+International Journal of Academic Research and Development
ISSN: 2455-4197, Impact Factor: RJIF 5.22
www.academicsjournal.com
Volume 1; Issue 12; December 2016; Page No. 13-23

Pattern and risk factors for bicycle and motorcycle related injuries in Kisumu city: An implication for prevention

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Abstract

Commercial cycling/Boda Boda injuries constitute a major but neglected emerging public health problem in Kenya and are a common cause of road traffic injuries. Cycling related injuries are among the leading causes of disability and deaths and the main victims are the motorcyclists, bicyclists, pillion passengers and pedestrians in their young reproductive age group. Commercial cycling involving both human powered and motorized cycles has currently been on the increase and this has had subsequent corresponding and significant increase on injuries. This was a descriptive cross sectional study with objectives of comparing the injuries due to cycling among motorcyclists and bicyclists focusing on the pattern and characteristics of commercial cyclists injuries, their causes and possible interventions. Data was collected using structured questionnaires, interview schedules, checklists and key informant interview. Analysis was done using different tests. Descriptive statistics was done and comparisons was undertaken using Chi square. Data was presented in tables, graphs, charts and in narration form. The incidence of injuries were highest among motorcyclists at 60.9%. Injuries to bicyclists accounted for 39.1%. Overall 86.6 % of cyclists had had injuries and only 13.4% had not had injuries. Motorcyclists are more likely to sustain injuries than bicyclists. There was significant association between the type of cyclists whether motorcyclist or bicyclist and injury occurrence. (χ^2= 18.2; P= 0.002). Most of casualties had suffered abrasion which accounted for (23.1%) of injuries. Slightly half (53%) of participants who reported they had had abrasion were bicyclists. Other respondents had suffered fractures (20.6%). Major factors contributing to injuries are: operating under influence of alcohol and other drugs cited by 84.8% of respondents, over-speeding cited by 49.5%, lack of training 32.9%, bad roads 32.1% and others. They have great economic loss to the affected individuals, families and society at large. Preferred intervention includes creation of awareness on matters surrounding commercial cycle injuries including discouraging alcohol consumption, wearing helmets and reflective jackets by both the operator and the passengers, avoiding over-speeding and others.

Keywords: boda boda, bicycle, motocyclist, casualty, comparison, injuries

1. Introduction

Road traffic injuries are a major global public health problem requiring concerted efforts for effective and sustainable prevention. Of all the system that people have to deal with on a daily basis road transport is the most complex and the most dangerous [1]. Road traffic injuries contribute significantly to the burden of disease and mortality throughout the world, but particularly in developing countries [2]. Currently about 3,300 lives are lost daily due to road crashes globally, about 50 million sustain injuries annually. Road traffic injuries are the leading killer of the most economically productive group (15-25 years) in the world [3, 4]. With increasing modernization in many developing countries, road traffic deaths are increasing and the 2020 prediction raises it to third most important health problem [5].

The most vulnerable road users in Kenya are pedestrians, two or three wheeled vehicles (cyclists) and the elderly [6]. This vulnerable group account for 57%, 51% and 39% of the deaths in low income, middle-income and high-income countries respectively [5]. Cyclists are more vulnerable to injury and fatality than other road users, due to the lack of physical protection like that of the body of a car [7, 8, 9, 10, 11].

Commercial cycling is increasingly becoming a popular mode of transportation in Kenya, in both rural and urban areas since early 1990's but can be traced back to 1960s [12]. These are either Human Powered Bicycles (HPV) or motorcycles used purposely for commercial activities which include transportation and delivery of merchandises from one area to another as well as transportation of human beings from one destination to the next. Human Powered Bicycles have been used by man since their invention but they gained momentum in 19th century and now number about one billion worldwide.[13] They were invented by De Sirvac in 1690, Then referred to as hobby horse, in 1840 they acquired peddles, work that was done by a Scottish blacksmith Kirkpatrick Macmillan credited with inventing the real bicycle [14]. While the urban motorbike taxi is a relative newcomer, its rural predecessor, the bicycle taxi already existed as far back as the 1930s in the Senegalese city of Kaolack and the 1960s in Kenya, Uganda and Benin where it was used to carry both people and goods. Motorbike taxis appeared in Nigeria in the 1970s, but their true rise seems to have started in the mid-1980s in Niger, Cameroon, Togo, Benin, Uganda and Kenya as a development from the bicycle taxi [15]. While the motorbike taxi is very popular in Uganda and Kenya under the name of boda-boda its use has above all

developed in West and Central Africa under a variety of different local names: zemidjan in Benin and Togo, bendskin in Cameroon, kabu-kabu in Niger, okada or alalok in Nigeria, oleyiain Togo [16].

