MAKERERE UNIVERSITY
DEPARTMENT OF OPHTHALMOLOGY

A SURVEY OF THE PREVALENCE OF REFRACTIVE ERRORS AMONG CHILDREN IN LOWER PRIMARY SCHOOL IN KAMPALA DISTRICT

BY

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A DISSERTATION FOR SUBMISSION TO THE FACULTY OF MEDICINE IN PARTIAL FULFILLMENT FOR THE AWARD OF A DEGREE OF MASTER OF MEDICINE (OPHTHALMOLOGY) OF MAKERERE UNIVERSITY
DECLARATION

I do hereby declare that this work is original and was done by me. It has never been presented at any institution or university for any academic award.

Sign........................................

ROBERT MAYEKU MBChB (MU)
(PRINCIPLE INVESTIGATOR)

Sign........................................

ASSOC. PROF. M. KAWUMA
(SUPERVISOR)
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DEDICATION

This work is dedicated to all those school children who participated in this study.
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1.0 ABSTRACT

BACKGROUND: The prevalence of refractive errors in children in most developing countries is not known. WHO has initiated the Refractive Error Study in Children (RESC) programme to try and address this problem in the Vision 2020. The Right to Sight.

In Uganda, like in many developing countries there is almost no established vision screening programme for children on commencement of primary school, such that those with early onset of refractive errors will have many years of poor vision.

The aims and objectives of this study was to determine the prevalence of Refractive Errors among school children attending lower primary in Kampala district, determine the frequency of the various types of refractive errors and their relationship to sex and ethnicity.

Methodology: This descriptive cross sectional study was carried out in Kampala district and a multistage type of sampling was used to select the 700 participants aged between 6 and 9 years. A total of 623 children had a vision testing done on them at school using the same protocol. Of these 301 (48.3%) were males and 322 (51.7%) females - M:F ratio of approximately 1:1. Seventy five children had a detailed ocular examination including retinoscopy under cycloplegia and fundoscopy according to the set criteria of a visual acuity of ≤ 6/9 and/or a squint in either or both eyes.

Results: There were 73 children with refractive errors giving a prevalence rate of 11.6% The 2 children who were emmetropic at retinoscopy had fundus abnormalities.

Of the refractive errors, the commonest type was astigmatism constituting 52.0% followed by hypermetropia and myopia (37.0% and 11.0% respectively). On further analysis of the astigmatic type it was found that the commonest component was the hypermetropic subtype accounting for 42.1% followed by the mixed (31.6%) and myopic (26.3%). There was no significant sex and ethnic influence in the frequency and distribution of refractive errors in this study.
Conclusion: From this study, there is a need to have a regular and simple vision testing in school children at least at commencement of school to detect those who may have early onset of refractive errors for referral.

This needs a wider population based survey to establish the national figures for prevalence of refractive errors, covering wider age strata, in view of creating a national programme for vision screening in schools.
2.0 INTRODUCTION

Children with learning and behavioral disabilities are often brought to an ophthalmologist for evaluation to find out whether an ocular disorder is responsible for the disability.

However, those who get this chance are very few and it is only those whose disabilities are so severe to be noticed by the parent or teacher, that get this attention. Anomalies of the optical state of the eye, refractive errors in children usually go on undetected; such young children do not know that it is an abnormality which can be corrected. The symptoms of these refractive errors are usually nonspecific, the commonest being defective vision, for which a child beginning school may not be aware that is abnormal.

Very few schools in this country ensure that children are screened for visual disorders before joining school. The problem is further compounded by the very few eye health workers available and their unequal distribution. The presence of significant refractive errors and other anomalies of vision will impair the visual and learning capabilities of such children. In the global initiative for the elimination of avoidable blindness, refractive errors have been emphasized as a cause of visual impairment together with other ocular disorders like cataracts, trachoma, and onchocerciasis. The Refractive Error Study in Children (RESC) has been formed under this initiative to try and assess the
prevalence of refractive errors in children. No study to assess this problem has ever been done before in Uganda, and elsewhere in Africa published literature is scanty. It is because of this that this study has been designed to try and assess the magnitude of this problem.

3.0 GENERAL BACKGROUND

3.1 Definition of a refractive error:
In the normal situation when there is no refractive error, rays of light are focused on the retina forming a clear image. This condition is called emmetropia.
A refractive error ( ametropia) is a condition in which parallel rays of light are not focused on the retina when accommodation is relaxed.

3.2 Aetiology of refractive errors:
Refractive errors occur mainly as a result of an anomalous development of the dioptic system of the eye either from an abnormal axial length of the eyeball or refractive power of the cornea and lens or both factors contributing in varying amounts.
For example if the axial length is abnormally long this will cause myopia while if it is relatively short, will be associated with hypermetropia. Meanwhile abnormalities of the refractive surfaces of the eye in form of curvature of the cornea or lens will lead to curvature hypermetropia if it is small and curvature myopia if it is large.

2
3.3 **CLASSIFICATION:**

There are 3 types of refractive errors of relevance to this study and these are:

- Myopia
- Hypermetropia
- Astigmatism

Other refractive errors like:
- Aphakia will be defined and described under hypermetropia.
- Presbyopia is found in adults especially those who are 40 years and above. It is not a problem in children.

a) **Myopia:**

In this type of refractive error, parallel rays of light after refraction through the dioptic system of the eye, come to a focus in front of the retina. The image formed on the retina is made of circles of diffusion formed by diverging light. This means that distant objects cannot be seen clearly, they are blurred. Myopia may be caused by:

- Increase in the refractive power of the eye as in:
  - Increase in the curvature of the cornea.
  - Increase in the curvature of the lens or its refractive index.
- There may be a relatively long anteroposterior diameter of the eyeball especially in people whose refractive errors exceed - 4.00D\(^3\). Here it is the axial length as a component which is greater than the upper limit of normal\(^3,4,5,17\).
- In high myopia (exceeding -5.00D) there may be pathological changes such as keratoconus and lenticus. In progressive myopia, changes in the posterior pole of the eye like scleral elongation and thinning may lead to posterior staphyloma, myopic crescent, retinal degeneration, atrophy and tears. Retinal detachment may occur as a result.

