VISION ASSESSMENT OF

PUBLIC SERVICE VEHICLE DRIVERS

IN NAIROBI

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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 has been submitted for the examination with our approval

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To

My husband Sammy and daughter joy for their support and encouragement.

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ABBREVIATIONS:

VA	-	Visual Acuity
KNH	-	Kenyatta National Hospital
PSV	-	Public Service Vehicle
RTA	-	Road Traffic Accidents
U.K.	-	United Kingdom
U.S.A.	-	United States of America
S.A.	-	South Africa
ARMD	-	Age related macular degeneration.

SUMMARY

This was a cross sectional study that was carried out in Nairobi. The main purpose of the study was to assess the vision of PSV drivers in Nairobi and to determine whether there was any association between accidents and impaired vision.

A total of 539 PSV drivers aged 21 to 65 years were examined (mean 38.3+/- 9.2years). The drivers were randomly selected from the terminuses. Majority of the drivers were male (99.6%) with only two female drivers.

Most of the drivers (76%) were having an eye check up for the first time and had obtained their driving license without their visual acuity being tested (68%). A hundred and forty drivers (26%) had problems with their eyes but only 37 drivers (27%) had sought medical attention.

The visual acuity in the better eye varied from 6/6 to 6/36 and in the other eye from 6/6 to no perception of light. Thirteen percent of the drivers had inadequate visual acuity for a driver's license. Nine drivers (1.7%) had colour vision deficiency, 2.2% had constricted visual fields and 4.5% had cataracts. Two hundred and eighteen drivers (40%) had been involved in accidents in the last three years. Cataracts were significantly associated with accidents ($p=0.007$). However no significant association was found between visual acuity, colour vision deficiency, visual field defects and accidents.

This study found that the percentage of drivers with inadequate visual acuity for driving is high. Evidently, regular check up of visual acuity is needed for a PSV driving license. This can be done at the time of renewal of the PSV license. Majority of the drivers had obtained their driving licence without their vision being checked. The law should be enforced to ensure that the vision of all driving license applicants is tested.

LITERATURE REVIEW

Introduction

Driving is the main mode of travel in our country. It facilitates the performance of routine daily activities. Most people in Kenya rely on public service vehicles for transport. To be a public service driver in Kenya, one is required to have a valid driving license and a PSV license. To obtain a PSV licence one must have a valid driving licenses and a clearance from the criminal investigation department confirming that one is not a criminal. However no medical examination is carried out. The license is renewed every 2 years.

The PSV drivers in Nairobi can be divided in two categories: those working for the formal sector and those working for the informal sector. The formal sector PSV drivers are mainly bus drivers and are employed by companies such as Kenya Bus Services, Coast Bus Services and Akamba Bus Services. The informal PSV drivers drive matatus and buses. Matatus is the local name for public service vans and mini-buses with passenger capacity of 18 to 25.

Vision plays a major role in safe driving and it's the one human sense that is absolutely essential for safe driving. Although other senses relay important information, 90% of the sensory input to the brain needed for driving comes form vision.[1] Sensory loss in drivers is an important risk factor for car accident.[2]

The number of accidents is on the increase in this country. The accident statistics show that there were 13938 accidents in 2000, compared to 12745 in 1996. In 2000, 2819

people were killed due to the accidents, 9659 seriously injured and 16539 slightly injured.[3] Several factors are responsible for accidents and they include human error, faulty vehicles, bad weather, and road defects. The drivers' behaviour during driving is affected by vision, fatigue, alcohol, vehicle visibility, road lighting and motor co-ordination. The annual accident statistics show that 82% of the accidents were due to human error. The other causes include vehicle defects, road defects and weather. Odero in his study found that human error was to blame for 84% of accidents. He also found that 42% of the accidents resulting in serious injuries involved public service vehicles.[4]

VISUAL REQUIREMENTS FOR DRIVING.

A person's vision can vary from blindness to 6/5. There must therefore be a minimum standard below which it will be unadvisable for anyone to drive. The two most important aspects of vision that are considered for driving are visual acuity and peripheral vision.

Visual acuity is the ability to recognize detail. Drivers need sufficiently detailed vision to recognize road signs at sufficient distance so that they can have sufficient time to execute the maneuver required by the sign. It is easy to measure and it has therefore become the visual criterion for a driver's license.

Peripheral vision is the extent of the visual fields most importantly the horizontal diameter. Adequate peripheral awareness is a pre-requisite for safe driving. However visual field defects are rare and this has led to omission of specific visual field requirements in driving regulations in many countries.[1]

The minimum visual requirements for driving license applicants vary form country to country. In Kenya the traffic acts state that the applicant must be able to read with glasses if worn a motor vehicle identification plate at a distance of 25 metres.[5] The law does not specify the size of the letters of the number plate. The screening of the vision is done by the police officer at the time of the driving test.