Globally the increase of bicycling has been witnessed in USA, according to Butcher and colleagues.[17] In Kenya, however, its related injuries cause significant morbidity and mortality. Many road users have viewed their presence in the roads as the cause of congestion, confusion, fear, and decreased safety in the road system [12] Commercial cyclist's injuries are injuries sustained by cycle operators or their passengers as well as the pedestrians or other road users because of the involvement of cycles in one way or another in a collision with a moving object from opposite direction, being hit from behind, falling or ramming onto a stationary object. There are about 800 million bicycles in the world, twice the number of cars [18]. In Asia alone, bicycles carry more people than do all the world cars. Nonetheless, in many countries, bicycle injuries are not given proper recognition as a road safety problem and attract little research [19]. The incidence of bicycle – related injuries varies between countries. In Beijing China, about a third of all traffic deaths occur among bicyclists [20]. In India, bicyclists represent up to 21% of road users fatalities, the second largest category after pedestrian [21]. China is one of the developing countries where public policy until recently has encouraged the use of bicycles as a form of commuting [22]. In the United States, there are 67 million bicyclists who ride approximately 15 billion hours peryear. Each year, approximately 750 persons die from injuries due to bicycle crashes and over 500,000 persons are treated in emergency departments. While over 90% of deaths from bicycle-related injuries are caused by collisions with motor vehicles [21]. These collisions cause less than 25% of non-fatal head injuries. Head injury is by far the greatest risk posed to bicyclists, comprising one-third of emergency department visits, two-thirds of hospital admissions, and three-fourths of deaths [23].

About 45 million motorcycles are produced annually globally, with the growth rate in Africa, being between about 12-30% [24]. Studies in many Low Medium Income Countries, reports that motorcycles increasingly has become a popular means of transport: In India, for instance, 69% of the total numbers of motor vehicles are motorized two- wheelers [25]. In Kenya motorcycle registration increased by 2324.87% in 2009 from about 3,759 units in 2005 [26]. In 2010, about 9,000 motorcycles entered into the transport sector every month and by December 2010, the registered number of motorcycles had surged to nearly 200,000 from 91,151 in December 2009.[27] Since 2005 the number of registered motorcycles in Kenya has increased almost 40 times, accounting for 70 percent of all newly registered vehicles in 2011(Xinhua, 2012) [28].

The use of motorcycles in Kenya as a means of transport can be traced from the 1960's where bicycle taxis were used to transport people and smuggled goods across the Kenya – Uganda border. From 1990's the bicycles are being replaced by light engine motorcycle (50-80cc) [29, 30]. The popularity of this mode of transport can be attributed to the following reasons; they are a quick means of transport especially for short distances in cities and towns, they are efficient in mitigating traffic jam delays in the cities and they are available throughout the day and night hours [31].

The reported prevalence of motorcycle injuries varies around the world, from 22.8% in China[32] to as high as 62% in Vietnam. In Nigeria, prevalence ranging from 12.8-60% have been reported in different studies 2004 [33, 34, 35] and in Kenya 39.4 % [36].

Currently there is no official data on total number of registered motorcycles and bicycles, though other sources estimate that motorcycles account for 70% of motor vehicles registered in Kenya each year. In Kenya, to legally drive a motorcycle, or bicycle one must be aged 18 years or older, possess a driving licence, and wear a helmet and reflective clothing while riding. However, enforcement of the national motorcycle safety law has been inefficient. RTIs are a multifactorial issue and high quality data for decision making is integral to the equation. The lack of useful, reliable and timely data to inform prevention strategies has been one of the major contributing factors hindering Kenya's efforts to address boda boda related injuries through policy and legislative responses within risk groups. There is paucity in literature on commercial cycling in Kisumu. The serious neglect ofcommercial bicyclists by stakeholders such as traffic engineers and planners who design and operate the roadway transportation system call for a review of the local situation. Indeed commercial bicyclists and related crashes and injuries are neglected; most studies and interventions have been focused on motorcycling and motor vehicles. Therefore this study will be carried out with a view to establish the burden of commercial motorcycle and bicycle injuries in Kenya, focusing on the pattern of injuries, risk factors and their relative contribution to commercial motorcycle and bicycle injuries and ways of reducing injuries in Kisumu city.

2. Materials and Methods

The study was done in Kisumu city the third largest city in Kenya. The city has a road network of 2,182.9Km of which 298.9Km are of bitumen standard, 923.3km of gravel and 960.7Km of earth. The main roads within the city are tarmacked. Roads in residential areas and those leading to industrial areas are in a state of disrepair. The main mode of transportation within and connecting down town Kisumu city to residential estates are matatus, commercial bicycles and walking (pedestrians). The estimated population within city is 600,000. A high proportion of the population is young, aged 0-19 years, which comprise 57.3%, while 41.2% is between 15-45 years. Those aged 45-65 and 65 and above are 8.98% and 3.4% of the population respectively.

The design of the current study is a descriptive cross sectional study where a multistage sampling process was carried out to identify and recruit the respondent. Three stages using different sampling were involved; multi stage sampling, systematic and simple random sampling. These were applied to select estates, cluster sites where cyclists waiting for clients, and cyclists respectively. Structured questionnaire were administered to random

sample of 368 commercial cyclists to obtain the following information: demographic data, factorstors contributing to road traffic injuries involving commercial cyclists and preferred road safety intervention.
The data were coded and analyzed using the SPSS statistical software. Statistical analysis was done using various tests like Chi square depending on the variables. The data were summarized using frequency table, contingency tables. Qualitative data were tape recorded, transcribed then content analysis done (coding and categorizing) manually to summarize the emerging themes and issues.