Symptoms of myopia:
Children with myopia have poor vision for distance. They may not be able to read what is written on the blackboard at a distance which other normal children are able to read and as such need to sit at the front of the classroom. They may become less attentive and begin playing with others or simply preoccupy themselves with things around them. They tend to avoid outdoor games and are declared self-conceited.

b) Hypermetropia:
In hypermetropia, parallel rays of light (from a distant object) come to a focus behind the retina when the eye is at rest. The rays are intercepted earlier by the retina before they come to a focus leading to formation of a blurred image.
Hypermetropia occurs at one stage in normal human development and is almost always present in infants.
Hypermetropia may be simple with most cases being less than +3.00 dioptres and in this situation, there are no pathological changes in the fundus, while in the high type (above +6.00D up to as
high as + 20.00D), there may associated fundus changes such as:

- Retinal appearance described as the shot-silk retina³.
- Optic disc appearance simulating a papillitis (pseudopapillitis).

Causes of hypermetropia:
Apart from being part of the normal growing process of the optical system, hypermetropia may be due to:

- Eyeballs having short axial lengths in naturally small eyes
- Pathological shortening of the anteroposterior diameter of the eyeball as in orbital tumors or intraocular neoplasms and in retinal detachments.
- Reduction of the refractive power of the elements of the dioptic system of the eye as in flattening of the cornea for example in cornea plana, decrease in power of the lens as in old age; dislocation of the lens or loss of the lens from the visual axis as in lens dislocation, or surgical removal leading to aphakia. In aphakia the eye is highly hypermetropic.

Symptoms of Hypermetropia:
Presentation in children may be subtle and will depend on the degree of hypermetropia and also on the age of the child. These may be in form of tearing, photophobia, eye pains, visual blurring and .headache. The headache occurs
on reading for a while and is relieved by rest. These are grouped together as asthenopic symptoms. The constant use of the muscles of accommodation in an endeavor to focus on near print for clear vision may lead to spasms of accommodation from contraction of the ciliary muscles. This will lead to pseudomyopia (artificial myopia). Children may develop a convergent squint, which may be manifest (esotropia) or latent (esophoria).

c) Astigmatism:
In astigmatism, there is no single point focus of an image formed on the retina because incident light rays are refracted unequally in different meridians of the eyes' dioptric system.

Aetiology: The unequal meridians can arise from any of the ocular refracting elements; however, 90% of the astigmatism occurs at the air corneal interface. The remaining astigmatism occur at the lenticular and the retinal surface.

Abnormalities of the corneal interface may arise from abnormal curvature of the cornea as in cornical cornea (keratoconous), lid tumours pressing on the cornea, following corneal lesions such as keratitis. Iatrogenic causes may arise from corneal surgery as in cataract extraction (poor suturing technique) whereby over tightening of the sutures will lead to the 'with the rule astigmatism' while loosening of the sutures will lead to 'against the rule astigmatism'. Lenticular abnormalities may result from obliqueness due to lens subluxation either congenitally or following trauma.
Uneven surface of the retina as in retrobulbar tumors pressing on the sclera, subretinal tumors, and subretinal effusions with elevation of the retina will all contribute to astigmatism up to a small extent though these are rare in children.

**Types of astigmatism**

Astigmatism is of 2 types:

i) Regular astigmatism: In this type of astigmatism, the rays of light can be resolved into 2 principle meridians and as such, easily amenable to correction using cylindrical lenses.

Under regular astigmatism, there are subtypes and these are classified as follows:

- Simple astigmatism in which one meridian is focused on the retina and the other is either in front or behind the retina—respectively called simple myopic and simple hypermetropic astigmatism.

- Compound astigmatism, where both foci are focused either in front or behind the retina; respectively called compound myopic or compound hypermetropic astigmatism.

- Mixed astigmatism, here one axis is myopic and the other is hypermetropic.

ii) Irregular astigmatism: Here, rays of light are refracted differently in several meridians forming several foci and as such cannot be resolved into 2 simple principle meridians.
Symptoms of Astigmatism:

Depending on the severity of the refractive error, the following complaints may occur.

- Symptoms of asthenopia such as eye strain and fatigue, blurring of vision, headache, and itching of the eyes.
- Distortion of letters and objects whereby circles appear as ovals and with such symptoms, children may be found to have bad handwriting.

3.4 VISION ACUITY TESTING

It is a measure taken to assess the dioptic system of the eye and the normal functioning of the visual pathway. Any abnormality of these will affect the level of visual acuity. For the refractive state of the eye, which is the main aim of this study, various methods are used to assess the level of visual acuity in children depending on the age.

In testing for distance vision, various methods are used depending on the age of the child. However from the age of 4 to 5 years and in school going children, tests based on Snellen's graded sizes are used eg.,

- Sheridan-Gardiner test
- Pictorial charts
- The illiterate E test chart
- Landolts broken ring test.

Children of school going age who know how to read the alphabet are tested with the standard Snellen's chart which uses letters as test types.

For near visual acuities, the reduced Snellen's test types or the Landolt's broken ring test is used with the card
held at 35cm (14 inches) away from the subject and the level of acuity noted.

It will be noted that children with a wide amplitude of accommodation may be able to read the Snellen's chart up to good levels and yet have symptoms of asthenopia on prolonged reading. Astigmatism will also lead to a reduction of visual acuity and the extent will depend on the clinical type of astigmatism as discussed before. There will be distortion of letters and objects in the patient's field of view.

In low visual acuities encountered in children and which do not improve with a pinhole, there may be need to exclude the presence of amblyopia. Refractive errors may be associated with a squint, which may be latent or manifest. So a test to exclude this is necessary when assessing children for refractive errors.

3.5 REFRACTION:

Refraction is the determination of refractive errors of the eye and their correction by lenses.

