils' caregivers, information on eye diseases among pupils' close family members and pupils' parents' socio-economic class.

The prevalence rate of ocular disorders of 19.9% found among pupils in this study compares favourably well with previous similar school studies: Yoloye[112] (Ibadan), 14.4%; Onyekwe[38] (Jos), 19.3%; Balogun[48] (Lagos), 21%;

Ugochukwu[13] (Nkanu west - Enugu), 12.32% and Isawumi[12] (Ilesa - Osun), 15.47%. The similarity and difference in the prevalence of previous studies and this present study might be related to the geographical location of the study, variation in definition used and time of the study. It appeared that school studies from cosmopolitan Nigerian cities had similar but high prevalence pattern: Jos [38], 19.3%; Lagos[48], 21%; Ilorin (present study), 19.9% while studies from rural-urban Nigerian towns had similar but lower prevalence pattern: Nkanu-West[13], 12.32% and Ilesa[12], 15.47%. However, the prevalence rate of 14.4% as Yoloye[112] found in Ibadan being also, a cosmopolitan Nigerian capital city appeared not to follow the above trend but the study apart from being the oldest in the quoted series might have been conducted among indigenous rural-urban school pupils in Ibadan.

There was nearly equal gender representation in the study population. This study showed statistically significant difference between socio-economic classes of the fathers and mothers ($p = 0.00$).

The most common eye complaints among the schoolchildren in Ilorin such as ocular pains, ocular itching and redness of the eyes correlated with the most common ocular disorders of refractive errors and vernal conjunctivitis found in this study. Other ocular complaints such as eye discharge, poor vision, photophobia, and lacrimation and eye trauma also were in agreement with ocular disorders reported in this study.

It is gratifying that most families of the studied pupils attended the hospital for their eye diseases. This was expected as most parents agreed that

good eyesight (normal vision) was very important and were also aware of availability of the eye care specialists in Ilorin. However, some parents thought good eyesight (normal vision) was not very important and were unaware of availability of eye care specialists in Ilorin. This could explain why some families treated eye diseases with traditional medicine, some practiced self medication and some never bothered to treat their eye diseases. This category of parents however, small in number but constituted important group because of their negative attitudes toward ocular health which need to be positively influenced. Some of these practices had been reported to cause visual impairment and blindness. Osahon previously reported the harmful practice of local concoction instillation into the eye of convulsing children in Benin City.[122] The harmful traditional eye medication as previously documented by Yorston affects the eye by causing chemical burns and / or by introducing pathogenic organisms which can worsen and / or initiate ocular insult.[67] Chirambo and Ben-Ezra had previously reported that one-quarter of blindness in Malawi school for the blind were traceable to harmful traditional eye medication.[30] Morgan also reported the contribution of harmful traditional eye medication to childhood blindness in Jos.[36]

Self medication on the other hand can worsen the visual outcome of salvageable eye conditions. This is of particular importance in steroid abuse in conditions such as microbial keratitis and glaucoma among others. Steroid abuse in self medication can lead to poor vision in vernal conjunctivitis.[13] The category of the pupils' families who preferred not to treat their ocular ailments

may end up blind from treatable blinding eye diseases. They need to have ocular health education. Although the literacy level of these families was unknown however, Olurin previously noted and attributed poor ocular awareness among Nigerians to the high percentage of illiteracy in the adult population.[123]

Refractive error, the most common ocular morbidity found in this study had been previously reported as a significant cause of ocular morbidity among school age children in Nigeria[12, 13, 27, 38, 48] and elsewhere[74-78]. The prevalence rate of 6.9% in this study is comparable to previous similar studies: Balogun[48], 8.7%; Isawumi[12], 5.8%; Okosa[47], 8.7%; Ugochukwu[13], 4.2% and Onyekwe[38], 10.5%. Elsewhere, about 1% of Cambodian[43] school children had refractive error and in Botswana[44], 1.5% of school children aged 5-15 years had VA of < 6/18 due to refractive error.

