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ROLE OF COMMERCIAL BICYCLISTS IN ROAD TRAFFIC INJURIES IN KISUMU CITY, KENYA

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ABSTRACT: *Background:* Commercial bicycling has become a popular mode of transportation in Kenya, in both rural and urban areas since early 1990's. In Kisumu city, 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 roads in the road system. Bicyclists are at high risk of road traffic accidents and the attendant injuries, but are greatly neglected and few community-based studies have investigated the problem in Kenya.
Objectives: The primary objectives were; to determine demographic characteristics of the commercial bicyclists, factors associated with road traffic injuries and crashes involving commercial bicyclists. Other objectives were to determine the perception surrounding commercial bicycling, and to determine preferred road safety interventions for commercial bicyclists.
Study design and Methods: Population based, cross-sectional study involving Four hundred and twenty commercial bicyclists, five key informants, victims of road traffic crashes and injuries involving commercial bicyclists Cluster, systematic and simple random sampling methods were used to select bicyclists at sites. Questionnaires were administered to the commercial bicyclists; Interviews were also carried out with key informants.
Results: The majority of the respondent attained primary education (55.3%), 40.7% completed secondary level of education. The ages of the respondents were grouped as 21-25 years which accounted for 51%, 26-30 years (21.3%),. People prefer using bicycles because they are flexible (39%), and not time consuming (28.9%). Inadequate signals that cannot be understood easily by other users (28.9%) and, riders losing control (19.1%) are the major risk factors. There was significant relationship between drug taking, length of time at work and occurrence of crashes. (χ^2 =7.745, p=0.001). A significant association between injury occurrence and condition of roads was also found, (χ^2=10.226, p=0.001). Road signs were inadequate (74.5%) and those available were misunderstood. There was significant relationship between inadequate road signs (signals), their misunderstanding within the road and subsequent occurrence of accidents (χ^2= 14.305; p= 0.002). Training for bicyclists (36.4%) and bicycle helmets were suggested as road safety intervention measures that could be adopted (34.5%).
Conclusion: Commercial bicyclists are men aged below 40years; they are highly exposed to crashes and injuries due to their interaction in the traffic system, since bicyclists riding in, traffic mix feel unsafe and fearful. Therefore, it is very dangerous to ride in a mixed system because there is increased risk of crashes or accident. There are poor traffic law enforcement mechanisms in Kenya. There is need to integrate this economic activity in the road system while minimizing risks to crashes and injuries.

KEYWORDS: Commercial bicyclist, Injury, risk factor, road safety, intervention, fatalities, crash, Kisumu, Kenya.

1 INTRODUCTION

Road traffic injuries contribute significantly to the burden of disease and mortality throughout the world, but particularly in developing countries[1]. Currently Road traffic injuries are ranked ninth globally among the leading causes of disability

adjusted life years lost. Globally, over 1.24 million people die road crashes annually and as many as 50 million are injured [2]. Without action, road traffic crashes are predicted to result in the deaths of around 1.9 million people annually by 2020 (WHO, 2013).[3] Low- and middle-income countries (LMICs) are estimated to be responsible for as much as 90 percent of this burden, with the African region accounting for approximately 205,000 fatalities and 7,151,000 DALYs due to RTIs (WHO 2004).[4]

Commercial bicycling is increasingly becoming a popular mode of transportation in Kenya, in both rural and urban areas since early 1990's[5]. Globally the increase of bicycling has been witnessed in USA,[6] and 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 roads in the road system.[5] As bicycling grows in popularity as a commuting option and a recreational activity, injuries sustained from bicycle-auto accidents are also on the rise.[7] Bicycle crashes and injuries are a public health priority because they are preventable, there are a large number of injuries and fatalities each year, and the number of vulnerable road users is increasing because bicycling is increasing. Bicyclists are identified as vulnerable road users due to lack of protection within a vehicle and differences in mass and speed compared to motor vehicles[7]

There are about 800 million bicycles in the world, twice the number of cars[8]. 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[9].