3. Results

Most of the respondents were aged between 20-29 (45.1%) years followed by 29-39(22.3%), others were aged between39-49(16.8%) followed by those who were below 18 years (12.8%).Least were in the49-59(3.0%) age bracket; Majority o of respondents were Christians accounting for 88.4%. Ten point nine percent Moslems, while other religions accounted for1.0%. Respondents were predominantly males with no female interviewed at all. Highest number of respondents 187(50.8%) had primary education as the highest level of education attained. This was followed by secondary education 146(39.7%) and tertiary19 (5.2%). University education constituted 12(3.3%). Other levels of education classified as others accounted for 0.8%. As regards employment status, Self-employed were the majority 300(81.5%) followed by not employed 29(7.9%), and about 6(1.6%) did not fall in any category. (Table 1)

Table 1: Demographic information of the respondents

Demographic information	Frequency	Percentage
Age		
Less than 18	47	12.8%
20 – 29	166	45.1%
29 – 39	82	22.3%
39 – 49	62	16.8%
49 – 59	11	3.0%
Education levels		
Primary	187	50.8%
Secondary	146	39.7%
Tertiary	19	5.2%
University	12	3.3%
Other	3	0.8%
Religion		
Christian	325	88.3%
Muslim	40	10.9%
Others	1	1.0%
Income		
Self employed	300	81.5%
Not employed	29	7.9%
Salaried	19	5.2%
Business	14	3.8%
Other	6	1.6%

Magnitude of cycle injuries in the study area

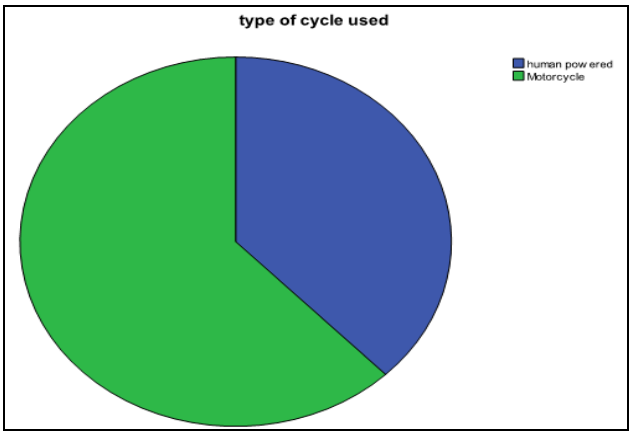

Fig 1: type of cycle used

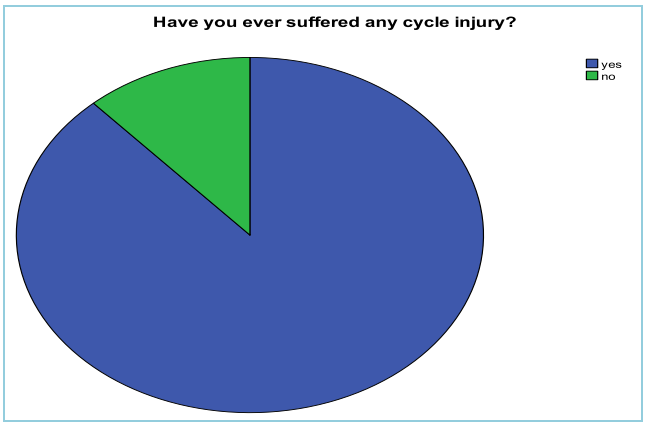

Fig 2: Period of commercial cyclists operation in the area of the study

Majority of the respondents 229(62.2%) were operating motorcycles while minority139 (37.8%) were operating human powered bicycles.
From the figure, majority of the respondents (52.2%) had operated the cycle for a period of 2-5 years followed by 16.8% who had operated the cycle for 5-10 years. least was (11.1%) who had operated the cycle for less than one year.

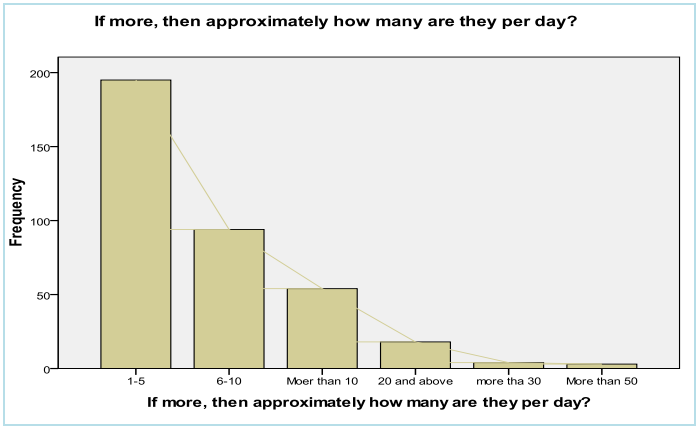

Fig 3: Ever suffered any cycle injuries

When the respondents were asked whether they had been injured as indicated in figure 2 Majority (88.3%) cited they had suffered cycle injuries while minority (11.3%) had not suffered any cycle injuries.

