

# Prevalence, Knowledge, Attitude and Practice on Refractive error among Students attending Public High Schools in Nairobi County

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Research dissertation in part fulfilment for the  
degree of Master of Medicine, Ophthalmology:

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**DECLARATION**

**This proposal is my original work and has not been presented for a degree in any other University.**

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## **DEDICATION**

To my dedicated husband, and to my loving and supportive family.

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## **ACRONYMS AND ABBREVIATIONS**

BCVA	Best corrected visual acuity
D	Diopter
DC	Diopter cylinder
DS	Diopter sphere
LE	Left eye
RE	Right eye
VA	Visual Acuity
CC	With correction
SC	Without correction
SR	Subjective refraction
OR	Objective refraction
cm	Centimetre
Mm	Millimetre
RE	refractive error
WHO	World Health Organization
SPSS	Statistical Package of Social Science
KAP	Knowledge Attitude and Practice
FGD	Focused Group Discussion

## STUDY DEFINITIONS

The following definitions will be considered for the study.

**Amblyopia** Unilateral or bilateral decreased best corrected visual acuity caused by any form of visual deprivation and /or abnormal binocular interaction for which there is no pathology of the eye or the visual pathway.

**Blindness:** vision less than 3/60 in the best corrected eye.

**Low vision: vision** worse than 6/18 and up to 3/60 in the better eye.

**Disabling / significant refractive error:** Presenting visual acuity of  $\leq 6/12$  in the better eye due solely to uncorrected refractive error. Also referred to as significant refractive errors<sup>35</sup> (Anon., 2014)

**Significant astigmatism:** of more than +/- 0.5 dioptre

**Significant hyperopia:** of more than +1.00 dioptre

**Significant myopia:** of more than -0.5 dioptre

**Vision 2020: WHO** global initiative by NGOs and Governments to reduce the burden of avoidable blindness (preventable and treatable) by the year 2020.

**Under corrected refractive error:** Presenting V.A with correction of less than 6/12 in the better eye.

**Corrected refractive error:** Presenting V.A cc of better than 6/12 in the better eye

**Spherical Equivalent:** Algebraic sum of the sphere and half the cylindrical value i.e sphere + cylinder/2

**Anisometropia:** S.E of at least 1D difference.

## **ABSTRACT**

**BACKGROUND:** Uncorrected refractive error is a major public health concern and is the biggest cause of visual impairment in the world. Refractive errors can be easily corrected with spectacles. Lack of knowledge, erroneous attitude and practices, contribute significantly to the magnitude of uncorrected refractive errors.

**PURPOSE:** The objective this study was to assess the prevalence and type of refractive error in urban public high school students as well as their knowledge, practice and attitude towards refractive errors.

### **METHODS:**

**Study Design and Study Population:** Cross sectional school based study with a qualitative component in at least 1297 public high school students of Nairobi County, Kenya.

**Data collection Procedure:** The schools were selected by multistage random sampling and the students included in each school category were based on proportion of students in each stratification. All Form 3 students in the selected schools participated in the study. First, a semi structured KAP questionnaire was administered to the students followed by an eye examination that consisted of visual acuity using a Log MAR chart. The cut off for defining significant refractive error was VA less than 6/12 in the better eye. For those whose vision was less than 6/12 in the better eye a dry objective refraction was performed followed by subjective refraction. Students with spectacles were tested for uncorrected and corrected VA. The power of spectacles was read using the lensometer. For those wearing spectacles and VA worse than 6/12 in the better eye with correction, objective then subjective refraction was done. If VA did not improve by at least two lines in all students anterior and posterior examination was performed to determine the cause. The students then participated in Focus

Group Discussion of 8-12 students and in-depth interviews with key informants (class or head teacher). The information gathered was recorded in a questionnaire or a tape recorder.

**Data Analysis:** The data was analysed using SPSS 20.0. Graphs, tables and charts were used to analyse means and proportions. Chi-square test was used compare means and proportions.

**Results:** The prevalence of significant R.E was found to be 17.2%. The prevalence of myopia, hyperopia and astigmatism was 15.6%, 0.9% and 7.6% respectively. The proportion of students with uncorrected refractive error was 64.1%. Only 39% of students had an eye exam prior to this study. Cost (38%) and fear of being teased (38.1%) were the most common reasons for not wearing spectacles amongst students. Mixed attitudes as regards spectacles preventing normalization of eyes and spectacles leading to dependence and worsening of vision were elicited. Most students (72.3%) of students with spectacles preferred another way of correcting their poor vision and 69.1% of these preferred contact lenses.

## **1.0 INTRODUCTION**

Globally, uncorrected refractive errors are the main cause of moderate and severe visual impairment and account for 43% of the world's causes of visual impairment. Although refractive errors are easy to correct and diagnose, 77.3% of children in Kenya who actually need spectacles due to disabling refractive error do not have or wear spectacles <sup>(1)</sup>. Therefore uncorrected refractive error could have a substantial socioeconomic and psychological impact, as it may hinder school performance and lead to development of amblyopia.

The prevalence of refractive error among the teenage age and high school students varies depending on the region, race and ethnicity, with myopia being the most prevalent refractive error ranging from 9.6% in South Africa <sup>(2)</sup> to 73.9% in Singapore <sup>(3)</sup>. Data are limited on the prevalence of refractive error among high school students and teenagers in Kenya. Several studies reported that a lack of knowledge regarding refractive error and incorrect attitudes about spectacles are major contributors in uptake of refractive services. A study in conducted among adults in Singapore with corrected and undercorrected refractive error reported those with corrected refractive error had better knowledge and improved beliefs regarding spectacle use <sup>(4)</sup>. However, data are limited regarding the knowledge and attitudes of refractive error among high school students. The objective of our study was to describe the prevalence and pattern of refractive error as well as the knowledge, attitude and practice of refractive error among in high school students in Nairobi, Kenya.

### **1.1.0 TYPES OF AMMETROPIA/ REFRACTIVE ERROR**

Refractive error or ametropia refers to the absence of emmetropia, (the refractive state in which parallel rays of light from a distant object are brought to focus on the retina in the non-accommodating eye). Ametropia arises when light rays converge in front or behind the retina, as a consequence of this, images seen are blurred, which is sometimes so severe that it creates

functional blindness for affected individuals. Refractive errors include myopia, hypermetropia and astigmatism.

Refractive error is a continuum and changes in refracting status may occur throughout life. Refractive changes result from a complex interplay of developmental, genetic, internal and external factors that influence eye growth, size and shape which also change throughout life and remain largely unknown. In general, infants are hyperopic at birth, become slightly more hyperopic until seven years, and then experience a myopic shift toward emmetropia until the eye reaches its adult dimensions, usually by about sixteen years<sup>(5)</sup>.

### **1.1.1 MYOPIA (SHORT-SIGHTED)**

This is a condition of the eye where the light that comes in does not directly focus on the retina but in front of it, causing the image that one sees when looking at a distant object to be out of focus, but in focus when looking at a close object.

For purposes of this study myopia can be classified by cause, degree and age of onset. In classification by cause, myopia is divided into axial and refractive myopia (further subdivided into curvature myopia and index myopia). Axial myopia is attributed to an increase in the eye's axial length. Refractive myopia is attributed to the condition of the refractive elements of the eye. Curvature myopia is attributed to excessive, or increased, curvature of one or more of the refractive surfaces of the eye, especially the cornea. Index myopia is attributed to variation in the index of refraction of one or more of the ocular media. Degenerative myopia, also known as malignant, pathological, or progressive myopia, is characterized by marked retinal changes, such as posterior staphyloma, and associated with a high refractive error and subnormal visual acuity after correction. This form of myopia gets progressively worse over time. Degenerative myopia has been reported as one of the main causes of visual impairment.<sup>(6)</sup>

In classification by degree or severity: Low myopia usually describes myopia of  $-3.00$  dioptres or less (i.e. closer to  $0.00$ ). Medium myopia usually describes myopia between  $-3.00$  and  $-6.00$  dioptres. High myopia usually describes myopia of  $-6.00$  or more <sup>(6)</sup>.

Myopia is sometimes classified by the age at onset. Congenital myopia, also known as infantile myopia, is present at birth and persists through infancy. Youth onset myopia occurs in the early childhood or teenage, and the ocular power can keep varying until 21 years of age, before which any form of corrective surgery is usually not recommended by ophthalmic specialists around the world. This is because the eye reaches adult dimensions by around 16 years of age <sup>(7)</sup>. School myopia appears during childhood, particularly the school-age years. This form of myopia is attributed to the use of the eyes for close work during the school years <sup>(6)</sup>. Adult onset myopia is further classified into early adult onset myopia occurs between ages 20 and 40 and late adult onset myopia occurs after age 40 <sup>(7)</sup>.

### **1.1.2 HYPERMETROPIA (LONG-SIGHTED)**

This is the refractive state of the eye where parallel rays of light coming from infinity are focused behind the retina in non-accommodating eye, resulting in a blurred image. People with hypermetropia are at a risk of developing asthenopia, accommodative dysfunction, binocular dysfunction, amblyopia and strabismus.

Hypermetropia can be classified etiologically, clinically and on severity in relation to accommodation and outcome of cycloplegic refraction. Etiologically hyperopia is classified as follows. Axial hyperopia, which is the commonest form, a one millimeter shortening of the eyeball results in 3 Dioptre of hypermetropia. Curvature hyperopia result by flattening of curvature of the cornea or lens or both, therefore diminish the refractive power of the eye. In Curvature hyperopia a one millimeter increase in radius of curvature results in 6 Diopter of hyperopia. Index hyperopia is due to change in refractive index of the lens in old age.



Positional hyperopia results from posteriorly placed crystalline lens while aphakia results in high hyperopia <sup>(6)</sup>.

Clinically hyperopia may be divided in three categories: Simple hyperopia, due to normal biological variation, can be axial or refractive. Pathological hyperopia is caused by abnormal ocular anatomy due to maldevelopment, ocular disease, or trauma. Functional hyperopia results from paralysis of accommodation <sup>(6)</sup>.

Hyperopia may also be categorized by degree of refractive error: Low hyperopia consists of an error of +2.00 Diopter or less. Moderate hyperopia includes a range of error from +2.25 to +5.00 Diopter while high Hyperopia consists of an error over +5.00 Diopter. <sup>(8)</sup>

Regarding hyperopia in relation to accommodation of the eye, facultative hyperopia is that which can be overcome by accommodation. Absolute hyperopia is that which cannot be compensated with accommodation <sup>(8)</sup>.

Hyperopia can also be based upon the outcome of non cycloplegic and cycloplegic refractions: Manifest hyperopia, is that which is determined by non cycloplegic refraction, it may be either facultative or absolute. Latent hyperopia is detected only through cycloplegia and can be overcome by accommodation <sup>(8)</sup>.

### **1.1.3 ASTIGMATISM**

Astigmatism is a refractive status that causes blurred vision due either to the irregular shape of the cornea, or sometimes the curvature of the lens. An irregularly shaped cornea or lens prevents light from focusing properly on the retina.

Regular astigmatism occurs when the cornea, retina or lens has two regular radii, one smaller than the other, that are located 90 degrees apart. The most common presentation is the corneal astigmatism. Regular astigmatism can be with the rule or against the rule according to

the axis and angle between the two principal meridians. With the Rule astigmatism, the vertical meridian is steepest and its correction requires the concave cylinder lens at  $180 \pm 20$  degrees or convex cylindrical lens at  $90 \pm 20$  degrees. In against the rule astigmatism, the horizontal meridian is steepest; its corrections require convex cylindrical lens at  $180 \pm 20$  degrees or concave cylindrical lens at  $90 \pm 20$  degrees. Oblique astigmatism has the principal meridians at or near 45 and 135 degrees. <sup>(8)</sup>

Regular astigmatism also can be classified according position of two focal lines in relation to the retina. In simple astigmatism, one ray is focused on the retina and the other is focused in front of retina (simple myopic astigmatism) or behind the retina (simple hyperopic astigmatism). In compound astigmatism, both meridians are either focused in front of retina (compound myopic astigmatism) or behind the retina (compound hyperopic astigmatism). In mixed astigmatism, one meridian is focused in front of retina and the other behind the retina <sup>(8)</sup>.

Irregular astigmatism is often caused by a corneal scarring or scattering in the crystalline lens. The principal meridians are not at  $90^\circ$  to each other. It cannot be corrected by standard spectacle lenses, but can be corrected by contact lenses <sup>(8)</sup>.

## **2.0 LITERATURE REVIEW**

### **2.1.0 PREVALENCE OF REFRACTIVE ERRORS**

The global prevalence of refractive errors has been estimated from 800 million to 2.3 billion (9). In Kenya, prevalence of refractive errors among primary school children (12-15years) in urban and rural areas has been found to be 11% <sup>(1)</sup> and 5.2% <sup>(10)</sup> respectively. In urban Kenya, myopia was found to be the most prevalent refractive error, with a prevalence of 10.2%, followed by hypermetropia at 0.3% and lastly astigmatism at 0.5% <sup>(1)</sup>. On the contrary hypermetropia was the most prevalent refractive error at 3.2% then myopia at 1.7% and astigmatism at 0.3% <sup>(10)</sup>. A survey of the prevalence of refractive errors among children aged 6-9 years in Kampala, Uganda by Kawuma et al found the prevalence of refractive error to be 11.6 percent <sup>(11)</sup>. These studies give as the prevalence of refractive error in two different age groups that is 6-9years and 12-15 years. The studies were done over ten years ago and literature is lacking in our set up on recent studies. In east Africa, data are also lacking in children who are seventeen years and above, in which case emmetropisation has occurred <sup>(5)</sup> and this study was able to address these some of these discrepancies in data.

In Ghana, in a study on prevalence of refractive error in school going children aged between five and nineteen years was 25.6 percent. Hyperopia was estimated to be 3.0%, myopia was found in 8.9% and 16.7% were astigmatic among 15 year olds. Of the children examined, only 0.6% had previous eye examination <sup>(12)</sup>. The study in Ghana showed a high prevalence in refractive error and poor eye health seeking behavior. In South Africa a study done among African children of ages five to fifteen, the largest cause of reduced vision in this age group was refractive error at 68 percent. With retinoscopy, the prevalence of myopia did not exceed 3% until age 13, after which a definite upward trend began, reaching 9.0% in 15-year-olds. With autorefraction, myopia was generally approximately 3% or 4%, before rising to 6.3% in

14-year-olds and 9.6% in 15-year-olds. The prevalence of hyperopia generally ranged between 1% and 2% when measured with retinoscopy and between 2% and 3% with autorefractometry. Astigmatism of 0.75 D or more was found in 6.7% of right eyes and 6.8% of left eyes, measured with retinoscopy; and in 9.3% and 9.6%, respectively, measured with autorefractometry. The study demonstrated myopia, hypermetropia and astigmatism with both retinoscopy and autorefractometry was associated with older children. <sup>(2)</sup> The studies carried out in Ghana <sup>(12)</sup> and South Africa <sup>(2)</sup> were able to compare refractive errors occurring in different age groups and a summation of the prevalence of the different types of refractive errors. These studies demonstrated an increase in the prevalence of refractive error among the older age groups. The study on the prevalence, knowledge, attitude and practice in refractive error among High school students in Nairobi was the beginning of an evaluation of the prevalence of refractive error in a different age group, averaging 17 years, that is comparable with different regions.

In Ohio, USA a study by Kleinstein et al of children aged 5-17 years, found 9.2% of the children were myopic, 12.8% were hyperopic, and 28.4% were astigmatic. There was a definite upward trend in the prevalence of refractive error with increasing age <sup>(13)</sup>. This study has a different distribution of refractive error compared to studies done in Africa and Asia where myopia is the most prevalent refractive error followed by astigmatism and lastly hyperopia <sup>(1) (2) (3)</sup>.

