PATTERN OF PRESENTATION OF STRABISMUS AMONG PATIENTS OF THE EYE CLINIC OF UNIVERSITY COLLEGE HOSPITAL (UCH), IBADAN.

BY

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A dissertation in the Department of Epidemiology, Medical statistics and Environmental health,

Submitted to the Faculty of Public Health

in partial fulfillment of the requirements for the Degree of

M.Sc. EPIDEMIOLOGY & BIOSTATISTICS

of the

UNIVERSITY OF IBADAN

APRIL 2010

CERTIFICATION

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DEDICATION

This dissertation is dedicated to the Almighty God, my teachers, my parents and my family.

ACKNOWLEDGEMENTS

I glorify the Almighty God, my Lord and my Saviour for His enduring mercy and limitless grace that enabled me to start and complete this dissertation.

I am eternally grateful to my supervisors Professor O. Ayeni and Dr. O.I. Fawole for their assistance, constructive criticisms and professional guidance during the conduct of this dissertation.

I am thankful to all my other lecturers in the Department of EMSEH for imparting knowledge to me in various ways, especially: Dr B. Adedokun, Dr M. Dairo, Dr A. Fatiregun, Dr (Mrs) I. O. Ajayi, Dr (Mrs) O.B. Yusuf, Dr L.V. Adekunkle, Dr Amahia, Dr Adebowale, Mr Akinyemi, Mr Fabgamigbe, Mr Aduroja, and Mr Afolabi.

I also acknowledge my teachers and senior colleagues in the Department of Ophthalmology, Dr. A.O. Ashaye, Head of Department; Professor A.M. Baiyeroju; Professor A.I. Ajaiyeoba; Dr C.O. Bekibele; Dr T.S. Oluleye; Dr O. Fasina; Dr A.O. Ogundipe and Dr O.O. Ogun for their advice and support throughout the period of my pursuit of this Masters degree.

I am very grateful to the members of staff of the Medical Records unit of the Eye Clinic of the University College Hospital for their assistance with the retrieval of case records of the patients included in this study. I am particularly grateful to Mr Iyiola, Mr Iwasokun and Mrs Ogunlabi. I am indebted to Dr Obioma Uchendu, Dr Adebayo and Dr Popoola for their assistance and encouragement during the Masters programme and particularly during the writing up of this dissertation. My gratitude also goes to Mr Tony, Mr Akindele, Mrs Osunsola and all the non teaching staff of the Department of EMSEH.

I give special thanks to the resident doctors in Ophthalmology department who assisted with some of my clinical and teaching responsibilities during the Masters programme.

I also thank my parents, Dr. and Mrs S.K. Olusanya, and my siblings, Ope and Moyo.

Finally, I appreciate my beautiful darling wife Adeola, and my son, Tife, for their unconditional love and support during this study and indeed all through my quest for the M.Sc degree.

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ABSTRACT

Background: Strabismus is a misalignment of the visual axes of the eyes which results from deviation of one or both eyes. It has a worldwide distribution and is relatively common in children. Strabismus is a disorder of public health significance because of its psychosocial impact and negative social prejudice. However, there is paucity of information on the prevalence of the different types of strabismus and treatment outcome in Nigerian patients.

Objective: To determine the pattern of presentation of strabismus among new patients of the Eye Clinic, University College Hospital (UCH) Ibadan, Nigeria between January 1999 and December 2008.

Methods: This was a retrospective cross-sectional study with both descriptive and analytical components. The study was conducted on patients who presented for the first time to the Eye Clinic of UCH, Ibadan between 1999 and 2008. Patients with a diagnosis of strabismus were identified from the clinic registers and their case records were retrieved. Information on age, sex, cause and type of squint, associated ocular disease, treatment given, outcome of treatment as well as duration of follow up was collected and analysed with the use of SPSS 16. Analysis was considered to show significant association when the p value was less than 0.05

Results: A total of 240 patients had strabismus, giving a prevalence of 1.2%. Mean age of strabismus patients was 19.8 (±19.7) years while male to female ratio was 0.98:1. Esotropia occurred in 53.8% of patients while 44.2% had exotropia. The mean age of patients with esotropia was 12.8 years compared with 27.9 years for patients with exotropia. ($p<0.001$). About 72% of the patients had secondary strabismus and commonest cause of secondary strabismus was cataract in 29%. Sensory strabismus was the commonest subtype of strabismus, occurring in 83 (34.5%) patients; while accommodative esotropia was found in 5.8% patients. With regard to treatment 25.4% of patients were prescribed spectacles, two (0.8%) patients had strabismus surgery, while 65.4% of patients did not receive any active treatment. Only 49.6% of the patients kept follow up appointments. Majority (64.7%) of them did not have any realignment of the eyes (unfavourable outcome) at follow up. A favourable outcome was more likely in patients with secondary strabismus ($p=0.005$) and among those who received active treatment ($p=0.003$).

Conclusion: The prevalence of strabismus in this study is fairly similar to other reports from Nigeria and Africa. Strabismus prevalence is lower in Africans compared to Caucasians. Esotropia was more common than exotropia and majority of patients had secondary strabismus.

Sensory strabismus was the commonest subtype of strabismus while accommodative esotropia appears to occur less commonly when compared to Caucasians. A larger proportion of the patients did not receive any active treatment for strabismus and strabismus surgery was performed infrequently. The follow up rate was suboptimal and outcome of treatment was favourable in less than half of the patients studied. Secondary strabismus and receiving some form of treatment were associated with a better outcome. There is a need for more ophthalmologists in UCH Ibadan to undergo subspecialty training in the evaluation and management of strabismus.

Key words: Strabismus, Prevalence, Esotropia, Exotropia, Ibadan.

CHAPTER ONE

INTRODUCTION

Strabismus is defined as a misalignment of the visual axes of the eyes which results from deviation of one or both eyes (Kanski, 2003). A misalignment of the visual axes of two eyes occurs when both eyes are not looking in the same direction or at the same object. Normally, the two eyes of an individual are well aligned so that the foveas (the central and most sensitive portion of the retina) are aimed at the same visual target. In strabismus, however, this alignment is disrupted such that the two eyes have different objects of regard. Another term for this misalignment is "squint". This term comes from the fact that people with strabismus often squint one eye to block out one of the two images that they see. The word, strabismus, originates from the Greek word "streblos" which means "turned" or "twisted"(Hirschberg, 1982). Hippocrates, the father of medicine, first used the word around 400BC (von Noorden and Campos, 2002).

Strabismus has a worldwide distribution and has been studied in various populations (Robaei et al., 2006). It is a relatively common disorder among Caucasian children and afflicts about 3-4% of them (Mohney, 2007). Studies in Asian populations reveal a lower prevalence between 0.7 and 1.9% (Dandona et al., 2002; Goh et al., 2005; Matsuo and Matsuo, 2005). The prevalence in Africans is reported to be 0.2- 1.3% (Wedner et al., 2000; Naidoo et al., 2003; Ntim-Amponsah and Ofosu-Amaah, 2007). In Nigeria, prevalence of strabismus ranges between 0.3 and 1.3% in different populations (Ogwurike and Pam, 2004; Adegbehingbe et al., 2006; Ajaiyeoba et al., 2007; Azonobi et al., 2008). A previous study from Ibadan reported a prevalence of 0.4% over a five year period (1992-1996) among patients presenting to the Eye Clinic of the University College Hospital (UCH), Ibadan (Baiyeroju- Agbeja and Owoeye, 1998).

Under normal circumstances, when both eyes have good vision and they are aligned properly, they focus on the same object. Each of the eyes sends a picture of the same object, viewed from a slightly different angle. When these two images reach the brain, they are fused to form a single three-dimensional picture with an added perception of depth. This is known as *binocular single vision*. However, in strabismus, when the eyes are not properly aligned, each eye focuses on a different object and sends a different picture to the brain (Kanski, 2003). This results in:

(a) *Visual confusion*: a situation in which two objects appear to occupy the same position in the individual's visual field and,

(b) *Diplopia*: a condition in which an individual perceives two images of one object. This is also referred to as *double vision*.

These two phenomena result in a disruption of binocular single vision and can be very annoying, interfering with work as well as other daily activities. Therefore, in an attempt to limit the incapacitation associated with visual confusion and diplopia, certain adaptations have evolved in individuals with strabismus. An example of these adaptations is *suppression*, a mechanism in which the brain actively inhibits (suppresses) the image from the deviating eye. This usually occurs in children and can lead to the development of *amblyopia* in the eye whose image is suppressed. Amblyopia is a decrease in the best-corrected visual acuity in an eye that is structurally normal and is devoid of any organic pathology which can explain the poor vision (Kanski, 2003).

Another adaptation is the adoption of an abnormal head posture (Kanski, 2003). This often occurs in adults or older children who cannot suppress. Such abnormal head postures include face turn, chin elevation or depression and head tilt. These postures attempt to maintain binocular vision and eliminate diplopia by turning the head to the direction where the deviating eye cannot turn adequately.

Apart from these clinical consequences, strabismus is also associated with a variety of psychological and social problems, both in childhood and adulthood (Satterfield et al., 1993). Strabismus is cosmetically unacceptable in most societies and this imposes a significant psychological burden on an individual with strabismus (von Noorden and Campos, 2002) and can negatively impact his or her quality of life (Burke et al., 1997; Olitsky et al., 1999; Menon et al., 2002; Hatt et al., 2007).

1.1 Statement of the Problem

Strabismus is a disorder of public health significance because of its psychosocial impact and negative social prejudice (Robaei et al., 2006). Children with strabismus are usually taunted and made fun of by school mates and peers (von Noorden and Campos, 2002). These negative attitudes toward strabismus emerge at a young age; sometimes, as early as 6 years (Paysse et al., 2001). This tends to result in the development of low self esteem and poor interpersonal relationships. In fact, strabismus may adversely affect an individual's ability to obtain (or hold) employment (Coats and Paysse, 2000).

Furthermore, uncorrected strabismus can result in amblyopia (Yassur et al., 1972; Shaw et al., 1988; Paysse et al., 2001; Donahue, 2007). Amblyopia is an important cause of unilateral visual impairment (Chew et al., 1994; Multi-ethnic Pediatric Eye Disease Study Group,

2008). As a result, early detection of strabismus is essential for restoration of the alignment of the visual axes and establishment of binocular vision. Thus, research into the prevalence and risk factors for strabismus (particularly factors that could identify children at risk) and the impact of strabismus on the visual function and the education of young children is of public health importance.

1.2 Study Justification

There is paucity of information on the prevalence of the different types of strabismus and treatment outcome in Nigerian patients. This study would provide information on the pattern of presentation of strabismus patients in this environment. Such information is invaluable for the estimation of the burden of strabismus among ophthalmic patients. Furthermore, this study would provide much needed data on the common types of strabismus in our patients and would help identify factors which may be associated with the different types of strabismus. This would aid the development of screening programmes for children at risk. Development of such screening programmes would enable early detection and treatment of children with strabismus and reduce the negative impact of strabismus on their visual function as well as their education. Early detection would also reduce the number of children who grow into adulthood with strabismus. Secondly, early treatment of strabismus would reduce the psychosocial burden borne by patients and would improve their quality of life as a result. This study would also provide information on the different treatment methods and outcome of management of strabismus in our patients. It would also identify factors that may affect outcome of management. This information would contribute towards the capacity building of eye care personnel for better management of strabismus patients.

