

Ghana College of Physicians and Surgeons

Faculty of Ophthalmology

Factors contributing to late presentation of patients with Strabismus to the Komfo

Anokye Teaching Hospital, Ghana

**A dissertation submitted to the Faculty of Ophthalmology, in partial fulfilment of the
requirements for the conferment of a Fellow of the Ghana College of**

Physicians/Surgeons (FGCS)

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DECLARATION

With the exception of all references duly acknowledged in this piece of work, I, Doreen Amankwaa-Frempong hereby declare that the work presented in this research was entirely done by me under the supervision of Dr Seth Lartey of the Ophthalmology Department, Komfo Anokye Teaching Hospital. I am therefore responsible for any errors and omissions. The results embodied in this dissertation have not been submitted to any other College or Institution for the award of any degree, diploma or fellowship.

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CERTIFICATION

This is to certify that this research dissertation submitted by the candidate, Doreen Amankwaa-Frempong, in partial fulfilment of the requirements for the conferment of a Fellow of the Ghana College of Physicians and Surgeons (Ophthalmology), is a record of bona fide work carried out by her under my supervision and has not been submitted for any degree or diploma elsewhere

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26/11/2020

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ABSTRACT

Introduction

Strabismus is an ophthalmic condition that refers to the misalignment of the eyes. It is a common eye problem in both children and adults resulting in reduced visual acuity, abnormal binocular vision and low self-esteem. Anecdotally, most patients with strabismus present late to the Eye Clinic at the Komfo Anokye Teaching Hospital (KATH). Factors contributing to this late presentation have not been studied. This study sought to determine the factors contributing to late presentation of patients with strabismus at KATH.

Methods

This was a hospital-based cross-sectional study of factors contributing to late presentation of patients with strabismus at KATH. Patients with strabismus who met the inclusion criteria were examined after informed consent and assent. Socio-demographic characteristics of the patients such as age, sex, place of residence, education, etc., were recorded using a structured questionnaire. Clinical findings (age at onset of strabismus, age at presentation, deviating eye, type of deviation, etc.) were documented on the questionnaire. Data collected was analysed using SPSS Version 20 and presented using descriptive and inferential statistics. Chi-square test, odds ratios and 95 % confidence intervals were computed. P-values less than 0.05 were considered statistically significant.

Results

A total of 330 (males-180, 54.5 % and females-150 (45.5 %)) patients were recruited into this study. The mean age at onset and presentation of strabismus were 4.0 ± 1.2 years and 10.1 ± 9.4 years. Age of patient, education of patient, having no relative with strabismus, monthly income level of family and having no knowledge about strabismus were associated with late presentation of patients with strabismus (p-values = 0.002, 0.001, 0.025, 0.001 and 0.001

respectively). There was no association between type of strabismus, type of deviation, presenting visual acuity, angle of deviation and late presentation of patients with strabismus (p-values = 0.423, 0.196, 0.446 and 0.624).

Children were 0.1 times less likely to present late compared to adults [OR = 0.1; CI = (0.01-0.8); p-value = 0.032]. Participants with lower education were 1.6 times more likely to present late with strabismus compared to those having higher education [OR = 1.6; CI = (1.1-2.3); p-value = 0.006]. Beneficiaries of National Health Insurance Scheme (NHIS) were 0.4 times less likely to present late compared with non-beneficiaries of NHIS [OR= 0.4; CI = (0.2-0.9); p-value = 0.037]. Patients with no knowledge about strabismus were 2.9 times more likely to present late compared with those who have knowledge about strabismus [OR= 2.9; CI = (1.5 -5.8); p-value = 0.002]. Patients who have no relatives with strabismus 2 times more likely to present late compared with those having relatives with strabismus [OR= 2.0; CI = (1.0 -4.3); p-value = 0.042].

Conclusions

Age, education of patient, having no relative with strabismus, monthly income level of family and having no knowledge about strabismus were associated with late presentation of strabismus. Being an adult, having a lower level of education, not having NHIS and knowledge about strabismus, not having relatives with strabismus could predict late presentation of patients with strabismus.

Key words: Strabismus, late presentation, factors, predictors, association.

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LIST OF ABBREVIATIONS

CDC	Centre for Disease Control
CHRPE	Committee on Human Research, Publication and Ethics
GHS	Ghana Health Service
IRB	Institutional Review Board
KATH	Komfo Anokye Teaching Hospital
KNUST	Kwame Nkrumah University of Science and Technology
MOH	Ministry of Health
OPHTH	Ophthalmologist
SMS	School of Medical Sciences
VA	Visual Acuity
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

The sight of every individual is very important and when impaired, affects the quality of life and function of the individual¹. Strabismus, which is a misalignment of the eyes, where one eye is turned away from the object of focus, is a health concern worldwide and may lead to double vision and visual confusion in most affected people². According to the Centre for Disease Control (2013), when the vision of an individual cannot be corrected to a normal level, this is regarded as functional limitation of the visual system. Strabismus is one of the eye conditions that can result in poor or low vision and will require prompt treatment which is critical for improvement of patient outcome in general³.

According to the World Health Organization (WHO), eye disorders denotes conditions occurring in all humans which if left untreated may result in severe visual impairment that is likely to be untreatable in the future⁴. In most advanced countries, screening for eye diseases or disorders in children is done routinely. The focus of such screening programmes is to identify people with amblyopia, strabismus and refractive errors early in order to institute treatment and thus prevent visual impairment, a measure that is cost effective. However, in most countries in sub-Saharan Africa, limited national routine eye screening services exist for both children and adults⁵.

Strabismus is a cosmetically noticeable problem due to the misalignment of the eye⁶. Strabismus as a major cause of amblyopia can lead to visual impairment^{7,8}. The African child policy forum came out to define a child as any person below the age of 18 years⁹.

A study done in sub-Saharan Africa has revealed a lower prevalence of strabismus among Africans (0.2%-2.4%) compared to the Asian population¹⁰. In Ghana, a study

conducted by Ntim-Amponsah, Ofosu-Amaah ¹¹, to determine the prevalence of refractive error and other eye diseases among school children reported a prevalence rate of 0.2% for strabismus. Other studies have shown that approximately 2-4% of children¹² and about 4% of the adult population¹³ have strabismus.

Many factors have been shown to influence the time of presentation of patients with strabismus to health facilities. Some of these factors may be lack of knowledge and awareness on the part of parents and guardians about strabismus, especially effect of delay in presentation on visual outcome, as well as where to seek for treatment¹⁴. Cost of treatment, which includes hospital bills and cost of transportation to health facilities, are also known factors¹⁵. Other factors including religious belief, fear of big hospitals and stigmatization may also pose as impediments to patients seeking early treatment¹⁵. The clinical characteristics of strabismus, such as its association with normal vision coupled with the type of strabismus (intermittent or constant) are known to be factors that may cause late presentation of individuals with strabismus and subsequently hinder early management of the condition¹⁶. Many of the studies examining factors influencing presentation of patients with strabismus for care have been undertaken in developed or western populations with few identified factors¹⁷. As a result of differences in geographical and socio-demographical characteristics among people in western populations and those within the African region, it is more essential to explore factors that contribute to late presentation of patients with strabismus and the effect of such delays in the African population.

In some hospital-based studies conducted in Western Nigeria among patients with strabismus, it was found that patient default rate for the treatment of strabismus was very high with low interest coupled with poor patient attitude and perception about strabismus in general^{18,19}. This situation of low interest and poor attitude and perception of patients about strabismus have been attributed to poor knowledge about strabismus and a general myth in

this region which suggests that people with strabismus would have their condition naturally corrected when aging^{19,20}. Also, in India, this low interest was attributed to the fact that awareness of the cause, effects and treatment of strabismus was poor in this population²⁰. Poor parental knowledge, misconception and misinformation have also been reported to adversely affect the age of presentation and management of strabismus, and this varies from country to country and from place to place within a country with developing countries being the most affected²¹. In Ghana, factors associated with delays in the presentation of patients with strabismus to hospitals may differ from that seen in developed and Western population due to variations in ethnicity, culture, socioeconomic features, and healthcare system²². These differences may impact on the management of strabismus and its outcomes in Ghana.

In the Eye Clinic of KATH, an unpublished data revealed that 51 patients with strabismus recorded in the year 2017 had majority of them, 30 (58.8%) reporting to the hospital late (after six months of noticing the deviation) while only few reported early (before six months after noticing the deviation). The six months was chosen as a determinant which is in line with a controlled, prospective, multicentre study done by Simonsz et al²³ that compared early versus late presentation of strabismus which showed that strabismus when reported early could be managed without significant adverse effect on vision compared to when it is reported late. The study by Simonsz et al was a hospital-based study carried out in 58 clinics in eleven European countries²³. Simonsz et al found that, majority (70.5%) of the patients treated using surgery had resultant improvement in binocular vision function²³. Among the patients who had early surgery, 13.5% of them as compared with 3.9% of those who had late surgery were able to recognize the Titmus fly (test for stereopsis) at age 6 years²³. Strabismus when managed within six months of onset will help restore not only ocular alignment and abnormal head posture, but also the restoration of binocular single vision¹⁴.

In the past Worth's theory said that the goal of producing binocular vision in a patient with strabismus was hopeless²⁴ and this was challenged by Chavasse²⁵ who suggested that normal binocular vision could be achieved through facilitation of conditioned reflexes that depend on early ocular alignment for proper development. Most people were not so convinced about what Chavasse said until Ing and co-workers began to report favourable binocular vision in some children who underwent strabismus surgeries in early (6 months to 2 years) childhood²⁶. These encouraging results became the basis for early management of strabismus.

In Ghana, there is paucity of published data on factors affecting reporting time of patients with strabismus. Anecdotally, some patients with strabismus present late for treatment and the numbers have been increasing over the years. Since the inception of the KATH Eye Clinic (about 20 years ago) no work has been done to ascertain the causes of delayed presentation of patients with strabismus to the hospital. Considering the potential effect of such delays on the vision of affected children and on the self-esteem of affected adults and older children, it is essential to conduct a study to find out the factors that contribute to the late presentation of patients with strabismus to the KATH Eye Clinic. This would help improve the management of strabismus in KATH and hopefully in the country as timely intervention and management of children with strabismus could prevent visual impairment and other adverse socio-economic consequences associated with late treatment.

1.2 Problem statement

Strabismus is one of the eye conditions that makes people have low self-esteem and causes disturbances in vision worldwide. Some of the adverse effects of strabismus on affected individuals impact on their health, economic, and social development. Prolonged and unnecessary delay in the management may result in some irreversible complications such as

visual impairment from untreated amblyopia²⁷. There is an increasing number of patients with strabismus in hospitals in developing countries including Ghana^{11,28}.

Availability of services for the management of strabismus in Ghana, especially strabismus surgeons, are limited and for the existing ones, very few individuals access them. Anecdotally, some patients with strabismus present late for treatment at the KATH Eye Clinic and the numbers have been increasing over the years. The delays could potentially impact negatively on the vision of affected patients, especially children, as well as on their self-esteem. There is however, limited information on the factors leading to the late presentation of these patients with strabismus to KATH and this is of great concern. Increasing awareness among people with strabismus on the disease, its causes, treatment and outcomes of delayed treatment, is essential to prevent the onset of amblyopia in such individuals at an early stage. This study therefore sought to determine the factors that contribute to the late presentation of patients with strabismus to the KATH Eye Clinic.

1.3 Research questions

1. What are the clinical characteristics of patients presenting with strabismus to the KATH Eye Clinic?
2. What are the socio-demographic factors associated with late presentation of strabismus at the KATH Eye Clinic.
3. What is the association between the clinical characteristics of strabismus and late presentation at the KATH Eye Clinic.
4. What are the predictors of late presentation of patients with strabismus at the KATH Eye Clinic.

1.4 Justification

Strabismus remains a global health challenge. However, early presentation and management within six months of onset is essential for the restoration of ocular alignment, abnormal head posture and binocular single vision¹⁴.

Many factors may prevent patients with strabismus from reporting to the clinic early after detection, thus leading to some irreversible complications. An improved understanding of the factors contributing to the late presentation of patients with strabismus to the eye clinic would enable better public health interventions, as some patients are unaware of the serious consequences that might arise from uncorrected strabismus. Looking at a study done by Kolling²³ patients who were operated on early gained stereopsis which is very important and very much needed in some professions (e.g. ophthalmology and aviation).

Literature available on strabismus in Ghana so far are descriptive cross-sectional studies which only sought to find prevalence of strabismus. This current study would identify the factors contributing to late presentation, and inform the creation of awareness programmes to improve on the treatment of patients with strabismus.

1.5 General objective

To determine the factors that contribute to the late presentation of patients with strabismus at KATH Eye Clinic.

1.6 Specific objectives

1. To determine the clinical characteristics of patients presenting with strabismus to the KATH Eye Clinic.
2. To determine the socio-demographic factors associated with late presentation of strabismus at the KATH Eye Clinic.
3. To determine the association between the clinical characteristics of strabismus and late presentation at the KATH Eye Clinic.
4. To determine the predictors of late presentation of patients with strabismus at the KATH Eye Clinic.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of Strabismus

Strabismus can cause visual problems during development, including loss of binocular single vision and abnormal retinal correspondence and thus disrupts stereopsis², which impacts on the performance of numerous practical tasks requiring precise judgment of depth. Whereas many animals have eyes located on either side of their head (such as horses, for example), the eyes of humans look forward in the same direction. When normal, the eyes move in a coordinated manner, so that the object of focus is centred in each eye. Because the eyes are set at a short distance apart, the image in each eye is slightly different. The brain fuses the images coming from both eyes to produce a three-dimensional image that has depth. This three-dimensional vision, also known as stereoscopic or binocular vision, gives us depth perception²⁹ This normal binocular vision allows us to judge distances more accurately, especially with objects close to us. In order to achieve normal binocular vision, the eyes must see well i.e. receive clear images of objects of interest, be well aligned (looking in the same direction), and be focused properly on the same object. To maintain alignment, the eyes must also move in a coordinated manner, a process involving twelve different muscles (six in each eye). The four rectus muscles move the eyes superiorly (superior rectus muscles), inferiorly (inferior rectus muscles), medially (medial rectus muscles) and laterally (lateral rectus muscles), and the two oblique muscles have more complex actions, with the superior oblique helping with the intorsion of the globe and the inferior oblique with extorsion².

Bui Quoc, Milleret³⁰ also described Strabismus or squint as a misalignment of the eyes such that when one eye is looking straight the other one is deviated. It is sometimes referred to by the lay populace as ‘lazy eyes’, ‘wall-eyes’, ‘wandering eyes’, ‘swivel eyes’,

goggle eyes', 'eye turns', 'deviating eyes', or 'crossed-eyes' and 'half past four eyes' in some local informal language.

Misalignment of the eyes can lead to double vision and visual confusion in some people³¹. Visual confusion is the simultaneous perception of two different objects projected onto corresponding retinal areas. Diplopia or double vision usually results from acquired misalignment of the visual axes that causes an image to fall simultaneously on the fovea of one eye and on the non-foveal point in the other eye. To avoid the visual confusion and diplopia there is sensory adaptation, where the visual system use the mechanism of suppression and anomalous retinal correspondence².

2.2 Causes and forms of Strabismus

There are different types of strabismus depending on the underlying cause³². There is sensory strabismus, where the underlying cause is the eye not getting the necessary impulses needed for visual development i.e. visual deprivation as occurs in children with congenital cataract and uncorrected refractive errors³³. Other causes of Strabismus may be attributed to motor or innervational causes. Innervational causes include dysfunction in the oculomotor control centre in the mid-brain at the level of the superior colliculus or abnormal innervation and control of the extraocular muscles³⁴. Strabismus can manifest throughout life, but most commonly develop in early childhood.

Strabismus can also be classified based on the time of onset. Congenital or infantile strabismus develops during the first six months of life and onset of strabismus after six months is referred to as childhood onset strabismus². Onset in adulthood is usually considered an acquired strabismus. A study done by Tobias et al³⁵ in a Danish population based cohort of children at age 7 and above to find out the cumulative incidence and age specific incidence profiles of the major strabismus subtypes realized that there was an interaction between

strabismus subtypes and age for congenital esotropia, fully accommodative esotropia, partially accommodative esotropia and exotropia, with congenital esotropia occurring more early in life³⁵. Strabismus that develops in adults can be caused by: Botulism, Diabetes (causes acquired paralytic strabismus), Graves' disease, Guillain-Barré syndrome, injury to the eye, Stroke, traumatic brain injury and vision loss from any eye disease or injury³⁶.

There are some conditions which predispose some individuals to the risk of developing strabismus. Some of these risk factors include retinopathy of prematurity, maternal smoking during pregnancy, low birth weight, and family history of strabismus³⁷. The hereditary aspect of strabismus is reflected in the higher prevalence of strabismus in children with family history of strabismus which may range from seventeen to thirty percent of children with strabismus³⁸. The exact gene or mode of inheritance is unclear. Twin studies have demonstrated the heritability of esotropia and exotropia as well³⁹. One study used a large sample of monozygotic and dizygotic twins to show that there is a 64% heritability of esotropia, whereas exotropia is caused mostly by environmental factors. Sanfilippo, et al³⁹. They also showed that the heritability of esotropia is independent of refractive error.

Strabismus may also occur when the muscles that move the eye in a particular direction do not work together. This may be caused by a problem with the muscles itself, its nerve supply or from the brain (in head injuries, cerebral palsy and brain tumours)⁴⁰. Hydrocephalus can also lead to strabismus through damage to some cranial nerves, where the cerebrospinal fluid pressure causes raised intracranial pressure and eventually affect the sixth cranial nerve (abducent) function leading to eye deviation⁴¹. Some viral infections, such as measles, can cause strabismus³⁴.

Strabismus may occur early in life in some individuals whiles some may acquire it later in life⁴². It may also be idiopathic⁴³. In the pathophysiology of strabismus, the extraocular muscles are known to control the position of the eyes. Thus, a problem with the muscles or

their innervation can cause paralytic strabismus. The extraocular muscles are controlled by cranial nerves III, IV, and VI. An impairment in cranial nerve III function causes the ipsilateral eye to deviate down and out and may or may not affect the size of the pupil. When the cranial nerve IV is affected, which can be congenital or acquired, the eye tends to drift up and inward. Sixth cranial nerve palsy causes the eyes to deviate inward. Due to the relatively long intracranial course of the Sixth cranial nerve, it can easily be damaged. Increased intracranial pressure can compress on the 6th cranial nerve as it runs between the clivus and brain stem. During forceps delivery there can be damage to some of the cranial nerves such as the third cranial nerve which then can lead to strabismus.

Evidence indicates that a cause for strabismus may lie with the input provided to the visual cortex. This allows for strabismus to occur without the direct impairment of any cranial nerve or extraocular muscle function. This type of strabismus is the sensory type which may lead to amblyopia due to the brain ignoring the blurred image formed in one eye. The development of the visual cortex of the brain requires well focused foveal image and well aligned visual axes. Any interference in any of these two factors such as defocused foveal image, may affect this development and hence affect the vision in the affected eye, resulting in sub-optimal vision compared with that in the fellow eye (amblyopia)².

Amblyopia is thus, the failure of one or both eyes to achieve normal visual acuity despite normal structural health. During the first seven to eight years of life, the brain learns how to interpret the signals that come from an eye through a process called visual development. Development may be interrupted by strabismus if the child always fixates with one eye and rarely or never fixates with the other. To avoid double vision, the signal from the deviated eye is suppressed, and the constant suppression of one eye causes a failure of the visual development in that eye and thus, that eye becomes amblyopic².

Amblyopia is responsible for more cases of childhood-onset unilateral decreased vision than all other causes combined, having different prevalence from different parts of the world, the highest prevalence from Europe⁴⁴. Amblyopia signifies a failure of normal neural development in the immature visual system and is caused by abnormal visual experience early in life resulting from strabismus, refractive error which can be anisometropia or high bilateral refractive errors (isoametropia)⁴⁵. It is the most common cause of unilateral visual impairment in adults younger than 60 years. The prevalence of amblyopia increases in children with a family history of amblyopia, children born prematurely and those with developmental delays².

Amblyopic vision loss is preventable or reversible with timely detection and intervention so it is important to screen children at risk of developing amblyopia. Risk factors for developing amblyopia includes strabismus, ocular media opacities, anisometropia, and isoametropia⁴⁵.

Some of the screening techniques used in the detection of amblyopia based on age are, direct measurement of visual acuity and testing for risk factors by doing the cornea light reflex test, and cover testing for detection of strabismus and the Bruckner test for detection of ocular media opacities, strabismus, anisometropia and isoametropia. Instrument or equipment based paediatric vision screening is effective in pre-school age and younger children. It includes the use of portable autorefraction devices to detect refractive errors and photo screening devices which uses optical images of the eye to detect strabismus, refractive errors and abnormalities of the red reflex⁴⁶.

Amblyopia can be classified based on the disorders responsible for its occurrence. Strabismic amblyopia is one of the most common forms of amblyopia, occurring in the deviating eye of the child⁴⁷. Constant non-alternating heterotropias are the types most likely to cause significant amblyopia. Strabismic amblyopia is thought to result from competitive or inhibitory interactions between neurons carrying non-fusible input from the two eyes. This

interaction leads to domination of cortical vision centres by input from the fixating eye and also results in reduced responsiveness to input from the non-fixating eye⁴⁷ In young children suppression develops quickly in order to avoid diplopia and visual confusion².

Refractive amblyopia is another common form of amblyopia. Here there is defocusing of retinal images in one or both eyes. There are two types, anisometropic amblyopia, where there is dissimilar refractive errors in the two eyes, that causes the image on one retina to be permanently defocused. Levels of anisometropia that can lead to amblyopia are greater than 1.5D of anisohyperopia, 2.00D anisoastigmatism and 3.00D of anisomyopia².

Isoametropic amblyopia is a bilateral decrease in visual acuity that results from large approximately equal uncorrected refractive errors in the two eyes of a child. The mechanism of this form of amblyopia involves the effect of blurred retinal images on the immature visual system. Hyperopia exceeding 4.00-5.00D and myopia exceeding 5.00-6.00D carry a risk of developing isoametropic amblyopia. Uncorrected bilateral astigmatism results in meridional amblyopia the degree of cylinder that can cause this amblyopia is not known but most doctors will correct it when there is more than 2.00-3.00D of cylinder².

There is also visual deprivation amblyopia that is the least common type but severe and difficult to treat⁴⁸. It occurs because of an eye abnormality that obstructs the visual axis and interferes with central vision. The most common cause of this type of amblyopia is congenital cataract or early acquired cataract. Ptosis, lesions around the eye that obstruct the visual axis, cornea opacities and vitreous hemorrhage may also cause visual deprivation amblyopia. Unilateral deprivation amblyopia is worse than bilateral deprivation amblyopia caused by similar degrees of deprivation. In children younger than 6 years dense cataracts occupying the central 3mm or more of the lens is capable of causing severe visual deprivation amblyopia. Similar lens opacities acquired after 6 years are less harmful. Reverse

amblyopia is a form of visual deprivation amblyopia that develops in the fellow eye as a result of patching or penalization².

Treatment of amblyopia involves the elimination of any obstruction of the visual axis such as cataract, correction of any significant refractive error and forced use of the amblyopic eye by limiting the use of the good eye. Patching is commonly employed to treat unilateral amblyopia. The good eye is patched so that the child will make use of the worse eye, using adhesive patches⁴⁹. This treatment can be part time patching which last between 2-6hrs per day and full time patching where patching is done throughout all waking hours. Both types gives rewarding results.

There are other methods employed in the management of amblyopia which include the pharmacologic and optical degradation of the vision in the better eye. This can also be referred to as penalization. This can successfully treat moderate amblyopia. With the pharmacologic degradation, topical atropine 1% is used and for the optical degradation it involves the prescription of excessive plus lenses(fogging) for the good eye⁴⁹.

There can be complications in the management of amblyopia. With patching and penalization there is the risk of overtreatment which can result in reverse amblyopia in the good eye. There is normally lack of adherence to therapy as well as unresponsiveness. There can also be recurrence which normally occurs when treatment is discontinued after complete or partial improvement in vision. It is always better to redraw therapy gradually by reducing the number of patching ours over a period of about 3 months⁴⁹.

Accommodative esotropia is a form of strabismus where there is a convergent deviation of the eyes associated with the activation of the accommodative reflex, which is a reflex action of the eye, in response to focusing on a near object comprising coordinated changes in vergence, lens shape and pupil size. If the accommodation needed is more than the usual

amount, such as with people with significant hyperopia, the extra convergence can cause the eyes to deviate and it is a type of accommodative esotropia⁵⁰ which is also known as refractive accommodative esotropia. Other types of accommodative esotropias are partially accommodative esotropia and high accommodative convergence/accommodation ratio esotropia².

Refractive errors tend to cause strabismus as well. Strabismus that results from refractive errors tends to emerge later on in life, usually around the age of 2 years or older. Early diagnosis of strabismus will enable effective treatment. In the past, it was thought that after a "critical period", strabismus could not be treated. While treatment offered up to the age of 6 years is believed to be most effective, strabismus can be treated at any time in life. By definition refractive error occurs if the eye cannot focus the light rays as it comes in through the lens². Studies done in school children in some parts of Ghana recorded children with refractive errors. One of such studies conducted in Agona Swedru recorded 85.9% of the study population having one form of refractive error, with hyperopia taking the lead⁵¹. Another one done in Cape Coast, recorded a lower percentage of refractive errors (25.6%) and of the numbers recorded, hypermetropia was the commonest type of refractive error⁵². A study carried out by Faderin and Ajaiyeoba to determine the prevalence of refractive errors in primary school children in Nigeria found a prevalence of 7.3%, with hypermetropia being predominant in the younger age group and more girls presented with refractive errors than boys⁵³. From the aforementioned studies, hypermetropia was found to be the commonest type of refractive errors. If this type of refractive error is not corrected early it can cause the eye to deviate. The following are some refractive errors that can cause strabismus. Figure 2.1.

- i. ***Myopia, or short-sightedness:*** This makes far-away objects look blurry. It happens when the eye ball is too long from anterior to the posterior part of the

eye, or when there are problems with the shape of the cornea or the lens. These problems make light rays focus in front of the retina instead of falling on the retina. Myopia can be classified into two: low to moderate myopia referred to as simple myopia (-0.50 to -6.0D) and high myopia or pathological myopia

(> -6.0D)⁵⁴. Current studies done on the management of myopia has found atropine to be very helpful in the retardation of the progress of myopia. A study was done in India to assess the efficacy of 1 % atropine eye drops for the retardation of progress of axial myopia. The mean duration of follow up was 23 months. The base line rate of progression was reduced from -0.6D/year to -0.2D/year after atropine therapy⁵⁵. Another study conducted in China in children using low dose of atropine(0.01%) in a randomized controlled trial realized a mean myopia progression of -0.4 in the atropine 0.01% group and -0.76 in the placebo group with a relative reduction of 34.2% in myopia progression⁵⁶. Some studies have also suggested that children playing outdoors can limit the progression of myopia⁵⁷. In studies done so far atropine has proven to reduce the rate of progression of myopia. Other forms of treatment is the use of spectacle lenses. Minus lenses are used to correct myopia by causing divergence of light rays entering the eye to focus on the retina⁴⁷.

- ii. ***Hypermetropia (long-sightedness):*** It is generally believed that children with uncorrected hypermetropia are at risk of developing unilateral or bilateral amblyopia which may lead to the development of esotropia⁵⁸. In this type of refractive error the light rays entering the eye comes to a focus behind the retina because the cornea is too flat or the eye ball is too short. Hypermetropia or farsightedness is corrected using glasses (plus or convex lenses). Children are normally hypermetropic but hypermetropia above +3.0D if not corrected

will cause amblyopia and the eye will start squinting (strabismus). Thus, in children with hypermetropia, full correction must always be given. A study done by Mac Ewin et al realized that children with fully accommodative esotropia when given full correction will demonstrate smaller and more controllable angles of deviation than those who are under-corrected by as little as one prism diopter⁵⁹.