Cordova et al studied the prevalence of refractive error among high school students in Cusco province Peru and found the prevalence to be 18.2% and astigmatism to be the commonest form of refractive error at 14.6%, followed by myopia, 3.4% and lastly hypermetropia at 0.1 percent <sup>(14)</sup>.

Studies done in children ranging in age from 3 to 15 years, the proportion of visual impairment due to uncorrected refractive error varies from 72.6% in Sydney Australia <sup>(15)</sup> to 75% in Beijing, China <sup>(16)</sup>, 76.8% in Sao Paulo, Brazil <sup>(17)</sup>, and as high as 94.9% Guangzhou, China <sup>(18)</sup>. The prevalence of uncorrected refractive error has been reported to be high especially in developing countries. In Kenya the proportion of students with significant refractive error who are uncorrected was found to be 77.3% in urban Kenya <sup>(1)</sup> and 95.6% in rural Kenya <sup>(10)</sup>. In Kenya the proportion of students with significant refractive error who are uncorrected is high.

## **2.2.0 DISTRIBUTION OF REFRACTIVE ERRORS IN SCHOOL AGE CHILDREN AND ADOLESCENTS**

### **2.2.1 MYOPIA**

A number of studies have reported the distribution of refractive errors among school age children /adolescents. Myopia increases steadily with increasing age. Myopia prevalence in children increases substantially from 7 – 17 years in East Asian populations. In a study by Fan DS et al myopia was the most common refractive error and was found in 36.7% of children. Prevalence of myopia correlated positively with older age. Children aged 11 years were almost 15 times more likely to have myopia than those aged less than seven years. Incidence of myopia was 144 per 1000 primary school children per annum. Increasing age correlated with increased incidence of myopia, with highest prevalence in children older than eleven years <sup>(19)</sup>.

In the United States, the mean rate of childhood myopia progression is reported at about 0.5 D per year. In approximately 75% of teenagers, refractive errors stabilize at about age 15 or 16. In those whose errors do not stabilize, progression often continues into the 20s or 30s. The prevalence of myopia in the United States, has been estimated at 3% among children aged 5 to 7 years, 8% among those aged 8 to 10 years, 14% among those aged 11 to 12 years, and 25% among adolescents aged 12 to 17 years. In particular ethnic groups, a similar trend has been demonstrated, although the percentages in each age group may differ. Ethnic Chinese children have much higher rates of myopia at all ages <sup>(20)</sup>.

In China a study by Lian-Hong et al among sub-urban children aged 6-15 years found that as children's ages increased, the prevalence rate of hyperopia decreased and that of myopia increased significantly. The prevalence of hyperopia, myopia and astigmatism were 3.26%, 13.75%, and 3.75%, respectively <sup>(21)</sup>.

In Germany, a study by Jobke et al among children, adolescents and adults found prevalence rates of myopia to increase with age. Prevalence was 0% in children aged 2–6 years, 5.5% in children aged 7–11 years, 21.0% in adolescents (aged 12–17 years) and 41.3% in adults aged 18–35 years<sup>(22)</sup>.

A study done in Ghana among children of 7-17 years, the frequency of the distribution of myopia was found to show a linear progression with age. In addition, myopia and astigmatism was found to be higher in the urban group with percentage differences of two percent<sup>(12)</sup>. The prevalence of myopia in the age group of 12-15 years has also been found to be higher among the urban group in Kenya at 10.2%<sup>(1)</sup> compared to the rural group whose prevalence was at 1.7 percent<sup>(10)</sup>.

Myopia prevalence varies with age, race and sex, increasing at least through adolescence, and is present in one percent of children at age five, increasing to 8% at ten years and about 15% at fifteen years<sup>(5)</sup>. The above studies have shown that the rate of myopia in most populations increases with age. In our population the studies done by Muma in 2007 and Nzuki in 2004 among the age group of 12-15 years in rural and urban settings differed in their findings. The prevalence of myopia among children in urban Kenya of ages 12- 15 years was 10.2% and was the commonest refractive error in this age group<sup>(1)</sup>. However, this was not the case for the same age group in rural Kenya, myopia was found to be the second commonest refractive error at 1.7% after hypermetropia at 3.2 percent<sup>(10)</sup>. Data on the patterns of refractive error among ages 16-19 years in Kenya was found to be lacking.

### **2.2.2 HYPEROPIA**

The prevalence of hyperopia in children appears to decrease during younger school age years and then stabilize during adolescence. In a study done in Australia, hyperopia prevalence

decreased between the ages six to seven years and 9-12 years. Prevalence of moderate hyperopia among children ages 6 and 12 was 13.2% and 5.0%, respectively<sup>(15)</sup>.

A study done in Nigeria among children aged between 7-17 years, the observed frequency for hyperopia followed a reverse pattern to that of myopia. The prevalence of hyperopia in the 7 year old subjects was at 26% and continued to decrease with age to 5% among the 17year old subjects<sup>(5)</sup>. Both studies in Australia and Nigeria are consistent with what is observed in other populations across the world.

In Kenya, there are no studies that have been done across wider paediatric age groups that have been published. However, in a study done by Muma et al, revealed that the prevalence of hypermetropia among ages 12-16 years in rural Kenya showed the converse, hypermetropia was found to be the commonest refractive error at 3.2% followed by myopia at 1.7 percent<sup>(10)</sup>. This is unlike what is found in most populations as discussed above.

### **2.2.3 ASTIGMATISM**

There have been no consistent age patterns observed for astigmatism. In a study done in southern Indian state of Andhra Pradesh, rural India, the prevalence of astigmatism of more than 0.75D was 10% higher than what is seen in most populations<sup>(23)</sup>.

In South African a study on refractive error and visual impairment in African children found astigmatism was associated with older age<sup>(2)</sup>.

A study done to determine the distributions of refractive, corneal, and internal astigmatism (IA) in 12-year-old Australian children concluded that the girls had significantly greater corneal astigmatism and internal astigmatism prevalence, with greater against the rule astigmatism and lower oblique internal astigmatism than did the boys. The European white-Australian children had lower corneal astigmatism prevalence than did the East Asian-



Australian children and higher internal astigmatism prevalence than did the South Asian-Australian children <sup>(24)</sup>.

In general, data regarding the patterns of astigmatism in Africa are scarce and would be an area to be studied in the future. In Kenya the studies by Muma et al and Nzuki et al have demonstrated a low prevalence of 0.3% <sup>(10)</sup> and 0.7% <sup>(1)</sup> respectively.

### **2.3.0 KNOWLEDGE, ATTITUDE AND PRACTICE IN REFRACTIVE ERROR**

Regarding knowledge, attitude, beliefs and practice of refractive errors, lack of knowledge and stigma plays a major role in uptake of refractive services in different continents. A study conducted in Singapore, Malay on the Knowledge and beliefs associated with refractive errors and undercorrection showed that in the urban Singapore population, the lack of knowledge and awareness of refractive errors played a big role in uncorrected and undercorrection of refractive error. The subjects found to have R.E, of the myopes, 79.5% had heard of myopia, 79.2% of hyperopes had heard of hyperopia, and only 7.7% of those with astigmatism had heard of astigmatism. Adults who had never previously visited an eye-care specialist were less likely to know that they had a refractive error ( $p < 0.01$ ). Adults with undercorrected refractive error were more likely to be female at 61.1% compared to the males, 49.3 percent. The females in the study were also less likely to wear spectacles, compared to the men (41.7% vs 22.3%). The study also compared the undercorrected group and the corrected group and found that the knowledge on astigmatism (1.4% vs 5.6%) and refractive errors (62.6% vs 77.5%) was significantly lower in the undercorrected group<sup>(4)</sup>.

A study conducted in University of Benin, Nigeria on attitude and beliefs of Nigerian undergraduates to spectacle wear showed significant lack of knowledge as well as erroneous beliefs towards refractive errors. Sixty eight percent of the total population studied had not heard of refractive error. Only Thirty eight percent believed wearing eyeglasses was one of the methods used to correct refractive error. Fifty percent believed they could wear spectacles if prescribed for one by their doctor. Sixty four percent believed eyeglasses are harmful to the eyes; and 65% did not know eyeglasses could be used to relieve other forms of ocular discomfort such as headache and tearing. Fifty seven percent of respondents regarded people who wore eyeglasses as visually handicapped, while 60% believed that eyeglasses were

meant for old people. Majority of the correspondents (56%) believed they would be teased if they wore glasses <sup>(25)</sup>.

A KAP study of refractive errors in students of rural central India showed that stigma regarding refractive errors and modalities to correct it is prevalent amongst high school students of rural central India. Most of the students were aware about spectacles (92%) as a modality to correct low vision. Very few knew about surgery (14%) and half of them knew about contact lenses (54%). The respondents refused to use spectacles at all if needed because of likely teasing from colleagues 82% as well as problem with handling of glass (71%). Many refused to use spectacles because of fear of rejection from opposite sex (65%) and for fear of being labelled as blind (48%), since it could lead to low self-esteem (58%). Sixty four percent respondents believed that long term use of spectacles can harm the eyes and even lead to blindness. Another finding was the belief that continued use of spectacle can increase the power of glasses (62%) and it prevents normalization of eyes (68%). Traditional methods like yoga, ayurveda and homeopathy were more useful for correction of low vision in comparison to allopath according to 57% of students <sup>(26)</sup>.

A study of the prevalence and determinants of spectacle non- wear among rural Chinese secondary school children, 62% of the children were not wearing correction despite the fact that they would benefit from doing so <sup>(27)</sup>.

Several studies have also explored the barriers to spectacle use in children. A study in rural china revealed significant knowledge gaps in families and schools about glasses use as a barrier to glasses use among children in rural China. Older students, students with greater visual impairment and higher parental education were found to be factors that contributed to greater awareness of visual difficulties. The purchase of spectacles was associated with greater visual impairment. Undercorrection by two lines or more in the better eye was found

in 30% of those already with spectacles, and it was associated with greater visual impairment and less frequent refraction check-ups. The study concluded half of the children in need of first-time or updated spectacles did not have them. This was an unacceptably high proportion. Younger children with moderate visual impairment were at particular risk for uncorrected refractive error. The study recommended that parental education and enhanced school-based screening programs would be necessary to address the unfilled need for refractive correction among school-aged children<sup>(27)</sup>.

These studies showed that the students' knowledge gaps on refractive error were quite significant and that their attitude and errors in beliefs affected their health seeking habits. Whether the same or converse was true in our set up was unknown and this is what the study set out to unveil.

### 3.0 STUDY JUSTIFICATION

Uncorrected refractive error continues to be a major public health concern. It is a leading cause of visual impairment and blindness. Worldwide uncorrected refractive error has been estimated to account for more than half of the cause of visual impairment and 18.2% of blindness<sup>(28)</sup>. A study in Kenya on significant refractive error among primary school children by Nzuki et al among primary school children aged 12-15 years found the prevalence of refractive error to be 10% of which 77% had uncorrected refractive error<sup>(1)</sup>. Why the students remained uncorrected is the unknown fact the study was trying to answer. No study come to light in this matter.

No study in East Africa has clearly tried to determine the factors affecting health seeking behaviour and barriers to health care in students with refractive error.

In addition there are no studies in our region that have attempted to compare the socio-demographic characteristics, eye health seeking behaviour and knowledge of refractive errors among students with and without refractive errors. There are also no studies that have compared the socio-demographic characteristics, eye health seeking behaviour and knowledge of refractive errors among students with corrected refractive errors and uncorrected refractive errors.

Lack of knowledge, stigma and erroneous beliefs towards refractive errors plays a major role in uptake of refractive services in different continents<sup>(4) (26) (25)</sup>. In Kenya and East Africa, there are hardly any studies that address the knowledge, attitude and practices of its people in refractive error. This study is aimed at gaining insight and assessing the gaps in the knowledge, attitude and practice in refractive error so as to justify appropriate intervention programmes.

The study was done among high school students as this group of people are in their formative years and intervention programmes can therefore be appropriately targeted to the knowledge, attitude and practice gaps found. The study is in public schools because these schools are less privileged as compared to the private schools. The high school age group in Kenya is between 14- 20 years and the study will be narrowed down to form 3 students whose average age is 17 years. In approximately 75% of teenagers, refractive errors stabilize at about age 15 or 16<sup>(5)</sup>. Refractive error patterns in this age group in Nairobi County have also not been studied.

## **4.0 STUDY OBJECTIVES.**

### **Broad objectives**

To determine the prevalence and pattern of refractive error among high school students in Nairobi County as well as the factors affecting their eye health seeking behaviour as regards refractive error.

### **Specific objectives**

1. To determine the prevalence of refractive errors (R.E) among high school students in Nairobi County.
2. To describe knowledge, attitude and practice regarding R.E. among students attending public high schools in Nairobi County.

## **5.0 METHODS**

### **5.1.0 STUDY DESIGN**

Cross sectional school based study with a mixed method approach (quantitative/qualitative).

### **5.2.0 STUDY POPULATION**

The study students were selected from public high schools in Nairobi County. All form 3 students (average age 17 years) in selected public high schools in Nairobi county, were invited to participate. By this age any manifest refractive errors of up to 75% would have developed<sup>(5)</sup>. The total number of students in Nairobi County, attending public schools is 37850 of which approximately 9400 are form 3 students<sup>(29)</sup>.

### **5.3.0 STUDY INCLUSION AND EXCLUSION CRITERIA**

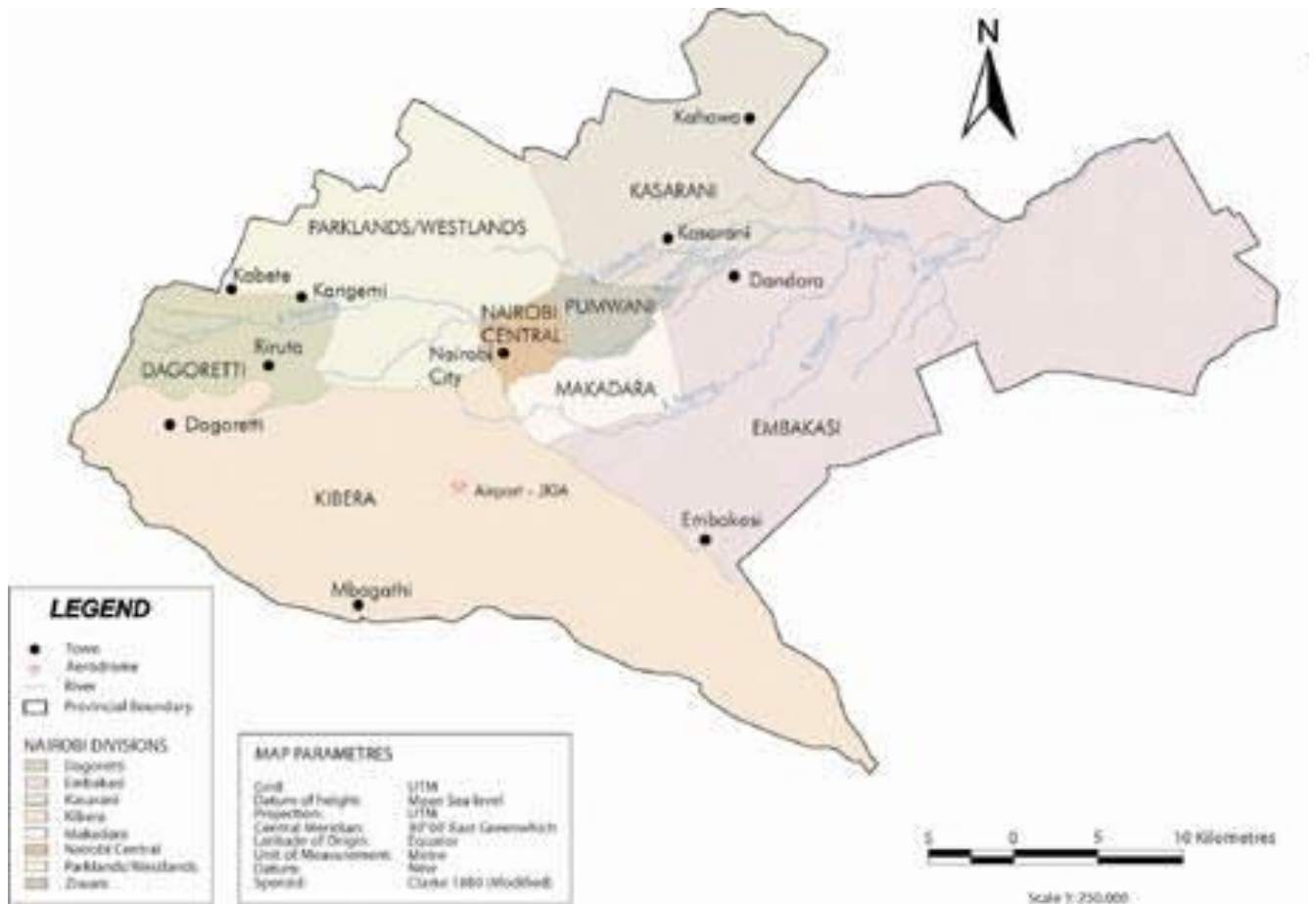
All the form three students in the schools that were selected were included in the study.