There Are Two Methods Of Refraction:

a) The objective method in which the examiner does not depend on the individual's response as to whether the technique improves his or her vision or not during the time one is assessing the refractive state of the eye. The objective method of refraction is by retinoscopy using an instrument called a retinoscope. This method
is very important and it is the most feasible way of assessing refractive errors in children.

b) The second method is by **subjective refraction**. This method requires the co-operation and responses from the subject being tested. The refractive state is determined by a method of trial by insertion of lenses of different powers into the trial frame worn by the individual, until a level is reached when one gets the best correction.

c) **The Use Of Cycloplegics In Refraction**

Most errors of refraction are compensated for by the constant use of the muscles of accommodation. This means that a patient may have a normal visual acuity and near reading vision at the expense of constant overtone of the muscles of accommodation such that the true error is not revealed.

Therefore, the use of cycloplegic drugs is necessary to paralyze the muscles of accommodation in order to reveal all the refractive error at objective refraction this is more so in hypermetropia\(^3,5,9,13\).

Almost two thirds to three quarters of the total hypermetropia may be masked. This emphasizes the importance of cycloplegic drugs in the objective refraction of children. These cycloplegics act through their anticholinergic activity on the ciliary muscles to cause paralysis (cycloplegia), and also on the sphincter pupillae muscles of the iris to cause dilation of the pupil (mydriasis) \(^19,20\).

Examples of Cycloplegic drugs include:
- Atropine sulfate (available as 1% drops or ointment)
- Homatropine (hyosine) 2% to 5% drops
- Cyclopentolate (cyclogyl) 0.5%, 1.0%, 2.0% drops
- Bistropamide (mydriacyl) 0.5% or 0.1% drops

Atropine is mainly used for cycloplegic refraction in infants and children up to the age of 5 years. It has the strongest cycloplegia and requires 2-3 days application for full paralysis of the ciliary muscles.

From about 6 years and above (i.e. in school going children) cyclopentolate is used and induces adequate cycloplegia and rapid mydriasis within 20-30 minutes. Its application is by instillation of a drop in the conjunctival sac of each eye and repeated after 5-10 minutes for 2-3 times.

Side effects of Cycloplegics:
- For Atropine, central nervous side effects are restlessness and excited behaviour. Others include dry mouth, inhibition of sweating leading to increase in temperature
  - 'Atropenic fever' flushing of the face and tachycardia.
- For cyclopentolate, neurotoxic side effects such as visual hallucinations, slurred speech and incoherence and ataxia. All these lead to abnormal behaviour in the child. Others include dry mouth and abdominal cramps.

3.6 Screening Of Children For Visual Abnormalities

Some form of routine vision screening is necessary to identify those children who should be referred for a full ophthalmic examination.
Useful tests for screening programmes in children include visual acuity tests: where an appropriate type of chart is used and placed at a standard distance from the child (usually 6 metres). Here, almost all myopes and those with medium to high astigmatism and those with amblyopia will be detected. Hypermetropia may also be detected though a young person with significant hypermetropia may well be able to read the 6/6 line or better with ease because the test is of short duration. However, near vision tests in hypermetropia will be poor.

The question which usually arises is: What level of visual acuity does one use to identify children who need further examination and refraction?

This always creates controversy. For example if a visual acuity of less than 6/6 in either eye is taken as cut off, almost all children with visual impairment will be identified but many of them may not have significant refractive errors to warrant spectacle correction. If less than 6/12 in either eye is used, some children who need spectacle correction may be missed. Studies done by eye health workers in India used a visual acuity of 6/9 as cut off for defining children who needed further ophthalmic examination for refractive error\(^1\). Robinson and Martin in the U.S.A. used a visual acuity of 6/9 in their study on the validity of vision screening programmes in school children\(^{15}\).

In this study a visual acuity of equal or less than 6/9 will be used as cut off point for children to undergo refraction.\(^1,15\)
4.0 Statement of the problem

Most studies done on the prevalence of refractive errors have been carried out on older children of the age of 12 to 18 years, usually in secondary schools and mainly targeting myopia. Therefore children who may have early onset of refractive errors will not be identified and will have many years of poor vision. There is no information available about the magnitude of refractive errors in school children in Uganda.

4.1 Justification for the study:

Since there is no pre-primary school vision screening programme in this country, there is need to establish whether there's a significant level of refractive errors in this category of children. This study is to provide information on the prevalence of refractive errors in children of lower primary schools using Kampala district as the area of study.
5.0 Aims and Objectives of the Study

Aim

- To document the magnitude of refractive errors among children in lower primary schools in Kampala district.

Objectives

- To determine the prevalence of refractive errors among school children in lower primary in Kampala district.

- To determine the frequency of the different types of refractive errors in this group.

- To determine their distribution by sex and ethnicity.
6.0 LITERATURE REVIEW

Kalikivayi V et al in India carried out a study to determine the prevalence of visual impairment due to refractive errors and other ocular diseases in the lower class school children of one of the urban areas of Hyderabad. A total of 3,669 children had an examination done including refraction. It was found that the prevalence of hypermetropia was 22.6, myopia was 8.6 and astigmatism 10.3. Other causes of visual impairment included amblyopia (1.1), squints (0.7), corneal diseases (0.1) and cataract (0.05).

Chen P, Changa RS et al in their retrospective study analysed data from a vision screening programme from a mobile eye clinic, collected over a period of 5 years (1985 - 1990) among the 6 to 7 year olds. A total of 1,469 children was analysed, 48.1% females and 51.9% males. The overall prevalence of refractive errors was 18.5 and other ocular disease was 4.

Proslan N and Novak A of the Baltimore vision screening project, U.S.A. in a study done on the prevalence of common visual disorders (refractive error, strabismus and amblyopia) in a group of inner city school children, a method of screening using the Snellen’s chart was used. Each child who failed a vision screen was examined by an ophthalmologist at school. A total of 680 children were screened in one year. Of these 76 (11%) failed the vision screen and were examined. From their results, those with refractive error were 8.2%, amblyopia 3.9% and strabismus 3.1%. From their
conclusion, the 3 conditions appeared in relatively high frequency in that population of city children and that a comprehensive vision screening programme and follow-up was necessary.