In Kenya and other developing countries, bicyclists are legally allowed to use any road but the engineers have not used bicycle as a 'design' vehicle for the roads. Since early 1990s, the bicycle has become common for Kenyan transportation in both rural and urban areas; there is increased use of these non-polluting, energy efficient and flexible vehicles. However, when one begins to investigate the use of the bicycles for transportation, one finds that there are a lot of dilemmas facing commercial bicyclists and road traffic planners[10].

The first dilemma is that the public has many misconceptions about commercial bicycling including the skills required, and the rights of bicyclists to use public roads. Many of the bicyclists think they know how to ride a bicycle, but many lack the basic bicycling skills. Instructions in technique and safety are necessary to be safe and effective. Among bicycle advocates there are relatively few who advocate for improved education and skill development[10].

The second one is that road engineers and traffic planners have often ignored bicyclists, failing to consider them in road design or traffic enforcement. The bicycle is not generally a "design vehicle," so roads are not routinely designed with bicyclists in mind. Many bicyclists operate their bicycles in dangerous or unlawful manner, but few enforcement agencies cite these violators. There are several reasons why police in many areas are unable to stop these violations. Police sometimes believe that enforcement is impossible partly because commercial bicyclists do not display number plates and cannot be threatened by license suspension[11]

Some bicycle advocates believe that until safe facilities are built society should stop blaming bicyclist for violating traffic laws. Further they argue that disobeying traffic rules is a rational response to bicyclists' predicament. This suggests that until road conditions and riding environments become more conducive to bicycling, commercial bicyclists will ride as they find it appropriate rather than as law requires of them[11]

Finally, designated bicycle facilities often do not serve the purposes their advocates propose and sometimes create dangerous conditions. The locations where bicycling is the most useful for transportation are also most challenging, especially for beginners. Bicycle education has not yet become available in a wide scale, in part because advocates, funding programs, politicians and public opinion focus on building road [11,12].

Getting beyond these dilemmas requires reliable data that can be used in policy formulation.

Risk in road traffic arises out of a need to travel to work, or for education or leisure pursuits. A range of factors determine who uses different parts of the transport systems, how it is used and at what time[13]. While in practical terms it may not be possible completely to eliminate all risks. It is possible to reduce the exposure to risk of severe injury and to minimize its intensity and consequences [13]. In road traffic, risk is a function of four elements the first is the exposure to the amount of movement or travel within the system by different users or a given population density. The second is the underlying probability of a crash given a particular exposure. The third is the probability of injury given a crash. The fourth is the outcome of injury[14]. The precise contribution of various errors such as riders loosing control, speed, environmental hazard, bicycle mechanical failure is unclear although they are all significant. [15-17] Another widespread problem is traffic signal that is not designed with bicyclist in mind. There are two problems here first in any traffic signals are actuated by buried loop

detectors and many of these are not sensitive to bicycles even though bicycle sensitive designs are readily available in some countries[18].

The human operator often adapts to changing conditions in ways that do not always serve safety. A single error can have life or death consequences. Behind road user errors, there are natural limitations. These include vision in night traffic, the detection of targets in the periphery of the eye and the estimation of speed and distance. Also influencing human error are external factors such as the design of roads traffic rules and their enforcements[19]. (http://www.etsc.be/eve.htm). Sophisticated and quality assured systems that combine human beings and machines therefore need to have an in-built tolerance of human error[14]. The incidence of bicycle – related injuries varies between countries. In Beijing China, about a third of all traffic deaths occur among bicyclists[3]. In India, bicyclists represent up to 21% of road users fatalities, the second largest category after pedestrian[20]. China is one of the developing countries where public policy until recently has encouraged the use of bicycles as a form of commuting[21]. In the United States, there are 67 million bicyclists who ride approximately 15 billion hours peryear.[20] 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[20], 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[22].