It appeared that there was higher prevalence of refractive error in this study and other urban-based studies[38, 47, 48] of Nigerian school children compared to their rural[12, 13] counterparts as reported among Indian[74, 75], Taiwan[76], Tibetian[77], and Oman[78] children. This probably may be related to increased use of the eyes for close work among urban school children than their rural counterparts as environmental factors had been documented to be risk factors for myopia.[81] There was positive family history of refractive error in 8.3% of the studied pupils and this agrees with a previous report.[81] As found in this study, refractive error is not only a cause of ocular discomfort, photophobia

and lacrimation but a significant cause of visual impairment and blindness and had been widely reported.[12, 13, 38, 47, 48, 74-78, 79]

In this study, the pupils with refractive error had nearly equal sex distribution with slight male preponderance which is in contrast to clear female preponderance in similar study among primary and secondary pupils / students in Ilesa.[12]

Poor eyesight due to uncorrected refractive errors as found in this study could have a negative impact on academic and professional achievement, and it increases the likelihood of trauma and social isolation.[27] Poor vision and inability to read materials written on the black board as found in 15.6% of pupils with refractive error in this study can have a serious impact on a child's participation and learning in class and this can adversely affect the child's education, occupation and socio-economic status for life.[82] Various studies in Nigeria and Britain showed that vision screening as in this study help in early detection of uncorrected refractive error.[26, 82, 83, 84]

The assistance of trained volunteer teachers in determining VA for the pupils is appropriate utilization of available resources at minimal or no cost (a form of appropriate technology) without compromising validity of VA test as they were under close supervision of the author. However, Abubakar and Ajaiyeoba previously reported that trained school teachers in Kaduna achieved a sensitivity and specificity of 78.3% and 92.1% respectively in carrying out VA test on school pupils.[28] In Tanzania similar study compares favourably well with Kaduna study as Wedner and associates found that trained school teachers

when engaged as vision screener of pupils with bilateral visual impairment achieved a sensitivity and specificity of 80% and 91% respectively.[56] These sets of trained volunteer teachers could be useful in screening pupils with refractive errors in their respective schools and refer appropriately.

The pin hole test as used as a screening criterion for refractive error in this work is not only appropriate technology but simple, basic and rapid. It is not only being used routinely in eye clinics but has been used in school eye surveys by previous workers such as Nkanga and Dolin[84], Ugochukwu[13] and Isawumi[12]. The use of VA of $\leq$ 6/9 which improved with pin hole test to define refractive errors in this study agrees with definitions used by Nkanga and Dolin[84] (VA < 6/6), Isawumi[12] (VA < 6/6), Faderin and Ajaiyeoba[26] (VA < 6/9) and Balogun[48] (VA <6/12). However, Nkanga and Dolin reported among primary school pupils in Enugu that VA of < 6/6 had a sensitivity, specificity, and positive predictive value of 83.3%, 69.4%, and 36.4%, respectively.[84] On the other hand using VA of < 6/9 in the better eye was found to be more specific (95.2%) and had better predictive value (67.6%). However, it compromised sensitivity (47.9%).[84]

The default of 47% of 96 pupils referred for refraction in the eye clinic of University of Ilorin Teaching Hospital may be related to lack of awareness of pupils' parents on the importance of the refractive error to ocular health. However, the reason(s) for this high default may be a subject of another study.

Vernal conjunctivitis was next and close to refractive error in magnitude with the number of affected boys almost doubling that of girls. The male

preponderance found in this study was in consonance with separate previous works by Abiose[57], Majekodunmi[58], Nwosu[29], and Dahan[59]. Recurrent ocular itching was the most constant complaint among the pupils with vernal conjunctivitis. Nwosu in his study reported this.[29] Usually vernal conjunctivitis does not cause visual impairment as noted in this study but may rarely lead to blindness as reported in separate studies by Hall and Shillo[62] as well as Mohammed[46]. About one fifth of the pupils studied had family history of ocular itching and this may suggest possible atopy among family members as previously reported by Akinsola.[45] However, this had been reported to be uncommon among Africans.[57]