Eugene, Janet, et al in their study on visual function and academic performance evaluated 1,910 primary school children in the city of Indianapolis, U.S.A.\textsuperscript{14}. The evaluation was to determine whether or not there was any relationship between ocular malfunction and academic performance. The visual functions tested included visual acuity for distance and near reading, muscle balance, near point of accommodations and convergence and Worth's 4 dot test for fusion abnormalities. Refraction was also done to identify any ametropia. Academic evaluation was done using the previous termly progressive tests for comparison. Others were teacher's assessment of reading level, writing and drawing tasks. In their findings, the most frequent refractive error was hypermetropia and that visual function and academic performance were not related.

Robinson and Martin in their study on the validity of preschool vision screening programme examined about 1100 children per year for a period of 3 years\textsuperscript{15}. It was found that an annual prevalence of vision problems ranged between 10.5\% and 13.8\%. A visual acuity of $\leq 6/9$ in either or both eyes was used in this study to determine those for referral to an ophthalmologist. The results indicated that a high percentage of children with visual abnormalities were identified for the first time.
Kasmann-Kellner, Haine and others offered a vision screening service to 1030 families. Nine hundred and forty eight children aged between 3 and 6 years were screened for strabismus, ambylopia and refractive error after obtaining consent from their parents. Results showed that the screening was readily accepted by the parents (92%) and the compliance of the children was good.

Of those who were examined, 38.7% of the children had one or more abnormalities, 21.4% had a reduced visual acuity (i.e. ≤ 6/9) and 3.7% had strabismus.

Dennis S.C did a vision screen on 8203 children (623 were pre-school and 7980 primary school) using visual acuity of 6/12, cover test, ocular movement assessment and cycloplegic refraction. Among the pre-school children, 17% had significant visual abnormalities, 6.32% had astigmatism, 5.82% had hypermetropia, 2.33% had myopia and 5.16% had anisometropia of 1.00D or more, 1.77% of the children had a squint.
7.0 METHODOLOGY

7.1 Study Area and Population
This study was done in Kampala district. Kampala is the capital city of Uganda. It is composed of 5 administrative divisions of Nakawa, Makindye, Rubaga, Kawempe and Central. The population of Kampala is heterogeneous in ethnicity from which children recruited into the study originated. The study was carried out on children in lower primary, and primary 2 pupils were used in the study. These knew the letters of the alphabet well and offered a fairly good cooperation throughout the period of the examination.

7.2 Study Setting and Design
The study was a descriptive cross-sectional study. Children had an ocular examination using the same protocol (see procedure page 22). Those who failed the set standard for normal vision were refracted and had a fundus examination done to identify any refractive error or any other visual disorder.

7.3 Sampling and Sample Size Calculation

Sample Size Calculation
Sample size was calculated using Kish and Leslie's formula using the expected prevalence of refractive errors of 18.5%\(^\text{23}\) and allowing for error of 5% at 95% confidence interval, and since cluster form of sampling was to be used in all the five divisions, then:
\[ N = \left( \frac{Z^2pq}{d^2} \right) \times \text{Deff} \]

where \( N \) = is the sample size
\( Z = 1.96 \) (the standard normal value corresponding to 95\% C.I)
\( P = 18.5\% \) the expected prevalence of Refractive error in the 6-9 year age group
\( q = 100-p = 81.5\% \)
\( d = 5\% \) (precision of the estimate)
\( \text{Deff} = \) design effect for cluster sampling which is \((= 2.8)\)

then \( N = \left( \frac{1.96^2 \times 18.5 \times 81.5}{5^2} \right) \times \text{Deff} \)
\( = 232 \times 2.8 = 649 \)

therefore \( N = 649 \) children was the minimum sample size. However to allow for non response the sample size was to be 700 children.

SAMPLING:
A census list for all the primary schools in Kampala district for the year 2000 enrollment was obtained from the city education office. The census list had all the schools in each of the 5 divisions of the city (see appendix iv).
For purposes of this study a multistage type of sampling was adopted.

Each division formed a cluster from which the number of children to be recruited into the study were determined by the PPS (probability proportional to size) method using the
figures of enrollment of primary two children in each of the 5 divisions. This was the first stage of the multi-stage sampling.

The second stage was the selection of schools from each division to be visited during the study. Here, an average of 2 schools was chosen per division by simple random sampling. This was done by writing down the numbers of the respective schools on small pieces of paper which were then folded and put in a closed box. The box was then shaken to ensure uniform mixing. Then a piece of paper was picked at random. The first two numbers to be picked corresponded to the schools visited.

The third stage was the recruitment of primary two children aged between 6 to 9 years. A class register was used and a systematic type of random sampling was used (for example, the index child in each P.2 class was chosen from the class list by picking at random the first piece of folded paper from a box with a corresponding number from the register. Thereafter every 3rd child after the index child till the required number was reached). Informed consent was obtained from the parents of all the children (see appendix III page 49).
The table below shows the various schools per division that were visited and the proportionate number of children that were recruited into the study.

<table>
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<tr>
<th>Division</th>
<th>No. of children recruited</th>
<th>Schools visited</th>
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<tr>
<td>Central</td>
<td>167</td>
<td>KCC Kamwokya</td>
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<tr>
<td></td>
<td></td>
<td>Nakivubo</td>
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<tr>
<td>Kawempe</td>
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<td>Kawempe</td>
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</table>

7.5 Inclusion/exclusion criteria

- **Inclusion Criteria**
  - Primary 2 children between the age of 6-9 years
  - Those children whose parents had consented to the examination.

- **Exclusion Criteria**
  - Children who were not willing to undergo the examination.
  - Children who were found sick and were on drugs some drugs have ocular effects.
7.6 Procedure

Details of each child were recorded in a data collection form and each child had an ophthalmic examination done using the same method as follows:

Each child had cyclopentolate applied.