Accident studies in USA show clearly that motorists were judged to be solely at fault in only 28% of car-bicycle collisions, cyclists solely at fault in 50% collisions and both were at fault in 14%[6]. This is partly due to factors such as road design, the traffic mix, climate and cultural attitude. Over 75% of fatal bicycle injuries are due to head injury[22]. Among children, bicycle injuries are the leading cause of head injury. [23]

Most bicycle related injuries occur to the upper or lower extremities, followed by the head, face, abdomen or thorax and neck.[24] Most of the injuries involve superficial trauma such as “abrasions road rash” contusions and lacerations.[25]

Head injuries occur in 22% – 47% of injured bicyclists, often as a result of collision with a motor vehicle and are responsible for over 60% of all bicycle – related deaths and the majority of long – term disabilities.[26] Injuries to the facial region include eye trauma from airborne objects such as dust, insects or debris, as well as facial soft tissue injuries and fractures.[27] Not only do injuries involve neck trauma, which usually occurs in riders who collide with motor vehicle but also trauma to the thorax, abdominal organs, viscera and pelvis are great.

Overall, off road cyclists have a 40 % lower incidence of head, facial dental injuries than on road bicyclists, primarily the result of being separated from vehicular traffic and more frequent helmet use[28]. Overuse injuries may occur in bicycle riders who regularly ride their bicycle, especially those involved in competitive racing and commercial bicycling. Ensuring that the bicycles seat (saddle), haul bars and pedals are correctly adjusted and that the bicycle is the appropriate size can be key in preventing overuse syndromes.[29] Neck aches and backaches are also common complaints resulting from the cyclists, upper body position with hyperextension of the neck and flexion of the back.[28]

Enforcement of laws on traffic violations committed by bicyclists is a necessary ingredient in improving bicyclists’ safety. It would also be helpful to target behaviour that is threatening to pedestrians such as weaving through a crosswalk (on a red signal) and riding on a sidewalk.[4]

To reduce bicycle injuries in Kenya, as elsewhere, several types of interventions are likely to be effective. Changes to the road environment can be highly beneficial. The 2004 World Report on road traffic injuries recommend the following strategies: Separating bicycles from other form of traffic, engineering measures to control traffic flow and reinforce low speeds, bicycle lanes, traffic signals and signs aimed at bicyclists, painted lines on the side of the roads, removing obstacles from roads and cycle paths, repairing road surfaces, to remove portholes, safe bicycling practices, and respectful behaviour towards others sharing the road[4.]

No studies have been done in Kenya on commercial bicycling. A lack of research means that the magnitude of the problem, its impact and the cost and effectiveness of intervention measures are not fully understood. Despite the marked increase of commercial bicycling in Kenya particularly in Kisumu and the related crashes and injuries, little effort has been made to develop and implement targeted effective interventions for commercial bicyclists. The serious neglect of commercial 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. In deed very little has been done about the safety of the commercial bicyclists in Kenya. Most riders at times ignore or do not know the safety laws and regulations. This is reflected in the absence of basic requirements such as helmets, license and training. Yet the sector is characterized by high exposure to road traffic crashes and injuries. The focus has entirely shifted to motorized road users.

This study aimed at providing epidemiological data on bicycle related injuries and to determine demographic characteristics of the commercial bicyclists, factors associated with road traffic injuries and crashes involving commercial bicyclists. Other objectives were to determine the perception regarding commercial bicycling, and to highlight some preferred road safety interventions for commercial bicyclists.

2 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 municipality is 970,000. 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. Selection of study participants was done in 3 stages involving 3 sampling techniques; multi stage sampling, systematic and simple random sampling. These were applied to select estates, cluster sites where bicyclists stand as they wait for clients, and bicyclists respectively. Structured questionnaire were administered to a random sample of 420 commercial bicyclists to obtain the following information: demographic data, perceptions regarding commercial bicycling, factors contributing to road traffic injuries involving commercial bicyclists 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 ETHICAL ISSUES

The purpose and methods involved in the study and its advantages were explained to the subjects/respondents in a language that they understood (English, Kiswahili, Luo). Their consent to participate was sought before administering the questionnaire. The respondents were assured of confidentiality, and that there were no risks or benefits to be derived by agreeing to participate in the study and that their participation was purely voluntary.

All the respondents were treated with respect. The respondents were allowed to withdraw from the study at their own pleasure if they were unable to continue because of some reasons. Confidentiality was ensured during and after the study, no identifying information was recorded, such as name or ID number. Ethical approval was sought from the Moi University Institutional Research Ethics Committee (IREC) prior to commencing the study.

