"OCULAR MORBIDITY IN NURSERY SCHOOL CHILDREN IN KILUNGU DIVISION, MAKUENI DISTRICT."

Dissertation in part fulfilment for the degree of Master of Medicine, Ophthalmology (M. Med Ophthalmology)

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DECLARATION

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

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APPROVAL

This dissertation is submitted with our approval as University supervisors.

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DEDICATION

To my loving husband, Brian and wonderful son, Caleb

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Above all, I am grateful to God who has kept me alive and healthy throughout the length of my studies.

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LIST OF ABBREVIATIONS

ACT	Alternate Cover Test
APD	Afferent Pupillary Defect
CT	Cover Test
DS	Dioptre Sphere
EOM	Extra Ocular Motility
KNH	Kenyatta National Hospital
NLDO	Nasolacrimal Duct Obstruction
NSPEC	National Strategic Plan for Eye Care
RAPD	Relative Afferent Pupillary Defect
WHO	World Health Organization

ABSTRACT

Title

Ocular morbidity in nursery school children in Kilungu Division, Makueni District

Objective

To establish the magnitude and pattern of ocular morbidity in rural-based nursery school children in Nunguni zone, Kilungu Division.

Methodology

This is a school-based cross-sectional study conducted in Nunguni zone, Kilungu division, Makueni District. Nine nursery schools were randomly selected and all the children present during the study were examined, giving a total of six hundred and two (602) children aged between 3 and 10 years of age. Visual acuity for each child was taken and presence of gross stereopsis determined. An orthoptic assessment was done followed by anterior and posterior segment examination. A torch, +20 dioptre loupe, direct and indirect ophthalmoscopes were used for this. Objective refraction was done on those children who either had visual acuity of < 0.6 (Lea chart), <6/9 (E chart) or had a difference in visual acuity of more than one line between the two eyes. A systemic evaluation completed the assessment for each child. All children with conditions requiring management were referred to the eye units at Machakos District hospital or KNH.

Results

Prevalence of ocular morbidity in nursery school children in Kilungu division of Makueni District was 26.5% (160/602), the commonest being allergic conjunctivitis (21.8 %). Other findings included refractive errors (3.0 %), ptosis (0.8%) and squints (0.3%).

Conclusion

The current burden and pattern of morbidity is not adequate to warrant pre-school ocular morbidity screening program.

1.0 INTRODUCTION

Provision of adequate health care to the paediatric age group is dependent on well-researched information on the epidemiology of the diseases prevalent in a particular region or country. Undetected ocular disorders that may lead to visual impairment and blindness in children cause a much longer duration of compromised quality of life. Moreover, some conditions like amblyopia can only be corrected within a particular period in childhood. Unfortunately, there is paucity of data concerning these disorders particularly in the developing countries. Efforts to address childhood blindness are seen in Vision 2020 (1), leaving out the other non-blinding causes of ocular morbidity. It is estimated that three quarters of childhood blindness is found in Africa and Asia (2). By inference, there are probably more children affected by other ocular disorders, whose magnitude remains elusive due to lack of adequate data. Planning for eye services for the paediatric age group is therefore hampered.

Preschool visual screening programs have been in existence in many developed countries (3). Their aim has been to identify children with visual loss, establish the cause and manage accordingly. However, most developing countries especially in Africa do not run such programs due to lack of resources or low priority accorded to ocular disorders, in view of other priorities like HIV and malaria. In addition, access to health care, which forms an integral part of such programs to ensure effective follow up, is still a major challenge in these countries (4).

The prevalence and causes of morbidity vary from one area to another as well as from one age-group to another. Regional/country specific data together with age-specific information is therefore critical in ensuring wholesome and adequate eye care services are accorded the relevant population.

2.0 LITERATURE REVIEW

The extent of ocular morbidity in pre-school school children in sub-Saharan Africa is largely unknown. What is known is derived from studies whose age range includes all school-going children or even whole populations. Inference may be made from the prevalence of blindness, estimated to be 0.3% and 1.5% per 1000 children in industrialized countries and sub-Saharan countries respectively (1), that there is a difference in the pattern of other categories of ocular morbidity as well. In addition, the varying socioeconomic status and level of health care among developing countries, as well as the burden of diseases like trachoma and vitamin A deficiency may influence the magnitude and pattern of ocular morbidity.

2.1 Prevalence

The presence of well-structured school and pre-school vision screening programs in developed countries can provide useful information on the burden of ocular diseases in children. In Sweden, routine screening for eye disease and visual dysfunction takes place at specified ages. It was therefore possible to look at eye records for 3,126 10-year-old children who had been examined from birth and in 11.8% of them pathological findings were picked up. Most of the ocular conditions were discovered before the age of 6 years and a peak of referrals for further examination occurred at 4 years (5) In Seoul, South Korea, after trying a new vision screening method on 36,973 urban children aged 3- to 5-years, ocular disorders leading to visual loss were found in 2.14% though their participation rate was noted to be low (6). Native Tibetan children aged between 6 and 14 years of age , living in a rural area of China underwent a screening process in which 199 out of 1084 (18.3 %) were found to have ocular morbidity. No routine eye check-up is done in this area and none of the children had ever had any ocular examination (7).

Over 40% of all the children aged 5-15 years studied by Chaturvedi et al in rural Delhi had one or more ocular problems, with a worse picture noted in the more underdeveloped areas (8). By contrast, in Kathmandu, a prevalence of 11% (121/1100) among schoolchildren aged 5-16 years in selected rural schools was detected (9). The difference

is probably due to the presence of trachoma in the former. Similarly, in a study to identify the causes of ocular morbidity in 826 children of a rural community in Ethiopia from birth to 15 years, the prevalence of ocular morbidity was found to be 55%, with trachoma present in 454 (33.7%) of them (10). In Kenya, no specific studies on ocular morbidity in children have been done. Nyaga et al looked at ocular morbidity in the general population from an informal settlement and in the age group of ages 5 to 10 years, 53 out of 86 children (61.6%) had an ocular disorder (11).Other studies among Kenyan children have targeted specific entities. A study done in urban-based nursery school children in Nairobi was looking specifically at strabismus (12) and others looked at refractive errors in older children in urban and rural setting. (13,14).

2.2 Causes of ocular morbidity

The most common causes of childhood ocular disorders worldwide are refractive errors, strabismus and amblyopia. This has been as a result of focusing studies on causes of visual loss rather than general ocular morbidity. However, the magnitude and pattern differ from country to country partially due to differing cut off points for the visual assessment as well as the age group studied. Significant refractive errors tend to be more prevalent towards adolescence; hence, studies that include this age group have a higher magnitude of refractive errors. Other causes seem to reflect the socioeconomic status of the region or country and availability of health care (1).