Table 2: No. of years worked by the cyclists

No. of years as cyclist	Motorcyclist	Bicyclists	Total	
	No.	No.	No.	%
Less than one	21	20	41	10.1
1-2 years	28	22	50	13.4
2-5 years	110	82	192	51.8
5-10 years	50	12	62	16.8
Over 10 years	20	3	23	8.9
Total	229	139	368	

Over half of the cyclists had worked as boda boda for between 2-5 years (51.9%). Of the cyclist who had worked for between 5-10 years 80.6% were motorcyclists. Ten point one percent of the cyclists had worked for less than one year. Ninety percent of motorcyclist who had worked for less than one year reported to have had crashes resulting into injuries particularly lower extremities with 98.3 % of bicyclists within the same agegroup had had abrasions.

Table 3: Injury occurrence among motorcyclists and bicyclists

Injury Occurrence	Motorcyclists		Bicyclists		Total	
	No.	%	No.	%	No.	%
Yes	208	60.9	117	39.1	325	88.6
No	21	46.5	22	53.5	43	11.4
Total	229		139		368	100

Ssventy six point nine percent (76.9%) of all the cyclists had been involved in cycle accident while 23.1% had never been involved in accident. The incidence of injuries were highest among motorcyclists at 60.9%. Injuries to bicyclists accounted for 39.1%. Overall 86.6 % of cyclists had had injuries and only 13.4% had not had injuries. Motorcyclists are more likely to sustain injuries than bicyclists. There was significant association between the type of cyclists whether motorcyclist or bicyclist and injry occurrence. (χ^2= 18.2; P= 0.002).

Table 4: Nature of Injuries sustained by the cyclists.

Type of injury	Motorcycle		Bicycle		Total	
	No.	%	No.	%	No.	%
Fracture	42	22.6	25	17.9	67	20.6
Lower extremities	14	7.5	29	20.9	43	13.3
Upper extremities	30	16.1	15	10.8	45	13.8
Abrasions	35	18.8	40	28.7	75	23.1
Head	30	16.1	9	6.5	39	12
Thorax	35	18.8	21	15.1	56	17.2
Total	186		139		325	

Most of casualties had suffered abrasion which accounted for 23.1% of injuries. Slightly half 53% of participants who reported they had had abrasion were bicyclists. Other respondents had suffered fractures (20.6%). Of those who had head injuries 76.9% were motorcyclists and 23.1% were bicyclists. Over three quarters of Head injuries (76.9%) were reported among motorcyclists than bicyclists. Generally, injuries to the lower extremities accounted for 13.3% but there was increase in the number of casualties in bicycle related than motorcycle at 71.6% and 21.6% respectively.

The figure above shows that majority 187(50.8%) said that cycle accidents are more in this area while minority 181(49.2%) said that cycle accidents are less in this area. There was significant association between the type of cyclists whether motorcyclist or bicyclist and natureof injury sustained (χ^2= 12.2; P= 0.004).

Approximate number of cycle casualties per day

Figure 3: Bar graph shows approximate number of casualties per day

Asked about approximate number of casualties per day, 53.0% of respondents mentioned 1-5 perday 25.5% mentioned 6-10 while 14.7% cited more than 10 per day. Another 4.9% said 20 and above while 1.1% cited more than 30 per day and 8% said more than 50 per day

Factors contributing to cycle accidents

Table 5: Factors contributing to Commercial Cycle Crashes

Factor contributing to crashes	Motorcycle		Bicycle		Total
	NO	%	NO.	%	
Over speeding	30	13.1	36	25.9	66
Unloading	30	13.1	3	9.1	33
Riding under the influence of alcohol	78	34.1	35	15.3	113
Lack of training and experience	18	7.9	26	18.7	44
Not wearing safety helmets	10	4.4	2	1.4	12
Bad roads	28	12.2	14	10.1	42
Disregard by bikes by motorists	7	3.1	13	9.5	20
Mechanical breakdown	18	7.9	7	5.0	25
Lack of service	10	4.4	3	2.2	13
Total	229		139		368

According to table 5 above, Majority of respondents (30.7%) said that major factor contributing to cycle accidents is cycling when drunk/under the influence of alcohol and other drugs followed by over speeding (17.9%), other factors mentioned included; lack of training (12%). The least (11.1%) said cycle mechanical breakdown. Of those who cited over speeding as a major factor causing accidents 54.5 % were motorcyclists while over three quarters (76.9%) of those who cited lack of service to the cycle as a factor causing crashes were motorcyclists. There was a significant relationship between mode of cycling and cause of injuries. χ2= 32.00 p=0.0001

According to the study majority of the respondents (83.3%) did not have reflective jacket and helmet while (16.7%) had and helmet. All the bicyclists did not have nor put on the helmets during the study. A spot check done during the study showed that they also did not wear reflective jackets.