4 RESULTS

Demographic Characteristic: The majority of the Commercial Bicyclists attained primary education (55.3%), 40.7% completed secondary level of education; only 4% had attained Post secondary level of education. Of those who had completed technical college 7 had done mechanics, carpentry (5). Of those who had University degree one did agricultural engineering, the other 2 did Bachelor of Science, Chemistry and Bachelor of Arts respectively. The ages of the respondents were grouped as 21-25 years which accounted for 51%, 26-30 years (21.3%), 31-35 years (6.5%), 15-20 years (17.7%) and 36-40 years (4.5%).Table 1

Table 1 Demographic characteristics of respondents

Age in years	No.	%
15-20	74	17.7
21-25	213	51.0
26-30	85	21.3
31-35	27	6.5
36 – 40	19	4.5
Educational level		
Primary	231	55.3
Secondary	170	40.7
Technical college	14	3.3
University	3	0.7
Total	418	100

Reasons for and not using bicycles for transport

Most people prefer using *boda boda* because they are flexible (39%) not time consuming (28.9%) and cheap (26.1%) a few said they are comfortable (6%). On the other hand, various reasons why people may not want to use bicycles for transport were mentioned. Nearly a third (31.6%) of the respondents said that bicyclists are not trained on traffic rules, 24.6% said the riders do not have skills to operate on the road, 21.1% considered them unsafe, while 22.7% perceive that bicycles are not design vehicle for ferrying passengers.(Table 2).

Risk assessment and Perception on Risk

Majority of the commercial bicyclists 89.8% cited that riding in a mixed traffic system is very dangerous, while only 10.2% said it is not dangerous. This is because they thought there is an increased risk of a crash (78.5%), other road users are bothersome to riders (13.3%) and all road users are allowed to use road.

Of those who reported that it is very dangerous to ride in a mixed system 70% said it is not safe to use road as it is (30.3%) compared to 83.3% who said it is very dangerous to ride in mixed system and do not think it is safe to use road as it is. According to χ^2 test, Cramers V test there was highly significant relationship between danger assessment and riding in a mixed system. χ^2= 14.308 P=0.000.(Table 3)

Human related factors that contribute to crashes among commercial bicyclists

Majority of the respondents (28.9%) cited inadequate signals that cannot be understood easily by other users as a major factor, riders losing control (19.1%), in- experienced riders in a mixed traffic system (18.5%), inadequate knowledge regarding road safety (12.7%), use of mobile phones while riding (11.0%), riding under the influence of alcohol (2.9%).

Time when they begin and stop working

Fifty one percent of the cyclists start work before 7am and 45% between 7 and 9am. Some 68% of the operators stop working between 5pm and 7pm while the remaining 24.1% stop after 7pm. 52% work for 10 hours, 32% work for 8 hours, 12% for 6 hours and for over 12 hours (4.%).

All of the respondents stated working for along time without rest contributes to crashes and injuries.

Drug abuse

Twenty six point six of commercial bicyclists consumed alcohol while 19.2% smoke bhang and 55.2% use both alcohol and bhang; they take to improve their strength (34.7%), to be courageous (58.2%), and feel good (6.7%). Most of them take drugs mainly in the course of the day as they work (54%), morning hours before work (26.8%) and very few take drugs in the evening after work 19.2%.Table 4

Of those who were involved in accident 58.3% take alcohol or bhang, while only 41.7% who had been involved in accident but neither use bhang or alcohol. Among the 208 respondents who drink alcohol or take bhang (53.3%) had been involved in an accident while riding a bicycle compared to 46.7 % non drug takers who had had an accident. Thirty one point one percent of the commercial bicyclists had neither been involved in accident nor take alcohol or bhang.

There was a significant relationship between the drug use and involvement of accident (χ^2 = 7.725; p= 0.005).