- External eye examination in diffuse light for any lid abnormalities like swellings or ptosis, any obvious squints and corneal opacities.
- Visual acuity tests were done both for distance and for near vision.
- Pupillary reflexes were examined with a penlight.
- The cover test was done to detect any manifest strabismus (tropia) and the alternate cover and uncover test for any latent strabismus (phoria) which could suggest a refractive error or amblyopia.

For distance vision, a standard Snellen’s chart was used, placed at a distance of 6 meters from the child. Those children who had a visual acuity of equal or less than 6/9 in either eye or a phoria/tropia in either or both eyes had cyclopentolate eye drops instilled in the conjunctival sac of both eyes.

Near vision was recorded using a reduced Snellen’s chart or the Landolts’ broken ring test. The chart for near vision was placed at a distance of 35cm (14 inches) from the child.

The cycloplegic drug used was 1% cyclopentolate. Retinoscopy was done followed by fundoscopy to rule out any abnormalities of the media and the fundus. This was done by direct ophthalmoscopy.
Findings from the above examination were recorded in a data collection form designed and coded as shown in Appendix I.

7.7 Study Tools

- A suitable premise at each school where the examination was to be carried out was availed and a temporary dark room was made.
- Visual acuity charts
  - Snellen’s chart for distance
  - Reduced Snellen’s chart or
  - Landolt’s broken ring test chart for near vision
- Ordinary torch with cells for diffuse illumination
- Pen light for focal illumination
- Retinoscope
- Trial lenses and frame with eye cover/occluder
- Ruler and measuring tape
- Ocular drugs- cyclopentolate 1% solution
- Clean cotton swabs
- Stationery
- Transport

Research Assistants

An ophthalmic clinical officer, a nurse and the class teacher participated in the screening exercise in schools. The role of the nurse was to help in organising children in the examination room together with the class teacher, guiding them in the reading of the VA charts. Application of cycloplegia was done by the nurse.
The ophthalmic clinical officer assisted in the taking of visual acuities.

7.8 Data Management and Analysis
The findings from the study were entered in a coded data collection form and results of analysis were presented in form of Tables, Pie charts and frequency Charts. A statistical package EPI-INFO was used to analyse the data with the help of a statistician.

7.9 Ethical Considerations
Permission was obtained from the Faculty of Medicine Research Committee to carry out the study.
Informed consent was obtained from the parents allowing the principle investigator do a medical examination on their children.
RESULTS

Table 1: Shows the number of children examined in each of the 10 schools during the study period

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>No. of children examined for refractive errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Makerere P/S</td>
<td>56</td>
</tr>
<tr>
<td>Kawempe Mbogo</td>
<td>58</td>
</tr>
<tr>
<td>Kyambogo P/S</td>
<td>47</td>
</tr>
<tr>
<td>Murchison Bay</td>
<td>62</td>
</tr>
<tr>
<td>Police P/S</td>
<td>81</td>
</tr>
<tr>
<td>Bbunga</td>
<td>58</td>
</tr>
<tr>
<td>Kitebi P/S</td>
<td>93</td>
</tr>
<tr>
<td>Namungoona</td>
<td>48</td>
</tr>
<tr>
<td>Nakivubo</td>
<td>73</td>
</tr>
<tr>
<td>KCC Kamwokya</td>
<td>49</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>623</strong></td>
</tr>
</tbody>
</table>

Out of the expected 700 children whom consent forms had been sent to their parents, 623 were examined which gave a response of 89.0%.
There were 301 males (48.3%) and 322 females (51.7%) with a male/female ratio of 1:1.1
Table 2: The ethnic distribution among the 623 children

<table>
<thead>
<tr>
<th>Tribe</th>
<th>Absolute no.</th>
<th>Relative freq. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acholi</td>
<td>20</td>
<td>3.2</td>
</tr>
<tr>
<td>2. Alur</td>
<td>12</td>
<td>1.9</td>
</tr>
<tr>
<td>3. Achola</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>4. Baganda</td>
<td>360</td>
<td>57.8</td>
</tr>
<tr>
<td>5. Bagwere</td>
<td>8</td>
<td>1.3</td>
</tr>
<tr>
<td>6. Bakiga</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>7. Banyankole</td>
<td>30</td>
<td>4.8</td>
</tr>
<tr>
<td>8. Banyarwanda</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>9. Banyoro</td>
<td>11</td>
<td>1.8</td>
</tr>
<tr>
<td>10. Basoga</td>
<td>30</td>
<td>4.8</td>
</tr>
<tr>
<td>11. Batoro</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>12. Langi</td>
<td>22</td>
<td>3.4</td>
</tr>
<tr>
<td>13. Lugbara</td>
<td>15</td>
<td>2.4</td>
</tr>
<tr>
<td>14. Madi</td>
<td>4</td>
<td>0.2</td>
</tr>
<tr>
<td>15. Bagisu</td>
<td>10</td>
<td>1.6</td>
</tr>
<tr>
<td>16. Itesot</td>
<td>44</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>623</td>
<td>100.0</td>
</tr>
</tbody>
</table>

A total of 16 ethnic groups were encountered during the study.

Table 3: Table of visual acuities

Table 3(a)

**Distance visual acuity**

(Right eye) | (Left eye)

<table>
<thead>
<tr>
<th>VA</th>
<th>No.</th>
<th>Frequency (%)</th>
<th>No.</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/6</td>
<td>15</td>
<td>20.0</td>
<td>8</td>
<td>10.7</td>
</tr>
<tr>
<td>6/9</td>
<td>49</td>
<td>65.3</td>
<td>53</td>
<td>70.7</td>
</tr>
<tr>
<td>6/12</td>
<td>10</td>
<td>10.7</td>
<td>11</td>
<td>14.7</td>
</tr>
<tr>
<td>6/18</td>
<td>2</td>
<td>2.7</td>
<td>2</td>
<td>2.7</td>
</tr>
<tr>
<td>6/24</td>
<td>1</td>
<td>1.3</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>(75)</strong></td>
<td><strong>100</strong></td>
<td><strong>(75)</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
The majority of the eyes had a visual acuity of 6/9 (68%) while 16% had visual acuities of 6/12 or worse.