In the United kingdom the basic visual requirement for applicants for a drivers license is the ability of the candidate to read in good day light with the aid of corrective lenses if necessary a number plate fixed to a motor vehicle and containing letters and figures 79.4amm high at a distance of 20.5 metres. This corresponds to snellens VA of 6/9. For PSV the applicants must have a visual acuity with corrective lenses if necessary of at least 6/9 in the better eye and 6/12 in the worse eye. Drivers with monocular vision diplopia, hemianopia are regarded as being unfit to drive PSV.[6]

In the United States of America the federal regulation states that a person is qualified to drive a commercial motor vehicle if he/she has a visual acuity of at least 6/12 in each eye with or without correction, a horizontal visual field of vision of at least 70 degrees in each eye and the ability to recognize the colors of traffic signals and devices showing standard red green and amber.[7]

Studies done on drivers show that some drivers fail to meet the minimum visual requirement. A study done in Finland showed that 6.5% of the drivers had inadequate VA for a professional driver's license (9). Davison in his study in U.K found a failure rate of 4% (10), Harms in Germany found a failure rate of 9%[11], while Jenning found a failure rate of 12% in Australia.[12] The most common cause of failure to meet the minimum

visual requirement is simple correctable refractive error. However some drivers refuse to wear a correction even when improved vision is demonstrated to them.[6] This suggests that some drivers fail routinely to take the opportunity to optimize their vision with appropriate optical correction while driving and that there may be a role for more vigorous driver education policies to overcome this problem.

EYE CONDITIONS AFFECTING DRIVING

Certain eye conditions have a significant impact on safe driving. These conditions include cataracts, glaucoma, diabetic retinopathy, age related maculopathy, retinal degenerations, uncorrected refractive error etc.

Cataract:

This is the major cause of vision impairment in adults over 60 years old. It compromises many aspects of vision including acuity, contrast sensitivity, visual fields, and it increases disability glare. Many people cope for an extended period of time with vision impairment induced by cataract until when surgical removal of cataracts occurs. This implies that there are many drivers on the road with cataracts. Owsley in her study on older drivers with cataracts found that they experience difficulty on the road and they avoid challenging driving situations.[12] The challenges include driving at night, in bad weather and in rush hour traffic. The drivers also reported that they restrict their driving exposure and restrict their driving space. She also found that the drivers with cataract were 2.5 times more likely to be involved in road accidents.[12]

Glaucoma:

It is one of the commonest causes of blindness in the world. People with glaucoma and restricted visual fields report difficulty in driving.[13] Studies on older drivers have shown that glaucoma may have a role in accident involvement among the elderly.[14] Hu et al in his study in Iowa, found that drivers with glaucoma were 1.7 times more likely to be involved in an accident than those without glaucoma.[15]

Diabetic Retinopathy:

This is a vascular complication of both type I and II diabetes that poses a serious threat to vision. Diabetic retinopathy is the most frequent cause of new cases of blindness among adults aged 20 to 74 years.[6] Several studies have been done to determine whether there is any association between diabetic retinopathy and crash risk. Waller in California found that drivers with diabetes had twice as many crashes as non-diabetic drivers.[16] Hansotia and Brostes reported that drivers with diabetes have slightly increased risks of traffic accidents than unaffected persons.[17] However Steven [18] and Eadington[19] did not find any association between diabetes and road accident involvement.

Age related macular degeneration:

This is a major cause of visual impairment in older drivers. Drivers with it report more difficulty driving[20] and avoid challenging driving situations than drivers without ARMD.[21] Little is known about whether ARMD elevates the risk of accidents.

DRIVING AND VISUAL IMPAIRMENTS

Visual sense provides most of the information used by the driver and it is therefore natural to ask if road accidents might be linked with defects in vision. Many studies have been carried out to try and relate visual abilities with driving performance.

Visual acuity

Visual acuity testing is perhaps the most ubiquitous visual screening test used by licensing agencies for the determination of driving fitness. Good central visual acuity is necessary for early recognition and reading of road signs. It also aids in the early detection of pedestrians, motorcycles, and other obstacles on the way. Good acuity allows the driver more time to make decisions about events, obstacles, and signs and in effect slows down the action. A driver with poor acuity requires the obstacles to be closer before he can appreciate it leaving less time for him to react. Such a driver will fatigue faster and become more easily perceptual overloaded.

Many studies have been done to evaluate the relationship between VA and driving performance. The most influential work was done by Burg where he evaluated 17,500 Californian drivers. This study showed a weak association between VA and crash involvement among the older drivers. However for young and middle aged drivers there was no association found between poor VA and road accidents.[22] Owsley in her study on visual impairment and driving reviewed several studies done to assess the association between VA and accidents. She found that very few studies found a positive association

between poor VA and accidents. She also found that there was very little support for a strong association between VA and unsafe driving.[7] Given that visual acuity is the most commonly used visual screening test for licensure it seems paradoxical that research generally does not support the conclusion that it can reliable identify high risk drivers.

Peripheral visual fields:

This is another screening procedure for driver licensing in some countries. A restriction of the visual field can never be fully overcome although increasing head and eye movements and car mirrors can be of help. The visual field is important for maintaining the drivers orientation and in establishing relationship between the many objects in the field of view.

Visual fields can be artificially reduced by aphakic corrections, thick spectacle frames, and by car designs. Diseases causing visual field defects include cataracts, glaucoma, and retinitis pigmentosa. Johnson and Keltner in their study on visual field examined 10,000 drivers. They found the incidence of field loss was 3% for drivers between 16-60years while for those over 60 years the incident was 13%. Drivers with binocular visual field loss were 2 times more likely to be involved in accidents than drivers without any loss.[23] North did a review on studies done to assess the influence of visual field on driving performance. He found no correlation between visual fields and accident rates and suggested that this could be due to the differences in the techniques used to measure the visual fields. The fact that drivers with deficit may partly overcome their head turning and restricting their driving also plays a role.[24]

The visual field is restricted in drivers with monocular vision. The driving performance of drivers with monocular vision has been assessed in several studies. Kite and King in their study found that monocularity is associated with a seven-fold increase in accidents at road junctions.[25] Liesmaa showed that monocular drivers had more hazardous driving patterns than the control drivers.[26] Keeney and Garvay based on their review of literature concluded that monocular drivers should not be licensed to drive public service vehicles.[27]