Factors influencing severity of injuries Involving commercial bicyclists

Analysis of the severity of injuries showed that lack of emergency preparedness including lack of first aid knowledge, equipment and materials (36.6%), and taking long time before those injured are taken to hospital and cared for (30.4%) were stated as major factors affecting severity of injuries, while other respondents stated kinetic energy of impact (20.6%) and crowding at the scene of injuries (12.4%).

Environmental factors contributing to crashes and injuries involving commercial bicyclists

The respondents were asked to state environmental factors contributing to crashes and subsequent injuries.

Of the respondents interviewed, 51.7% cited inadequate space for riding as the major factor, while other 32.5% mentioned poor road surface and 16.5% stated presence of roadside objects.

Other factors contributing to bicycle related road traffic crashes and injuries

This section includes responses which were placed as other factors because they could not fall into the above mentioned categories, nevertheless the quantity of responses were high enough to warrant inclusion.

Safety seems to be a major concern of the bicycle riders, when asked whether they had training in bicycling as business, only 3.6% said they had some training in bicycling as a business, but a large majority (96.7%) had not received any form of training in the bicycle riding as business.

In addition some 70.8% of the commercial bicyclists stated they were fearful, 22.5% felt courageous and only 6.7% felt safe while riding in a mixed traffic system.

Most of the respondents (97.9%) reported, particles enter their eyes as they ride, 55.6% of them stop to remove the particles then continue, 39.5% just rub their eyes and continue riding while 4.9% assume, only blink their eyes as they continue riding. On the other hand all respondents stated that there are obstructions on the road that always challenge their work. The object they stated include, handcarts (45.8%), stones (46.2%), sharp edge of the pavements (4.4%) and luggage to be transported or those that have been left offloaded (3.6%). All of the respondents said some loads they carry are sometimes very heavy. They quoted large and heavy passengers.

Safety equipment and materials

As summarized in Table 5, the respondents mentioned, bicycle helmets (34.9%), headlamps (30.6%), reflective clothing (17.2%), indicators (16.3%) and 1.9% gloves (1.9%) were necessary.

Other safety measures that would be adopted for and by commercial bicyclists

When asked about any other road safety measures that could be adopted for and by commercial bicyclists to prevent their exposure to road traffic crashes and injuries. They cited free training on road safety laws and regulation (36.4%); 28.9% suggested bicycle lanes. Others (16.8%) suggested strict adherence to rules and regulation by riders, while 15.6% mentioned keeping bicycle in good state by cyclists. The least of them stated promotion of bicyclists' right (2.4%) as a measure that should be adopted (Table 6)

Table 2 Reasons for and not using bicycles for transport

Why people use bicycles for transport		
	No.	%
Flexible	163	39.0
Comfortable	25	6.0
Not time consuming	121	28.9
Cheap	109	26.1
Why people may not want to use bicycle for transport.		
	No.	%
Unsafe	88	21.1
Unskilled riders	103	24.6
Bicycles are not vehicles	95	22.7
Riders need to be trained	132	31.6
Total	418	100

Table 3 Risk assessment and perception of risk

Risk assessment	No.	Percent
Very dangerous	376	89.8
Not dangerous	42	10.2
Reasons		
There is an increased risk of a crash	328	78.5
Other road uses are a bother	56	13.3
All are allowed to use road	34	8.2
Total	418	100.0

Table 4 Types of drugs taken

Type of drug	No.	%
Alcohol	76	26.6
Bhang	40	19.2
Both alcohol and bhang	112	55.2
Reasons for taking the drugs		
Strength	72	34.7
To be courageous	122	58.6
To feel good	14	6.7
When drugs are taken		
Morning hours before work	56	26.8
In the evening after work	40	19.2
During working hours	112	54
Total	208	100

Table 5 Safety equipment and materials

Equipment / Material	No.	%
Bicycle helmets	146	34.9
Gloves	8	1.9
Headlamp	124	30.6
Reflective clothing	12	2.2
Indicators	68	16.3
Side mirror	60	15.1
Total	**418**	**100**

Table 6 Other safety measures

Safety measure	No.	%
Training on road safety	143	36.4
Bicyclists own paths/lane constructed	121	28.8
Strict adherence to rules by bicyclists	71	16.8
Keeping bicycle in good state	64	15.6
Promotion of bicyclists right to use roads	10	2.4
Total	418	100

5 DISCUSSION

Road transportation plays an important part in a society for the movement of not only people but also of goods. The consequences of road crashes cannot be overemphasized as their related injuries results into significant morbidity, mortality and increased economic costs in terms of managing injuries and hospitalization.