- iii. ***Astigmatism (irregular cornea curvature):*** This occurs as a result of an irregularly shaped cornea. Light rays entering the eye are refracted to a multiple focus points at the back of the eye making patients with astigmatism not able to see things from both far and near. There are two types of astigmatism which are the regular and irregular astigmatism. Currently laser corneal ablation continues to be highly effective for correcting low-to-moderate levels of astigmatism and may be the best option for younger patients. For eyes with astigmatism and cataract both peripheral corneal-relaxing incisions and cataract extraction with toric intraocular lenses have proven to be effective⁶⁰.
- iv. ***Anisometropia:*** This condition occurs when the refractive state of the right eye is different from that of the left and it varies by more than 1 diopter. This can lead to amblyopia causing strabismus. There are two categories of anisometropia. We have the absolute and the relative anisometropia. The absolute anisometropia has sub types which are as follows, simple anisometropia, where one eye sees normally whiles the other is myopic or hyperopic, compound anisometropia, both eyes are myopic or hyperopic. And the mixed type one eye is myopic and the other is hypermetropic. There is relative anisometropia when the total refraction of the two eyes is the same but there is a difference in the axial length between the eyes. This means that both

eyes put out a clear image but the images are of different sizes. There is also compound astigmatic anisometropia where both eyes are astigmatic but to an unequal degree and simple astigmatic anisometropia where one eye is either myopic or hyperopic and the other is astigmatic. Management involves the use of contact lenses or spectacle lenses².

REFRACTIVE ERRORS

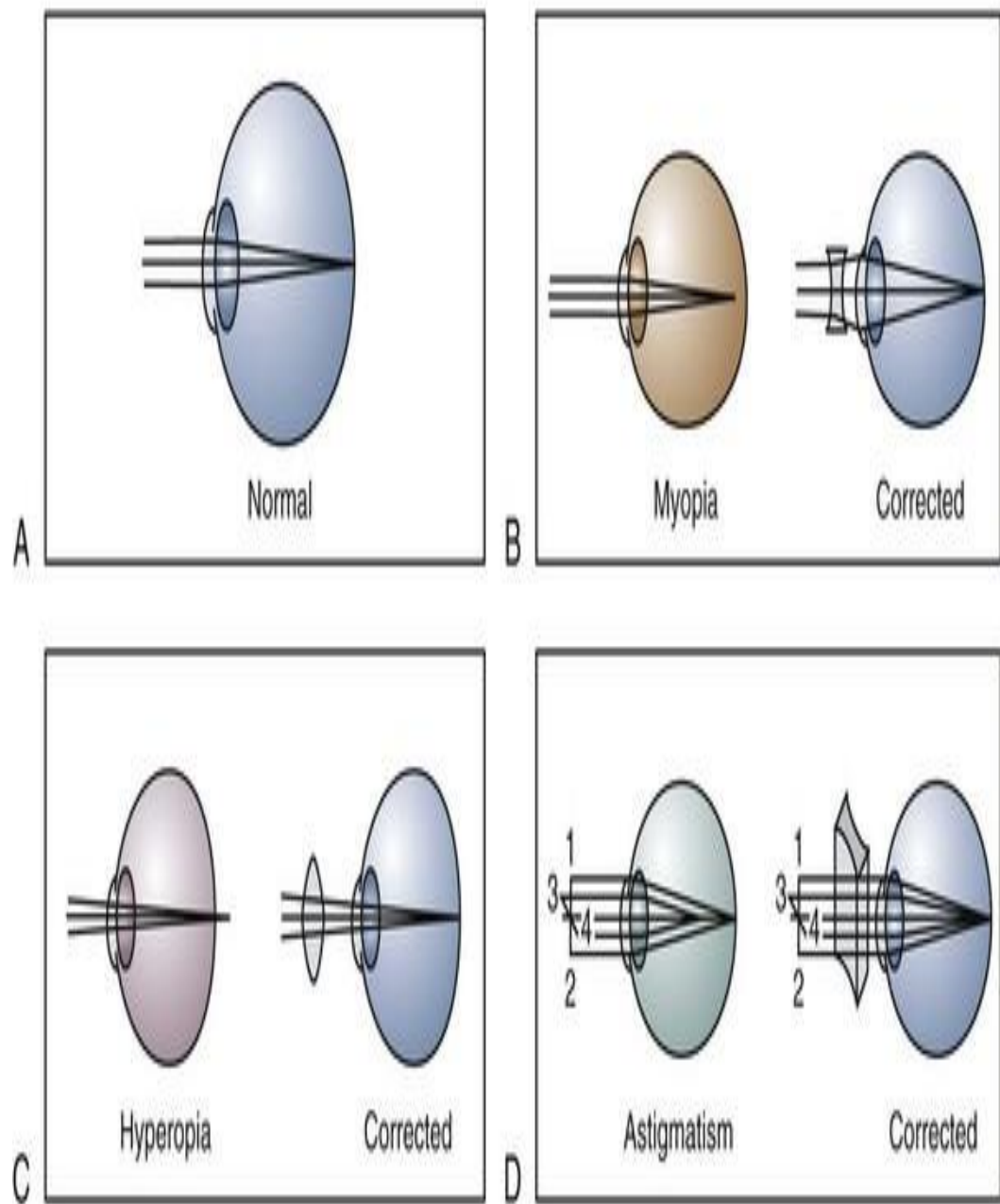


Figure 2.1Types of refractive errors .

2.3 Classification of Strabismus

There are different ways in classifying strabismus. They can be classified by the age of onset as infantile and acquired. With infantile, the deviation is documented before 6 months of age and might be related to a defect present at birth. With the acquired, the deviation occurs after 6 months of age after the period of normal visual development. Strabismus can also be classified in terms of fixation, whether alternating or monocular. With alternating type of strabismus, there is spontaneous alternation of fixation from one eye to the other. In monocular fixation, there is a preference for one eye in terms of fixation and always the eye with clear image is preferred².

Another way of classifying strabismus is the variation of the amount of deviation with gaze position or fixating eye. In this type of classification, there can be comitant and incomitant strabismus. Comitant strabismus has the size or amount of the deviation being equal in all directions of gaze. Incomitant strabismus has the size of the deviation being unequal in all directions of gaze. Incomitant strabismus are mostly paralytic or restrictive².

2.4 Types of Strabismus

There are different types of strabismus. Most of the names describe the various types of ocular deviations. A lot of prefixes and suffixes are used based on the relative position of the visual axes of both eyes.

Prefixes: These include 'Eso', here the eye is rotated so that the cornea is deviated nasally and 'Exo', where the eye is rotated such that the cornea is deviated temporally. The 'Eso' and 'Exo' describe horizontal deviations. 'Hyper' and 'Hypo', are terms used to describe vertical strabismus. 'Hyper', is when the eye is rotated such that the cornea is deviated upwards or superiorly. 'Hypo', depicts the eye rotating so that the cornea is deviated inferiorly².

There are torsional strabismus which may have an 'In' as a prefix, representing intorsional strabismus, where the eye is rotated such that the superior pole of the vertical meridian rotates or twist nasally. In 'Ex' prefix (extorsional strabismus), the eye is rotated such that the superior pole of the vertical meridian is rotated or twisted temporally².

Suffixes: These are tropia and phoria. 'Tropia' is a manifest deviation of the eye. In tropia the fusional mechanism control is exceeded so that the eye is misaligned under binocular conditions. Tropias can be constant (present all the time) or intermittent (not present at all times). 'Phoria' is a latent deviation that is controlled by the fissional mechanism so that the eyes remain aligned under binocular conditions⁶¹. So from the aforementioned descriptions there exist the following types of strabismus (Figure 2.2):

- i. Hypertropia /Hyperphoria is when the eye turns upwards.
- ii. Hypotropia/Hypophoria is when the eye turns downwards.
- iii. Esotropia/Esophoria is when the eye turns inwards. There are different types of esotropia ,we have the infantile esotropia, accommodative esotropia under which we have refractive, nonrefractive and partially accommodative. Infantile esotropia is defined as an esotropia that is present by 6 months of age. As known in literature², variable transient intermittent strabismus is commonly observed in the first 2-3 months of life and it is common to see both intermittent esotropia and exotropia in the same infant termed ocular instability of infancy. By three months, this should resolve if it does not and it becomes constant, more than 30D then it is unlikely for it to resolve on its own and surgical intervention will be needed. Patients with infantile esotropia normally have a family history of esotropia. The cause of infantile esotropia remains unknown. Infantile esotropia when evaluated has normal ductions and versions initially, the deviation is comitant and larger than 30D and after one

to two years of age, they can develop overelevation in adduction and dissociated strabismus complex develop in more than 50% of patients².

With accommodative esotropia, in the refractive type, it involves 3 factors, uncorrected hypertropia, accommodative convergence and insufficient fusional divergence. Uncorrected hyperopia forces the patient to accommodate to focus objects on the retina, and accommodation comes with the other components of the near triad which are vergence and miosis. The amount of deviation is approximately equal at distance and near and have an average of +4.00D esotropia. In those with high accommodative convergence over accommodative ratio excess convergence tonus for the amount of accommodation required to focus is present when proper full cycloplegic refraction is used. Here the deviation is larger at near and the refractive error is around +2.25D. In partially accommodative esotropia there is a reduction in the angle of deviation when wearing the glasses but has a residual esotropia that needs to be corrected with glasses.

- iv. Exotropia/Exophoria is when the eye turns outwards. Intermittent exotropia is the most common type of exodeviation² The onset is usually before age 5 years and the deviation is not present all the time. The deviation becomes manifest during visual inattention, fatigue or stress. The deviation is normally larger at distant and may not be elicited at near. Untreated intermittent exotropia may progress to become constant which can become associated with amblyopia⁶². On evaluating a patient with intermittent exotropia, the control can be graded using the Newcastle Control Score and the score can also be used to serially assess improvement or deterioration of the intermittent deviation⁶³ Exotropia can be classified into four different types made up of

pseudo divergence excess, basic exotropia, true divergence excess and convergence weakness.

With pseudo divergence excess there is a larger deviation at distance than at near initially but the difference becomes minimal after monocular occlusion or with +3.00D lenses at near. Basic exotropia has the amount of deviation being the same at distant and at near. True divergence excess which is the least common occurs when the deviation at distance is larger than at near and the deviation does not equalize after monocular occlusion or with +3.00D lens. Convergence weakness exotropia is present when the exodeviation is greater at near than at distance. Patients with intermittent strabismus have stereopsis on sensory testing when the eyes are aligned.

There are other types of exotropia, Constant exotropia, infantile exotropia, sensory exotropia and consecutive exotropia. Constant exotropia mostly occur in older children or long standing intermittent exotropia that has decompensated. Here the deviation is always present and surgery is the treatment of choice. Infantile exotropia is present before age 6 months with a large-angle constant deviation. Sensory exotropia normally occurs when there is any condition that reduces vision in one eye, eg. in anisometropia, cornea or lens opacities, optic atrophy or hypoplasia, retinal lesions, or amblyopia. Consecutive exotropia is an exotropia that occurs after a period of esotropia. Rarely exotropia may spontaneously develop in a patient who has not had surgery but the commonest type of consecutive exotropia develops after previous surgery of esotropia.(postsurgical exotropia)⁶⁴. This usually develops within few months or years after the initial surgery. Treatment of postsurgical exotropia depend on many factors, including the type and amount of previous surgery, the presence of duction limitation and lateral incomitance.

The age of the patients and type of strabismus are factors known to impact upon the detection and prevalence of strabismus². Sampling a population that is too young may not detect certain types of strabismus with delayed onset such as accommodative esotropia while onset of other subtypes such as intermittent exotropia may be delayed even further, and thus lead to late reporting of the condition to the hospital. Few studies have reported that congenital esotropia and accommodative esotropia appears at the age of 2-3 years and most exotropia, particularly intermittent exotropia, becomes manifest between the ages of 6 -10 years².

Horizontal types of strabismus are commoner than vertical and torsional types, with esotropia being commoner than exotropia as horizontal types of strabismus⁶⁵. A study done in Southwest Nigeria on the common forms of strabismus in a tertiary eye hospital realized that esotropia (53.8%) was more common than exotropia (44.2%) and the male to female ratio was 0.98 :1⁶⁶. Another study by Khorrami et al in India found the prevalence of esotropia to be about two and a half times more than exotropia⁶⁵. Another study done by Shimauti et al in Portugal realized that esotropia (46.3%) was more prevalent followed by exotropia (38.2%) 15.4% of the deviations were associated vertical or horizontal syndromes⁶⁷.

In another study, it was the reverse where there were more people with exotropia than esotropia and this was seen in a study on Japanese adult population where the ratio of exotropia to esotropia was 18.5:1⁶⁸. Strabismus may be constant or intermittent. A study on school children in Iran found that 2.17% of those who had strabismus were boys and 1.27% were girls⁶⁹. They also realized that 1.27% of the children had exotropia and 0.44% had esotropia. The prevalence of constant and intermittent strabismus was 0.73% and 0.96% respectively, meaning majority of the children had intermittent strabismus⁶⁹. Another study done in the United kingdom by Allison Bruce et al, to determine the prevalence, types and early-life risk factors associated with strabismus in children aged 4-5 years saw that the

commonest type of strabismus was exotropia (53%) followed by esotropia (45%) and the vertical deviations (2%)⁷⁰.

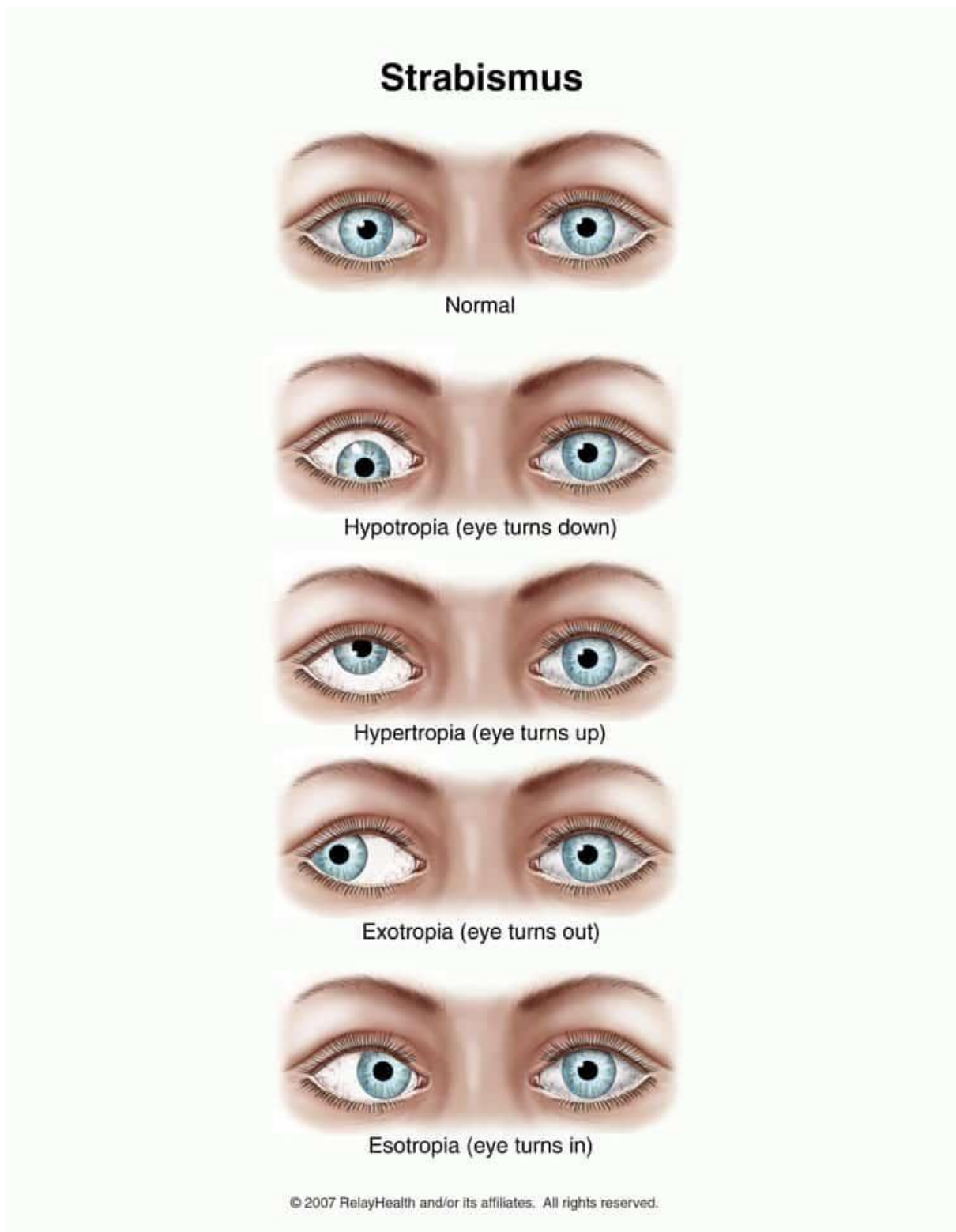


Figure 2.2: Types of Strabismus.



Figure 2.3. Before surgical correction (Exotropia).



Figure 2.4. After surgical correction (Exotropia)



Figure 2.5. Before spectacle correction (Esotropia).



Figure 2.6: After spectacle correction and patching (Esotropia).

2.5 Screening and Diagnosis of strabismus

Screening of the eye is done to detect any abnormality of the eye. Through early detection, the prognosis for strabismus after treatment is good, making it extremely important to refer any child with strabismus to an ophthalmologist for treatment⁷¹. In the management of strabismus, children and babies should have routine eye screening as they develop. The American Optometric Association recommends starting eye tests at 9 months, or earlier if the child has a constant eye turn⁷². If there are signs of strabismus, the physician or optician will refer the child to an ophthalmologist for further management.

During an eye examination, tests such as cornea light reflex test and cover testing are used in the diagnosis of strabismus. The cornea light reflex test forms the basis for the Hirschberg and the Krimsky tests, and these are used in the diagnosis and measurement of strabismus⁷³. The Hirschberg test, or Hirschberg corneal reflex test, is used to assess whether the patient has strabismus. The ophthalmologist shines a light in the eye and observes the position of the cornea light reflexes simultaneously in both eyes. If the eyes are well-aligned, the light reflex will be observed at the center of the cornea in each eye. If it does not align in the center, then depending on the position of the light reflex, the eye can be exotropic (where the reflex is medial or nasal to the center of the cornea), esotropic (where the reflex is lateral

or temporal to the centre of the cornea), hypertropic (where the light reflex is inferior to the centre of the cornea) or hypotropic (where the light reflex is superior to the centre of the cornea). The Krimsky test uses prisms to quantify the decentration of the corneal light reflexes. This is done by holding a prism over either eye and adjusting the prism power to center the corneal light reflexes in the two eyes. The amount of deviation is equal to the power of the prism required to centre the light reflexes simultaneously in both eyes, it is possible to approximate the near deviation.

The cover test can also be done to diagnose strabismus. It has 3 components which are as follows.

- i. Cover-uncover test – is the most important test for detecting manifest strabismus and for differentiating a heterophoria from a heterotropia. As each eye is covered the examiner watches for any movement in the fellow eye, that is the non-covered eye and such movements indicate heterotropia. If there is no movement of the non-covered eye, movement of the covered eye as the cover is applied and movement in the opposite direction as the cover is removed indicates a heterophoria. If the patient has heterophoria the eyes will be straight before and after the cover-uncover test. An individual with heterotropia will start with a deviated eye and after testing, ends with the same eye or in the case of an alternating heterotropia, the fellow eye deviated. With regards to patients with intermittent heterotropia the eyes are normally straight before the test but they dissociate into a manifest deviation after the occlusion which interrupts binocular vision.
- ii. The alternate cover test – it detects both latent and manifest deviation and it is done at both distance and near fixation. The deviation is quantified by using prisms to eliminate the eye movement as the occluder is switched from one eye to the other. It may be necessary to use both horizontal and vertically placed prisms. This measures

the total deviation. It does not distinguish between latent and manifest components of the deviation.

- iii. Simultaneous prism and cover test- this is used to determine the manifest deviation without occlusion (only heterotropia). The test is done by placing a prism in front of the deviating eye and covering the fixating eye at the same time. The test is repeated using increasing prism powers until the deviated eye no longer moves. This simultaneous prism and cover test provides the best indication of the size of the deviation under real- life conditions².

2.6 Management of Strabismus

Historically, treatment of strabismus began in the late seventeenth century with Chevalier Taylor through an unofficial strabismus surgery he performed in 1750 to manage squint⁷⁴. His idea was officially accomplished by the German scientist Johann Friedrich Dieffenbach who successfully and officially performed a strabismus surgery on a living person by cutting the inner rectus muscle in order to cure squint in 1839⁷⁵. This led to the advancement of strabismus surgeries such as tenotomy, muscular advancement surgery, muscular pleating surgery, muscular resection and treatment for esotropia at the end of the nineteenth century⁷⁴.

The primary therapeutic goal for management of those with strabismus is to give them a contented, single, clear, normal binocular vision at all distances and directions of gaze⁷⁶. Strabismus is usually treated with a combination of eyeglasses, vision therapy and surgery, depending on the underlying cause of the misalignment⁷⁷. Prompt treatment reduces the risk of complications, such as amblyopia, or lazy eye. The younger the patient is, and the earlier the treatment intervention, the better the treatment outcome. Treatment options include non-surgical and surgical management.

Non-surgical management.

Glasses: It is always important as a first step in the management of strabismus to correct refractive errors which helps the patients to have clear vision which in turn aids in fusion of images ⁵⁸. In cases of accommodative esotropia if it is the refractive type giving only glasses will align the eyes. In patients with accommodative esotropia with high AC/A ratio they can be managed optically, pharmacologically or surgically². Optically the management involves the use of bifocal lenses and the additional plus further reduces or eliminate the need to accommodate for near fixation. Pharmacological therapy which is no longer in use helped to reduce the central demand for accommodation innervation and thus reduce the amount of convergence induced by accommodation. Treatment of partially accommodative esotropia involves the use of glasses and surgical correction of the deviation left when the patient wears his or her full correction. Basic acquired non accommodative esotropia is normally managed with surgery after ruling out any underlying cause. Exotropic deviations are managed by first correcting all refractive errors after which if there is progression from intermittent to constant then surgery must be considered. Occlusion therapy also helps in the management of exotropia in patients with amblyopia and this may improve control of the exotropic deviation. Active orthoptic treatments like antisuppression therapy/diplopia awareness and fissional convergence training can be used in combination with patching.

Strabismus surgeries are also done to align the eyes by shortening, lengthening, or changing the position of one or more of the extra ocular eye muscles. Vision Therapies are also done to alter the entire nervous system resulting in a much better lasting cure.

Botulinum toxin A injection, or botox: This is injected into a muscle on the surface of the eye. The doctor may recommend this treatment if there is evidence of threatened or recently lost binocularity or risk of creating or worsening diplopia after surgery. The botox temporarily weakens the injected muscle, and this can help the eyes to align properly.⁷⁸.

Optometric Vision Therapy is an individualized, supervised, non-surgical treatment program designed to correct eye movements and visual-motor deficiencies⁷⁹. Vision Therapy sessions include procedures designed to enhance the brain's ability to control:

- i. eye alignment,
- ii. eye teaming,
- iii. eye focusing abilities,
- iv. eye movements, and/or,
- v. visual processing.

Vision therapy exercises for strabismus focus on increasing fusional vergence ranges (increasing convergence in exotropics and divergence in esotropics). Esotropia therapy in children has been shown to be more successful in individuals with a later onset of deviation, having accommodative component to the deviation and successful amblyopia treatment⁸⁰. Children with exotropia also benefit from vision therapy and their therapy a very successful when they did not have amblyopia, had gross stereopsis and when the deviation was intermittent⁸⁰. There are some vision therapy exercise known to help in the management of strabismus⁸¹ some of them are, brock string, vectograms, life saver cards, eccentric circles, aperture rule, jump vergence and computer orthoptics (computer programmes that train the eyes).

Brock string trains patient to have gross vergence ability. The string is stretched so that one end is on the patients nose and another end is pulled far apart. The patient

then fixates on the beads at different distances from the eye to improve their convergence and divergence skills.

The barrel card trains convergence. The patient holds the card up to the bridge of the nose with the smallest barrel closest to the patient. The patient will work on looking at the different barrels, and they should see a combination of the red and green colours of each barrel.

Aperture rule trains both divergence and convergence. The device has a stick that looks like a rule with an aperture slide on one end and the viewing card on the other. The single apertures is used for convergence and the double one is used for divergence. The aperture is moved along the stick corresponding with the numbered cards and this provides varying vergence demands beginning with 2.5 prism diopters up to 30 prism diopters and also includes antisuppression tools.

Vectogram train divergence and convergence Variable vectograms come as a pair of translucent slides with polarised image on them, one slide to be viewed by each eye when the patient is wearing polarized glasses. The patients goal is to keep the image single and clear during the exercise. The slides begin on top of one another requiring no vergence demand to fuse. As the slides are separated the vergence demand increases. Life saver cards can be used to learn convergence or divergence, depending on the location of the patients focus. There are four magnitudes of set vergence demand on the card, These cards come in opaque or translucent options.

Computer Orthoptics are computer programmes that utilizes different techniques to train vergence ability which includes increasing the velocity of vergence fissional responses.

Visual-motor skills and endurance are developed through the use of specialized computer and optical devices, including therapeutic lenses, prisms, and filters. During the

final stages of therapy, the patients newly acquired visual skills are reinforced and made automatic through repetition and by integration with motor and cognitive skills⁸².

There are some exercises for strabismus. A standard type of exercise for strabismus is home-based pencil pushups (HBPP). This is indicated for intermittent strabismus. To do HBPP, the following steps are employed: The individual

- i. Holds a pencil at arm's length, positioned midway between the eyes.
- ii. Looks at the pencil while moving it toward the nose, and tries to maintain a single image of it.
- iii. Keeps moving the pencil toward the nose until s/he can no longer see it as a single image.
- iv. Holds the pencil at the closest point where a single image is possible.
- v. If the individual cannot regain a single image, the test is restarted.

A study by Frantz⁸³ on patients who performed two sets of 20 "push-ups" each day for 12 weeks suggested that the exercise could be "an easy, cost-free, and effective therapy.



Figure 2.7: An aperture rule.



Figure 2.8: A picture of barrel cards.



Figure 2.9: A picture of a brock string.



Figure 2.10: A picture of a child with a brock string.

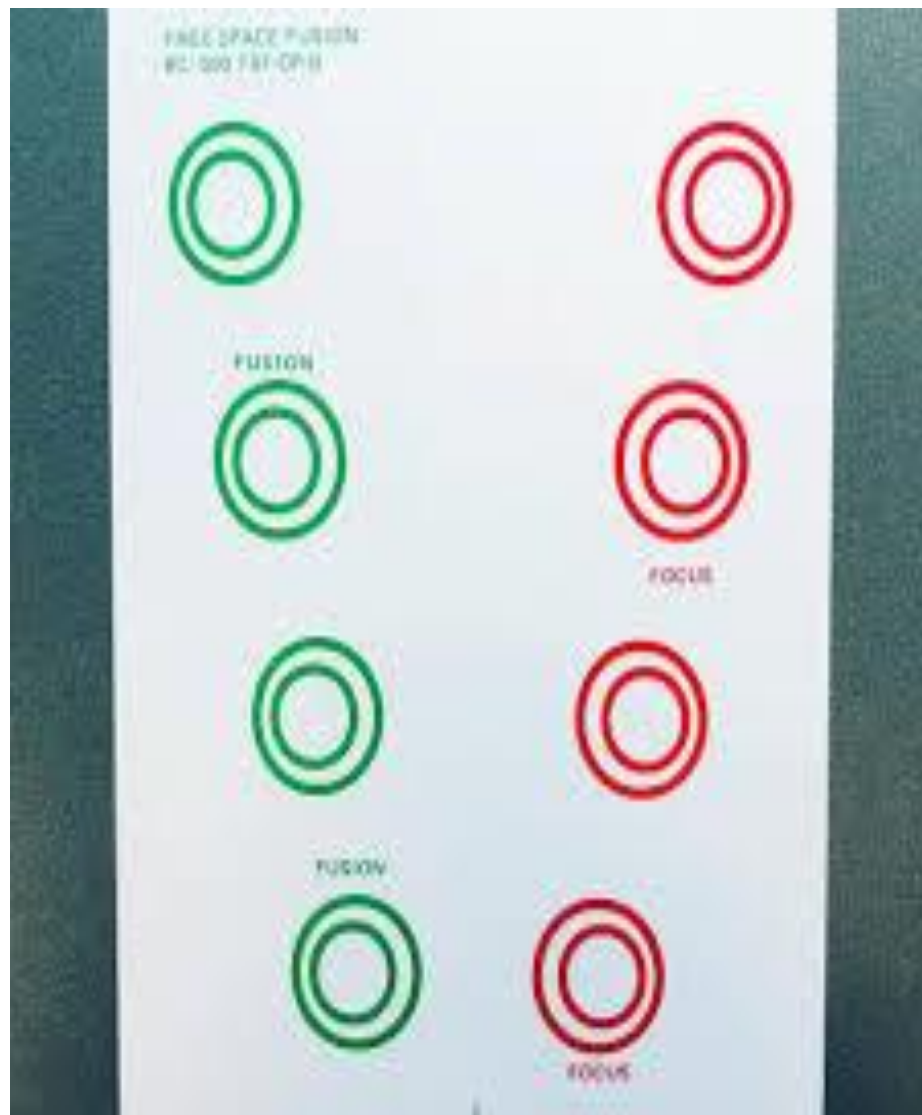


Figure 2.11: Life saver cards.