1.3 AIM AND OBJECTIVES

General aim:

To determine the pattern of presentation of strabismus among new patients seen at the Eye Clinic, University College Hospital, Ibadan between January 1999 and December 2008.

Specific objectives:

(1) To determine the prevalence of strabismus in patients presenting at the Eye clinic.

(2) To determine the causes and types of strabismus in the patients.

(3) To describe the clinical features of patients with strabismus.

(4)To assess the outcome of management of patients with strabismus.

CHAPTER TWO

LITERATURE REVIEW

2.0 Prevalence of Strabismus

Strabismus has been described as a relatively common ocular disorder in children (Robaei et al., 2006). It has a worldwide occurrence and has been studied in various populations with variation in the observed prevalence in different populations depending on the race and age group studied. Furthermore, prevalence figures differ depending on whether studies are clinic-based, school based or population based. Studies conducted in eye clinics are generally more likely to detect a higher prevalence of strabismus because the base population is made of individuals with eye complaints and diseases who have an increased possibility of having strabismus. On the other hand, school based studies are performed in otherwise healthy children and the prevalence of strabismus would be expected to be different from clinic prevalence. Moreover, population based studies involving the general population are likely to be different from school based studies because the incidence of strabismus is greater in childhood (Govindan et al., 2005; Greenberg et al., 2007).

Prevalence in Caucasian populations: Graham (1974), reported a prevalence of 5.7% in a population of five year old school children in Cardiff, United Kingdom. Other school-based studies in Caucasians have reported prevalence of strabismus ranging between 2.5 and 9% (Frandsen, 1960; Komder et al., 1974; Macfarlane et al., 1987; Preslan and Novak, 1996; Ohlsson et al., 2001; Junghans et al., 2002). Friedman and co-workers (1980) in a clinic based study of 38,000 children aged between 12 and 30 months found a prevalence of 1.3%. While Stidwill (1997), reported a prevalence of 5% in another clinic survey involving patients of all ages. However, more recent population based studies in children have reported values ranging between 2.3 and 3.3% (Kvarnstrom et al., 2001; Barry and Konig, 2003; Robaei et al., 2005; Friedman et al., 2009). The prevalence of strabismus in adults in the United States has been reported to be approximately 4% (Beauchamp et al., 2003).

Prevalence in Asian populations: The prevalence of strabismus appears to be lower in Asians. Nepal and co-workers (Nepal et al., 2003) in a school based study observed a strabismus prevalence of 1.6% among children aged 5-16 years. In a population based study of 5-15 year old children living in urban India, Murthy et al. (2002) reported that 0.5% of them had strabismus. Other investigators who conducted surveys on children of similar ages found prevalence of strabismus ranging between 0.7 and 3.0% (Pokharel et al., 2000; Zhao et al., 2000; Dandona et al., 2002; He et al., 2004; Goh et al., 2005; Matsuo and Matsuo, 2005).

Prevalence in Hispanic/ Latino populations: Rodríguez and Castro González (1995) studied over 17,000 children in public schools in Colombia and found a strabismus prevalence of 3.1%, while in a population based study, Maul et al. (2000) studied almost 7,000 children aged between 5 and 15 years and observed a prevalence of 9.9%. Varma and the Multiethnic Paediatric eye Disease Study Group (2008) recently reported a strabismus prevalence of 2.4% among Hispanic/ Latino children aged between 6 and 72 months living in Los Angeles, California.

Prevalence in African American populations: The Multi-ethnic Paediatric Eye Disease Study (2008) reported a strabismus prevalence of 2.5% in African American children aged 6-72 months in Los Angeles, while the Baltimore Paediatric eye disease study (Friedman et al., 2009) found a similar prevalence of 2.1% in children of the same age group and also of African descent. Both studies were population- based surveys.

Prevalence in Africa: The relative rarity of strabismus in African populations, especially those in multiracial societies, has previously been commented upon (Chumbley, 1977). Wedner et al. (2000) in a primary school survey in Tanzania detected a strabismus prevalence of 0.5%, while, Ntim-Amponsah and Ofosu-Amaah(2007) in a study of Ghanaian school children reported that strabismus was rare with a prevalence of 0.2%. A population based study of 5-15 year olds in Durban, South Africa observed a strabismus prevalence of 1.3% (Naidoo et al., 2003).

Prevalence in Nigeria: Only a few studies have been conducted in Nigeria with the aim of determining the prevalence of strabismus in Nigerian populations. Most of the available data on strabismus are from studies in which the prevalence and/or pattern of eye diseases, in general, was the subject of the research. Actually, strabismus was initially considered rare in Nigeria (Ajaiyeoba, 1994). In a hospital based report from Ibadan, Nigeria, Baiyeroju-Agbeja and Owoeye (1998) reported a prevalence of 0.4% over a five year period (1992-1996) among patients presenting to the Eye Clinic of the University College Hospital (UCH), Ibadan. More recently, Onakpoya and Adeoye (2009) observed a frequency of 2.4% among 286 seen in a tertiary hospital over a period of six years. Other studies which were mainly school- based have reported prevalence ranging from 0.3 to 1.3% (Ogwurike and Pam, 2004; Adegbehingbe et al., 2006; Ajaiyeoba et al., 2007; Azonobi et al., 2008)

A few of the studies on the prevalence of strabismus are presented in Table 2.1 with respect to the different populations in which the studies were conducted.

Table 2.1 Selected studies on prevalence of strabismus in different populations

Population	School based studies	Clinic based studies	Population based studies
Caucasians	Frandsen (1960) - 4.5% Graham (1974) - 5.7% Macfarlane et al (1987) - 2.5% Preslan and Novak (1996) - 3.1%	Friedman et al. (1980) - 1.3% (ages 1-2.5 yrs) Stidwill (1997) - 5%	Kvarnstrom et al (2001) – 3.1%
Asians	Nepal et al (2003) – 1.6% Matsuo and Matsuo (2005) – 1.3%		Pokharel et al.(2000) – 2.1% Murthy et al. (2002) - 0.5% Goh et al. (2005) – 0.7% Multiethnic Paediatric eye Disease Study Group (2008) – 2.4%
Latinos	Rodríguez and Castro González (1995) - 3.1%		
African Americans			Multi-ethnic Paediatric Eye Disease Study (2008) – 2.5% Friedman et al. (2009) – 2.1%
Africans	Wedner et al. (2000) – 0.5% Ntim-Amponsah and Ofosu-Amaah(2007) – 0.2% Adegbehingbe et al., 2006 – 1.3%	Baiyeroju- Agbeja and Owoeye (1998) – 0.4% Onakpoya and Adeoye (2009) – 2.4%	

2.1 Classification of Strabismus

There are a variety of ways of classifying strabismus. Classification could be based on the direction of deviation, the age of the individual at onset of strabismus, the laterality (side involved), the temporal behaviour i.e. constancy of deviation, the fixation pattern, concomitance of the eyes, and the cause of the strabismus. Based on the direction of deviation, strabismus may be classified into *horizontal* and *vertical* types, the horizontal type being more common (Tollefson et al., 2006). Horizontal strabismus is further classified into two main forms: *esotropia* which is characterized by an inward deviation of the eye i.e. towards the nose (Greenberg et al., 2007); and *exotropia*, characterized by an outward deviation of the eye i.e. away from the nose (Govindan et al., 2005). Esotropia is also referred to as convergent squint, while exotropia is referred to as divergent squint. Vertical strabismus is classified as either *hypertropia* which is an upward deviation of the eye or *hypotropia*, a downward deviation of the eye (Ticho, 2003). Various forms of esotropia have been

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described including congenital esotropia, accommodative esotropia, acquired non-accommodative esotropia, sensory esotropia, and paralytic esotropia depending on the cause and associated clinical features (Mohney, 2001a). While the different forms of exotropia include intermittent exotropia, sensory exotropia, congenital exotropia, convergence insufficiency, and paralytic exotropia (Mohney and Huffaker, 2003).

Based on the age of the individual affected, strabismus may be referred to as *congenital* (or more appropriately, *infantile*) when it occurs at birth or within the first six months of life. Strabismus with onset after this age is called *acquired* strabismus (von Noorden and Campos, 2002). Strabismus can also be classified as *unilateral* or *bilateral* depending upon whether one or both eyes are involved. Unilateral strabismus can be either a *right* squint or a *left* squint, while bilateral cases, which are relatively rare, affect both eyes (von Noorden and Campos, 2002). With respect to the constancy of the deviation, strabismus may be classified as either *constant* or *intermittent*. A constant strabismus is a deviation that is present at all times, while an intermittent strabismus is a deviation that is manifest only at certain times e.g. when a person awakes from a nap or is tired, ill, under stress, or in particular test situations (von Noorden and Campos, 2002). Based on the fixation pattern, strabismus can described as *alternating* when the individual fixates visual targets with either eye or *non-alternating* when the individual habitually uses one eye for fixation (von Noorden and Campos, 2002).

Concomitance, in the context of strabismus, refers to the degree to which the eyes move together into the different positions of gaze. In *concomitant* strabismus, the eyes move in concert and the amount of deviation measured in degrees (°) is constant in all directions of gaze; while in *incomitant* strabismus the deviation is greater in certain directions of gaze and is indicative of restriction of movement or extra-ocular muscle weakness (Wright et al., 2006). Most types of congenital and childhood strabismus are concomitant (Wright et al., 2006).

2.2 Aetiology of Strabismus

Regarding the cause, strabismus may be classified into *primary* or *secondary* strabismus. Primary strabismus is idiopathic and occurs without any apparent cause or organic pathology involving the eyes. Secondary strabismus occurs as a result of primary visual loss or organic ocular or neuromuscular pathology (von Noorden and Campos, 2002).

The exact cause of primary strabismus is not known but a few theories have been suggested. Two of these theories are more popular and are mentioned here. They are the *Worth theory* and the *Chavasse theory* (Wright et al., 2006). Worth (1929) suggested that the strabismus is

caused by a congenital absence of cortical fusion potential. This theory places the blame on a primary cortical fusion deficit present at birth and states there is little prospect for obtaining good binocular function. Chavasse (1939), on the other hand, proposed that strabismus occurs as a result of a primary motor misalignment, and the poor binocular sensory status so often seen in these patients is secondary to a disruption of binocular visual development caused by the infantile strabismus. This theory speculates that patients with congenital esotropia have binocular cortical potential for high-grade stereopsis and fusion but that the presence of an esotropia during the early period of binocular visual development permanently damages binocular function.

In secondary strabismus, a definite cause can be identified; and the deviation occurs as a result of primary visual loss or organic ocular or neuromuscular pathology (von Noorden and Campos, 2002).

Causes of secondary esotropia include

- High refractive errors e.g. e.g. high hypermetropia and high myopia
- Anisometropia i.e different refractive errors in the two eyes
- Sixth cranial nerve (Abducens) palsy
- Cataract
- Congenital toxoplasma chorioretinitis with macular involvement
- Retinopathy of prematurity
- Intraocular tumours especially Retinoblastoma
- Corneal opacities and
- Optic atrophy.

(Bremer et al., 1998; Berk et al., 2000; Ebana Mvogo et al., 2000; von Noorden and Campos, 2002; Vutova et al., 2002; Ticho, 2003; Watts, 2003)

Causes of secondary exotropia include

- Third cranial nerve (Oculomotor nerve) palsy
- Craniofacial abnormalities
- Amblyopia
- Cataract
- Retinal detachment
- Maculopathies and
- Optic neuropathies.