**Near vision acuities**

Table 3(b)

<table>
<thead>
<tr>
<th>Visual acuity*</th>
<th>No.</th>
<th>Frequency (%)</th>
<th>No.</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>60</td>
<td>80.0</td>
<td>62</td>
<td>82.7</td>
</tr>
<tr>
<td>0.75</td>
<td>12</td>
<td>16.0</td>
<td>12</td>
<td>16.0</td>
</tr>
<tr>
<td>0.50</td>
<td>3</td>
<td>4.0</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>(75)</td>
<td></td>
<td>(75)</td>
<td></td>
</tr>
</tbody>
</table>

* Near visual acuity was taken by using the reduced Landolt's broken ring test (See appendix IV page 50).

For near vision the majority of the eyes had a normal visual acuity of 1.00 (81%) while the remaining 19% had 0.75 or worse.

Of the 623 children who participated in the study, none of them had ever had an ocular examination and as such even those with refractive errors were not putting on spectacles.

Seventy five children out of 623 qualified for a detailed examination and refraction under a cycloplegia, according to the set criteria of visual acuity of equal or less than 6/9 or a tropia/phoria in either or both eyes.

One female child had a phthisical eyeball with a corneal opacity following a childhood illness. Of the 75 children who had a detailed ocular examination 5 had a squint in one
or both eyes and 70 had a visual acuity of equal to or less than 6/9 in one or both eyes.
Fig. II: Histogram showing the proportion of children identified by each criteria (i.e. visual acuity of ≤ 6/9 and a squint in either eye)

Table 4: Age distribution of the 75 children who had refraction and fundoscopy

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>Relative freq. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
<td>8.0</td>
</tr>
<tr>
<td>7</td>
<td>17</td>
<td>22.7</td>
</tr>
<tr>
<td>8</td>
<td>28</td>
<td>37.3</td>
</tr>
<tr>
<td>9</td>
<td>24</td>
<td>32.0</td>
</tr>
<tr>
<td>Total</td>
<td>75</td>
<td>100</td>
</tr>
</tbody>
</table>

Thirty two were males and 43 were females representing 42.7% and 57.3% respectively.
Fig III: Histogram showing Sex distribution of those with refractive errors
FUNDOSCOPY AND REFRACTION

Of the 75 children who had a detailed ocular examination including refraction and fundoscopy; 73 had a refractive error at retinoscopy and 2 had none. The 75 children with refractive error gave a prevalence of 11.6% among the 6-9 year old children in Kampala district.

The remaining 2 children had fundus abnormalities.

Fig. IV: Frequency of the various types of refractive Errors

The commonest refractive error in this study group was Astigmatism with 38 children (52.0%) followed by Hypermetropia with 27 children (37.0%) and the least was Myopia with 8 children (11.0%).
Table 5: Showing various types of astigmatism present
Among the 38 children

<table>
<thead>
<tr>
<th>Type</th>
<th>No.</th>
<th>Frequency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypermetropic</td>
<td>16</td>
<td>42.1</td>
</tr>
<tr>
<td>Mixed</td>
<td>12</td>
<td>31.6</td>
</tr>
<tr>
<td>Myopic</td>
<td>10</td>
<td>26.3</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 6: Distribution of the Dioptric equivalents for the spherical errors

<table>
<thead>
<tr>
<th>Refractive error in dioplers</th>
<th>hypermetropia</th>
<th>myopia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>0.25</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>0.50</td>
<td>7</td>
<td>26</td>
</tr>
<tr>
<td>0.75-1.00</td>
<td>9</td>
<td>33.3</td>
</tr>
<tr>
<td>1.25-1.50</td>
<td>1</td>
<td>3.7</td>
</tr>
</tbody>
</table>

For Astigmatic errors, the highest spherical component was 3.25 D while the cylindrical component was 4.25 D at Retinoscopy.
Table 7: Table below shows the frequency of Refractive Errors by ethnic group among the 73 children examined during the study

<table>
<thead>
<tr>
<th>Tribe</th>
<th>Freq. of refractive Error %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acholi</td>
<td>2.7</td>
</tr>
<tr>
<td>2. Alur</td>
<td>2.7</td>
</tr>
<tr>
<td>3. Adhola</td>
<td>1.3</td>
</tr>
<tr>
<td>4. Baganda</td>
<td>58.0</td>
</tr>
<tr>
<td>5. Bagwere</td>
<td>1.3</td>
</tr>
<tr>
<td>6. Bakiga</td>
<td>5.3</td>
</tr>
<tr>
<td>7. Banyankole</td>
<td>2.7</td>
</tr>
<tr>
<td>8. Banyarwanda</td>
<td>2.7</td>
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<tr>
<td>9. Banyoro</td>
<td>2.7</td>
</tr>
<tr>
<td>10. Basoga</td>
<td>4.0</td>
</tr>
<tr>
<td>11. Batoro</td>
<td>2.7</td>
</tr>
<tr>
<td>12. Langi</td>
<td>1.3</td>
</tr>
<tr>
<td>13. Lugbara</td>
<td>6.7</td>
</tr>
<tr>
<td>14. Madi</td>
<td>1.3</td>
</tr>
<tr>
<td>15. Itesot</td>
<td>0.0</td>
</tr>
<tr>
<td>16. Bagisu</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
DISCUSSION OF RESULTS
AND
RECOMMENDATIONS
DISCUSSION

Although there is some information available on the prevalence of refractive errors in relationship to geographical area, age, sex and racial differences, it remains difficult to compare the reported prevalences and the distribution of the main types of refractive errors as regards age, sex and ethnicity.

In this study 623 children were examined out of the expected 700. This represented a response of 89.0% from the parents of these children.

- There were 301 males and 322 females representing 48.3% and 51.7% respectively, with a M:F ratio of approximately 1:1.

