VISION AMONG BODABODA MOTORCYCLE RIDERS IN KISUMU

A DISSERTATION SUBMITTED AS PART FULFILMENT FOR THE DEGREE OF MASTER OF MEDICINE IN OPHTHALMOLOGY, UNIVERSITY OF 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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DEDICATION

This work is dedicated to:

My wife, Dr. Nyambura Wanjiru-Korir

My daughter, Larhette Korir

Almighty God for grace and provision.

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LIST OF ABBREVIATIONS

Bodaboda	Border to Border transportation by bicycles and motorcycles
CI	Confidence Interval
CAP	Chapter
CDR	Cup Disc Ratio
DVLA	Driver and Vehicle Licensing Agency
FDT	Frequency Doubling Technique
HVF	Humphrey's Visual Field
KNH/UON – ERC	Kenyatta National Hospital / University of Nairobi – Ethics and Research Committee
LogMAR	Logarithm of Minimum Angle of Resolution
MAIDS	Motorcycle Accidents in Depth Study
MS Excel	Microsoft Excel
PGH	Provincial General Hospital
PSV	Public Service Vehicle
RTA	Road traffic accidents
SPSS	Statistical Package for Social Sciences
USA	United States of America
VA	Visual Acuity
WHO	World Health Organisation

ABSTRACT

Title: Vision among bodaboda motorcycle riders in Kisumu

Objectives

To determine the proportion of bodaboda motorcycle drivers with inadequate vision for riding and its association with road traffic accidents in Kisumu.

Method

This was a cross section study conducted on bodaboda motorcycle riders in Kisumu. All the participants had visual acuity assessment using LogMAR visual chart, colour vision using Ishihara colour plates, stereopsis using Titmus fly test and visual field assessment by confrontation. History regarding the number of major and minor accidents the rider had been involved was be documented. Riders found to have inadequate vision or eye diseases were referred to New Nyanza Provincial General Hospital for treatment. Data was entered into a questionnaire and analysed using SPSS version 17.0. A significance level 95% was used.

Results

A total number of 186 bodaboda motorcycle riders were evaluated. Eleven riders of which two had single eyes refused to consent to participate. All were male and with a mean age of 31.3 years. Five (2.7%) of bodaboda motorcyclist riders had their vision assessed prior to licensing. Most bodaboda riders had eye complaints (58.1%) and the commonest complaints were tearing (17.2%), poor vision (9.7%), photophobia (8.1%) and itching (8.1%). Five (2.7%) bodaboda motorcycle riders had inadequate visual acuity for riding. Four (2.2%) bodaboda riders had red green colour deficiency. The proportion of bodaboda motorcyclists with poor or no stereopsis was 4.3% and those

with constricted confrontational visual fields were 2.7%. Majority (56%) of the bodaboda motorcycle riders had been involved in minor accidents. There is no association between visual acuity, colour vision, confrontational visual fields and rate of road traffic accidents involving motorcycles in this study.

Conclusion

Majority of the bodaboda riders were young adults and met the visual requirements for riding. There was no statistical significance between vision and rate of accidents in this study. This is likely due to low number of participants and particularly by riders with eye diseases. Majority of the bodaboda riders had eye complaints and have never had an eye evaluation. Visual assessment prior to licensing needs to be increased, a larger study assessing vision and ocular morbidity in bodaboda riders is recommended.

1. INTRODUCTION

Road traffic accidents is the world's leading cause of death as a result of injury.[1] 1.2 Million people worldwide and 3000 Kenyan die each year from roads traffic accidents.[2] The most vulnerable road users to die from RTA are pedestrians, pedal cyclists and motorcyclists.[3]

Kenyan public transport system is made up of buses, mini vans, taxis and recently motorcycles. Motorcycles in the country are used commercially for courier and delivery services, public and private transport service. Bodaboda originally started as bicycles that would transport passengers and goods across Kenya – Uganda border (border to border) in the 1960s and 1970s at Busia and Malaba towns. The two wheeled pedal bicycles have been replaced by the motorcycles recently and spread to different cities and towns in Kenya. There has been an increase in number and use of motorcycles in Kenya since 2008. Some of the reasons are that they provide employment for the youth, their ability to meander through traffic congestion and also the ability to ply inadequately maintained earth roads more easily than buses and cars.[4] The Kenya Economic Survey 2011 shows there has been a massive increase in the motor cycles accounting 59.7% of new motor vehicles registered in 2010. In 2010, 117,266 units of motorcycles were imported compared to 3,176 units in 2000. Currently the country has an estimated 370,232 motorcycles compared to 44,894 in year 2000.[5] The rise in motorcycles and other two wheelers is comparable to other low income and middle income countries such as India, China, Thailand and Malaysia.[2]

Motorcycle road traffic accidents have increased significantly causing some hospitals to set up special wards such as New Nyanza Provincial General Hospital and Kitale District Hospital to cater for victims in their respective regions. There has been public outcry on the numbers of people involved in motorcycle accidents and concerns of individuals riding without adequate training and licensing.[6] Road traffic accidents injuries has been found to increase with rise in motorcycle numbers and this has been observed in Vietnam, China (Taiwan province) and Malaysia.[2]

1.1 Risk Factors associated with motorcycle accidents.

Motorcyclists are 20 times at risk of death and severe injuries than car occupants.[3] They sustain multiple injuries, including head, chest and legs either due to direct contact with the impacting vehicle or as a result of being crushed.[2,7] Ocular injuries associated with motorcycle accidents commonly involve lids, conjunctiva and cornea.[4]

This is because they share the traffic space with fast moving cars, buses, trucks. The shape and size of the motorcycle make it less easy to see and have poor visibility at daytime.[8] Most crashes occur at daytime.[9] Turning headlights on is protective with crash rates 10 to 29% less than of those without.[2] Use of bright coloured jackets, orange or yellow increases visibility of the motorcyclist significantly reduce the rate of accidents.[8] Kenyan Traffic act CAP 403 requires every motorcyclist to run daylights on.

Male individuals aged between 21 – 30 years of age are at risk of motorcycle accidents and injuries. About 86.6 to 96% of motorcycle accident victims involving motor vehicles are Male.[3, 8, 19]

1.2 Riding Visual Standards Overview

Vision is the most important sensory input while riding. The rider should be able to see the traffic signs, obstacles, the road and other road users while moving at maximum speed at daylight or night.[10] The aspects of visual evaluation prior to licensing vary in different countries.

Kenya, Canada, United Kingdom and Australian standards are discussed. United States Standards are omitted as they vary in each State.

1.2.1 Canada

Visual acuity requirements for taxi or commercial use with both eyes open should not be less than 6/12 and the worse eye 6/60. Visual Field requirements are 120 continuous degrees along meridian and 15 degrees above and below fixation with both eyes opened and examined together.

Diplopia within 40 degrees is incompatible with riding. Such patients are evaluated by ophthalmologists or optometrists and treated with patching or prisms and undergo an adjustment period of 3 months. Colour Vision is not a requirement for commercial motorcycles. Emergency vehicle drivers are required to have a normal colour vision. Contrast sensitivity, stereopsis, dark adaptation and glare recovery are mentioned and that riders should be made aware of these problems as they make riding difficult. No restrictions have been made.[11]

1.2.2 United Kingdom

Visual acuity: The rider must be able to read in good light with aid of (with aid of glasses or contact lens if worn) either old (Pre-September 2001) format number plate at 20.5m or new (Post September 2001) format at 20m. This corresponds to 6/10 Snellen acuity.

Visual fields: The riders must have at least 120 degrees horizontal (Goldman III4e setting or equivalent) and no significant defect in the binocular field encroaching within 20 degrees above and below the horizontal meridian. Where a rider has a fully adapted static, long standing defect DVLA may consider them as exceptional case.

Monocular riders may ride when clinically advised that they have adapted to the disability, satisfy the visual acuity requirement and have a normal monocular visual field.

Diplopia: Riders with uncorrected diplopia must not ride. Riding may be resumed if controlled; patching is acceptable subject to constraints above on monocularity.

Blepharospasm: Riders with severe blepharospasm must not ride. Those with mild, successfully treated, blepharospasm may drive subject to Ophthalmology consultant approval.[12]

1.2.3 Australia

Visual acuity of 6/9 in their better eye, with a minimum of 6/18 in the other eye

Commercial motor vehicle riders are expected to have normal visual fields but a conditional licence may be issued if the binocular horizontal visual field is at least 140 degrees.