(Berk et al., 2000; von Noorden and Campos, 2002; Wright et al., 2006)

Other causes of secondary strabismus particularly in adults include vascular disease, inflammatory disease, infiltrative processes (including Graves' disease), myasthenia gravis, and direct orbital trauma (Donahue, 2007).

2.3 Risk factors for Primary Strabismus

As stated earlier, the cause of primary strabismus is unknown, but it is believed to occur as a result of a defect in central nervous system control over the extra-ocular muscle system (Chew et al., 1994). However, a number of factors have been found to be associated with an increased risk of strabismus generally as well its different forms. These risk factors can be categorised into demographic, perinatal, maternal, paternal, and socioeconomic characteristics as well as some associated medical conditions in infancy and childhood.

Demographic factors

Age: Strabismus is most common during the first decade of life and reduces in occurrence with age (Govindan et al., 2005; Greenberg et al., 2007). However, within the first decade, prevalence of strabismus is low during the first year of life and begins to increase thereafter (Multi-ethnic Pediatric Eye Disease Study Group, 2008; Friedman et al., 2009). Esotropia is more common than exotropia in the first six years of life; beyond this age exotropia predominates until the teenage years when both types of squint have a similar but decreased incidence (Mohney et al., 2007).

Race: Strabismus appears to be more prevalent in Caucasians than in Asians and blacks (Matsuo and Matsuo, 2005; Friedman et al., 2009). Specifically, esotropia has been found to be more common in whites than in blacks, but the occurrence of exotropia was similar in the two races (Chew et al., 1994). Furthermore, esotropia has been found to be more common than exotropia in white populations (Frandsen, 1960; Graham, 1974; Kvarnstrom et al., 2001; Greenberg et al., 2007; Mohney, 2007), while the reverse is the case in Asians with exotropia being more common (Yu et al., 2002; Matsuo and Matsuo, 2005). However, Friedman et al. (2009) recently reported nearly equal rates of esotropia and exotropia among white children in the Baltimore paediatric eye disease study. They attributed this to a possible decline in the prevalence of esotropia in Caucasians.

In Africans, the pattern is uncertain, some reports state that esotropia is commoner (Baiyeroju- Agbeja and Owoeye, 1998; Azonobi et al., 2008) while other studies found that exotropia is more common in Africans (Kikudi et al., 1988; Ebana Mvogo et al., 1996). The Baltimore paediatric eye disease study found similar rates of both esotropia and exotropia in children of African origin (Friedman et al., 2009).

Gender: Although, no gender predilection has been observed for strabismus as a whole (Chew et al., 1994; Yu et al., 2002; Govindan et al., 2005), Nusz and co-workers (2005) found that intermittent exotropia was nearly twice as common in girls compared with boys in a retrospective, population-based cohort study conducted on a predominantly Caucasian population. The reason for this female preponderance is unclear.

Family history: A positive family history of strabismus is known to be a risk factor for strabismus (Paul and Hardage, 1994; Podgor et al., 1996; Abrahamsson et al., 1999; Ticho, 2003; Govindan et al., 2005; Donahue, 2007; Greenberg et al., 2007). Mohney (1998) observed that a positive family history was associated with a 3.5-fold excess risk of developing congenital esotropia. Major and others (2007) also found that children with family history had over a 9- fold increase in the risk of developing strabismus compared with those without a family history. It is not known what factor is inherited nor the mode of inheritance. Transmission in some families has been explained by both Mendelian dominant and codominant models (Dufier et al., 1979; Maumenee et al., 1986).

Perinatal factors

Prematurity: The occurrence of strabismus has been found to be significantly associated with prematurity (Chew et al., 1994; Bremer et al., 1998; Mohney et al., 1998; Ticho, 2003; Holmstrom et al., 2006). Robaei et al (2006) reported a fivefold increase in the risk of esotropia among premature children, while Major et al (2007) observed a 10 fold increase in the risk of strabismus (esotropia and exotropia). The mechanism of the association between strabismus and prematurity has not been elucidated but Pennefather et al (1999) have suggested the relationship may be due to the effect of retinopathy of prematurity on the development of strabismus.

Low birth weight: Low birth weight is associated with increased prevalence of strabismus (Goldstein et al., 1967; Podgor et al., 1996; Pott et al., 1999; Williams et al., 2008). Chew et al. (1994) using a multivariable logistic regression model showed that the risk of strabismus increased with low birth weight ($P<0.0001$). Another study reported children with a birth weight less than 2500 grams had an odds ratio of 4.6 compared with those greater than 2500 grams (Mohney et al., 1998).

Other perinatal factors: Birth asphyxia (low APGAR scores), use of supplemental oxygen during the neonatal period, birth trauma, toxemia of pregnancy, and admission into Neonatal intensive care unit (NICU) have all been associated with an increased risk of strabismus (Medkova et al., 1959; Chew et al., 1994; Mohney et al., 1998; Matsuo et al., 2001; Robaei et al., 2006; Major et al., 2007).

Maternal factors

A maternal history of previous pregnancy loss has been noted to be a risk factor for strabismus (Goldstein et al., 1967). Increasing maternal age has also been reported to increase the risk of esotropia (Chew et al., 1994; Major et al., 2007). Maternal cigarette smoking during pregnancy is a significant risk factor for both esotropia and exotropia (Hakim and Tielsch, 1992; Chew et al., 1994; Podgor et al., 1996).

Paternal factors

A study by Hakim et al. (1991) has suggested the possibility of a weak association between paternal lead exposure and strabismus in children, while Robaei et al (2006) reported that older paternal age was associated with a 5-fold increase in the risk of esotropia.

Associated medical conditions

Associated medical conditions e.g. central nervous system abnormalities such as cerebral palsy, seizure disorders and Down's syndrome have been found to be strongly associated with strabismus (Black, 1982; Chew et al., 1994; Pennefather and Tin, 2000; Jacobson et al., 2002; Kristjansdottir et al., 2002; Akinci et al., 2009). Furthermore, an association of strabismus with central nervous system injuries has been previously reported (Blazso and Giesel, 1971).

2.4 Clinical subtypes of Strabismus

The common subtypes of strabismus and their distinguishing features are as follows:

Accommodative Esotropia

This is a convergent squint usually associated with hypermetropia, a refractive error also referred to as farsightedness, and it is the most common form of strabismus in children (Mohney, 2001a; Mohney, 2007). Children with hypermetropia need to accommodate (a process of changing the focussing power of the eye) to see clearly, and because accommodation is linked with convergence, excessive focusing efforts make the eyes to convergence excessively, producing esotropia (Donahue, 2007). Usually the eyes become properly aligned upon optical correction of the underlying hypermetropia with the use of spectacles (von Noorden and Campos, 2002).

Primary Infantile (Congenital) Esotropia

This is a convergent squint associated with a large angle of deviation, usually presenting before the age of six months in an otherwise developmentally and neurologically normal child (Donahue, 2007). It is a less common form of esotropia than accommodative esotropia and is often associated with amblyopia (Mohney et al., 1998; Mohney, 2001a). Unlike

accommodative or other acquired forms of esotropia, congenital esotropia requires early surgical correction to facilitate binocular vision (Wright et al., 1994).

Acquired Non-accommodative Esotropia

This is a convergent squint which develops after six months of age, is not associated with accommodative effort and is usually limited to childhood (von Noorden and Campos, 2002; Mohney, 2007). This form of strabismus is considered uncommon and may be associated with an underlying neurologic or neoplastic disorder (Mohney, 2001b). Surgical correction is usually indicated (Mohney, 2001b; von Noorden and Campos, 2002)

Primary Intermittent Exotropia

Intermittent exotropia is the commonest type of exotropia (divergent squint) and the second most common form of strabismus in children (Mohney, 2007). It has been found to be more common than esotropia in Asian populations (Yu et al., 2002). A female preponderance has also been reported (Nusz et al., 2005). Intermittent exotropia usually presents in older children, with squinting (particularly outdoors, in bright lights, and with distance fixation), diplopia, and eyestrain (Ticho, 2003). Amblyopia is considered less common in intermittent exotropia (von Noorden and Campos, 2002; Wright et al., 2006). Although spontaneous resolution had been documented in some patients (Nusz et al., 2006), treatment is generally surgical (von Noorden and Campos, 2002)

Sensory strabismus

Sensory strabismus occurs when one or both eyes have severe visual loss, causing a lack of stimulus for the brain to achieve ocular alignment (Ticho, 2003). Causes include high refractive errors, anisometropia, albinism, media opacities such as cataracts and corneal opacities, optic atrophy and retinal scarring involving the macula (Ebana Mvogo et al., 2000; Mohney, 2001a; Mohney and Huffaker, 2003). Sensory esotropia is more common in very young patients, on the other hand, sensory exotropia is more common with longstanding visual loss in older children and adults (Havertape et al., 2001). Treatment usually involves treatment of the cause as well as strabismus surgery if indicated (Wright et al., 2006)

Paralytic strabismus

This form of strabismus occurs as a result of weakness of one or more of the extra-ocular muscles that move the eye and is usually incomitant (Kanski, 2003). The paralysis is often as result of some insult to the cranial nerves which innervate these muscles. These nerves are the third cranial nerve (Oculomotor), the fourth cranial nerve (Trochlear) and the sixth cranial nerve (Abducens) (Kanski, 2003). These nerves may be affected by congenital, traumatic, infectious, ischemic, and compressive processes within the brain or the orbital cavity (Ticho,

2003). Such involvement could be isolated (affecting only one nerve) or multiple (affecting more than one nerve at a time) (Kanski, 2003). Typically, oculomotor nerve palsy causes exotropia, abducens nerve palsy causes esotropia, while trochlear nerve palsy causes hypertropia (Wright et al., 2006). Spontaneous resolution often occurs in paralytic strabismus and it is often recommended that strabismus surgery be delayed for at least six to eight months after the onset of the deviation to assess the degree of resolution (von Noorden and Campos, 2002; Kanski, 2003).

Restrictive strabismus

Restrictive strabismus occurs as a result of mechanical forces which limit the movement of the eye within the orbital cavity (Ticho, 2003). This restriction in movement may be secondary to stiffness, fibrosis or entrapment of the extraocular muscles as may occur in orbital wall fractures, orbital tumours, and Thyroid eye disease (Graves disease) (Wright et al., 2006). The deviation is often incomitant (Ticho, 2003). Treatment often depends on the cause and strabismus surgery may be required (von Noorden and Campos, 2002).

2.5 Treatment options in strabismus

The diagnosis of strabismus is mainly clinical and involves exhaustive evaluation by an ophthalmologist to determine the type, cause, magnitude and associated consequences and adaptations. The aims of treatment of strabismus are, first to preserve or restore vision, secondly to align the eyes and thirdly, to restore binocular vision. The treatment options for strabismus which depend on the type and cause include spectacle prescription, use of prisms, eye exercises, pharmacologic agents, and surgery (Kanski, 2003; Kraft, 2008). In addition, in cases of secondary strabismus, treating the cause of the strabismus, if possible, may reduce the ocular deviation (von Noorden and Campos, 2002).

Spectacle prescription

Glasses are useful in the treatment of strabismus when blurring from a significant uncorrected refractive error makes fusion difficult, as can happen with both esotropia and exotropia (Ticho, 2003). Correction of hypermetropia is particularly important in the treatment of accommodative esotropia (Berk et al., 2004; Liang and Fricke, 2006).