During the screening exercise, 75 out of 623 children qualified for cycloplegic refraction and fundoscopy according to the set criteria of:

- a visual acuity of equal or less than 6/9
- and a tropia/phoria in either or both eyes.

This criteria had been used by other workers like Robinson and Martin\(^5\) and Kasmann K et al\(^{12}\).

Of the 75 children examined, 70 had a visual acuity of ≤ 6/9 and 5 had a squint representing 93.3% and 6.7% of the visual abnormalities(respectively)requiring a detailed eye examination. From results of Table 3 of visual acuities, the majority of the eyes had a distance visual acuity of
6/9 accounting for 68% on average and those with a visual acuity of 6/12 or worse were 16%. For near visual acuity, the majority had a visual acuity of 1.00 (81%) while only 16% (12 eyes) had a visual acuity of 0.75 and only 1.3% (one eye) had a visual acuity of 0.50 (see table 3).

- The median age of these children was eight years. On retinoscopy and fundoscopy, 73 children were found to have refractive errors while 2 were emmetropic. The 73 children gave a prevalence rate of 11.6% among school children aged between 6-9 years in Kampala district. The 11.6% prevalence rate in this study is lower than that of Chen P. et al\textsuperscript{25} done on the 6 to 7 year olds (of 18.5%). This could be due to racial differences in these two groups. However, this is comparable to other studies done by Prosland et al in the Baltimore vision screening project\textsuperscript{26} where the prevalence of refractive errors was 8.2%. Male to female ratio for those with refractive error was 1:1.3 showing no significant sex preponderance in the distribution of refractive errors in this group.

- Among the refractive errors, astigmatism was the most frequent accounting for 52.0% of the refractive errors followed by hypermetropia (37.0%) and myopia (11.0%) (see fig. 3 in results). This distribution is similar to results obtained by Dennis S.C among the pre-school children where astigmatism was the commonest (6.32%), hypermetropia, (5.8%) and myopia(2.33%)\textsuperscript{24}. However, this contrasts with results from studies done by other workers like Kalikivayi V et al\textsuperscript{22} among Indian children.
where hypermetropia was the commonest refractive error with 22.6%, followed by astigmatism with 10.3% and myopia 8.6% and also from studies done by Kazuhiro where myopia was commonest among Japanese children with 58% followed by astigmatism and hypermetropia with 26% and 13% respectively.

- These contrasts can be attributed to differences in age groups and racial variations of the children involved in the various studies on refractive errors. For example, myopia is the commonest refractive error among the Japanese, whereas among blacks such as those in the Sudan and West Africa, hypermetropia predominates.

- The commonest type of refractive error among those with astigmatism was the hypermetropic type accounting for 42.1% followed by the mixed and myopic type of astigmatism (31.6 and 26.3%) respectively, see Table 4.

For the spherical type of refractive errors, the spreads of the dioptre equivalents were: For hypermetropia 63% had values between +0.25 to +0.50 D and 33.3% between +0.75 to +1.00 D. While for myopia the majority were -0.25D (54.6%), then 0.50D (9.0%) and -0.75 to -1.00 (36.4%), see table 6. Meanwhile for astigmatic errors, the highest spherical component was 3.25D while the cylindrical component was - 4.25D after retinoscopy. The above information gives an idea of how many children may need correction and/or follow up since some refractive errors like myopia may progress while hypermetropia may shift to emmetropia as the child grows.
There were 16 ethnic groups (tribes) encountered among the children during the study and results from figure 4 shows that there was no significant ethnic differences in the prevalence of refractive errors. These results may not give a definitive picture of the ethnic differences in the frequency of refractive errors because the study was done in a limited geographical area and dealt with small number of children from each tribe. A national survey involving sampling from each ethnic group in their own localities would provide better figures.

CONCLUSION

This study attempts to fill the information gap on data concerning the magnitude of refractive errors among school children in this country using Kampala district as the area of study.

The prevalence of refractive errors in the 6-9 year old school children who participated in this study was 11.6% with the commonest type of refractive error being astigmatism (52.0%) followed by hypermetropia (37.0%) and myopia (11.0%). Further analysis of the astigmatic component showed that the hypermetropic subtype was the commonest with 42.1%. There was no demonstrable sex or ethnic inclination to any of the types of refractive errors in this study.
RECOMMENDATIONS

The following are the recommendations from this study:

1. A national population based survey would be appropriate to ascertain the magnitude of refractive errors among children so that a proper Vision screening programme is incorporated into the school health activities.

2. Considering the high costs of conducting national surveys, a provisional measure should be for the school children to have routine vision testing done at the commencement of Primary school by use of simple means such as a Snellen's chart to identify those who could be having refractive errors.

The testing could be done by Eye care health providers or by school teachers who have received some training from an Eye health worker and given simple vision testing kits for screening of those children who may need referral.
9.0 References


8. Basic and Clinical Science Course. Sec. 3 Optics and Refraction Pgs 135-146.


Appendix I: QUESTIONNAIRE

PERSONAL DETAILS OF CHILD

Name:..............................................................................................................................................

Age of Child: .....................................................................................................................................

Sex M=1, F=2: .....................................................................................................................................

Tribe: ................................................................................................................................................

School: ................................................................................................................................................

Parents/Guardian's name: ......................................................................................................................

Home Address: .................................................................................................................................

(where child is residing at the moment)

Does the child use a spectacle correction?