In a metropolitan preschool vision screening program in South Korea, the main causes of ocular disorders causing visual loss among 3 to 5-year olds studied were refractive errors 1.6%, amblyopia, 0.4% and manifest strabismus 0.14 %. Of the latter, those with exotropia were three times more than those with esotropia (6). Other findings were epiblepharon with trichiasis, conjunctivitis, keratitis, bilateral congenital cataract, and ptosis. Another three children had fundus abnormalities. In Sweden, cumulative findings for ten-year old children examined from birth were significant refractive errors of 7.7%, strabismus 3.1 %, (most were picked at or before 4 years of age), and amblyopia at 2.9 %. Organic lesions accounted for only 0.6 % (5). In Brazil, 1,965 of 13,471 preschool up to fourth grade schoolchildren (14.5%) were found to have vision less than 0.7. Further

examination showed that 894 of them had an ocular disorder, mainly refractive errors (4.55%), amblyopia (1.76%), and manifest strabismus (0.84%) (4). Other causes included chorioretinitis, cataract (of which 58% were congenital), ptosis, and congenital anomalies.

The pattern of ocular morbidity changes when countries in Africa and parts of Asia are considered to include more of infectious conditions and nutritional deficiencies like trachoma and vitamin A deficiency. The immunization rate also plays a role since measles is an important cause of corneal scarring. Trachoma (18%) was the most common cause of ocular morbidity followed by vitamin A deficiency (10.6%), and apparent/latent squint (7.4%) in rural Delhi (8). A higher figure for trachoma was noted in the Ethiopian study where it was the highest cause of ocular morbidity at 33.7 % (10) while refractive errors at 6.3% were the main cause of subnormal vision. Other findings included non-trachomatous conjunctivitis and Bitot's spots. A survey on prevalence of eye disease in 1,386 primary school children in Tanzania found active trachoma (5.5%), night blindness (5.3%), Bitot spots (0.6%), corneal scars (0.8%) in addition to refractive errors (1%), strabismus (0.5%) and amblyopia (0.2%) (15). As a result, one of the recommendations was that school screening programs in Tanzania should not be solely designed to address refractive errors, as the prevalence was too low. Nevertheless, it is worth noting that the refractive errors were still the main cause of poor vision. South Africa is one of the better-developed countries in Africa. The pattern of ocular morbidity also seems to reflect this as it is similar to the picture found in western and Asian countries. An urban-based community study of 4,890 children aged 5-15 years in Durban, found that of those with reduced vision (191 children), 63.6% was due to refractive errors, 7.3% amblyopia and 2.4% strabismus. The most common ocular disorders were corneal and conjunctival in nature and were seen in 528 (10.8 %) children. Media and fundus abnormalities were seen in 96 children (2%) (16). Nyaga et al from Kenya found conjunctival disorders were the commonest across all the age groups (about 23%) in a slum population (11).

2.3 Vision screening

The visual system continues to mature after birth and any interruption of this process, during the critical and sensitive periods may lead to reduced visual function. However, the plasticity of the visual system, which extends up to 12yrs, allows for interventions that may result in better visual outcome (17) This is the principle behind visual screening programs.

Population or school-based visual screening programs exist in various developed countries whose main target is children in their first year of schooling or at the beginning of the teenage years. These have provided valuable information on ocular morbidity that has helped identify children who required further ophthalmic assessment and management. Over the years though, various concerns have arisen. One, lack of standardized methods for screening especially taking visual acuity in young children; two, inadequate follow up of children identified after such programs; three, uncertainty concerning some treatment modalities especially amblyopia; four, high rate of false positive referrals. Further, it is still not clear whether screening would be more effective if done in the community or in schools.

A task force in the US reviewed both research and policy issues involved in vision screening in preschool-aged children. There was general agreement on the importance of vision screening in preschool children and the need for continuing work in the realms of both application and research. However, what was and is still lacking is high quality data on the effectiveness and validity of screening methods (3). Rahi has, however, noted that though there are questions regarding effectiveness of screening programs in the UK, there is little evidence supporting benefits of the service but also none proving the contrary (18). A Cochrane review published in 2004 on effectiveness of vision screening in children to detect refractive errors was of a similar view (19). The authors concluded that there is not enough evidence to show the potential benefits and harms of vision screening and so recommended that well-planned randomized controlled trials should be undertaken in various settings. Furthermore, studies especially on amblyopia therapy have not been conclusive yet this is one of the main reasons given for screening at younger ages rather than older.

In developing countries screening programs are almost non-existent reasons being lack of resources and relative low priority given to eye diseases. Some efforts, though, are being made towards this. In Kenya, one of the activities outlined in the National Strategic Plan for Eye Care, NSPEC, 2005-2010 is to advocate for screening of all children entering primary school (20). The evidence for this is however not clear. It is hoped that as access to health care is also improved that such programs will prove to be effective.

3.0 STATEMENT OF THE PROBLEM

The actual burden of eye diseases in preschool children in Kenya is unknown.

4.0 RATIONALE

Prevalence and pattern of diseases differ from region to region, even within the same country (21). Eye diseases are ranked among the top ten causes of morbidity in Kenya with a prevalence of approximately 1.6% in 2006 (22). This data is, however, not age specific probably due to the format of the data collection tool. (Appendix A). Hence it is difficult to determine the actual burden in children. Services to the paediatric age group have thus been limited by the lack of adequate information on the actual burden of ocular morbidity in addition to the lack of resources, both monetary and human.

Research on ocular morbidity in Kenya so far has been done in a general slum population in Nairobi city (11). Studies that have concentrated on children have looked at specific entities like strabismus and refractive errors, (12,13,14). Little is known about the situation in rural areas and whether any significant difference exists between rural and urban populations.

At the Kenya Ministry of Education there is no current policy that requires eye examination at school entry for both primary and secondary levels. This may be partially due to lack of supporting data.

The study therefore aims to establish how many children in rural-based nursery schools have ocular problems and to identify the type of ocular conditions. This will enhance the current knowledge on ocular findings in children in Kenya. It is also hoped that this will aid in deciding whether a primary school entry eye examination is necessary and aid in planning within the ministries of Education and Health. This study may also contribute towards the designing of a new format of the outpatient morbidity chart used in all our hospitals and eye units. This shall assist capture of ocular morbidity more accurately, especially in children.

5.0 OBJECTIVES

5.1 Main objective

To establish the magnitude and pattern of ocular morbidity in rural-based nursery school children in Nunguni zone, Kilungu Division.