Most children with accommodative esotropia see reasonably well without using glasses. The accommodative effort needed to overcome the hypermetropia stimulates convergence, which contributes to their esotropia, however. Use of hypermetropic glasses reduces accommodative drive and, thereby, excess accommodative convergence (Ticho, 2003).

Prisms

Prism glasses may be used either optically to correct a strabismus or to stimulate sensory fusional effort, most commonly by triggering convergence (Beauchamp et al., 2003). Ground-in prisms offer excellent clarity but are fixed in amount and are expensive and heavy. Press-on Fresnel prisms are thin and light, allowing for stronger prescriptions that would be too thick to allow ground-in correction. Fresnel prisms are also less costly and easier to change but may induce blurring and glare and are hard to keep clean (Ticho, 2003).

Eye exercises (orthoptic therapy)

These are ineffective for esotropia, largely because the voluntary divergence ability is limited (Ticho, 2003). Convergence ability, on the other hand, may usually be increased through exercises, thus orthoptic therapy is frequently employed for exotropia and, in particular, for convergence insufficiency (von Noorden and Campos, 2002). Orthoptic treatment may also be a useful adjunct to surgical treatment. Orthoptic exercises have traditionally been performed in an office setting, or at home using quite simple methods (Ticho, 2003). With the advent of computer-based programs, sophisticated and effective treatment can be done outside the office, with attendant reduction of expense and increased convenience (Ticho, 2003). Such programs usually include the ability to track the compliance of patient use, as well as the progression of strabismic control over time.

Pharmacologic agents

Miotic drugs have been in use since the late 18th century when Javal first used physostigmine, and pilocarpine in the treatment of strabismus (von Noorden and Campos, 2002). Miotic agents cause constriction of the pupil and act on the ciliary muscle to facilitate accommodation thereby reducing accommodative effort and accommodative convergence. They have some efficacy in the treatment of accommodative esotropia (Liang and Fricke, 2006), but their use has steadily declined in recent years (von Noorden and Campos, 2002).

Botulinum toxin has been used to produce artificial weakening of an extraocular muscle as an alternative to surgical weakening to correct strabismus (Scott, 1981). This procedure is especially useful as a temporary measure in paralytic strabismus, when the antagonist of the weak muscle is injected with botulinum. For example, botulinum toxin may be injected in the medial rectus following an abducens (sixth cranial nerve) palsy. This method of treatment is used more often in adult strabismus compared to pediatric strabismus (Ticho, 2003).

Surgery

In general, strabismus surgery is appropriately reserved for patients in whom nonsurgical methods are likely to be unsuccessful. On the other hand, untoward delay of surgical

management can reduce the effectiveness of the operation by preventing the establishment of binocularity and prolonging the period of strabismic suppression (Ticho, 2003).

Strabismus surgery consists of loosening (recession) and tightening (resection) procedures. A recession weakens a muscle while resection strengthens a muscle (von Noorden and Campos, 2002).

The amount that a muscle is recessed or resected and the number of muscles operated depends in part on the severity or amplitude of the ocular deviation. Usually the muscle is moved a fixed distance (in millimeters) which has been preselected by the surgeon (Ticho, 2003).

2.6 Outcome of Management

As stated earlier, the goals of strabismus management are mainly to maximise vision, then realign the eyes and if possible to restore binocular vision. Therefore, outcome of management is usually considered with respect to visual outcome and ocular alignment (von Noorden and Campos, 2002).

In general, existing reports on the outcome of strabismus treatment which are mostly from Caucasian populations are based on studies conducted on accommodative esotropia, infantile esotropia, and intermittent exotropia.

Accommodative esotropia has been documented to have a very favourable prognosis especially if the appropriate treatment is initiated promptly (Lambert et al., 2003; Berk et al., 2004; Liang and Fricke, 2006). Spectacle correction is usually the main stay of management of accommodative esotropia (Berk et al., 2004) and majority of patients achieve realignment with excellent functional and cosmetic outcomes (Liang and Fricke, 2006).

However, after successful alignment of a child's eyes with spectacle correction, there remains a risk that the alignment control will deteriorate, requiring surgical correction to maintain alignment (Ludwig et al., 2003).

Intermittent exotropia has a less favourable prognosis. Although, spontaneous resolution has been reported (Nusz et al., 2006), recurrence of the deviation following surgery is fairly common (von Noorden and Campos, 2002; Koklanis and Georgievski, 2009). Success rates vary between 50 and 79% depending on the preoperative status and post operative duration (Ekdawi et al., 2009).

Congenital esotropia has a worse prognosis, especially with respect to poor binocular vision and the presence of amblyopia (Mohney et al., 1998). As a result early surgical intervention is recommended (Wright et al., 1994; Ing, 1995; Helveston et al., 1999). However recurrence of

deviation often occurs and multiple surgeries may be required (Louwagie et al., 2009). Success rates vary between 45 and 80% depending on the preoperative status and post operative duration (Louwagie et al., 2009).

CHAPTER THREE

METHODOLOGY

3.0 Study Design

This was a retrospective cross-sectional study. The descriptive component of the study includes the prevalence, types and causes of strabismus; modes and outcome of management of strabismus while the analytical component includes the determination of factors associated with types of strabismus and outcome of management.

3.1 Study Location

The study was conducted at the Eye Clinic of the University College Hospital, Ibadan, Oyo state. The University College Hospital was established in 1957 and is the first tertiary health institution in Nigeria. The hospital offers quality patient care in all specialties of Medicine and Surgery and serves as a major referral centre for other hospitals in south-western Nigeria. The eye clinic of the hospital provides general ophthalmic medical services as well as sub-specialist eye care to patients from all over south-western Nigeria through daily clinic sessions. The subspecialty units of the eye clinic include glaucoma unit, retina and vitreous unit, orbit and oculoplasty unit, paediatric ophthalmology and strabismus unit, cornea and anterior segment unit, neurophthalmology unit and the community ophthalmology unit.

The eye clinic is made up of seven consulting rooms, three refraction rooms, two nurses' stations, a medical records section, a visual field investigation room and a laser therapy room. In the refraction rooms, optometrists perform tests on patients to determine their refractive errors (refraction). The eye clinic also has an annexe at the General Outpatient department (GOPD) which mainly serves patients who are brought in from outreach programmes for cataract surgery. This annexe is run by the community ophthalmology unit.

The staff of the eye clinic include 11 consultant ophthalmologists, 19 resident doctors, two optometrists, ophthalmic nurses, medical records officers, public health nurses and ophthalmic medical assistants.

Patients who attend the eye clinic do so after referral from one of several sources. Sources of referral include the General Outpatient department; other clinics in the hospital i.e. Surgical Outpatient (SOP), Medical Outpatient, and Children Outpatient (CHOP); private clinics within Ibadan and its environs; as well as other government hospitals within the south-western region of Nigeria.

Daily clinic sessions comprise a general ophthalmology clinic and at least two subspecialty clinics run by different units on different days of the week. During the clinics new patients

i.e. patients attending the clinic for the first time are seen by a consultant ophthalmologist or occasionally by a resident doctor who subsequently discusses with the consultant in charge of the patient before a treatment plan is advised. Patients returning for follow up visits are often seen by resident doctors under the supervision of the consultant ophthalmologists.

3.2 Study Population

The study population comprised of all patients with strabismus presenting to the Eye clinic for the first time during the study period (1999- 2008).

3.3 Exclusion Criteria

Patients with missing and incomplete records were excluded from the study.

3.4 Sample Size Determination

Total number of patients with strabismus seen between January 1999 and December 2008 who had complete records was the sample size for the study.

3.5 Sampling Technique

Total population sampling technique was used for this study. Thus, all patients identified as fitting the inclusion criteria were recruited and included in the study.

3.6 Data Collection

Patients with a diagnosis of strabismus were identified from the clinic registers for the study period and their case records were retrieved from the Medical Records unit of the Eye clinic. With the use of a proforma (Appendix A), information was retrieved from the case notes of each strabismus patient. This information included age at last birthday, sex, clinical history, type of strabismus, visual acuity, associated refractive errors, cause of strabismus, associated ocular disease, treatment given, outcome of treatment and duration of follow up.

Clinical information included ocular symptoms, duration of symptoms, history of spectacle wear, history of ocular trauma, significant medical history, and family history of strabismus. Visual acuity was tested objectively in school age children and adults with a Snellen chart or Illiterate E chart placed at a distance of six metres from the patient. Preverbal and preschool children as well as those who could not cooperate for testing with the Snellen chart were subjectively tested with the use of behavioural methods of assessing vision e.g. ability to fixate or follow light and bright objects, and/or aversion to occlusion of one eye compared with the other.

All patients had been seen either by a consultant ophthalmologist or a senior resident doctor. Ocular examination included anterior segment examination with a pen torch and/or a slit lamp biomicroscope and a posterior examination with an ophthalmoscope. Refraction was performed by either of the two optometrists for patients who required refraction. Ocular

deviation was detected using the Hirschberg test in which a pen torch was shone onto the eyes and the reflection from the cornea observed. A deviation of the corneal reflex in an eye indicated a misalignment of that eye. Deviation was measured in degrees (°) based on the millimetres of deviation observed. One millimetre of deviation corresponded approximately to 7.5 degrees of misalignment.

3.7 Data Management and Analysis

Data collected was entered into a database on a personal computer and statistical analysis was performed with the aid of Statistical Package for Social Sciences version 16 software (SPSS Inc, Chicago IL., USA).

After data cleaning, results were analyzed by generating summary indices for the variables. These were in the form of frequency distributions for categorical variables and measures of central tendency (mean, median) as well as measures of dispersion (standard deviation, interquartile range) for the quantitative variables. The frequency distributions were presented with the aid of tables and charts.

Bivariate analysis was conducted with the use of cross tabulations and chi-square test to evaluate associations between categorical variables such as between gender and type of ocular deviation; between type of deviation and treatment outcome; and between type of treatment and outcome. The Mann Whitney test was used to evaluate associations between continuous and categorical variables such as association between age and type of deviation. The Mann – Whitney test was used in place of Student t test because of positive skewness observed in the age distribution of the patients. The analysis was considered to show significant association when the p value was less than 0.05.

Multivariate analysis with the use of logistic regression was also performed to adjust for the effect of confounding in observed associations. (Associations with a p value of 0.1 or less on bivariate analysis were entered into the logistic regression.)

3.8 Ethical Considerations

Ethical approval was obtained from the University of Ibadan/ University College Hospital Institutional review board (Appendix B). Confidentiality was ensured by keeping information under lock and restricted access. The private information and clinical data was treated as confidential.

3.9 Definitions of terms

1. Blindness: Presenting visual acuity less than 3/60 in the better eye.
2. Visual Impairment: Presenting visual acuity less than 6/18 in the better eye.