Figure 2.12: Vectogram.

Surgical Management of Strabismus

With basic strabismus, surgery must be done to align the eyes and restore binocular vision single vision if possible. Sometimes both eyes need to be operated on to get the correct ocular alignment. There are different types of surgeries indicated for different types of strabismus. Thus, it is very important to know the type of strabismus one is dealing with, in order to plan for the appropriate surgery. With strabismus one may want to do the surgery in only one eye(eye with poor vision) or in both eyes(when there is equal vision in both eyes). Strabismus surgeries to align the eyes may be by shortening, lengthening, or changing the position of one or more of the extra ocular eye muscles². With horizontal or vertical strabismus, one may want to do recession of the extraocular muscles in both eyes or do a recession/ resection in one eye depending on the type of strabismus.

Complications of strabismus surgery

Some complications can occur in the surgical management of strabismus. Some of these complications may occur intraoperatively or postoperatively. Intraoperative complication may include, lost and slipped muscles and perforation of the sclera. Postoperative complications may include diplopia. A patient may complain of diplopia after strabismus surgery but will under normal circumstances not persist for a long time. Prolonged postoperative diplopia need to be managed and one may use prisms to manage the diplopia².

Other complications of strabismus surgery are unsatisfactory alignment, iatrogenic Brown Syndrome, anti-elevation syndrome, ‘pulled in two’ syndrome, and postoperative infections.

2.7 Distribution and Socioeconomic Burden of Strabismus in the World and Africa

Globally, it is projected that 285 million people around the world are visually impaired with 19 million of this number being children below the age of 14 years⁸⁴. About

43% of this population of visually impaired is due to refractive errors, which is the principal cause of visual impairment in children including strabismus⁸⁵. Most studies on patients with strabismus show no sex preponderance thus it not clear the effects of gender on strabismus⁸⁶.

2.8 Effect of Strabismus on Vision

It is known that patients with strabismus may have problems with visual acuity and other deficits in their vision in terms of functional vision such as poor depth perception⁸⁷. A study by Hatt et al, established that children with strabismus had lower functional vision and eye related quality of life as compared to their peers who had normal functional vision⁸⁷. The same study further showed that the parents of the children with strabismus had reduced quality of life as compared to those with children who had normal vision. Strabismus may or may not have an impact on vision with vision being normal and equal in both eyes or unequal in both eyes. Azonobi et al in Nigeria in their study assessed the vision in strabismic children where they found 78.1% of these children had normal vision and most of the children had esotropia⁸⁸.

2.9 Barriers to the Utilization of Strabismus Screening Services and Management

Diversity of barriers exist which prevent both parents and children from accessing vision screening at various health facilities and these include social, economic and political problems⁸⁹. The social barriers include ignorance, language and lack of health providers. Some studies have revealed that most patients with strabismus are ignorant of the condition hence do not know what to do⁹⁰. However, in some settings, the situation is different as there are no eye specialists in the community to attend to the patients when they report⁹¹.

In communities where there is an eye specialist available, some patients, for fear of humiliation and ridiculing from some of the care providers do not access care and treatment⁹². Low income families face financial barriers consequently they prioritise other

paediatric health needs over visual needs⁹³. It is clear that low income, uninsured families are at higher risk of not utilizing vision screening programs especially those related to strabismus. Ignorance remains a major problem at all levels so improvements in the dissemination of information and education on health are needed to help bridge the gap between service providers and patients⁹⁴. A review by Castanes⁹⁵ on the underutilization of vision screening for amblyopia, optical anomalies and strabismus among preschool age children showed that a variety of barriers exist which prevent children from receiving proper vision screening. They include social, economic and even political factors. Social barriers include ignorance, language, and lack of providers. Financial barriers affect low-income families. Political barriers reside in the disproportionately meagre funding for preventive medicine. Moreover, there are additional factors, which put preventative medicine for vision at a disadvantage compared to other paediatric demands like immunizations.

A final report on the early versus late infantile strabismus surgery study indicated that at age six years, 13.5% of the children whose surgeries were done early gained stereopsis, they could recognise the Titmus fly in their assessment for stereopsis as against 3.9% of the children who were operated late⁹⁶. In this same study it was shown that early surgery group demonstrated some significant gains in vision when compared with the late surgery group, especially with respect to the presence of amblyopia⁹⁶. A cohort study conducted in the United States demonstrated that the incidence of adult onset strabismus increases with age, specifically after the sixth decade of life and peaks in the eighth decade of life with the lifetime risk of being diagnosed with adult onset strabismus being about 4% in women and 3.9% in men⁹⁷.

Sathyan and Jose in their study at a tertiary eye centre in Kerala, India, which examined the barriers responsible for delay in surgical management among adult patients with strabismus established that social factors such as lack of awareness of surgery, fear of

surgery and non-affordability of care were the main contributors to the delays in seeking for treatment. The reason for them seeking care in adulthood was to improve self-esteem and quality of life and also pressure from the family¹⁵. Coats et al also found reasons for delay in seeking surgical treatment by some adults with strabismus in their centre, Texas Children Hospital after a mean delay of about 20 years⁹⁸. Some of the reasons alluded to by their study participants included 'care was never sought for, never offered surgery by specialist, surgery was offered but was declined by the patient, that nothing could be done, was too old to have surgery, was treated non-surgically until recently and poor experience with previous strabismus surgery⁹⁸.

A study reported 85% of adult patients with strabismus had problems with work, school, and sports because of their strabismus with 70% of them reporting that strabismus had a negative effect on their self-image³.

2.10 Knowledge, Perception and Awareness of Strabismus

Strabismus can have a negative impact on an individual's life. Knowledge and awareness of strabismus in advanced countries is known to be high with a strong positive correlation between the level of awareness about strabismus and interest in its treatment⁹⁹

Some studies have suggested and recommended that in order to address the low interest in the uptake of treatment by individuals with strabismus in developing countries, there is the need to determine the level of knowledge of strabismus within this settings to inform the planning of suitable interventional programs²⁰.

The contribution of factors such as gender and age on awareness of strabismus, have had varying results in the literature. A study done in Ilorin in Nigeria on the prevalence and patterns of strabismus realized that there were more males than females¹⁰⁰. Where some studies have demonstrated significant association between awareness of strabismus and

gender others have shown no significant impact of age and gender, when compared with other socioeconomic parameters, on the perception of strabismus by adults and children in Switzerland ¹⁰¹. Another study done in Portugal by Shimauti et al⁶⁷. showed that the frequency of strabismus in the population was on the average 1.4% with no difference between gender⁶⁷.

In Cheha district in central Ethiopia in a developing country, 62.8% did not know about strabismus, though some individuals and parents reported to know the consequences of diseases that affected the eye, they did not know much about strabismus ²¹. This is contrary to a study performed in the United Kingdom that established that majority of adults with strabismus had enough knowledge about it and sought for treatment at the hospital⁹⁹.

A study undertaken in India among adolescents with strabismus aged between 15 and 25 years revealed that 80 % of them had problems with their social life and this was attributed to their perception about the cause and treatment of strabismus, with some thinking it could be cured surgically or through drugs¹⁰².

In Turkey the effects of socioeconomic status on visual disorders and the accessibility to eye care services among school children was conducted. the study revealed that about 65% and 22% of the children in government and private schools respectively had never been formerly examined¹⁰³. A similar study in Canada, that also evaluated socioeconomic status and its association with equal utilisation of amblyopia services at a tertiary paediatric hospital, found that majority (32.5%) of the children with amblyopia who reported at the clinic were from the rich neighbourhood while children from poor areas were around 14.6% - 15.5%¹⁰⁴.

A study conducted in Ethiopia to assess knowledge about strabismus and associated factors among adults in the Gonda town, northwest Ethiopia realised 52.3% of the population had good knowledge about strabismus and being a student was positively associated. This

meant that the students had more knowledge about strabismus. while income was negatively associated with good knowledge, since those who had high incomes did not have a lot of knowledge about strabismus. Most of the information about strabismus was from television and internet¹⁰⁵.

Provider barriers such as attitudes towards patients with strabismus also contribute to the willingness of patients to seek care from health facilities when strabismus is noticed. A study conducted in Iran suggested that 70% of patients with strabismus were attracted to, and felt comfortable going to health centres with friendly care providers¹⁰⁶.

A study conducted in the United Kingdom reported on psychosocial costs associated with strabismus and its treatment, with children who wear glasses or eye patches more likely to be physically or verbally intimidated¹⁰⁷. Such bullying occurs irrespective of the child's social class and other factors such as, the level of maternal education¹⁰⁸. These challenges relating to socially visible strabismus even persist with some people into adulthood,^{103,107} thereby impacting negatively on a patient's life in the area of their self-image, confidence, ability to interact with social peers and also their ability to form romantic attachments in the society¹⁰⁹.

Social phobia has been found to be significantly higher in patients with strabismus than in a normal control group, affecting their social, family and professional lives¹¹⁰. Depression is a negative sequelae of strabismus on some individuals with some patients with strabismus willing to trade a portion of their life expectancy in return for a cure for strabismus and its associated effects¹¹¹.

A study by Isawumi, Ulaikere, Adejumo, Adebayo, Kekunnaya¹¹² on the awareness, perceptions and knowledge of strabismus among patients visiting a tertiary eye clinic in Southwest Nigeria, using a descriptive cross-sectional study through a total sampling technique and a Face-to-face interview by the employment of questionnaire. The study showed that approximately 75 % of patients were aware of strabismus. Perceived causes were

unknown to 53 % while 18.0 and 12 % mentioned eye disease and congenital-related, respectively. There was no knowledge of treatment in 54 % of patients, while 21 and 25 % knew about medical and surgical treatment, respectively⁹².

Singh et al¹¹³ did a study on the knowledge and attitude of parents toward children suffering from strabismus in the Indian subcontinent. they found that the source of information for parents with higher education strata was mainly internet (81.3%) which is much more reliable as compared to the other group where source of information was mainly relatives and peer group (91.1%) which may not be reliable. Thus, education level may have a significant impact on knowledge and attitude of parents toward strabismus and their willingness to seek for treatment for their children¹¹³.

In Nigeria, Ebeigbe, Emedike¹¹⁴ also demonstrated a high parental awareness and perception of children's eye diseases including strabismus (57.1%). A finding corroborated by Bodunde et al in South Western Nigeria¹¹⁵. Despite the high awareness or knowledge about strabismus in some settings, the knowledge about the cause of strabismus remains poor, with some attributing the disease to reasons such as watching television for too long a time, sitting at one position during pregnancy among others¹¹⁵.

2.11 Stigmatization and Self Esteem

Some children with strabismus may have low self-esteem due to the way their peers relate to them, as compared to those with normal eyes. A study by Uretmen et al looked at the social acceptance of children with strabismus by their peers showed that at age 6 years, children with strabismus are less likely to be accepted by their peers¹¹⁶. Another study which determined whether the presence of noticeable strabismus creates a negative social bias against children using photographs simulating different types of strabismus found that children with strabismus were rated more negatively than those with straight eyes¹¹⁷. Mojon et al did a study to determine the influence of strabismus on the ability to find a partner in

Switzerland using digitally altered photographs of strabismus man and woman, as well as images of other computer-generated facial anomalies, of the 40 dating agents 92.5% judged that patients with strabismus had more difficulty finding a partner (p-value <0.001). The difficulty was not associated with either gender or age but was seen as being greater in exotropia than in esotropia and they concluded that visible or manifest strabismus has a negative influence on the ability to find a partner¹⁰⁹. A study done by Archer et al¹¹⁸ to evaluate the psychosocial effects of childhood strabismus surgery using parents as proxy, observed a statistically significant improvement in social, emotional and functional measures in the children with overall improvement in the quality of life of the children.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter comprises study design, study area, study setting, variables to be studied, study population, sample size estimation and sampling techniques. It also describes the data collection technique used, quality control aspect of the study, data processing, data analysis and ethical consideration.

3.2 Study design

This was a hospital-based cross-sectional study of factors contributing to late presentation of patients with strabismus at the KATH Eye Clinic.

3.3 Study setting

The study setting is the Komfo Anokye Teaching Hospital (KATH) located within the Kumasi Metropolis. The Kumasi Metropolis is centrally located in the Ashanti Region of Ghana. It is the second largest city in the country and is one of the 30 administrative districts in Ashanti Region. It is a fast growing Metropolis with an estimated population of more than two million people and an annual growth rate of about 5.4%¹¹⁹. Its unique central position makes it accessible from all parts of the country.

There are five hundred and twenty seven (527) health facilities in Ashanti region and Kumasi has the highest number of facilities (29%) of which Komfo Anokye teaching hospital is one.

Komfo Anokye Teaching Hospital (KATH) is a tertiary hospital located in Kumasi, the Ashanti Regional capital, with a bed capacity of thousand two hundred (1,200). KATH is

the second largest hospital in Ghana after Korle- Bu Teaching Hospital in Greater Accra Region. KATH serves as the referral centre for patients from its catchment area, the Ashanti region with a total projected population of 4,780,380. It also receives referrals from the middle belt of Ghana, Eastern, Western and the five Northern Regions (Upper East, Upper West and Northern).



Figure 3.1: Map of Ghana showing the location of Komfo Anokye Teaching Hospital.

The KATH Eye Clinic is a modern two-storey building, with a basement, that has a theatre complex with five operating tables, as well as a 20-bed ward capacity. Other floors house a spacious out-patient's department with a large waiting area, training and lecture wings, a diagnostic section, consulting rooms, vision area, nurses screening area, revenue and medical records units. Additionally, there are rooms for refraction, the ocularist and an optical work shop among others. Among the key eye activities undertaken at the eye clinic are general ophthalmology, sub-specialty clinics for retina, paediatric ophthalmology, cornea and external eye, glaucoma and oculoplastics. The clinic also carries out eye surgeries, Laser procedures and eye investigations and imaging (visual field testing , ultrasound scans, OCT etc). The clinic sees about 90 new patients daily. The staff strength, apart from other auxiliary workers such as both male and female orderlies, pharmacy technicians, staff nurses and revenue collected, the clinic has about 25 ophthalmic nurses, 6 specialist ophthalmologists and 3 consultant ophthalmologist. The clinic also undertakes outreach services in the community and it is one of the residency training centres for ophthalmology in Ghana.

3.4 Study population

Children and adults of all ages presenting with strabismus to the Eye Clinic at the Komfo Anokye Teaching Hospital formed the study population.

3.5 Inclusion criteria

All children and adults who presented with strabismus to the Eye Clinic at the Komfo Anokye Teaching Hospital and whose parents/guardians consented and others (children aged 8 years to 17 years) who gave assent in addition to the parental/guardian consent, were included in this study. The adult patients gave their consent as well.

3.6 Exclusion criteria

Patients with strabismus who did not consent or whose parents/guardians did not consent to be part of the study.

3.7 Sample size calculation

$$n = z^2 p(1-p)/(d^2)$$

Where “n” is the sample size, “p” is a known prevalence (17.9 %) of strabismus among Ethiopian children which was obtained from a study by Agaje et al ¹²⁰ “d” is degree of accuracy desired, i.e., 0.05 and “z” is confidence level, i.e., 1.96. The sample size formula was derived from the Cochran sampling sample size formula¹²¹.

$$n = z^2 p(1-p)/(d^2) = \frac{1.96 \times 1.96 (1-0.179) 0.179}{0.05 \times 0.05} = 225.73 \sim 226$$

Accounting for non-response of 20%;

$$n = \frac{120 \times 226}{100} = 271.$$

Hence the minimum sample size required for this study is 271.

3.8 Sampling method

Children and adult patients presenting with strabismus were consecutively selected to participate in the study after satisfying the inclusion criteria for the study.

3.9 Data collection and measurements

Data collection commenced after the ethical approval of the study. Patients with strabismus who satisfied the eligibility for inclusion into the study were examined by the researcher after ethical consent and assent where necessary. Data on the socio-demographic and clinical characteristics of the participants were recorded.

Socio-demographic characteristics

The socio-demographic characteristics included; age at onset of squint, sex of patient, place of residence, education, marital status, employment, religion, level of monthly income, family history of strabismus, knowledge about strabismus, stigmatization and religious beliefs concerning surgery, beneficiary of the national health insurance scheme, affordability of medical bills and presentation time (early or late presentation). Early presentation was defined as patients who reported to the hospital within 0-6months after recognizing the deviation while late presentation was defined as patients who report to the hospital more than 6months after noticing the deviation.

Visual acuity assessment

All the participants had visual acuity assessment using methods appropriate for age. For children between ages 0-6months, objection to occlusion was used to assess the visual acuity by observing the behaviour of the child on the occlusion of one eye after the other. If the child remains calm on occlusion of one eye then it means that the un-occluded eye has vision and child is comfortable. If the child resist occlusion of one eye then it means that there is no vision in the un-occluded eye and rather the eye that is covered is the one with good vision. Children who were between the ages of 6months – 36months old, preferential looking test (Cardiff cards) was used. Those between the ages of 36months – 60 months, Sheridan Gardner was used. Above 60 months, Snellen Visual Acuity chart was used. For each patients, visual impairment was classified according to the International Classification of Disease version 11 (ICD 11) as follows; normal vision (6/6 to 6/12), mild vision (worse than 6/12 to 6/18), moderate vision (worse vision 6/18 to 6/60), severe vision (worse than 6/60 to 3/60), blindness (worse than 3/60).

Assessment of the strabismus and other ocular examinations

Cover test was used to assess the type of deviation. This test was done by going through 3 stages, the cover-uncover test, the alternate cover test and simultaneous prism cover test. With the cover-uncover test, the test was done to identify the type of deviation. As one eye is covered the other is being observed for any movement in the opposite direction. The alternate cover test helps us to know the total amount of deviation and was done at both distance and near fixation. By using prisms to eliminate eye movement, an occluder was switched from one eye to the other until the maximum amount of prism was used which became visible when there was no movement in the eye. Full eye examination from the anterior aspect of the eye to the fundus was done using the Topcon slit lamp (United Kingdom) for the anterior segment and dilated fundoscopy done with HEINE OMEGA 500 LED binocular indirect ophthalmoscope from Germany with +20D lens. All the children had cycloplegic refraction using Guttae Cyclopentolate 1% and Guttae Phenylephrine 2.5%.

Appendices XI-XIV show pictures of the researcher with participants during various stages of the data collection and examinations.

3.10 Validity and reliability of measuring tools

The questionnaire was pretested among two adult patients and eight parents/guardians of the children with strabismus visiting the Eye Clinic at the Atonsu-Agogo Hospital in Kumasi. This was done by going through the questionnaires with them to make sure they understood all that the question meant after which those questions were answered by the respondents. The questionnaires were then evaluated to see whether the questions answered were adequate to answer the specific objectives. They were administered by the researcher and the two research assistants who were ophthalmology residents. With patients who could not comprehend the English language, an ophthalmic nurse who could

communicate in the local language of the patient assisted with translation during the questionnaire administration. After the pretesting of the questionnaire, the pilot data was analysed for internal consistency and reliability coefficient (Cronbach's α). A Cronbach's α value of 0.742 was obtained.

3.11 Quality control

Two research assistants received a two-day training on how to collect data. The research assistants were supervised within the period to ensure collection of accurate data. The two research assistants assisted the researcher with the data collection. Data collected was checked daily for necessary corrections.

The study was done in keeping with the Declaration of Helsinki for human subjects in medical research. Data security, quality assurance and confidentiality of participants' information was held paramount. Consequently, the principal investigator was responsible for ensuring that adequate, accurate and relevant data is collected and not excessive for the purposes of the study to uphold quality assurance. The principal investigator also ensure appropriate archiving of data generated during the study and at the end of the study. Identities of study participants was concealed by codes. The researcher will assign codes to each questionnaire or participants' information. Information of study participants was treated as confidential. To ensure confidentiality of participants' information, names of participants did not appear on any write-up. All non-electronic research data were stored in locked filing cabinets (including CD and flash drive). This was accessible only to authorized persons.

3.12 Data management and analysis

Data was entered into Microsoft Excel 2013 and cleaned before analysis. Data analyses was done using the International Business Machine's Statistical Package for the Social Sciences (IBM SPSS Corp. Version 20.0 Armonk, NY, and USA). Socio-demographic

characteristics of patients such as age, sex, place of residence, education, religion, among others were recorded. Clinical findings such as; age at onset of strabismus, age at presentation, deviating eye, type of deviation, direction of deviation, visual acuity, type of strabismus, angle of deviation, type of angle, and time of presentation (early/late) were also documented after the examination of the patients. These statistics were analysed using descriptive statistics such as percentages, means and standard deviations. Appropriate charts, tables and graphs were used in visualising the data.

Chi square test of association and Fisher's Exact Test were used in determining socio-demographic factors and clinical characteristics associated with late presentation of strabismus. The mean difference in duration between the age at onset of strabismus and age at presentation to KATH was calculated using an independent sample t-test. Multivariate logistic regression analysis was used in analysing predictors of late presentation of patients with strabismus to the Eye Clinic. Odds ratios and 95 % confidence intervals were recorded. P-values less than 0.05 were considered to be statistically significant.

3.13 Ethical and legal considerations

Ethical approval of the study by relevant faculty procedures were followed. Ethical clearance was obtained from the research and development unit of the Komfo Anokye Teaching Hospital and the Committee on Human Research, Publications and Ethics (CHPRE) of the Kwame Nkrumah University of Science and Technology (KNUST), before commencement of the study. Administrative permissions were also obtained from the Eye Clinic of KATH and the Ghana College of Physicians and Surgeons. Informed consent was sought from adult patients and parents/ guardians of children with strabismus. Assent to participation was obtained from children aged 8 years and above.

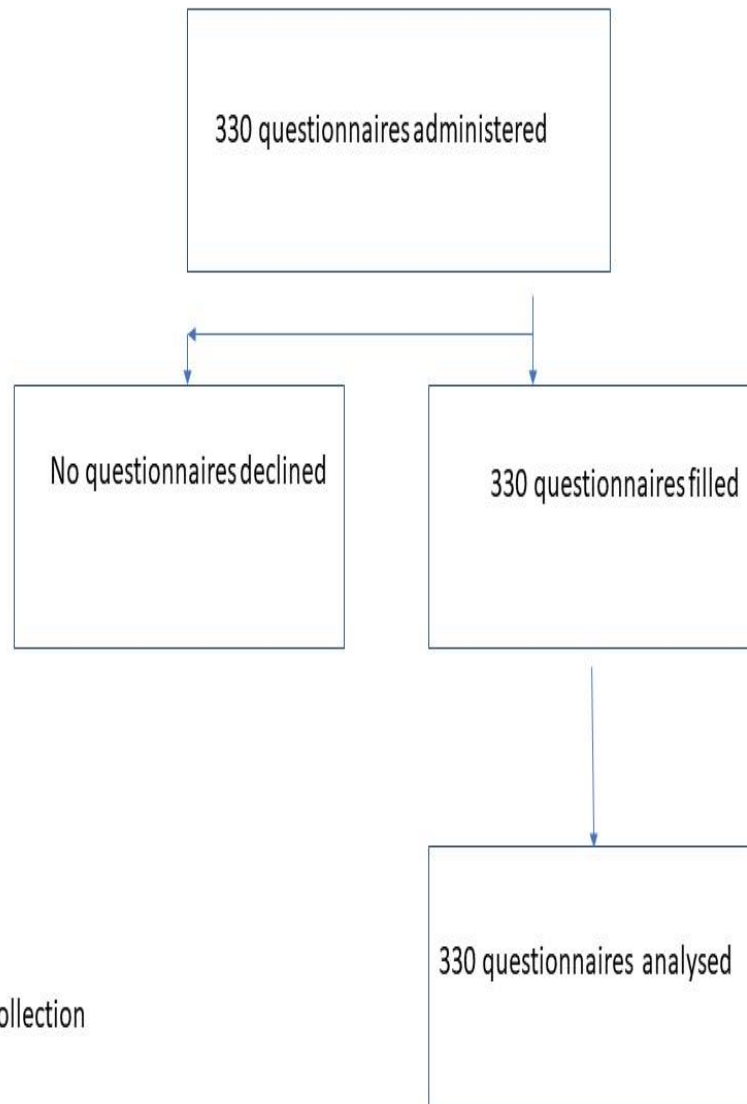
Patient information was treated as confidential. To ensure confidentiality, names of patients did not appear on the questionnaire or any write-up. Information obtained from study

participants was kept in a file which did not have the participant's name on it but a code number assigned.

The study posed minimum risk to participants which had to do with the instillation of eye drops during examination procedures. This was discomfort on the eyes and transient vision loss for 4 to 6 hours after which vision was restored fully, the latter being the direct action of the drugs. This was explained to the participants. No experimental procedures were involved. Study participants were told of their right to voluntarily participate or refuse to participate in the study which would not affect their management in any way. There was no conflict of interest in this study.

Study participants were informed they could contact the Chairman of the KATH IRB in case they needed to ask further questions with regards to the conduct of the study.

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Flow chart of data collection

Figure 3.2. Flow chart for data collection .

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the descriptive and inferential statistical analysis of the data obtained during the data collection. The general objective of the study was to determine the factors that contribute to late presentation of patients with strabismus to the eye clinic. The study was designed to determine the socio-demographic factors and clinical characteristics associated with late presentation of strabismus and the predictors of late presentation of patients with strabismus to the eye clinic.

4.2 Socio-demographic characteristics of patients with strabismus presenting at the Komfo Anokye Teaching Hospital

A total of 330 patients were recruited in this study. Out of the 330 patients, 180 (54.5 %) were males and 150 (45.5 %) were females. The mean age and standard deviation of the patients was 10.1 ± 9.4 years. The modal age was 4.0 years and the minimum and maximum ages were 3.0 years and 53.0 years respectively. Majority (236, 71.5 %) of the patients were within the age range of 0-10 years. Fifty (15.2 %) out of the 330 patients were within the age range 11-20 years. Twenty-five (7.6 %) patients were within the age range 21-30 years. Twelve (3.6 %) patients were within the age range, 31-40 years. Five (1.5 %) were within the age group 41-50 and two patients (0.6 %) had ages >50 . Table 4.1.

The mean age and standard deviation at onset of strabismus was 4.0 ± 1.2 years. The modal age at onset of strabismus was 3.0 years. Most (294, 89.1 %) of the patients had the deviation of their eyes noticed in their early childhood (2-5 years) years. The rest (36, 10.9 %) of the patients had the deviation of their eyes noticed in their middle childhood (6-11 years) years.

Most (295, 89.4 %) of the patients were rural dwellers and 35 (10.6 %) were from urban areas.

Two-hundred and forty-six (74.5 %) patients were registered members of the National Health Insurance Scheme (NHIS).

Forty-eight (14.5 %) patients presented early (before 6 months) to the eye clinic and 282 (85.5 %) presented late (after 6 months) to the KATH. Figure 4.1.

In terms of proximity to the Komfo Anokye Teaching Hospital (KATH), 144 (43.6 %) of the participants lived at a distance less than 50km away from the hospital and 186 (56.4 %) of participants lived more than 50 km from the hospital. The mean travel distance from the home of the patients with strabismus to the Komfo Anokye Teaching Hospital was 52.5 ± 10.7 km. The minimum travel distance recorded was 3 km and the maximum was 75 km. Figure 4.2.