Monocular drivers may not hold a commercial driver's licence in Australia but may be issued with a conditional licence.[13]

1.2.4 Kenya

The motorcycle drivers attain a class “F” or “G” drivers licence after passing a riding test. The requirements of vision to pass the test as per the Kenyan Law is able to read, with glasses if worn, a motor vehicle identification plate at a distance of twenty-five metres.10 The Kenyan Standard number plates have letters and figures that use 84mm in height. Given that the number plates should be 25m away, each letter subtends a visual angle of 13.3minutes of arc. This corresponds to Visual acuity of 6/9 and LogMAR 0.2.

If the licensing officer notes an illness or disability that may hinder riding then he is authorised to refer the patient to a medical officer who will evaluate the applicants' fitness and make recommendations.[14]

Visual acuity is the only stipulated visual requirement in the Kenyan law. The conditions of taking the visual acuity are not clearly stated. There is no mention on whether the vision is taken binocularly, illumination, weather conditions, background colour, crowding effect and cleanliness of the number plate. These factors affect the clarity of the number plate and ultimate acuity of the subject as demonstrated by Kiel et al. No laws on monocular riders, diplopia, colour vision and visual field defects.

2. LITERATURE REVIEW

There is little doubt that the visual sense provides most of the information used by the vehicle driver, with only relatively minor contributions from hearing. It is therefore natural to ask if road traffic accidents are linked with visual defects.[10] Several studies have been carried out assessing visual impairment and motor vehicle driving. No Study has been done on motorcyclists.

2.1 Visual Acuity

Visual acuity is the most carried out screening test in most licensing departments worldwide. In Kenya a study by Mwangi et al on PSV drivers she found 68% did not have their vision assessed prior to licensing.[15]

Most studies done to assess visual acuity and occurrence of road traffic accidents have shown no association[15, 16] or weak association[10, 17, 18]. The most influential work was by Burg who analysed data from 17,500 California drivers. These analyses indicated that for young and middle-aged drivers, there was no relationship between poor visual performance and crash rates. With respect to older drivers, visual acuity demonstrated significant relationships with crash rates.[10]

Some of the reasons for this weak association include drivers with poor visual acuity may already be involved in an RTA and are incapacitated [19] dynamic visual acuity which is done as the head is moved may yield more association as opposed to the static visual acuity.[20] Patients with poor vision may be selectively driving only at the times they can cope. Elderly patients avoid driving at night when they have glare and cataracts. [21]

2.2 Visual Field

There are several studies indicating that restricted visual fields are associated with accidents. Johnson and Kelter used an automated perimetry in a sample of 10,000 applicants for a driver's licence, found that those with a field loss had crash and conviction rates twice those for drivers with normal visual fields. They found the incidence of visual field loss among applicants aged 16 to 60 years was 3%, half of whom were unaware of their visual field defect.[22] Fishman et al found no correlation between the visual field loss and the number of road crashes for drivers with field loss due to retinitis pigmentosa. However, he found that patients with retinitis pigmentosa were at a higher risk of road traffic accidents.[23] Elkington et al interviewed 214 glaucoma patients in Southampton regarding their driving and documented difficulties experienced by the patients such as parts of traffic light missing and near crash from suddenly appearing pedestrian or vehicle.[24] Slykz et al evaluated 40 glaucoma patients against 17 controls and subjected them to a driving simulator, they found significantly higher accidents in glaucoma patients, history from these patients also revealed that they had been involved in more accidents in the past 5 years compared to controls.[25]

Visual field screening has been a challenge in Africa and the two studies done by Adekoya et al and Mwangi et al were performed using confrontation method. Mwangi et al evaluated 539 drivers, 2.2% had visual defects. Adekoya et al evaluated 450 drivers, 4% of drivers had visual field defects. Both studies showed no association between road traffic accidents and visual field defects [15, 16]

2.3 Monocular vision

Studies done on monocular drivers have found no reduction in driving performance. Johnson & Kelter found no difference between drivers with controls.[22] Wood & Troutbeck performed a simulated monocular vision did not find a difference in driving performance with controls.[18] Keeney et al and Liesmaa et al found that the monocular patient are at a higher risk of junction accidents.[26,27]

2.4 Contrast sensitivity

Several authors have found some correlation between contrast sensitivity and driving performance. The test most widely used is the Pelli & Robson chart in which letters of constant size but gradually diminishing contrast are viewed to establish the contrast threshold. Wood and Troutbeck found high (0.71) correlations between Pelli-Robson scores and performance on a driving task in studies of the effect of various simulated visual impairments.[18] Contrast sensitivity is reduced commonly by cataracts. Drivers with cataracts were found to be 3 times more likely to be involved in road traffic accidents.[15, 21]

2.5 Colour vision

Drivers with protan colour deficiency regardless of their severity have been shown by Cole et al to have a reduced ability to see red signals. These drivers have a reduced ability to see the red traffic lights and brake lights.[28] Protan deficient individuals in

Australia are not eligible for commercial driving as the risk is thought to be higher as these drivers drive heavy truck, dangerous goods and spend more hours on the road. [13]

2.6 Stereopsis and Diplopia

Studies show correlation between stereopsis and driving performance. Humphris 1987 reported an association between stereopsis and driving ability of the brain injured.[29] Shute and Woodhouse (1990) consider that any apparent correlation between poor stereopsis and accident rate is more likely to be due other associated factors, such as lowered acuity in one eye.[30]

Diplopia: There is very limited publication on diplopia possibly because the risk appears obvious. Shute and woodhouse 1990 published a case report of a 23 years old with diplopia after a road traffic accident who was treated with frosting his glasses and was able to drive again.[29]

3. RATIONALE

There is rise in the motorcycle use in Kenya and associated increase in road traffic accident involving the motorcycle users. There is no literature looking at the vision of these riders yet vision is the main sensory input that the riders use in scanning the traffic. Eyes are also potentially at risk of injury from projectiles and tear film instability in riders who do not wear protective goggles.

A study on PSV motor-vehicle drivers in Nairobi had shown a high number (13%) of drivers had inadequate visual acuity.[15] This figure may be higher in motorcyclists as some may not have valid licences as they do not undergo formal training and testing.

WHO recommends research in all aspects to reduce deaths and injuries secondary to road traffic accidents. [2]

Results of the study will contribute to reduction of RTA involving this risky group of road users and contribute towards road safety.

4. OBJECTIVES

4.1 Broad objective

To determine vision among bodaboda motorcycle riders

4.2 Specific Objectives

1. To determine the proportion of bodaboda motorcycle riders with inadequate visual acuity for riding

2. To describe visual acuity of bodaboda motorcycle riders involved in road accidents.

3. To determine colour vision among bodaboda motorcycle riders

4. To determine stereopsis among bodaboda motorcycle riders

5. To determine visual field among bodaboda motorcycle riders

6. To determine the proportion of bodaboda motorcycle riders who had vision tested prior to licensing

5. METHODOLOGY

5.1 Study design

Cross sectional study design

5.2 Reference Population

Bodaboda motorcycle riders in Kisumu

5.3 Source Population

Consecutive sample of bodaboda motorcycle riders in Kisumu

5.4 Sample Population

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

Where:

N = the minimum sample size required (approximation)

Z = Standard normal deviation set at 1.96 which corresponds to 95% confidence interval

P = Proportion of drivers with inadequate visual acuity corresponding to PSV vehicle drivers. (13%) [15]

α = 5% Significance level

d = absolute precision (5%)

5.5 Minimum sample size: 174

5.6 Study Period: March 2012

5.7 Inclusion Criteria

Bodaboda motorcycle rider

Informed consent

5.8 Exclusion criteria

Refusal to give consent

5.9 Instruments

Questionnaire

LogMAR Chart

Isihara colour plates

Occluder

Pin hole

Red and White Pins

5.10 Procedure

5.10.1 Data collection procedure

Data collection was done by the principal investigator with assistance from an ophthalmic clinical officer – cataract surgeon and an optometry student. 25 termini of bodaboda riders were visited. All riders consenting to the study were enrolled until the desired sample size was reached. Consent was taken and confirmation that the rider was a holder of a motorcycle drivers licence (Class F and G) was done. A brief history was taken including the name initials, age, sex, vision screening prior to licensing, major and minor accidents involved and whether they were at fault. Minor injury was defined as injury that was treated at the site of the accident while Major injury was defined as injury requiring medical attention at a medical facility. All these were entered in a questionnaire. The rider underwent examination as detailed below.