Table 6: Nature of commercial cycle accidents

Type of injury	Motorcycle		Bicycle		Total
	No.	%	No.	%	No.
Head on collisions	31	77.5	9	22.5	40
Hit from behind by motorcycle	5	38.5	8	61.5	13
Hit from behind by other vehicles	34	73.9	12	26.1	46
Hit a pedestrian	15	71.4	6	28.6	21
Hitting a stationary object	27	75.6	20	14.4	37
Head on collision with other vehicles	31	56.3	24	44.7	55
Self-falling	19	67.7	9	32.3	28
Falling due to mechanical breakdown	10	66.7	5	33.3	15
Tyre burst	27	60	18	40	45
Total					

Table 6 indicates that majority of respondents(39.5%) that commercial cyclists usually with other vehicles, 25.6% usually get involved in head on collision with each other motorcycle, (23.2%) account for head on collision by falling. Seventy seven point eight of all head collision with each other were from commercial motorcyclists. Eleven point seven percent (11.7%) represent involvement in accident while being hit from behind by another motorbike. More bicyclists were likely to be hit from behind(61.5%) than motorcycle. While a third of the motorcyclists were more likely to fall due to mechanical breakdown than their bicyclists counterparts.

Possession of reflective jacket and helmet

Majority of the respondents (83.3%) did not have reflective jacket and helmet while (16.7%) had the reflective jacket and helmet. More motorcyclist had helmets while no individual bicyclist had helmets.

Table 7: Showing serious injuries sustained by commercial cyclists

Injuries sustained	Frequency	percentage
Operator(me)	169	45.9%
Passenger	59	16%
Both	65	17.7%
None of the above	75	20.4%

Table 7 above indicates who sustained serious injuries, Majority of respondents (45.9%) got serious injuries followed by both the passengers and Operators (17.7%). Finally the passengers alone (16.0%).However (20.4%) said that had never been involved in cycle accidents.

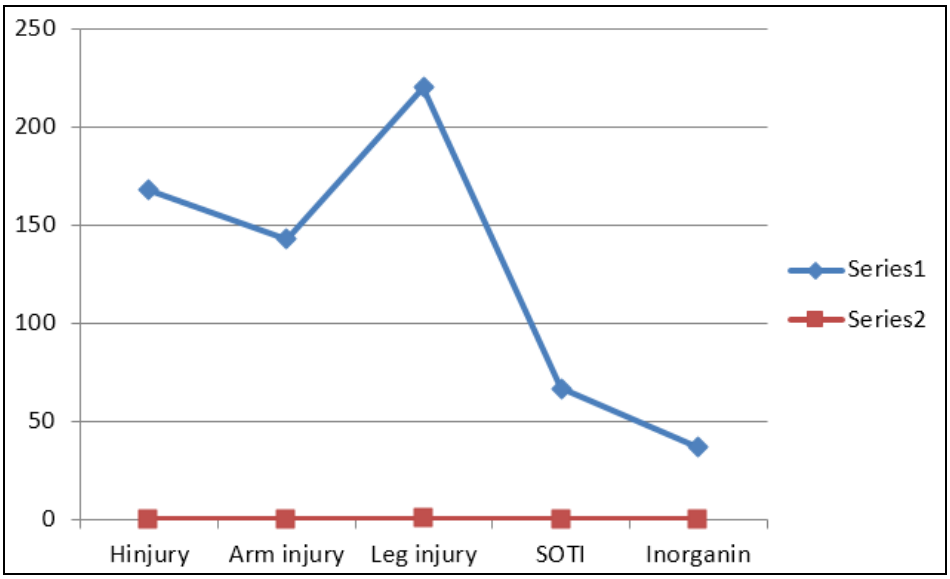

Fig 4: Indicating the injury treated at the time of visiting the hospital

The graph shows that (45.4%) of respondents suffered from leg injury, followed by head injury (45.4%), Arm injury (38.9%), soft tissue injuries(18.2%) while Internal organ injuries 37(10.1%) was the least.

Length of time for staying in Hospital for medication

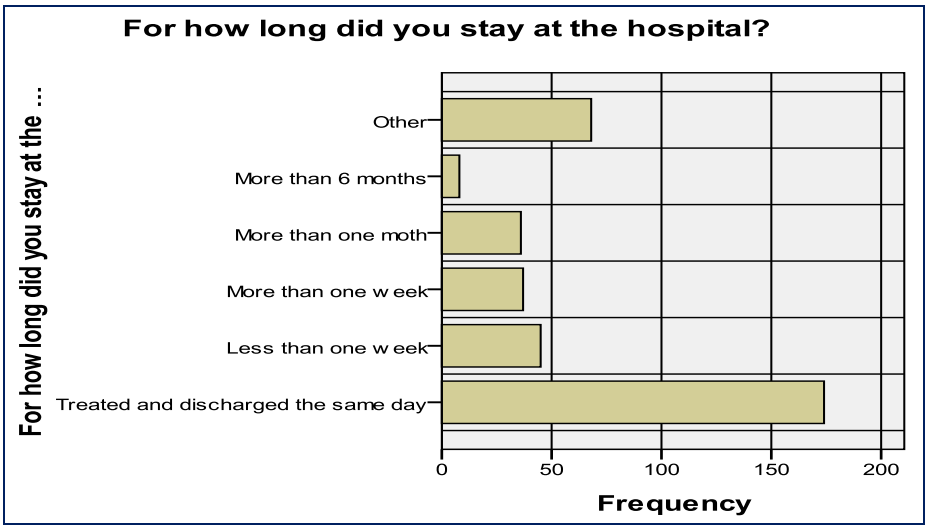

Fig 5: Showing length of staying in the hospital.