### **5.4.0 STUDY AREA**

The study was carried out in Nairobi County (Figure 1) where Kenya's capital city is located. Nairobi County has a total of 80 public high schools distributed across 10 divisions Central, (Dagoretti, Embakasi, Kasarani, Langata, Makadara, Pumwani, Starehe, Njiru and Westlands)<sup>(29)</sup>. Eleven schools from Kamkunji, Embakasi, Kasarani, Dagoretti, Langata, Westlands, and Makadara districts were randomly selected to participate in the study.



**Figure 1: Map of Nairobi County**



### 5.5.0 STUDY PERIOD

The study was conducted from September 2013 to February 2015.

### 5.6.0 SAMPLE SIZE CALCULATION AND SAMPLING METHOD

To calculate the required sample size, the following parameters were used:

1. Estimate of the expected proportion ( $p$ )
2. Desired level of absolute precision ( $d$ )
3. Estimated design effect ( $DEFF$ )
4. Confidence limit (usually 95% and Z score = 1.96)

The sample size formula is:

$$n = \frac{1.96^2 p(1-p)(DEFF)}{d^2}$$

$$n = \frac{1.96^2 \times 0.1 \times 0.9 (1.5)}{0.02^2}$$

$$n = 1297$$

To estimate the assumed prevalence of refractive error 10% <sup>(1)</sup> with 95% CI (8% - 12%) among high school students, adjusting for the design effect of 1.5 and confidence limit (usually 95% and Z score = 1.96), the final minimal sample size was 1297.

A factor of 10% was added to the minimal sample size to give 1427, so as to account for absentees and those who decline to participate.

### **5.7.0 SAMPLING PROCEDURE**

The total number of public high schools in Nairobi County is 80 spread out across 10 divisions. The mode of sampling was a multistage random sampling, to select the schools.

The schools were stratified into whether they were National, County and District schools then further sub stratified into girl, boy and mixed schools. There were a total of 7, 29, 44

National, County and District schools respectively. The total number of students in National, County and District are 6276, 16425 and 14888 respectively giving a total of 37850 students.

The total number of form 3 students in Nairobi County is approximately nine thousand four hundred. The population of form 3 students per school ranges from 250 in National schools,

125-250 in County schools and 50-210 in the District schools. Schools from each category

were randomly selected for the study using a random generated number. If a school was not able to participate for any reason the next school of the same category on the list was

selected. The number of students to be included in each school category was based on proportion of students in each stratification using the enrolment statistics (Table 1).

**Table 1: Sampling frame of high school students in Nairobi County<sup>(29)</sup>**

Type of school (Stratification)	Total schools	Category	Total Students in each stratum	% per stratum	Required students per stratum	Number of form 3 students who participated	Schools Planned to visit
National school	7	Girls= 3 Boys= 4	6276	17	275	275	Girl=1 Boy=1
County schools and extra-county	29	Girls= 17 Boys= 11 Mixed=1	16425	44	633	633	Girl=1 Boy=1 Mixed=2
District schools	44	Girls=5 Boys=7 Mixed=3 2	14888	39	585	482	Mixed=4
Total	80	33	37580	100	1500	1390	11

633(45%) were selected from county schools, (482, 35%) from district schools and (275, 20%) from national schools.

### **5.8.0 STUDY TEAM**

The study team was composed of the principal investigator, the first and second supervisors, two qualified ophthalmologists and research assistant.

### **5.9.0 MATERIALS REQUIRED**

1. Two Retinoscopes- for refraction.
2. Two Ophthalmoscopes (direct and indirect) - For anterior and posterior segment examination.
3. Two 20 Diopter loupe- For anterior and posterior segment examination.
4. Torches with batteries and spare bulbs- for anterior segment examination
5. 3 LogMAR charts - for visual acuity assessment
6. Refraction set and trial frames – for refraction
7. Lensometer – measuring power of spectacles
8. Blinders( curtains)
9. Data collection forms - Questionnaires
10. Stationary- referral papers, data collection forms, pencils, pens, staplers etc.
11. Vehicle for hire and fuel
12. Tape recorder
13. Photographs

### **5.10.0 DATA COLLECTION PROCEDURE**

Ethical approval was obtained from University of Nairobi - Kenyatta National Hospital Research and ethics committee. Approval was also attained from the Ministry of Education and permission to carry out the study from individual school head teachers. Assent from the individual form 3 students in the selected schools was sought. The individual students were each allocated a study number. The students were then issued with a self-administered questionnaire to obtain basic demographic data and determine their knowledge, attitude and practice towards refractive error (APPENDIX 3: KAP QUESTIONNAIRE AND VISUAL ASSESSMENT). The questionnaire also included whether they have had any refraction done, any ocular disease or abnormalities and challenges in accessing eye care services. Once this was done, visual acuity of each eye without correction (sc) and with correction (cc) was taken using a Log MAR chart at 3 metres. The students with VA of better than 6/12 in the better eye had their information recorded in a visual assessment section (APPENDIX 3: KAP QUESTIONNAIRE AND VISUAL ASSESSMENT). Those with visual acuity of less than 6/12 in either eye underwent further ocular examination which included a dry objective refraction in a darkened room while fixating at a distant target placed at 6 meters. This was followed by a subjective refraction. Those whose VA improved by two lines or more were classified into myopia, hyperopia and astigmatism depending on the type of lens used. If vision did not improve by at least two lines, anterior segment examination was performed using a torch and a magnifying loupe followed by an undilated fundus examination. The information obtained was recorded in a questionnaire. (APPENDIX 4 - VISUAL ASSESSMENT OF STUDENT WITH R.E AND ALL THOSE CURRENTLY USING SPECTACLES.)

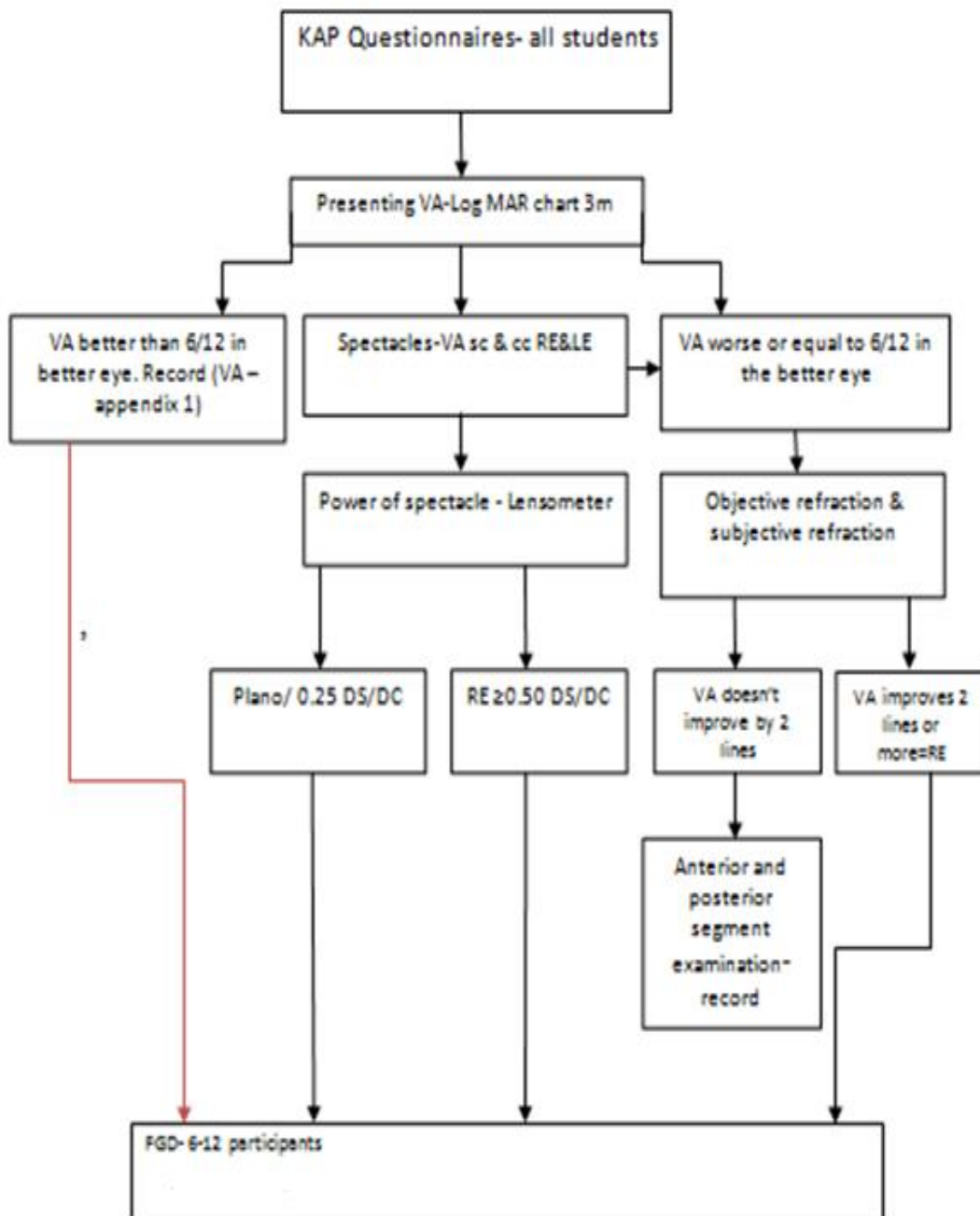
For the students who had spectacles, visual acuity of both eyes with and without correction was taken using Log MAR chart. If the VA with correction  $<6/12$  in the better eye, the power

of the spectacles was read using the lensometer to give the power of spectacles used to correct the refractive error. If the vision with correction was worse than 6/12 in the better eye then the participant was refracted objectively then subjectively. If visual acuity did not improve by at least two lines, anterior and undilated posterior segment examination was done to determine the cause of reduced vision. The information obtained was recorded in a questionnaire (APPENDIX 4 - VISUAL ASSESSMENT OF STUDENT WITH R.E AND ALL THOSE CURRENTLY USING SPECTACLES.)

A spectacle prescription was issued where applicable and referral to a facility for conditions that could not be handled in the field. Phone numbers of students were recorded for follow-up.

The students were organised into groups of 6-12 students who participated in focus group discussions. In depth interviews were conducted with key informants, these included class teachers, house masters or the principal.

**Figure 2: Data collection process (all form III students)**





### **5.11.0 TRAINING PROCEDURES FOR KEY RESEARCH PERSONEL**

Three medical students were given a training session on how to take visual acuity so as to assist the Principal investigator and the ophthalmologists with taking visual acuity. The training session included key lecture on refractive errors and significant refractive error, video on how to take visual acuity, practical sessions on how to take visual acuity and an evaluation on taking visual acuity.

### **5.12.0 QUALITY ASSUARANCE MEASURES**

Visual Acuity was taken using a Log Mar chart held 3 meters away from the participant. The Log Mar chart is one of the standard and accurate charts used to take visual acuity.

The standard measure of refractive error is objective retinoscopy (O.R). Objective Retinoscopy was carried out using a streak retinoscope and lenses in increments of 0.50 diopter sphere until neutralization was achieved in the two principal meridians. The test is objective and not examiner dependent. The patient may however accommodate and a target of 6 meters was provided so as to relax accommodation and avoid errors associated with accommodation. The objective refraction was repeated twice and average was taken to be the true R.E. Measurements that were 0.50 dioptre difference were repeated and the average of the two closest measurements was taken as true refractive error.

Subjective refraction- The subjective refraction further refines the results of the objective refraction to suit the needs of the patient.

Anterior segment examination was done using a touch and magnifying loupe. With this method the examiner is able to pick up most anterior segment abnormalities, however the slit lamp is the gold standard. Patients found or suspected to have any anterior segment abnormalities were referred to an eye hospital for further management.

The direct ophthalmoscope was used to pick up posterior segment abnormalities. The students found to have any abnormalities were referred to an eye hospital for further management.

A calibrated lensometer was used to measure the power of the lenses of the students wearing spectacles.

### **5.13.0 ETHICAL CONSIDERATIONS**

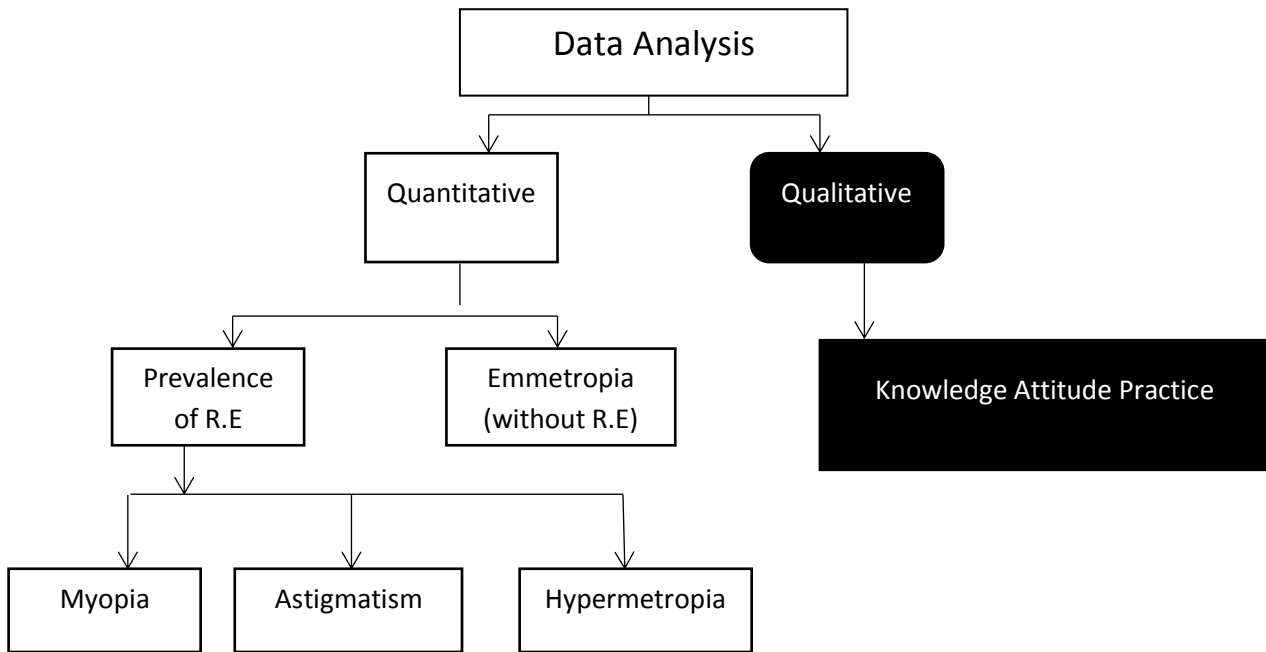
1. Approval was sought from Ethical Committee of University of Nairobi – Kenyatta National Hospital in Nairobi Kenya.
2. Permission was sought from the Permanent Secretary, Ministry of Education.
3. Permission from head teachers of schools was obtained
4. Assent from the students was sort and obtained.
5. Confidentially of students records was observed.
6. Spectacle correction and follow up was recommended for all the students found to have refractive error.
7. Students with other ocular diseases were referred to local eye hospitals.
8. A phone follow-up will be made to confirm that students having refractive errors have been able to access the recommended health facilities.