5.10.2 Clinical procedures

Visual Acuity: Vision in each eye was determined using a LogMAR chart with the rider wearing their daily glasses or contact lenses if worn.

Lea Numbers LogMAR chart by Lea Test limited was placed 3 meters away from the seated rider under natural light. Each eye was occluded in turn and the rider read the smallest line they can. If a rider missed two or more letters in a particular row then the reading of the row above was taken. Riders with visual acuity of less than 0.2 LogMAR had their vision tested with a pinhole to determine best possible visual acuity. Riders with refractive errors were referred to New Nyanza Provincial Hospital for refraction.

Colour vision was assessed using Ishihara's Test for colour deficiency 24 colour plates (1996 edition). The plate was held 75cm from the subject and the plane of the paper tilted at right angle to the line of vision. An abbreviated 6 plate exam was done using plate 1, 2, 4, 8, 10 and 14. The results were recorded as Normal, Red Green anomaly or Colour blind.

Stereopsis was then tested using Titmus stereo optical Co, 3D Vectogram. The plate was held at 50 to 75cm. The polarized viewers were worn over glasses if the rider used them. The Titmus fly was presented and the subject was asked to pinch the wings of the fly with the thumb and the index finger. The book was turned at 90 and 180 degrees to rule out monocular clues. This provided gross stereopsis of 3000sec. Further examination was done using Stereotest- circles where the subject was presented with a series of sets of 4 circles and was asked to say the circle that seems closer to him or her. This was continued until the subject gives up or makes two successive mistakes.

All riders then underwent a confrontation visual field test. The rider sat the same level as the examiner. He was asked to open both eyes and look at the bridge of the examiners nose and report if any part of the face appeared to be missing to asses for gross homonymous defects. The rider then underwent a peripheral visual field test in which he was instructed to occlude the non-testing eye. Using a white pin the examiner mapped out the visual field from unseen to seen. This was repeated with a red pin to map out central defects. Mono-ocular riders were regarded as having constricted visual fields. All riders with abnormal fields were referred to New Nyanza PGH for further evaluation and management. All data was entered in the questionnaire.

Riders found to have serious eye diseases endangering their vision or impairing their riding were counselled and referred for appropriate treatment and follow up at New Nyanza Provincial General Hospital.

5.11 Limitations

The accident data collected was self-reported and this could lead to under reporting. Eleven (5.6%) of motorcycle riders refused to give consent of whom two were mono ocular. This suggests that more riders with serious eye diseases may have refused to participate in the study. Visual field by confrontation is not an accurate method for visual field assessment. Only the principal investigator performed all the confrontational visual field assessment for consistency.

5.12 Data Management and Analysis

Data was coded and entered into a MS Excel® spreadsheet. Analysis was performed using SPSS version 17.0. The demographic characteristics of the population were described using age, sex and years of riding. Categorical data was summarised into proportions while continuous data was presented as means/medians. The factors associated with road accidents was analysed using Chi-square and Student's t-tests for categorical and continuous data respectively. Results were presented using graphs and tables. All statistical tests will be performed at 5% level of significance (95% Confidence Interval).

6. ETHICAL CONSIDERATION

Ethical approval was sought and granted from Kenyatta National Hospital / University of Nairobi – Ethical Research Committee.

The Ophthalmologist at New Nyanza Provincial General Hospital through the Medical Superintendent was informed of the proposed study and that some riders were to be referred for further evaluation and treatment after screening. The riders met their own cost of treatment at the New Nyanza PGH.

The riders gave a voluntary informed consent before participating in the study. No coaxing on incentive methods was used.

Data collected was handled confidentially. Those that are found to have eye diseases were referred to New Nyanza Provincial General Hospital.

7. RESULTS

The study was conducted over a period of 3 weeks. During this period a total of 186 motorcycle riders were examined in different termini in Kisumu. 11 riders refused to give consent to participate.

Figure1: Flow Chart of Participants

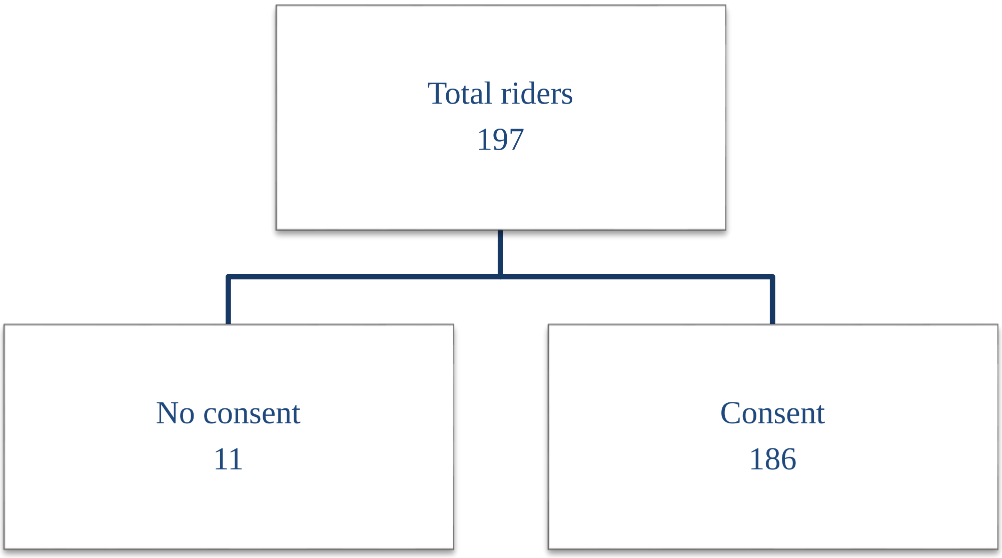
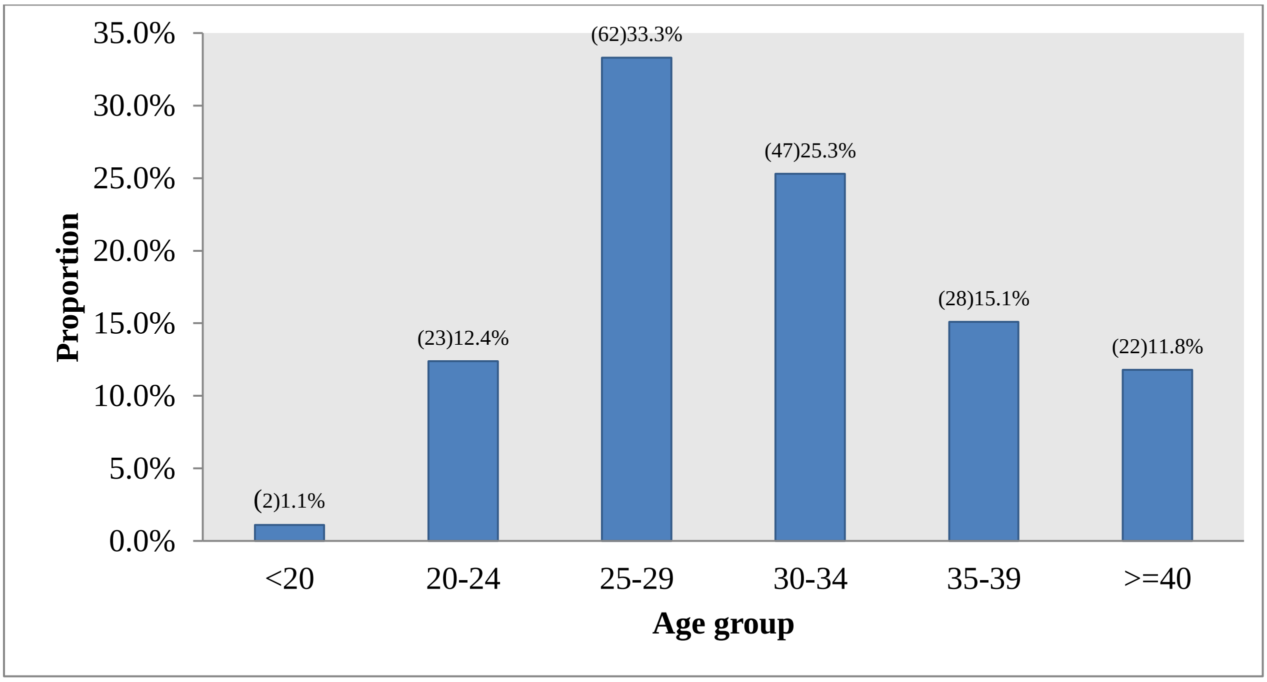
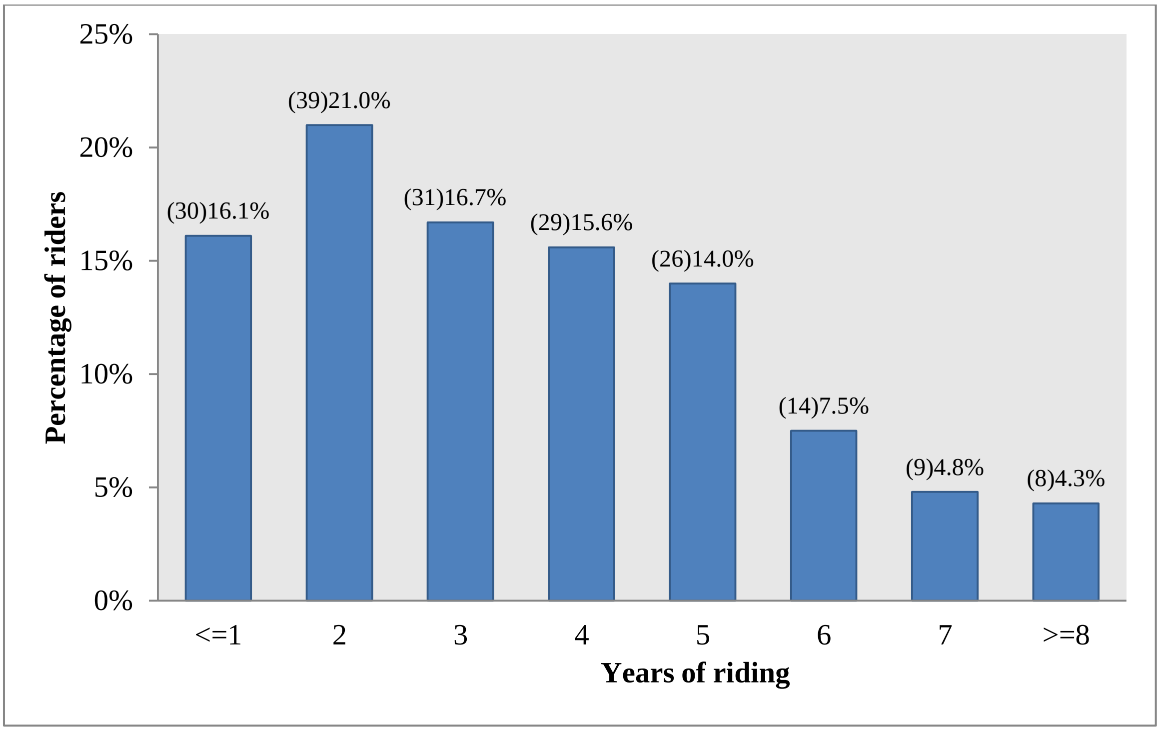