Colour vision

In the USA color vision is tested at license application. This is done to ensure that the drivers can obey color traffic control devices. Vingrys and Coles in their comprehensive review of literature on studies done on colour vision and road accidents concluded that there is no association between colour deficiency and road accidents.[28]

Age

Among the older drivers there is a decline in visual performance, an increase in reaction time, and general psychomotor slowing. Visual impairments are more prevalent in the older drivers and this is thought to play a role in the etiology of older driver's crashes, which result in injury.[2]

Wood in his study found that older drivers have more road accidents than the younger drivers. He recommended that older drivers should restrict their driving to off-peak hours and daytime driving.[29]

RATIONALE

The number of road traffic accidents in this country has been on the increase with 82% of the accidents being due to human error. No study has been done to find whether there is any association between visual impairments and road traffic accidents. This study will determine whether poor vision plays any role in accidents.

Forty two percent of accidents that result to serious injuries involve public service vehicles. The study will therefore concentrate on this category of drivers.

The law requires that vision screening be carried out before issuing of a driving license. However, this is not routinely done. The study will assess the percentage of drivers that got their driving license without having their vision screened.

OBJECTIVES

Broad

To assess the vision of PSV drivers.

Specific

1. To determine the proportion of drivers with inadequate visual acuity for driving and whether there is any association between visual acuity and road accidents.

2. Determine the proportion of drivers that had their vision tested before licensing.

3. Determine the proportion of drivers that have ever had an eye check up done.

4. Determine the visual fields of the drivers.

METHODOLOGY

Study design:
Cross-sectional study

Reference population:
PSV drivers in Nairobi.

Source population:
PSV drivers in 10 terminus in Nairobi.

Sample population:
Random sample of PSV drivers from 10 terminus in Nairobi .

Sample size:

$$N = \frac{Z^2\ 1\text{-}\alpha/2\ P(1-P)}{d^2} \times D$$

Where:
Z = standard errors form mean corresponding to 95% confidence interval.

P = Proportion of drivers with inadequate visual acuity. (6.5%)

α = 5% significance level.

d = absolute precision (5%)

D = design effect

$$\frac{0\ 1.96^2 \times 0.065 \times 0.935}{0.05^2} \times 1$$

$$= 94$$

The minimum sample size required was 94. However 539 PSV drivers were examined.

Study period.
October 2000 to April 2001

Inclusion criteria:

- PSV driver
- Informed consent

Exclusion criteria:

- Refused to give consent

Instruments:

- Questionnaire
- Snellens chart
- 20D Volk loupe
- 90 D Volk loupe
- Direct ophthalmoscope (Heine)
- Indirect ophthalmoscope (Heine)
- Ishahara colour plates.
- Pin hole

PROCEDURE :

The drivers were selected by simple random sampling from 10 terminuses in Nairobi. Every third driver to arrive at the terminus was selected for the study. The selected drivers were then examination in offices near the terminus. The drivers age and name were first recorded .The drivers were then asked about vision screening before obtaining their licence, previous eye check ups, their driving experience and their accident history in the last 3 years. The accident history included both minor and major accidents. All the information obtained was filled in the questionairre. (Appendix 1)

The vision for each eye was then determined using the snellens chart. Those who did not have a VA of 6/6, the vision was taken again using the pinhole to determine the best possible vision. The drivers requiring refraction were referred to eye clinic in KNH. The

colour vision was then assessed using the ishahara colour plates and visual field by confrontation visual field testing.

The anterior segment was then examined with a light source and +20 volk loupe. The posterior segment was then examined with a direct or indirect ophthalmoscope.Those requiring dilatation were dilated with tropicamide 1% if they were not going back to work or were referred to the eye clinic.Those found with CDR >0.5 were also referred to the eye clinic for visual fields testing to be done with Humphrey automated visual field machine. All the data was filled in the questionairre.(Appendix 1)

Limitations

1. Five percent of the selected drivers refused to be included in the study.
2. There was loss of follow-up of the patients referred to the eye clinic for further examination.
3. The accident data was self-reported and this could have lead to under reporting of the accidents.

Ethical consideration.

Informed consent was obtained before participation and all the data collected was confidential. Any driver found with any disease was referred for medical attention.

Data management.

Data management and analysis was done using the statistical package for social sciences programme.

RESULTS:

Table 1: Drivers that were examined(N =539).

	Number of drivers	Percentage %
Matatu	323	60
Bus	216	40
Total	**539**	**100**

A total of 539 PSV drivers were examined. Three hundred and twenty three (60%) were matatu drivers while 216 (40%) were bus drivers

Table 2: Sex Distribution (N=539).