Considering the duration of travel from the home of study participants to the hospital, it took less than 30 minutes for 23 (7.0 %) patients to get to the hospital and about 30 minutes to 1 hour for 149 (45.1 %) participants to get to the hospital. One hundred and fifty-eight (47.9 %) patients indicated it took them more than one hour to get to the hospital. The mean duration of travel to the hospital was 2.4 ± 0.6 hours. The minimum duration recorded was 30 minutes and the maximum was 3 hours. Figure 4.3.

Most (233, 70.6 %) of the patients travel by public transport to the hospital followed by 48 (14.5 %) participants who use tricycle for travelling to the hospital. Forty (12.1 %) participants indicated they walk from their homes to the hospital and 9 (2.7 %) said they use their own car in travelling to the hospital. Figure 4.4.

Most (175, 53.0 %) of the patients were educated up to the basic school level. Pre-schoolers were 99 (30.0 %), those with tertiary education were 28 (8.5 %), SHS were 21 (6.4 %) and 7 (2.1 %) had no education. Figure 4.5.

Most (71.7 %) of the participants were Christians. Forty-four (15.4 %) were Muslims and 37 (12.9 %) were traditionalists. Figure 4.6.

Two hundred and fifteen (65.0 %) indicated they were able to afford their hospital bills. One hundred and fifteen (35.0 %) reported they were not able to afford their hospital bills. Figure 4.7.

Table 4.1:Socio-demographic information of patients with strabismus

Parameter	Frequency	Percent (%)
Total	330	100.0
Sex of Patient		
Male	180	54.5
Female	150	45.5
Age of patients (years)		
0-10	236	71.5
11-20	50	15.2
21-30	25	7.6
31-40	12	3.6
41-50	5	1.5
>50	2	0.6
Place of residence		
Rural area	295	89.4
Urban area	35	10.6
Age at onset of strabismus		
2-5	294	89.1
6-11	36	10.9
Registered for NHIS		
Yes	246	74.5
No	84	25.5

NHIS = National Health Insurance Scheme. Mean age and standard deviation = 10.1±9.4 years. Modal age = 4.0 years, minimum and maximum ages were 3.0 years and 53.0 years respectively. Mean age and standard deviation at onset of strabismus = 4.0±1.2 years. Modal age at onset of strabismus was 3.0 years.

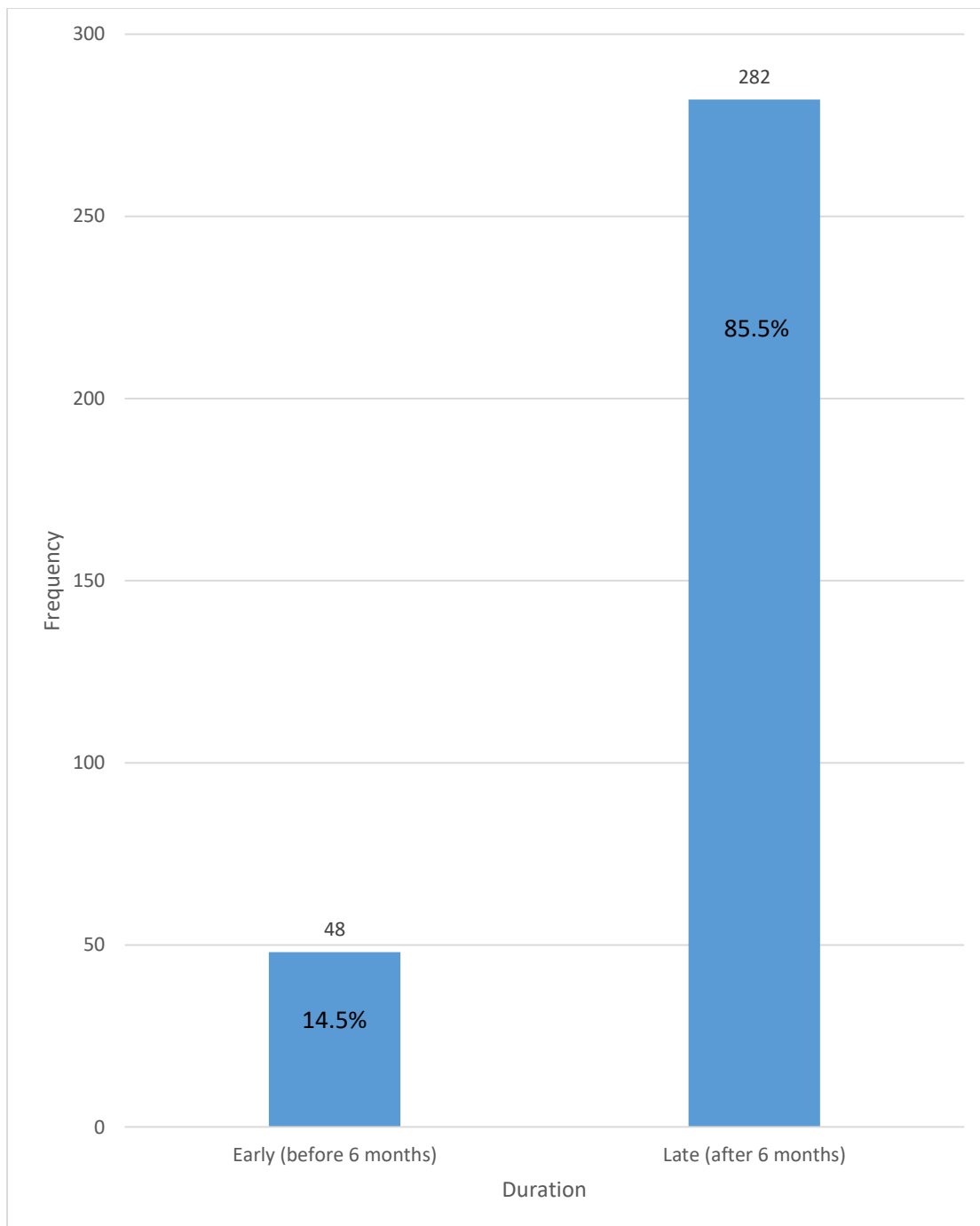


Figure 4.1. Reporting time (early or late) of children with strabismus to Komfo Anokye Teaching Hospital (KATH)

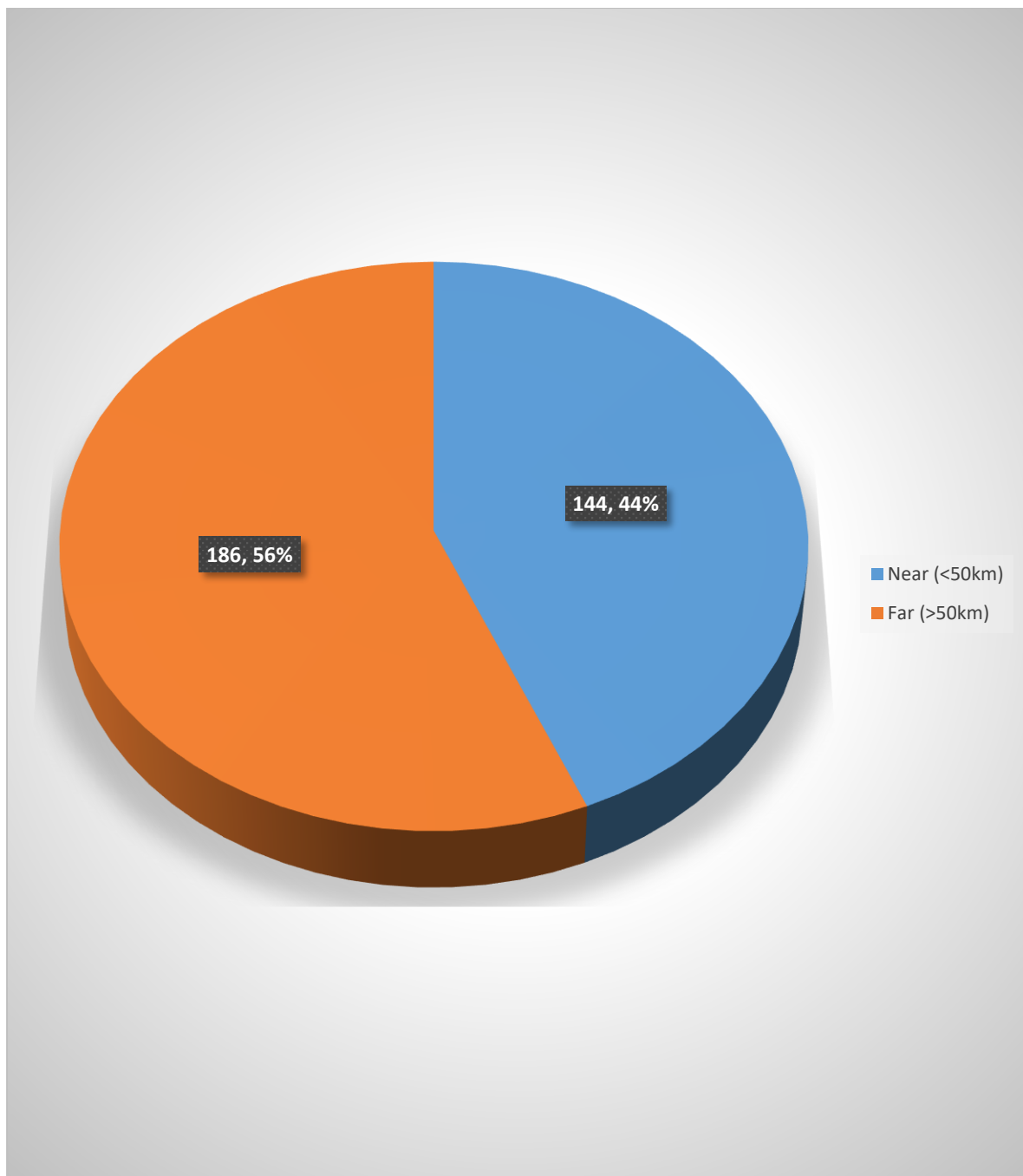


Figure 4.2. Proximity of the home of patients with strabismus to Komfo Anokye Teaching Hospital (KATH). The minimum travel distance = 3 km and the maximum = 75 km

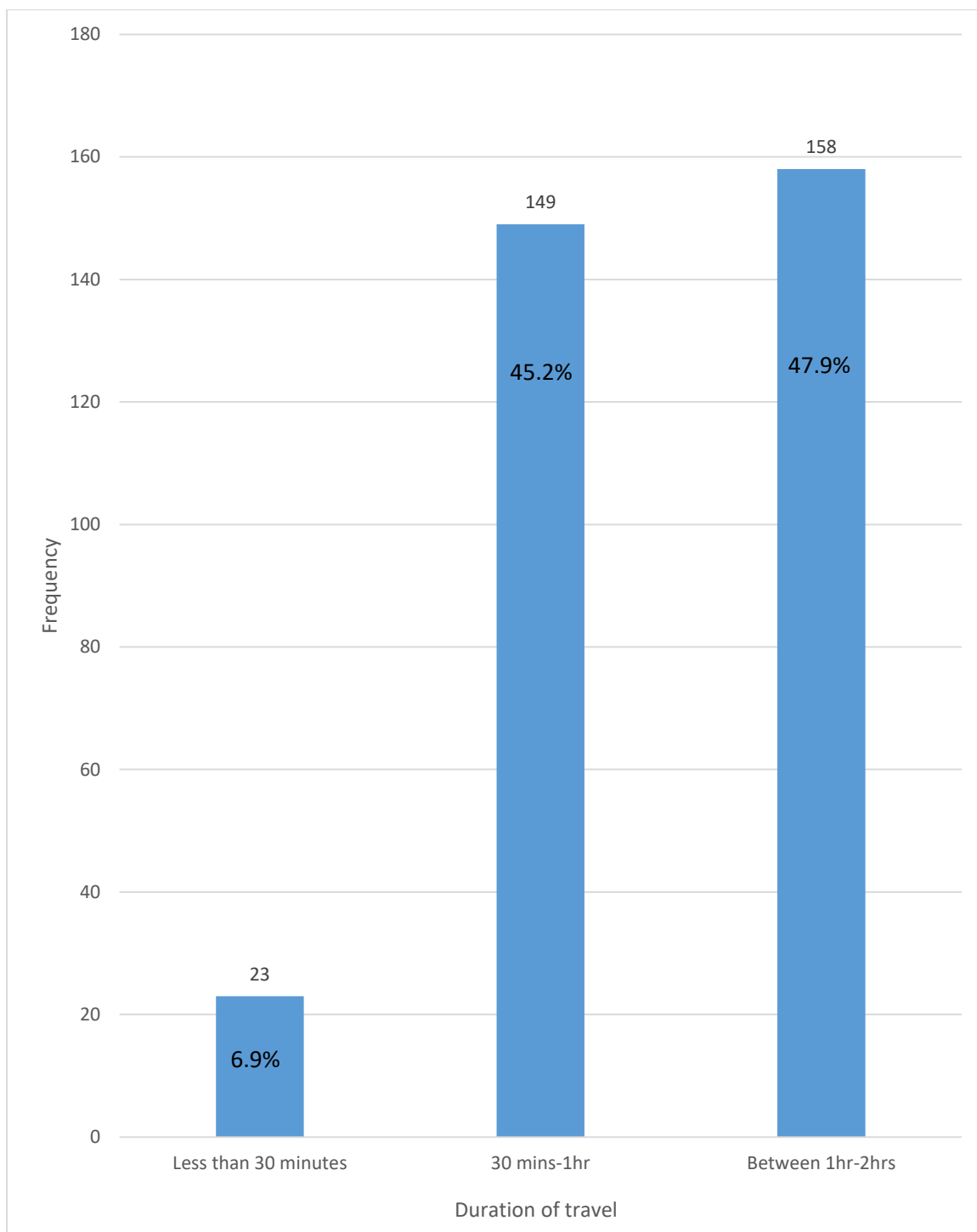


Figure 4.3: Duration of travel of children with strabismus to Komfo Anokye Teaching Hospital

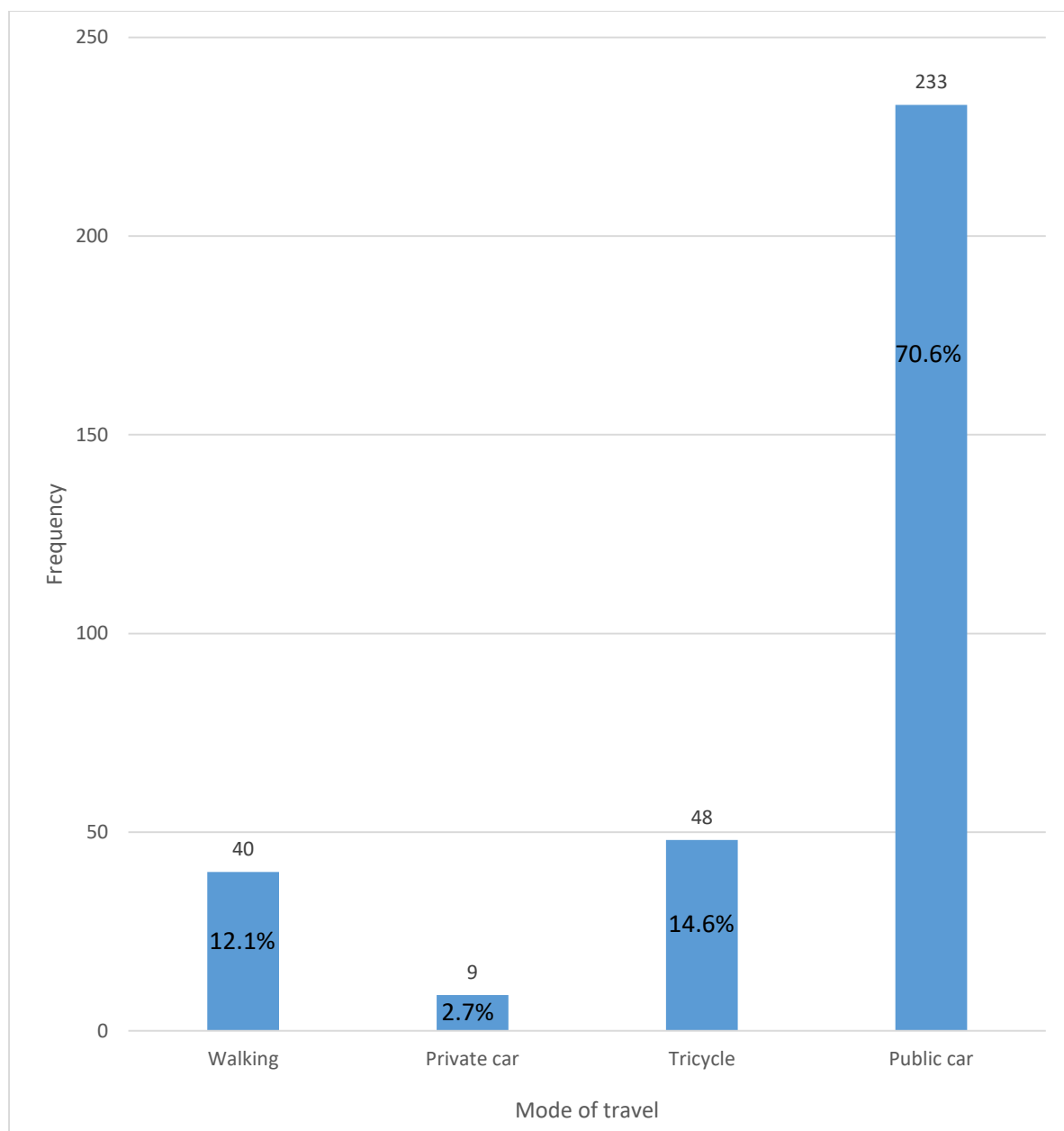


Figure 4.4: Mode of transportation of patient with strabismus to Komfo Anokye Teaching Hospital

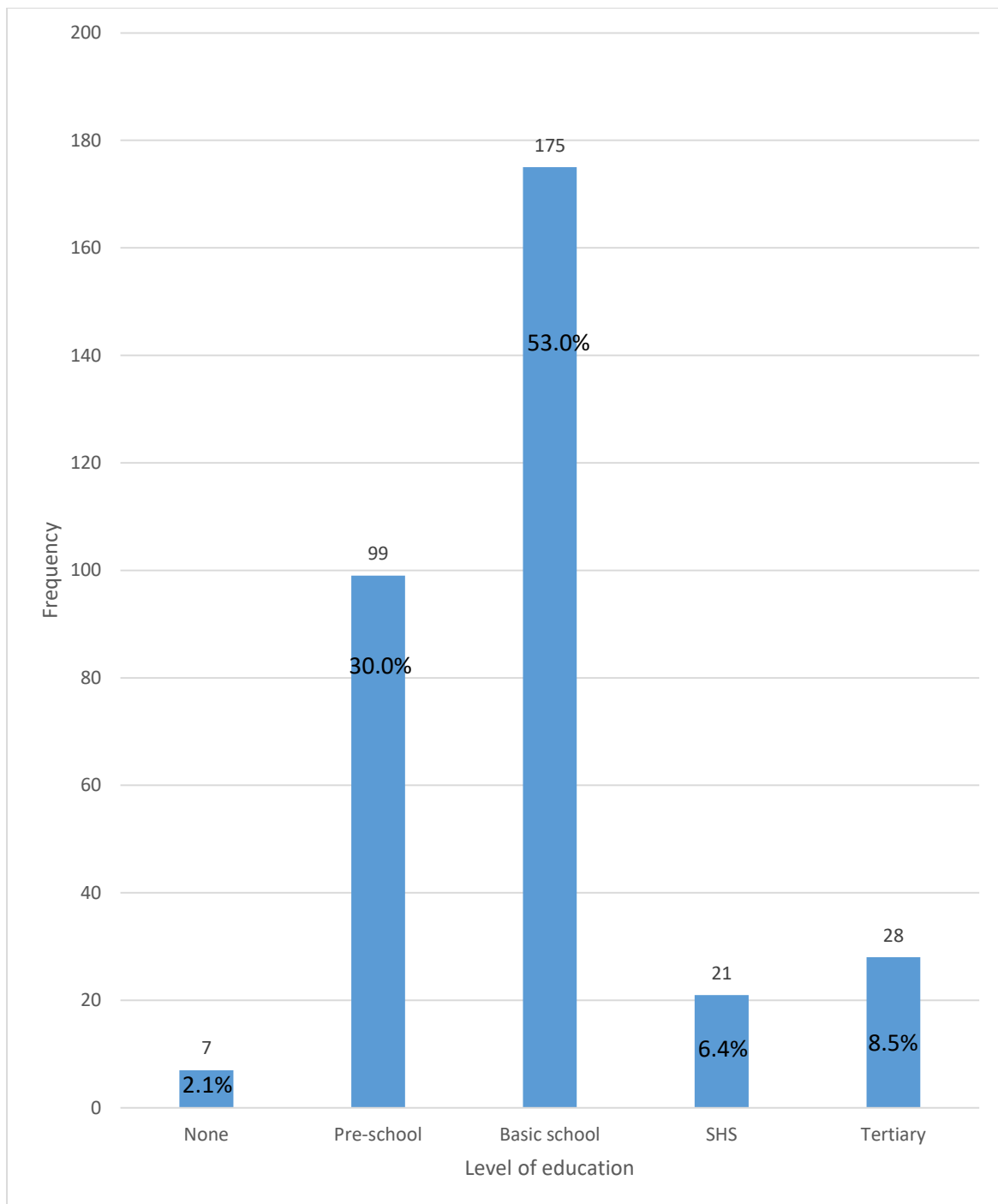


Figure 4.5: Educational status of patients with strabismus at the Komfo Anokye Teaching Hospital

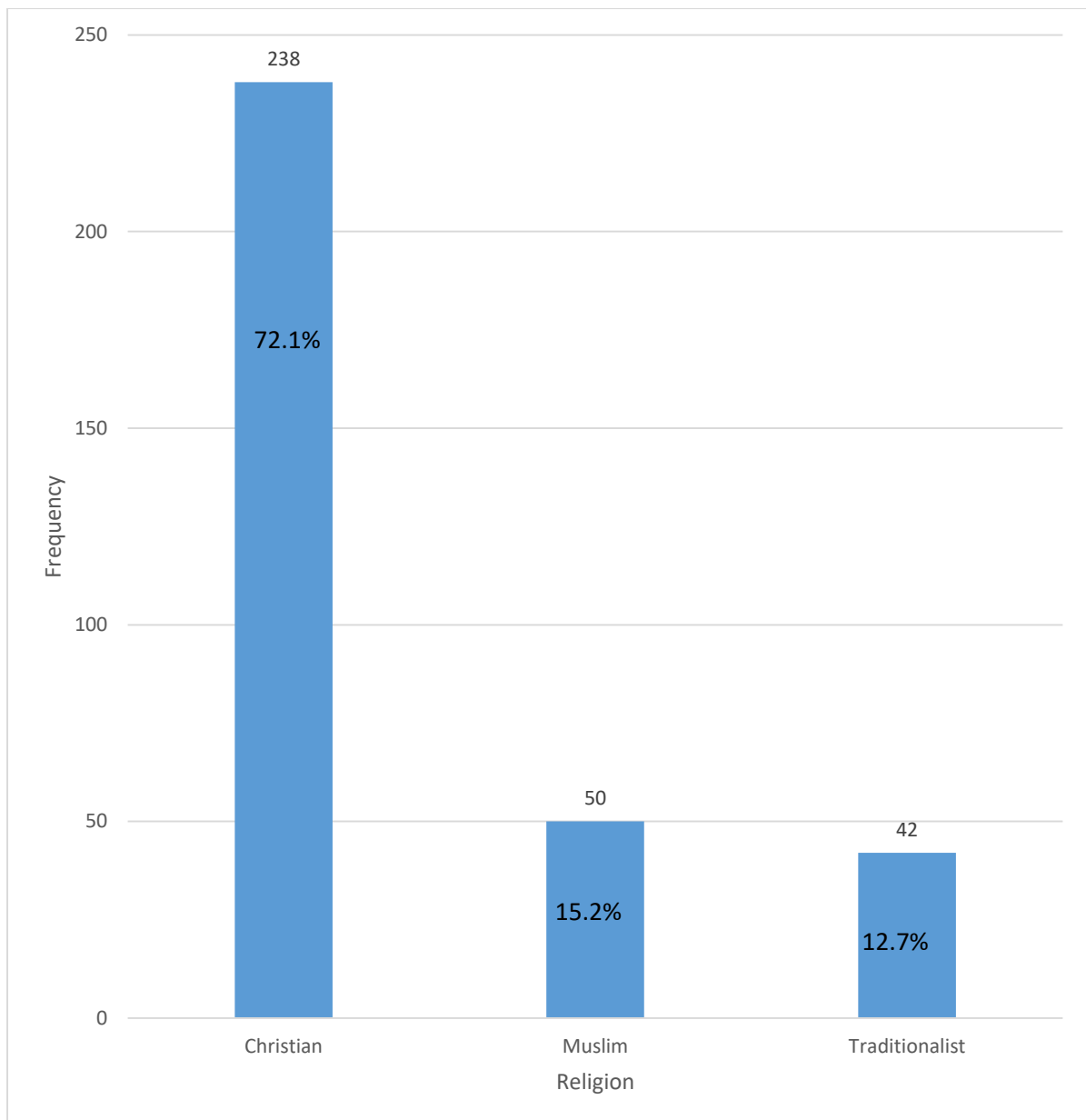


Figure 4.6: Religion of patients with strabismus

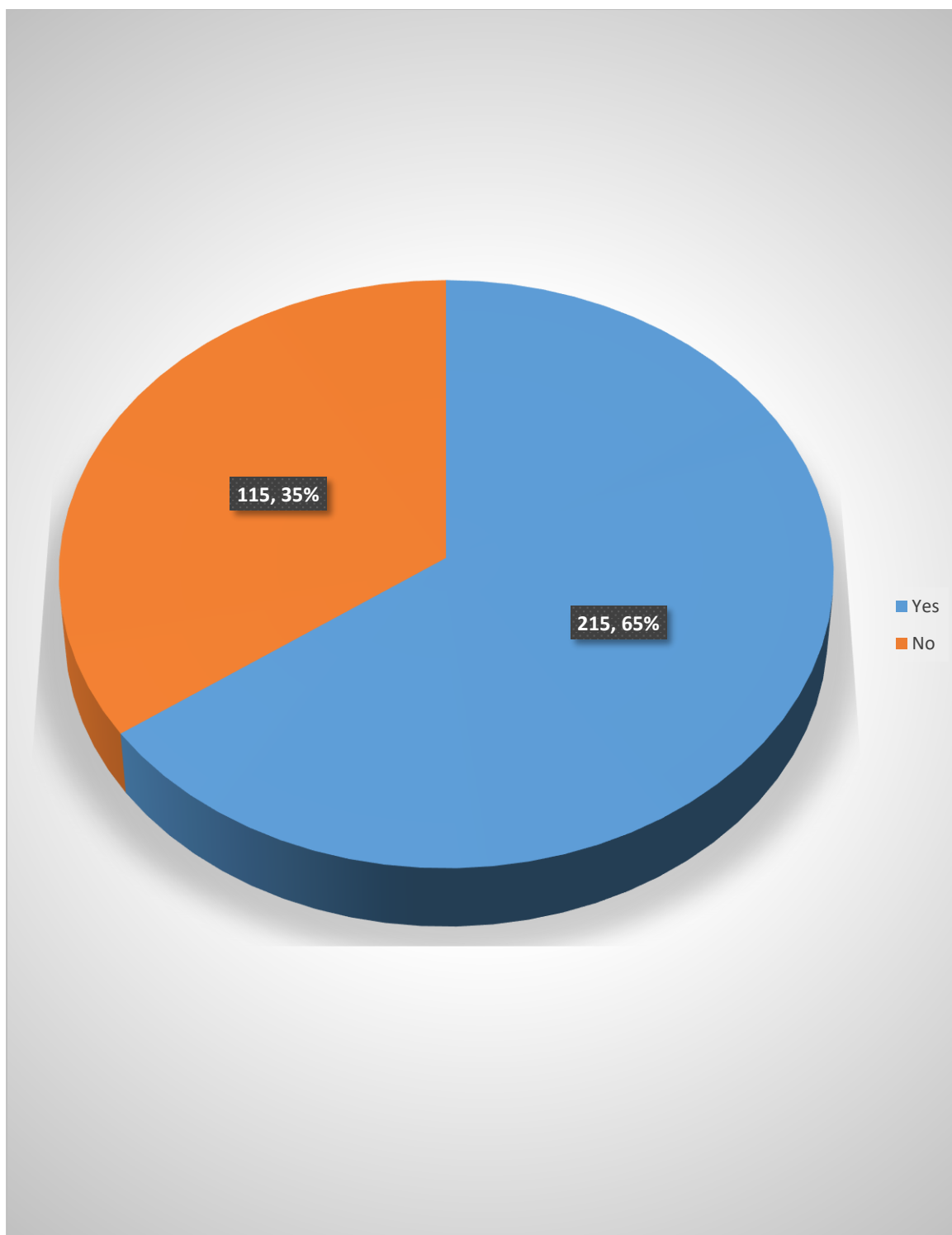


Figure 4.7: Affordability of hospital bills of children by parents/guardians

4.3 Clinical characteristics of patients with strabismus presenting at the Komfo Anokye Teaching Hospital(History and Examination)

Findings from the clinical characteristics of patients with strabismus presenting at the Komfo Anokye Teaching Hospital revealed that a total of 196 (59.4 %) participants had deviation on the left eye and 88 (26.7 %) had deviation on the right eye. Forty-six (13.9 %) participants had deviations on both eyes. Table 4.2.