3. Cataract: Obvious lens opacity with obvious dark shading of the red reflex on distant direct ophthalmoscopy in an eye with presenting visual acuity less than 6/18.
4. Glaucoma: Presence of an ophthalmoscopically visible vertical cup-disc ratio of 0.8 or more.
5. Refractive error: Presenting visual acuity less than 6/18, improving with spectacle correction.
6. Anisometropia: Marked difference in the refractive error of the two eyes ≥ 2.50 dioptres.
7. High Myopia: Refractive error ≥ - 6.00 dioptres
8. Pathological Myopia: High myopia associated with retinal pathology causing lack of improvement in visual acuity with spectacle correction.
9. Pterygium: Presence of a wing- like conjunctival fibrovascular growth extending onto the cornea.
10. Corneal opacity (leucoma): Easily visible corneal opacity present over the pupil such that at least part of the iris is obscured when viewed through the opacity.
11. Optic atrophy: Optic disc pallor without cupping in absence of other retinal pathology.
12. Pseudophakia: Absence of the crystalline lens from the central pupil but with an intraocular lens (IOL) inserted into the eye.
13. Aphakia: Absence of lens from the eye following cataract extraction without the insertion of an intraocular lens.
14. Macular Scar/ Degeneration: Obvious or severe pigmentary disturbance or any other deviation from what is considered a 'normal' aspect of the macular area.
15. Ptosis: Downward drooping of the upper eye lid.
16. Microphthalmos: An abnormal congenital reduction in the size of the eye ball with associated abnormal intraocular anatomy.
17. Hyphaema: Blood filling the anterior chamber of the eye precluding a view of the pupil and iris.
18. Cortical visual impairment: A condition in which vision is impaired as a result of brain injury following hypoxia or infection.

CHAPTER FOUR

RESULTS

A total of 20,328 new patients presented to the eye clinic for the first time during the study period. Two hundred and forty (1.2%) of these patients had strabismus.

4.0 Demographic characteristics of strabismus patients

The mean age of the patients with strabismus was 19.8 (± 19.7) years, while their ages ranged between 3 months and 75 years. There were 119 males (49.6%) and 121 females (50.4%). The male to female ratio was 0.98: 1. The age and sex distribution of the patients are shown in Table 4.1 and Figure 4.1.

Table 4.1 Age distribution of patients with strabismus

Age group (years)	Frequency (n)	Percent (%)
Less than 1	26	10.8
1 – 9	78	32.5
10 – 19	30	16.7
20 – 29	40	12.5
30 – 39	19	7.9
40 – 49	23	9.6
50 – 59	10	4.2
60 – 69	8	3.3
70 and above	6	2.5
Total	240	100.0

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Total	240	100.0

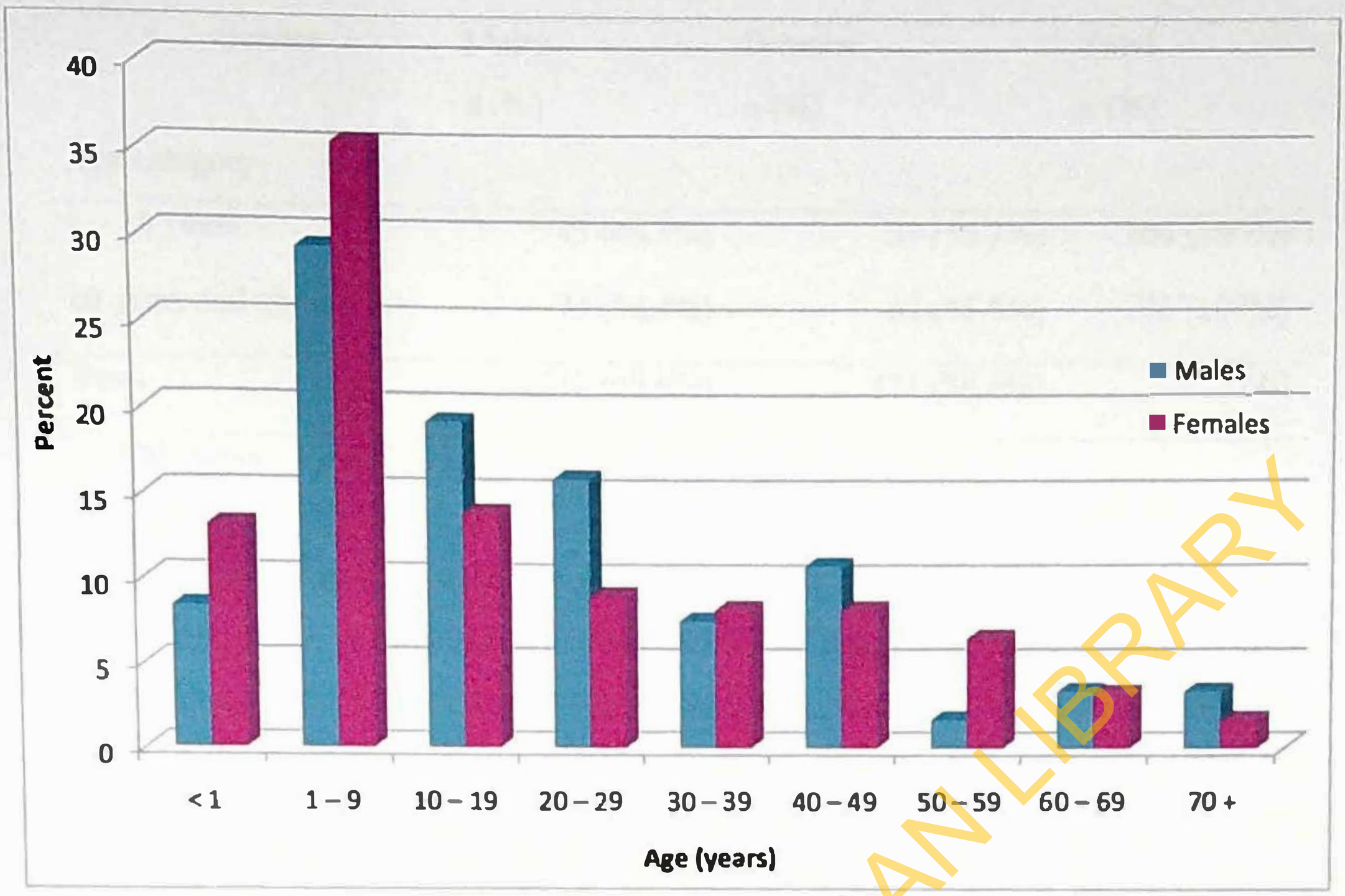

Figure 4.1 Age and sex distribution of patients with strabismus

The mean age in males was 20.4 (± 19.0) years, compared to the mean age in females which was 19.1 (± 20.4) years. The median age in males was 16 years (Interquartile range, IQR,= 27) while the median age in females was 11 years (IQR = 33.5). However, this difference in age between the genders was not statistically significant (Mann – Whitney test; p value = 0.229).

Furthermore, there were more females than males among those aged less than 20 years, while there was a male preponderance in the older age groups. However this difference in sex distribution was not statistically significant with a p value = 0.087 (Table. 4.2).

Table 4.2 Cross tabulation of Sex by Age of strabismus patients

Gender	Males	Females	Total
	n (%)	n (%)	n (%)
Age category			
0 – 19 years	45 (43.3%)	59 (56.7%)	104 (100%)
20 years and above	74 (54.4%)	62 (45.6%)	136 (100%)
Total	119 (49.6%)	121 (50.4%)	240

Chi- square = 2.927; p value =0.087

4.1 Clinical history of strabismus patients

A total of 108 (45%) of the patients had poor vision as their presenting complaint, while in 102 (42%) patients the presenting complaint was ocular deviation (squint). Other presenting symptoms included double vision, drooping of eyelids, headaches, eye aches and face turn. The frequencies of these and other symptoms are presented in Table 4.3. Four patients (1.7%) did not have any presenting complaints but came for routine ophthalmological evaluation following referrals from the paediatric neurology unit of the Children Outpatient clinic. Seventy (29.2%) patients had more than one presenting symptom.

Table 4.3 Frequency of symptoms among patients with strabismus

Symptom	Frequency (n)*	Percent (%) (N=240)
Poor vision	108	45.0
Ocular deviation (Squint)	102	42.0
Double vision (diplopia)	30	12.5
Drooping of upper eyelid	24	10.0
Headaches	15	6.3
White spot in the eye (opacity)	8	3.3
Eye aches	7	2.9
Blurring of vision	6	2.5
Red eye	3	1.3
Itching of the eye	3	1.3
Watering of the eye	1	0.4
Face turn	1	0.4

* 70 (29.2%) patients had more than one symptom.

In 59 (24.6%) patients the duration of symptoms was not specified but was recorded as either "since birth" or "since childhood". In the remaining 75.4%, the mean duration of symptoms was 26.2 (± 43.4) months with a range of 2 weeks to 25 years. The median duration was 12 months, while the interquartile range was 34 months. Twenty two (9.2%) patients had a positive history of spectacle wear, while six (2.5%) of the patients reported a positive family history of strabismus. In five of the patients with a positive family history, the family member affected was a first degree relation; while in one patient, it was a second degree relation that also had strabismus. Other aspects of the patients' ocular and medical history are shown in Table 4.4.

Table 4.4 Ocular and medical history of strabismus patients

	Frequency (N= 240)	
	Present (%)	Absent (%)
Ocular trauma	39 (16.3)	201 (83.8)
Neuro-developmental delay	25 (10.4)	215 (89.6)
History of spectacle wear	22 (9.2)	218 (90.8)
Cerebral palsy	18 (7.5)	222 (92.5)
Family history of strabismus	6 (2.5)	234 (97.5)
Congenital anomaly	6 (2.5)	234 (97.5)
Prematurity	4 (1.7)	236 (98.3)

4.2 Ocular examination findings in strabismus patients

Visual acuity was assessed with the use of objective measurement methods in 169 (70.4%) patients who were old enough to perform the test. Only subjective methods were practicable in 69 (28.8%) patients who were either too young or could not cooperate for objective tests due to neuro-developmental delay. The visual acuity was not recorded in two (0.8%) patients. Of the 69 patients who had subjective visual assessment, 43 (62.3%) had normal behavioural responses in one or both eyes indicating that they had normal vision, while 26 (37.7%) had abnormal responses in the better eye which suggests that they had some visual impairment in both eyes. In those patients who had objective visual assessment, the visual acuity of the better eye with the best possible optical correction is presented in Figure 2. Majority had good vision, 14.8% had visual impairment while 7.1% were blind.