### **5.15.0 DATA MANAGEMENT**

After collection of data, it underwent double entry to ensure accuracy. The qualitative data was analysed using SPSS 20.0. Proportions were used to estimate the prevalence and pattern of refractive errors as well as knowledge, attitude and practice (KAP) in refractive error.

Descriptive statistics and chi-square tests were used to compare knowledge, attitude and practice among students with normal vision, uncorrected refractive error and corrected refractive error. The notes and tape recorded information obtained during the FGD and IDI was analysed using observer impression and regression analysis. Results were presented using ratio, proportion, rates, tables and diagrams wherever appropriate.

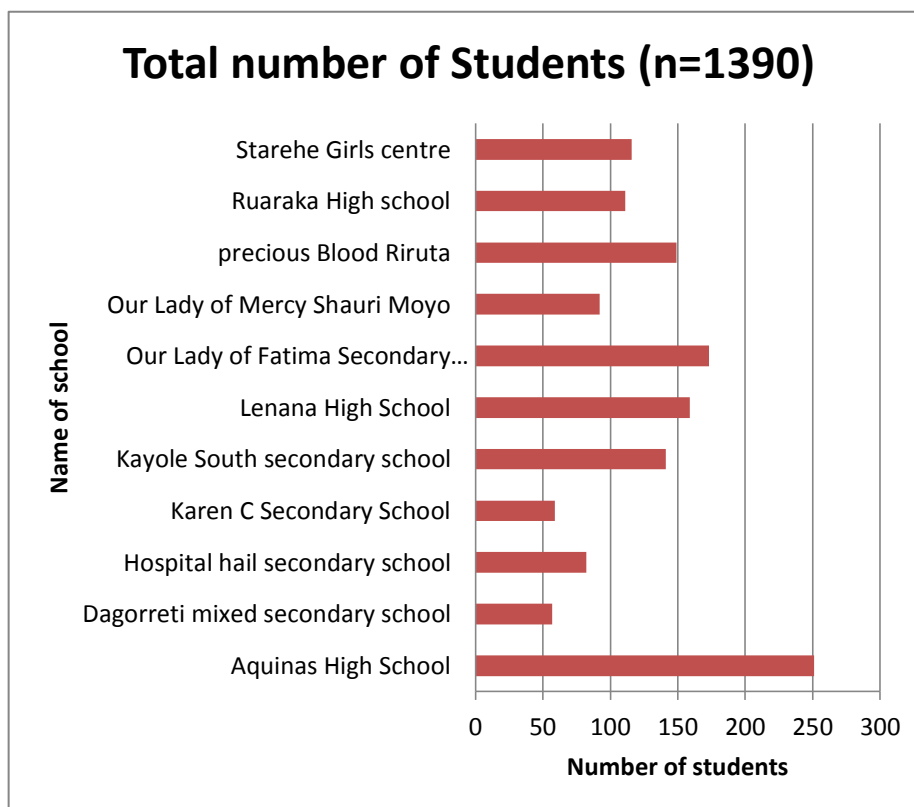
**Figure 3: Data analysis**



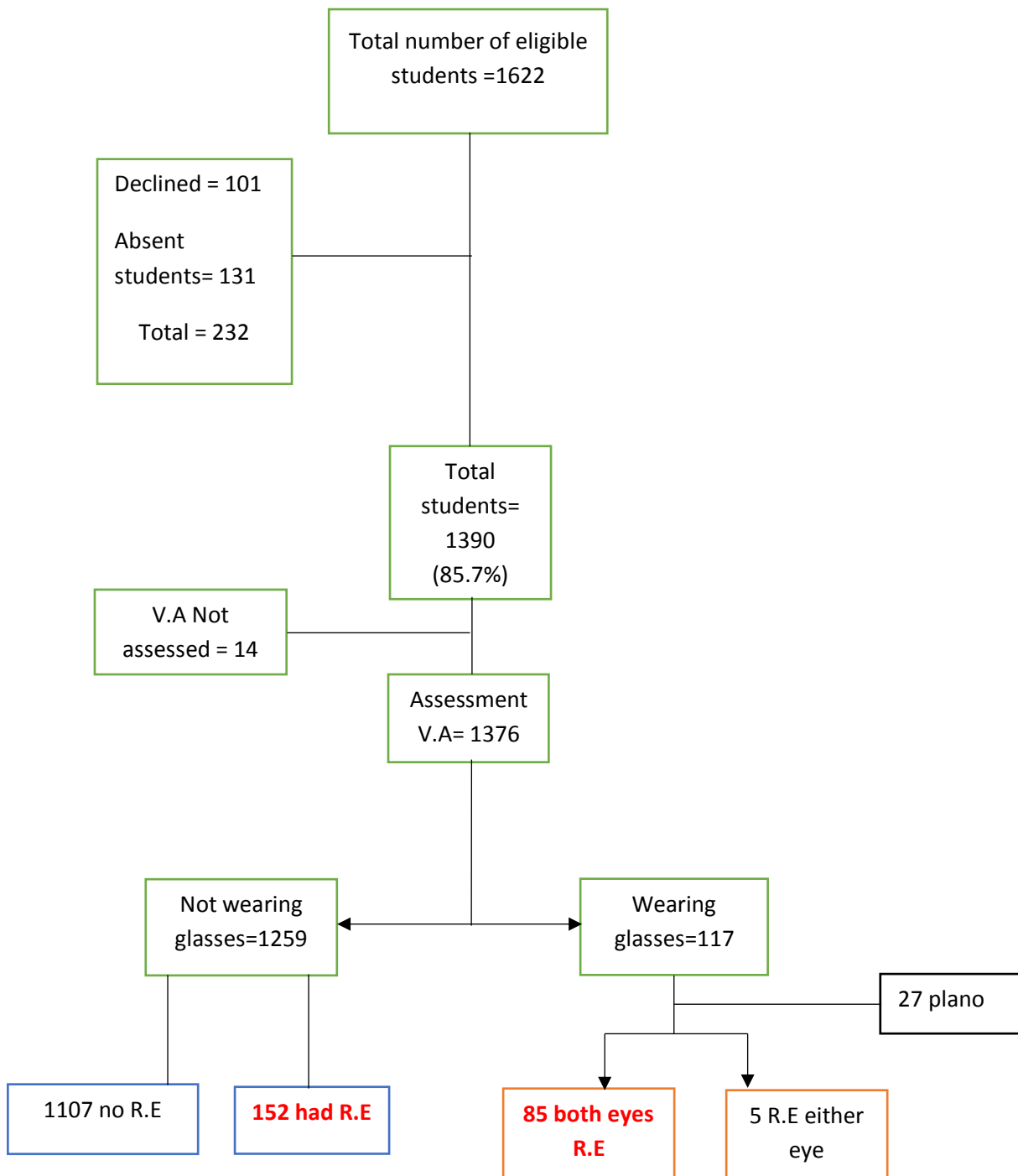
## 6.0 RESULTS

The total number of students in Nairobi County, attending public schools is 37,850 of which approximately 9,400 are form III students <sup>(29)</sup>. The students were recruited from 11 public secondary schools, 5 county schools, 4 district schools and two national schools. Of the students who were selected from form III, 633(45%) were from county schools, (482, 35%) from district schools and (275, 20%) from national schools.

**Figure 4: Total number of students in respective schools**



**Figure 5: Flow diagram of students**



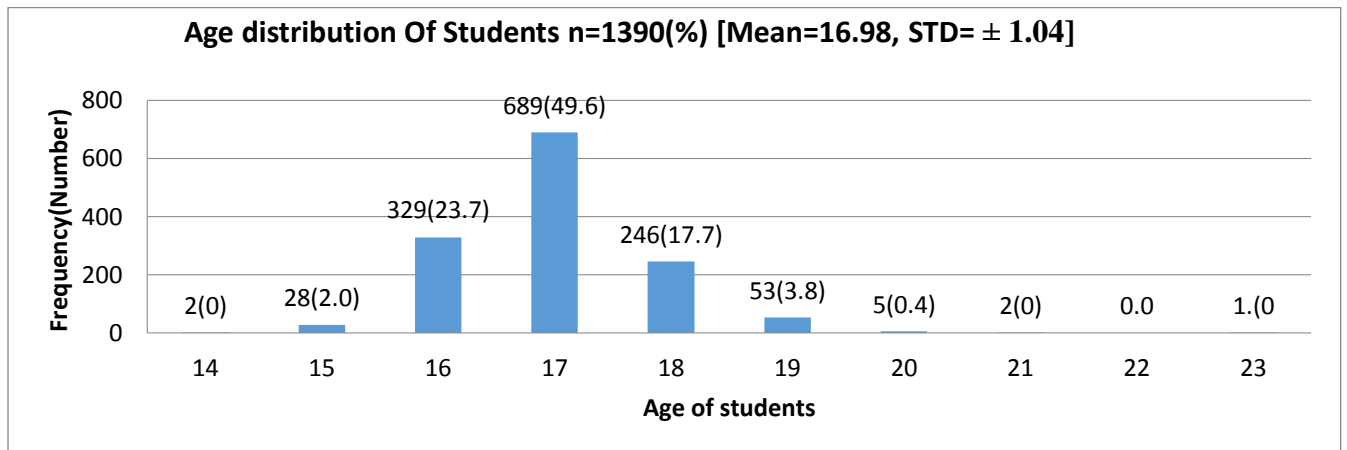
The students recruited were 1,622 out of which 1,390 participated (85.7% participation rate), 131 students were absent and 101 students declined.

**Table 2: Demographic characteristics of the students enrolled**

<b>Characteristics of the Study Population</b>	<b>Total N= 1390</b>
<b>Sex</b>	
Male	751 (54.0%)
Female	639 (46.0%)
<b>Schools</b>	
County	633 (45.5%)
District	482 (34.7%)
National	275 (19.8%)
<b>Spectacle use (students response)</b>	
No	1210 (87.1%)
Yes	148 (10.6 %)
No response	32 (2.3%)
<b>Mother's education</b>	
None	40 (2.9%)
Primary	129 (9.3%)
Secondary	176 (12.7%)
College/University	820 (58.9%)
No response	225 (16.2%)
<b>Father's education</b>	
None	41 (2.9%)
Primary	65 (4.7%)
Secondary	143 (10.3%)
College/University	854 (61.4%)
No response	287 (20.6%)

Of the students, 639 (46%) were females and most of them, 633(45.5%) were from County schools. Most students' parents, constituting 70% (820) of the students' mothers and 77% (854) of the students' fathers had a college/university education.

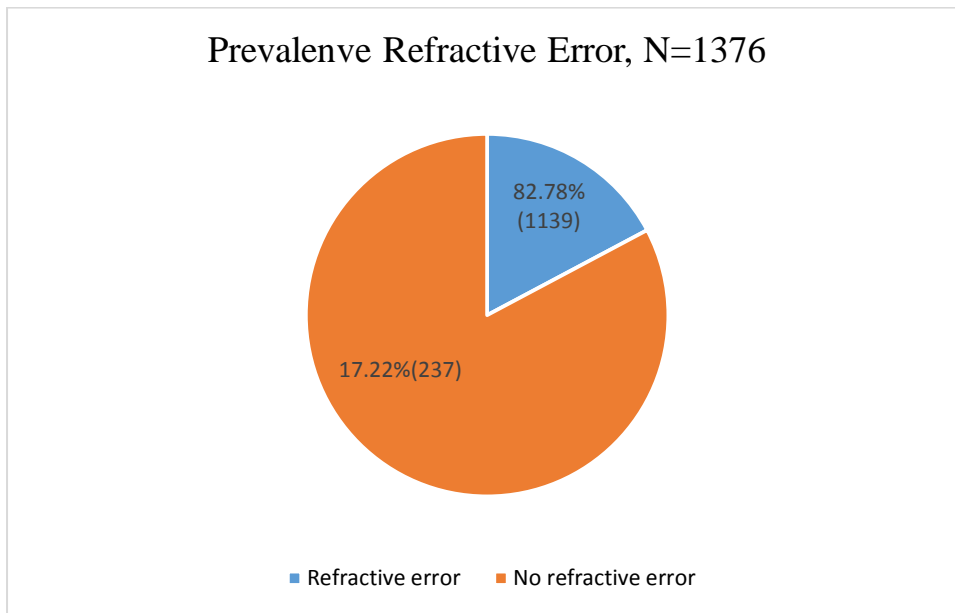
**Figure 6: Age distribution of the students**



The mean age was 16.98 years (range 14-23 years, Standard deviation= ± 1.04)



**Figure 7: Prevalence of Refractive Error, N=1376**



The total number of students who were assessed and found to have significant refractive error was 237(17.2%).

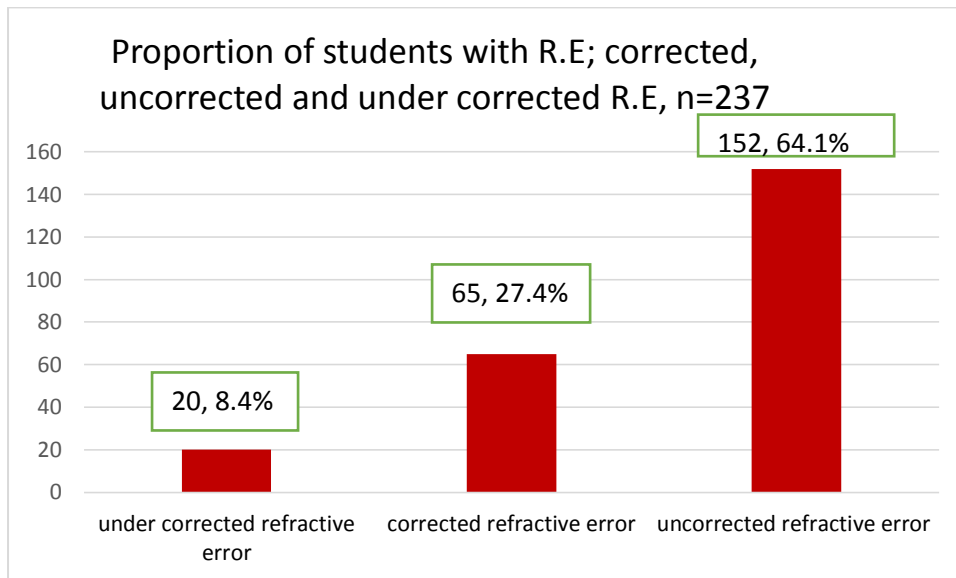
**Table 3: Prevalence of the types of refractive errors and comparison between males and females**

Description	Myopia % [95% C.I]	P value *	Astigmatism % [95% C.I]	P value	Hyperopia % [95% C.I]	P value*
<b>N=1376 Total (%)</b> <sup>1</sup>	215 (15.63%)		104 (7.55%)		12 (0.87%)	
<b>Sex</b>						
Male	103 (7.49%)	0.52	54 (3.92%)	0.69	4 (0.29%)	0.25
Female	112 (8.14%)		50 (3.63%)		8 (0.58%)	

\*All proportions accurate to  $\pm 0.02$

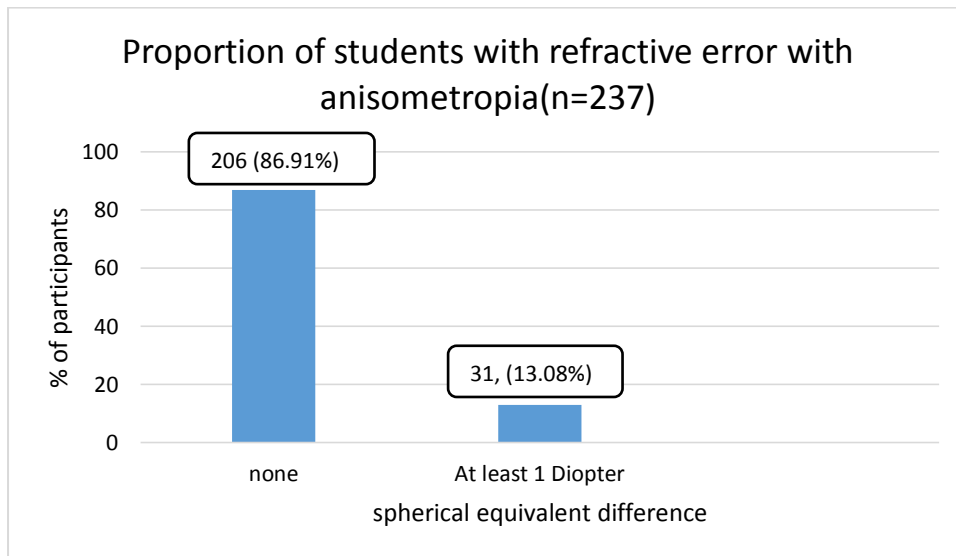
Myopia, at 15.6% was found to be the most prevalent form of refractive error.