SEX	NUMBER OF DRIVERS	PERCENTAGE %
Male	537	99.6
Female	2	0.4
TOTAL	**539**	**100**

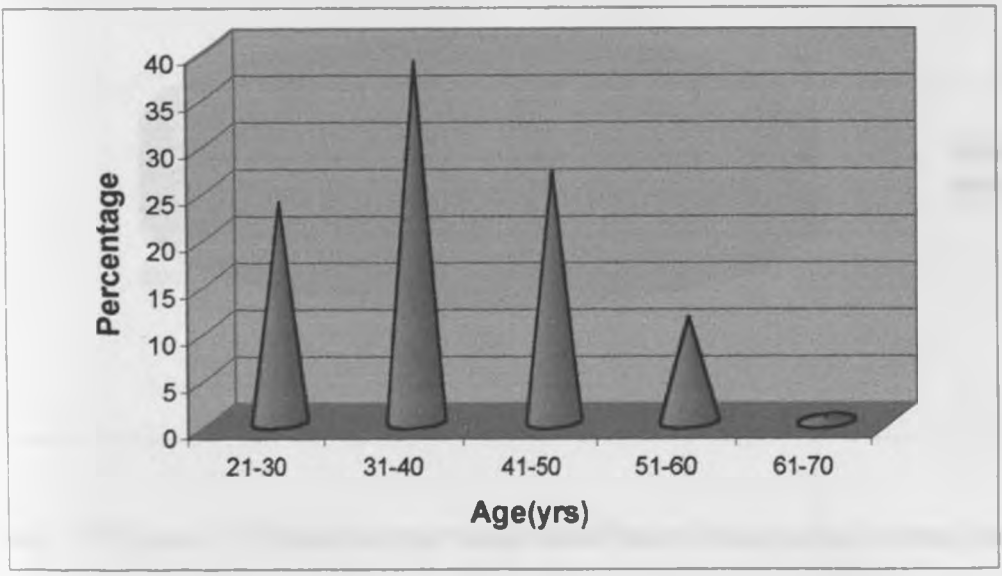
There were only 2 (0.4%) female drivers in the study.

Age Distribution (N=539).

Table 3:

Age (years)	Number of drivers	Percentage %
21-30	126	23.4
31-40	207	38.4
41-50	144	26.7
51-60	60	11.1
61-70	2	0.4
TOTAL	**539**	**100**

Fig. 1



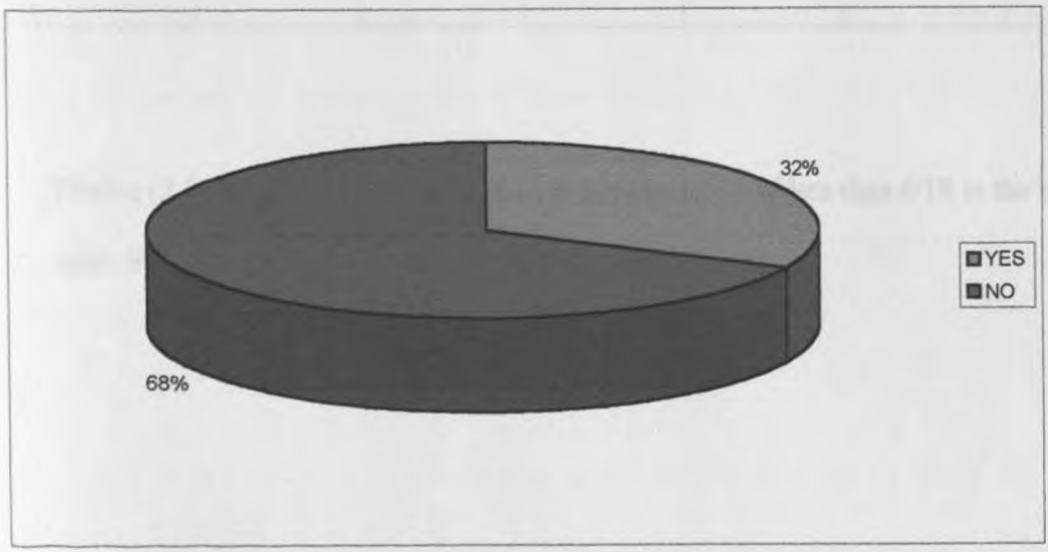
The mean age of the drivers was 38.3years with a standard deviation of 9.2years. The mode was 40 years while the median was 38 years.

Drivers who had their vision tested before obtaining their driving license (N=539)

Table 4

Vision tested	Number of drivers	Percentage %
YES	174	32
NO	365	68
TOTAL	**539**	**100**

Fig. 2



Only 174 drivers (32%) had had their vision tested before obtaining their driving license.

Table 5: Visual acuity in the better eye.

VA	Bus drivers N =216	%	Matatu drivers N =323	%	Total N=539	%
6/6	148	68.5	254	78.6	402	74.6
6/9	31	14.2	38	11.8	69	12.8
6/12	23	10.6	15	4.6	38	7.0
6/18	10	4.6	8	2.5	18	3.3
6/24	3	1.4	7	2.2	10	1.9
6/36	1	0.1	1	0.3	2	0.4
6/60	0	0.0	0	0.0	0	0.0
TOTAL	**216**	**100**	**323**	**100**	**539**	**100**

Twelve (2.3%) of the drivers were visually impaired (VA of less than 6/18 in the better eye). Four were bus drivers and seven were matatu drivers.

Table 6: Visual acuity in the worse eye.

VA	Bus drivers N=216	%	Matatu drivers N=323	%	Total N=539	%
6/6	104	48.1	215	66.7	319	59.1
6/9	33	15.3	48	14.8	81	15.0
6/12	31	14.4	17	5.3	48	8.9
6/18	31	14.4	25	7.7	56	10.4
6/24	11	5.1	4	1.2	15	2.8
6/36	5	2.3	10	3.1	15	2.8
6/60	0	0.0	1	0.3	1	0.2
HM	1	0.4	0	0.0	1	0.2
PL	0	0.0	1	0.3	1	0.2
NPL	0	0.0%	2	0.6%	2	0.4%
TOTAL	**216**	**100%**	**323**	**100%**	**539**	**100.%**