Considering the direction of deviation, 166 (50.3 %) had inward deviation, 80 (24.2 %) had an outward deviation, 54 (16.4 %) had superior deviation and 30 (9.1 %) had inferior deviation.

The types of deviation were; constant deviation - 272 (82.4 %) and intermittent deviation - 58 (17.6 %). Table 4.3.

The types of strabismus recorded were; esotropia- 238 (72.1 %), exotropia- 42 (12.7 %), hypertropia -38 (11.5 %) and hypotropia- 12 (3.6 %). Table 4.3.

The angle of deviation for the strabismus was record for each participant. Fifteen (4.5 %) participants had deviation <20 prism diopters. Fifty (15.2 %) had eye deviation between 20-30 prism diopters. Two-hundred and forty (72.7 %) participants had angle of deviation between 31- 60 prism diopters and 25 (7.6 %) recorded angle of deviation greater than 60 prism diopters. Figure 4.8.

The type of angle of deviation was categorized into small angle (< 20 prism diopter) and large angle (> 20 prism diopter) respectively. Majority (315 95.5 %) of the participants had large angle of deviation (> 20 prism diopter) and 15 (4.5 %) had small angle of deviation. Figure 4.9.

Equality of vision in strabismus patients at the Komfo Anokye Teaching Hospital was assessed. Two hundred and eighty (84.8 %) participants had equal vision in both eyes and 50 (15.2 %) unequal vision in both eyes. Figure 4.10.

Thirty six (62.1 %) children had intermittent deviation occurring when they were sick. Eighteen (31.0 %) experience intermittent deviation when they were tired and 4 (6.9 %) experiences intermittent deviation when they lose concentration. Figure 4.11.

A total of 248 (75 %) patients had relatives with strabismus. Figure 4.12.

Table 4.2: Clinical characteristics of patients with strabismus presenting at the Komfo Anokye Teaching Hospital from history from parents/guardian

Parameter	Frequency	Percent (%)
Deviated eye		
Left eye	196	59.4
Right eye	88	26.7
Both eyes	46	13.9
Direction of deviation		
Inward	166	50.3
Outward	80	24.2
Superior	54	16.4
Inferior	30	9.1

Table 4.3: Clinical characteristics of patients with strabismus presenting at the Komfo Anokye Teaching Hospital from examination findings

Parameter	Frequency	Percent (%)
Type of deviation		
Constant	272	82.4
Intermittent	58	17.6
Type of strabismus		
Esotropia	238	72.1
Exotropia	42	12.7
Hypertropia	38	11.5
Hypotropia	12	3.6

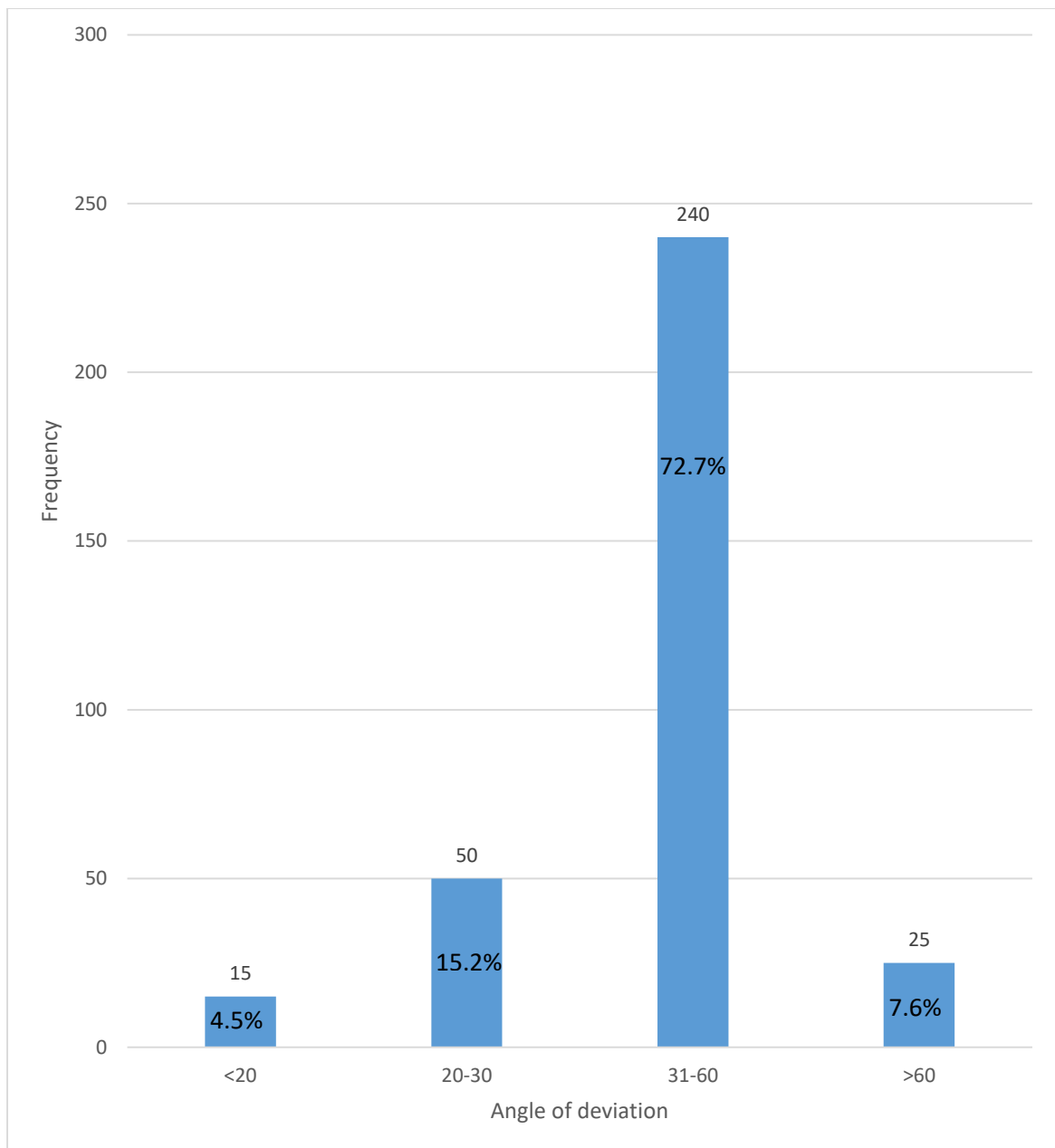


Figure 4.8: Angle of deviation(prism diopters) in patients with strabismus at the Komfo Anokye Teaching Hospital

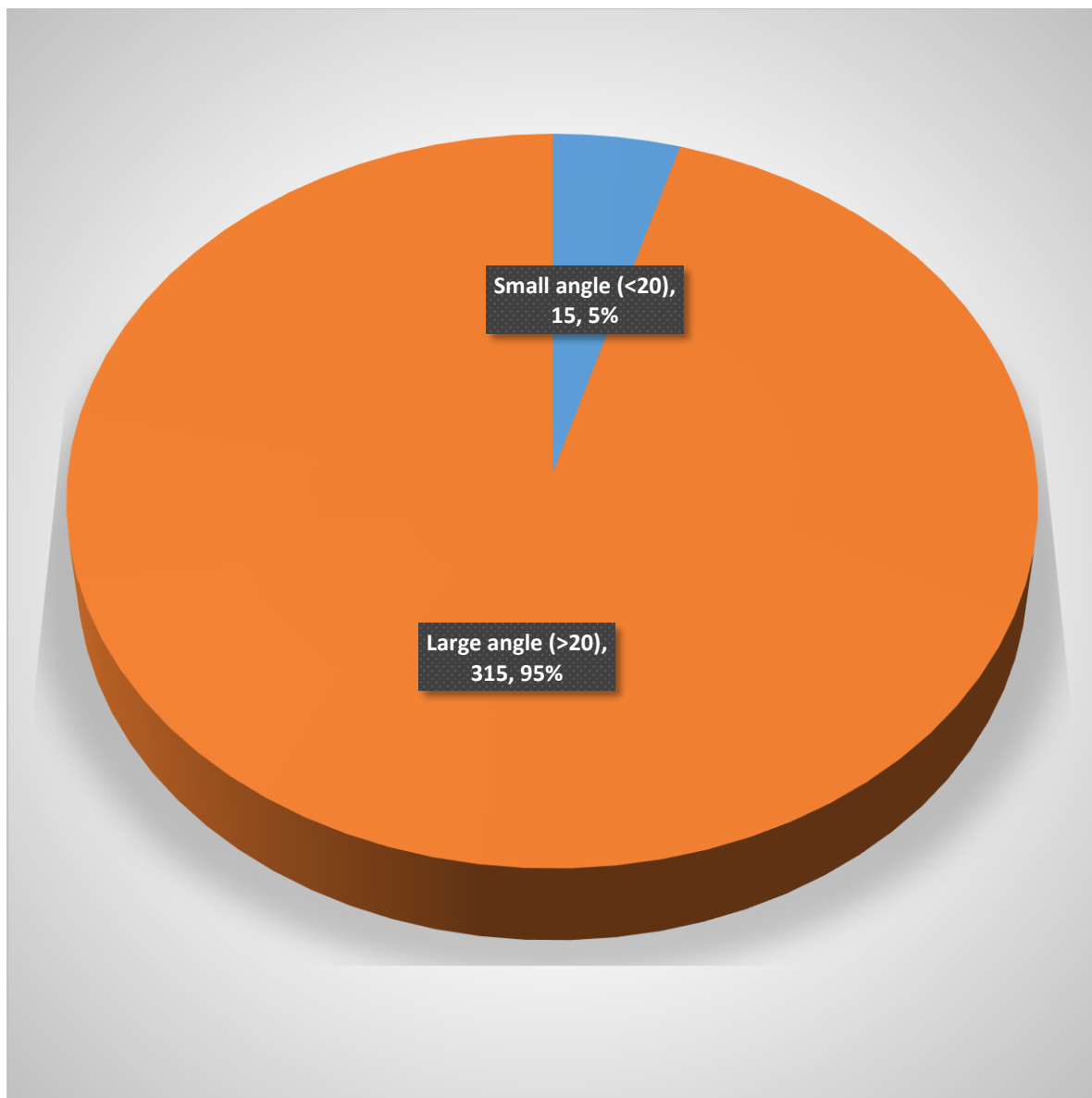


Figure 4.9: Type of angle of deviation in strabismus patients at the Komfo Anokye Teaching Hospital

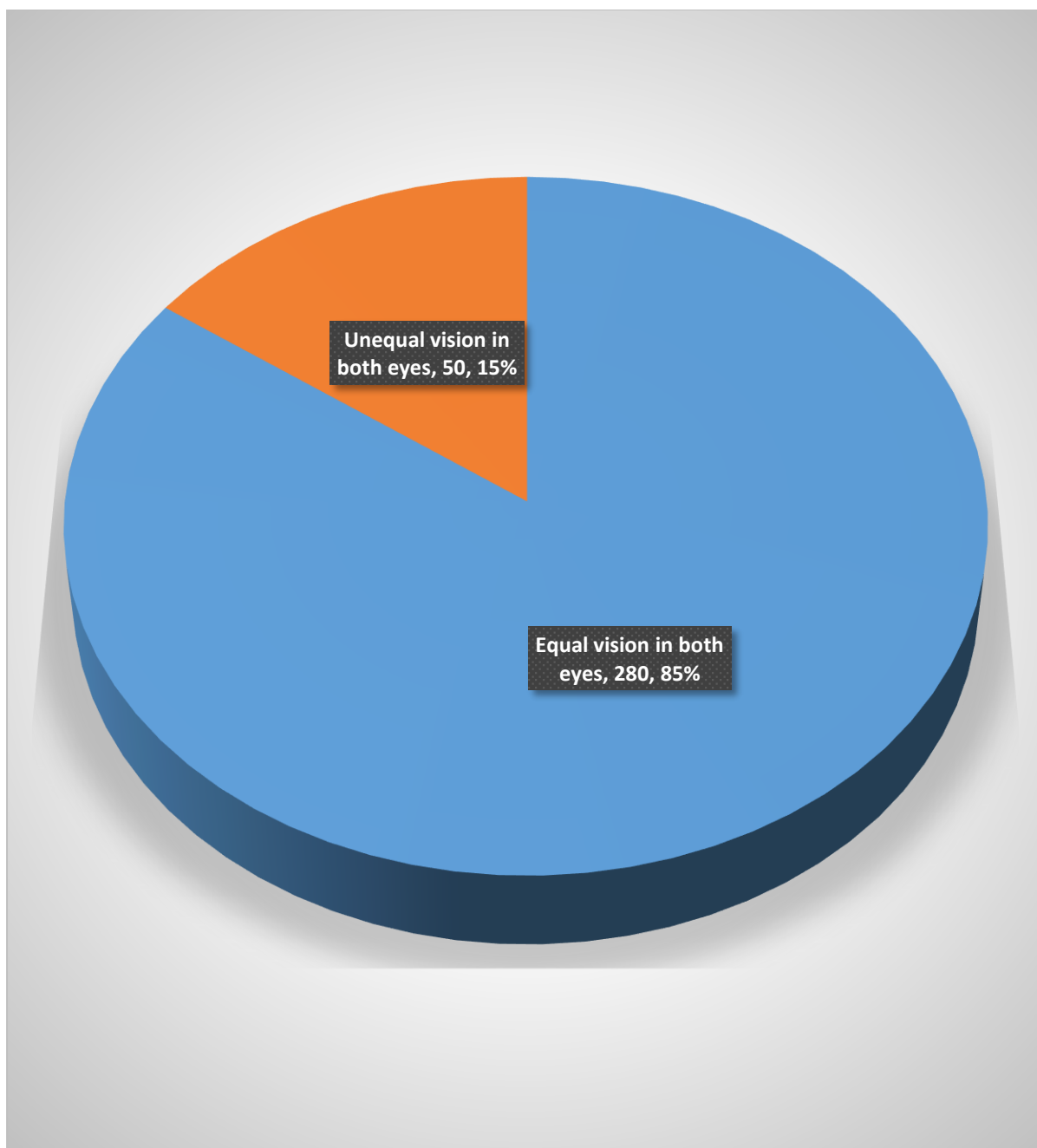


Figure 4.10: Equality of vision in children with strabismus at the Komfo Anokye Teaching Hospital

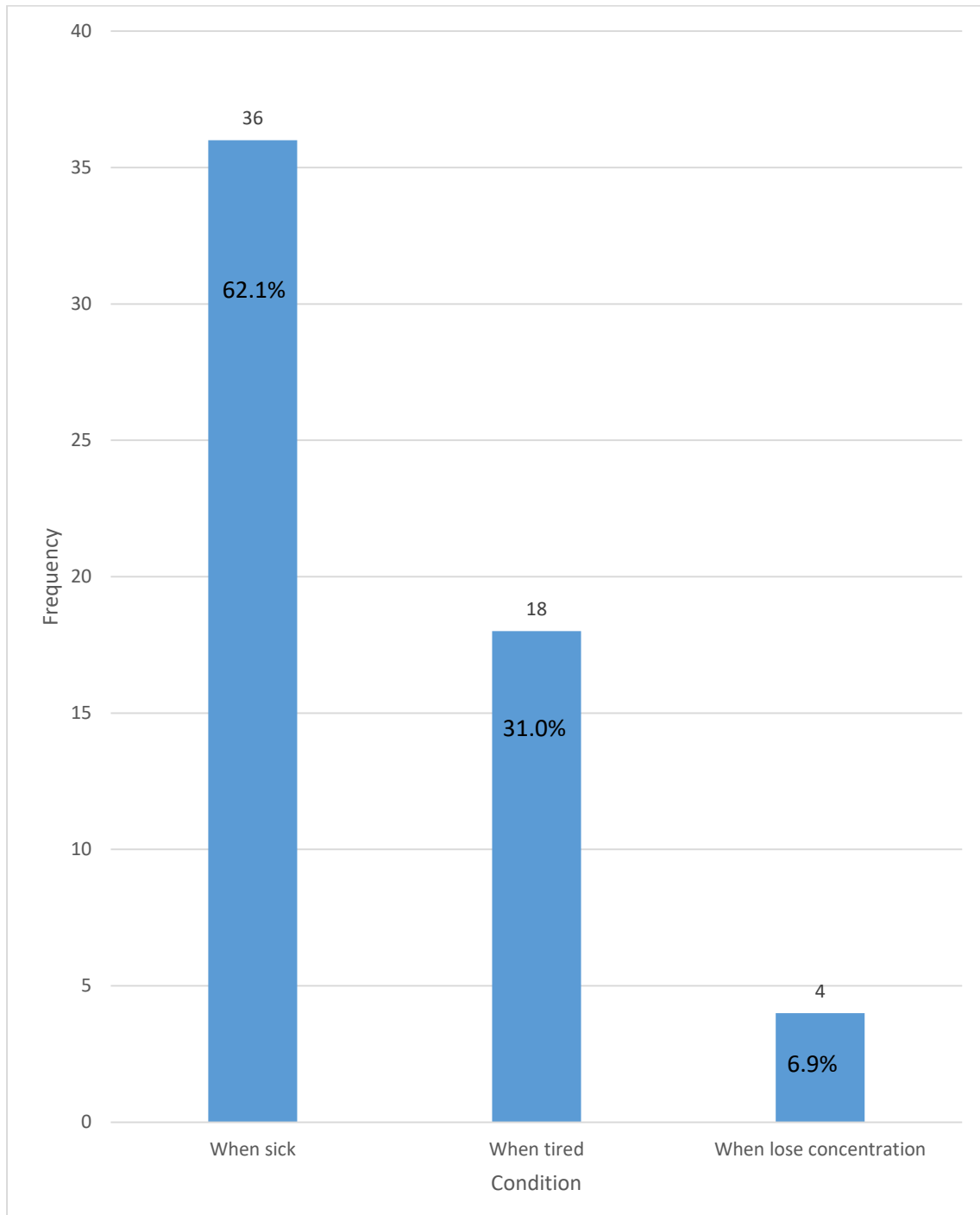


Figure 4.11: Occurrence of intermittent deviation among patients with strabismus at the Komfo Anokye Teaching Hospital

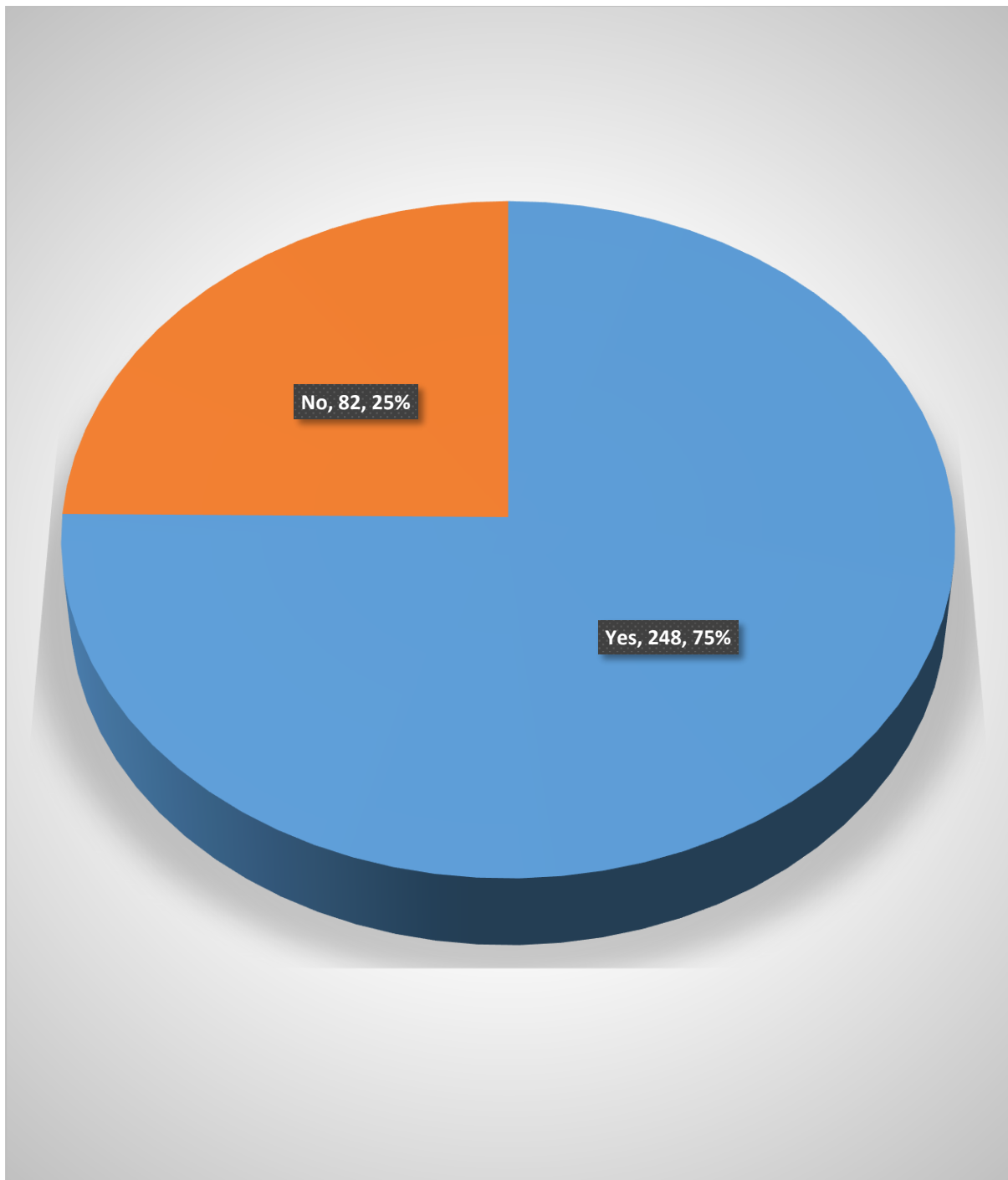


Figure 4.12: Patients with strabismus at the Komfo Anokye Teaching Hospital with relatives who have strabismus

4.4 Visual impairment among patients with strabismus presenting at the Komfo Anokye Teaching Hospital

Visual impairment (VI) was grouped using the International Classification of Disease version 11 (ICD 11) as follows; normal vision (6/6 to 6/12), mild VI (worse than 6/12 to 6/18), moderate VI (worse vision 6/18 to 6/60), severe VI (worse than 6/60 to 3/60), blindness (worse than 3/60) respectively. Normal vision was observed in 225 (68.2 %), 227 (68.8 %) and 241 (73.0 %) of the patients for the right eye, left eye, and both eyes respectively. Mild VI was seen in 37 (11.2 %), 40 (12.1 %) and 32 (9.7 %) of the patients for the right eye, left eye, and both eyes. Moderate VI was seen in 9 (2.7 %), 7 (2.1 %) and 7 (2.1 %) of the patients for the right eye, left eye, and both eyes. Severe VI, was observed in 1 (0.3 %) of the patients for each eye and for both eyes. Blindness was seen in 10 (3.0 %), 7 (2.1 %) and 1 (0.3 %) of the patients for the right eye, left eye, and both eyes respectively. There was no significant association between visual impairment and late presentation of strabismus among the patients (p-value = 0.543). Table 4.4.

Table 4.4: Visual Impairment of patients with strabismus presenting late at the Komfo Anokye Teaching Hospital

Visual acuity	Right Eye	Left Eye	Both Eyes	P-value
	N (%)	N (%)	N (%)	
Normal vision (6/6 to 6/12)	225 (68.2)	227 (68.8)	241 (73.0)	
Mild VI (worse than 6/12 to 6/18)	37 (11.2)	40 (12.1)	32 (9.7)	
Moderate VI (worse vision 6/18 to 6/60)	9 (2.7)	7 (2.1)	7 (2.1)	
Severe VI (worse than 6/60 to 3/60)	1 (0.3)	1 (0.3)	1 (0.3)	
Blindness (worse than 3/60)	10 (3.0)	7 (2.1)	1 (0.3)	0.543

VI= Visual Impairment

4.5. Mean duration between the age at onset of strabismus and age at presentation to KATH Eye Clinic

From the analysis, there was a statistically significant difference in mean duration between the age at onset of strabismus and age at presentation to KATH (p-value = 0.001). Table 4.5.

Table 4.5: Difference in mean duration between the age at onset of strabismus and age at presentation to KATH

T	p-value	mean difference	95% CI	
			Lower	Upper
41.2	0.001	6.1	5.3	7.1

CI = Confidence interval. KATH = Komfo Anokye Teaching Hospital.

4.6. Association between type of strabismus and late presentation of patients with strabismus at KATH

From the analysis, there was no association between type of strabismus and late presentation of patients with strabismus at the KATH (p-value = 0.423). Table 4.6.

Table 4.6: Association between type of strabismus and late presentation of patients with strabismus at KATH

Type of strabismus	Late presentation			P-value
	Yes	No	Total	
	N (%)	N (%)	N (%)	
Esotropia	202 (61.2)	36 (10.9)	238 (72.1)	
Exotropia	37 (11.2)	5 (1.5)	42 (12.7)	
Hypertropia	31 (9.4)	7 (2.1)	38 (11.5)	
Hypotropia	12 (3.6)	12 (3.6)	24(7.2)	0.423

KATH = Komfo Anokye Teaching Hospital.

4.7 Association between angle of deviation and late presentation of patients with strabismus at KATH

From Table 4.6 below, there was no association between angle of deviation and late presentation of patients with strabismus at the KATH (p-value = 0.624). Table 4.7.

Table 4.7: Association between angle of deviation and late presentation of patients with strabismus at KATH

Type of angle of deviation	Late arrival			P-value
	Yes	No	Total	
	N (%)	N (%)	N (%)	
Small angle (<20 prism diopter)	13 (3.9)	2(0.6)	15 (4.5)	
Large angle (>20 prism diopter)	269 (81.5)	46 (13.9)	315 (95.5)	0.624

KATH = Komfo Anokye Teaching Hospital.

4.8 Association between type of deviation and late presentation of patients with strabismus at KATH

From the data analysis, type of deviation was not associated with late presentation at KATH (p-value = 0.196). Table 4.8.

Table 4.8: Association between type of deviation and late presentation of patients with strabismus at KATH

Type of deviation	Late presentation			P-value
	Yes	No	Total	
	N (%)	N (%)	N (%)	
Constant	235 (71.2)	37(11.2)	272(82.4)	0.196
Intermittent	47 (14.2)	11 (3.3)	58 (17.6)	

KATH = Komfo Anokye Teaching Hospital.

4.9 Association between presenting visual acuity and late presentation of patients with strabismus at KATH

There was no statistically significant association between presenting visual acuity and late presentation of patients with strabismus at KATH (p-value = 0.446). Table 4.9.