The prevalence of congenital defective colour vision of 1.2% in this study (with a male to female ratio of 1:1) compares with such previous studies across Nigeria: Jos[38], 3.9%; Lagos[48], 0.1%; Anambra[29], 0.4% and elsewhere: Desai et al[64] 2.9% and Swansen and Everett[109] 1.9%. However, the gender distribution was not available in the above-quoted Nigerian studies for comparison with present study. This not withstanding, reports elsewhere had shown that 7-8% of males and 0.5% of females had congenital colour defect.[105-107,109, 110] The gender equality of colour vision defect as observed in this study which differed from already established value could not be accounted for by possible false positive values alone as the test had to be painstakingly repeated in doubtful cases. In addition, possible false positive from acquired colour vision defects especially among girls may be far from the truth as Ishiara colour plates (used in this work) test for congenital colour

defect however; sample size may be too small for any valid conclusion on gender distribution. Therefore, for reference value on colour vision defect in this locality there may be need to conduct a large scale survey using Ishiara colour plates and other instruments such as Farnsworth-Munsell 100 hue colour test for comparison as done elsewhere.[109, 110]

The five pupils with strabismus had normal vision as all had alternating type of either eso or exodeviation, which is not usually associated with visual impairment. However, it may have serious cosmetic implications such as jest making among playmates or inability to get suitable life partners later in life. The pupils were referred to Ophthalmologist for appropriate management. Almost one-half of the pupils who had strabismus also had history of ocular deviation in their mothers. This may suggest possible genetic transmission in this cohort of pupils. The mild blepharoptosis found among 4 pupils was not associated with visual impairment but could be of cosmetic importance as in pupils who had strabismus.

The amblyopia detected among some pupils underscores the need for periodic routine school screening in this environment so as to detect and manage potential amblyogenic factors such as refractive errors, anisometropia, strabismus and media opacity among others very early when amblyopia could be reversed.[12, 13, 48, 114, 115] Amblyopia may not be as difficult to treat as to convince both the pupils and parents to comply with management regimen. This identified set of pupils with amblyopia may have to live with this disability for the remaining period of their lives.

Two of the 3 pupils with glaucoma were referred to the eye clinic of the University of Ilorin Teaching Hospital for management. However, they failed to report in the hospital despite the proper information (on glaucoma) given to the pupils and their parents, and teachers inclusive. The third pupil had been receiving treatment in the teaching hospital even before this study. The parents of the pupils who were glaucoma suspects and the affected pupils were advised about the need to be properly followed up in the eye clinic of University of Ilorin Teaching Hospital, as this would ensure early detection / treatment in order to preserve vision. In addition, this can be of predictive value by knowing how many of them would eventually develop glaucoma and within how many years. Glaucoma is better diagnosed very early in order to be able to save or preserve sight hence the need for regular eye test in this category of pupils before the signs of damage become so obvious and irreversible.[123] Controlling blindness from glaucoma requires early detection, life-long treatment and compliance of the patients.[124] The parents of pupils with glaucoma / glaucoma suspect were advised to take all first degree relatives to the pupils for ophthalmic assessment in the eye clinic of University of Ilorin Teaching Hospital for early glaucoma case detection.

Presumed congenital ocular toxoplasmosis and measles were two preventable infective causes of loss of vision in this work. It was quite unfortunate that toxoplasmosis and measles, which could have been prevented by good hygiene[125] and immunization respectively, cost some pupils their vision. Toxoplasmosis was responsible for 1 out of 2 cases of bilateral

blindness found in this study and accounted for 3.3% of total causes of visual impairment and blindness. Earlier studies reported toxoplasmosis among Nigeria children: Majekodunmi[126] in 1987 reported toxoplasmosis as the commonest cause of uveitis in Nigerian children, Mohammed[46] in 1997 reported 2 cases among children in Kaduna and Ugochukwu[13] reported a case of presumed toxoplasmosis in Nkanu area of Enugu state with associated visual impairment.