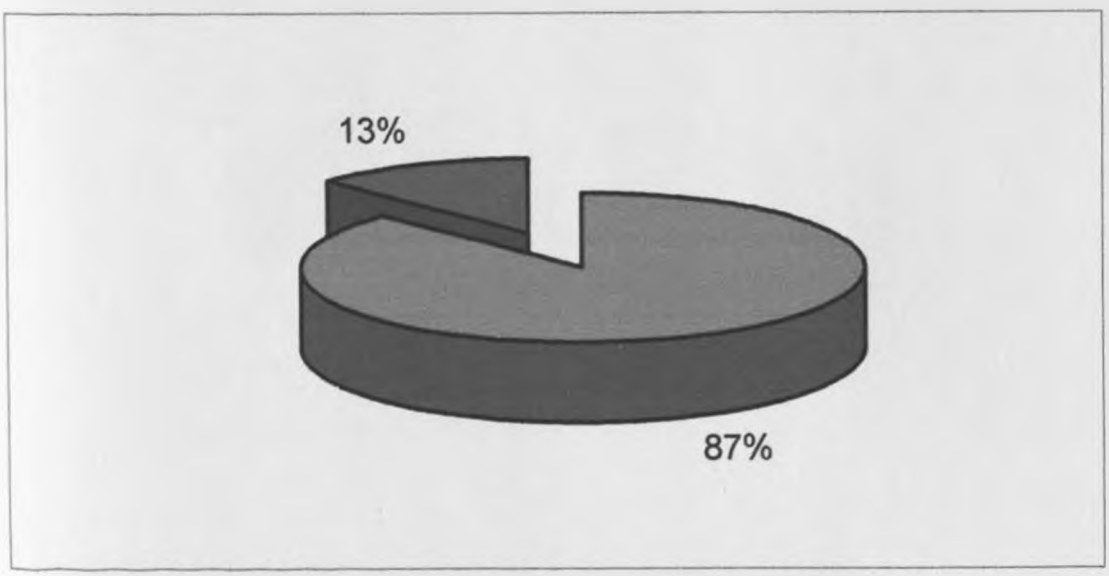
A total of 319 drivers (59.1%) had visual acuity of 6/6 in both eyes. Four (0.8%) of the drivers were blind in one eye. Sixty six point seven percent of the matatu drivers had VA of 6/6 in both eyes compared to 48.1% of the bus drivers.

Drivers that met the visual acuity requirement for driving (N=539)

Table 7

VA in the better eye	Number of drivers	Percentage %
≥6/9	471	87
<6/9	68	13
Total	**539**	**100**

Fig 3:



Four hundred and seventy one drivers (87%) met the visual acuity requirements for driving.

Table 8: Drivers involved in accidents (N=539).

Accident involvement	Bus drivers		Matatu drivers		TOTAL	
	N=216	%	N=323	%	N=539	%
YES	136	62	82	25	218	40
NO	80	38	241	75	321	60
TOTAL	**216**	**100**	**323**	**100**	**539**	**100**

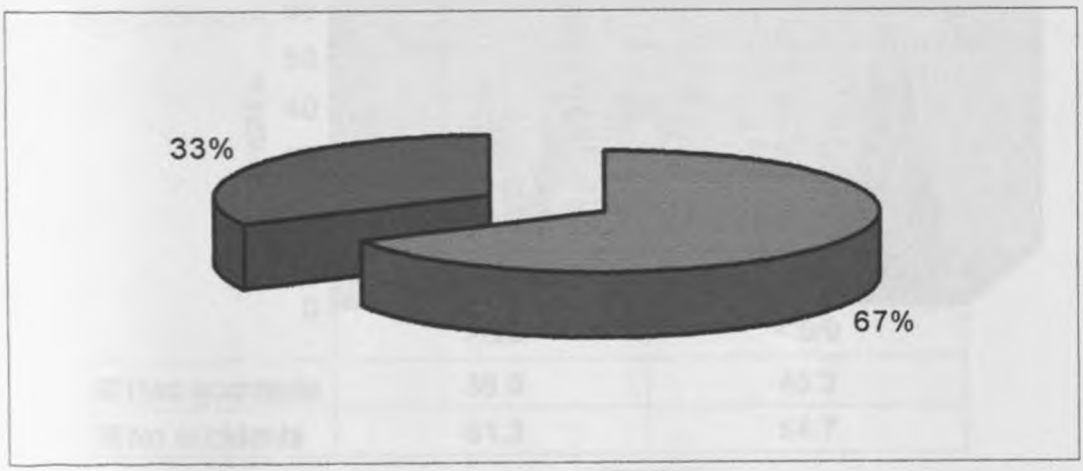
A total of 218 (40%) drivers had been involved in accidents in the last 3 years, 62% were bus drivers while 82 (38%) were matatu drivers.

Drivers blamed for causing the accidents (N =218)

Table 9

Accidents	Number of drivers	Percentage %
BLAMED	147	67
NOT BLAMED	71	33
Total	**218**	**100**