Table 4.9: Association between presenting visual acuity and late presentation at KATH

Visual acuity	Late presentation			P-value
	Yes	No	Total	
	N (%)	N (%)	N (%)	
Equal vision in both eyes	240 (72.7)	40 (12.1)	280 (84.8)	
Unequal vision in both eyes	42 (12.7)	8 (2.4)	50 (15.2)	0.446

KATH = Komfo Anokye Teaching Hospital

4.10 Socio-demographic factors associated with late presentation of patients with strabismus at KATH

The association between socio-demographic factors and late presentation of strabismus are presented on Tables 4.10a, 4.10b and figures 4.13 and 4.14 below. Findings revealed that age of patient, education level of patient, having a relative with strabismus, monthly income level of family and knowledge about strabismus were associated with late presentation of patients with strabismus to the KATH (p-values = 0.002, 0.001, 0.025, 0.001 and 0.001 respectively).

Table 4.10a: Socio-demographic factors associated with late presentation of patients with strabismus

Factor	Late presentation			P-value
	Yes	No	Total	
	N (%)	N (%)	N (%)	
Sex of patient				
Male	154(46.7)	26(7.8)	180(54.5)	0.538
Female	128(38.8)	22(6.7)	150(45.5)	
Religion				
Christian	205(62.1)	33(10.0)	238(72.1)	0.850
Muslim	42(12.7)	8(2.4)	50(15.2)	
Traditionalist	35(10.6)	7(2.1)	42(12.7)	
Affordability of hospital bills	215(65.2)	115(34.8)	330(100.0)	0.254
Proximity to KATH				
Near (<50 kilometers)	126(38.2)	18(5.5)	144(43.6)	0.432
Far (>50 kilometers)	156(47.3)	30(9.1)	186(56.4)	

Table 4.10b: Socio-demographic factors associated with late presentation of strabismus

Factors	Yes N (%)	No N (%)	Total N (%)	P-value
Age at presentation				
0-10	189(57.3)	47(14.2)	236(71.5)	0.002
11-20	49(14.8)	1(0.3)	50(15.2)	
21-30	25(7.6)	-	25(7.6)	
31-40	12(3.6)	-	12(3.6)	
41-50	5(1.5)	-	5(1.5)	
>50	2(0.6)	-	2(0.6)	
Level of education				
Lower (Pre-school to JHS)	233(70.6)	48(14.5)	281(85.2)	0.001
Higher (SHS to Tertiary)	49(14.8)	-	49 (14.8)	
Monthly income				
<GHC 500	182(55.2)	43(13.0)	225(68.2)	0.001
GHC 500-GHC 1000	66(20.0)	1(0.3)	67(20.3)	
Above GHC 1000	34(10.3)	4(1.2)	38(11.5)	
Knowledge of patients with strabismus				
About strabismus	201(90.5)	21(9.5)	222(100.0)	0.001
Having a relative with strabismus	218(87.9)	30(12.1)	248(100.0)	0.025

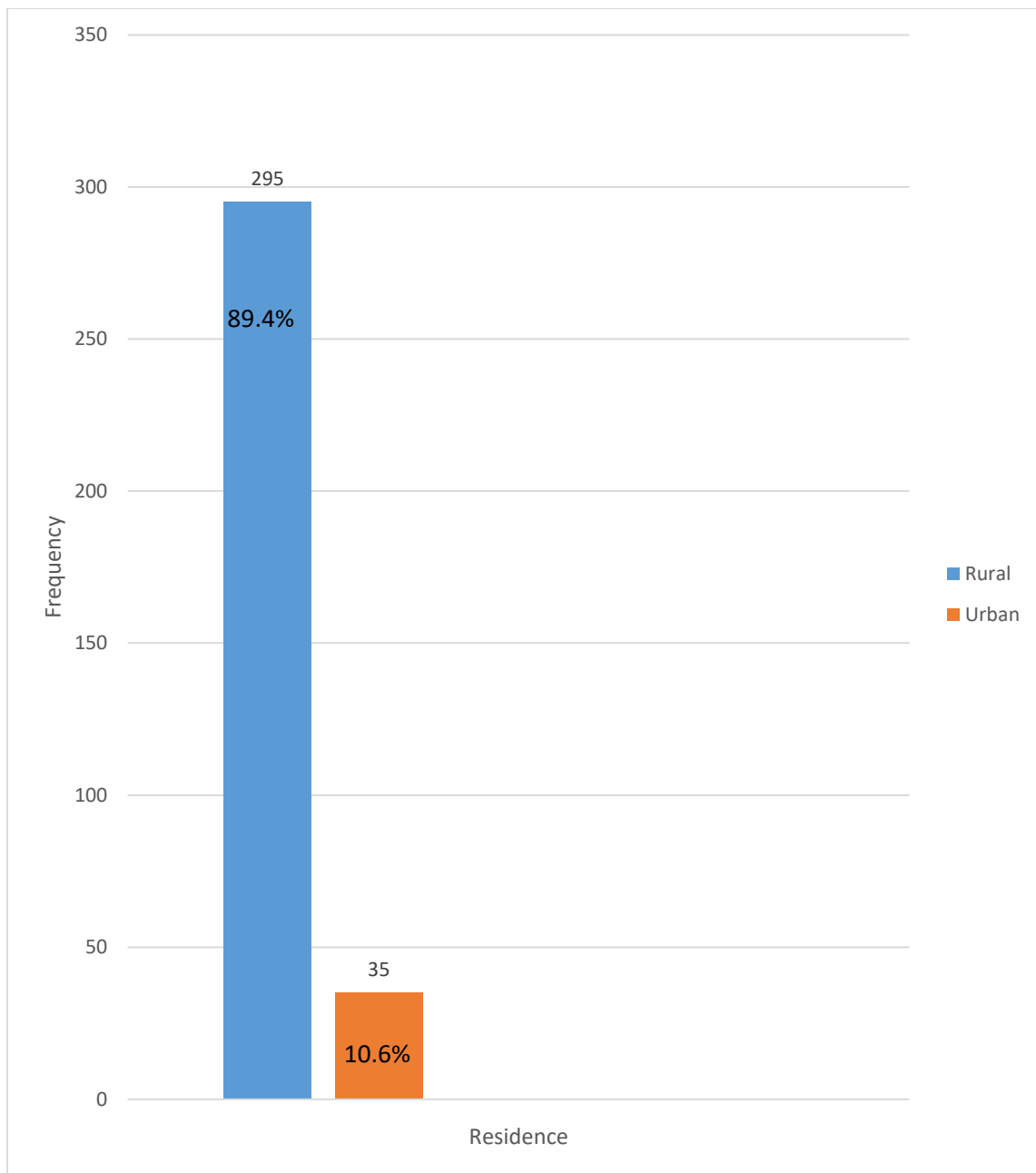


Figure 4.13: Association between place of residence and late presentation of patients with strabismus at the Komfo Anokye Teaching Hospital (p-value = 0.600)

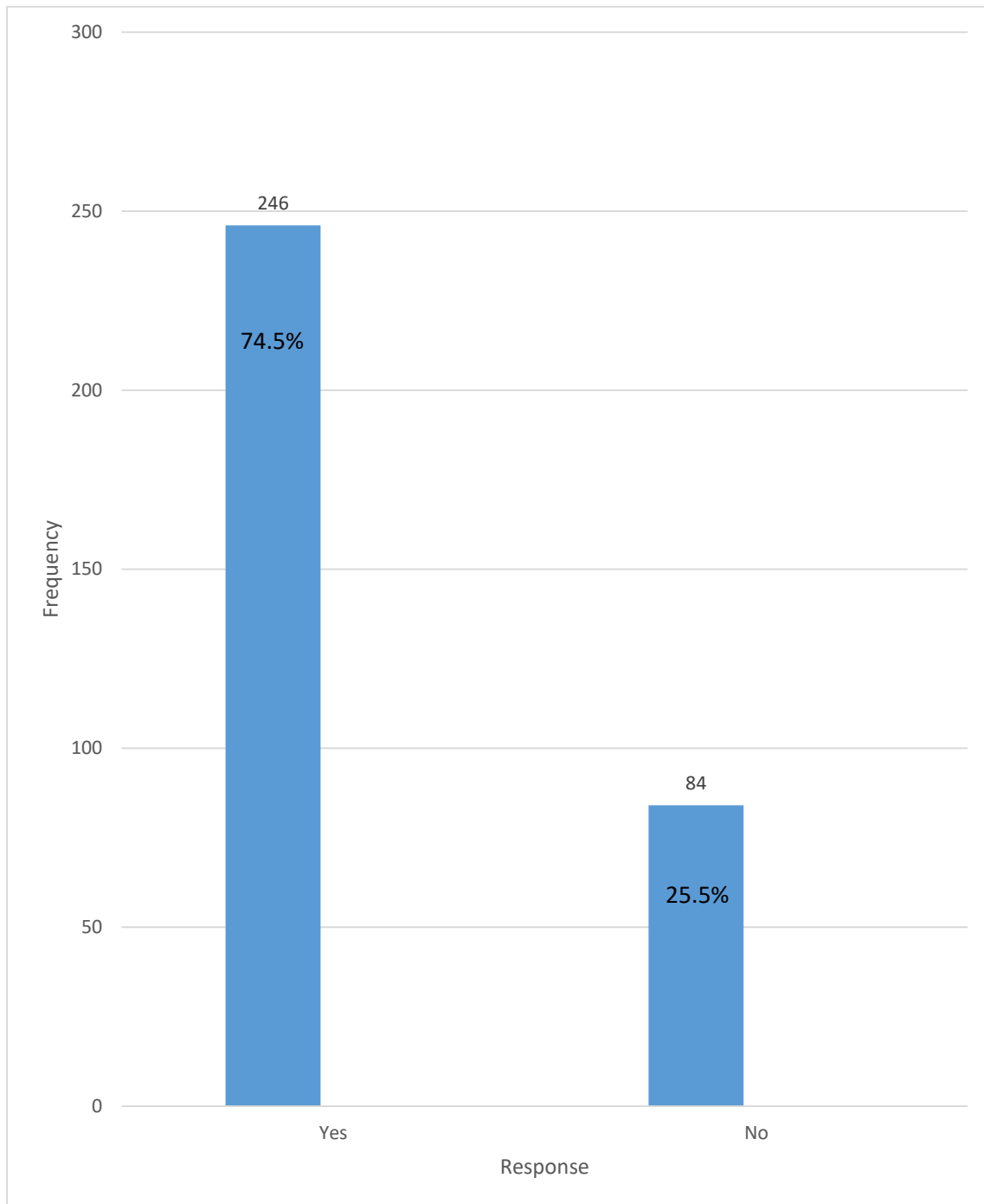


Figure 4.14: Association between being an NHIS beneficiary and late presentation of patients with strabismus at the Komfo Anokye Teaching Hospital (p-value = 0.088).

4.11 Association between sex, type of strabismus and visual impairment in patients with strabismus presenting late at the Komfo Anokye Teaching Hospital

The association between sex, type of strabismus and visual impairment in patients with strabismus presenting late at the Komfo Anokye Teaching Hospital is presented on tables 4.11 and 4.12. From the tables, there was no statistically significant association between sex and visual impairment for both left and right eyes (p-values = 0.420 and 0.803). In addition, there was no association between type of strabismus and visual impairment in patients with strabismus presenting late at the Komfo Anokye Teaching Hospital (p-values = 0.408 and 0.297). Table 4.12.

Table 4.11: Association between Sex and visual impairment of patients with strabismus presenting late at the Komfo Anokye Teaching Hospital

Visual impairment (VI)	Sex			P-value
	Male	Female	Total	
	N (%)	N (%)	N (%)	
Right eye				
Normal vision	139 (42.1)	127 (35.8)	266 (80.6)	0.420
Mild VI	24 (7.3)	15 (4.5)	39 (11.8)	
Moderate VI	6 (1.8)	4 (1.2)	10 (3.0)	
Severe VI	1 (0.3)	-	1 (0.3)	
Blindness	10 (3.0)	4 (1.2)	14 (4.2)	
Left eye				
Normal vision	145 (43.9)	124 (37.6)	269 (81.5)	0.803
Mild VI	26 (7.9)	18 (5.5)	44 (13.3)	
Moderate VI	3 (0.9)	4 (1.2)	7 (2.1)	
Severe VI	1 (0.3)	-	1 (0.3)	
Blindness	5 (1.5)	4 (1.2)	9 (2.7)	

Table 4.12: Association between type of strabismus and visual impairment in patients with strabismus presenting late at the Komfo Anokye Teaching Hospital

Visual impairment	Type of strabismus				P-value
	Esotropia	Exotropia	Hypertropia	Hypotropia	Total
	N (%)	N (%)	N (%)	N (%)	N (%)
Right eye					
Normal vision	196 (59.4)	32 (9.7)	29 (8.8)	9 (2.7)	266(80.6)
Mild VI	26 (7.9)	3 (0.9)	7 (2.1)	3 (0.9)	39(11.8)
Moderate VI	7 (2.1)	3(0.9)	-	-	10(3.0)
Severe VI	1 (0.3)	-	-	-	1(0.3)
Blindness	8 (2.4)	4 (1.2)	2 (0.6)	-	14(4.2)
Total	238 (72.1)	42 (12.7)	38 (11.5)	12 (3.6)	330 (100.0)
					0.408
Left eye					
Normal vision	198 (60.0)	32 (9.7)	30 (9.1)	9 (2.7)	269(81.5)
Mild VI	30 (9.1)	4 (1.2)	7 (2.1)	3 (0.9)	44(13.3)
Moderate VI	5 (1.5)	2 (0.6)	-	-	7(2.1)
Severe VI	1 (0.3)	-	-	-	1(0.3)
Blindness	4 (1.2)	4 (1.2)	1(0.3)	-	9(2.7)
Total	238 (72.1)	42 (12.7)	38 (11.5)	12 (3.6)	330(100.0)
					0.297
VI = Visual Impairment					

4.12 Predictors of late presentation of patients with strabismus at the KATH

A multivariate logistic regression analysis of predictors of late presentation of patients with strabismus at the KATH is presented below on Table 4.13. Age of patients (being a child/adult), having a lower level of education, being a non-beneficiary of NHIS, having no knowledge about strabismus and having no relative with strabismus were predictors of late presentation of patients with strabismus.

Children are 0.1 times less likely to present late compared to adults [OR = 0.1; CI = (0.01-0.8); p-value = 0.032].

Participants with lower education are 1.6 times more likely to present late with strabismus to the clinic compared to those having higher education [OR = 1.6; CI = (1.1-2.3); p-value = 0.006].

Beneficiaries of NHIS are 0.4 times less likely to present late compared with those who are not beneficiaries of NHIS [OR= 0.4; CI = (0.2 -0.9); p-value = 0.037].

Patients with no knowledge about strabismus are 2.9 times more likely to present late compared with those who have knowledge about strabismus [OR= 2.9; CI = (1.5 -5.8); p-value = 0.002].

Patients who have no relatives with strabismus are about 2 times more likely to present late compared with those having relatives with strabismus [OR= 2.0; CI = (1.0 -4.3); p-value = 0.042].

Table 4.13: Predictors of late presentation of children with strabismus at the KATH

Predictors	Number(%)	Odds Ratio (95 % CI)	p-value
Age of patients (years)			
Child	234(70.9)	0.1 (0.01-0.8)	0.032
Adult	96(29.1)	Reference category	
Education			
Lower education	281(85.2)	1.6 (1.1-2.3)	0.006
Higher education	49(14.8)	Reference category	
Proximity to KATH			
Near	144(43.6)	Reference category	0.160
Far	186(56.4)	1.6 (0.8- 3.2)	
Residence			
Rural	295(89.4)	Reference category	0.743
Urban	35(10.6)	1.2 (0.4-3.5)	
Beneficiary of NHIS			
Yes	246(74.5)	0.4 (0.2-0.9)	0.037
No	84(25.5)	Reference category	
Knowledge about strabismus			
Yes	222(67.3)	Reference category	0.002
No	108(32.7)	2.9 (1.5-5.8)	
Relative with strabismus			
Yes	248(75.2)	Reference category	0.042
No	82(24.8)	2.0 (1.0 -4.3)	
Monthly income level			
< GHC1000.00	292(88.5)	1.4 (0.2-1.6)	0.534
> GHC1000.00	38(11.5)	Reference category	

KATH = Komfo Anokye Teaching Hospital

4.13. Knowledge of patients with strabismus about strabismus

From Table 4.14 below, 222 (67.3 %) participants indicated they had knowledge about strabismus. The source of information about knowledge of strabismus were as follows; from hospital- 109 (49.1 %), from school- 23 (10.4 %), social media- 23 (10.4 %), from radio/television- 65 (29.3 %) and from home-2 (0.9 %). Most (274, 83.0 %) study participants indicated that the best treatment centre for strabismus was the hospital. Others also believed that church (48, 14.5 %) and the native doctor (8, 2.4 %) were the best treatment centre for strabismus.

Table 4.14: Knowledge of parents/guardians of patients with strabismus about strabismus

Parameter	Frequency	Percent (%)
Knowledge of strabismus		
Yes	222	67.3
No	108	32.7
Source of information on strabismus		
Hospital	109	49.1
School	23	10.4
Social media	23	10.4
Radio/Television	65	29.3
Home	2	0.9
Best treatment center for strabismus		
Hospital	274	83.0
Church	48	14.5
Native doctor	8	2.4

4.14 Community perception about strabismus

Findings from the study showed that 151 (45.8 %) of the participants indicated that their community perceived strabismus as a disease that is treatable. One hundred and twenty-three participants indicated that their communities did not consider strabismus to be a disease. Forty-five participants mentioned that their communities perceived strabismus as an untreatable disease and 11 (3.3 %) said the communities perceived it as a curse from the gods for punishment for sins. Table 4.15.

Table 4.15: Community perception about strabismus

Perception	Frequency	Percent (%)
It is a disease that is treatable	151	45.8
Does not consider it as a disease	123	37.3
It is an untreatable disease	45	23.6
It is a curse from the gods for punishment for sins	11	3.3

CHAPTER FIVE

DISCUSSION

5.1 Introduction

This chapter discusses the results seen in the study and how it relates to other studies that have been done elsewhere.

5.2 Clinical characteristics of strabismus and its association with late presentation of strabismus to the KATH Eye Clinic

The predominant type of strabismus in this study was esotropia (72.1%) followed by exotropia (12.7%), and the other vertical deviations: hypertropia (11.5%) and hypotropia (3.6%). This trend in the types of strabismus corroborates findings from a study by Olusanyo et al in Southwest Nigeria on the common forms of strabismus in their tertiary eye clinic where they also found that esotropia (53.8%) was the commonest type of strabismus⁶⁶. Nigeria and Ghana share similar socio-geographical factors, with both countries situated in the West African Sub-region. This feature may explain in part the similarities. However other studies from other populations of different races have also demonstrated similar trends with esotropia as the commonest type of strabismus⁶⁵. In India, Khorrami et al also found the prevalence of esotropia to be two and a half times more than exotropia⁶⁵. Shimauti et al in Portugal found esotropia to be more prevalent than exotropia with the least of the type of strabismus to be the vertical deviations⁶⁷. On the contrary, a study conducted on adult Japanese patients showed the reverse where exotropia was more prevalent than esotropia⁶⁸. This is not surprising because children have a lot of accommodation and it occurs in all

children everywhere so with uncorrected refractive errors, like hyperopia, accommodative convergence and insufficient fusional divergence forces the child to accommodate to focus retinal images and accommodation goes with convergence and thus the eye tend to deviate inwards (esotropia)². In Iran, a similar study with 7 year old school children as study participants, Hassan et al also found exotropia to be more prevalent than esotropia in these children⁶⁹. This can be attributed to racial differences since strabismus is inherited in children and depending on the race one may be at risk of getting a particular type of strabismus¹²².

Majority of the deviation were constant deviation (82.4%) and few were intermittent (17.6%). A study by Akpe in Benin-Nigeria on the prevalence and patterns of strabismus in primary school pupils revealed that the prevalence of constant or manifest strabismus was low in that population⁸, which is a contrasting finding compared with this current study. The findings in this current study also contrasts that from Iran where affected school children with strabismus demonstrated the commonest type of strabismus to be intermittent⁶⁹. This might have been for a fact that these studies were community based studies where the children were screened for strabismus, and for intermittent ones, the parents might not have noticed it at home but with this current study which was a hospital based, one realized the opposite and it might have been the constant nature of the deviation that made the patients come to the hospital. There is limited published data on hospital based studies published to identify the type of strabismus, whether constant or intermittent. Almost all the studies were community based and as probably may explain the differences in results.

Most of the patients had equal vision in both eyes (85%) and 15% had unequal vision in both eyes. Majority of the patients in this study had normal vision (73%) which is in agreement with the observation by Azonobi et al¹⁰⁰ in his study which evaluated the visual pattern of children with strabismus in a primary school in Ilorin, Nigeria where most(78.1%) of the children with strabismus had normal vision with the prevalence of low vision and

blindness being very low¹⁰⁰. This can be attributed to the fact that most strabismus occurring in children are of the basic type and the deviation alternate between the two eyes².

Majority(95%) of the participants in this current study had an angle of deviations above 20 prism dioptres with majority(72.7%) of them with an angle of deviation between 30-60 prism dioptres. In the literature, not much is reported on the amount of deviation seen in patients with strabismus in contrast with the relatively large numbers of studies that report on the management of wide angle strabismus and how patient's quality of life improves after surgery¹¹⁸. It is expected that if the deviation is large, that should influence the affected individuals to seek for medical treatment early, but this was not so in this current study where majority had large angles of deviation and majority also reported late. Further studies need to be done to explore qualitatively the interplay of factors influencing such delays and how best to get affected individuals to report early.

The various clinical characteristics of strabismus such as the type of strabismus, whether constant or intermittent, amount of deviation and the level of vision had no significant association with late presentation. This findings suggests that patients' decision to come to health facilities for treatment early or late does not depend so much on the clinical characteristics of the strabismus. Further studies are needed to explore important factors that influence patients' health seeking behaviours. There is paucity of published data to explain this situation in the Ghanaian setting.

5.3 The demographic characteristics of patients with strabismus at KATH Eye Clinic

This current study found majority of the participants to be males (54.5%). There are varying findings when gender is considered. Male preponderance with the occurrence of strabismus has been previously documented in a study from Ilorin in Nigeria where males accounted for 59.4% and females were 40.6%¹⁰⁰. Other studies have demonstrated almost equal

proportions as was seen in the study conducted in Southwest Nigeria which reported a male to female ratio of 0.98:1⁶⁶. A number of other studies have also not shown any sex preponderance⁶⁷. On the contrary there are studies that have reported on female preponderance as reported by Musa et al¹²³ in a study done at a tertiary hospital in Lagos looking at the spectrum of childhood strabismus, where they realized a male to female ratio of 1:1.7 (36.7% males, 63.3% females). Awoyesuku et al¹²⁴ in Nigeria found less males than females (42% males and 58% females). It is unclear what is accounting for this differences in gender in relation to strabismus. In societies where there is cultural bias in favour of the male child as in some African countries¹²⁵ it may be postulated that the male child will receive more attention. However, in this current study majority who presented late were also males suggesting that the ill effect of strabismus on cosmesis may not be considered as a problem for the male child as compared with the female child. Further studies are needed to investigate this further.

Most(89.1%) of the affected individuals with strabismus in the current study presented to the hospital with the age of onset of strabismus within the ages of two to five years. It is known from literature that the onset of most esotropias is early childhood, between the ages of two to three years² and this current study supports this finding given that the commonest type of strabismus encountered was esotropia(72.1%) and most of the patients reporting between the ages of two and five years. These findings contrast that found in the study by Tobias et al³⁵ which determined the incidence, age distribution and subtypes of strabismus among children seven years and younger. They found the median age at detection for the 4 subtypes to be zero, thirty two, twenty six and sixteen and a half months for congenital esotropia, fully accommodative esotropia, partially accommodative esotropia and exotropia respectively³⁵.

The national health insurance scheme (NHIS) helps with the financing of the health needs of individuals who are registered with the scheme. Some studies done elsewhere have established financial constraints as barriers preventing parents from bringing their wards for care in health facilities¹²⁶. The study by Sathyan and Jose at a tertiary eye center in Kerala, India, which examined the barriers responsible for delay in surgical management among adult patients with strabismus established that social factors such as lack of awareness of surgery fear of surgery and non-affordability of care were the main contributors to the delays in patients seeking for treatment¹⁵. In this current study, NHIS card holders are 0.4 times less likely to come to the clinic late as compared to those who do not have health insurance suggesting that affordability may not be an issue and that their hospital bills are taken care of by the scheme. So in this current study with majority of patients (74.5%) having the national health insurance, one expected that more patients would have reported earlier for treatment at the hospital but this was not so as majority of the patients (85.45%) presented late. This suggests that there may be other causes apart from finances preventing patients from reporting to the clinic early for treatment.

5.4 Socio-demographic factors associated with late presentation of strabismus at the KATH Eye Clinic

A number of socio-demographic factors relating to the patients and their guardians were studied and some of the factors found to be associated with late presentation of the patients with strabismus to the KATH Eye Clinic. Those factors with significant association with late presentation were age of patients in years, level of education of the patients, family history of strabismus, monthly income of the family, and knowledge about strabismus.

The age range at presentation of most (89.1%) of the patients was between zero to ten years confirming strabismus as an early childhood eye condition² This corroborates findings

from previous studies from Karachi, Pakistan by Azam et al¹²⁷ where most of the patients were between the age of six to nine years. It is important to assume that because children are minors who depend on others i.e. parents and guardians to take decisions regarding their health care and other needs, other factors relating to these parents/guardians may influence greatly the time they are presented to hospital for care.

Another factor with strong association with late presentation was knowledge about strabismus. Most of the parents and guardians knew about strabismus (67.3%) yet majority of them reported late. This corroborates previous findings from a study by Tegegn et al in Ethiopia¹⁰⁵ where knowledge of strabismus was assessed among adults in Gonda town. The study found most of the patients (52.3%) had good knowledge about strabismus and good knowledge had a negative association with those with higher income but had a positive association with being a student. The study however did not assess the association of knowledge about strabismus with late presentation of patients for treatment in hospitals. In this study there was a strong association between knowledge about strabismus and late presentation of strabismus (p- value, 0.001). This could be explained in part by the fact that most of the patients were children and could not come to the clinic on their own and depended on their parents and guardians in which majority of them (97.8%) had some form of formal education to decide for them and their decision to bring their wards early or late might have been influenced by other factors although they had knowledge about strabismus. This contrasts with findings from Cheha in Ethiopia who established low levels of knowledge about strabismus among their study participants²¹. This could be because the study done in Cheha had majority(51.7%) of the participants being illiterates, whiles in this study 97.8% of the participants had some form of formal education. This may have influenced these parents having a higher level of knowledge. No significant association was established between the knowledge about strabismus and late reporting time in the study done Cheha. Isawumi et al⁹²

in their study demonstrated that about 75% of their study participants in the tertiary hospital were knowledgeable about strabismus which this current study corroborates.

Family history of strabismus had a strong association with late presentation of patients with strabismus in the current study (p-value, 0.001). Those patients who did not have relatives with strabismus were about 2 times more likely to present late to the clinic. This could be due to the fact that the families were already aware of strabismus through generations and thus knew about the need to seek for medical attention early. This supports findings by Aurell et al who demonstrated that there was a higher prevalence of strabismus in children with family history of strabismus and if one had someone in the family with strabismus it may serve as knowledge base for early presentation³⁸. This is supported by a study done in twins which was able to demonstrate that strabismus is inherited³⁹. Another study also done in monozygotic and dizygotic twins also showed that there is a 64% heritability of esotropia whereas exotropia is mostly caused by environmental factors. And also the heritability of strabismus also reflects in a study done to find out the prevalence of strabismus among children with family history of strabismus and the high prevalence of strabismus in children with family history of strabismus ranged from seventeen to thirty percent³⁸.

Being a beneficiary of the NHIS also had no significant association with late presentation of strabismus in this study (p-value =0.088). NHIS in Ghana takes care of most of the Hospital bills of their beneficiaries including surgeries for strabismus in children. This means beneficiaries do not have to worry about payments of hospital bills and this should encourage them to come to the hospital early but most of the patients in this study came late. This is in line with a study from Gonda where the rich had less knowledge about strabismus due to the nature of their work. They were mostly merchants who had busy schedules hence hardly knew about strabismus let alone seek for medical care¹⁰⁵. So they not seeking for medical care was not financial but rather knowledge.