Majority of the cyclists (participants) (48.3%) were treated and discharged the same day, (12.2%) were hospitalized for less than one week, (10.1%) took more than One week in the hospital, (9.8%) were hospitalized for more than one month while (2.2%) were in hospital for more than six months (Figure 5).

Table 6: Opinion on use and safety provided the helmet

	Frequency	Percentage
Useful	331	89.9
Not comfortable	22	6.0%
Hot and heavy	8	2.2%
Not available	7	1.9%

Table 7: Opinion on what can be done to reduce cycle injuries and increase safety

	Frequency	Percentage
Avoid operating under the influence of alcohol	261	70.9%
Reduce over-reliance on cycles	71	19.3%
Avoid over-speeding	180	48.9%
Use helmet and protective equipment	151	41.0%
Road repair	100	27.2%
Separate road for pedestrians	55	26.4%
Training of operators properly	102	51.9%
Licensing of the operators(valid)	97	26.4%
Safety	191	51.9%
Legislation and other relevant policies	94	25.5%
Law enforcement by relevant departments	136	37.0%
Reduce overloading	136	37.0%

Avoiding operating under influence of alcohol was mentioned by majority (70.9%) this was followed by wearing helmet and reflective jacket which accounted for (51.9%)

Avoiding over speeding followed at 180 (48.9%), least was reduction of a reliance on cycle which accounted for 19.3%.

Concerning whether law and order could reduce injuries associated with cycle accident majority (82.3%) agreed that it can reduce, however (17.7%) disagreed.

4. Discussion

The consequences of road crashes cannot be overemphasized as it leads to morbidity, mortality and increased economic cost in terms of managing injuries and hospitalization. Commercial cycling has become major form of public transportation in developing countries. This mode of transportation has introduced attendant risk of road traffic crashes being higher among this group of vulnerable road users. In Kenya, however, its related injuries cause significant morbidity and mortality.[12] Many road users have viewed their presence in the roads as the cause of congestion, confusion, fear, and decreased safety in the road system.[12] Due to the relative cost of purchase and ease of maintenance in comparison to motor vehicles, the use of motorcycles in Kenya as a means of transportation is seen as a cheap alternative in the movement of people and goods both on a commercial and private basis. In addition the commercial motorcycle operators claim that the motorcycles are fuel efficient in the light of frequent fuel scarcities, and are able to navigate poor network of roads with the frequent attendant traffic congestion both in the cities and rural areas [36].

The study found out that commercial Motorcycling sector is dominated by the male gender. Respondents were

dominantly males with no female interviewed at all. There was no single female found working within the sites covered in this survey. Consequently the sample was composed entirely of men. This could be attributed to the nature of the work, partly due to the time and energy involved in riding the whole day on a daily basis. Most of the respondents were aged between 20-39 (67.4%) and only 3 % were aged 50-59(3.0%). It means that 97% of the cyclists were below 49 years and 12.8% of the cyclists were under 18 years. The key issue in the case of the worker under 18 years is how they could adapt work and working conditions to their capacity since they are known to be inexperienced and most of them do not know road traffic rules.[37]

The age group most commonly affected in road trauma involving cyclist was 20-29 years.which accounted for 65.3%. This concurred with a study carried out in United States of America which indicated that the largest number of motorcycle rider fatalities per 100,000 population in the United States has been found to be in the 21 -24 years age group, and persons 16 to 20 years old and 21 to 24 years old had the highest injury rate. Children 5 to 9 years old had the lowest fatality rate, and children under 5 years old had the lowest injury rate per 100,000 population [38] Other studies in United Kingdom have found that there are two peak age groups for motorcyclist casualties namely 16 -20 years and 35 -39 years.[39] Increasing age has been found to be protective from motorcycle crashes [40].

Majority of respondents were Christians accounting for 88.4%. Another 10.9%.While other religions accounted for1.0%. Highest number of respondents (50.8%) had primary education as the highest level of education attained. This was followed by secondary education (39.7%) and tertiary (5.2%). University education constituted (3.3%). Other levels of education classified as others accounted for 0.8%. As regards employment status. The highest percentage of the respondent had primary education. As such this sector absorbs the unemployed school drop outs and thereby reducing the number of idlers and crime. 81.5 % of the cyclists were Self-employed, followed by employed by others to ride (7.9%), and about 6(1.6%)did not fall in any category The indication her is that commercial cycling is an activity done by young people as indicated.