Fig.5



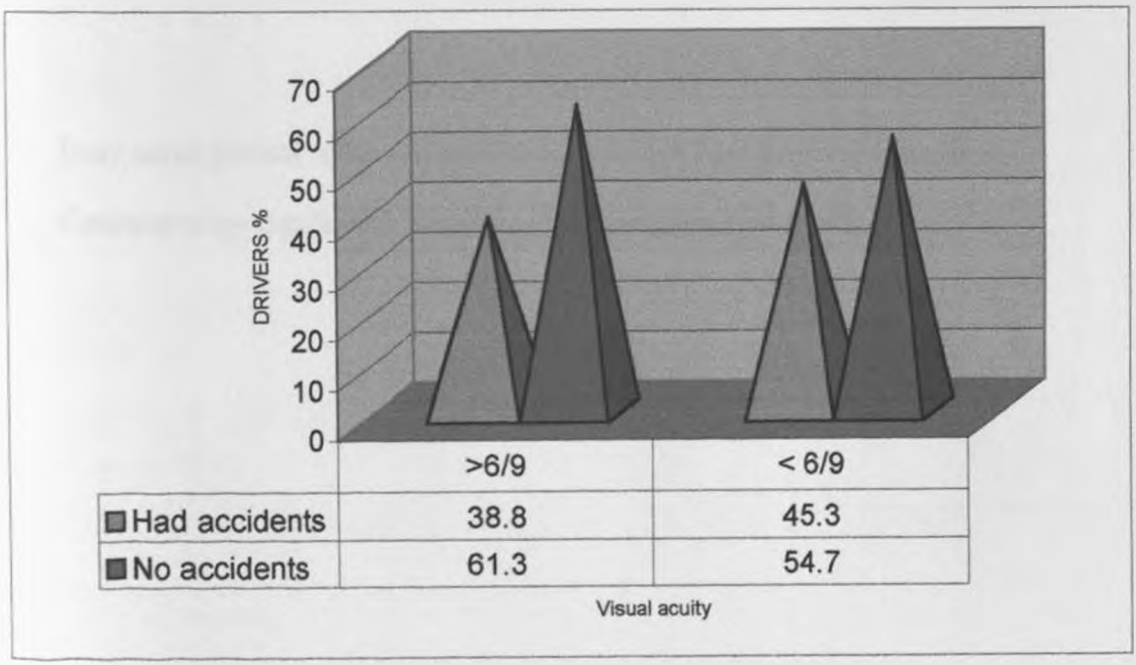
A hundred and forty seven (67%) drivers were to blamed for causing the accidents, 79% were bus drivers while 21% were matatu drivers.

The association between visual acuity and accidents.

Table 10

	VA ≥ 6/9		VA < 6/9	
	N=400	%	N= 139	%
Drivers involved in accidents	155	38.8	63	45.3
Drivers not involved in accidents	245	61.2	76	54.7
Total	**400**	**100**	**139**	**100**

Fig 6:



Thirty eight point eight percent of drivers with VA of 6/9 or better in both eyes had been involved in accidents. While for drivers with VA of less than 6/9 in both eyes 45.3% had been involved in accidents. This study did not show any significant association between VA and accidents ($p = 0.76$).

Table 11: The association between cataract and accidents

	Cataract N= 24	%	No Cataract N=515	%
Drivers involved in accidents	16	67	202	39
Driver not involved in accidents	8	33	313	61
Total	**24**	**100**	**515**	**100**

Sixty seven percent of the drivers with cataract had been involved in accidents.

Cataracts were significantly associated with accidents ($p = 0.007$).

Table 12 : Colour vision assessment.

Colour vision	Number of drivers N =539	Percentage %
Normal	530	98.3
Deficient	9	1.7
Total	**539**	**100**

Nine drivers (1.7 %) had colour vision deficiency.

Table 13: Relationship between colour vision and accidents

	Normal colour vision N= 530	%	Colour vision deficiency N= 9	%
Drivers involved in accidents	213	40.2	5	55.6
Driver not involved in accidents	317	59.8	4	44.4
Total	530	100	9	100

Fifty five point six percent of the drivers with colour deficiency had been involved i accidents as compared to 40.2% of drivers with normal colour vision. However th difference was not statistically significant ($p = 0.27$).

Table 14: Visual Fields testing.

Visual Fields	Number of drivers N = 539	Percentage %
Normal	527	97.8
Constricted	12	2.2
Total	**539**	**100**

Twelve (2.2%) of the drivers had constricted visual fields.

Table 15: The association between visual fields and accidents.

	Normal visual fields N= 525	%	Constricted visual fields N=12	%
Drivers involved in accidents	213	40.4	5	41.7
Driver not involved in accidents	312	59.6	7	58.3
Total	**523**	**100**	**12**	**100**

Forty point four percent of the drivers with normal visual fields had been involved in accidents as compared to 41.7% of drivers with constricted visual fields.

There was no significant association found between visual fields and accidents ($p = 0.57$).

Table16: Presenting complaints (N=539)

Complaint	Drivers	Fercentage %
Allergy symptoms	105	15.1
Glare	90	13
Inability to read small print	76	10.9
Poor distant vision	25	3.6
No complain	399	57.4
Total	**695**	**100**

Allergy symptoms: Itchiness, photophobia, foreign body sensation and redness of the eyes.

The total is greater than 539 because some drivers had more than one complaint. A hundred and forty drivers had problems with their eyes. However only 37 (27%) of these drivers had sought medical attention for their problem.

Table 17: Ocular findings (N=539).

	Number of drivers	Percentage %
Refractive error	192	29.2
Allergic conjunctivitis	105	16
Incipient cataract	24	3.6
Exotropia	4	0.6
Retinal detachment	2	0.3
Non proliferative diabetic retinopathy.	2	0.3
Cornea foreign body	1	0.2
Pthisis bulbi	1	0.2
Maculopathy	1	0.2
Macular scar	1	0.2
Normal findings	323	49.2
Total	**656**	**100**

N is greater than 539 because some drivers had more than one finding. There were 192 (33.6%) drivers with refractive errors. One of the drivers had a cornea foreign body and 2(0.4%) of the drivers had retinal detachment in one of their eyes.

Table 18: Drivers that had eye examination prior to the study.