Figure 2: Age Distribution (n=184)



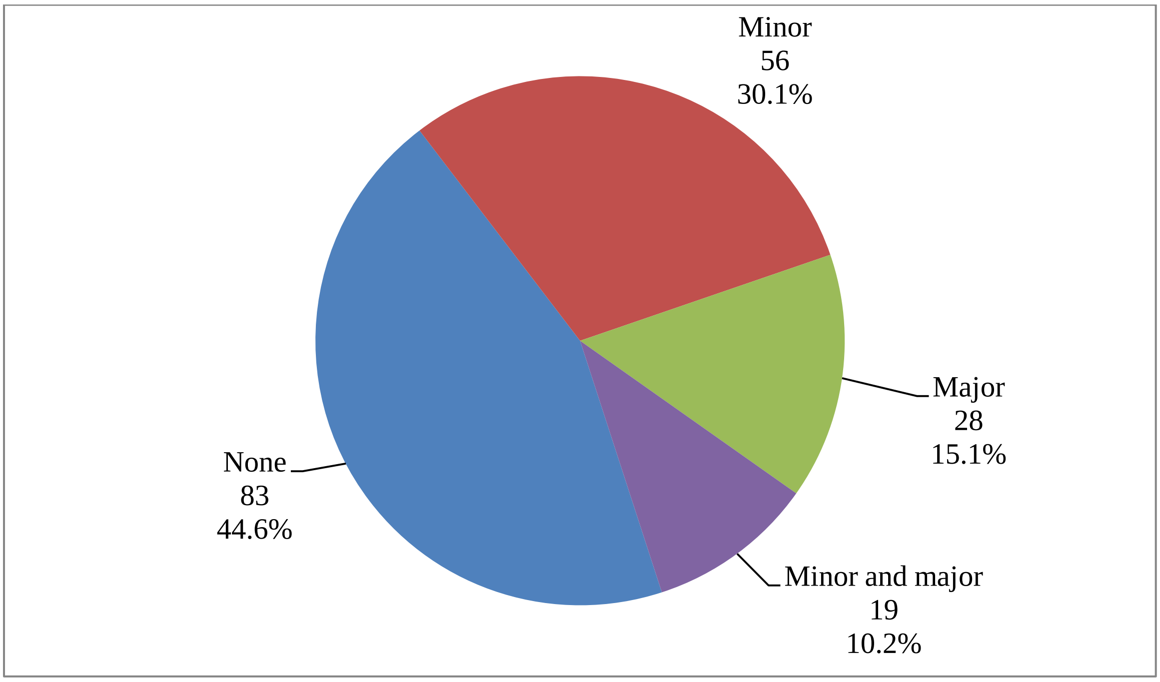
The mean age was 31.3 years and range was from 18 to 52 years. Majority of the riders were between the ages of 25 to 29. All the participants were male.

Figure 3: Years of riding (n=186)



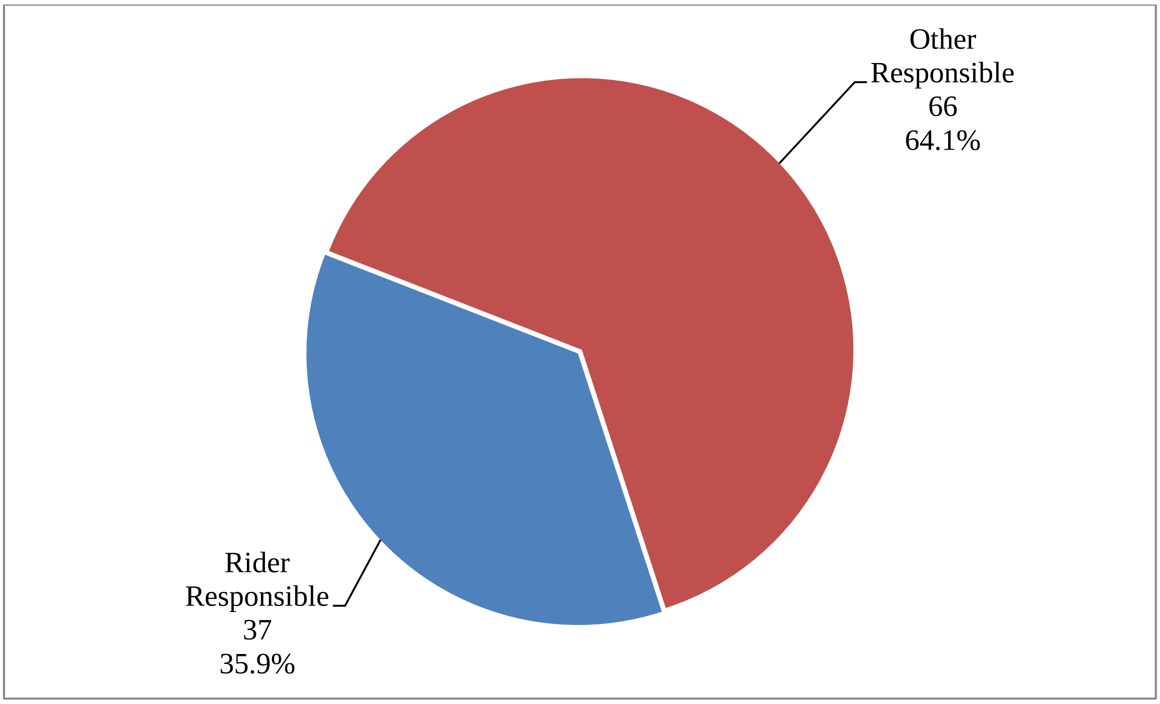
The median number of years of riding was 3 years with an interquartile range of 2 to 5 years. Most riders started riding between 2006 and 2010. Majority 39 (21%) of riders had been riding for 2 years.