Specific Objectives

1. To determine the magnitude of ocular morbidity of nursery school children in Kilungu division
2. To determine the pattern of ocular morbidity of nursery school children in Kilungu division
3. To determine the anatomical distribution of ocular morbidity in nursery school children in Kilungu division

6.0 METHODOLOGY

6.1 Study area (23) and Location (Appendix B)

Makueni District is one of the thirteen districts that form Eastern Province of Kenya. The District is generally sparsely populated, except in Mbooni and Kilungu where there is more natural resource potential. The overall district female: male ratio is 100: 93

Kilungu is one of the 16 divisions in the district. It is the 2nd most populous division with a population density of over 400 persons per square kilometre and is classified as a high potential rural area. It is predominantly hilly, served by a few all weather roads but the rest of the earth roads present transport difficulties during the rainy season. The main economic activity is subsistence farming and small business enterprises. The division is divided into three education zones namely Ilima, Kilungu and Nunguni. Most nursery schools are public, are located in primary schools and run by the same administration. Only 2 pre-schools are owned privately. Children attend nursery school for one year.

6.2 Study population

Nursery school children in Nunguni zone, Kilungu division, Makueni District.

6.3 Study design

A school-based cross-sectional study.

6.4 Sample size

To calculate the required sample size the sampling fraction n/N, and the design effect W was taken into consideration. Therefore, calculation of the sample size required was as follows: -

$n = A/ \{(E^2 + (A/N)\}$

Where n = minimum sample size required

A = 3.8416PQW

P = assumed population prevalence, strabismus at 3% (see ref 12onsomu)

Q = 100 – P

W = the likely design effect taken as 3

E = maximum acceptable random sampling error, (5%)

N = population size, 2171

Substituting the above in the formula

$n = 3.8416 * 0.03 * 0.97 * 3/ \{(0.0025 + (A/2,171)\}$

= 502.3 minimum of 502 children

The original plan to visit schools in all the zones did not materialise due to weather conditions at the time of study and state of the roads. Nunguni zone was chosen. All the 23 schools in the zone were allocated computer-generated random numbers and sampling done. Nine schools were selected with a total population of 537 using records from the district education office. While in the field, we found that the actual number of children in the schools was higher than that in the records. We therefore ended up examining a total of 602 children.

6.5 Inclusion criteria

All nursery school children who were present during survey and in whom a full ocular examination was done. Zero (0) children were excluded.

6.6 Study Definitions

The following definitions were considered for the study.

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

Anisocoria: a difference in the size of the pupils

***Anisometropia*:** A difference in refractive error of an individual's eyes

***Aphakia*:** absence of the crystalline lens from the pupillary area.

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

***Low vision*:** Visual acuity of worse than 6/18 and up to 3/60.

***Nystagmus*:** A repetitive, involuntary back and forth oscillation of the eyes which may be physiological or pathological.

***Significant astigmatism*:** more than +/- 1.5 dioptre (D)

***Significant hyperopia*:** more than + 2 D

***Significant myopia*:** more than - 0.5 D (24)

Strabismus: Misalignment of the eye, which may be obvious/manifest (tropia) or latent (phoria). This may be congenital or acquired.

(A description of special tests is given in Appendix C.)

6.7 Procedure

The study was conducted during the third term of the school year in the month of November, 2007.

Administrative logistics

Approval from the Ministry of Education was obtained and presented to the District Commissioner, District Education Officer and Early Childhood Development program officer, Makueni District and subsequently to the Division Officer, Kilungu Division. The school head-teachers were then informed who in turn passed on the information to parents and teachers of pre-school classes. One of the area education officers availed himself to act as a guide throughout the study. All children present on the day of examination, with consent given were recruited in the study. The examination was done at a pre-arranged time to ensure minimal interference with the school schedule.

A brief explanation of the procedure was given to teachers and children on arrival at each school. A demonstration of key tests like taking visual acuity was also done. Each child was then registered and the findings were recorded in the individual questionnaires. (Appendix D).

Assistants

Besides the principal researcher, there were two assistants to help in collecting the data. The study involved both quantitative and qualitative parameters so as to capture any form of morbidity in the children. Thus, to ensure standardization and reproducibility of the findings, two residents in the department of Ophthalmology of comparable length of training with the principal investigator were recruited. To enhance the examination techniques already attained during their training, all three examined patients in the paediatric eye clinic, run twice a week in the base unit, and findings were validated by the consultant in charge, who is one of the supervisors in this study.

History taking

Any known history and complaints that may be related to an ocular problem was noted with the help of teachers.

The Ophthalmic Examination:

Visual Acuity

This was the first assessment done in a well-lit area using Snellen E chart at a distance of 6 meters. Vision for each eye was taken separately after occluding the other eye. For younger children and those unable to use the Snellen E chart, Lea symbol chart was used at a distance of 3metres. Each correctly read line was recorded as the visual acuity. No child was wearing spectacles during the study.

Binocular vision

The Lang I test was then used at reading distance as a screening test for binocular functions. The figures were unfamiliar to the children, so pointing at them was accepted as positive.

Orthoptic assessment

Any abnormal head posture was noted followed by Brueckner test using a direct ophthalmoscope at one metre, corneal light reflexes (Hirschberg) using a torch and finally cover tests at far and near.

Any child with a squint had their pupils dilated for fundoscopy and cycloplegic refraction.

Extra ocular motility was assessed and presence of nystagmus was noted.

Orbit, lacrimal system and Lids

Examination was done by observation and palpation to look for asymmetry, swellings, abnormal tearing and lacrimal duct discharge. Presence of drooping of the eyelids (ptosis) with or without chin elevation was also recorded.

Anterior segment

This was examined using a magnifying loupe and appropriate light source. Following is a description of the *minimal* characteristics to be identified per structure:

Conjunctiva: discharge, injection, masses

Cornea: clarity, opacity, ulcer. Fluoroscein stain and blue light from the direct ophthalmoscope was used to confirm corneal ulcers where suspected.

Anterior chamber: depth, hyphema, hypopyon

Iris: presence, shape, nodules, abnormal discoloration.

Pupil: Assessment was done using a source of light in dim lighting to determine anisocoria, reaction to light and abnormal pupillary reflex.

Lens: presence, clarity, position, opacity.

Posterior segment

Direct and indirect ophthalmoscopes were used to look for any optic nerve, macula and retinal pathology. All children with reduced vision as explained below, unequal Brueckner test, abnormal pupillary reactions and lens abnormality had their pupils dilated with tropicamide dilating drops for further fundus examination.

Refraction:

This was done on those children who either had visual acuity of < 0.6 (Lea chart), <6/9 (E chart) or had a difference in visual acuity of more than one line between the two eyes. One drop of 1% cyclopentolate was instilled in the eye three times at 10-minute intervals. Objective refraction was then done 50-60 minutes after instillation of the first drop.

Systemic examination

The children also had a systemic examination done and any relevant finding recorded.

Referrals

All children with conditions requiring management were referred to the eye units at Machakos District hospital or KNH.