Other factors examined in this current study included the source of information for those who had knowledge about strabismus. This was found to be mainly from the hospitals, with majority of them indicating that treatment could be obtained from the hospital. This is in contrast with findings by Tegegn et al in Nigeria who found that the source of information for their patients was mainly from the internet and television¹⁰⁵. The difference in the source of information about strabismus might be the level of computer literacy in the various countries, a factor that was not examined in this current study.

5.5 Predictors of late presentation of patients with strabismus at the KATH Eye Clinic

Strabismus remains a public health condition which is usually characterised by late presentation. Thus, after noticing the condition, patients often take longer periods before seeking treatment. In this study late presentation of strabismus patients to the clinic was a common occurrence which was found in 85.5 % of strabismus patients presenting after six months from the onset of strabismus. Late presentation of strabismus may increase the risk of developing amblyopia¹²⁸. This underscores the significance of identifying predictors of late presentation of patients with strabismus.

From the study; age of patient (patient being a child or an adult), educational level of patient (having a lower or higher level of education), patient not being an NHIS beneficiary (being a non-beneficiary of NHIS), not having a family history of strabismus and not having knowledge about strabismus were identified as predictors of late presentation of patients with strabismus.

Children were found to be 0.1 times less likely to present late compared to adults. Currently, there is scarcity of literature to discuss or support this prediction from this current study. However, children with strabismus whose parents have higher education and more awareness about the condition may turn to present earlier to seek eye care, whereas most adults may have lived with the condition and therefore may be reluctant in seeking eye care.

Also, patients with lower education were about two times (1.6 times) more likely to present late with strabismus compared to those having higher education. Education may play a major role in the management of health condition. In this study, the educational level of the patients were grouped into two [thus, those with low education (from nursery school to Junior High School level) and those with higher level of education (from the Senior High School level to Tertiary level of education)]. A study done in India to assess knowledge and attitude of parents towards children suffering from strabismus by Singh et al¹¹³ realized that some parents, especially those with lower education, had poor understanding of strabismus resulting in late presentation which was also observed in this current study. Another study have shown that patients with strabismus whose parents have higher education are seen to be more optimistic about the availability of treatment of the condition of their children as a result of their higher level of awareness¹¹³. Such parents may have access to the internet and other educative materials and may even be more assertive in asking health care workers about the condition of their children. Parents of children with strabismus who have lower education including adult patients with strabismus who also have lower education may not have significant knowledge about the availability of treatment options and management for strabismus. Such persons may subsequently present late to the facility which may lead to the development of amblyopia and poor vision. A study done in United kingdom established that majority of adults with strabismus had enough knowledge about the condition and sought for treatment⁹⁹. Although Geta et al²¹ mentioned the significance of having knowledge about strabismus as a key issue, not much was said about it being a predictor of late presentation.

Beneficiaries of NHIS in this study were 0.4 times more likely to present early compared to non-beneficiaries of NHIS. The NHIS which is the national health insurance system in Ghana was enacted into law in 2003 but fully implemented in the year 2005¹¹⁷. This health insurance scheme was designed to abolish user, fees traditionally known as the “cash and carry” system¹²⁹. Since its inception, the scheme has supported individuals and

families with low income in subsidising their health care expenses (hospital bills). Studies have demonstrated financial constraints as a barrier in patients accessing health care in general. A study done by Sathyan et al¹⁵ at a tertiary eye center in Kerala, India, which examined the barriers responsible for delay in surgical management among adult patient with strabismus, established that social factors such as affordability of care among others, was the main reason for the delay in seeking treatment. Other studies also did not agree with this current study that affordability(not having NHIS) was a predictor to late presentation but rather knowledge about strabismus as seen in a study done by Tegeg et al¹⁰⁵ where individuals with high income who could afford their hospital bill, because of lack of knowledge came to the hospital late. These differences in the predictors might be due to national policies in the individual countries that is Ethiopia and Ghana. In Ghana the NHIS accommodates the cost of hospital bills, whereas the Ethiopian health care system are still operating the system of “cash and carry”^{100,117}.

From the study, patients with no knowledge about strabismus are about 3 times (2.9 times) more likely to present late to the clinic compared with those who have knowledge about strabismus. Knowledge about strabismus among patients with strabismus is significant in the prevention of visual impairment, low self-esteem and social stigmatization associated with untreated strabismus^{21 130}.

From the study, 75 % of the patients had relatives with strabismus. Patients who have no relatives with strabismus were 2 times more likely to present late compared with those having relatives with strabismus. Having a family member with strabismus could serve as a source of reference for an individual with strabismus or a parent having a child with strabismus. This could influence early presentation. It is therefore not surprising from this current study, that patients who don't have any family member with strabismus presented

late to the clinic. Currently, there is not much literature on family history of strabismus as a predictor of late presentation. Further studies could give a better insight into this relationship.

Other studies have indicated that heredity is a factor related to strabismus^{122 131}. Further research into examining the relationship between late presentation and having a relative with strabismus will be significant in explaining better the relationship.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The age and education of patients with strabismus, having no relative with strabismus, monthly income level of a family and having no knowledge about strabismus were associated with late presentation of patients with strabismus to the eye clinic at KATH. There was no association between clinical characteristics such as; type of strabismus, type of deviation, presenting visual acuity, angle of deviation and late presentation of patients with strabismus at the eye clinic at KATH.

From the logistic regression analysis, children are 0.1 times less likely to present late with strabismus to the eye clinic compared to adults. Also, participants with lower education are 1.6 times more likely to present late with strabismus compared to those having higher education. Beneficiaries of NHIS are 0.4 times less likely to present late to the eye clinic compared with non-beneficiaries of NHIS. Patients with no knowledge about strabismus are 2.9 times more likely to present late to the eye clinic compared with those who have knowledge about strabismus. Patients who have no relatives with strabismus are about 2 times more likely to present late to the eye clinic compared with those having relatives with strabismus.

Therefore age, education of patient, having no relative with strabismus, monthly income level of family and having no knowledge about strabismus were associated with late presentation of patients with strabismus to the eye clinic. Being an adult, having lower

education, not having NHIS and knowledge about strabismus, not having relatives with strabismus could predict late presentation of patients with strabismus to the eye clinic.

6.2 Recommendations

Considering the findings above, the researcher suggests the need for a public eye health education and creation of awareness through social media for all ages to improve on knowledge about strabismus and the need to seek for early treatment.

Pre-school screening programs for early detection of children with strabismus is highly recommended.

Treatment of strabismus must not be seen as cosmetic issue but as a medical condition that needs early management.

REFERENCES

1. Langelaan M, De Boer MR, Van Nispen RM, Wouters B, Moll AC, Van Rens GH. Impact of visual impairment on quality of life: a comparison with quality of life in the general population and with other chronic conditions. *Ophthalmic epidemiology*. 2007;14(3):119-126.
2. Ophthalmology AAo. *Pediatric Ophthalmology and Strabismus: 1993-1994 (last Major Revision 1991-1992)*. American Academy of Ophthalmology; 1993.
3. Coats DK, Stager DR, Beauchamp GR, Mazow ML, Paysse EA, Feliuss J. Reasons for delay of surgical intervention in adult strabismus. *Archives of Ophthalmology*. 2005;123(4):497-499.
4. Organization WH. Action plan for the prevention of avoidable blindness and visual impairment, 2009-2013. 2010.
5. Wedner S, Ross D, Balira R, Kaji L, Foster A. Prevalence of eye diseases in primary school children in a rural area of Tanzania. *The British Journal of Ophthalmology*. 2000;84(11):1291-1297.
6. Wilmer JB, Backus BT. Genetic and environmental contributions to strabismus and phoria: evidence from twins. *Vision research*. 2009;49(20):2485-2493.
7. Robaei D, Rose KA, Kifley A, Cosstick M, Ip JM, Mitchell P. Factors associated with childhood strabismus: findings from a population-based study. *Ophthalmology*. 2006;113(7):1146-1153.
8. Akpe BA, Dawodu OA, Abadom EG. Prevalence and pattern of strabismus in primary school pupils in Benin City, Nigeria. *Nigerian Journal of Ophthalmology*. 2014;22(1):38-43.

9. Ruiz-Casares M. The African Report on Child Wellbeing 2008: How child-friendly are African Governments? By the African Child Policy Forum. *African Affairs*. 2009;109(434):163-164.
10. Garvey KA, Dobson V, Messer DH, Miller JM, Harvey EM. Prevalence of strabismus among preschool, kindergarten, and first-grade Tohono O'odham children. *Optometry-Journal of the American Optometric Association*. 2010;81(4):194-199.
11. Ntim-Amponsah C, Ofosu-Amaah S. Prevalence of refractive error and other eye diseases in schoolchildren in the Greater Accra region of Ghana. *Journal of pediatric ophthalmology and strabismus*. 2007;44(5):294-297.
12. McKean-Cowdin R, Cotter SA, Tarczy-Hornoch K, et al. Prevalence of amblyopia or strabismus in asian and non-Hispanic white preschool children: multi-ethnic pediatric eye disease study. *Ophthalmology*. 2013;120(10):2117-2124.
13. Vázquez JT. Prevalence of amblyopia and strabismus in white and african american children aged 6 through 71 months. *Annals d'oftalmologia: òrgan de les Societats d'Oftalmologia de Catalunya, Valencia i Balears*. 2010;18(1):9.
14. Assaf AA. Early versus late alignment of infantile esotropia. *Strabismus*. 1995;3(2):61-69.
15. Sathyan S, Jose J. Barriers responsible for delay in surgical correction of strabismus: A study among adults undergoing strabismus surgery at a tertiary care center in Kerala. *Kerala Journal of Ophthalmology*. 2017;29(2):102-107.
16. Chantada G, Fandiño A, Manzitti J, Urrutia L, Schvartzman E. Late diagnosis of retinoblastoma in a developing country. *Archives of disease in childhood*. 1999;80(2):171-174.
17. Oystreck DT, Lyons CJ. Comitant strabismus: Perspectives, present and future. *Saudi Journal of Ophthalmology*. 2012;26(3):265-270.

18. Bodunde O, Onabolu O, Fakolujo V. Pattern of squint presentations in children in a tertiary institution in Western Nigeria. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*. 2014;13(5):29-31.
19. Bodunde O, Runsewe-Abiodun T, Alabi A, Adetunji J, Olowonyo M, Adefuye B. Awareness and Perception of Strabismus Among the Youths and Women of Child-Bearing Age in a Local Government in South Western Nigeria: A Qualitative Study. *Int Q Community Health Educ*. 2016;37(1):21-25.
20. Senthilkumar D, Balasubramaniam SM, Kumaran SE, Ramani KK. Parents' awareness and perception of children's eye diseases in Chennai, India. *Optometry & Vision Science*. 2013;90(12):1462-1466.
21. Geta K, Bejiga A. Knowledge, attitude and practice towards strabismus in Cheha District, Central Ethiopia. *Ethiopian Journal of Health Development*. 2011;25(3):212-215.
22. Pi L-H, Chen L, Liu Q, et al. Prevalence of eye diseases and causes of visual impairment in school-aged children in Western China. *Journal of epidemiology*. 2012;22(1):37-44.
23. Simonsz H, Kolling G, Unnebrink K. Final report of the early vs. late infantile strabismus surgery study (ELISSS), a controlled, prospective, multicenter study. *Strabismus*. 2005;13(4):169-199.
24. Worth CA, Bridgeman GJO, Lyle TK, Chavasse FB. *Worth and Chavasse's Squint: the binocular reflexes and the treatment of strabismus*. Baillière, Tindall & Cox; 1959.
25. Chavasse F. An Examination of Existing Theories of Concomitant Convergent Strabismus. *Trans. Ophthal. Soc. UK*. 1930;50:168.
26. Ing MR, Pang SW. The racial distribution of strabismus. A statistical study. *Hawaii medical journal*. 1974;33(1):22-23.

27. van Leeuwen R, Eijkemans MJC, Vingerling JR, Hofman A, de Jong PTVM, Simonsz HJ. Risk of bilateral visual impairment in individuals with amblyopia: the Rotterdam study. *British Journal of Ophthalmology*. 2007;91(11):1450-1451.
28. Abu E, Boampong J, Afoakwah R, Ameyaw E, Ntodie M, Ayi I. Visual outcome in ocular toxoplasmosis: A case series of 30 patients from Ghana. *Journal of Clinical & Experimental Ophthalmology*. 2015;6(04):458.
29. Cumming BG, DeAngelis GC. The physiology of stereopsis. *Annual review of neuroscience*. 2001;24(1):203-238.
30. Bui Quoc E, Milleret C. Origins of strabismus and loss of binocular vision. *Frontiers in Integrative Neuroscience*. 2014;8:71.
31. Archer SM, Sondhi N, Helveston EM. Strabismus in Infancy. *Ophthalmology*. 1989;96(1):133-137.
32. Clarke WN. Common types of strabismus. *Paediatrics & Child Health*. 1999;4(8):533-535.
33. Spanou N, Alexopoulos L, Manta G, Tsamadou D, Drakos H, Paikos P. Strabismus in pediatric lens disorders. *Journal of Pediatric Ophthalmology and Strabismus*. 2011;48(3):163-166.
34. Ing EB, Sullivan TJ, Clarke MP, Buncic JR. Oculomotor nerve palsies in children. *Journal of pediatric ophthalmology and strabismus*. 1992;29(6):331-336.
35. Torp-Pedersen T, Boyd HA, Skotte L, et al. Strabismus incidence in a Danish population-based cohort of children. *Jama Ophthalmology*. 2017;135(10):1047-1053.
36. Ye XC, Pegado V, Patel MS, Wasserman WW. Strabismus genetics across a spectrum of eye misalignment disorders. *Clinical Genetics*. 2014;86(2):103-111.
37. Maconachie GD, Gottlob I, McLean RJ. Risk factors and genetics in common comitant strabismus: a systematic review of the literature. *JAMA ophthalmology*. 2013;131(9):1179-1186.

38. Aurell E, Norrsell K. A longitudinal study of children with a family history of strabismus: factors determining the incidence of strabismus. *British Journal of Ophthalmology*. 1990;74(10):589-594.
39. Sanfilippo PG, Hammond CJ, Staffieri SE, et al. Heritability of Strabismus: Genetic Influence Is Specific to Eso-Deviation and Independent of Refractive Error. *Twin Research and Human Genetics*. 2012;15(5):624-630.
40. Ruete CT. Ocular physiology. *Strabismus*. 1999;7(1):43-60.
41. Hall CJ. Eye Movement Disorders in Hydrocephalus and Increased Intracranial Pressure. *American Orthoptic Journal*. 2005;55(1):35-38.
42. Mojon-Azzi SM, Mojon DS. Strabismus and employment: the opinion of headhunters. *Acta ophthalmologica*. 2009;87(7):784-788.
43. Dahlberg G, Nordlöw W. Genetics of convergent strabismus. *Human Heredity*. 1951;2(1):1-14.
44. Hashemi H, Pakzad R, Yekta A, et al. Global and regional estimates of prevalence of amblyopia: A systematic review and meta-analysis. *Strabismus*. 2018;26(4):168-183.
45. Webber AL, Wood J. Amblyopia: prevalence, natural history, functional effects and treatment. *Clinical and Experimental Optometry*. 2005;88(6):365-375.
46. Williams C, Harrad RA, Harvey I, Sparrow JM. Screening for amblyopia in preschool children: Results of a population-based, randomised controlled trial. *Ophthalmic Epidemiology*. 2001;8(5):279-295.
47. Wright KW, Spiegel PH, Thompson LS. *Handbook of pediatric strabismus and amblyopia*. Springer; 2006.
48. von Noorden GK, Maumenee AE. Clinical observations on stimulus-deprivation amblyopia (amblyopia ex anopsia). *American journal of ophthalmology*. 1968;65(2):220-224.

49. de Zárata BR, Tejedor J. Current concepts in the management of amblyopia. *Clin Ophthalmol*. 2007;1(4):403-414.
50. Wang J, Morale SE, Ren X, Birch EE. Longitudinal Development of Refractive Error in Children With Accommodative Esotropia: Onset, Amblyopia, and Anisometropia. *Investigative Ophthalmology & Visual Science*. 2016;57(4):2203-2212.
51. Ovenseri-Ogbomo G, Assien R. Refractive error in school children in Agona Swedru, Ghana. *African Vision and Eye Health*. 2010;69(2):86-92.
52. Ovenseri-Ogbomo G, Omuemu V. Prevalence of refractive error among school children in the Cape Coast Municipality, Ghana. *Clin Optom (Auckl)*. 2010;2:59-66.
53. Faderin M, Ajaiyeoba A. Refractive errors in primary school children in Nigeria. *Nigerian journal of ophthalmology*. 2001;9(1):10-14.
54. Maduka Okafor FC, Okoye OI, Eze BI. Myopia: a review of literature. *Nigerian journal of medicine : journal of the National Association of Resident Doctors of Nigeria*. 2009;18(2):134-138.
55. Kothari M, Rathod V. Efficacy of 1% atropine eye drops in retarding progressive axial myopia in Indian eyes. *Indian J Ophthalmol*. 2017;65(11):1178-1181.
56. Wei S, Li SM, An W, et al. Safety and Efficacy of Low-Dose Atropine Eyedrops for the Treatment of Myopia Progression in Chinese Children: A Randomized Clinical Trial. *JAMA Ophthalmol*. 2020;138(11):1178-1184.
57. Leo SW. Current approaches to myopia control. *Current opinion in ophthalmology*. 2017;28(3):267-275.
58. Bekibele CO. Pediatric ophthalmology and strabismus. *Nigerian Journal of Ophthalmology*. 2015;23(3):3-7.
59. MacEwen CJ, Lymburn EG, Ho WO. Is the maximum hypermetropic correction necessary in children with fully accommodative esotropia? *British Journal of Ophthalmology*. 2008;92(10):1329-1332.

60. Mozayan E, Lee JK. Update on astigmatism management. *Current opinion in ophthalmology*. 2014;25(4).
61. Hashemi H, Nabovati P, Yekta A, Ostadimoghaddam H, Behnia B, Khabazkhoob M. The prevalence of strabismus, heterophorias, and their associated factors in underserved rural areas of Iran. *Strabismus*. 2017;25(2):60-66.
62. Matsuo T, Matsuo C. The prevalence of strabismus and amblyopia in Japanese elementary school children. *Ophthalmic Epidemiol*. 2005;12.
63. Buck D, Hatt SR, Haggerty H, et al. The use of the Newcastle Control Score in the management of intermittent exotropia. *British Journal of Ophthalmology*. 2007;91(2):215-218.
64. Folk ER, Miller MT, Chapman L. Consecutive exotropia following surgery. *British Journal of Ophthalmology*. 1983;67(8):546-548.
65. Khorrami-Nejad M, Akbari MR, Khosravi B. The prevalence of strabismus types in strabismic Iranian patients. *Clin Optom (Auckl)*. 2018;10:19-24.
66. Olusanya B, Ugalahi M, Ayeni O, Fawole O, Baiyeroju A. Common Forms of Strabismus in a Tertiary Eye Clinic in Southwest Nigeria. *Nigerian Journal of Ophthalmology*. 2019;27(2):62-67.
67. Shimauti AT, Pesci LdT, Sousa RLFd, Padovani CR, Schellini SA. Strabismus: detection in a population-based sample and associated demographic factors. *Arquivos brasileiros de oftalmologia*. 2012;75(2):92-96.
68. Goseki T, Ishikawa H. The prevalence and types of strabismus, and average of stereopsis in Japanese adults. *Japanese Journal of Ophthalmology*. 2017;61(3):280-285.
69. Hashemi H, Yekta A, Jafarzadehpur E, et al. The Prevalence of Strabismus in 7-Year-Old Schoolchildren in Iran. *Strabismus*. 2015;23(1):1-7.

70. Bruce A, Santorelli G. Prevalence and Risk Factors of Strabismus in a UK Multi-ethnic Birth Cohort. *Strabismus*. 2016;24(4):153-160.
71. Yeung J. Management of Strabismus. *Medical Bulletin, Hong Kong Medical Society*. 2010.
72. Ciner EB, Dobson V, Schmidt PP, et al. A survey of vision screening policy of preschool children in the United States. *Survey of ophthalmology*. 1999;43(5):445-457.
73. Eskridge BJ, Wick B, Perrigin D. The Hirschberg test: a double-masked clinical evaluation. *Optometry & Vision Science*. 1988;65(9):745-750.
74. Evens L. History of strabismus treatment. *Convergent Strabismus*: Springer; 1982:19-52.
75. Remy C, Aracil P. History of strabismus surgery. *Journal francais d'ophtalmologie*. 1983;7(6-7):493-498.
76. Taylor D. How early is early surgery in the management of strabismus? *Archives of Ophthalmology*. 1963;70(6):752-756.
77. Group M-ePEDS. Prevalence of amblyopia and strabismus in African American and Hispanic children ages 6 to 72 months: the Multi-ethnic Pediatric Eye Disease Study. *Ophthalmology*. 2008;115(7):1229-1236. e1221.
78. Rayner SA, Hollick EJ, Lee JP. Botulinum toxin in childhood strabismus. *Strabismus*. 1999;7(2):103-111.
79. Wold R, Pierce J, Keddington J. Effectiveness of optometric vision therapy. *Journal of the American Optometric Association*. 1978;49(9):1047-1054.
80. Krumholtz I, FitzGerald D. Outcome indicators in a strabismic sample treated by vision therapy. *J Behav Optom*. 1999;10(6):143-146.
81. Minichello MA. *Adult Strabismus and Vision Therapy*, The Ohio State University; 2015.

82. van der Fels IM, te Wierike SC, Hartman E, Elferink-Gemser MT, Smith J, Visscher C. The relationship between motor skills and cognitive skills in 4–16 year old typically developing children: A systematic review. *Journal of science and medicine in sport*. 2015;18(6):697-703.
83. Frantz KA. Beyond the Patch: Management of Amblyopia with Optometric Vision Therapy.
84. Pang S. The racial distribution of strabismus. A statistical study. *Hawaii medical journal*. 1974;33(1):22-23.
85. Maritto S. *Global data on visual impairment 2010*. Geneva: World Health Organization; 2012. WHO/NMH/PBD.
86. Nelson BA, Gunton KB, Lasker JN, Nelson LB, Drohan LA. The psychosocial aspects of strabismus in teenagers and adults and the impact of surgical correction. *Journal of American Association for Pediatric Ophthalmology and Strabismus*. 2008;12(1):72-76. e71.
87. Hatt SR, Leske DA, Castañeda YS, et al. Association of Strabismus With Functional Vision and Eye-Related Quality of Life in Children. *JAMA Ophthalmology*. 2020;138(5):528-535.
88. Azonobi IR OF, Adido J, Osayande OO. Vision of Strabismic Children in Ilorin, Nigeria. *Nigerian Journal of Ophthalmology*. 2008;16(1).
89. Steinman D. Health in rural poverty: some lessons in theory and from experience. *American Journal of Public Health and the Nations Health*. 1970;60(9):1813-1823.
90. Solan HA, Mozlin R. Biosocial consequences of poverty: associated visual problems. *Optometry & Vision Science*. 1997;74(4):185-189.
91. Ilechie AA, Otchere H, Darko-Takyi C, Halladay AC. Access to and Utilization of eye Care Services in Ghana. *Int J Health Res*. 2013;6(3):7-14.

92. Isawumi MA, Ulaikere M, Adejumo OO, Adebayo M, Kekunnaya R. Awareness, perceptions and knowledge of strabismus among patients visiting a tertiary eye clinic in Southwest Nigeria. *International Ophthalmology*. 2014;34(5):1037-1042.
93. Peters GB, Simon JW, Zobal-Ratner J, Malone A. Developmental delay and poverty in the strabismus clinic. *Journal of American Association for Pediatric Ophthalmology and Strabismus*. 1999;3(6):363-365.
94. Shonkoff JP, Hauser-Cram P, Krauss MW, Upshur CC, Sameroff AJ. Development of infants with disabilities and their families: Implications for theory and service delivery. *Monographs of the Society for Research in Child development*. 1992;i-163.
95. Castanes MS. Major review: The underutilization of vision screening (for amblyopia, optical anomalies and strabismus) among preschool age children. *Binocul Vis Strabismus Q*. 2003;18(4):217-232.
96. NWACHUKU. The Early vs. Late Infantile Strabismus Surgery Study: Monitoring Report: The Early vs. Late Infantile Strabismus Surgery Study Group. *Strabismus*. 1995;3(3):131-142.
97. Martinez-Thompson JM, Diehl NN, Holmes JM, Mohnney BG. Incidence, Types, and Lifetime Risk of Adult-Onset Strabismus. *Ophthalmology*. 2014;121(4):877-882.
98. Coats DK, Stager DR, Sr, Beauchamp GR, et al. Reasons for Delay of Surgical Intervention in Adult Strabismus. *Archives of Ophthalmology*. 2005;123(4):497-499.
99. Astle AT, Foulsham T, Foss AJ, McGraw PV. Is the frequency of adult strabismus surgery increasing? *Ophthalmic and Physiological Optics*. 2016;36(4):487-493.
100. Azonobi IR, Olatunji FO, Addo J. Prevalence and pattern of strabismus in Ilorin. *West Afr J Med*. 2009;28(4):253-256.
101. Mojon-Azzi SM, Kunz A, Mojon DS. The perception of strabismus by children and adults. *Graefe's Archive for Clinical and Experimental Ophthalmology*. 2011;249(5):753-757.

102. Menon V, Saha J, Tandon R, Mehta M, Khokhar S. Study of the psychosocial aspects of strabismus. *Journal of pediatric ophthalmology and strabismus*. 2002;39(4):203-208.
103. Serap Azizoglu SGC, Funda Şerefhan, Ayla Barutçu, Sinan Göker and Barbara M Junghans. Effects of socioeconomic status on oculo-visual disorders in school children. 2nd Global Pediatric Ophthalmology Congress; June 05-06, 2017, 2017; Milan, Italy.
104. Sharma A, Wong AM, Colpa L, Chow AH, Jin Y-P. Socioeconomic status and utilization of amblyopia services at a tertiary pediatric hospital in Canada. *Canadian Journal of Ophthalmology*. 2016;51(6):452-458.
105. Tegegn MT, Assefa NL, Yibekal BT. Knowledge towards Strabismus and Associated Factors among Adults in Gondar Town, Northwest Ethiopia. *Journal of Ophthalmology*. 2020;2020.
106. Yekta A, Fotouhi A, Hashemi H, et al. The Prevalence of Anisometropia, Amblyopia and Strabismus in Schoolchildren of Shiraz, Iran. *Strabismus*. 2010;18(3):104-110.
107. Horwood J, Waylen A, Herrick D, Williams C, Wolke D. Common visual defects and peer victimization in children. *Investigative Ophthalmology & Visual Science*. 2005;46(4):1177-1181.
108. Young JM, Solomon MJ. How to critically appraise an article. *Nature Clinical Practice Gastroenterology & Hepatology*. 2009;6(2):82-91.
109. Mojon-Azzi SM, Potnik W, Mojon DS. Opinions of dating agents about strabismic subjects' ability to find a partner. *British Journal of Ophthalmology*. 2008;92(6):765-769.
110. Bez Y, Coşkun E, Erol K, et al. Adult strabismus and social phobia: a case-controlled study. *Journal of American Association for Pediatric Ophthalmology and Strabismus*. 2009;13(3):249-252.