The study found out that commercial bicycling sector is dominated by the male gender. 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.

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.

The survey found out that while the youngest worker was only sixteen years old, the eldest was 39 years. But in general the sector accommodates a comparatively young work force with majority (95.5%) being below 35 years of age. 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.

Most people preferred to use commercial bicyclist because they are flexible, not time consuming and cheap. They provide the most convenient mode of transport for the poor due its low fares for relatively short distances and transport from door to door. In addition they are reported to be fast and reliable as compared to 'matatu' which mostly have to wait for people to fill them to capacity at terminals before they can move. Although it is perceived that this mode of transport is cheaper compared to matatu, tricycle and motorcycle the latter could be cheaper over relatively long distances within the city, as they have fixed rate.

On the other hand, most of the people may not want to use bicycles as mode of transport because riders are not trained since many believe they don't have required skills to operate in road way system, others perceive bicycles are not design vehicles and therefore should not operate in roads, the more logical and ethical position is that bicycle should be design vehicles wherever they are permitted[11], although good highway design will accommodate bicyclists in many roads without special provisions, there are several key deficiencies in roadway design that reveal the lack of considerations of bicycle traffic,[13] while others thought it was unsafe. It is also perceived to be unsafe partly due to fear and the behaviour of bicyclists. According two bus park managers, People may not use bodaboda as means of transport because;

'There is lack of road safety or the fear of it due to mixing with motorists, the manner of bodaboda operation, behaviour of bicyclists, many are just thugs – but hiding in this operation. We therefore suggest, there should be proper law adherence, enforcement and training for us '

Although commercial bicyclists are always blamed for the traffic confusion and the consequences that usually befall them for their exposure to crashes and injuries in mixed traffic system, there should be a shift of focus to the government sectors because of their lack of commitment to design and effectively implement policy regarding commercial bicycling. As yet for over twenty years there is no established and functional policy on commercial bicycling. This is evidenced by lack of licensing mechanisms for commercial bicycles, lack of bicycle lanes to accommodate them, foot paths and uniforms.

Many governments including U.S. and Kenya treat bicyclist by law as drivers of vehicles and grant them right and responsibilities accordingly; however the public is not aware of this law.[14] Motorist often feel that bicyclist have no right to be on the road especially where bicyclist presence required the motorist to wait before overtaking. Some motorists tell bicyclist to get off the road. The frequency with which many bicyclists disobey traffic law contributes to public attitudes that bicyclists operate outside the law and therefore do not deserve the same treatment[13]

This study revealed that it is very dangerous to ride in a mixed system because there is increased risk of crashes or accident. It is significant to note also that more than three quarters of the bicyclists riding in, or near traffic reported feeling unsafe and fearful.

The majority of the commercial bicyclist (93.5%) stated there is no proper traffic law enforcement mechanism in Kisumu city and many of them (96%) do not have uniforms or reflective clothing.

Factors contributing to Bicycle related crashes and injuries

Most of those who took drugs didn't have work rest schedule, majority took combination of drugs including bhang, cigarettes and alcohol. The respondents who were drug users said that they use drugs for courage and strength, data from focus group discussion emphasized that they must consume drugs since, "we can't work empty headed that is, without drugs because if we don't take, one may not appear at the site for work the following day." There was significant relationship between drugs use and consequent occurrence of crashes and injuries.

The majority of the riders (79.1%), reported that the paths are not distinct and adequate and that this condition results into accidents. There was a highly significant relationship between the nature of the paths used and the occurrence of accident. The smaller and less distinct they are the higher the rate of accident. Most cyclists start work before 7am and few begin their work between 7 and 9am and stop working between 5pm and 7pm while very few stop after 7pm. Majority work

for 10 hours, others work for 8 hours, 6 hours over 12 hours. And all respondents reported that riding for long times due to fatigue contribute to crashes. The recommended duration for commercial bicyclists to take while riding has not been established and documented. Although the precise role of riding for long and crash occurrence has not been established its contribution cannot be underestimated.