6.8 Data collection and processing

Questionnaires were used to collect data and stored in confidential files. All data was entered into a computer and analyzed using the SPSS. Statistical significance testing was carried out whenever appropriate and level of significance taken at 95%.

7.0 ETHICAL CONSIDERATIONS

1) Confidentiality of child's records was observed throughout the study.
2) No invasive examination was carried out. Use of medication for the purpose of examination was explained to the parents and/or the teachers.
3) Approval from the KNH ethical committee and the Ministry of Education was obtained.
4) Children with other ocular findings or diseases requiring management were referred to the eye units at Machakos District hospital or KNH.

8.0 STUDY LIMITATIONS

1) The original plan was to go to all the zones in the division. This was however limited to one zone by the rainy weather which rendered a number of roads impassable.
2) The study was school based, so some relevant family, medical and developmental history was missed, especially in one of the schools where we found physically challenged children.

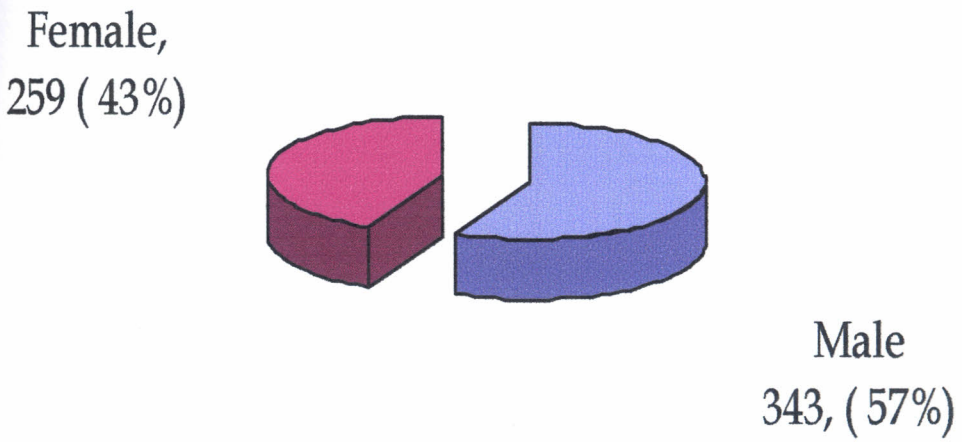
9.0 RESULTS

We visited nine schools in Kilungu division, Makueni District, and examined 602 children who were present during the survey. The schools that participated are shown in Table 1. One of the schools incorporates children from nearby church-sponsored children's home for the physically challenged

Table 1: Distribution of Children by School (n = 602)

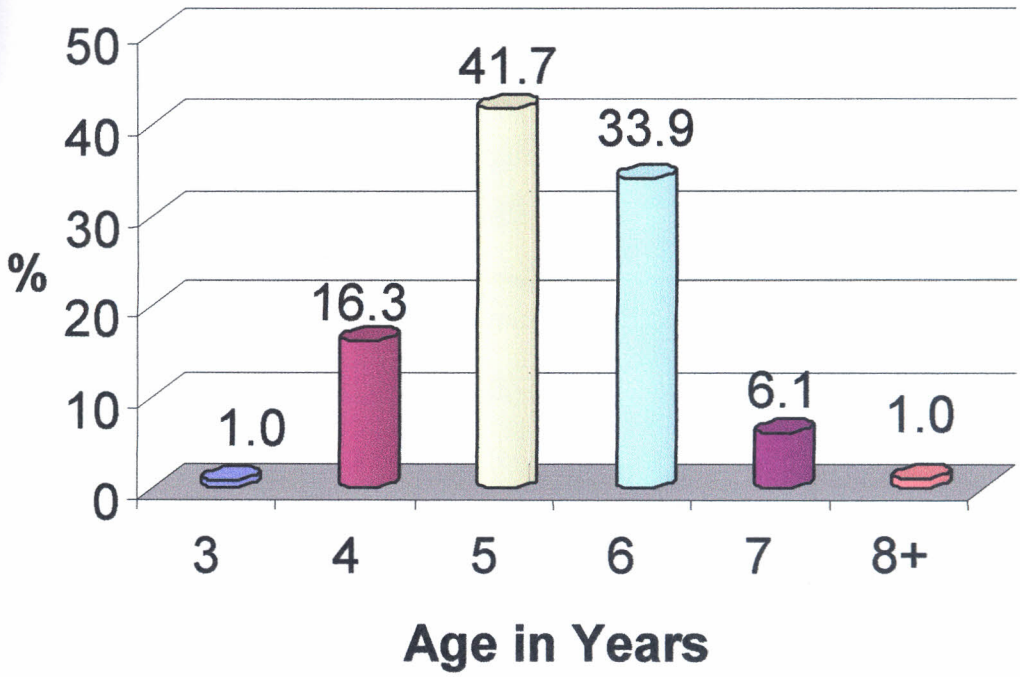
School	Frequency	Percentage
Nunguni	124	20.6
Katulye	102	16.5
Mutonguni	84	14.5
Kyale	71	11.8
Tusunini	58	9.6
Kaeani	50	8.3
Mutungu	43	7.1
Ivengeani	39	6.5
Kithembe	31	5.1
Total	**602**	**100.0**

Figure 1: Distribution of Children by Sex (n = 602)



The male to female ratio was 1.3:1. The projected 2007 population for 5-9 year-old children in Makueni District was 61,320 males and 58,946 females giving a ratio 1.04:1 (23).

Figure 2: Distribution of Children by Age in years (n = 602)



The mean age of the children was 5.31 (±0.037) with the minimum age being 3 years and the oldest 10 years (range = 7 years). There were two mentally challenged children aged 8 and 10 years.

Table 2: Visual Acuity in the better eye using LogMAR (n = 602)

VA (LogMAR)	Frequency	***Percentage***
0.0	522	86.7
0.2	52	8.6
0.3	9	1.5
0.5	5	0.8
0.7	2	0.3
0.8	2	0.3
FL*	3	0.5
Uncooperative	7	1.3
Total	**602**	**100.0**

*FL: Following Light

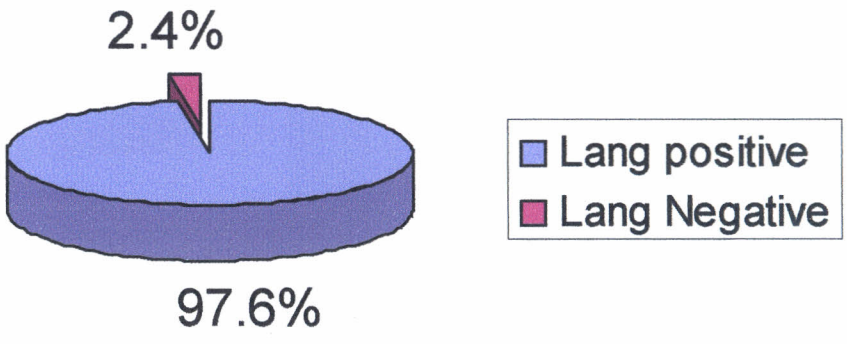
All the measurements were converted to logMAR units (Appendix E). None of the children had spectacle correction. Two children were mentally challenged and one three-year-old was unable to use Lea chart; so the best assessment of vision that could be attained in them was following light (FL). Seven (7) children were labelled uncooperative as they easily lost concentration during the visual acuity assessment. However they underwent successful ocular examination including retinoscopy and so were included in the analysis.