Measles accounted for 6.7% of the total causes of visual impairment and blindness in this study and represented 33.3% of total causes of unilateral blindness. Healed measles keratitis resulting to corneal scar and leading to blindness as found in this study is a problem that had been previously reported among school age children by Olurin[127], Faal[65], Dawodu and Ejegi[88], Yorston[67], Morgan[36] and Onyekwe.[38] The measles related blindness as observed among pupils might be a reflection of failed health care delivery system at governmental and service levels as well as ignorance on the part of the parent. The persistence of measles related ocular pathology in this environment may be due to inadequate immunisation coverage of children population against measles as theoretical herd immunity of 92-95% is yet to be achieved in Nigeria compared to elsewhere.[70, 128] The government must ensure adequate provision of measles vaccines as well as adequate coverage of the children population. There should be continuous medical education for medical personnel and legislation on minimum standard for establishing and running of health facility should be enforced as well as regular monitoring for compliance

with standard practice. There should be continuous and regular enlightenment of the public on importance of immunization and where to seek medical help.

The associated features on ocular trauma such as male preponderance, majority of trauma occurring at unsupervised play, corporal punishment and during fight in this work agree with most other previous works despite low prevalence rate of 0.8% in this study compared to high prevalence rate in Enugu[97] 35%, Ile-Ife[101] 31.6%, Kaduna[96] 13.4%. The observed difference in prevalence may be related to the fact that reports from Enugu[97], Ile- Ife[101] and Kaduna[96] were hospital based. As also found in this work Ugochukwu[13] in Enugu and Onyekwe[38] in Jos reported 1 and 2 cases respectively of phthisis bulbi resulting from trauma among school children.

Couching used to be an ancient method of treatment for cataract but still being practiced by some traditional healers especially in northern Nigeria[129, 130] and elsewhere[131] is associated with complications usually leading to vision loss as found in this work. Mahmoud reported direct observation of couching performed by two traditional couchers in northern Nigeria and adjudged the procedure as unsafe alternative to modern cataract surgery.[129] Couching is still thriving in developing parts of the world especially Nigeria because of many factors. However, ignorance and poverty had been documented albeit in adult in Ilorin[130] and elsewhere.[131] Couching as found performed on a pupil in this work was not only deplorable but a disturbing development. This has underscored the need to put effective measures in place to reduce/eradicate couching. These measures may include a potent legislation

to outlaw the practice, occupationally rehabilitating the existing couchers, improving our cataract surgical rate and outcome[129] and addressing the lopsidedness in distribution of trained ophthalmic personnel[129]. Others include making health services affordable to all by making health a social service, regular public enlightenment campaign on couching as a cause of blindness, and peoples' positive attitude toward ocular health. Couching as found in this study has also underscored the painful outcome of the family who use traditional way to treat their ocular diseases as already noted in this work.

Oculocutaneous albinism and maculopathy were two unavoidable causes of loss of vision and accounted for 6.7% and 3.3% respectively of causes of visual impairment and blindness in this work. Ugochukwu[13] reported a case of oculocutaneous albinism with VA of < 3/60 and Onyekwe[38] reported 2 cases with visual impairment in Jos.

Sickle cell retinopathy is a potentially visual impairing and blinding condition as noted in this work and has been previously reported among school age children.[104, 132] Sickle cell retinopathy can be prevented through genetic counseling as sickle cell disease, which is necessary for its manifestation has Mendelian mode of inheritance.

There were no cases of ocular tumour, trachoma, vitamin A deficiency and cataract among the studied pupils. Childhood ocular tumours exist and had actually been reported in Ilorin.[102] However the absence of trachoma may be related to good environmental and personal hygiene while vitamin A deficiency is not only uncommon in the studied age group but may also be related to the

success of incorporating vitamin A supplement into our National Programme on Immunisation (NPI). Although cataract is not observed in this work, it exists among children as been observed in the eye clinic of University of Ilorin Teaching Hospital (UITH), Ilorin. Elsewhere across Nigeria cataract had been reported in ocular surveys among children.[12, 29, 36, 45]