Figure 4: Type of accidents (n=186)



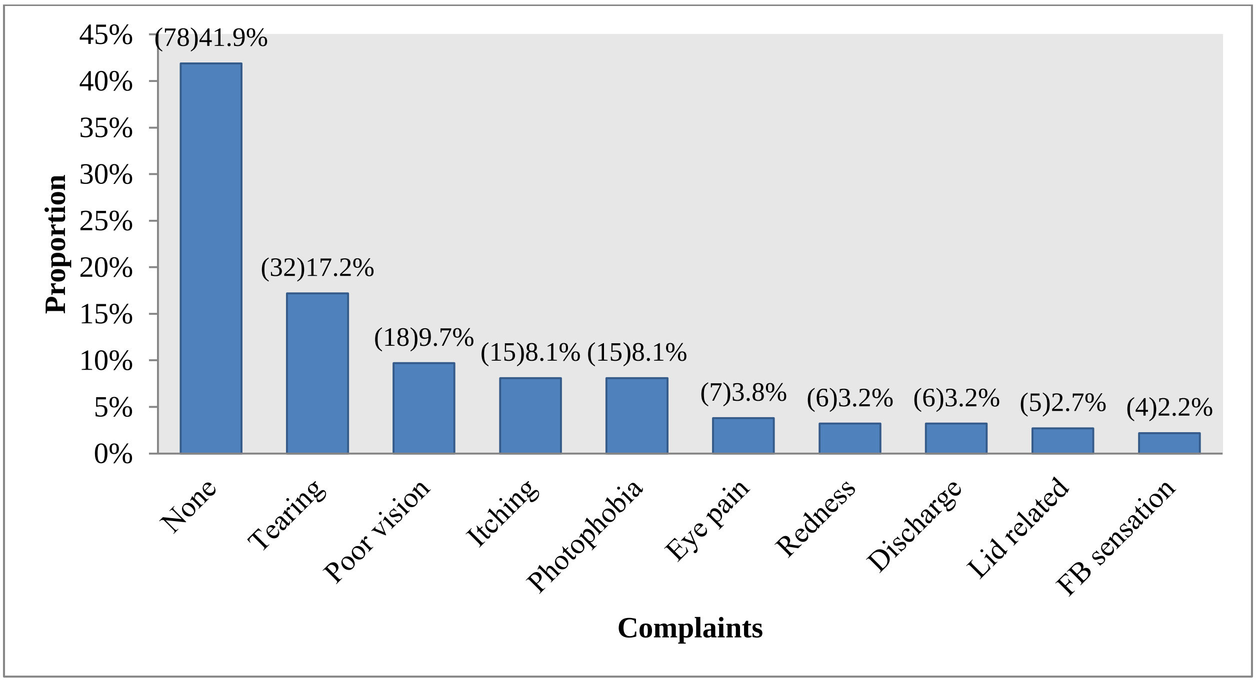
A total of 103 (55.4%) riders had been involved in an accident, of whom the majority 56 (30.1%) were minor accidents.

Figure 5: Rider responsible for accident (n=103)



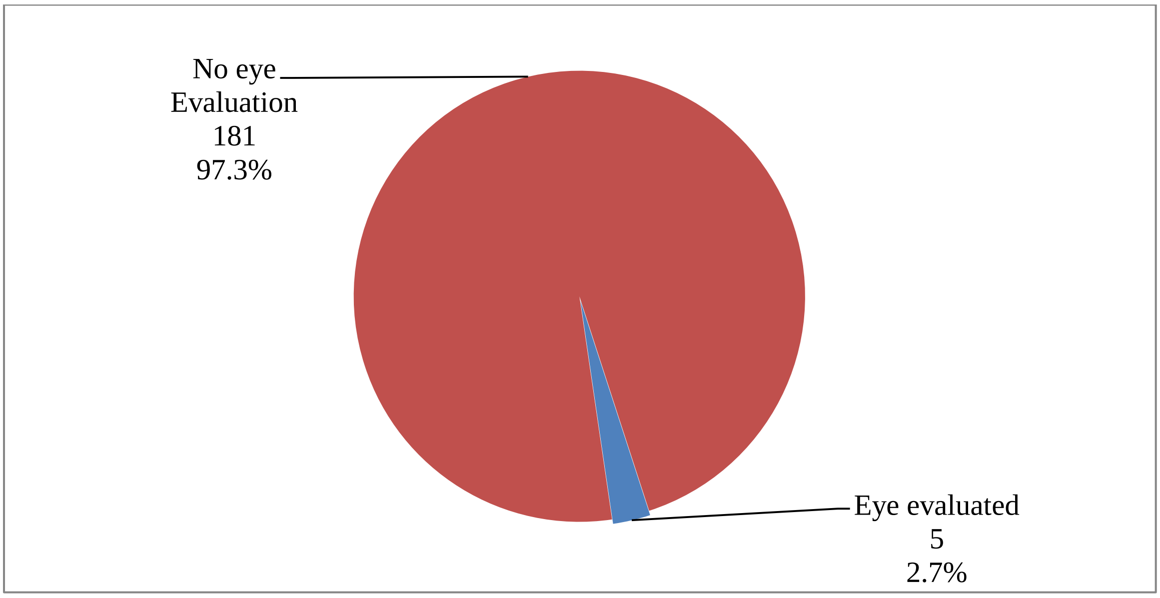
Riders were responsible for 37 (35.9%) of all accidents.

Figure 6: Presenting major ocular complaints (n=186)



A total of 108 (58.1%) of riders had eye complaints. Majority presented with tearing, poor vision, itching and photophobia.

Figure 7: Previous vision evaluation (n=186)



A total of 5 (2.7%) had vision evaluation prior to licensing and 181 (97.3%) had not.

Table 1: Riders meeting Visual acuity requirements (n=186)

Variable	Frequency (%)
VA Standard Met Not met	 181 (97.3) 5 (2.7)
Total	186

Majority of the riders 181(97.3%) met the visual acuity requirements for riding of LogMAR 0.2 and better.

Table 2: Visual Acuity in the better eye by WHO Standards (n = 186)

WHO Visual standard	Visual Acuity (LogMAR)	Frequency (%)
Normal	Better than 0.18	173(88.2%)
Mild	0.18 – 0.48	12(6.5%)
Moderate	0.54 – 0.90	1(0.5)
Severe	1.00 – 1.30	0
Profound	1.40 – 1.70	0
Near total	>1.70 – PL	0
Total	NPL	0
	Total	**186**

The mean visual acuity in the better eye was –0.1 with a standard deviation of 0.143. No rider had severe to total visual impairment.

Table 3: Riders not meeting visual acuity requirements in the better eye (n = 5)

WHO Visual standard	Visual Acuity (LogMAR)	Frequency (%)
Normal	Better than 0.18	0
Mild	0.18 – 0.48	4 (80%)
Moderate	0.54 – 0.90	1(20%)
Severe	1.00 – 1.30	0
Profound	1.40 – 1.70	0
Near total	>1.70 – PL	0
Total	NPL	0
	Total	**5**

Four of the riders who did not meet the visual requirements had mild visual impairment as per the WHO visual acuity standards and no rider was blind.