Table 3: Comparison between Sex and VA (n = 592)

Sex	Mean VA	Mean difference	95%CI	p-value
Male	0.035 (±0.01)	0.008	(-0.01 to 0.025)	0.304
Female	0.027 (±0.01)			

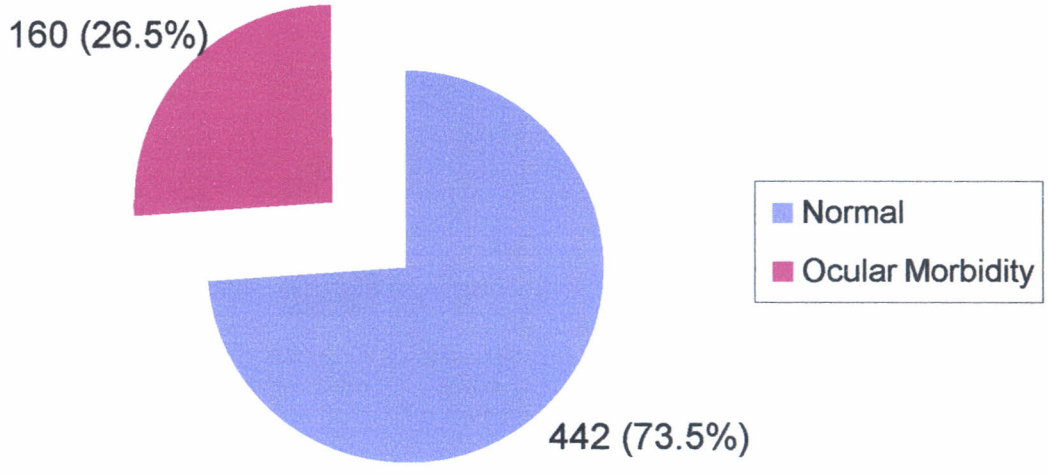
The mean visual acuity (VA) was within normal limits for both sexes with no statistical difference.

Fig 3: Assessment of Gross Stereopsis (n=602)



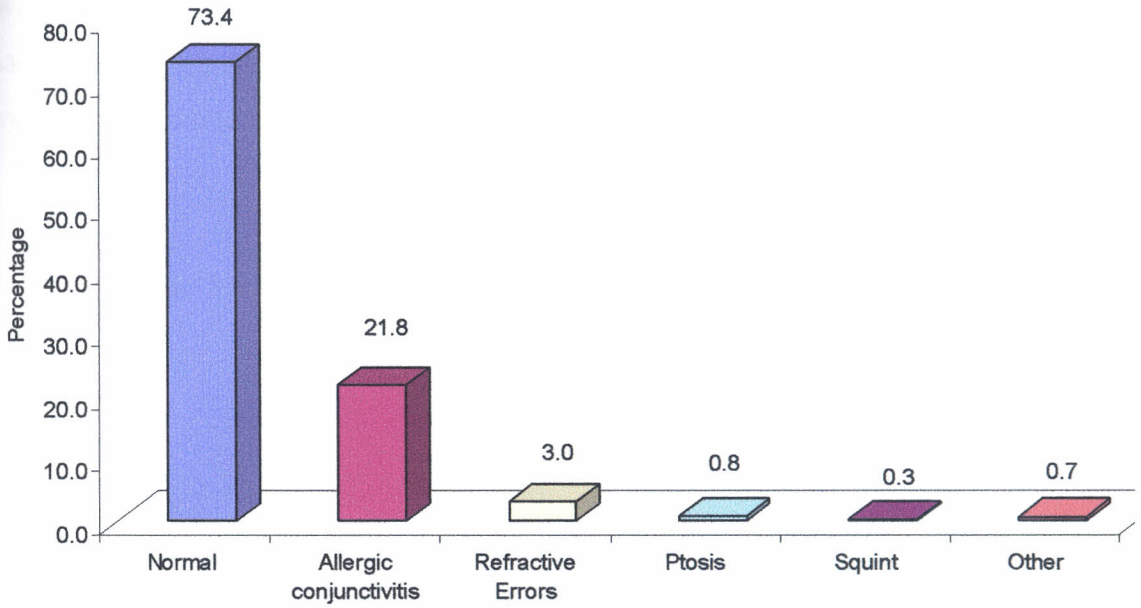
Almost all the children could see and point on the pictures on the Lang 1 chart even though many could not correctly identify them by name. This was probably due to the fact that the pictures were not familiar to them.

Fig 4: Prevalence of Ocular Morbidity (n=602)



At least one ocular anomaly was detected in 160 children and of these, 63% were males and 37% were females

Fig. 5: Types of Ocular Morbidity in Percentage (n=602)



Among the children with allergic conjunctivitis, none had visual impairment (WHO standards) and most were aged 5 years which was also the mean age of the children in the study. Of those who had refractive errors, majority had hyperopia (12 out of 18) though not clinically significant for their age. The one child who had clinically significant hypermetropia at +3.50 and +4.00 DS also had esotropia and is captured under squints. Of the myopes, only one out of the five had significant myopia at -1.50DS. Astigmatism was detected in one girl but this was also not clinically significant. Only two children had manifest squints both of which were esotropia. Eyelid ptosis was present in 5 children, who were all female and their vision was not affected significantly. Of these, one had been noticed by the teachers and in one the ptosis was unilateral. Under the category "Other" were four children with the following findings:

- small corneal opacity
- small anterior capsule cataract not in visual axis
- posterior synechiae of unknown cause and
- whitish nodules on iris with café au lait spots on trunk