The incidence of injuries were highest among motorcyclists at 60.9%. Injuries to bicyclists accounted for 39.1%. Overall 86.6 % of cyclists had had injuries and only 13.4% had not had injuries. Motorcyclists are more likely to sustain injuries than bicyclists. Regarding the type of collision, over half 60% of the motorcyclists who had accidents reportedly collided with other motorcyclists. The Hurt Report indicated that after crash, the likelihood of injury is extremely high in these motorcycle accidents - 98% of the multiple vehicle collisions and 96% of the single vehicle accidents resulted in some kind of injury to the motorcycle rider; 45% resulted in more than a minor injury. Studies carried out by Bachani and collegues [39] blamed a majority of motorcycle accidents on the motorcyclists while other studies found road traffic injuries among motorcyclists, their passengers and pedestrians to account for 46% of all road traffic related injuries. Motorcycle-related injuries are associated with considerable morbidity and mortality [41]. The inherent nature of motorcycles offers riders and passengers no protection like cars making them potentially dangerous. Riders often absorb all kinetic and compressive energy resulting from a motorcycle crash contrary to a car crash [42]. Motorcyclists are about three times more likely than car occupants to be injured in a crash, and 16 times more likely to die.[43]Bicyclist injuries as reported at 39.1% in this study; is extremely high compared to those reported by other researches done on road traffic injuries which have shown that the proportion of all bicycle injuries ranges from 11 to 21%[44]. The burden to the society from this injury is substantial. It can be attributed to variable levels of exposure to specific environmental conditions as well as human behaviour. This could increase if no efforts are made to implement intervention strategies identified. This means that bicycle specific interventions are urgently needed rather than the currently generalized road accident prevention programmes. Currently attention is more on motorvehicle and motorcycles.

The study revealed that the injuries sustained by the cyclists are abrasion, Fractures, lower and upper extremities, and head injuries and few had other types of injuries categorised as other complications which accounted for (1.6%). Most of casualties had suffered abrasion which accounted for (23.1%) of injuries. Slightly half (53%) of participants who reported they had had abrasion were bicyclists. Most of the injuries involve superficial trauma such as “abrasions road rash” contusions and lacerations[45]. Generally, injuries to the lower extremities accounted for 13.3% but there was increase in the number of casualties in bicycle related than motorcycle at 71.6% and 21.6% respectively. The vulnerability of the extremities in particular the lower limbs could be due to a number of factors such as anatomical location, lack of protectors on the extremity and poor assembly of rear wheel. Other respondents had suffered fractures (20.6%). Of those who had head injuries 76.9% were motorcyclists and 23.1% were bicyclists. More bicyclists were injured on the lower extremities than motorcyclists. These injuries occur when exposed limbs become trapped between the bicycle and the ground or impacting vehicle. This concurred with a study by Ross and colleagues that reported that most bicycle related injuries occur to the upper or lower extremities, followed by the head, face, abdomen or thorax and neck [46]. Over three quarters of Head injuries (76.9%) were reported among motorcyclists than bicyclists. This concurs with a study by Sisimwo and colleagues [36] which reported that, the most commonly sustained motorcycle related injuries were to the head followed by injuries of the lower and upper extremity as reported previously from other populations [47]. Some studies have however reported head injury as the most frequently occurring injury among motorcyclists. The increased risk of serious head injury in the absence of helmet wearing as has been documented previously and this study reinforces these findings in a kenyan context [48]. The use of approved safety helmets at the time of injury is said to significantly reduce the morbidity and

mortality from head and neck injuries from motorcycle accidents [49, 50]. In fact, severe head injury is generally a reflection of low usage of helmets by motorcyclists.

This study showed that factors contributing to crashes include predominantly riding under the influence of the alcohol and other drugs, followed by overpeeding, lack of training and experience other factors mentioned are bad roads, mechanical breakdown. Most of the cyclists who participated in the study took drugs and by observation it was clear during the study that cyclists oversped particularly the motorcyclists. This was similar with other studies that reported riding under the influence of alcohol and drugs, low motorcycle conspicuity, or the inability of the motorcyclist to be seen by other road users. [51, 52]. In Kenya, often young men are the ones predominantly involved in the motorcycle business, yet they are poorly trained, often unlicensed and inexperienced motorcyclists and more likely to take risks.[53] The outcomes of such injuries have an impact on a country, not only on its working population but also on families where most of the drivers are the family bread winners as exemplified by the current study where 70% of the injured reported to have lost some income following the injury.

In 2014, 33 percent of all motorcycle riders involved in fatal crashes were speeding, compared with 20 percent for drivers of passenger cars, 17 percent for light truck drivers and 7 percent for large truck drivers [53].

The study indicates that majority of respondents (39.5%) said that commercial cyclists usually collide with themselves. Twenty five point six percent usually get involved in head on collision with another motorcycle, (23.2%) account for head on collision with other vehicles. The least (11.7%) represent involvement in accident while being hit from behind by another motorbike. This was also supported by provincial Traffic Superintendent who said that most of the motorbikes self-fall either as a result of over speeding, lack of paying attention, lack of observing traffic rules and lack of proper training. More bicyclists were likely to be hit from behind (61.5%) than motorcycle. While a third of the motorcyclists were more likely to fall due to mechanical breakdown than their bicyclists counterparts, majority of Head on collisions were from motorcyclists, this was supported by Holland and colleagues [54] who noted that another major contributor to fatal and serious injuries to both motorcyclist and bicyclist. The study noted that (83.3%) of the cyclists did not have reflective jacket and helmet while (16.7%) had the reflective jacket and helmet. A Greek study identifies several reasons for low helmet use amongst motorcycle riders like peer pressure, lack of appropriate information, high cost and lack of convenience, disturbance of hearing and vision, or messing up of hair.[55] The motorcyclists rarely use reflectors at night and daytime headlights during the night. Reflective clothing is aimed at improving visibility of the rider, which has been shown to be quite effective in reducing motorcycle crashes. The use of reflective clothing by both motorcyclists and passengers is mandated in Kenya through a law enacted in 2009. A study done in Kenya showed that that a majority (63%) of motorcycle drivers in Naivasha wore reflective clothing. However, the compliance was lower in Thika (25%) and among passengers (1.3%). The low use of such clothing may be due to multiple factors such as the relative newness of the law, cost of materials, low levels of enforcement, and lack of awareness. Failure to put on helmet and reflective jackets are also factors in this case whereby helmets protects the head in case of accidents as reflective jackets improves the visibility of cycle operator thus he or she can be seen or noticed.