Table 4: Association between visual acuity and accidents (n = 186)

Variable	VA standard		OR (95% CI)	P value
	Met	Did not meet		
Accident				
Yes	99 (54.7%)	4 (80.0%)	0.3 (0.0-2.8)	0.383
No	82 (45.3%)	1 (20.0%)	1.0	
Total	181	5		186
Mean number of accidents	1 (0–2)	1 (1-1)		0.613

Motorcycle riders who did not meet the visual acuity standards involved in accidents were 4 (80%). A total of 99 (54.7%) riders of those who met the VA standards had been involved in road traffic accidents. This study did not show any statistical significant association between VA and accidents (p=0.383).

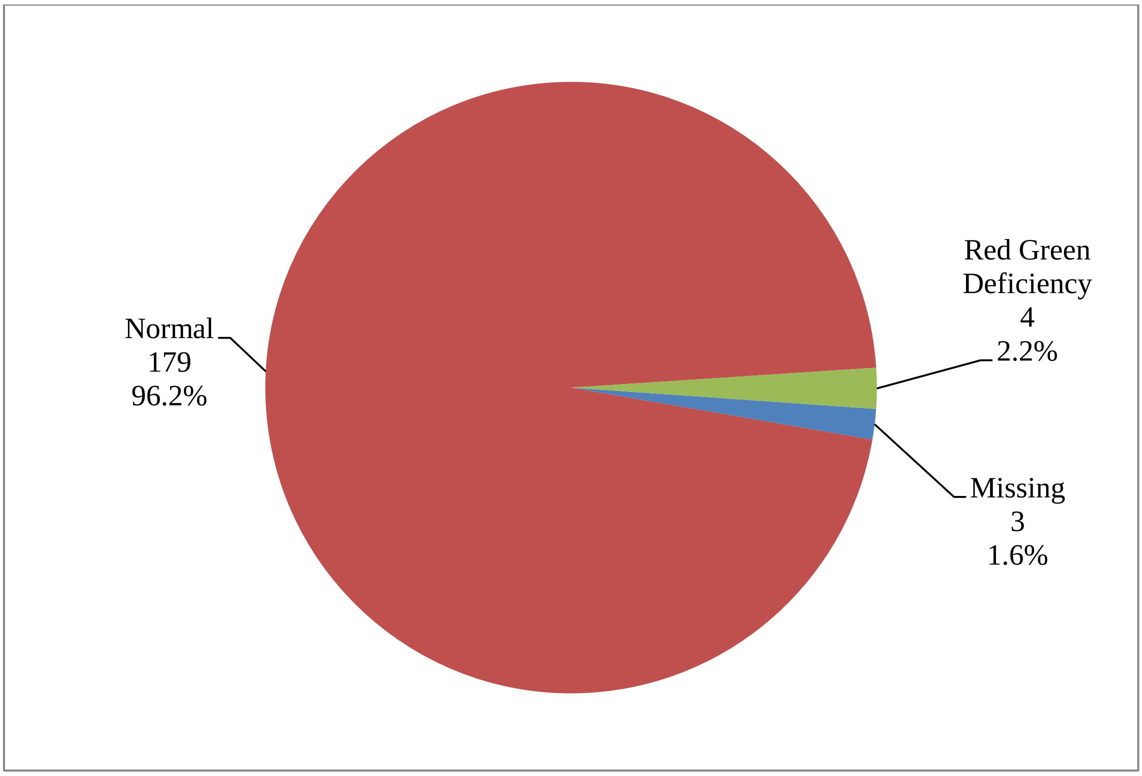
The mean number of accidents was 1 in both groups of those meeting the VA requirements and those not meeting the requirements. This finding was not statistically significant (p =0.613).

Table 5: Association between VA and type of accident (n = 186)

Variable	VA standard		OR (95% CI)	P value
	Met	Did not meet		
Type of accidents involved				
None	82 (45.3%)	1 (20.0%)	1.0	
Minor	52 (28.7%)	4 (80.0%)	0.2 (0.0-1.5)	0.104
Major	28 (15.5%)	0 (0.0%)	-	0.998
Minor and major	19 (10.5%)	0 (0.0%)	-	0.999
Total	181	5		186

Minor road traffic accidents were the highest type in both groups of riders. Motorcycle riders who did not meet the VA requirements were not involved in major road traffic accidents. The association between visual acuity and type of road traffic accident was not statistically significant (p=0.169).

Figure 8: Colour vision (n=186)



Four motorcycle riders (2.2%) had red green colour deficiency. No rider had total colour blindness.

Table 6: Association between colour vision and road traffic accidents (n = 183)

Variable	Colour vision		OR (95% CI)	P value
	Normal	**Red Green deficiency**		
Accident Yes No	 99 (55.3%) 80 (44.7%)	 2 (50.0%) 2 (50.0%)	 1.2 (0.2-9.0) 1.0	1.000
Total	179	4		183
Mean number of accidents	1 (0-2)	1 (1-5)		0.666

Two (50%) of the riders had been involved in a road traffic accident. This is almost similar to the riders with normal colour vision. This was not statistically significant (P = 1.00)

Riders with normal colour vision were involved in a mean of 1 (0 – 2) accidents and those with red – green deficiency, 1 (1 – 5). There was no statistical difference between the two (P = 0.666).

Table 7: Confrontational Visual Fields (n=186)

Vision Field	n (%)
Normal Constricted Missing	179 (96.2) 5 (2.7) 2 (1.1)
Total	186(100)

Motorcycle riders with constricted confrontational visual fields were 5 (2.7%).

Table 8: Association between confrontational visual fields and accidents (n = 184)

Variable	Visual field		OR (95% CI)	P value
	Normal	**Constricted**		
Accident Yes No	 98 (54.7%) 81 (45.3%)	 4 (80.0%) 1 (20.0%)	 0.3 (0.0-2.8) 1.0	0.383
Total	179	5		184
Mean number of accidents	1 (0-2)	1(1-3)		0.180

Eighty per cent of riders with constricted confrontational visual fields were involved in accidents compared to 54.7% with normal. However, this did not show any statistical significance (p = 0.383).

The mean number of accidents between those with normal and constricted visual fields was 1. This was not statistically significant (p=0.180).

Table 9: Stereopsis (n=186)

Variable	**Frequency (%)**
Stereopsis	
40	115 (61.8)
50	8 (4.3)
60	2 (1.1)
80	24 (12.9)
100	11 (5.9)
140	7 (3.8)
200	3 (1.6)
400	5 (2.7)
3000 to 0	8 (4.3)
Missing	3 (1.6)
Total	186

Majority of the motorcycle riders had stereopsis of 40sec, 115 (61.8%).

Table 10: Association between stereopsis and accidents (n = 183)

Variable	**Stereopsis**		**OR (95% CI)**	**P value**
	40-400	**3000 - 0**		
Accident				
Yes	96 (54.9%)	5 (62.5%)	0.7 (0.2-3.1)	0.733
No	79 (45.1%)	3 (37.5%)	1.0	
Total	175	8		183
Mean number of accidents	1 (0-2)	1 (0-1.5)		0.836

Five riders (62.5%) of those with gross or no stereopsis had been involved in an accident. This differed slightly with those with stereopsis better than 400 who 96 (54.9%) had been involved in an accident. This finding was not statistically significant (p = 0.733).

There was no difference in the mean number of accidents between the riders with stereopsis and those without. Both had an average of 1 accident. This was not statistically significant. ($p = 0.836$)

8. DISCUSSION

The study was conducted over a period of 3 weeks. During this period a total of 186 motorcycle riders were examined in different termini in Kisumu. 11 riders refused to give consent to participate (Figure 1). Two of the riders who refused to give consent had single eyes. It is therefore possible that the riders who refused to give consent to participate may have eye diseases or poor vision and for fear that the information collected will be used against them. All the participants were assured and that the information was to be handled confidentially.

All the riders were male. Mwangi et al found only 0.2% of female drivers in public service vehicle transport industry.[15] Adekoya in Nigeria found no female in his survey of commercial motor vehicle drivers.[16] Enock et al in his survey of motorcycle related ocular injuries found no female.[4] The reasons are motorcycle riding is demanding and stressful requiring long hours at work. Traditionally women are expected to stay at home. Women can be easily be targeted by criminals posing as clients since they are culturally and physically regarded as the weaker sex.