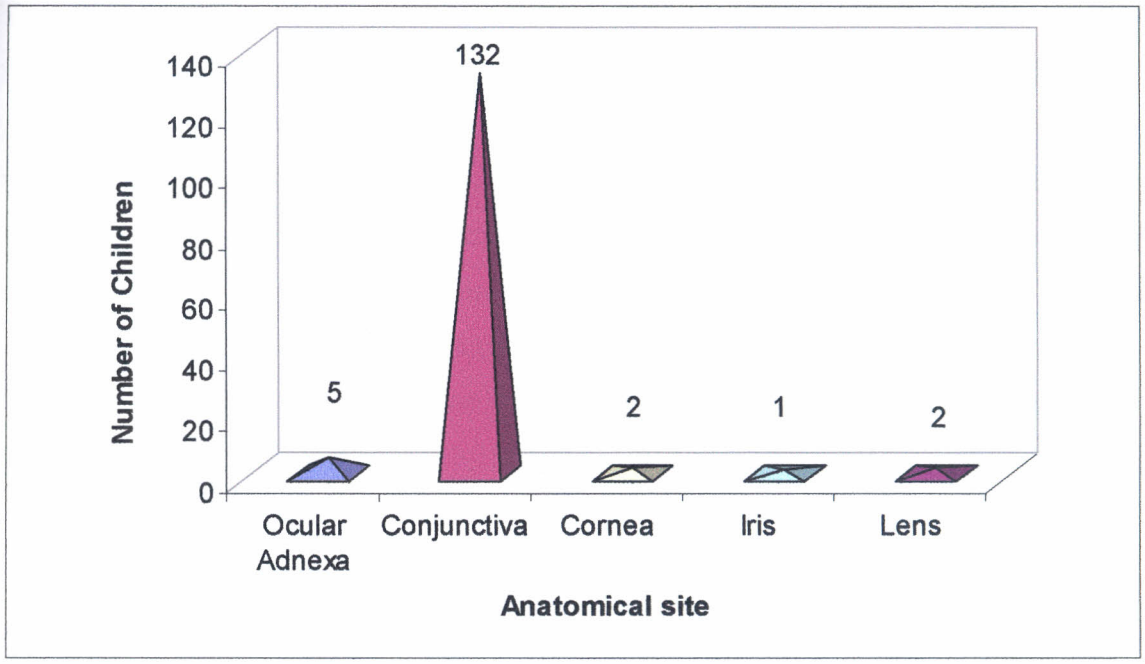
Worth noting was a child who had hydrocephalus, had undergone VP shunt surgery and had vision of 0.2 (logMAR). Since she had normal ocular findings, her reduced vision was probably due to cerebral visual impairment.

Table 4: Ocular Morbidity by Sex. (n=160)

		Male (n, %) (n=343)	Female (n, %) (n=259)	p-value
Allergic conjunctivitis		85 (24.8)	46 (18.1)	0.775
Refractive Errors	Hyperopia	8 (2.3)	4 (1.5)	0.540
	Myopia	3 (0.8)	2 (0.7)	0.602
	Astigmatism	0.00	1 (0.4)	-
Ptosis		0.00	5 (1.9)	-
Squint		2 (0.6)	0.00	-
Other		3 (0.8)	1(0.4)	0.536
Total		101 (29.5)	59 (22.7)	

There was no statistical difference in all the forms of morbidity among the males and females.

Fig 6: Anatomical Distribution of Ocular Morbidity (n=140)



No posterior segment anomalies were noted. Nineteen children had refractive errors and are not included.

Referrals

Six children were referred for further evaluation and management. The referral notes and spectacle prescriptions were given to the head teacher who was to hand them over to their respective parents/guardians.

10.0 DISCUSSION

This study was done among **nursery school children** majority of them aged 5 and 6 years while most studies on ocular disorders have been done in children aged 5 to 15 years of age. Since some of the studies are community-based while others are school-based, comparison will be difficult. In most other studies, children in the sample have their visual acuity taken and only those who score below a predetermined value undergo further ocular examination. The reason for this is that the studies' focus is on visual impairment and its causes. In this study, however, every child in the sample had a full ocular examination in order to determine any form of ocular morbidity, as was the case in Nepal, Ethiopia and Tanzania. (9,10,15). It was also important to determine any preventable or treatable ocular disorders in this age group.

Visual acuity assessment was done using Lea symbols and the Snellen E charts, which are appropriate for this age group. Conversion of both to logMAR units enabled combined analysis. The children were able to follow the instructions even though this was the first time they were being assessed. We did not manage to take vision in 7 (1.3%) children but from the fact that we were able to do further ocular examination implies that it may be possible to take vision on another visit. Among the studies reviewed, 50 to 60% of children aged 5 and 6 years end up with no visual assessment (4, 8, 16, 25), thereby underestimating the actual disorders present. The authors in all of these studies have only used the Snellen chart (including the tumbling E chart) to assess visual acuity in children. We therefore suggest that the use of available and proven methods suitable for this age group should be encouraged in future studies.

Only 4 children in this study were **visually impaired** (visual acuity <0.5>1.0 in logMAR) and due to lack of history from the parents/guardians, it was not possible to fully establish the cause of visual impairment in them. None of the children examined had severe visual impairment or blindness. This could either be due to the fact that blind children were likely to be in schools for the blind or at home, or that the prevalence of blindness in children is actually low. Though there aren't many studies done in other areas of Kenya

involving this age group, it is possible that most nursery school children have normal vision. A study of school children from Tibet showed that almost 96% had normal vision (7) comparable with this study with 96.8%. In the Ethiopian study none of the children, whose mean age was 5.8years, was blind and 1% (8/826) had unilateral blindness (10). More research is definitely needed in order to build up evidence that can be used in policy making and planning as far as school vision screening at the nursery school level is concerned.

The WHO classification of visual impairment (Appendix F) is used for standardization and in assessing the various visual requirements. However, it does not take care of children who cannot use matching symbols due to young age or mental challenges. The use of "Following light" (FL) may not be a quantifiable measurement but it is useful as a gross form of visual assessment, so that no child is labelled blind when they are not. None of the studies which included younger children mentions the use of the term "FL". Despite the special challenges posed by assessment of vision in younger children, efforts should be put towards developing a standardized classification. This would go along way in improving eye care for these children and contribute to the tenets of vision 2020,

Out of the 602 children screened for binocular functions using Lang 1 test, 97.6% had **gross stereopsis.** The method used was simple and easy to understand for most of the children. Most of the literature reviewed does not indicate the assessment of the same. It is not clear why this assessment is omitted yet it is a useful guide in the rapid detection of squints and amblyopia. We believe this should be part of any such survey or screening programs as it is simple and quick to perform.

Of those examined in this study, 26.4% had one or more **ocular abnormality**. Prevalence of ocular disorders ranges from 11 to 55% in children aged 5 to 15 years with higher prevalence documented in areas which are endemic for trachoma like Tibet, India, Ethiopia and Tanzania (7, 8, 10, 15). Ocular disorders and their prevalence will vary from area to area and be related to the level of health care available as well as environmental and hygienic factors. In a study of ocular disorders in a Kenyan informal settlement, out

of the 86 children aged 5 to 10 years, 53 (61.6%) had an ocular disorder (11). This may be explained by the overcrowded and dusty environment in the slum. Kilungu was less dusty and the living conditions appear generally better. Therefore, country-specific as well as region-specific data is crucial for planning purposes at the district level to take care of these differences.