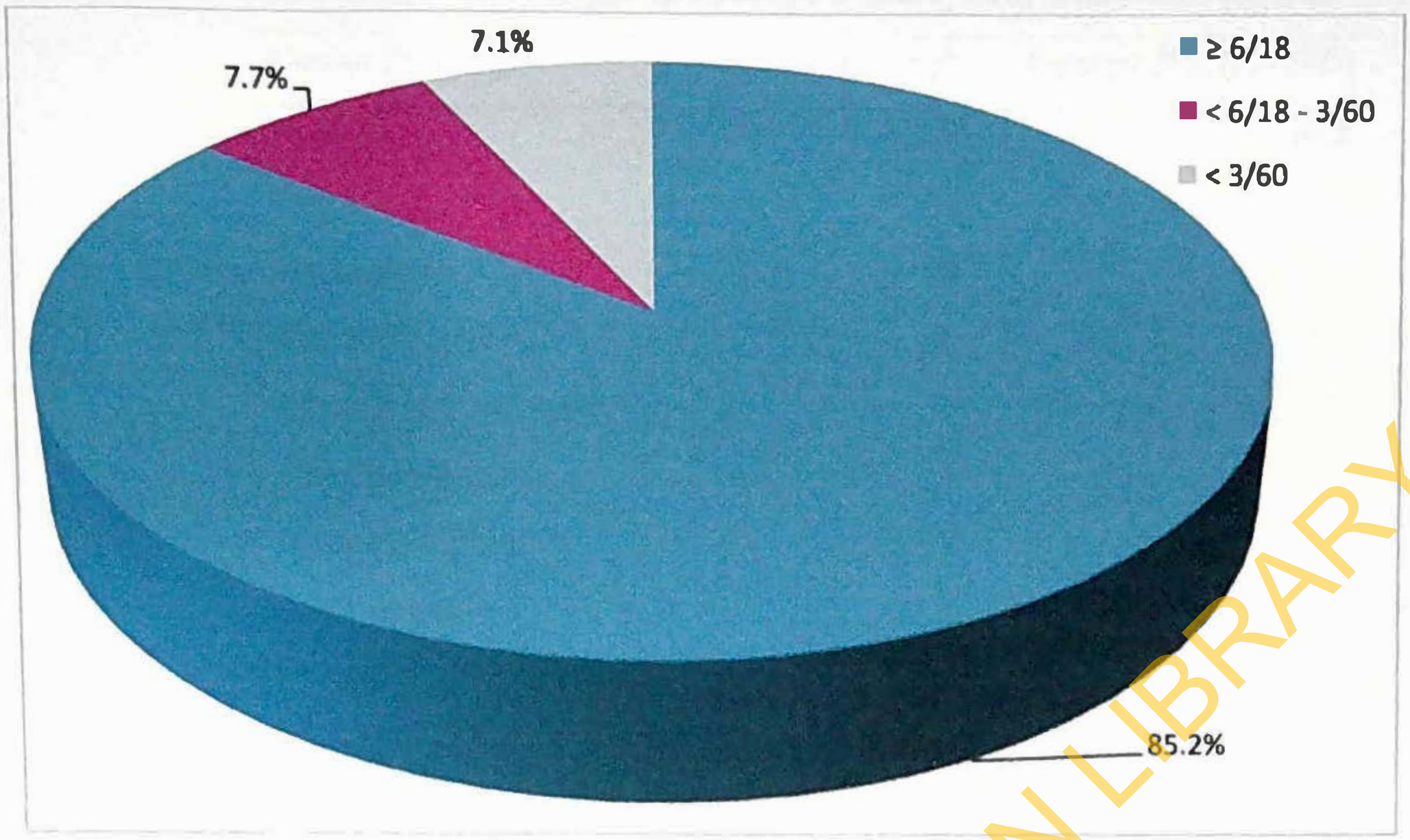

Figure 4.2 Best corrected visual acuity in better eye of strabismus patients.

With respect to examination findings, 105 (43.8%) patients had abnormal findings in the anterior segment of the eye, while 51 (21.3%) had abnormal posterior segment findings. The commonest abnormal ocular finding in the anterior segment was cataract (50 patients; 20.8%), followed by ptosis (21 patients; 8.8%). Macular scar was the commonest abnormal posterior segment finding, occurring in 20 (8.3%) patients. Other abnormal findings in the anterior and posterior segments of the patients are shown in Tables 4.5 and 4.6.

Table 4.5 Abnormal Anterior Segment findings in the eyes of strabismus patients

Ocular Finding	Frequency (n)*	Percent (%) (N=240)
Cataract	50	20.8
Ptosis	21	8.8
Nystagmus	14	5.8
Corneal opacity	12	5.0
Abnormal pupil reflex	7	2.9
Enophthalmos	4	1.7
Microphthalmos	3	1.3
Lagophthalmos	1	0.4
Pterygium	1	0.4
Occlusio pupillae	1	0.4
Aphakia	1	0.4
Pseudophakia	1	0.4
Phthysis bulbi	1	0.4

*10 (4.2%) patients had more than one abnormal finding.

Table 4.6 Abnormal Posterior Segment findings in the eyes of strabismus patients

Ocular Finding	Frequency (n)*	Percent (%) (N=240)
Macular scar	20	8.3
Optic atrophy	12	5.0
Pale cupped discs	5	2.1
Maculopathy	4	1.7
Retinal detachment	4	1.7
Myopic retinopathy	3	1.3
Foveal hypoplasia	2	0.8
Chorioretinal atrophy	2	0.8
Papilloedema	1	0.4
Retinal coloboma	1	0.4

*4 (1.7%) patients had more than one abnormal finding.

One hundred and thirty seven patients (57.1%) had a refraction test performed to determine the presence and degree of refractive error. Out of them, seven (5.1%) did not have refractive errors. The refractive errors detected in the remaining 130 patients are shown in Table 4.7.

Table 4.7 Types of Refractive errors in strabismus patients

Type of refractive error	Frequency (n)	Percent (%)
Hypermetropic Astigmatism	48	36.9
Myopic Astigmatism	30	23.1
Hypermetropia	30	23.1
Myopia	17	13.1
Simple Astigmatism	5	3.8
Total	130	100

4.3 Characteristics of the deviation in strabismus patients

In majority (97.1%) of the patients the direction of the deviation was horizontal, five patients (2.1%) had a vertical deviation, while two patients (0.8%) had a combination of vertical and horizontal deviation. One hundred and twenty nine patients (53.8%) had esotropia, while three (1.3%) patients had hypertropia. The frequency of the types of deviation is presented in Figure 4.3. The deviation was unilateral in 192 (80%) patients while it affected both eyes in 48 (20%) patients. The degree of deviation was recorded in only 153 (63.8%) patients. The mean deviation was 26.2° (± 11.6°), and the deviation ranged between 7° and 45°.

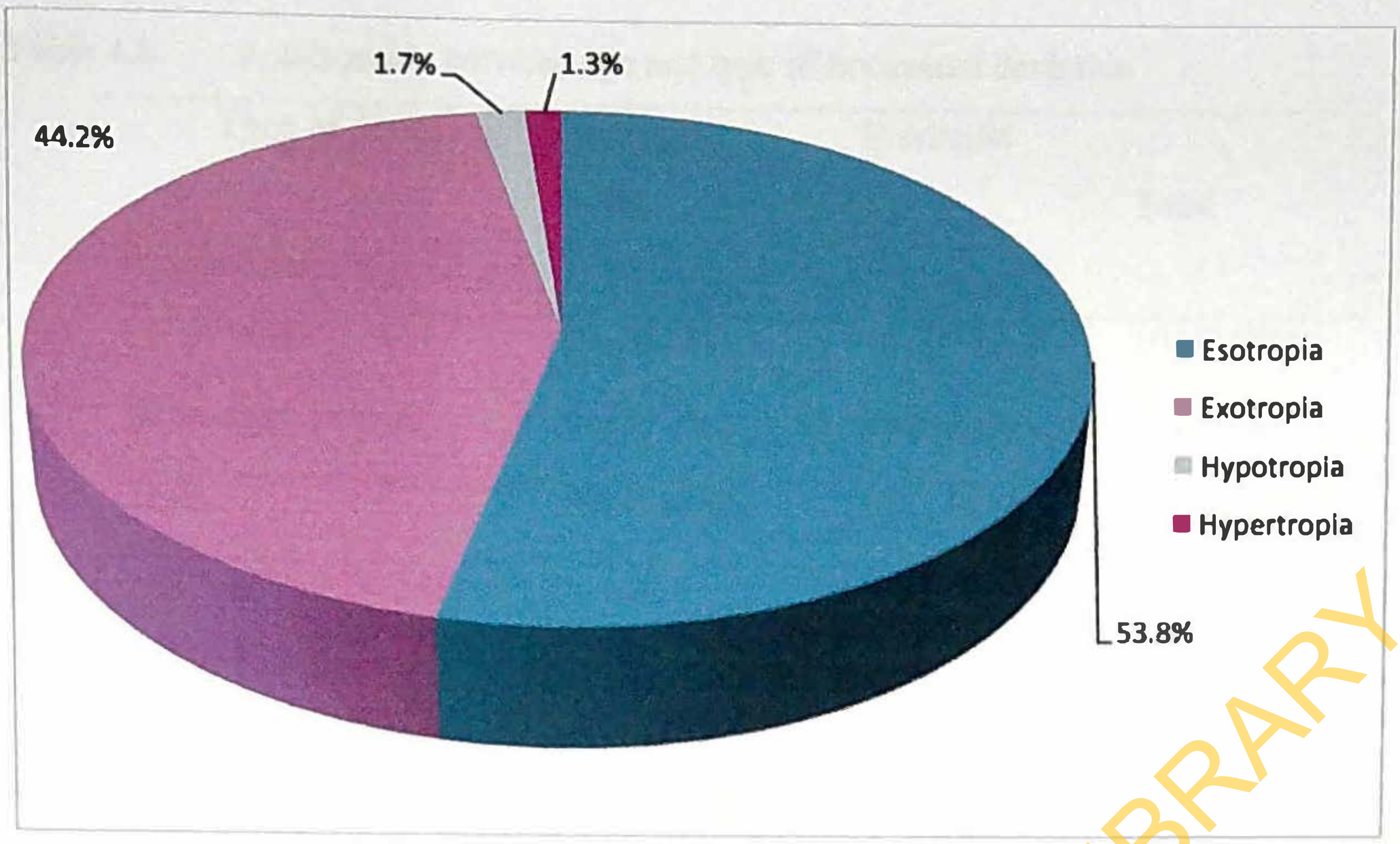

Figure 4.3 Type of deviation in strabismus patients

* 2 patients had a combination of esotropia and hypertropia

4.4 Factors affecting the type of horizontal deviation in strabismus patients

Further analysis was carried out to determine the factors that are associated with the type of horizontal deviation that occurred in the patients with strabismus.

These included age, the mean age of patients with esotropia was 12. 8 (±16.7) years compared with 27.9 (± 20.1) years for patients with exotropia. The median age for patients with esotropia was 5 years (IQR = 18), while that of patients with exotropia was 24 years (IQR = 29.25). This difference was statistically significant (Mann – Whitney test, p value < 0.001) Furthermore, 82.5% of patients aged 0-19 years (children and adolescents) had esotropia compared with 33.3% of those aged 20 years and above who had esotropia (p < 0.001). The patients between 0 and 19 years of age were about nine and a half times more likely to have esotropia compared with those aged 20 years and above (Table 4.8).

Table 4.8 Relationship between age and type of horizontal deviation

Type of deviation	Esotropia n (%)	Exotropia n (%)	Total
Age category			
0 – 19 years	85 (82.5%)	18 (17.5%)	103 (100%)
20 years and above	44 (33.3%)	88 (66.7%)	132 (100%)
Total	129 (54.9%)	106 (45.1%)	235 (100%)

Chi- square = 56.540; p value < 0.001

Odds ratio (95% C.I.) = 9.44 (5.06 – 17.63)

About 51% of the males had esotropia compared with 58.7% of females who had esotropia (p = 0.23) There was no statistically significant association between gender and type of horizontal deviation (Table 4.9).

Table 4.9 Relationship between gender and type of horizontal deviation

Type of deviation	Esotropia n (%)	Exotropia n (%)	Total
Sex			
Male	58 (50.9%)	56 (49.1%)	114 (100%)
Female	71 (58.7%)	50 (41.3%)	121 (100%)
Total	129 (54.9%)	106 (45.1%)	235 (100%)

Chi- square = 1.442; p value = 0.23

Three (50%) of the patients with a positive family history of strabismus had esotropia, while 55% of those with a negative family history had esotropia (p =0.99).There was no statistically significant association between family history of strabismus and type of horizontal deviation. This analysis is shown in Table 4.10.