Majority of the riders were between the age of 25 to 29 (Figure 2) these findings are similar to those found by Enock et al among motorcycle riders.[4] Older age groups are more involved in driving commercial motor vehicles (31 – 50) as seen in Mwangi et al and Adekoya's studies.[15 16] This can be explained by the fact that the young men are attracted to motorcycles as they provide a means of employment and cheaper alternative requiring little skill to ride.

The riders' median number of years of riding was 3 years with an interquartile range of 2 to 5 years (Figure 3). Most riders started riding in the year 2010. This coincides with the period that the taxes on motorcycles were reduced by the Kenyan government and this explains the increased number.[5] There is a decline thereafter in 2011. This could be due to market saturation.

A total of 103 (55.4%) riders had been involved in an accident, of whom the majority 56 (30.1%) were minor accidents (Figure 4). Mwangi et al found 40% of PSV motor vehicle drivers had been involved in road accidents in Kenya.[15] This shows that motorcycle riders are at a higher risk of accidents compared to motor vehicle drivers.[2] Riders were responsible for 37 (35.9%) of all accidents (Figure 5). This shows that majority of the riders are not responsible for the accidents. Riders may have underreported cases that they were at fault.

Majority of the motorcycle riders 108 (58.1%) had eye complaints (Figure 6). The commonest complaints were tearing, poor vision, itching and photophobia. Other complaints were redness, foreign body sensation, eye discharge, eye pain and lid related complaints. Tearing which was the largest complaint is possible from tear instability while riding against the wind and projectiles entering the eye. This will also explain the itching and eye pain. There are no studies looking at ocular morbidity among motorcycle riders. Enock et al in Nigeria investigated ocular injuries related to motorcycle accidents and found lid, conjunctiva and cornea to be more affected.[4] This suggests that motorcycle riding may be associated with ocular surface and adnexal disorders.

Five riders (2.7%) had eye evaluation prior to licensing (Figure 7). Mwangi et al in 2001 found 32% of PSV motor vehicle riders had their vision tested prior to licensing. This suggests that there is laxity in enforcing the law on motorcycle riders. This could be due to the lack of knowledge to the fact that the motorcyclists are more risky road users and the overwhelming numbers of those requiring licenses.

The mean visual acuity in the better eye was –0.1 with a standard deviation of 0.143 (Table 2). The mean visual acuity for the worse eye was -0.04 and standard deviation was 0.21 (Table 2). Only 5 riders (2.7%) did not meet the visual requirements for riding (Table 1). Of these 4 had mild visual impairments as per the WHO visual acuity standards and 1 had moderate visual impairment (Table 3). Mwangi et al found 13 % of PSV motor vehicle drivers did not meet the visual requirements.[15] Their figure was higher possibly due to the older age group of the drivers compared to the motorcycle riders and are more likely to have eye diseases and hence poorer vision.

Motorcycle riders who did not meet the visual acuity standards involved in accidents were 4 (80%). A total of 99 (54.7%) riders of those who met the VA standards had been involved in road traffic accidents (Table 4). This study did not show any statistical significant association between VA and accidents (p=0.383). The mean number of accidents was 1 in both groups of those meeting the VA requirements and those not meeting the requirements (Table 4). This finding was not statistically significant (p =0.613). No study has been done evaluating the visual acuity of motorcyclist and its association with road accidents. Most studies done to assess motor vehicle drivers' visual acuity and occurrence of road traffic accidents have shown no association [15, 16] or weak association.[10, 17, 18] The most influential work was by Burg who analysed data from 17,500 California drivers. These analyses indicated that for young and middle-aged drivers, there was no relationship between poor visual performance and crash rates. It is thus paradoxical that laws in different countries insist on visual acuity checks prior to licensing yet there is little evidence to support the association with road accidents. The reasons for weak association could be because riders and drivers with poor visual acuity may avoid the road when it's busy or when visibility is poor like at night (Selective riding/driving).[21] The other reason is that riders who have poor vision may avoid being interviewed as seen during this study where 2 out of the 11 riders who refused to give consent to participate in the study had monocular vision. Other studies have suggested that perhaps using dynamic visual acuity which is done when the head is in motion may yield a better association with road accidents since one is usually in motion when riding/driving.[20]

Minor road traffic accidents were the highest type in both groups of riders. The association between visual acuity and type of road traffic accident was not statistically significant (p=0.169). The p value is not statistically significant due to the low number of riders with inadequate visual acuity for riding (Table 5). No rider with inadequate visual acuity was involved in major road traffic accidents. This could be due to under reporting or selective riding as described above.[21]

Four motorcycle riders (2.2%) had red green colour deficiency, 179(96.2%) had normal colour vision. No rider had total colour deficiency. There were 3 riders who did not have the colour vision assessed and this was due to the fact that they were in a hurry to leave with a client and did not complete the entire assessment (Figure 8) Mwangi et al found colour deficiency in 1.7 % of PSV motor vehicle drivers. Fifty percent of riders with red green deficiency had been involved in road traffic accidents, compared to 44.7% of riders with normal colour vision (Table 6). There was no statistical significance in the association between colour vision and accidents (p = 0.674). Riders with normal colour vision were involved in a mean of 1 (0 – 2) accidents and those with red – green deficiency, 1 (1 – 5). There was no statistical difference between the two groups (P = 0.666) (Table 6).This is comparable with studies done by Mwangi et al and Adekoya on motor vehicles showing no relationship between colour vision and accidents . [15, 16]

Motorcycle riders with constricted visual fields were 5 (2.7%). 179 riders (96.2%) had normal visual fields. Three riders did not have visual fields done as they left to carry clients before completion of the examination (Table 7). Eighty percent of riders with constricted visual fields were involved in accidents compared to 54.7% with normal (Table 8). The mean number of accidents between those with normal and constricted visual fields was 1. This was not statistically significant (p=0.180) (Table 8). Mwangi et al evaluated 539 drivers, 2.2% had visual defects. Adekoya et al evaluated 450 drivers, 4% of drivers had visual field defects. Both studies showed no association between road traffic accidents and confrontational visual field defects. [15, 16] Johnson and Kelter used an automated perimetry and found a higher crash rate among drivers with constricted visual fields.[22] Visual field by confrontation method is not sensitive and may explain the weak association in the results.

Majority of the motorcycle riders had stereopsis of 40sec, 115 (61.8%). Three riders did not complete the test as they were in a hurry to leave with a client. Eight (4.3%) of the riders had poor or no stereopsis (Table 9). Five riders (62.5%) of those with gross or no stereopsis had been involved in an accident (Table 10). This differed slightly compared to those with stereopsis better than 400 who 96 (54.9%) had been involved in an accident. This finding was not statistically significant (p = 0.733). Little had been done comparing stereopsis and accident rate. Shute and Woodhouse (1990) considered that any apparent correlation between the stereopsis and accident may be due to confounding factors such as lowered visual acuity in one eye which is the case in the 2 out of 5 of the cases with no stereopsis seen in this study.[30]

9. CONCLUSION

1. The proportion of bodaboda motorcycle riders with inadequate visual acuity for riding was 2.7%.
2. Majority (56%) of the bodaboda motorcycle riders had been involved in minor accidents.
3. There was no association between visual acuity, colour vision, confrontation visual field and stereopsis with the rate of road traffic accidents involving motorcyclists.
4. Most bodaboda riders had eye complaints (58.1%) and the commonest complaint was tearing.

10. RECOMMENDATIONS

1. The study showed that majority of the motorcyclists has eye complaints particularly tearing. An ocular morbidity study needs to be carried out to find the cause.
2. All bodaboda operators should be subjected to visual acuity testing prior to obtaining their driver's license.

3. There is need to do a larger similar study to compare association between vision and motorcycle riders comparing them with police records of accidents as this will provide a more accurate analysis.