It is remarkable that general apathy on children ocular health was observed among many parents whose children had ocular pathology. This could be observed from their failure to report in the hospital as referred. Also, the post survey period of this study coincided with the time Kwara State Eye Care Programme in collaboration with department of Ophthalmology, UITH was recruiting patients with ocular pathology such as corneal opacity and strabismus among others toward Orbis International free eye surgery later in the year (August 28 - September 4) 2006. However, there was poor response from parents of some already identified pupils with cornea opacity and strabismus who might have benefited, author's efforts notwithstanding. Hence, this among others, underscores the need for vigorous public ocular health awareness campaign among parents in Ilorin.

There were a number of limiting factors that arose in the course of this study however; efforts were made to ensure a reliable survey. These factors included:

1. Inability to carry out refraction for pupils with refractive error in their schools as only about 53% of pupils referred for refraction at the University of Ilorin Teaching Hospital eventually reported (47% defaulted).

2. Lack of fundal camera to take photograph of some detected posterior segment lesions.
3. Failure of some parents / pupils to co-operate with survey plan such as giving consent and honouring referral letter.
4. The period of survey was limited mainly to school hours and this prolonged the study period.
5. Non availability of other colour vision test instruments for comparison with the Ishiara colour plates.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7:1 CONCLUSIONS

The two most common ocular disorders among pupils in Ilorin were refractive error and vernal conjunctivitis. Parents of most pupils had positive attitude towards ocular health in children. However, some parents had negative attitude towards pupils' ocular health and constitute a very important group whose orientation should be positively changed. The observed general apathy of parents in bringing identified pupils with ocular pathologies for management in the teaching hospital is a source of concern and should be of research interest. The parents of the pupils who had treatable but potential blinding ocular conditions such as glaucoma should urgently get such pupils treated. Pupils who were glaucoma suspects should be followed up in ophthalmic clinics by Ophthalmologists. A detailed work on colour vision defects among pupils in this environment to compliment the findings in this work is suggested. Measures that will eradicate couching as a form of treatment for cataract should be put in place. It is regrettable that measles infections still contribute to childhood blindness in Ilorin in the year 2006.

The majority of the causes of visual impairment and blindness were avoidable. Of the total causes, avoidable accounted for almost nine-tenth and unavoidable causes being about one-tenth in this work. The sheer magnitude of avoidable causes of visual impairment and blindness as well as the implications on the life of affected children and national growth underscores the importance of a study like this, which could be of immense benefit in planning

interventional measures for management of visual impairment and blindness among pupils.

7:2 RECOMMENDATIONS

The following recommendations would assist to promote ocular health and thus reduce the burden of visual impairment and blindness among pupils in Ilorin.

1. Effective school eye health programme should be established in primary schools. This should be manned by qualified nurses with bias for school pupils' health. The nurses would screen pupils, manage appropriate cases and refer complex cases to the specialist.
2. There is the need to provide necessary resources such as teachers with bias in blind education and teaching aids for the blind children in conventional schools not necessarily having them transferred to schools for the blind as this is cheaper and encourages social integration.
3. Low visual aids may be found useful by some of the pupils with low vision from conditions such as oculocutaneous albinism, maculopathy, optic atrophy and amblyopia. Effective low vision services should be established at the University of Ilorin Teaching Hospital and the Kwara State Eye Care Programme for easy access of pupils in Ilorin.
4. Eye screening programmes for school children should be part of our school curriculum and enforced. The screening should be coordinated by Kwara State Eye Care Programme and assisted by schoolteachers.
5. Government should ensure availability of vitamin A supplement and potent vaccines against vaccine preventable childhood diseases

including vitamin A deficiency and measles under the aegis of National Programme on Immunisation (NPI). Adequate coverage of children population (about 95% coverage to ensure theoretical herd immunity) should not be compromised.

6. There is the need for public enlightenment on the importance of children ocular health in Ilorin especially among parents. This can be done by Ophthalmologist / trainee Ophthalmologist through talk on radio / television. This should be focused on prevention of sickle cell disease, ocular trauma in children, vaccine preventable childhood diseases including measles and the need to get ocular conditions among pupils managed by the eye specialists.