**Figure 8: Proportion of students with refractive error; corrected, uncorrected and under corrected refractive error, n=237**



A large proportion of students with refractive error, 152/237 (64.1%) were uncorrected. The prevalence of uncorrected refractive error was 11.04 percent (152/1376).

**Figure 9: Proportion of students with refractive error with anisometropia**



Of the students with refractive error, 31 (13.1%) students were found to have anisometropia.

The prevalence of anisometropia was 2.25% in the general population.

**Table 4: Students knowledge regarding refractive error**

<b>Knowledge regarding refractive error and poor vision</b>	<b>Total population n=1390</b>
<b>Do you feel you have normal vision</b>	
I don't know	385 (27.6%)
I don't have normal vision	416 (29.9%)
Yes I have normal vision	439 (31.6%)
No response	23 (1.7%)
<b>Knowledge on causes of poor vision among students</b>	
Short sightedness	429 (30.9%)
Long sightedness	178 (12.8%)
Poor nutrition	526 (37.8%)
Astigmatism	111 (7.9%)
Don't know	257 (18.4%)
No Response	128 (9.2%)
<b>Knowledge on methods of correcting poor vision</b>	
Spectacles	851 (61.2%)
Medicine	400 (28.8%)
Contact lenses	365 (26.2%)
Surgery	296 (21.3%)
Don't know	28 (2.0%)
No response	30 (2.2%)
<b>What are the reasons for wearing spectacles</b>	
Improve vision	992 (71.4%)
Protect eyes from excessive light and injury	472 (33.9%)
Look intelligent	105 (7.6%)
No response	5 (0.3%)
<b>Reasons students with poor vision do not wear spectacles</b>	
Don't know	51 (3.7%)
Spectacle prevent normalization of eye sight	334 (24.0%)
Cosmetically unacceptable and embarrassing in public	149 (10.7%)
Cost	488 (35.1%)
Fear of being teased	529 (38.1%)
No response	161 (11.6%)
<b>Do you know where to seek help if you have poor eye sight?</b>	
<b>Yes</b>	<b>880</b>
<i>Sources of eye care shop</i> Optic	155 (11.1%)
General hospital	236 (16.9%)
Eye specialist/ Hospital	515 (37.0%)
<b>I don't Know</b>	316 (22.7%)
<b>No response</b>	194 (13.8%)

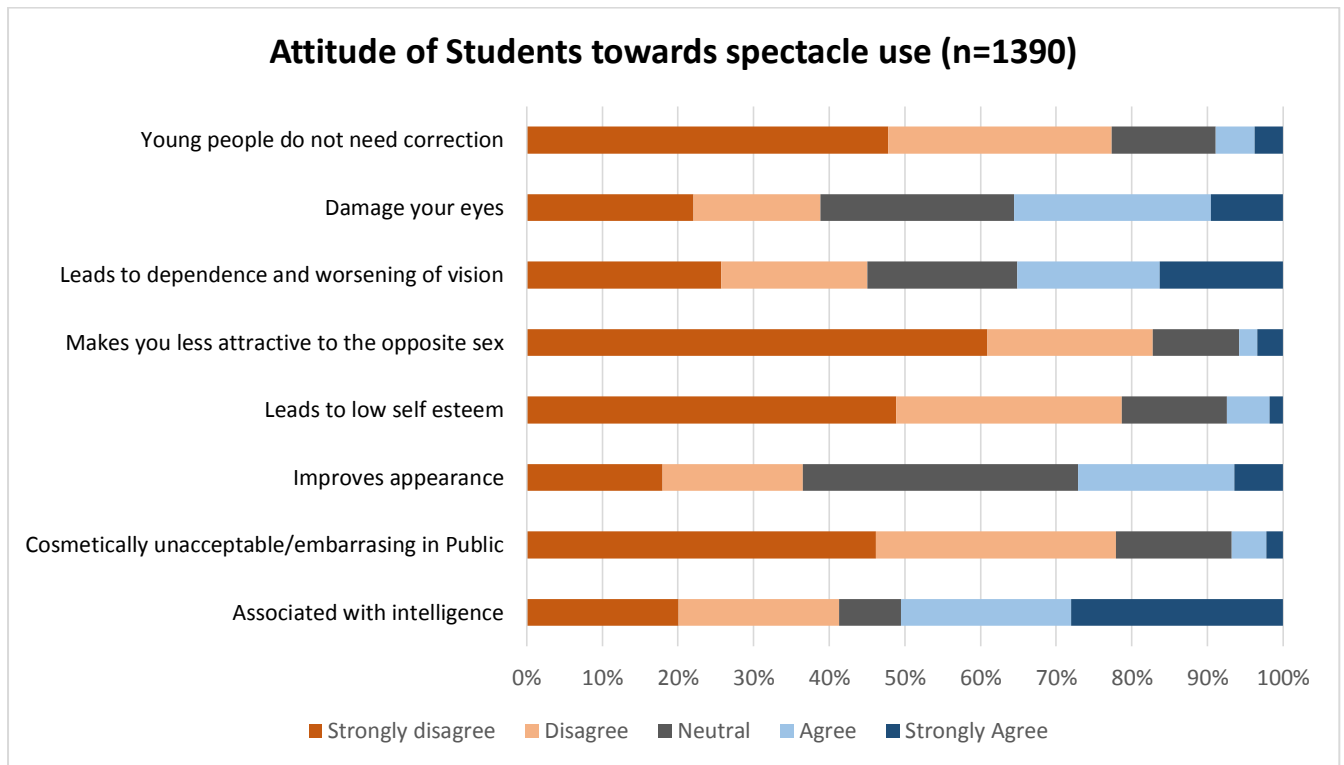
Only 491 (35.3%) students knew their vision was normal.

Most of the students gave poor nutrition 578 (42%) as a cause of poor vision. However, majority of the students 1096 (78.8%) knew that spectacles were used to improve vision. The

fear of being teased 529 (38.1%) and cost 488 (35.1%) were the major reasons for not wearing spectacles when needed to correct poor vision.

Most students (63%, 880) knew where to seek help if they had poor eyesight; majority (37.0%, 515) would go to an eye specialist/ eye hospital.

**Figure 10: Attitude of students towards spectacle use**



**Table 5: Students’ general attitude towards spectacle use**

<b>Attitude towards spectacle use</b>	<b>Median- Likert scale score</b>
Spectacle users or wearing spectacles is associated with intelligence	2
Spectacles are cosmetically unacceptable and embarrassing in Public	2
Wearing Spectacles improves appearance	3
Wearing Spectacles leads to low self esteem	2
Wearing spectacles makes you less attractive to the opposite sex	1
Wearing spectacles leads to dependence and worsening of vision	3
Wearing spectacles can damage your eyes	3
Young people do not need spectacle correction	2

**Key-** 1-strongly Disagree, 2- Disagree, 3- Neutral, 4 Agree, 5- Strongly agree

Most of the students disagreed with the notions that spectacles were cosmetically unacceptable/ embarrassing in public and strongly disagreed spectacles makes one less attractive to the opposite sex.

The students attitude was mixed as regards if wearing spectacles could damage eyes and as to whether wearing spectacles leads to dependence and worsening of vision.



**Table 6: Students practice regarding refractive error**

<b>Practice on Refractive error- Eye Check-up</b>	<b>N= 1390</b>
<b>Have you ever had an eye-check-up</b>	
<b>1. Students who have had eye check-up</b>	<b>n=539/1390(39%)</b>
<b>Where students had an eye check-up (&gt;1 responses allowed)</b>	<b>n= 463/539 (85.9%)</b>
Optical shop	87 (16.1%)
General hospital	110 (20.4%)
Eye specialist/ hospital	345 (64.0%)
No response	76 (14.1%)
<b>2. Students who have not had an eye check up</b>	<b>829/1390 (59.6%)</b>
<b>Reasons why not had eye check-up(&gt;1 responses allowed)</b>	<b>n= 829 (83.0%)</b>
No money	390 (47.0%)
No hospital/ clinic	43 (5.2%)
No time	140 (16.9%)
No need	603 (72.7%)
No Response	141(17.0%)
<b>3. No Response</b>	<b>22/1390(1.5%)</b>

Regarding practice on refractive error, only 539 (39%) of the students had an eye checkup prior to this study. Majority of them 345 (54.7%) visited an eye specialist/ hospital and most of them, 305 (56.6%) did so when they had an eye problem. Of the students without a prior eye check-up, 829 (60%), 603 (72.7%) didn't see the need and 390 (47.1%) stated cost as reason for not having an eye checkup before.

**Table 7: Students Practice on Spectacle Use**

<b>Practice on Refractive error- Spectacle use</b>	
<b>1. Have you been advised to wear spectacles</b>	<b>n=1390</b>
Yes (been advised to wear spectacles)	427(30.7%)
No (not been advised to wear spectacles)	867(62.4%)
No Response	96(6.9%)
<b>2. If yes do you have your spectacles</b>	<b>n=427</b>
<b>(Yes) Been advised wear spectacles and have them</b>	<b>170 (39.8%)</b>
<b>(No) Been advised wear spectacles and don't have them</b>	<b>245 (57.4%)</b>
<b>Why students been advised to wear spectacles don't have/don't wear</b>	<b>n=245</b>
Expensive	124 (50.6)
Not much difference in vision	118 (48.2)
Makes vision worse	35 (14.3)
Fear of being teased	25 (10.2)
Broken/ lost	4 (1.6)
<b>(No response) Been advised wear spectacles and didn't respond</b>	<b>12 (2.8%)</b>
<b>3. How often students with spectacles wear them</b>	<b>n=170</b>
All the time	76 (45%)
Sometimes	90 (55%)
No response	4 (2.4%)
<b>4. Would you Prefer another way to correct vision ( students with spectacles)</b>	<b>n=170</b>
(Prefer another way to correct vision) Yes	123 (72.3%)
(Do not prefer another way to correct vision) No	37 (21.8%)
No response	10 (5.9%)
<b>5. What method would you prefer (for only those who said yes, prefer another way to correct vision)</b>	<b>N=123</b>
Contact lenses	83 (69.1%)
Surgery	37 (31.7%)
No response	3 (2.4%)

Of the students who had been advised to wear spectacles and did not have them/ wear them (427, 31%), gave cost (126, 50.6%) and not much difference in vision (118, 48.2%) as the major reasons they did not wear/ have their spectacles.

Most of the students who wore/ had their spectacles (123/170, 72.3%), preferred another modality of correcting their vision and most gave contact lenses (83/123, 69.1%) as the preferred modality.

## **Focus Group Discussions**

The focus group discussions were carried out among the study students in groups of 12 students after the KAP questionnaire was filled and the eye examination was carried out. The selection of students was random from the class register.

### **Students' knowledge regarding their vision and barriers to spectacle use**

*'..I have never seen the need... I thought my eyes were perfectly alright'*

Most of the students felt their vision was normal and had never had an eye check-up prior to the study. However, some who thought their vision was normal or had never seen the need to go to hospital, discovered they had refractive error or were found to have refractive error during the clinical exam.

*'.. I know my vision is poor, I have told my parents and they advised me it will get better.'*

*'.. I know my vision is poor, so I am waiting for it to get better'*

*'... I know my eyesight is poor but I just cannot ask my parents to take me to hospital, I cannot ask for more, my parents have no money, they are struggling to take me and my siblings through school.'*

*'.. I have noticed for the past two years I have poor vision and even went to an optical shop to seek for help, I even know the cheapest pair of spectacles cost Ksh. 2000 but I simply cannot afford it..'*

*'.. I know my vision is poor, so I simply sit at the front of the class and beg the teacher not to move me.'*

*'... my vision is poor, I know because when I use my desk mate's glasses, I see better, I cannot explain why I have not had my eyes checked..'*

*‘.. I thought there was something wrong with my vision, but I did not think it was that serious....’*

Most of the students who had poor vision had realised their vision was sub optimal. However, in spite of having poor vision, most of them had not previously had an eye check-up. The reasons for not had having a previous eye check-up were cost, poor eye health seeking habits among the parents as well as students and some students had developed coping mechanisms to deal with their poor vision like sitting in front in class.

*‘.. I do not see the difference with my vision if I am wearing my glasses or not....’*

*‘.. I have poor vision but I cannot stand how my spectacles look, if I could get a better frame I would definitely wear my glasses.’*

*‘.. I used to have spectacles but, I broke them and I am too scared to let my parents know because they will be annoyed with me....’*

*‘..I know my vision is poor, I had spectacles but I stopped wearing them so that my eyes could normalize.’*

*‘.. My spectacles were stolen last term and my parents don’t have money to replace them... they cost me Ksh. 15000... .’*

*‘.. Some of us live in the country side. I wear my spectacles mostly at school, when I am at home for the holidays, it is cumbersome to wear spectacles in the field when harvesting. In the country side people will also view you to be peculiar if you wear spectacles.’*

*‘.. if you have the right spectacle frames and tint, you look swag.’*

Of the students who had poor vision and did not have their spectacles, the reasons for not wearing spectacles were broken spectacles, stolen spectacles, high cost of glasses, no

difference in vision or vision made worse, difficulty handling spectacles, fear of being teased and poor communication between parents and children. One of the students was not willing to replace his spectacles with less trendy glasses after they were stolen. A fascinating response for not wearing spectacles was that spectacles left marks on the side of the face and made the eyes appear smaller.

*'.. I simply didn't know my vision was poor, I thought this is how I am meant to see....'*

*'..until today I didn't realise how poor my vision was, now I know with spectacles I can see much better.'*

Some students were found to have significant refractive error during the screening process but they were unaware of their poor vision.

*'.. when I started to notice I couldn't see well I told my parents, my parents are lecturers and they took me to see an eye specialist and was given a spectacle prescription.'*

The students found to be wearing spectacles due to poor vision had a much better realization of their poor vision and the need to do something about it. They also seemed to have a better knowledge of poor vision as regards refractive error and eye care. The students with spectacles also seemed to come from a better socioeconomic background, as we observed most of them were from County schools and very few from district schools. The students who had spectacles also had more educated parents.