11. APPENDICES

11.1 Appendix A: Study Questionnaire

<table>
<tr><td colspan="6">STUDY QUESTIONNAIRE</td></tr>
<tr><td colspan="6">I. Bio data</td></tr>
<tr><td colspan="3">No.</td><td colspan="3">Mobile No.</td></tr>
<tr><td>Initials</td><td colspan="2">DOB:</td><td>M/F</td><td colspan="2">Year started Riding</td></tr>
<tr><td colspan="6">I. Accident History</td></tr>
<tr><td colspan="6">(a) Have you ever been involved in an accident? Y/N</td></tr>
<tr><td colspan="6">Minor/ Major</td></tr>
<tr><td colspan="6">How many times? Minor Major</td></tr>
<tr><td colspan="6">How many were you directly responsible for?</td></tr>
<tr><td colspan="6">II. Past Ophthalmic history</td></tr>
<tr><td colspan="6">(a) Do you have any eye problem? Y/N</td></tr>
<tr><td colspan="6">State problem if yes</td></tr>
<tr><td colspan="6">(b) Did you have eye evaluation prior to licensing? Y/N</td></tr>
<tr><td colspan="6">III. Vision Assessment</td></tr>
<tr><td>Visual acuity</td><td colspan="2">OD</td><td colspan="2">PH</td><td></td></tr>
<tr><td></td><td colspan="2">OS</td><td colspan="2">PH</td><td></td></tr>
<tr><td colspan="6">Colour vision: Normal/Red Green Deficiency/Colour blind</td></tr>
<tr><td colspan="6">Stereopsis:</td></tr>
<tr><td colspan="4">Visual Field:</td><td colspan="2"></td></tr>
</table>

11.2 Appendix B: Consent Forms

English

I __________________________________ of __________________________ do give consent to participate in the study assessing vision in PSV Motorcycle drivers in Kisumu. I am aware that the information that I give will be handle confidentially. I reserve the right to withdraw from participation in the study at any level. I shall not receive any monetary incentive for participating.

Signature: _____________________ Date: ____________________

I hereby confirm that I have explained the nature of the study to the participant and I guarantee to keep the information collected confidential.

Signature_____________________Date__________________

If you have any problems or further questions about the study contact:

The Principal Investigator,

Dr Korir Frederick Kipkoech

Telephone number 0721255840,

Department Of Ophthalmology

College of Health Sciences,

University of Nairobi

P.O. Box 19676-00202

Swahili

Mimi__________________________________kutoka_________________________natoa idhini ya kushiriki katika utafiti wa kutathmini maono katika madereva wa pikipiki za abiria katika mji wa Kisumu. Ninatambua kuwa taarifa abayo nitakayotoa yatashughulikiwa kwa siri. Mimi ninaelewa kwamba nina haki ya kujiondoa kwenye utafiti huu wakati wowote kama nipendavyo bila vikwazo vyovyote. Naelewa pia kwamba sitapokea pesa kama motisha kushiriki katika utafiti huu.

Sahihi ________________________Tarehe ________________________

Ninakubali kuwa nimemueleza kinaganaga mshiriki huyu kuhusu utafiti huu naninamuhakikishia kuwa taarifa yake atakayotoa yatashughulikiwa kwa siri.

Sahihi: ____________________ Tarehe: ___________________________

Kama uko na swali lolote kuhusu utafiti huu, unaweza kuwasiliana na:

Mtafiti Mkuu

Dr Korir Frederick Kipkoech

Nambari ya Simu 0721255840,

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College of Health Sciences,

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11.3 Appendix C: Maps

Map 1: Location of Kisumu in Kenya.

12. REFERENCES

1. World Health Organisation, Department of Injuries and Violence Prevention Non-communicable Diseases and Mental Health Cluster, The Injury Chart Book, A graphical overview of global burden of Injuries, 2002

2. World Health Organisation, edited by Margie Peden, Richard Scurfield, World report on road traffic injury prevention, 2004

3. **Koornstra MK, ed.** Transport safety performance in the EU. Brussels, European Transport Safety Council, Transport Accident Statistics Working Party, 2003 (http://http://www.etsc.eu/documents/statoverv.pdf , accessed 25 July 2008)

4. **Enock M E**, Dowadu O A, Osahon A I, Motorcycle related ocular injuries in Irrua Teaching Hospital, Irrura, Edo State, Nigeria, *Journal of Medicine and Biomedical Research, Vol. 7, No. 1 & 2, December 2008, pp. 24-29*

5. Statististical abstract 2010, Kenya National Bureau of Statistics. ISBN: 9966-767-24-X

6. The Standard Newspaper Online, http://www.standardmedia.co.ke/editorial/InsidePage.php?id=2000030587&cid=16&accesed 17 July 2011

7. **Owoaje E T**, Amoran O E et al, Incidence of road traffic accidents and pattern of injury among commercial motorcyclists in a rural community in south western Nigeria, Nigeria,*Journal of Community Medicine and Primary Health Care. June 2005; 17(1): 7-12*

8. **Hurt HH**, Quellet JV, Thomas DR. Motorcycle accident cause factors and the identification of countermeasures. Washington, DC, National Highway Traffic Safety Administration, 1981 (DOT HS 805-862-3)

9. **Radin URS**, Mackay GM, Hills BL. Preliminary analysis of motorcycle accidents: short-term impacts of the running headlights campaign and regulation in Malaysia. *Journal of Traffic Medicine, 1995, 23:17–28)*

10. **Burg A,** Hill B.L: A reanalysis of California driver vision data: General findings. Report No. LR 788. Transport and Research laboratories, Crothorne, Berkshire.

11. Canadian Ophthalmological Society, Vision Standards for driving in Canada, Policy Statement, *Canadian Journal of Ophthalmology 2000;35:187–91*

12. **At a glance Guide** to the current Medical Standards of Fitness to Drive, For Medical Practitioners, updated February 2011 incorporating April 2011 amendments

13. **Horton P,** Chakman J, Optometrists Association Australia position statement on driver vision standards, *Clin Exp Optom2002; 85: 4: 241-245*

14. **Kenya Law**, Section 403 The Traffic Act

15. **Mwangi C W** , Karimurio J, Ilako D, Vision assessment of Public Service Vehicle drivers in Nairobi, Dissertation for MMed. Ophthalmology, University of Nairobi, 2001

16. **Adekoya B J**, Adepoju F G, Visual function survey of commercial intercity vehicle drivers in Ilorin, Nigeria, *Can J Ophthalmol 2009; 44: 261-4*

17. **Ivers R Q,** Mitchell P, Cumming R G, Sensory Impairment and Driving: The Blue Mountains Study, Am J Public Health. 1999; 89:85 - 87

18. **Wood J M, Troutbeck,** A report to the Federal Office of Road Safety on the elderly drivers and visual impairment, Centre for Eye Research, Queensland University of Technology, June 1993.

19. **Kiel A W**, Butler T, Alwitry A, Visual acuity and legal visual requirement to drive a passenger vehicle, *Eye (2003) 17, 579–582.*

20. **Charman W N**, Vision and driving – a literature review and commentary, *Opthal. Physiol. Opt. Vol. 17, No. 5, pp. 371-391, 1997*

21. **Owsely C**, Gerald M, Vision Impairment and Driving, *Survey of Ophthalmology, Vol. 43, No. 6, May-June 1999*

22. **Johnson CA,** Kelter JL: Incidence of visual field loss in 20,000 eyes and its relationship to driving performance. *Arch Ophthalmol 101: 371 – 375, 1983*

23. **Fishman G A,** Anderson R J, Stinton L, Haque A, Drining performance of retinitis pigmentosa patients, *British Journal of Ophthalmology, 1981, 65, 122-126*

24. **Elkington A R**, MacKean, Glaucoma and Driving, *Brit Med J 1982, 285,177-178*

25. **Szlyk J P,** Mahler C L, Seiple W, Edward D P, Wilensky J T, Driving performance in glaucoma patients correlates with peripheral visual field loss, *J Glaucoma, 2005 Apr; 14(2): 145-50*

26. **Keeney, A. H.** Relationship of ocular pathology and driving impairment. *Trans. Am. Acad. Ophthalmol. Otolaryngol. 72, 737-740.*

27. **Liesmaa, M.** The influence of drivers' vision in relation to his driving ability, *Optician 166, November 13, 10-13.*

28. **Cole B L**, Protan colour vision deficiency and road accidents, *Clin Exp Optom 2002; 85: 4: 246253*

29. **Humphriss D,** Three South African studies on the relation between road accidents and drivers' vision. *Ophrhal. Physiol. Opt. 7, 73-79.*

30. **Shute R H,** Woodhouse J M, Visual fitness to drive after stroke or head injury, Ophthal. Physiol. Opt., 1990, Vol. 10, October 327.

31. Uhuru Ministries, http://www.uhuruministries.org.uk/img/NeilTest1.jpg accessed 14 July 2012