Looking at the actual **causes of ocular morbidity** in our study, allergic conjunctivitis was the commonest (21.8%). However, it was not so debilitating in nature as to keep the children from attending school or interfere significantly with their vision. In the Kenyan slum population survey, allergic conjunctivitis was also the major cause of ocular morbidity (11). This is unlike most developed countries where the main causes of ocular morbidity are refractive errors, amblyopia and squints. Significant refractive errors were not a major finding in our survey and so would support the view of Wedner et al (15), that preschool screening programs in East Africa would not focus on refractive errors. No Bitot spots or other evidence of vitamin A deficiency were noted in this study, nor evidence of trachoma. The area of study is not endemic for trachoma. Further, it has arable land for farming and these children may get a sufficient diet. Only 2 (0.6%) children had squints unlike Onsomu's finding of 3% among nursery school children in Nairobi city (12). Brazilian children examined by Scimti et al in Ibiporã revealed a prevalence of 0.84% while in Kathmandu it was 1.6% and Tanzania had 1% (4, 9, 15) even though all had much wider age range. The two children in our study had esotropia which again differs with Onsomu's finding of children having exotropia in his study. In Kathmandu, there was more of exotropia as well, though in Brazil there was more esotropia than exotropia. It is not clear why these differences exist.

Most studies do not assess the **anatomical causes** of morbidity. From this study, most disorders were in the anterior segment (81% conjunctival) as was the case in the Tanzanian and Ethiopian studies, and they are preventable or treatable. Though we suggest that screening program in Kenya should focus on the anterior segment, any child with poor vision must have a full eye examination. This kind of information may also be useful when equipping local eye units and should be part of similar studies in the future.

11.0 CONCLUSION

The prevalence of ocular morbidity in nursery school children in Kilungu division of Makueni District was 26.5%, the commonest being conjunctival in nature. The current burden of ocular morbidity more so refractive errors in this population is not adequate to warrant pre-school ocular morbidity screening program, and can be managed by a zonal eye surgeon.

12.0 RECOMMENDATIONS

1. There is probably no point in advocating for ocular screening of pre-primary school children. Scarce resources could then be used for other eye care programs.

2. Teachers could be trained in identifying and appropriate referral of detectable disorders that could lead to interruption of the child's education and general quality of life. This should be integrated into their curriculum.

3. Studies involving children should make use of available methods of measuring visual acuity so as not to miss valuable information and accord the relevant service to these children.

4. Further studies need to be done in other regions of the country, including a comparative study of children in the semi-arid part of Makueni District. This will help build up adequate evidence for or against ocular screening in children at different ages, and if so, what disorders to target.

13.0 APPENDICES

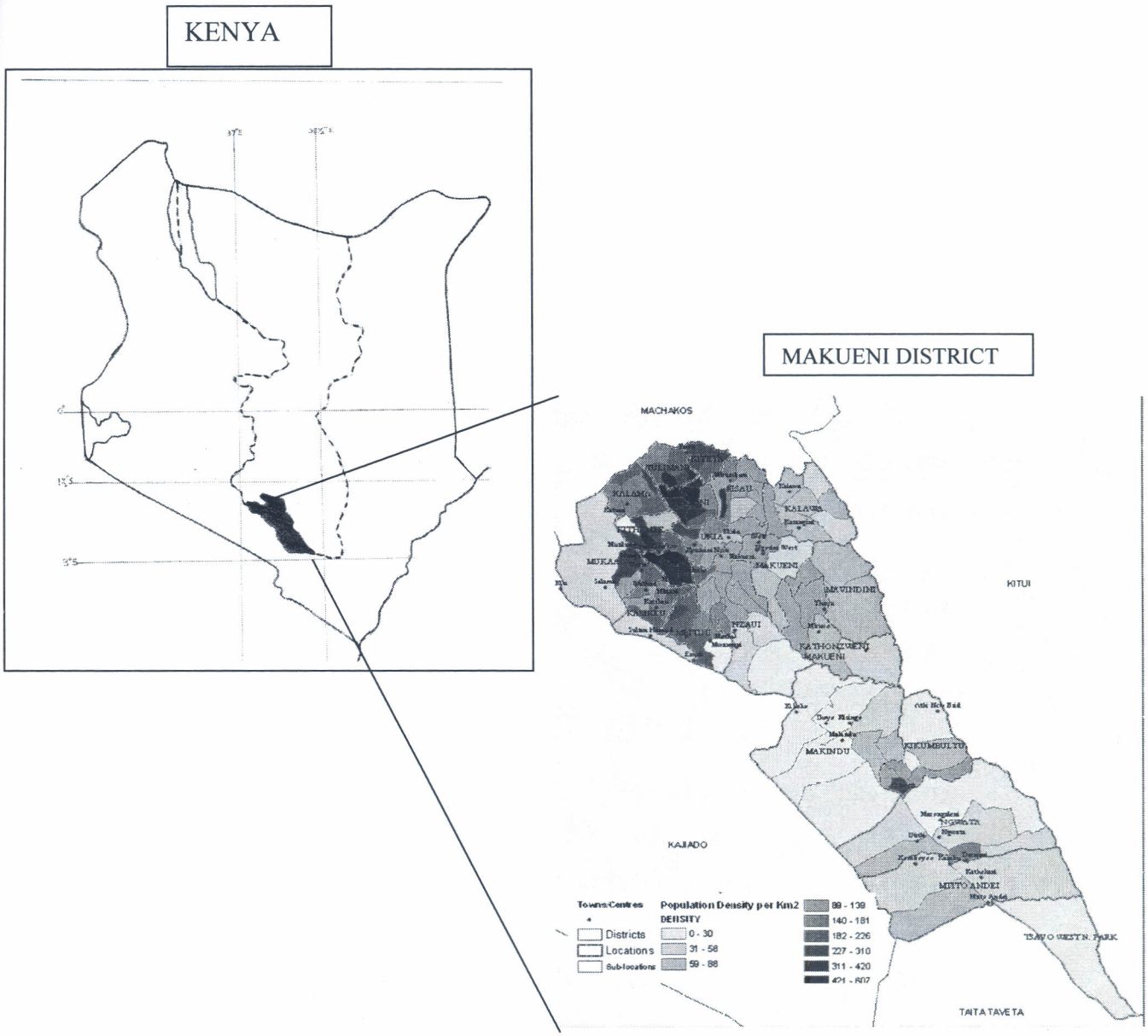
Appendix A: OUTPATIENT OCULAR MORBIDITY FORM