### **Attitude towards spectacles**

The general attitude towards spectacles and spectacle use in certain aspects were positive among high school students in Nairobi County. There were certain attitudes the students embraced that stood in the way in better uptake of refractive services.

*‘.. I wear spectacles but my vision keeps getting worse, my eyes are dependent on the spectacles because I cannot see without them....’*

*‘..you see, for the students who wear glasses, their vision gets worse and you see them buying spectacles with more power....’*

*‘.. most students who wear spectacles don’t stop; they are dependent on them....’*

Many of the students were of the opinion that spectacles led to dependence of spectacles and that spectacles made the vision worse. The students attributed the change of refractive status of the eye to the wearing of spectacles as they realized some students kept getting stronger spectacles to see clearly. Some students account that they even discontinued spectacle use to allow their eyes to normalize as their eyes were getting worse on spectacles.

*‘.. as a matter of fact if you want to be attractive to boys get a pair of spectacles, especially the ones that tint.’*

Interestingly most of the students were of the opinion that spectacles made one attractive to the opposite sex, particularly if the frames were trendy and the lens were tinted.

*‘... spectacles make you look ‘swag’, if they are fashionable and can tint’*

Spectacles were also found to be a fashion statement among high school students in Nairobi County.

*‘... I am in basketball and not having good eyesight is sometimes looked at like a disability....’*

Though few, some students considered wearing spectacles due to poor vision a form of disability especially if you were in a sport and were concerned not being selected for the main team.

## **In depth interviews with key informants**

The in-depth interviews were carried out one on one by either the principals of the respective schools we went to, the class teachers of the form three class or the house mistress/ master.

This depended on who was free. The interviews were held after the data collection from the students was complete.

## **Barriers to uptake of eye health care among high school students**

*‘.. some of the students are struggling to put food on the table, even if they had problems with their vision it would not be considered a priority.’*

The class teachers or principals were able to recognize that some of the students did have problems with their vision. They realised that some of them however were not able to afford appropriate eye care due to financial and social constraints at home. In the district schools particularly, this was the major problem. The teachers reported that the students had such difficult social problems like prostitution among girls, being involved in gangs especially among boys, not having homes, not being able to pay school fees, illicit drug abuse, teenage pregnancies, absenteeism and having serious health problems like H.I.V infections and having to take anti-retroviral therapy. The head teachers in these schools pointed out they spend much effort looking for funds to mainly keep the students in school. Having to face these problems, for both teachers and students, eye health is very low in the priority list. In the County and National schools the picture was different. In one National school the director pointed out they had a yearly eye check-up for the students.

*‘.. I have noticed some students do not see well, when you ask them they say they have been on medication without improvement.’*

*'.. it is a high school requirement to have your eyes checked but from my observation many do not because if you look at some of the medical records, you can tell the person commenting on the eyes did not even examine.'*

Some of the teachers were observant and noticed some of the students had poor vision they had also made an effort to enquire about whether the students had sought help. Some of the students had sought in-appropriate help. Many of the students sought eye care in a pharmacy where they were given eye drops without referral to an eye specialist or hospital. Some teachers made the observation that some of the clinicians the students sought help from had no training/ knowledge in eye health and they could judge this by the inappropriate comments in the students' medical records.

*'.. some students have told me they cannot see well and would like to be moved in front.'*

The teachers made an observation many students who could not see well, noticed and requested to be moved to sit at the front.

*'.. I have noted some once brilliant students, dropping in performance in class. I usually enquire and many times they will tell you they have noticed something wrong with their vision.'*

It was also observed by the teachers that poor vision had a bearing on school performance. Poor vision seemed to lead to poor performance among students.

*'.. these children are having so many changes going on in their bodies and are sometimes shy or scared to reveal this to anyone unless you ask them in a friendly way.'*

It was also noted by the teachers that in the teenage years students are undergoing so many changes in their bodies, they may be overwhelmed. The teachers also noted the children do



not have proper mentorship and guidance and therefore are not open or able to speak out their problems.

*'.. some students particularly the girls are concerned about their image and may therefore be more reluctant to wearing spectacles.'*

All the district schools visited in the study were mixed and almost all the district schools in the county are mixed. The teachers in the district schools pointed out that school was particularly difficult for the girls because they generally had more social problems to deal with coming from low socio-economic background. Being in a mixed school the girls were very concerned about their image and would be reluctant to wearing spectacles particularly if it made them less attractive. The teachers reported that the girls faced a lot of teasing from the boys and this was one of the reasons they had to separate the girls and boys into different classes.

*'.. some of these students like to pretend so that they go home on sick off. I do not think anything is wrong with their eyes. I can see perfectly well.'*

*'.. we have never been keen to look at eye health as a major concern. I have never thought these young students could have problems with their vision.'*

Unfortunately a few teachers had no insight on eye healthcare. They thought the students' health problems as regards to the eye were unfounded and a way of absconding class. Some of them thought that if they could see well, there was no reason why a teenager should not.

## 7.0 DISCUSSION

### Prevalence and Pattern of Refractive Error

Nairobi County has approximately 40000 students attending public high schools<sup>(29)</sup>. Our study population was form III students numbering 9500 students with  $16.98 \pm 1.04$  years (Figure 6) as the mean age. This study population was selected because they have an average age of above 16 years and most refractive errors have manifested by this age<sup>(5)</sup>. The form IV class ahead was not selected to participate because they were sitting a national examination. Our sample size for the study was 1622, with a response rate of 85.6% making the survey study valid. Most of the students who did not participate were absent or declined (Figure 5). In one school, an inter-house football tournament was underway with a bull as the first prize and thus some students declined to participate even after revisiting the school. Access to schools is more for boys and this is shown by the higher response rates among male students 54% versus 46% for girls. More than 50% of the students' parents of both sexes had college/university education, reflecting the urban setting of the study (Table 2).

### Prevalence of Refractive Error

The prevalence of significant refractive error (R.E) amongst high school students was 17.2% in Nairobi County, Kenya (Figure 7). There are no comparable published studies in this age group done in Kenya. Studies that are comparable in other parts of the world the prevalence of refractive error was found to be at least 16.2% in Ghana<sup>(12)</sup>, 18.2% in Peru<sup>(14)</sup>, 9.6% in South Africa (African children)<sup>(2)</sup>, 73.9% in Singapore<sup>(3)</sup>, 29.3% in Western Iran<sup>(31)</sup>, 21% in German adolescents and approximately 30% in Polish students<sup>(32)</sup>. The prevalence of refractive error in Kenya is comparable to that of Ghana, but much lower than Singapore, Poland and Iran. As evidenced by these studies, there is difference in the prevalence of

refractive error with the highest prevalence in Asians, followed by Europeans and lastly in Africans. The heterogeneity of the prevalence can be attributed to the difference in methods of the study design, as our study had a cut off of visual acuity of 6/12 or less in the better eye. Other contributory factors to the difference in prevalence are racial differences, geographical distribution, near work, outdoor exposure, genetics<sup>(33)</sup> and has been further illustrated in a study by Kleinstein et al that showed significant differences in the prevalence and types on R.E in different ethnic groups<sup>(13)</sup>.

In Kenya, studies with similar methods have been conducted among younger age groups. Nzuki et al. studied prevalence of refractive error amongst an urban population with a mean age of  $14 \pm 0.9$  years. The prevalence of refractive error was 10.2 % in this age group.<sup>(1)</sup> Lower prevalence of refractive error in younger age groups has been corroborated in several studies<sup>(2) (12) (13) (22)</sup> and literature<sup>(5)</sup> showing that the prevalence of refractive error increases with age.

Muma et al. in a follow up study amongst a predominantly rural population with a similar age group(14 years) found the prevalence of refractive error to be 5.2 percent<sup>(10)</sup>. This was a much lower figure when compared to their urban counterparts.<sup>(1) (10)</sup>. Kenya has a heterogeneous population with many tribes and the genetic differences could play a role in this difference. However near work, which is more common in urban populations, and outdoor pursuits, amongst the rural counterparts, have been shown to influence the prevalence of refractive error in this populations<sup>(33)</sup>.

Msiska et al in a similar study in urban and rural malawi mean age  $12.96 \pm 0.02$  years, found a the prevalence of refractive error in Lilongwe (urban) to be 2.3% and 2.4% in Ntcheu (rural). The refractive error rate was much lower than in the studies previously mentioned. This is

one of the lowest prevalence of refractive error reported and could be attributed to genetics and the environment<sup>(33)</sup>.

### **Pattern of Refractive Error**

In our study we found the commonest type of refractive error in this age group ( $16.98 \pm 1.04$ ) to be myopia at 15.63%, followed by Astigmatism at 7.55% and hyperopia at 0.87% (Table 3).

This trend is similar to Nzuki et al, in Kenyan urban population (mean 14 years), who found myopia to be the most prevalent refractive error at 9.4 %, followed by Astigmatism at 0.5 % and Hypermetropia at 0.3 percent. This shows that the general trends of refractive error shown in our study are already established at this younger age group<sup>(1)</sup>.

In a similar study conducted by Msiska et al. who considered both urban and rural populations in Malawi, refractive error trends in Lilongwe(urban) were similar to our study. However the prevalence was much lower with myopia, hyperopia and astigmatism found to be 1.5%, 0.4% and 0.3% respectively. The prevalence rates in the Ntcheu(rural) were hyperopia at 1.4%, Myopia at 0.8% and Astigmatism at 0.2 percent<sup>(34)</sup>.

The only comparable study done in the rural areas done in Kenya was by Muma et al. which confirmed hyperopia being more prevalent in the rural areas. The general trend of refractive error in rural Kenya was hypermetropia at 3.2 percent. This was followed by myopia at 1.7% and astigmatism 0.3 percent<sup>(10)</sup>.

A possible mechanism for the difference in the pattern of refractive error between urban and rural populations, could be that children in the urban settings are engaged in more near work

compared to their counterparts in the rural setting leading to higher rates of myopia in urban children. Other mechanisms involved could be environmental and geographical <sup>(33)</sup>.

Internationally studies done in 15-18 years age group showed great differences across regions as summarised in Table 8.

**Table 8: Comparison of Pattern of refractive error across regions**

Author/region	Myopia	Astigmatism	Hypermetropia
Quek T.et al. (Singapore) <sup>(3)</sup>	73.9%	58.7%	1.5%
Teofilo et al. (Cusco,Peru) <sup>(14)</sup>	3.4%	14.6%	0.1%
Hassan et al. (Western Iran) <sup>(31)</sup>	29.3%	20.7%	21.7%
Ovenseri et al. (Ghana) <sup>(12)</sup>	8.9%	16.7%	3.0%
Naidoo et al. (South Africa) <sup>(2)</sup>	9.6%	6.7%	2.0%
Kleinstei n et al.(Ohio, USA) <sup>(13)</sup>	9.2%	28.4%	12.8%
Czepita et al (Poland) <sup>(32)</sup>	23.4%	22.2%	4.5%
Nyamai et al(Nairobi,Kenya)	15.6%	7.6%	0.9%

These studies demonstrate variable patterns of refractive error in different continents among people of different ethnicities. If comparable then populations of Asian origin have the highest prevalence of Myopia and Astigmatism amongst the quoted studies. Iranians, who are part of the asian continent have the highest rates of Hypermetropia. Of note the study definitions for the different types of errors were the same in the different studies.

South Americans have the lowest prevalence of myopia, Africans the lowest prevalence of astigmatism while South Americans have the lowest prevalence of hypermetropia. This comparison however is not accurate as continents have diverse populations within them and more population studies are required to find out whether these trends are true.

The prevalence of anisometropia in our study was found to be 2.3% (Figure 9) which was lower than their counterparts in Western Iran at 4.6% and Singapore at 11.2 percent <sup>(3)</sup> <sup>(31)</sup>.

Our study had a cut-off visual acuity of less than 6/12 in the better eye and this could have resulted in under estimation of the prevalence of anisometropia.

## Uncorrected refractive error in the study population

Uncorrected refractive error is a significant cause of blindness and the major cause of impaired vision<sup>(35) (36)</sup>. In the world, 153 million people are either blind or visually impaired due to uncorrected distance refractive error<sup>(28)</sup>. As a result, the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB), both separately and in their joint initiative, VISION 2020: The Right to Sight, have put uncorrected refractive error on the blindness prevention agenda. The goal is to develop strategies for the elimination of, this most simple, avoidable cause of vision loss<sup>(37)</sup>.

In our study we found the proportion of students with uncorrected significant refractive error out of the total number of students with refractive error to be 64.1 percent (Figure 8). This ranged from 96.8% in district schools to 54.3% in county schools. This wide range could be an indicator of inequality of access to eye care services and corrective devices. A majority(50.6%) of students who had uncorrected refractive error stated that lack of money was a major factor that prevented them from having spectacles. A small proportion(10%) feared being teased(Table 7). This however was at variance with attitudes towards spectacle use as the median responses all encouraged spectacle use(Table 5).

The proportion of students with significant refractive error who were uncorrected in previous studies was 77.3% according to Nzuki et al in Nairobi (urban)<sup>(1)</sup>, 98.7% by Muma et al (rural Kenya)<sup>(10)</sup>, 68.5% by Teofilo et al Cusco, Peru<sup>(14)</sup> and 95.3% by Msiska et al in Malawi<sup>(34)</sup>. The proportion of students with uncorrected refractive error in these studies is very high signifying that it is a major cause of visual impairment in schools. However, in our study we had a lower proportion as compared to various studies that have been carried out in Africa. This shows that most school going children with significant refractive error are

uncorrected, and is a major concern as it may hamper productivity and school performance in this age group.

The proportion of students with significant refractive error who were under-corrected (Improved by two lines when refracted) was 8.4 percent. This was 23.5% (20/85) of students who had correction. Almost 1 in 4 students who were refracted were undercorrected. Students who had been advised to wear spectacles and did not have them, 48.2 % said that there was not much difference in their vision when they wore the spectacles. A further 14.3 % stated that wearing spectacles made their vision worse (Table 7). This shows that less than perfect refraction services are a major cause of reduced spectacle use amongst students in Nairobi county.

## **Knowledge, attitude and practice regarding Refractive Error among students**

We found a high proportion of uncorrected refractive error among the students who had significant refractive error. This was similar to studies done in different regions <sup>(1) (10) (14) (34)</sup>. To explore why this is the case, we enquired the knowledge, attitude and practices (KAP) as regards refractive error of all the students who participated in the study. This included students with no significant refractive error, uncorrected refractive error, under corrected refractive error and corrected refractive error. One of the strengths of the study is that we carried out the KAP study on refractive error before examining the students and therefore the responses were not affected by the clinical examination. This method was unique among the other published studies.

## **Students' knowledge as regards R.E**

Interestingly, only 491 (35.3%) of the students felt their vision was normal, 458 (32.9%) felt their vision was abnormal and 433(32%) did not know whether they had normal vision or not (Table 4). The reason for this, could be that a great number of the students had never had their eyes examined (829, 60%) prior to this study (Table 6). During the in depth interviews, the teachers attributed the students' lack of realization of their poor vision to the many changes occurring in adolescence that may be overwhelming to them. To cope with their poor vision some of the students had developed mechanisms like sitting in front in class and sharing spectacles with their desk mates.

Most of the students gave poor nutrition 578 (42%) as a cause of poor vision, followed by short sightedness 465 (33.5%) and lastly 121 (8.7%) astigmatism (Table 4). Compared to Agarwal et al study in India <sup>(26)</sup>, on the KAP of refractive error, with an emphasis on spectacle usages in students, they found that most common reason for low vision was nutritional



deficiency at 68 percent. This proportion was much higher than in our study but in both studies it was cited by high school students as the most common cause of poor vision.