The study identified that the signals (like waving hands) used are inadequate and these signals are misunderstood by other road users with consequent contribution to crash.

There was significant relationship between inadequate signals and misunderstanding within the road system and subsequent occurrence of crashes ($\chi 2$ =14.305; P=0.002).

Particles enter the eyes of the riders. While majority stop to remove the particles, some just rub their eyes and continue and others assume, blink their eyes and continue riding. While the best response to adopt is not yet established, abrupt stops could also pose danger, rubbing the eyes and mere assumption and eye blinking could also be very tricky depending on the energy of impact of the particles on the eye and the size. Objects or obstructions on the road system like hand carts, stones and different types of items to be transported or those offloaded pose a lot of challenge to commercial bicyclists. All of the respondents said some loads they carry are sometimes very heavy. They quoted heavy women. It was stated that these could cause crashes.

The majority of the bicyclists (96.4%) had no formal training in road safety. At the moment there is no established training institution where commercial bicyclists can be trained on road traffic rules and regulation. The negligible proportion that had formal training were probably those who had trained as drivers but were not employed.

The major factors contributing to crashes and injuries are inadequate signals, over speeding in a mixed system, riders losing control, bicycle mechanical failure, others include, environmental hazards, riding at night without light and riding after rains.

The issue of concern is road traffic emergency preparedness this is because very negligible proportion of bicyclists prepared for emergency; they did not have first aid kit nor knowledge and skill concerning first aid. This means that most bicyclists cannot help themselves or others in the event of a crash, they have to wait for the police and this may worsen the outcome of the injuries sustained.

The study also found out that lack of emergency preparedness, and taking long time before those injured are taken to hospital are the major factors influencing severity of injuries involving commercial bicyclists. The pre hospital phase of trauma care encompassing rapid and safe transport to hospitals by use of ambulances coupled with immediate surgical treatment within the trauma system significantly reduces preventable deaths[22].

Inadequate space for riding was cited as major environmental factor resulting to crashes and subsequent injuries. Poor road surface like the case of Ondiek highway, Nairobi road, Kenyatta highway and presence of road side objects also were mentioned, example of such roads are Oloo Street and Shaurimoyo road. Other environmental solutions include separating bicyclist from traffic by use of designated lanes on streets, assuring bicycles and lacking in obstacles and discouraging "wrong way" riding on sidewalks and roads. The protective effect of sidewalks is unclear. A study suggested that riding on sidewalks may actually be more dangerous than riding on road, perhaps because rules are followed less often. [26]

Inadequate signals that could not be understood easily by other road users, inexperienced riders in a mixed system, riders losing control, inadequate knowledge regarding road safety laws and regulation, use of mobile phones accounted for more than three quarters (90.2%) of the human errors that contribute to crashes. Moreover the study revealed that human errors account for the most road crashes involving commercial bicyclists according to the data derived from the traffic police. This has a positive element to it, in that people's knowledge, attitude and behaviour can change and if this happens, there is potential to significantly reduce the number of crashes and hence death and injuries on roads.

Use Bicycle helmets, reflective clothing, and appropriate use of headlamp, are the main interventions that should be adopted, very negligible proportion stated gloves as interventions that could be adopted. Despite the least number of patient who needed gloves; cycling gloves can reduce superficial hand injuries for bicyclists, provide insulation in cold weather and prevent nerve compression. Helmets provide the best protection from head injury for bicyclist involved in road traffic crashes.[30] 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%. Lack of helmet use was recognized by the world report on road traffic injury prevention in 2004 as one of the most important risk factor that contribute to road crashes and injury severity.[31] There is now good evidence that bicycle helmets are effective in reducing head injuries. Early population based research in the USA showed that bicycle helmets reduced the risk of severe head injuries by about 85% [32].