Table 4.10 Relationship between family history of strabismus and type of horizontal deviation

Type of deviation	Esotropia n (%)	Exotropia n (%)	Total
Family history of strabismus			
Positive	3 (50 %)	3 (50%)	6 (100%)
Negative	126 (55%)	103 (45%)	229 (100%)
Total	129 (54.9%)	106 (45.1%)	235 (100%)

p value = 0.99 (Fisher's exact test)

Most (75%) of those who had a history of prematurity had esotropia compared with 54.5% of those without a history of prematurity (p = 0.629). Those patients with a history of prematurity appeared more likely to have esotropia compared with exotropia but this difference was not statistically significant (Table 4.11)

Table 4.11 Relationship between history of prematurity and type of horizontal deviation

Type of deviation	Esotropia n (%)	Exotropia n (%)	Total
History of prematurity			
Yes	3 (75%)	1 (25%)	4 (100%)
No	126 (54.5%)	105 (45.5%)	231 (100%)
Total	129 (54.9%)	106 (45.1%)	235 (100%)

p value = 0.629 (Fisher's exact test)

4.5 Ocular diagnosis of strabismus patients

The commonest primary ocular diagnosis was esotropia in 74 (30.9%). Other ocular diagnoses made in the patients with strabismus are shown in Table 4.12.

Table 4.12 Primary Ocular Diagnosis in strabismus patients

Ocular Diagnosis	Frequency (n)	Percent (%)
Esotropia	74	30.9
Cataract	50	20.8
Third Cranial nerve paralysis	21	8.8
Sixth Cranial nerve paralysis	20	8.3
Exotropia	19	7.9
Macular scar	15	6.3
Multiple Cranial nerve paralysis	7	2.9
Anisometropia	5	2.1
Orbital blow out fracture	4	1.7
Glaucoma	4	1.7
High Myopia	3	1.3
Cortical visual impairment	3	1.3
Corneal leucoma	2	0.8
Oculocutaneous Albinism	2	0.8
Myastenia gravis	2	0.8
Microphthalmos	2	0.8
Pathological Myopia	1	0.4
Aphakia	1	0.4
Anterior segment dysgenesis	1	0.4
Craniosynostosis	1	0.4
Maculopathy	1	0.4
Traumatic optic atrophy	1	0.4
Hyphaema	1	0.4
Total	240	100

4.6 Causes of strabismus

In 68 (28.3%) patients there was no specific cause for the strabismus, thus these patients were classified as having primary strabismus. On the other hand, 172 (71.7%) patients had secondary strabismus, the commonest cause being cataract in 50 (29%) patients. Table 4.13 shows the causes of secondary strabismus in 172 patients.

Table 4.13 Causes of Secondary strabismus

Cause	Frequency (n)	Percent (%)
Cataract	50	29.0
Cranial nerve paralysis	49	28.4
Refractive error	20	11.6
Cerebral palsy/ Neurological disorder	16	9.2
Macular scar	15	8.7
Orbital blow out fracture	4	2.3
Glaucoma	2	1.2
Myasthenia gravis	2	1.2
Optic atrophy	2	1.2
Oculocutaneous Albinism	2	1.2
Microphthalmos	2	1.2
Corneal opacity (leucoma)	2	1.2
Duane's syndrome	2	1.2
Maculopathy	1	0.6
Hyphaema	1	0.6
Aphakia	1	0.6
Craniosynostosis	1	0.6
Total	172	100.0

4.7 Clinical subtypes of strabismus

Sensory strabismus was the commonest subtype, occurring in 83 (34.5%) patients, while the least common was congenital exotropia (3 patients; 1.3%). The subtype of strabismus was undetermined in three (1.3%) patients). The frequency of the different subtypes of strabismus found in the patients is presented in Table 4.14.

Table 4.14 Clinical subtypes of strabismus in 240 patients

Subtype of strabismus	Frequency (n)	Percent (%)
Sensory strabismus	83	34.5
Paralytic strabismus	49	20.4
Infantile esotropia	31	12.9
Intermittent Exotropia	18	7.5
Strabismus associated with neurological disorders	16	6.7
Accommodative esotropia	14	5.8
Acquired Non-accommodative esotropia	14	5.8
Restrictive strabismus	5	2.1
Strabismus associated with syndromes	4	1.7
Congenital Exotropia	3	1.3
Undetermined	3	1.3
Total	240	100

4.8 Treatment of strabismus

Sixty one patients (25.4%) were prescribed with spectacles to optically correct their refractive errors with a view towards eliminating or reducing the deviation. Two patients (0.8%) underwent strabismus surgery, while two other patients (0.8%) were treated with eye exercises. Four patients (1.7%) who were scheduled for strabismus surgery, failed to come for surgery. With regard to the treatment of secondary strabismus, 17 (7.1%) patients had cataract surgery, one patient (0.4%) was treated with Pyridostigmine (therapy for Myasthenia gravis), and 15 (6.3%) patients were referred to the Neurosurgeons and Neurologists for specialist care. Majority (65.4%) of patients did not receive any active treatment.

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4.9 Follow up and Outcome of treatment

Only 119 (49.6%) patients returned for a follow up visit. The follow up period ranged from one month to 9.5 years. The median follow up period was 10 months, while the interquartile range was 16 months. Out of the patients who kept at least one follow up appointment, 16 (13.5%) had complete realignment of the visual axis. Complete or partial realignment was considered as favourable outcome while lack of realignment was deemed unfavourable. The outcome of treatment in 119 patients is shown in Table 4.15.

Table 4.15 Treatment outcome in strabismus patients seen at follow up

Treatment outcome	Frequency (n)	Percent (%)
Complete realignment of visual axes	16	13.5
Partial realignment of visual axes	26	21.8
No realignment	77	64.7
Recurrence	Nil	Nil
Total	119	100

Specifically, out of the patients who had spectacles prescribed and were followed up, 10 (30.3%) had a favourable outcome. Both patients who had strabismus surgery had a favourable outcome, while 16 (25%) of those who did not receive any active therapy had a favourable outcome. The treatment outcome within the various treatment groups is presented in Table 4.16.

Table 4.16 Treatment outcome within the different treatment categories

Treatment	Outcome Favourable n (%)	Unfavourable n (%)	Total
Spectacles	10 (30.3%)	23 (69.7%)	33 (100%)
Strabismus surgery	2 (100%)	0 (0%)	2 (100%)
Cataract surgery	11 (64.7%)	6 (35.3%)	17 (100%)
Eye exercises	2 (100%)	0 (0%)	2 (100%)
Pyridostigmine	1 (100%)	0 (0%)	1 (100%)
No active treatment	16 (25%)	48 (75%)	64 (100%)
Total	42 (35.3%)	77 (64.7%)	119 (100%)

4.10 Factors affecting treatment outcome

Further analysis was carried out to determine the factors that are associated with outcome of strabismus treatment.

Active treatment:

About 47% of patients who received active treatment had a favourable outcome compared with 25% of those who did not receive active treatment ($p = 0.011$). Patients who received active therapy such as spectacles, strabismus surgery and cataract surgery had a higher likelihood of having a favourable outcome compared with those patients who did not receive any active treatment. This analysis is shown in Table 4.17.

Table 4.17 Relationship between active treatment and outcome

Active treatment	Outcome Favourable n (%)	Unfavourable n (%)	Total
Yes	26 (47.3%)	29 (52.7%)	55 (100%)
No	16 (25%)	48 (75%)	64 (100%)
Total	42 (35.3%)	77 (64.7%)	119 (100%)

Chi- square = 6.425; p value =0.011 Odds ratio (95% C.I.) = 2.69 (1.24 – 5.84)

Type of horizontal deviation:

Table 4.18 shows that 37.3% of patients with esotropia had a favourable outcome compared with 31.4% of those with exotropia. But, the relationship between the type of horizontal deviation and treatment outcome may be confounded by the type of treatment received and therefore it was necessary to adjust for this, in the evaluation of the association. This is shown later in Table 4.20.

Table 4.18 Relationship between type of horizontal deviation and treatment outcome

Outcome Type of deviation	Favourable n (%)	Unfavourable n (%)	Total
Esotropia	25 (37.3%)	42 (62.7%)	67 (100%)
Exotropia	16 (31.4%)	35 (68.6%)	51 (100%)
Total	41 (34.7%)	77 (65.3%)	118 (100%)

Type of strabismus:

About 19% of patients with primary strabismus had a favourable outcome while 41.4% of those with secondary strabismus had a favourable outcome (Table 4.19). However, the relationship between the type of strabismus and treatment outcome may be confounded by the type of treatment received and therefore it was necessary to adjust for this, in the evaluation of the association. This is shown later in Table 4.20.

Table 4.19 Relationship between type of strabismus and treatment outcome

Outcome Type of strabismus	Favourable n (%)	Unfavourable n (%)	Total
Primary strabismus	6 (18.8%)	26 (81.2%)	32 (100%)
Secondary strabismus	36 (41.4%)	51 (58.6%)	87 (100%)
Total	42 (35.3%)	77 (64.7%)	119 (100%)

A multivariate analysis was performed using a binary logistic regression to examine association between type of deviation and treatment outcome as well as between type of strabismus and treatment outcome adjusting for the type of treatment received. After this adjustment, secondary strabismus was associated with approximately a fivefold increase in likelihood of favourable outcome, while there was no significant association between type of deviation and treatment outcome (Table 4.20).

Table 4.20 Binary logistic regression of factors affecting treatment outcome

Variables	OR (95% C.I.)	P value
Type of deviation		
Esotropia	1.57 (0.67-3.78)	0.295
Exotropia	1.00	
Type of strabismus		
Primary	1.00	0.005*
Secondary	4.78 (1.59-14.34)	
Active treatment		
Yes	3.58 (1.54-8.34)	0.003*
No	1.00	

* p value < 0.05 (i.e. significant)

OR = Odds ratio; C.I. = Confidence Interval

CHAPTER FIVE

DISCUSSION

5.0 Prevalence of strabismus

The prevalence of strabismus among eye clinic patients in this study was found to be 1.2%. This is higher than the prevalence of 0.4% observed by Baiyeroju-Agbeja and Owoeye (1998) in the same clinic over a decade ago. This disparity may be because in their study, the targets were children less than 16 years of age, while this study was on patients of all age groups. It could also indicate a true increase in the incidence of strabisrnus in the population, or an increase in the awareness and utilisation of eye care services by the population. A prospective population based study specifically designed to determine the prevalence of strabismus would be useful to confirm or refute this hypothesis.

On the other hand, the prevalence observed in this study is lower than the prevalence of 2.4% reported by Onakpoya and Adeoye (2009) from another tertiary eye facility in southwestern Nigeria. They conducted a five year retrospective review of all patients less than 15 years old who presented to the eye clinic of a secondary health facility in Ilesa, Osun state with the aim of describing the spectrum of childhood eye diseases. The higher prevalence obtained in their study may be a reflection of the fact that strabismus is more common in the first decade of life (Govindan et al., 2005; Greenberg et al., 2007), whereas this study was not limited to children. Another consideration is the comparatively smaller sample size of their study.

Furthermore, it is also relatively difficult to compare the strabismus prevalence in this study with other reports from Nigeria and Africa which ranged between 0.2 and 1.3%, (Wedner et al., 2000; Naidoo et al., 2003; Adegbehingbe et al., 2006; Ajaiyeoba et al., 2007; Ntim-Amponsah and Ofosu-Amaah, 2007; Azonobi et al., 2008) because the target population of these previous studies were children. Notwithstanding, this study provides further evidence that the prevalence of strabismus is lower in Africans compared to Caucasian populations, and that strabismus may not be rare in Africans as was previously thought (Chumbley, 1977).