As regards refractive error, most students responded to spectacles 938 (67.5%) as a mode of correcting poor vision. Argawal et al, found most of the students were aware about spectacles (92%) as a modality for correcting low vision <sup>(26)</sup>. In our study 365 (26.2%) of students identified contact lenses and 296 (21.3%) surgery, as methods of correcting poor vision (Table 4). In India, 54% knew of contact lenses and only 14% of surgery <sup>(26)</sup>. While in Nigeria, Ebeigbe et al found only 38% knew about spectacles, 22.8% contact lenses and 14% surgery as a means of correcting refractive error <sup>(25)</sup>. Generally the Argawal study showed that students in India had more knowledge on correcting poor vision than students in our study and Nigeria.

The fear of being teased 529 (38.1%) followed by cost 488 (35.1%) were the major reasons the students gave for not wearing spectacles (Table 4). In rural India <sup>(26)</sup> students stated that the fear of being teased (82%) and problems with handling of spectacle (71%), were the major reasons for refusal to use spectacles if need arose. In Nigeria <sup>(25)</sup>, 56.0% of the students would not wear spectacles for fear of being teased or mocked. This shows students in Kenya were generally less averse to negative peer pressure. However, it remains a major cause of uncorrected refractive error.

Other causes for not wearing spectacles were poor eye health seeking behaviours among students and their parents. There was also lack of awareness as regards eye healthcare, evidenced by some students and their parents suggesting that they wait for their eye problems to subside instead of seeking medical advice (Focus Group Discussions and In depth interviews with key informants).

Most students, 880 (63%) knew where to seek help if they had poor eyesight and majority 515 (37.0%) would go to an eye specialist or eye hospital (Table 4). However access to healthcare was hindered as most had not been evaluated due lack of awareness and cost. (Table 6)

### **Students' attitude on spectacle use**

The Likert scale was used to grade attitude of students towards spectacle use. Generally, we found the students disagreed with the notions that spectacles are associated with intelligence, spectacles are cosmetically unacceptable and embarrassing in public, wearing spectacles leads to low self-esteem and that young people do not need spectacles. The attitude was neutral and generally mixed as regards the notions that wearing spectacles improves appearance, wearing spectacles leads to dependence and worsening of vision and wearing spectacles can damage the eyes (Figure 10, Table 5). During the FDG, the opinion that spectacles lead to dependence and worsening of vision came out even more strongly. The students attributed changes in the refractive status of the eye to the wearing of spectacles as they realised some of their counterparts with spectacles kept getting stronger lenses with time. On this account, some students had discontinued spectacle use to allow their eyes to normalize. However, most students strongly disagreed wearing spectacles makes one less attractive to the opposite sex. In fact, amongst the students, spectacles are considered a fashion statement, if the frames are trendy, and the lenses are photochromatic. At the time of this study, there was a popular musician called 'Pharrell Williams' who wore spectacles and many students referred to a particular fashionable frame by his name. Few students in sports did not find spectacles very popular because it was viewed as a flaw and it reduced their chances of being in the main team. These students feared their abilities would be down played and their peers would view them as less of a superstar in the particular sport. In a

similar study in India <sup>(26)</sup>, 68% responded spectacles prevent normalisation of eyes, 64% spectacles can harm the eyes, 62% felt spectacles were cosmetically unacceptable, 54% thought spectacles were unattractive to the opposite sex and 48% responded spectacles could lead to low self-esteem. Among undergraduates in Nigeria <sup>(25)</sup>, 64% thought glasses were harmful to the eyes and 60% thought glasses were meant for old people. The attitude towards spectacle use in the rural India and Nigeria setting seemed similar but so much different to that of students in Nairobi. The attitude of high school students towards spectacles in many aspects tends to be generally positive. However, mixed reaction was elicited as regards spectacles damaging eyes and preventing normalization of eyes. In Nigeria and India students leaned towards the idea spectacles damage eyes and prevent normalization of eyes and this notion is similar across these study populations. The differences in attitude as regards spectacle use could be attributed to difference in culture, ethnic background as well as urban verses rural backgrounds.

### **Practice of students in regard to refractive error and eye healthcare**

Only 539/1390 (39%) of the students had an eye checkup prior to this study of whom 345/539 (64.0%) had visited an eye specialist/ eye hospital and majority, 305/539 (56.6%) only did so when they had an eye problem. Of those who had not had an eye checkup, 829/1390 (60%), majority lacked awareness (72.7%) while 390/1390 (47.1%) stated cost as reason for not having an eye checkup (Table 6).

We found the prevalence of significant refractive error to be 17.2 percent. However, we found 31% (427/1390) of the students had been advised to wear spectacles before. Of these students, 57.4% (245/427) stated they did not wear spectacles mainly because, they could not afford (50.6%) and 48.2% saw no improvement in vision. On further enquiry, 170/427 (39.8

%) students stated they had spectacles, but during the study, we found only 117 students had their spectacles in school. Out of these 117 students, 85 had significant refractive error with 65/85 having the right correction and 20/85 under corrected. This suggests the quality of refractive services in the County may be wanting because 152 students who were visually impaired and 20 students who were undercorrected had improved vision after refraction. Another aspect pointing to the quality of refractive services is that 427 students had previously been advised that they needed spectacles but when we examined them we found that only 237 actually needed them. Of the students who stated they wore spectacles, 123/170 (74.1%) preferred another way of correcting their vision, with majority 83/123 (69.1%) preferring contact lenses (Table 6, Figure 5, Figure 7, Figure 8). This cascade of events in provision of refractive services shows a deficiency in screening and correction for refractive errors.

A captivating aspect brought about by teachers in the key informant interviews that leads to the reduced uptake of refractive services is the socioeconomic status of the individual students. Generally in all categories of schools, the teachers realised that some of the students were not able to access or prioritize eye healthcare because of financial and social constraints at home. This was particularly so for students in district schools, some of which happen to be situated in slums. They are also ranked lowest in terms of cut-off marks for intake from the national primary examinations compared to the National and County schools. Their overall performance in the National examinations is collectively poorer than the other school categories with the exception of some schools <sup>(30)</sup>. The teachers especially in the district schools pointed out that the students had such difficult social problems like poverty, absenteeism, prostitution, alcohol, drug abuse, teenage pregnancies and serious health problems like H.I.V infections. The teachers reported much of their efforts would be geared to solving these issues rather than addressing eye health issues. We observed that majority of

the students with uncorrected refractive errors out of the total number of students with refractive error ranged from 96.8% in district schools to 54.3% in county schools. This points to the inequality in the distribution of refractive services with the social constraints as a major impediment.

## **8.0 LIMITATIONS AND STRENGTHS**

### **Limitations**

- Absenteeism and Missing questionnaires: Some of the students were issued with questionnaires which they did not return even on subsequent follow up because certain school activities coincided with the data collection.
- Anisometropia may not have been fully described because we had a cut of visual acuity of  $<6/12$  in the better eye yet there were disparity in some of the students visual acuity probably due to different refractive status in both eyes.
- Small number of studies to make comparisons with on the same research topic.
- The limitation was only carried out in Nairobi County, Kenya and therefore the results cannot be generalised to all high school students in the country.

### **Strengths**

- The strength in this study is that we performed an objective refraction followed by subjective refraction which was not carried in previous studies in the region.
- Sampling was representative of the entire Nairobi County.
- This study had a large sample size.
- The knowledge, attitude and practice questionnaire was issued before the clinical examination and therefore bias was reduced answering the questions.
- This study was the only study in the region that did lensometry reading.
- This study was the only study in the region on refractive error that performed a KAP study, in addition to a clinical exam.

## 9.0 CONCLUSION

- There is a high prevalence of significant refractive error among high school students in Nairobi County (17.2%) with a high preponderance of myopia at 15.6%.
- There is a high prevalence of uncorrected refractive error at 11 percent.
- There is a high burden of uncorrected refractive error at 64.1% out of all the students with significant refractive error.
- The refractive services in the county are wanting as students who required spectacles; majority could not afford neither did they see any improvement in vision.
- The uptake of refractive services was poor due to lack of awareness 72.7%, cost (38%) and flawed attitudes.

## **10.0 RECOMMENDATIONS**

- A well designed screening protocol of refractive error in high school students, as well as regular screening programs, would help in reducing the prevalence of uncorrected refractive error and improving uptake of refractive services.
- The provision of visual acuity charts in schools with instructions on how to use them would greatly improve the knowledge of students on the status of their vision.
- Raise awareness of refractive error among students.
- Provision of low cost trendy spectacles.
- Alternative refractive services like contact lenses where feasible and affordable should be explored by weighing the benefits versus the risks.
- Regular continuous professional developments training programs for ophthalmic health professionals on refraction to provide quality refractive services.
- A similar study to our study should be conducted in rural Kenya so as to compare the differences in prevalence and characteristics of R.E among teenagers/ high school students in urban versus rural Kenya



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## APPENDIX 1: ETHICAL APPROVAL



**UNIVERSITY OF NAIROBI**  
COLLEGE OF HEALTH SCIENCES  
P O BOX 19676 Code 00202  
Telegrams: varsity  
(254-020) 2726300 Ext 44355

**KNH/UON-ERC**  
Email: [uonknh\\_erc@uonbi.ac.ke](mailto:uonknh_erc@uonbi.ac.ke)  
Website: [www.uonbi.ac.ke](http://www.uonbi.ac.ke)

**KENYATTA NATIONAL HOSPITAL**  
P O BOX 20723 Code 00202  
Tel: 726300-9  
Fax: 725272  
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/314      Link: [www.uonbi.ac.ke/activities/KNHUoN](http://www.uonbi.ac.ke/activities/KNHUoN)      10<sup>th</sup> September 2014

Dr. Lily A. Nyamai  
Dept. of Ophthalmology  
School of Medicine  
University of Nairobi

Dear Dr. Nyamai

**Research proposal : Prevalence, Knowledge, Attitude and Practice on Refractive error among students attending Public High schools in Nairobi county (P268/05/2014)**

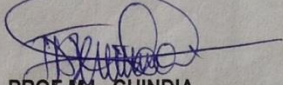
This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 10<sup>th</sup> September 2014 to 9<sup>th</sup> September 2015.

This approval is subject to compliance with the following requirements:

- Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
- All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
- Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
- Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
- Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
- Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
- Submission of an *executive summary* report within 90 days upon completion of the study  
This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website [www.uonbi.ac.ke/activities/KNHUoN](http://www.uonbi.ac.ke/activities/KNHUoN).

Yours sincerely



**PROF. M.L. CHINDIA**  
**SECRETARY, KNH/UON-ERC**

- c.c.     The Principal, College of Health Sciences, UoN  
          The Deputy Director CS, KNH  
          The Chair, KNH/UoN-ERC  
          The Assistant Director, Health Information, KNH  
          The Dean, School of Medicine, UoN  
          The Chairman, Dept. of Ophthalmology, UoN  
          Supervisors: Dr. Margaret W. Njuguna, Dr. Lucy Njambi Ombaba

## APPENDIX 2: APPROVAL, COUNTY DIRECTOR OF EDUCATION



Republic of Kenya

### MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY State Department of Education

Telegrams: "SCHOOLING", Nairobi  
Tel. 0202453699  
Fax 2244831 Nairobi  
When replying please quote

COUNTY DIRECTOR OF EDUCATION  
NAIROBI COUNTY  
NYAYO HOUSE  
P.O. BOX 74629-00200  
**NAIROBI**

Ref: NC/GA/14/224

Date: 22<sup>th</sup> September, 2014


TO WHOM IT MAY CONCERN

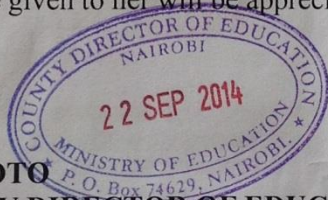
#### **RE: DR LILY ADHIAMBO NYAMAI**

This is to confirm that Dr. Lily Adhiambo Nyamai is a Masters student in Ophthalmology at the University of Nairobi. She is in the process of collecting data from students in high schools for purposes of completing the course.

She will offer free eye check and prescription for any condition noted while undertaking the study.

Any assistance given to her will be appreciated by our office.

  
**SAMWEL BOTO**  
**FOR COUNTY DIRECTOR OF EDUCATION**  
**NAIROBI COUNTY**



ISO 9001:2008 CERTIFIED





### APPENDIX 3: KAP QUESTIONNAIRE AND VISUAL ASSESSMENT

Date:

Study number:

Name of the school: \_\_\_\_\_

Age: \_\_\_\_\_ Years

Gender: Male

Female

Form: \_\_\_\_\_

Using spectacles: Yes

No

Mother's education level  None  Primary  Secondary  College

University other: \_\_\_\_\_

Father's education level  None  Primary  Secondary  College

University other: \_\_\_\_\_

#### Knowledge

1) Do you feel you have normal vision?

I do not know  Yes  No

2) What do you think are the causes of poor vision amongst students (give as many examples)

I don't know  Short sightedness

Long Sightedness  Poor nutrition

Other: \_\_\_\_\_

3) What methods of correcting low vision do you know of?

I don't know  Spectacles  Medicine  Contact lens  Surgery

Other: \_\_\_\_\_

4) What do you think are some of the reasons for people wearing spectacles?

I don't know  Protect eyes from excessive light and injury

Improve vision  Look intelligent

Other: \_\_\_\_\_

5) It's been shown that many students with poor vision do not want to wear spectacles. Why do you think so?

I don't know

Spectacles prevent normalisation of eyes

Cosmetically unacceptable and embarrassing in public

Cost

Fear of being teased

Other: \_\_\_\_\_

5) In your area do you know where you can seek help if you found out you had poor eye sight?

I don't know

Yes (go to 5 a)

a) If yes where?

Optical Shop  Hospital  Clinic  eye clinic

Other: \_\_\_\_\_

## Attitude

For each of the following statements, indicate whether you.....

**Strongly agree, strongly disagree, neutral, moderately agree, disagree**

1) What are some of your beliefs towards spectacle wearing?

	Strongly agree	Strongly disagree	Neutral	Moderately agree	Disagree
Spectacle users or wearing spectacles is associated with intelligence					
Spectacles are cosmetically unacceptable and embarrassing in public					
Wearing spectacles improves appearance					
Wearing spectacles leads to low self esteem					
Wearing spectacles makes you less attractive to the opposite sex					
Wearing spectacles leads to dependence and worsening of vision					
Wearing Spectacles can damage your eye					
Young people do not need spectacle correction					

Other: \_\_\_\_\_

## Practice

1) Have you ever had an eye checkup?

Yes (go to 1b &c)  No (go to 1a)  I don't know (go to 1a)

a) Why have you not had your eyes checked?

b) Where have you had your eyes checked?

Optical Shop  Hospital  Clinic  eye clinic

c) How often do you have your eyes checked?

2) Have you ever been advised to wear spectacles?

I don't know  Yes (go to 2 b)  No

a) If yes, do you have your spectacles?

Yes (go to ii then iii)  No (got to 2b)

i) If no why?

ii) If yes, when do you wear your spectacles?

Yes  No (go to 2b)

iii) Would you prefer another way of correcting your poor vision?

Yes  No

b) What are some the reasons you don't wear your spectacles or don't have spectacles?