To promote the wearing of bicycle helmets many governments have introduced legislation making bicycle helmets mandatory. During 1990's, Australia, Canada, New Zealand and the United States brought in such laws. Since then, the Czech Republic, Finland, Iceland and Spain have followed suit [33].

In New Zealand, it has been estimated that there was a 19% reduction in head injuries among cyclists over the first three years following the introduction of bicycle helmet laws[34]. 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, there is no evidence to support it[33]. 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[34].

The majority of the bicyclists stated they needed free training on road safety laws and regulation. Bicycle education involves learning skills, knowledge and decision making ability in traffic, it assumes that individuals can make appropriate decisions in a variety of complex traffic situations. Unfortunately, many cyclists, motorists and governments do not place the same value on cyclists training as on drivers' education, even though they share the same roads[35]. By teaching the commercial bicyclists the necessary skills and knowledge to cycle safely, bicycle safety education can be useful means of preventing injuries and deaths. Bicycle lanes were suggested that they should be constructed for commercial bicyclists. The separation of different road users is key step for improving safety. Crashes will reduce if pedestrians and cyclists are kept off motorways; bicycle lanes and sidewalks are provided[35]. Road crashes involving bicyclists tend not to be evenly distributed throughout the network. They occur in clusters at single sites, along particular sections of road or scattered across whole residential neighbourhood, especially in areas of social deprivation[36]. While road engineering can greatly help in reducing the frequency and severity of road traffic crashes, poor engineering can contribute to crashes. The road network has an effect on crash risk because it determines how road users perceive their environment and provides instructions for road users through signs and traffic controls on what they should be doing. Many traffic management and road safety engineering measures work through their influence on human behaviour[37]. Although good highway design will accommodate bicyclists in many roads without any special provisions, there are several key deficiencies in roadway design that reveal the lack of considerations of bicycle traffic [37].

6 CONCLUSION

Commercial bicyclists are men aged below 40years; they are highly exposed to crashes and injuries due to their interaction in the traffic system, since bicyclists riding in, traffic mix feel unsafe and fearful. It is very dangerous to ride in a mixed system because there is increased risk of crashes or accident,

The massive influx of the commercial bicycles into the city has led to major conflicts within the existing transportation channels. Hence a major challenge to both city authority and the traffic today is how to tackle the large number of accidents involving cyclists and their passengers. The initial plans for the roads in the city had no provision for commercial bicycling as demonstrated by the narrow paths, congestions and lack of training for commercial bicyclists.

The commercial bicycle are preferred to other mode of transport in Kisumu city because they are perceived to be flexible as they help in door to door transport, not time consuming and relatively cheap for short distance. However other people do not use them because bicyclists are not trained on road safety and therefore they do not have skills to operate in the road system and there is un-safety caused by their presence roads.

There are poor traffic law enforcement mechanisms in Kisumu city and bicyclists do not have uniforms or reflective clothing. Human errors like misunderstanding the road signals, riders losing control, riding too fast, and drug use are the factors that contribute to crashes involving commercial bicyclists in Kisumu city. .

Human errors such as drink driving and riding, speeding, fatigue, inadequate signals use and environmental factors should remain the focus of targeted road safety intervention. This is because it has a positive element as peoples' knowledge, attitude and behaviours can change and this can significantly reduce the number of crashes through advocacy, dialogue and effective implementation.

There is need to integrate this economic activity into transport system while minimizing users conflicts and ensuring safety by providing enough space on roads and construction of bicycle lanes and ensuring that the bicyclists have the protective equipments and materials like helmets, reflective clothing and headlamps.

Information is an important resource, which commercial bicyclists lacked; generally the riders do not have adequate information regarding road safety laws and regulations. This could be attributed to lack of training programmes for the

commercial bicyclists. There is great need to identify and establish effective and mandatory training programmes for commercial bicyclists.

There is need for a more objective estimation of the contribution of various risk factors, people's perceptions and other aspects of the problem. The findings will help in stimulating interest among researchers, various government agencies and the public in this major health problem. It is hoped that specific policies and strategies for injuries prevention in this country, Kenya will be developed.

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CONFLICT OF INTEREST

The authors declare that that was no competing interests.

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