Yes = 1

No = 2

VISUAL ACUITY ASSESSMENT

Distance Visual Acuity

(Each eye is tested separately)

1. Is a VA of 6/6 or better in either eye?
   Yes = 1,
   No = 2

2. If Yes, record the reading in the respective boxes.

   R    L

   Use this coding for No. (3,4.)
   - 6/6 or better    - 1
   - 6/9              - 2
   - 6/12             - 3
   - 6/18             - 4
   - 6/24             - 5
   - 6/36             - 6
   - 6/60             - 7
   - less than (6/60) - 8

3. Distance Vision Unaided

4. Near Visual Acuity Unaided

   □□
## External Eye Examination

### Eyelids

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td><strong>Eyelids</strong></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Ptsis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes=1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No=2</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Swellings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes=1,</td>
<td></td>
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### Obvious Squint

<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>6.</td>
<td><strong>Obvious Squint</strong></td>
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<tr>
<td></td>
<td>Yes=1,</td>
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</tr>
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<td>No=2</td>
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</table>

### If Yes, is it:

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>L</th>
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</thead>
<tbody>
<tr>
<td>7.</td>
<td><strong>If Yes, is it:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Esq=1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exo=2</td>
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</tbody>
</table>

### Cover Tests

<table>
<thead>
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<th>L</th>
</tr>
</thead>
<tbody>
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<td>8.</td>
<td><strong>Any Troplas</strong></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>No=2</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td><strong>If Yes, is it:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Esq=1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exo=2</td>
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### If No, Any Phorias?

<table>
<thead>
<tr>
<th></th>
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<th>L</th>
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<tbody>
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<td>10.</td>
<td><strong>If No, Any phorias?</strong></td>
<td></td>
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<td></td>
<td>Yes=1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No=2</td>
<td></td>
</tr>
</tbody>
</table>

### Yes, is it:

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<tr>
<th></th>
<th>R</th>
<th>L</th>
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</thead>
<tbody>
<tr>
<td>11.</td>
<td><strong>Yes, is it:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Esq=1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exo=2</td>
<td></td>
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### Pupillary Reflexes

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*If No, comment: ..........................................................*
**REFRACTION**

Record of Retinoscopic findings

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Retinoscopic findings after subtracting effect of cycloplegia and working distance.

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If not normal give details...

Full diagnosis

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Any other ocular findings...

Recommendations...

EXAMINED BY: ...

SIGNATURE...

DATE:....
Appendix II

Definition of Terms

Refractive Error - Is an eye defect that prevents light rays from being brought to a single focus on the retina. No clear image is formed.

Amblyopia - Reduced visual acuity which can not be explained by any refractive error or defect in the eye or its visual pathway.

Ametropia - Is refractive error

Emmetropia - No refractive error (normal vision)

Asthenopia - Subjective sensation of eye fatigue or strain

Visual Acuity - Is a measure of acuteness of vision i.e. the finest detail an eye can distinguish.

Strabismus (squint) - Deviation of the eye(s). If it is manifest (obvious) it is a tropia. If it is latent (hidden) it is phoria. Inward deviation of the eye is eso. Outward deviation of the eye is exo.

Refraction - Is the determination of refractive errors of the eye and their correction by lenses.
Dioptre (D) - Is a unit of measurement of refractive power of the eye or the lenses.

Cover Test - A method used for describing the presence and amount of latent or manifest strabismus by covering one eye with an opaque card thus eliminating fusion and observing the direction and degree of movement of the other eye as it takes a new point of fixation.

P.P.S (Probability Proportion to Size) way of determining rationally the relative numbers of participants from clusters of different sizes:

e.g. for central division, No of children to be recruited

\[
\text{enrollment of P.2 children} \times \text{sample size N}
\]

Total enrollment of P.2 in all the 5 divisions

Lower primary: Includes primary one and two.
APPENDIX III

CONSENT FORM

CONSENT TO ALLOW MY CHILD TO PARTICIPATE IN THE STUDY

TOPIC: EXAMINING CHILDREN FOR VISUAL DISORDERS and emphasizing mainly those affecting reading in class.

The study will be carried out by Dr. Robert Mayeku a postgraduate student from Eye department Makerere University, Mulago Hospital. The examination that is going to be carried out on my child is a painless procedure. At one point during the examination, eye drops may be applied in both eyes if necessary to enable a detailed examination of the eye. I am informed that the drops used during the course of the examination give rise to mild discomfort and a tingling sensation as well as a few hours of disturbance of near vision. That these effects clear away within 6 to 12 hours. I am further informed that the child may experience behavioral changes like hallucinations, slurred speech and fits.

The examination will be carried out at my child's school and does not require me to be present. The doctor will supervise the exercise and the class teacher will be present.

The consent to allow my child to be examined is voluntary and there are no monetary benefits or otherwise resulting from this study.

The findings from the study on my child and any recommendations will be communicated to me in writing and in case I require further information I can contact Dr. Robert Mayeku using the address enclosed together with my child's examination results.

CONSENT: I……………………………………………………

Mother/father/legal guardian to……………………………………of…………………

(NAME OF CHILD) (NAME OF SCHOOL)

in primary 2 having read and understood the above information I hereby do agree that the above study be done on my child.

………………………………………………………………………………………..

(NAME OF PARENT/GUARDIAN) (SIGNATURE)

………………………………………………………………………………………..

(ADDRESS) NAME & ADDRESS OF WITNESS (TEACHER)

………………………………………………………………………………………..

(INVESTIGATOR'S SIGNATURE)
APPENDIX IV

COPY OF THE LANDOLT'S BROKEN RING TEST WHICH WAS USED FOR TESTING OF NEAR VISUAL ACUITIES.

THE SCALE OF THE VISUAL ACUITY LEVELS WAS IN DECIMAL UNITS.

THE CARD WAS HELD AT A READING DISTANCE OF 35 CM
APPENDIX V PHOTOGRAPHIC ILLUSTRATION

The following photographs were taken using a flash Camera in one of the 10 Schools visited during the Study (Police children's F/School Nsambya).

PHOTO 1
Principal Investigator writing down a child's particulars, while the Research Assistant is helping in taking of visual acuities. Note the temporary dark room in one corner.

PHOTO 2
Research Assistant taking Visual acuity from one of the children using a Snellens' chart.
PHOTO 3
A children being dilated with cyclopentolate before retinoscopy and fundoscopy.

PHOTO 4
Principle investigator doing retinoscopy on one of the children.
Figure 5

Principle investigator preparing to do fundoscopy using a direct ophthalmoscope.
### APPENDIX VI  Census list for primary schools in Kampala district.

#### UNIVERSAL PRIMARY EDUCATION CENSUS FOR 2000

#### CENTRAL

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