5.1 Causes of strabismus

The proportion of secondary strabismus in this study (71.7%) was significantly higher than that observed by Berk et al (2000) who reported that 13% of their patients had secondary strabismus. This difference may be as a result of the fact that this study is hospital based and is simply a reflection of referral patterns and eye care utilisation behaviour of the population; not representing the true picture in the population. A population based study would elucidate this further. Cataract was the commonest cause of secondary strabismus, closely followed by

cranial nerve paralysis. Cataract is a known cause of strabismus especially in children (France and Frank, 1984; Weisberg et al., 2005; Merino et al., 2007), however previous studies have not identified it to be a leading cause of secondary strabismus. Berk et al (2000) in their study of secondary strabismus observed that cataract was responsible for it in 9.7% of the patients, while Ebana Mvogo et al (2000) reported that 16.1% of their patients with secondary strabismus were due to cataracts. These figures are relatively less than the finding in this study (29%).

Also, previous studies revealed that posterior segment abnormalities were a more common cause of strabismus than anterior segment abnormalities. This contrasts with our findings in which anterior segment causes were predominant. Further investigation into the causes of strabismus in Africans is required to clarify these differences. Cranial nerve paralysis have been found to be a fairly common cause of strabismus (Holmes et al., 1999) and this was also observed in this study. While most of the other causes of secondary strabismus identified in this study have been previously reported (Bremer et al., 1998; Berk et al., 2000; Ebana Mvogo et al., 2000; von Noorden and Campos, 2002; Vutova et al., 2002; Ticho, 2003; Wright et al., 2006); it is worthy to note that hyphaema has not been previously reported as a cause of strabismus.

5.2 Factors affecting the type of horizontal deviation

Esotropia was more common than exotropia in the present study. This finding is similar to the earlier report from Ibadan (Baiyeroju- Agbeja and Owoeye, 1998) as well as a report from Ilorin, Kwara state (Azonobi et al., 2008). But it differs from the findings of Ebana Mvogo et al (1996) in Cameroon, and Kikudi et al (1988) in Zaire, that exotropia was more common. It is however important to note that the study population in these two studies were much smaller than the number studied in the present study as well as the other Nigerian studies. This might have biased the ratio of esotropia to exotropia that Ebana Mvogo and Kikudi observed in their studies. It may thus be safe to conclude that esotropia is indeed more common than exotropia in Africans, although a prospective population based study may be necessary to make an assertion on this.

The effect of age on the type of horizontal deviation has been previously documented. Mohney et al (2007) reported that esotropia is more common than exotropia in the first six years of life while exotropia becomes predominant thereafter. The present study also found that older age was associated with an increased likelihood of having exotropia compared to esotropia. In this study gender was not associated with the type of horizontal deviation. This is in concert with previous reports that gender has no influence on the occurrence of

strabismus (Chew et al., 1994; Yu et al., 2002; Govindan et al., 2005). In addition, family history of strabismus and history of prematurity were not associated with the occurrence of esotropia as compared with exotropia. Previous reports have documented that family history of strabismus (Mohney et al., 1998) and prematurity (Robaei et al., 2006) are strongly associated with the development of esotropia. The present observation may be due to the relatively few number of patients who had a history of prematurity or a positive family history in this study. In view of the retrospective nature of the study, it is possible that more patients actually had such history but were missed out because the information was not recorded in their case files.

5.3 Clinical subtypes of strabismus

Few studies have previously reported on the frequency of the various subtypes of strabismus. The commonest subtype of strabismus identified in this study was sensory strabismus. This finding is at variance with population based reports, mostly in Caucasians, that have stated that accommodative esotropia is the commonest form of strabismus (Mohney, 2001a; Mohney, 2007). This finding may stem from the fact that the population studied included all ages, whereas the previous reports were on childhood populations. Secondly, the high proportion of secondary strabismus in this study may account for this difference.

Paralytic strabismus was the second commonest subtype of strabismus in this study but was found to be the fifth common by Mohney (2007). In addition, in the present study infantile esotropia was more common than intermittent exotropia, whereas intermittent exotropia was observed to rank second after accommodative esotropia in Mohney's study (2007). This may suggest that infantile esotropia is more common than intermittent exotropia in Africans but further research is needed to confirm this. On the other hand, in keeping with Mohney's observation (2007), congenital exotropia was the least uncommon subtype of strabismus in this study.

5.4 Treatment and outcome of treatment

Although majority of the patients in this study did not receive any treatment, prescription of spectacles was the commonest mode of management of strabismus. Strabismus surgery was performed infrequently. The latter finding may be a reflection of the relative lack of ophthalmologists who are well versed in strabismus surgery. It is imperative that more ophthalmologists are trained in strabismus evaluation and management to promote the delivery of comprehensive eye care service to patients attending the eye clinic of the University College Hospital (UCH), Ibadan. The low surgery rate may also be due to low acceptance and poor uptake of eye surgery in our environment which have been reported by

previous authors (Awobem et al., 2005; Ayeni et al., 2005). Patients who had been scheduled for surgery sometimes fail to turn up.

The suboptimal follow up observed in these patients is a common problem in Nigerian populations and has been previously documented in patients of the UCH eye clinic (Bekibele and Olusanya, 2004; Ashaye and Adeoye, 2008). Poor follow up may occur because patients lack the financial resources to pay consultation fees and/or transport fare during subsequent visits. Secondly, it is possible that our patients are unaware that follow up is important. Albeit, poor follow up is likely to militate against the achievement of satisfactory outcomes in the management of patients generally, and as such patients and their care givers should actively be encouraged to keep their follow up appointments.

The outcome of management of strabismus was considered favourable in less than half of the patients studied. The association of better outcome with secondary strabismus suggests that the treatment of the cause is valuable in correcting the misalignment in cases of secondary strabismus. For example, strabismus due to cataract is amenable to cataract surgery. Conversely, primary strabismus such as infantile esotropia or intermittent exotropia often requires surgical management and this was performed infrequently in our patients. Furthermore, the relatively poor outcome was associated with lack of active treatment in majority of the patients. This underscores the need for more expertise and proficiency in the management of strabismus in our environment.

5.5 Study limitations

Firstly, incomplete information and missing records were encountered in the cause of this study. Specifically, the information was not always recorded in a standard format and relevant data was occasionally missed out. This could have resulted in the inadvertent omission of eligible patients from this study. Secondly, information on the visual outcome of the patients who received treatment was not collected and therefore could not be evaluated.

5.6 Strengths of the study

This study has provided information on the prevalence of strabismus among a fairly large population of eye clinic patients. It has also provided much need data on the common forms of strabismus in a Nigerian population.

CONCLUSION

The prevalence of strabismus among eye clinic patients in this study is fairly similar to previous reports from Nigeria and Africa. Although, strabismus is not as rare as was previously thought, its prevalence in Africans is lower than in the Caucasian populations. With regard to the direction of deviation, esotropia was more common than exotropia; however, older age was associated with an increased likelihood of exotropia. Majority of the patients in the study had secondary strabismus. Sensory strabismus was the commonest subtype of strabismus followed by paralytic strabismus, while accommodative esotropia appears not to be as common as in Caucasian populations. A larger proportion of the patients did not receive any active treatment for strabismus while strabismus surgery was performed infrequently. This appears to have contributed to a preponderance of unfavourable outcome of management in this population of patients. The follow up rate was suboptimal, with less than half of the patients attending at least one follow up visit.

RECOMMENDATIONS

1. There is a need for ophthalmologists in the University College Hospital, Ibadan to undergo further training on the evaluation and management of strabismus in more advanced countries.
2. Patients and their care givers should actively be encouraged to keep their follow up appointments. This could be achieved by subsidizing the fees paid by patients who require frequent follow up as well as adequate counselling on the need for follow up during their first visits.
3. Proper and detailed documentation of clinical findings in the case records of patients is imperative. In addition, efforts should the doubled in ensuring that patients' case files are not misplaced or lost.
4. There is a need to develop screening programs which would enable early detection and treatment of children with strabismus. This would improve the visual potential of such children and enhance their education.
5. Further research on strabismus, specifically a population based survey or a prospective survey, is necessary to better understand the prevalence, causes, risk factors and types of strabismus in our population.

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APPENDIX A

PROFORMA FOR DATA COLLECTION ON PATIENTS WITH STRABISMUS

Serial Number .....

Patient initials .....

A. Demographic variables

1. Age .....
2. Sex .....
3. Tribe .....
4. Occupation .....
5. Residence (a) Rural (b) Urban

B. Clinical history

6. Presenting complaint .....
7. Other complaints .....
8. Duration of symptoms ..... (Days/weeks/months/ years)
9. Ocular history
   a. (i) Spectacles wear 1. Yes 2. No (ii) If yes, how long .....
   b. Ocular trauma 1. Yes 2. No
   c. Other significant history .....
10. Medical history
    a. Cerebral palsy or Neuro-developmental delay 1. Yes 2. No
    b. Prematurity 1. Yes 2. No
    c. Low birth weight 1. Yes 2. No
    d. Congenital abnormality 1. Yes 2. No
    e. Other significant history .....
11. (a) Family history of strabismus 1. Yes 2. No
    (b) If yes, what is the degree of relative 1. 1st 2. 2nd 3. Other (specify).....

C. Examination findings

12. Visual acuity RE ..... LE .....
13. Type of deviation 1. Esotropia 2. Exotropia 3. Hypertropia
14. Laterality of deviation 1. Right 2.Left 3. Both eyes
15. Degree of deviation (degrees) .....

16. Anterior segment pathology 1. Yes 2. No

If yes specify .....

17. Posterior segment pathology 1. Yes 2. No

If yes specify .....

D. Refraction

18. Refraction done 1. Yes 2. No

19. If yes, Refractive error RE ..... LE .....

E. Diagnosis and management

18. Ocular Diagnosis .....

19. Type of strabismus 1. Primary 2. Secondary

20. Cause of strabismus (if secondary type) .....

21. Treatment 1. Spectacles 2. Surgery 3. None

4. Other (specify) .....

22. Outcome of treatment (as at last follow up visit)

1. Complete realignment of visual axes
2. Partial realignment of visual axes
3. No realignment
4. Recurrence
5. Unknown outcome

23. Duration of follow up .....

APPENDIX B

CERTIFICATE OF ETHICAL APPROVAL

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IMRAT)
COLLEGE OF MEDICINE, UNIVERSITY OF IBADAN, IBADAN, NIGERIA.
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UI/UCH EC Registration Number: NHREC/05/01/2008a

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Pattern of Presentation of Stabismus among Patients of the Eye Clinic of University College Hospital (UCH), Ibadan

UI/UCH Ethics Committee assigned number: UI/EC/09/0100

Name of Principal Investigators: Dr. B. A. Olusanya

Address of Principal Investigator: Department of EMSEH,
College of Medicine, University of Ibadan, Ibadan

Date of receipt of valid application: 27/07/2009

Date of meeting when final determination of research was made: N/A

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

This approval dates from 30/08/2009 to 29/08/2010. If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the* UI/UCH EC *assigned number and duration of* UI/UCH EC *approval of the study.* In multiyear research, endeavour to submit your annual report to the UI/UCH EC early in order to obtain renewal of your approval and avoid disruption of your research.

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

UI/UCH EC
APPROVED
COLLEGE OF MEDICINE

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