Fear of being teased

Not much difference in vision

Broken/ lost

Makes vision worse

Expensive (cost)

Others: \_\_\_\_\_

## VISUAL ASSESSMENT

Wearing Spectacles Yes  No

Visual Acuity:

Right Eye		Left Eye	
Without correction	With correction	Without correction	With correction
/	/	/	/

Power of spectacle:

Right eye			Left eye		
Sphere	Cylinder	Axis	Sphere	Cylinder	Axis

**APPENDIX 4 - VISUAL ASSESSMENT OF STUDENT WITH R.E AND ALL THOSE CURRENTLY USING SPECTACLES.**

Date:

Study number:

Name of the school: \_\_\_\_\_

Phone no: \_\_\_\_\_

Age: \_\_\_\_\_ Years

Gender: Male

Female

Wearing spectacles: Yes

No

Visual Acuity:

Right Eye		Left Eye	
Without correction	With correction	Without correction	With correction
/	/	/	/

Power of spectacle:

Right eye			Left eye		
Sphere	Cylinder	Axis	Sphere	Cylinder	Axis

DIAGNOSIS 1:

1. RE UNCORRECTED
2. RE CORRECTED
3. OTHER .....SPECIFY

Refraction of all with uncorrected RE:

	Right eye			Left Eye		
	Sphere	Cylinder	Axis	Sphere	Cylinder	Axis
Objective refraction						
Subjective refraction						

BCVA: RE \_\_\_\_\_

LE \_\_\_\_\_

STUDENTS WHO'S VISUAL ACUITY (VA) DOES NOT IMPROVE WITH 2 LINES

Anterior Segment findings:

---

Posterior segment findings:

---

Diagnosis:

Right eye				Left Eye			
Myopia	Hyperopia	Astigmatism	Other	Myopia	Hyperopia	Astigmatism	Other

Action taken:  Glasses prescribed  Referral to eye centre for further examinations and management

## **APPENDIX 5: FOCUSED GROUP DISCUSSION AND IN DEPTH INTERVIEW GUIDE ;**

**Study title: Prevalence, Knowledge, Attitude and Practices on refractive errors among high school students, in Nairobi County, Kenya.**

### **Introduction**

Welcome and a quick round of introductions, overview of topic and ground rules.

### **Knowledge**

- 1) What conditions do you think people wearing spectacles have?
- 2) What modes of correction can these people (refer to Q.1) use to improve their vision?
- 3) What do you think are the causes of poor vision amongst students?
- 4) It has been shown that many students with poor vision do not take steps to correct their vision. Why do you think so?
- 5) In your area do you know where you can seek help if you have poor vision?

### **Practice**

- 1) Have you ever had an eye checkup?
  - a) Where have you had your eyes checked?
  - b) How often do you have your eyes checked?
  - c) Why have you not had your eyes checked?
- 3) What are some of the reasons that make wearing of spectacles popular among students?

### **Attitude**

- 1) What are some of your beliefs towards spectacle wearing?



## APPENDIX 6: BUDGET AND BUDGET JUSTIFICATION

Unit Number	Material	Unit Price(Ksh)	Total(Ksh)
2	Torches with batteries	@ 900	1800
3	Blinders( curtains)	@500	1500
1400	Data collection forms	@50	70000
	Stationary		2000
1	Vehicle for hire and fuel		30000
1	Statistician		50000
1	Social scientist		50000
1	Refractionist		50000
1	Research Assistant		50000
1	Lens meter-rent		10000
1	Recorder		5000
	Total		320300

## APPENDIX 7: RANDOMIZATION OF SCHOOLS

Lenana School		0.086004		Lenana School			
Nairobi School		0.25956		Pangani Girls			
Pangani Girls		0.319016					
Starehe Boys Centre		0.537677					
Starehe Girls		0.653027					
The Kenya High		0.664213					
Moi Forces Acedemy		0.83902					
County schools				District schools			
Kangemi Sec	BB	0.023005		Our Lady of Fatima Sec	MD	0.003131	
Highway Secondary	BB	0.107394		Kariobangi North Girls	GD	0.021139	
Precious Blood	GB	0.140389		Kayole South Bondeni	MD	0.025372	
Karen C Secondary	GB	0.276156		Ruaraka Secondary	MD	0.038424	
Hospital Hill Secondary	BB	0.301446		Dagoretti Mixed Secondary	MD	0.043886	
Aquinas Boys	BB	0.387698		Lavington Secondary School	MD	0.056675	
Ourlady of Mercy	GB	0.402904		Peter Kibukosya	MD	0.061353	
Jamuhuri High	BD	0.410598		Dr. Mwenie secondary	MD	0.110791	

**APPENDIX 8: LETTER TO THE SCHOOLS FOR SEEKING  
PERMISSION**

Name of school and Address

Date

Dr. Lily A. Nyamai

University of Nairobi

P.O Box 30197, G.P.O, Nairobi, Kenya

Telephone: (+254 - 20) 318262. Fax: (+254 - 20) 245566...

To:

Head teacher /principal

---

**RE: REQUEST FOR THE ASSESSMENT OF REFRACTIVE ERRORS**

My name is Dr. Lily Nyamai a post graduate student in Ophthalmology at the University of Nairobi. I am doing a study to find out the Prevalence, knowledge, attitude and practice in refractive error in high school students in Nairobi County. Your school has been selected to participate in this study. This study is not invasive and poses no risk for the student. It will also benefit students in way of picking those with refractive errors for possible correction and give us information on barriers to correction of refractive errors.

Therefore, I am earnestly requesting you to allow me to do the study, looking forward to a favorable response

Yours Sincerely.

Dr. Lily Nyamai

University of Nairobi-Kenya

Tel: +254721710027

Email: [lilynyamai@gmail.com](mailto:lilynyamai@gmail.com)

**The University of Nairobi (UON) in conjunction with the Kenyatta National Hospital (KNH) ethics committee for protection of human subjects has reviewed and approved this project. Any questions regarding your rights as a research subject may be addressed to the chairperson of the ethics committee for the protection of human subjects Prof A. Guantai Tel 0733220580, [aguantai@uonbi.ac.ke](mailto:aguantai@uonbi.ac.ke)**

## APPENDIX 9: ASSENT FORM FOR CHILDREN/DEPENDENTS

(English)

***TITLE OF STUDY: PREVALENCE, KNOWLEDGE ATTITUDE AND PRACTICE ON REFRACTIVE ERROR AMONG HIGH SCHOOL STUDENTS IN NAIROBI COUNTY***

***Investigator: Dr. Lily A.Nyamai, Department of Ophthalmology, University of Nairobi, Kenyatta National Hospital, P.O. Box 19676-00202, Nairobi, Kenya.***

Child (parent/guardian on their behalf) / young person to circle all they agree with:

Have you read (or read it to you) information about this study? Yes/No

Has somebody else explained this study to you? Yes/No

Do you understand what this study is about? Yes/No

Have you asked all the questions you want? Yes/No

Have you had your questions answered in a way you understand? Yes/No

Do you understand that you may stop taking part at any time? Yes/No

If any answers are 'no' or you **don't** want to take part, don't sign your name!

If you **do** want to take part, you can write your name below

Your name \_\_\_\_\_ Date \_\_\_\_\_

For students aged < 18 years

Parent/guardian to write their name if they agree for you to participate in the study.

Name \_\_\_\_\_ Sign \_\_\_\_\_ Date \_\_\_\_\_

Signature of the researcher who explained this project

Name \_\_\_\_\_ Sign \_\_\_\_\_ Date \_\_\_\_\_

## APPENDIX 10: ASSENT FORM FOR CHILDREN/DEPENDENTS

(Kiswahili)

***TITLE OF STUDY: KIWANGO CHA MAAMBUKIZI, MAARIFA, TABIA NA MAZOEZI  
KATIKA ‘REFRACTIVE ERROR’KATI YA WANAFUZI WA SHULE YA UPILI  
KATIKA KATA YA NAIROBI.***

***Mchunguzi: Dr. Lily A. Nyamai, Idara ya Utafiti ya Macho, Chuo kikuu cha Nairobi,  
S.L.P. 19676-00202, Nairobi, Kenya.***

Mtoto (mzazi/mlezi kwa niaba ya) / mtoto aweke alama pahali anakubaliana na:

Je, umesoma/ kusomewa habari kuhusu utafiti hili?                      Ndio/La

Je, umeelezewa kuhusu utafiti hili?                      Ndio/La

Je, unaelewa utafiti hili linahusu nini?                      Ndio/La

Je, umeuliza maswali kuhusu utafiti hili unge penda kujua?                      Ndio/La

Je, umepata majibu ya maswali zote umeuliza kwa njia unaelewa?                      Ndio/La

Je, unaelewa unweza kuondoka kwa utafiti hili wakati wowte?                      Ndio/La

Kama jibu lolote ni la, basi hutaki kuunga utafiti hili. Tafadhali usipige sahihi.

**Ukitaka** kujiunga na utafiti hili, tafadhali andika jina lako kwa nafasi umepewa.

Jina lako \_\_\_\_\_ Date \_\_\_\_\_

Mzazi/ Mlezi tafadhali andika jina lako na sahihi ukikubali mtoto wako ajiunge na utafiti.

Jina \_\_\_\_\_ Sahihi \_\_\_\_\_ Tarehe \_\_\_\_\_

Mtafiti ambaye amekuelezea juu ya utafi hili anafaa pia kupiga sahihi.

Jina \_\_\_\_\_ Sahihi \_\_\_\_\_ Tarehe \_\_\_\_\_

**The University of Nairobi (UON) in conjunction with the Kenyatta National  
Hospital (KNH) ethics committee for protection of human subjects has**

**reviewed and approved this project. Any questions regarding your rights as a research subject may be addressed to the chairperson of the ethics committee for the protection of human subjects Prof A. Guantai Tel 0733220580, [aguantai@uonbi.ac.ke](mailto:aguantai@uonbi.ac.ke)**

# APPENDIX 11: PATIENT REFERRAL FORM

## Patient referral form

Dear parent.

Please note that your child

..... Who had an eye  
examination today was found to have ..... please

Kindly bring him/her to the

.....  
.....eye clinic for management.

Dr. Lily A Nyamai .

Date: .....



## APPENDIX 12: WHO CATEGORIES OF VISUAL IMPAIRMENT AND BLINDNESS

WHO categories of visual impairment and blindness.

<b>Presenting distance Visual Acuity with BCVA in the better eye</b>		
<b>Category</b>	<b>Worse than</b>	<b>Equal to or better than</b>
<b>0 Mild or no Visual impairment (Normal Vision)</b>		<b>6/18</b>
<b>1 Moderate visual impairment</b>	<b>6/18</b>	<b>6/60</b>
<b>2 Severe visual impairment</b>	<b>6/60</b>	<b>3/60</b>
<b>3 Blindness</b>	<b>3/60</b>	<b>1/60</b>
<b>4 Blindness</b>	<b>1/60</b>	<b>Light perception</b>
<b>5 Blindness</b>	<b>No light perception</b>	
<b>9</b>	<b>Undetermined or unspecified</b>	

## APPENDIX 13-EYE EXAMINATION AND FOCUS GROUP DISCUSSION



## **APPENDIX 14: PUBLIC SECONDARY SCHOOLS IN NAIROBI COUNTY**

### **National Schools**

20400001 LENANA SCHOOL- Boys boarding

20400002 NAIROBI SCHOOL- Boys boarding

20400003 THE KENYA HIGH SCHOOL- Girls Boarding

20400004 STAREHE BOYS' CENTRE AND SCHOOL- Boys boarding

20400008 MOI FORCES ACADEMY- NAIROBI- Boys boarding

20400009 STAREHE GIRLS CENTRE- Girls boarding

### **County Schools**

20401001 AQUINAS HIGH SCHOOL – Boys Boarding

20401005 OFAFA JERICHO HIGH SCHOOL – Boys Boarding

20401003 HURUMA GIRLS' HIGH SCHOOL – Girls Day & Boarding

20401084 BURUBURU GIRLS SECONDARY SCHOOL – Girls Boarding

20402006 O.L.M SHAURI MOYO GIRLS SEC. SCHOOL – Girls Boarding

20403003 PUMWANI SECONDARY SCHOOL – Boys Boarding

20403004 NGARA GIRLS' HIGH SCHOOL – Girls Boarding

20405001 DAGORETTI HIGH SCHOOL – Boys Boarding

- 20405002 UPPER HILL SCHOOL – Boys Boarding
- 20405003 MOI GIRLS’ SCHOOL NAIROBI – Girls Boarding
- 20405004 PRECIOUS BLOOD RIRUTA – Girls Boarding
- 20406001 PARKLANDS ARYA GIRLS HIGH SCHOOL – Girls Boarding
- 20406002 STATEHOUSE GIRLS H. SCH – Girls Boarding
- 20406007 KANGEMI HIGH SCHOOL – Boys Boarding
- 20406009 HOSPITAL HILL HIGH SCHOOL – Mixed Boarding
- 20406011 ST. GEORGE’S GIRLS’ SECONDARY SCHOOL – Girls Boarding
- 20405007 NEMBU GIRLS HIGH SCHOOL – Girls Boarding
- 20406018 LAVINGTON MIXED SECONDARY SCHOOL – Mixed Boarding
- 20406019 HIGHRIDGE MIXED SECONDARY SCHOOL – Mixed Boarding
- 20408007 EMBAKASI GIRLS SECONDARY SCHOOL – Girls Boarding
- 20409002 MUHURI MUCHIRI BOYS HIGH SCHOOL – Boys Boarding
- 20409005 JEHOVA JIRE SECONDARY SCHOOL – Mixed Boarding
- 20409006 DRUMVALE SECONDARY SCHOOL – Mixed Boarding
- 20409007 ST. GEORGE ATHI SECONDARY SCHOOL – Mixed Boarding

**District Schools**

- 20401002 HIGHWAY SECONDARY SCHOOL – Boys Day
- 20401004 OUR LADY OF MERCY SECONDARY SCHOOL SOUTH B – Girls Day

20401006 NILEROAD SECONDARY – Girls Day

20401008 ST. TERESA’S BOYS SECONDARY SCHOOL – Boys Day

20401008 MAKONGENI SECONDARY SCHOOL – Mixed Day

20401081 RUARAKA HIGH SCHOOL – Mixed Day

20401088 OUR LADY OF FATIMA SECONDARY SCHOOL – Mixed Day

20401233 BABA DOGO SECONDARY SCHOOL – Mixed Day

20401258 C.G.H.U SECONDARY SCHOOL – Mixed Day

20402001 EASTLEIGH HIGH SCHOOL – Boys Day

20402003 MAINA WANJIGI SECONDARY SCHOOL – Mixed Day

20402004 UHURU SECONDARY SCHOOL – Boys Day

20402005 KAMUKUNJI SECONDARY SCHOOL – Mixed Day

20403001 JAMHURI HIGH SCHOOL – Boys Day

20403002 PARKLANDS SECONDARY SCHOOL – Boys Day

20403005 ST TERESA’S GIRLS SECONDARY SCHOOL – Girls Day

20403019 NDURURUNO SECONDARY SCHOOL – Mixed Day

20403024 MURANG’A ROAD MIXED DAY SECONDARY SCHOOL – Mixed Day

20403026 PUMWANI GIRLS SECONDARY SCHOOL – Girls Day

20404001 LANG’ATA HIGH SCHOOL – Mixed Day

20404022 KAREN ‘ C ‘ SECONDARY SCHOOL. – Mixed Day

- 20404024 OLYMPIC HIGH SCHOOL – Mixed Day
- 20404025 RAILA EDUCATIONAL CENTRE – Mixed Day
- 20405005 MUTUINI HIGH SCHOOL – Boys Day
- 20405006 RUTHIMITU SECONDARY SCHOOL – Mixed Day
- 20405008 RUTHIMITU GIRLS SEC SCHOOL – Girls Day
- 20405009 DAGORETTI MIXED SEC SCHOOL – Mixed Day
- 20406012 NAIROBI MILIMANI SECONDARY SCHOOL – Boys Day
- 20407002 KAHAWA GARRISON SECONDARY SCHOOL – Mixed Day
- 20407004 KAMITI SECONDARY SCHOOL – Mixed Day
- 20408001 KAYOLE SECONDERY SCHOOL – Mixed Day
- 20408014 PETER KIBUKOSYA SECONDARY SCHOOL – Mixed Day
- 20408015 KAYOLE SOUTH SECONDARY SCHOOL – Mixed Day
- 20409001 DANDORA SECONDARY SCHOOL – Mixed Day
- 20409003 HON. DR. MWENJE SECONDARY SCHOOL – Mixed Day
- 20409004 USHIRIKA SECONDARY SCHOOL – Mixed Day