Eye check up	Number of drivers N =539	Percentage %
YES	127	24
NO	412	76
TOTAL	**539**	**100**

One hundred and twenty seven (24%) drivers had had an eye check up prior to the study.

DISCUSSION:

The study was carried out in Nairobi. A total of 539 PSV drivers were examined, 323 (60%) were from the informal sector and 216 (40%) were from the formal sector (table 1).

There were 539 (99.6%) male drivers and only 2 (0.4%) female drivers (table 2). Men for along time have dominated this field and it is only recently that a few women have ventured into it. It is a very demanding and stressful job with long working hours: sometimes from 4.00 am to 11.00 pm. This could explain why few women have ventured into the field since traditionally they are expected to stay at home taking care of their families while such jobs would keep them away from home. The age of the drivers ranged from 21yrs to 65 years with a mean age of 38.3 years and a standard deviation of 9.2 years (table 3).

The law requires that driver's vision be checked before issuing the driving license. This is carried out by the traffic police officers when one goes for the driving test. In this study only 174 (32%) drivers had had their vision tested before obtaining their drivers license (table 4). Majority of the drivers (68%) obtained their driving licence without having under gone the test. This shows that there is some laxity on the law enforcers as far as vision testing is concerned which could be due to ignorance to the importance of drivers having good vision.

The vision in the better eye ranged from 6/6 to 6/36 while in the other eye from 6/6 to no perception of light (table 5, 6). A total of 319 (66.7%) drivers had VA of 6/6 in both eyes and only 2.3% of the drivers were visually impaired according to WHO classification. Seventy three percent of the drivers with visual impairment claimed that they had good vision indicating that they were not aware that they had a problem with their sight. It is important for routine vision testing to be done as required by the law so that such drivers can be made aware of their problem and be advised to go for proper eye examination and treatment. The average age of drivers with normal vision was 37.5yrs while the average age for those with visual impairment was 42.6 years ($P<0.001$).

Four (0.8%) of the drivers were blind in one eye and three of whom had been involved in accidents. In the UK, USA, Germany and South Africa drivers with monocular vision are not allowed to drive public service vehicles. Kite and King in their study found that monocularity is associated with a sevenfold increase in accidents at road junctions.[25] Liesmaa showed that monocular drivers had more hazardous driving patterns than the control drivers.[26] Keeney and Garvay based on their review of literature concluded that monocular drivers should not be licensed to drive public service vehicles.[27]

The traffic act in Kenya states that a driver should be able to read a motor vehicle identification plate at a distance of 25 metres.[5] The act does not specify the size of the letters and figures in the number plate nor the lighting conditions. It does not also specify

the vision requirements using the Snellens chart. In Kenya the standard number plates have letters and figures that are 84mm in height. Given that the number plate should be 25m away then each letter subtends a visual angle of 13.3 minutes of arc. This corresponds to a VA of approximately 6/9. To be able to pass the number plate test the minimum visual requirement is 6/9. Four hundred and seventy one drivers (87%) had VA of 6/9 or better in the better eye and thereby met the visual acuity requirement of obtaining a driving licenses. Sixty-eight (13%) drivers failed to meet the vision requirements for obtaining a driver's license (Table 7). Davison in his study done in U.K. found that 4% of the drivers failed to meet the vision requirement for driving.[10] Mantyjarvi in his study in Finland found a failure rate of 6.5%[9] while Harms et al in Germany found 9%.[11] The failure rate in this study was high when compared to that of other studies. It was almost four times that in U.K. This can be attributed to the fact that vision screening is not routinely done before issuing of the driver's license and also during the renewal of the PSV license. If the PSV drivers in this study were to go to UK then 15% of them would not meet the visual acuity requirement for a PSV driving license.

The traffic act in Kenya does not take into consideration the VA in the worse eye, which was less than 6/12 in 15% of the drivers. It also does not comment about monocular drivers and whether they should be allowed to drive PSV. In countries such as UK, USA and Germany, the law takes into consideration the VA in the worse eye and this should at least be 6/12.[6,7]

The most common cause of inadequate vision for driving in this study was refractive errors (33.6%). Guest and Jennings in their study in Australia found that almost all the drivers that failed to meet the visual requirement for obtaining a driving license had refractive errors.[6] Davison and Harms also found refractive errors to be the most common cause of inadequate vision for driving in their studies in UK and Germany respectively.[10,11] This is a problem that can be corrected and if the drivers could be made aware of their problem, and made to understand the importance of having it corrected, then the percentage of drivers with inadequate vision for driving would decrease.

There were 218 drivers (40%) that had been involved in accidents, 67% of whom were to blame (table 8, 9). The average age of those involved in accidents was 40.4yrs while that of those not involved was 36.9yrs. The difference in age was statistically significant ($P<0.001$). This showed that older drivers were involved in accidents more than younger drivers. This is in keeping with the study done by Wood and Troutbeck in which they found that older drivers had an increased risk of being involved in accidents.[29]

In table 10, we see that 45% of the drivers with inadequate vision for driving had been involved in accidents as compared to 38% of the drivers that met the vision requirement. There was a weak association between visual acuity and accidents, however this was not statistically significant ($p=0.76$). This could be due to the fact that some of the drivers selected for the study refused to be included. These drivers may have had poor vision and for fear of being incriminated they refused to be examined. In addition, the accidents were self reported which may have lead to under reporting. Burg examined 17,500

drivers and he did not find any association between poor visual acuity and accidents amongst the young drivers. In the older drivers he found only a weak association between visual acuity and road accidents.[22] Owsley, after reviewing the studies done on vision and driving came to the conclusion that most of the studies done had failed to show a strong association between visual acuity and road accidents.[7]

Given that VA is the most commonly used screening test it is paradoxical that research generally does not support the conclusion that it can reliably identify high-risk drivers. The existing variability with respect to visual acuity requirements for licensing drivers is equally puzzling and may reflect arbitrary decisions as to what level of acuity a driver should possess in order to safely operate an automobile. There are possible reasons why studies have failed to find a strong association between visual acuity and accidents. First, the visual acuity tests used do not by themselves reflect the visual complexity of the driving task test. Secondly, driving a vehicle involves the simultaneous use of central and peripheral vision and requires monitoring of primary and secondary tasks, all in the midst of a visually cluttered environment. Lastly the visual world is in motion and in this regard stationary test targets used in screening tests are not very representative of the visual real scene.