111. Jackson S, Harrad R, Morris M, Rumsey N. The psychosocial benefits of corrective surgery for adults with strabismus. *British Journal of Ophthalmology*. 2006;90(7):883-888.
112. Isawumi MA, Ulaikere M, Adejumo OO, Adebayo M, Kekunnaya R. Awareness, perceptions and knowledge of strabismus among patients visiting a tertiary eye clinic in Southwest Nigeria. *Int Ophthalmol*. 2014;34(5):1037-1042.
113. Singh A, Rana V, Patyal S, Kumar S, Mishra S, Sharma V. To assess knowledge and attitude of parents toward children suffering from strabismus in Indian subcontinent. *Indian Journal of Ophthalmology*. 2017;65(7):603-606.
114. Ebeigbe JA, Emedike CM. Parents' awareness and perception of children's eye diseases in Nigeria. *Journal of Optometry*. 2017;10(2):104-110.
115. Bodunde O, Runsewe-Abiodun T, Alabi A, Adetunji J, Olowonyo M, Adefuye B. Awareness and Perception of Strabismus Among the Youths and Women of Child-Bearing Age in a Local Government in South Western Nigeria:A Qualitative Study. *International Quarterly of Community Health Education*. 2016;37(1):21-25.
116. Mojon-Azzi SM, Kunz A, Mojon DS. Strabismus and discrimination in children: are children with strabismus invited to fewer birthday parties? *British Journal of Ophthalmology*. 2011;95(4):473-476.
117. Uretmen O, Egrilmez S, Kose S, Pamukçu K, Akkin C, Palamar M. Negative social bias against children with strabismus. *Acta Ophthalmologica Scandinavica*. 2003;81(2):138-142.
118. Archer SM, Musch DC, Wren PA, Guire KE, Del Monte MA. Social and emotional impact of strabismus surgery on quality of life in children. *Journal of American Association for Pediatric Ophthalmology and Strabismus*. 2005;9(2):148-151.
119. GSS. 2010 Population and Housing Census, District Analytical Report. 2014.

120. Hashemi H, Pakzad R, Heydarian S, et al. Global and regional prevalence of strabismus: a comprehensive systematic review and meta-analysis. *Strabismus*. 2019;27(2):54-65.
121. Cochran 2nd W. Sampling techniques 2nd Edition, 1963 New York. John Wiley and sons Inc.
122. Maconachie GDE, Gottlob I, McLean RJ. Risk Factors and Genetics in Common Comitant Strabismus: A Systematic Review of the Literature. *JAMA Ophthalmology*. 2013;131(9):1179-1186.
123. Musa K, Ikuomenisan S, Idowu O, Salami M, Olowoyeye A. Spectrum of Childhood Strabismus seen at Lagos University Teaching Hospital, Lagos, Nigeria. *literatures*. 2017;10:11.
124. Awoyesuku E, Fiebai B, Onua A. Pattern of strabismus in a tertiary hospital in Nigeria: a six-year review. *Port Harcourt Medical Journal*. 2016;10(1):14-14.
125. Tuwor T, Sossou MA. Gender discrimination and education in West Africa: strategies for maintaining girls in school. *International Journal of Inclusive Education*. 2008;12(4):363-379.
126. Alexander KE, Brijnath B, Mazza D. Parents' decision making and access to preventive healthcare for young children: applying Andersen's Model. *Health Expectations*. 2015;18(5):1256-1269.
127. Azam P, Nausheen N, Fahim M. Prevalence of Strabismus and its type in Pediatric age group 6-15 years in a tertiary eye care hospital, Karachi. *Biom Biostat Int J*. 2019;8(1):24-28.
128. Chia A, Dirani M, Chan Y-H, et al. Prevalence of Amblyopia and Strabismus in Young Singaporean Chinese Children. *Investigative Ophthalmology & Visual Science*. 2010;51(7):3411-3417.

129. Agyepong IA, Adjei S. Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. *Health policy and planning*. 2008;23(2):150-160.
130. Satterfield D, Keltner JL, Morrison TL. Psychosocial Aspects of Strabismus Study. *Archives of Ophthalmology*. 1993;111(8):1100-1105.
131. Chew E, Remaley NA, Tamboli A, Zhao J, Podgor MJ, Klebanoff M. Risk factors for esotropia and exotropia. *Archives of ophthalmology*. 1994;112(10):1349-1355.

BUDGET

	ELEMENT	QUAN TITY	BASIS FOR CALCULATION OF COST	COST (GH¢)
A	Administrative costs			
	Printing of Clerking sheets (2 pages set of questionnaires)			
B	Phone call credit cost			
	For the purposes of making phone calls related to the study.	1		440.00
C	Diagnostics and consumables			
	Cyclopentolate	5	@ C45.00 per bottle	225.00
	Mydriacyl	5	@ C45.00 per bottle	225.00
	Phenylephrine	5	@ C 45.00 per bottle	225.00
	Amethocaine	5	@ C45.00 per bottle	225.00
	Fluorescein	5	@ C45.00 per bottle	225.00
	Alcohol swab	5	@ C10.00 per box	50.00
	Methylated spirit	1 litre	@ C50.00 per litre	50.00
	Batteries for and light source (touch light)			
	Size “AA”	10	@ C2.00 per pair of battery	
	Cotton wool rolls	5	@ C 10.00 per box	50.00
	Hand sanitizers	5 bottles	@ C 30.00 per bottle	150.00
	Hand gloves	2 boxes	@ C 25.00 per box	50.00
E	Protocol Review fee		200.00	200.00
F	Total cost			1890.00
G	Contingency cost (10 %)			189.00
H	GRAND TOTAL			2,079.00

TIMELINES

	OCT 2018 TO APR. 2019.	APR. TO JUNE 2019.	JUNE 2019 TO DEC 2019.	JUL. 2019.	JUL. 2019 TO NOV. 2020
Proposal writing					
Ethics					
Data collection					
Statistical analysis					
Manuscript writing					
Dissemination of results					

APPENDICES

Appendix I: Informed Consent Form

CONSENT FORM

Statement of person obtaining informed consent:

I have fully explained this research to _____ and have given sufficient information about the study, including the procedures, risks and benefits, to enable the prospective participant to make an informed decision to or not to participate.

DATE: _____ NAME: _____

Statement of person giving consent:

I have read the information on this study/research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction.

I understand that my participation is voluntary (not compulsory).

I know enough about the purpose, methods, risks and benefits of the research study to decide that I want to take part in it.

I understand that I may freely stop being part of this study at any time without having to explain myself.

I have received a copy of this information leaflet and consent form to keep for myself.

DATE: _____ SIGNATURE/THUMB PRINT: _____

Statement of person witnessing consent (Process for Non-Literate Participants):

I _____ (Name of Witness) certify that information given to

_____ (Name of Participant), in the local language, is a true reflection of what I have read from the study Participant Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate): _____

MOTHER'S SIGNATURE (maintain if participant is under 18 years): _____

MOTHER'S NAME: _____

FATHER'S SIGNATURE (maintain if participant is under 18 years): _____

FATHER'S NAME: _____

Appendix II: Assent Form

ASSENT FORM

Statement of person obtaining assent:

I have fully explained this research to _____ and have given sufficient information about the study, including the procedures, risks and benefits, to enable me as a child to make an informed decision to or not to participate.

DATE: _____ NAME: _____

Statement of person giving consent:

I have read the information on this study/research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction.

I understand that my participation is voluntary (not compulsory).

I know enough about the purpose, methods, risks and benefits of the research study to decide that I want to take part in it.

I understand that I may freely stop being part of this study at any time without having to explain myself.

I have received a copy of this information leaflet and consent form to keep for myself.

DATE: _____ SIGNATURE/THUMB PRINT (CHILD):

_____ **Statement of person witnessing consent (Process for Non-Literate Participants):**

I _____ (Name of Witness) certify that information given to

_____ (Name of Participant), in the local language, is a true reflection of what I have read from the study Participant Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate): _____

MOTHER'S SIGNATURE (maintain if participant is under 18 years): _____

MOTHER'S NAME: _____

FATHER'S SIGNATURE (maintain if participant is under 18 years): _____

FATHER'S NAME: _____

Appendix III: Parental Informed Consent Form

CONSENT FORM

Statement of person obtaining informed consent:

I have fully explained this research to _____ and have given sufficient information about the study, including the procedures, risks and benefits, to enable me to make an informed decision to or not to allow my child to participate.

DATE: _____ NAME: _____

Statement of person giving consent:

I have read the information on this study/research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction.

I understand that my participation is voluntary (not compulsory).

I know enough about the purpose, methods, risks and benefits of the research study to decide that I want to take part in it.

I understand that I may freely stop being part of this study at any time without having to explain myself.

I have received a copy of this information leaflet and consent form to keep for myself.

DATE: _____ SIGNATURE/THUMB PRINT: _____

Statement of person witnessing consent (Process for Non-Literate Participants):

I _____ (Name of Witness) certify that information given to

_____ (Name of Participant), in the local language, is a true reflection of what I have read from the study Participant Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate): _____

MOTHER'S SIGNATURE (maintain if participant is under 18 years): _____

MOTHER'S NAME: _____

FATHER'S SIGNATURE (maintain if participant is under 18 years): _____

FATHER'S NAME: _____

Appendix IV: Participant Information Leaflet

FACTORS CONTRIBUTING TO LATE PRESENTATION OF PATIENTS WITH STRABISMUS AT THE KOMFO ANOKYE TEACHING HOSPITAL, GHANA

Participant Information Leaflet

**This leaflet must be given to all prospective participants to enable them to know enough
about the research before deciding to or not to participate**

Title of Research: Factors contributing to late arrival of patients with strabismus at the Komfo Anokye Teaching Hospital, Ghana

Name(s) and affiliation(s) of researcher(s): Dr Doreen Amankwaa-Frempong, Komfo Anokye Teaching Hospital.

Background (Please explain simply and briefly what the study is about): Misalignment of the eyes can lead to double vision and visual confusion. Prompt treatment of eye conditions especially strabismus, whether vertical or horizontal is critical for improving patient outcome.

Purpose(s) of research:

The main purpose of this study is to investigate factors contributing to late presentation of patients with strabismus at the Komfo Anokye Teaching Hospital, Ghana.

Procedure of the research, what shall be required of each participant and approximate total number of participants that would be involved in the research: There will be nothing new done here. You will go through your usual routine eye treatment as when you attend the hospital, either by referral or on your own. The only new aspect is that your consent will be sought for the information you will give us. In all we hope to recruit a minimum of 323 patients from the Komfo Anokye Teaching Hospital. You will not be

required to pay anything for these procedures. Everything will be catered for by the principal investigator.

Risk(s): This study poses minimum risks to you. The risk will not be higher than what you will ordinarily face in the hospital consulting rooms. For example some of the eye drops which may be instilled during examination procedures may sting for few seconds. In addition, some eye drops can cause blurriness of vision for 4 to 6 hours after which vision will be restored fully. No experimental procedures are involved. And there will not be any documentation of participants' name.

Benefit(s): You and I will know the exact factors contributing to your late presentation of strabismus at the Komfo Anokye Teaching Hospital which will help me put up measures to improve our care and delivery. The study outcomes will inform the Ministry of Health to provide policy for better management of the cases in the future. You will also receive a copy of the signed consent form.

Confidentiality: All information collected in this study will be given code numbers. No name will be recorded. Data collected would not be linked to you in anyway. No name will be used in any publication or reports from this study. However, as part of our responsibility to conduct this research properly, we may allow the investigator and the Ethical committee to have access to your records/information given us.

Voluntariness: Taking part in this study should be out of your own free will. You are not under obligation to and taking part in this research is entirely voluntary. There are no costs to you for taking part in this study.

Alternatives to participation: If you choose not to participate, this will not affect your treatment in this hospital/institution in any way.

Withdrawal from the research: You are a volunteer. If you join the study, you can change your mind later. You may choose to withdraw from the research at any time without having to explain yourself. You may also choose not to answer any question you find uncomfortable or private.

Consequence of Withdrawal: There will be no consequence, loss of benefit or care to you if you choose to withdraw from the study. Please note however, that some of the information that may have been obtained from you, before you chose to withdraw, may have been modified or used in analysis reports and publications. These cannot be removed anymore. We do promise to make good faith effort to comply with your wishes as much as practicable.

Costs/Compensation: You will not receive any compensation, as this will take place during your normal hours at the hospital.

Contacts: If you have any question concerning this study, please contact Dr Doreen Amankwaa -Frempong 0206300408

Further, if you have any concern about the conduct of this study, your welfare or your rights as a research participant, you may contact:

The Office of Research and Development Komfo Anokye Teaching Hospital Kumasi

Tel: 03220 22301-3

APPENDIX V

QUESTIONNAIRE/DATA COLLECTION INSTRUMENT

FACTORS CONTRIBUTING TO LATE PRESENTATION OF PATIENTS WITH STRABISMUS AT THE KOMFO ANOKYE TEACHING HOSPITAL, KUMASI.

Dear respondent,

I am a medical practitioner from Department of Eye, Ear, Nose and Throat conducting a study on “**Factors Contributing to Late Presentation of Patients with Strabismus at the KATH Eye unit**”. You are assured that the information that would be obtained will be treated confidentially and would be used for academic purposes only. Your identity will not be linked to your responses and no part of the information would be used for any other purpose without your permission. I will be grateful if you will participate in the study.

Please would you like to take part in this interview (Consent)? 1. Yes ☐ 2. No ☐

Unique ID for Respondent |||

Date of interview (dd/mm/yyyy): ||

Section A

Socio-demographic Information of Parent/guardian of Patient

1. Sex: 1. Male ☐ 2. Female ☐
2. What is your current age in years (i.e. age at last birthday) in years
3. Marital status: 1. Married ☐ 2. Single ☐
4. Place of residence: 1. Rural area ☐ 2. Urban ☐
5. Educational status: 1. None ☐ 2. Basic ☐ 3. Secondary ☐ 4. Tertiary ☐
6. Employment status: 1. Unemployed ☐ 2. Employed ☐
7. Type of Employment: 1. None ☐ 2. Formal sector ☐ 3. Informal sector ☐
8. Religion 1. Christian ☐ 2. Muslim ☐ 3. Traditionalist ☐ 4. Others
(specify).....

Socio-demographic Information of Patients

9. Sex 1. Male ☐ 2. Female ☐
10. What is your current age in years (i.e. age at last birthday) in years
11. Patient type 1. Child ☐ 2. Adult ☐
12. Marital status 1. Married ☐ 2. Single ☐
13. Place of residence 1. Rural area ☐ 2. Urban ☐
14. Educational status 1. None ☐ 2. Basic ☐ 3. Secondary ☐ 4. Tertiary ☐
15. Employment status: 1. Employed ☐ 2. Unemployed ☐
16. Type of Employment: 1. Formal sector ☐ 3. Informal sector ☐
17. Religion 1. Christian ☐ 2. Muslim ☐ 3. Traditionalist ☐ 4. Others
(specify).....

Section B

Onset of strabismus and arrival time

18. At what age did you first notice or suspected that there was a deviation in your child's eyeyrs.?
19. When did you first report the case to the/a health facility after you saw the deviation?
1. Before 6months |___| 2. After 6months |___|

Section C

Clinical Characteristics of strabismus

A. History

20. In which eye do you normally see the deviation ? 1. Left eye |___| 2. Right eye |___| 3. Both eyes |___|
21. In which direction is the deviation? 1. Inward (L) |___| 2. Outward (R) |___| 3. Superior (T) |___| 4. Inferior (D) |___|
22. Is the deviation 1. Constant |___| 2. Intermittent |___|
23. If Intermittent, under what condition? 1. When sick |___| 2. When tired |___| 3. When lose concentration 4. Others (Specify)

B. Examination of the Eye (type of strabismus)

24. Visual acuity 1. Equal vision in both eyes |___| 2. Unequal vision in both eyes |___|
25. Type of Deviation 1. Esotropia |___| 2. Exotropia |___| 3. Hypertropia |___| 4. Hypotropia |___|
26. Angle of Deviation (PCT)/Diopter 1. <20 |___| 2. 20 – 30 |___| 3. 31 - 60 |___| 4. >60 |___|
27. Type of angle 1. Small angle (<20) |___| 2. Wide angle (>20) |___|

Section D

Factors contributing to late arrival

A: Economic Status:

28. Are you Registered for National Health Insurance card? 1. Yes ☐ 2. No ☐
29. What is your range of salary/monthly income? 1. Less than GHC 500 ☐ 2. GHC 500- GHC 1000 ☐ 3. Above GHC 1000 ☐
30. How much do you spend monthly on your health or health of the ward? 1. About GHC 100 ☐ 2. GHC 200 ☐ 3. GHC 300 – GHC 400 ☐ 4. Above GHC 400 ☐
31. Are you able to afford the bills of your ward including education, health, etc.?
1. Yes ☐ 2. No ☐ 3. Somehow ☐
32. Do you see the condition of your ward as burdening your family financially?
1. Yes ☐ 2. No ☐ 3. Somehow ☐
33. How many people depends on you in your family?
34. How many children do have?

B: Fear and Patient Cultural Perception:

35. How do people in your community perceive strabismus?
1. Do not consider it as a disease ☐ 2. As a disease that is treatable ☐
3. As an untreatable disease ☐ 4. As a curse from the gods for punishment for sins ☐
36. Do people in your community shun away (stigmatization) from people with strabismus?
1. Yes ☐ 2. No ☐
37. Will you marry someone with the strabismus condition? 1. Yes ☐ 2. No ☐
38. Does your religion endorse surgery of the eye? 1. Yes ☐ 2. No ☐
39. Do you fear eye surgery? 1 Yes ☐ 2 No ☐

C: Accessibility

40. Proximity to the hospital 1. Near (<50km) ☐ 2. Far (>50km) ☐
41. What is the distance to facility? Km/m
42. By what means do you go to the Hospital?
1. Walking ☐ 2. Private Car ☐ 3. Tricycle ☐ 4. Public car ☐
43. How much is the fare (Cost by means in Q42)) from your place of residence to the KATH? GHC
44. How long does it take you to get to the facility using the means in Q42 above?
1. Less than 30 minutes ☐ 2. 30min-1hr ☐ 3. Between 1hr – 2hrs ☐ 4. Above 2hrs ☐
45. State of road network to hospital 1. Bad ☐ 2. Good ☐
46. How long did it take you to see the eye specialist at KATH after reporting the case?
- 1 Days ☐ 2. Weeks ☐ 3. Months ☐ 4. Years ☐

D: Awareness

47. Have you heard of strabismus? 1. Yes ☐ 2. No ☐
48. If the answer in Q 47 is yes, from where? 1. Hospital ☐ 2. School ☐ 3. Social Media ☐ Radio /TV ☐ 4. Home ☐ 5. Other (Specify).....
49. Do you have people with strabismus in your family? 1. Yes ☐ 2. No ☐
50. Which/where among this do you think strabismus could be best treated?
1. Hospital ☐ 2. Church ☐ 3. Native doctors ☐ 3. Others (Specify)

E: Centers

51. Are there available health centers where strabismus is easily treated? 1 Yes ☐ 2. No ☐ 3. Not sure ☐

Thank You

APPENDIX VI: ETHICAL APPROVAL FROM CHPRE KNUST



KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS



Our Ref: CHRPE/AP/321/19 22nd May, 2019

Dr. Doreen Amankwaa - Frempong
Department of Ophthalmology
Komfo Anokye Teaching Hospital
Post Office Box 1934
KUMASI

Dear Madam,

LETTER OF APPROVAL

Protocol Title: *"Factors Contributing to Late Presentations of Patients with Strabismus to the Komfo Anokye Teaching Hospital."*

Proposed Site: *Eye Department, Komfo Anokye Teaching Hospital.*

Sponsor: *Principal Investigator.*

Your submission to the Committee on Human Research, Publications and Ethics on the above-named protocol refers.

The Committee reviewed the following documents:

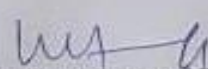
- A notification letter of 4th March, 2019 from the Komfo Anokye Teaching Hospital (study site) indicating approval for the conduct of the study at the Hospital.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning 22nd May, 2019 to 21st May, 2020 renewable thereafter. The Committee may however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

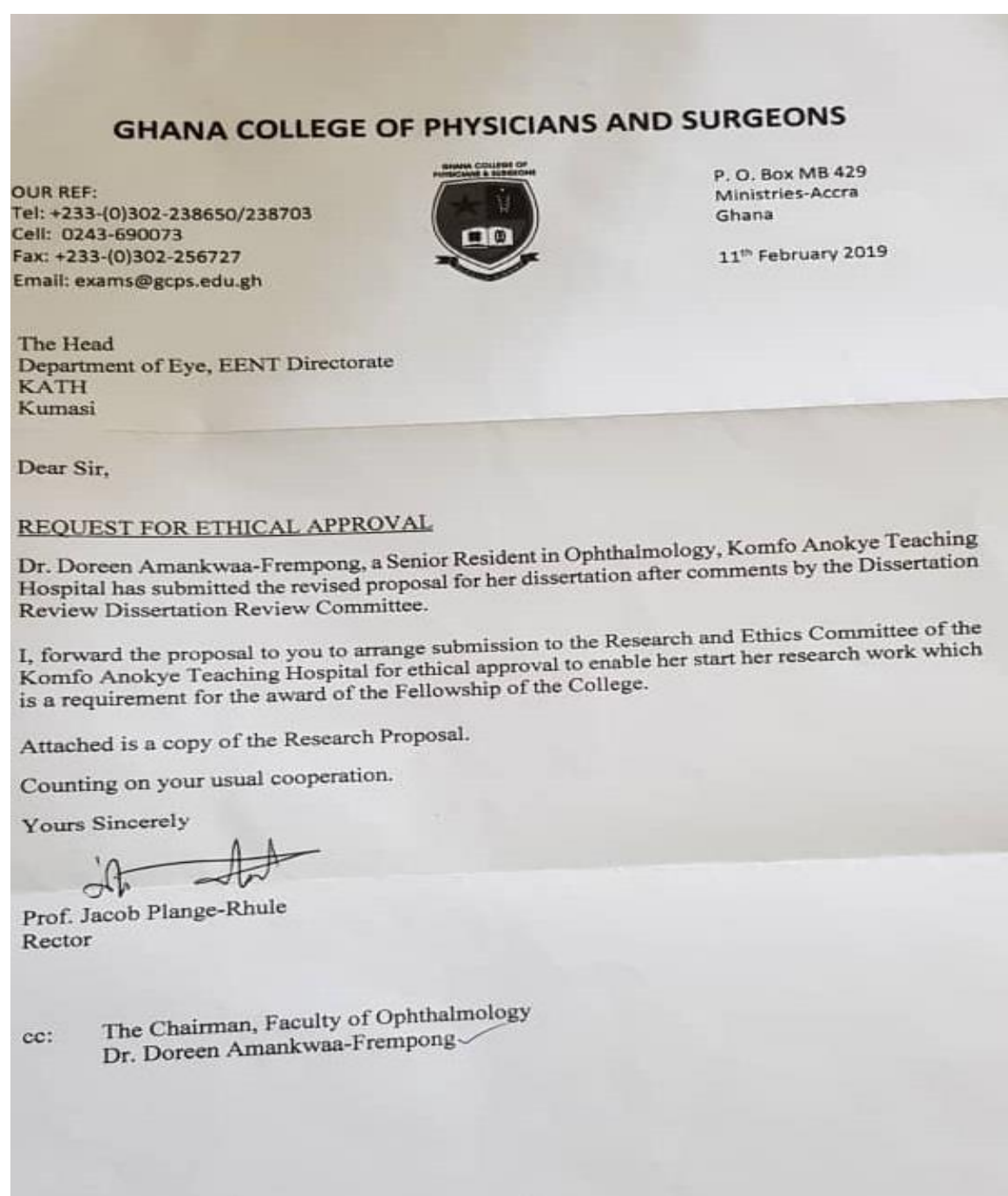
The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Yours faithfully,


Osomfo Prof. Sir J. W. Acheampong MD, FWACP
Chairman

Room 7 Block 2, School of Medical Sciences, KNUST, University Post Office, Kumasi, Ghana
Phone: +233 3220 63248 Mobile: +233 20 5453785 Email: chrpe.knust.kath@gmail.com / chrpe@knust.edu.gh

APPENDIX VII: ETHICAL APPROVAL FROM GCPS



APPENDIX VIII: CERTIFICATE OF REGISTRATION FROM KATH R&D UNIT



KOMFO ANOKYE TEACHING HOSPITAL
RESEARCH AND DEVELOPMENT UNIT (R & D)
CERTIFICATE OF REGISTRATION

REG. NO: *RD/CR19/039...*

This is to certify that

Prof/Dr/Mrs/Mr/Ms...Doreen Amankwaa-Frimpong.....
has registered his/her proposed study titled *Factors Contributing to.....*
Late Presentations of Patients with Strabismus to the Komfo Anokye.....
Teaching Hospital.....
..... with the Research and Development Unit.

Date: *04-March-2019.....*

Name of issuing officer

Mr. Bernard Arhin.....

Signature

K/17/0594991.....

*Receipt number must tally with pay-in slip from the bank

Note

This certificate does not constitute ethical clearance for the conduct of the study but proof of registration of study with KATH. Ethical clearance from the Committee of Human Research, Publications and Ethics (CHRPE) is required to conduct the study in KATH. Copies of all relevant regulatory approvals including CHRPE must be submitted to the R&D Unit prior to commencement of the study.

Version RD/REG-01ST JUNE, 2018

Please note: All previous versions of the certificate of registration becomes obsolete

Form expires 30TH JUNE, 2019

APPENDIX IX: PERMISSION LETTER TO KATH R&D

2ND OCTOBER 2018

RESEARCH & DEVELOPMENT UNIT
KATH

Dear Sir/Madam,

APPROVAL TO CONDUCT RESEARCH AT THE EYE UNIT, KATH

I hereby grant approval for Dr. Doreen Amankwaa-Frempong to conduct research on *“Factors Contributing to Late Arrival of Patients with Strabismus at the Komfo Anokye Teaching Hospital”* at the Eye Unit, subject to approval from the Committee on Human Research, Publications & Ethics.

I agree to provide access for the approved research. If there are any concerns or the need for additional information, I will contact the Committee on Human Research, Publications & Ethics.

Thank you.

Yours sincerely,



Dr. Seth Y. Lartey
Head, Eye Unit
Consultant Ophthalmic Surgeon, KATH
Senior Lecturer, KNUST

APPENDIX X: PERMISSION LETTER TO KATH EYE CLINIC

Dr Doreen Amankwaa-Frempong
Department of Eye
Eye, Ear, Nose and Throat Directorate
KATH -Kumasi
5th January 2019

The Head of Department
Department of Eye
Eye, Ear, Nose and Throat Directorate
KATH -Kumasi

Dear Sir,

PERMISSION TO CARRY OUT RESEARCH IN THE EYE DEPARTMENT

I write to seek permission to carry out an important study at the Eye department/unit titled ***‘Factors contributing to late arrival of patients with strabismus at the Komfo Anokye teaching hospital, Ghana’***. This study will be conducted on patients presenting with strabismus to the hospital. Progress reports and final findings will be made known to the department.

Hope my request would be granted. Thank you.

Yours faithfully,

.....

Dr. Doreen Amankwaa-Frempong
(Eye Specialist)

APPENDIX XI: APPLICATION LETTER TO KATH CHRPE KNUST

Dr Doreen Amankwaa-Frempong
Department of Eye
Eye, Ear, Nose and Throat Directorate
KATH -Kumasi
5th December 2019

The Chairman
CHRPE
KATH/KNUST
Kumasi

Dear Sir,

APPLICATION FOR ETHICAL APPROVAL

I wish to apply for ethical approval for a study entitled '*Factors contributing to late arrival of patients with strabismus at the Komfo Anokye teaching hospital, Ghana*'

This study aims to evaluate the factors that hinders patients with strabismus from reporting the condition to the hospital immediately. The study will be carried out at the Komfo Anokye Teaching Hospital in the Ashanti Region.

The documents attached include:

- Ethics application form
- Participant information leaflet and consent form
- Study protocol
- Data capturing sheet
- Written approval or letters of collaboration from research sites
- Evidence of payment

Hope this will be favourably considered.

Many thanks

Yours sincerely,

.....

Dr. Doreen Amankwaa-Frempong
(PRINCIPAL INVESTIGATOR)

**APPENDIX XII: PICTURES OF SOME PATIENTS WITH STRABISMUS
RECRUITED FOR THE STUDY**



Before correction (Exotropia)



After correction (Exotropia)



After correction (Exotropia)



Before correction (Esotropia)



After correction (Esotropia)



Before correction (Esotropia)

APPENDIX XIII: PICTURES OF EXAMINATION OF A PATIENT WITH STRABISMUS



Examination of the eye of a patient with strabismus



Examination of the eye using Prism cover test

APPENDIX XIV: PICTURES OF DATA COLLECTION





ENREF 2