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APPENDIX I

PARENT INFORMATION LETTER

Department of Ophthalmology,
University of Ilorin Teaching Hospital,
Ilorin.

29th June 2005.

Dear Parent/Guardian,

Greetings to you and your family.

Some school children may have eye diseases that could eventually lead to loss of sight and the diseases are not yet known to the children and parents alike. These eye diseases can be detected by an eye examination conducted by an eye care specialist. This informs my decision to carry out this study on a randomly selected number of primary school pupils within Ilorin metropolis. The findings from this study will be useful in planning eye care programme that may assist in preventing blindness among children.

Risks: The eye test will not be harmful or injurious to the children eyes.

Benefits: 1.The test will be free of charge to the children. 2. Vision threatening eye condition if detected will be communicated to the concerned parents. 3. Free Medical prescription will be given where indicated. 4. Referral to appropriate eye care centre will be made when indicated.

Confidentiality: The outcome of the test will be kept confidential.

Participation: This is voluntary and contingent on parent approval

Withdrawal: It will be possible to withdraw your child from the study if you desire.

Your child/ward has been selected out of many school pupils for the study but I will need your prior approval for your child/ward to participate. Kindly fill the consent section of the proforma form sent through your child along with this letter to indicate your informed consent. I shall also appreciate your filling of the sections on your child socio-demographic data and information on eye health of your child/ward.

Kindly return through your child/ward the filled proforma form as quickly as possible

Thanks for your support and God bless.

Dr. A.A. Ayanniyi
(Senior Registrar, Ophthalmology).

APPENDIX II

CONSENT

Having been properly informed and understood the nature of this study on ocular health status of primary school children in Ilorin, I (name of parent/guardian) ---------- ---------- hereby give my informed consent for my child /ward (name of child /ward) ---------- ---------- to participate in the study titled ***Ocular health status of primary school children in Ilorin*** being conducted by Dr. A.A. Ayanniyi.

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

Signature or Thumbprint (Parent/Guardian) Date

APPENDIX II (Continued)

PROFORMA

SOCIO-DEMOGRAPHIC DATA OF THE CHILD

1. Name of the school ……..……...

2. Class ……..……..……..…….

3 Age…….……...……..…….....

4. Sex…….…….……..

5. State of Origin…….……..…….

6 Ethnicity …….……...……

7. Religion…….…….

8. Father's occupation ……...

9. Mother's occupation ……...…….

Tick as appropriate in (10) below

10. Whom does the child stay with?

(a) Both parents [ ]

(b) Mother only [ ]

(c) Father only [ ]

(d) Relation (specify)….…….

APPENDIX II (Contd.)

INFORMATION ABOUT THE EYE HEALTH OF THE CHILD (IF ANY)

1. Kindly tick eye complaints your child used to have (if any)

   (a) Cannot see well [ ]

   (b) Pain in the eyes (with or without headache) [ ]

   (c) Itching of the eyes [ ]

   (d) Redness of the eye [ ]

   (e) Discharge from the eyes [ ]

   (f) Excessive watering from eyes [ ]

   (g) Pain in the eyes on looking at light [ ]

   (h) Others (please specify)……

2. Kindly tick one thing you usually do when any member of your family has eye disease.

   (a) We treat with native medicine [ ]

   (b) We don't apply any treatment [ ]

   (c) We go to the hospital for treatment [ ]

   (d) We buy drugs from medicine store and apply it [ ]

3. Kindly indicate your view on the importance of good eyesight (normal vision) in children.

   (a) Very important [ ]

   (b) Important [ ]

   (c) Not important [ ]

   (d) Not very important [ ]

4. Kindly tick any eye disease that any member of your family has.

(If any)

(a) Glaucoma [ ]

(b) Recurrent eye itching (with or without asthma) [ ]

(c) Cataract [ ]

(d) Refractive error (use glasses to see and or read) [ ]

(e) Eye deviation (eyes are not straight) [ ]

(f) Others (please specify)……

5. What is the relationship of the family member in 4 above to the child?

(a) Father [ ]

(b) Mother [ ]

(c) Brother [ ]

(d) Sister [ ]

(e) Grandfather [ ]

(f) Grandmother [ ]

(g) Others (please specify)……

6 Are you aware that there are eye care specialists in Ilorin in case you need their help?

(a) Yes

(b) No

APPENDIX III

BRIEF HISTORY RELEVANT TO OCULAR CONDITION IN PUPIL (WHERE NECESSARY)

……..