Majority of those who wore helmets were motorcyclists with none of the bicyclists putting any helmet. Bicycle operator and his passengers who are not wearing helmets while operating in the road system are major safety concern. Helmets provide the best protection from head injury for bicyclist involved in road traffic crashes.[56] Non-use of helmets increases the risk of head injuries for riders by a factor of three and helmets reduce fatal and serious injuries by between 25% and 45%.[57] Early population based research in the USA showed that bicycle helmets reduced the risk of severe head injuries by about 85%. Those opposed to bicycle helmet legislation argue that wearing bicycle helmet encourages cyclist to take greater risks and therefore makes them more likely to incur injuries. To date, this argument has not found empirical evidence to support it. Other opponents of bicycle helmet use have suggested that bicycle helmet legislation reduces the number of cyclists and it is for this reason that there are fewer head injuries. The most recent evidence though, suggests the contrary: the number of bicyclists in Canada actually increased in the three years following the introduction of bicycle helmet laws [56].

There is unequivocal evidence that bicycle helmets reduce both incidence and severity of head, brain and upper facial injuries. Making the wearing of bicycle helmets compulsory together with other improvement to the road environment that improve safety for cyclists is therefore an effective strategy for reducing bicycle-related injuries. Barriers to more widespread use of bicycle helmets include discomfort, poor fit, cost, misconceptions regarding the personal risks of cycling and lack of knowledge regarding effectiveness [57]. In a study carried out by Andrew *et al.* Uganda recorded only a 3.4% use of helmets by motor cyclists compared to 16.7% who wore helmets as indicated in this study. WHO estimates that helmet use by motorcyclist's ranges from slightly over 0 to 100% in countries in which helmet law has been enforced? In countries where motorcycle helmets have been enforced, reduction in occurrence of serious head injuries by 20 to 45% have been reported [58]. Motorcycle riders who do not wear a helmet run a much higher risk of sustaining head and traumatic brain injuries, or a combination of them. Helmets create an additional layer for the head and thus protect the wearer from some of the more severe forms of traumatic brain injury. In spite of the protective nature of helmets, and the impact of traumatic brain injury for motorcycle users [59] low rate of helmet use in middle and low-income countries is the commonly observed phenomena [60]. To make matters worse, in spite of the low rate of helmet use, helmets are not worn properly by having the chin strap fastened. Of the motorcyclists who had not worn helmets 72% had head injuries. Motorcycle crash victims

form a high proportion of those killed or injured in road traffic accidents. Injuries to the head, following motorcycle crashes, are a common cause of severe morbidity and mortality. It seems intuitive that helmets should protect against head injuries but it has been argued that motorcycle helmet use decreases rider vision and increases neck injuries.

Majority of the cyclists (48.3%) were treated and discharged the same day, 12.2% were hospitalized for less than one week, (10.1%) took more than One week in the hospital, and 9.8% were hospitalized for more than one month while (2.2%) were in hospital for more than six months. Majority of the cyclists who were treated and discharged (73.4%) were bicyclists and had fell due to mechanical breakdown and had soft tissue injuries due to abrassions. Those who reported taking more than six months in the hospital were motorcyclists who had collisions with motorvehicles.

Avoiding operating the cycle while under the influence of alcohol and other drugs is major step toward prevention of cycle injuries, training of the cyclists on road safety, proper law enactament and enforcement, proper rad design, Using fluorescent or reflective clothing, wearing white or light-coloured helmets, and voluntary daytime use of headlight were associated with reduced risks of motorcycle crashes in a study

5. Conclusion

Young males were mostly involved in cycling and injured in cycle-related trauma. There were more motorcyclists than in Kisumu. The number of motorcycle has increased and the bicyclists are seemingly being replaced by Th motorcyclist in this business. The incidence of injuries were highest among motorcyclists at 60.9%. Collisions between motorcycles and other vehicles formed the most common mechanism of injury. Abrassions injuries were the most common injuries sustained. Head injuries were involved in among motorcyclists than bicyclists, fractures, lower and upper extremity injuries (fore and hind limbs), hand, ribs and other body parts. Lower and upper extremities injuries were sustained by bicyclists. Specific Legislative laws and policy should be put in place targeting bicyclists and motorcyclists.

6. Authors' contributions

Shem Olela and Wilberforce Cholo contributed equally to this work.

7. Acknowledgements

The authors are grateful to the research participants, Central Police Division, Kisumu City, all commercial cyclists who participated in the study

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