MINISTRY OF HEALTH
KENYA OPHTHALMIC PROGRAMME
OUT-PATIENT EYE MOBINDITY TALLY SHEET

i.	EYE CLINIC:	DATE:	OPHTH/OCO:	SIGNATURE:
ii.	**Attendance Record:**			
	New Patients	00000 00000		
	Revisits	00000 00000		

		VISUAL ACUITY (better eye) - All patients				
iii.	***Clinical Diagnosis - All Patients***	Children (0 - 5 yrs.)	Normal Vision (>6/18)	Vision loss (<6/18)	Blind (<3/60)	Blind NPL
1	Normal	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
2	Cataract	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
3	Glaucoma	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
4	Strabismus / Amblyopia	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
5	Presbyopia	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
6	Other refractive Error	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
7	Active Trachoma	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
8	Inactive Trachoma	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
9	Corneal Scar - Trachoma	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
10	Corneal Scar - Injury / Infection	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
11	Purulent Conjunctivitis	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
12	Allergic Conjunctivitis	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
13	Ophthalmia Neonatorum	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
14	Active Corneal Ulcer	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
15	Optic Atrophy (non-glaucoma)	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
16	Xerophthalmia	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
17	Retinal Disease	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
18	Macular Degeneration	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
19	Injury	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
20	Uveitis	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
21	Chalazion / Stye	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
22	Pterygium	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
23	Retinoblastoma	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
24	Herpes / Simplex	00000 00000 00000	00000 00000 00000 00000	00000 00000 00000 00000	00000 00000 00000	00000 00000 00000
25	Other Eye Diseases (Specify)	00000 00000 00000 00000 00000 00000 00000 00000 00000	00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000	00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000	00000 00000 00000 00000 00000 00000 00000 00000 00000	00000 00000 00000 00000 00000 00000 00000 00000 00000

Appendix B: LOCATION OF MAKUENI DISTRICT



Appendix C: DESCRIPTION OF SPECIAL TESTS

Brueckner test

The test is a quick guide to presence of strabismus. Using a direct ophthalmoscope held at one metre in a dimly illuminated room, the light is shone into both eyes simultaneously. The brightness of the fundus reflex between the two eyes are then noted by the observer though the ophthalmoscope. In the presence of strabismus, the reflex is darker in the fixating eye.

Lang test

This is one of the tests used to test binocular vision. It is simple to use and does not require the use of any other equipment apart from the card itself, hence it is useful test in the field. The targets are seen alternately by each eye and displacement of the dots creates disparity. The patient is asked to name or point to a simple shape on the card, or observation of the child's eye movements from object to object on the card. Degree of disparity is from 1200 to 600 seconds of arc and this can be used for grading.

Hirschberg

This test gives a rough estimate of the amount of deviation in manifest strabismus. A source of light is shone from an arm's length into the eyes and patient asked to fixate on the light. The corneal reflexes are studied. In a normal eye, the reflection will be centred in the pupil. If there is a squint, the reflex will be decentred in a direction opposite that of the deviation. The approximated distance of the reflex from the centre of the pupil is used to estimate the amount of deviation in degrees, which can then be converted to prism dioptres (1mm of deviation $\approx 7^0$ or 14 prism dioptres).

Cover tests

There are three types of cover tests: cover-uncover test, alternate cover test and simultaneous prism cover test. For this study, the first one will be used to detect and differentiate phoria from a tropia. Patient looks at a distance fixation target and position of the eyes noted which should correspond to the finding in hirshberg test. The examiner positions himself directly opposite the patient at arm's length. Using an occluder or hand, the fixating eye is covered and movement observed in the uncovered eye. The first eye is uncovered and the second one covered. Movement of the fellow eye is observed. Once uncovered, the position of both eyes is noted once again

Appendix D: DATA COLLECTING TOOL

OCULAR MORBIDITY IN NURSERY SCHOOL CHILDREN IN KILUNGU DIVISION

NO._____ Date __/__/__

A. DEMOGRAPHIC DATA

Name.....

Age (yr) .....

Sex 1= Male, 2= Female ☐

B. COMPLAINTS

.....

.....

C. RELEVANT HISTORY

.....

.....

D.VISUAL STATUS

Visual Acuity: 1= Snellen E chart, 2= Lea chart ☐

Without correction	With correction
RE _____	RE _____
LE _____	LE _____

E. ORTHOPTICS

Brueckner: 1= Equal 2= Unequal ☐

Hirschberg 1=Central 2= Decentred ☐

Head posture 1= Normal 2=head tilt 3=head turn 4=tilt &turn ☐

CT/ACT 1=Normal 2= Esophoria 3= Esotropia 4= Exophoria 5= Exotropia ☐

Stereopsis (Lang I) 1= Yes 2= No ☐

EOM 1= Normal 2= Restricted ☐

F. OCULAR EXAMINATION

Lids: 1= Normal 2=Ptosis. 3=Ectropion ☐
4= Entropion 5= Other (specify).....

Conjunctiva: 1= Normal 2=Injected 3=Discharge ☐
4= Other (specify) .....

Cornea: 1= Clear 2=opacity 3= Ulcer ☐
4. Other (specify) .....

Pupil: 1= Normal 2=RAPD 3=APD ☐
4= Other (specify) .....

Lens 1= Clear 2=Opacity 3= Malposition 4= Aphakia ☐

Retina: 1= Normal 2= Other (specify) ..... ☐

Optic nerve 1= Normal 2= Atrophy 3. Other (specify) ☐

.....
Lacrimal system 1= Normal 2= Epiphora 3= others ☐

Others .....

G. REFRACTIVE STATUS (as per study definitions) ☐

Objective/Cycloplegic refraction (OR):
RE..... LE.....

1= Emmetropia 2=Hyperopia 3=Myopia 4= Astigmatism

H. RELEVANT SYSTEMIC FINDING:
.....
.....
.....
Final Impression:
.....

Referrals ☐
1= None 2= Machakos eye unit 3= KNH

Spectacle prescription .....

Appendix E: CONVERSION OF VISUAL ACUITY INTO LOGMAR UNITS

Snellen notation	LogMAR equivalent
6/6	0.0
6/9.5	0.2
6/12	0.3
6/18	0.5
6/24	0.6
6/36	0.8
6/60	1.0

Lea chart notation	LogMAR equivalent
3/3	0.0
¾	0.2
3/5	0.2
3/6	0.3
3/9	0.5
3/15	0.6
3/21	0.8
3/30	1.0

Appendix F: WHO CLASSIFICATION OF VISUAL IMPAIRMENT

Visual Acuity	Approximate LogMAR equivalent	Class
>6/18	>0.5	Normal
<6/18 >6/60	<0.5>1.0	Visual impairment
<6/60 >3/60	>1.0	Severe visual impairment
<3/60		Blind

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