……..

……..

……..

……..

……..

OCCULAR EXAMINATION

1. VISUAL ACUTY (VA)

	RE	LE
UNAIDED	☐	☐
PIN HOLE	☐	☐
AIDED	☐	☐

2. COLOUR VISION (ISHIARA CHART)

	RE	LE
Number of plates failed	[ ]	[ ]

3. EYELIDS

		RE	LE
1.	Normal	[ ]	[ ]
2.	Ptosis	[ ]	[ ]
3.	Style	[ ]	[ ]
4.	Chalazion	[ ]	[ ]

			RE	LE
	5.	Blepharitis	[ ]	[ ]
	6.	Others (specify)	[ ]	[ ]
4.	**OCULAR MUSCLE BALANCE**			
		(State type)	[ ]	[ ]
5.	**CONJUNCTIVAL**			
	1.	Normal	[ ]	[ ]
	2.	Vernal Conjunctivitis		
		Limbal	[ ]	[ ]
		Palpebra	[ ]	[ ]
	3.	Infective conjunctivitis	[ ]	[ ]
	4.	Pseudopterygium.	[ ]	[ ]
	5.	Subconjunctival haemorrhage	[ ]	[ ]
	6.	Xerosis	[ ]	[ ]
	7.	Others (specify)	[ ]	[ ]
6.	**CORNEA**			
	1.	Normal	[ ]	[ ]
	2.	Opacity	[ ]	[ ]
	3.	Ulcer	[ ]	[ ]
	4.	Foreign body	[ ]	[ ]
	5.	Laceration	[ ]	[ ]
	6.	Others (Specify)	[ ]	[ ]

			RE	LE
7.	**ANTERIOR CHAMBER**			
	1.	Normal	[ ]	[ ]
	2.	Shallow	[ ]	[ ]
	3.	Very deep	[ ]	[ ]
	4.	Hyphema	[ ]	[ ]
	5.	Hypopion	[ ]	[ ]
	6.	Others (specify)	[ ]	[ ]
8.	**PUPIL / IRIS**			
	1.	Normal	[ ]	[ ]
	2.	Miosed	[ ]	[ ]
	3.	Dilated	[ ]	[ ]
	4.	APD	[ ]	[ ]
	5.	Synechiae	[ ]	[ ]
	6.	Others (specify)	[ ]	[ ]
9.	**DIRECT OPHTHALMOSCOPY.**			
	(a).	OPTIC DISC		
		i. Normal	[ ]	[ ]
		ii. Cupped	[ ]	[ ]
		iii. Pallor	[ ]	[ ]
		iv. Hypoplasia	[ ]	[ ]
		v. Oedematous	[ ]	[ ]
		vi. Others (specify)	[ ]	[ ]

	RE	LE
(b). RETINAL DISEASE		
(State type)	[ ]	[ ]
10. INTRAOCULAR PRESSURE.		
11. DIAGNOSIS		

APPENDIX IV

REFERRAL LETTER

OCULAR HEALTH STATUS OF PRIMARY SCHOOL CHILDREN IN ILORIN

Date …….……

Consultant Ophthalmologist,
UITH,
Ilorin.

Dear Sir / Madam,

Re:……

The above named pupil of……..primary school was found to have…….. during a school eye survey and would need specialist care. Kindly take over the management.

Thanks for your anticipated co-operation.

Dr A.A. Ayanniyi
Senior Registrar
Department of Ophthalmology,
UITH, Ilorin.