Twenty- four of the drivers had incipient cataracts. Sixty- seven percent of them had been involved in accidents compared to 39% of those that had no cataracts (table 11). The presence of cataract was associated significantly with accidents (P=0.007). Drivers with

cataracts were 3 times more likely to be involved in accidents than those without (relative risk 3). This is in keeping with Owsley study, which found a relative risk of 2.5 [12]

On colour vision, nine drivers (1.7%) had colour vision deficiency (table 12). No significant association was found between colour deficiency and accidents (p = 0.3). Vingry also did not find any association between colour deficiency and accident involvement.[29]

Visual field screening was done using confrontation visual field test. More accurate testing was to be done on the PSV drivers that were referred to the eye clinic. However majority of the drivers referred did not turn up. Visual fields were normal in 97.8% of the drivers (table 14). Visual field impairment was not associated with accidents (0.57%). This was not in keeping with other studies done by Johnson and North.[23,24] This can be explained by the fact that confrontation visual field testing may not have been sensitive enough to detect the visual field defects. Johnson and Keltner in their study in UK found the incident of visual field loss to be 3-3.5% for persons aged between 16–60 years. They also found that binocular field loss was significantly associated with accidents.[23]

One hundred and forty drivers (26%) had ocular complaints (table 16). They complained of itchiness, foreign body sensation, glare, poor distant vision and inability to read small print. Twenty seven percent of them had sought medical attention while 73% despite their complaints had not. This could be due to the fact that they were paid on a daily basis and

taking time off go to hospital would have meant losing their day's wages. It could also be that the drivers were unaware of the impact their problems would have on safe driving. Glare for example is associated with an increased risk of night time accidents.[1] One of drivers examined was found to have a cornea foreign body yet he was just about to drive to Kampala which is 600 kilometres away. Other significant findings on examination as seen on table 17 included retinal detachment in 2 drivers, phthisis bulbi in 1 driver and a macular scar in another. Only 127 (24%) drivers had had eye examination prior to this study (table 18).

Given that there were several drivers with ocular problems and that some of the ocular findings were significant then regular visual examination should be legislated. The percentage of drivers that didn't meet the visual acuity requirement for driving was high. However this study only found a weak association between visual acuity and accidents. A significant association may be found if a larger sample size is used and the state accidents record used rather than relying on self reported accidents.

CONCLUSION:

1. The proportion of drivers that did not meet the visual acuity requirements for driving was higher than in studies done elsewhere.
2. Vision screening is not routinely done before issuing of the driving license. Only 32% of the drivers had their vision screened before obtaining their driving license.
3. Cataracts were significantly associated with accidents. There was a weak association between visual acuity and accidents though it was not statistically significant. No significant association was found between colour vision deficiency, visual fields defects and accidents.
4. Older drivers were involved in accidents more than younger drivers.
5. There were drivers who had eye problems yet they had not sought any medical attention. Most were having eye check up for the first time.

RECOMMENDATIONS:

1. Regular testing of the visual acuity should carried out on all the PSV drivers to ensure that they have adequate vision for driving. This can be done when they go to renew their PSV license. A qualified eye specialist should examine drivers above the age of 40years.
2. The traffic act should take into consideration the visual acuity in both eyes to ensure that drivers that are blind in one eye don't end up driving public service vehicles.
3. Most of the drivers had obtained their driving license without having their vision tested. The traffic police officers should be made aware of the importance of assessing the visual acuity of the drivers. They should also be trained on how to assess visual acuity. Medical personnel should be incorporated in the vision screening of the drivers so that those drivers with ocular problems can be identified and referred accordingly.
4. This study showed only a weak association between visual acuity and accidents. This could have been due to under reporting of the accidents. Another study should therefore be done on drivers involved in accidents to determine whether visual impairment plays any role in causing the accidents.

QUESTIONAIRE **STUDY NO.**----------

NAME: ----------ROUTE----------

AGE: ---------- SEX: ----------

1. Do you have any problem with your sight? YES---------- NO----------
b. What problem. ----------
2. Have you ever had an eye checkup? YES---------- NO----------

3. Was your vision checked before you got your license?
YES-------- NO--------

4. Have you been involved in an accident in the last 3yrs? YES---- NO -----
b. If yes how many times? -------- ----------
c. How many were you blamed? ----------
5. For how long have you been a driver? ----------

EXAMINATION:

	RIGHT EYE	LEFT EYE
Visual acuity:	----------	----------
Pinhole	----------	----------
Conjunctiva:	----------	----------
Cornea:	----------	----------
Anterior chamber:	----------	----------
Pupil:	----------	----------
Lens:	----------	----------
Fundus: Disc:	----------	----------
CDR	----------	----------
Macular:	----------	----------
Peripheral retina:	----------	----------
Colour test:	----------	----------
Confrontation test:	----------	----------

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