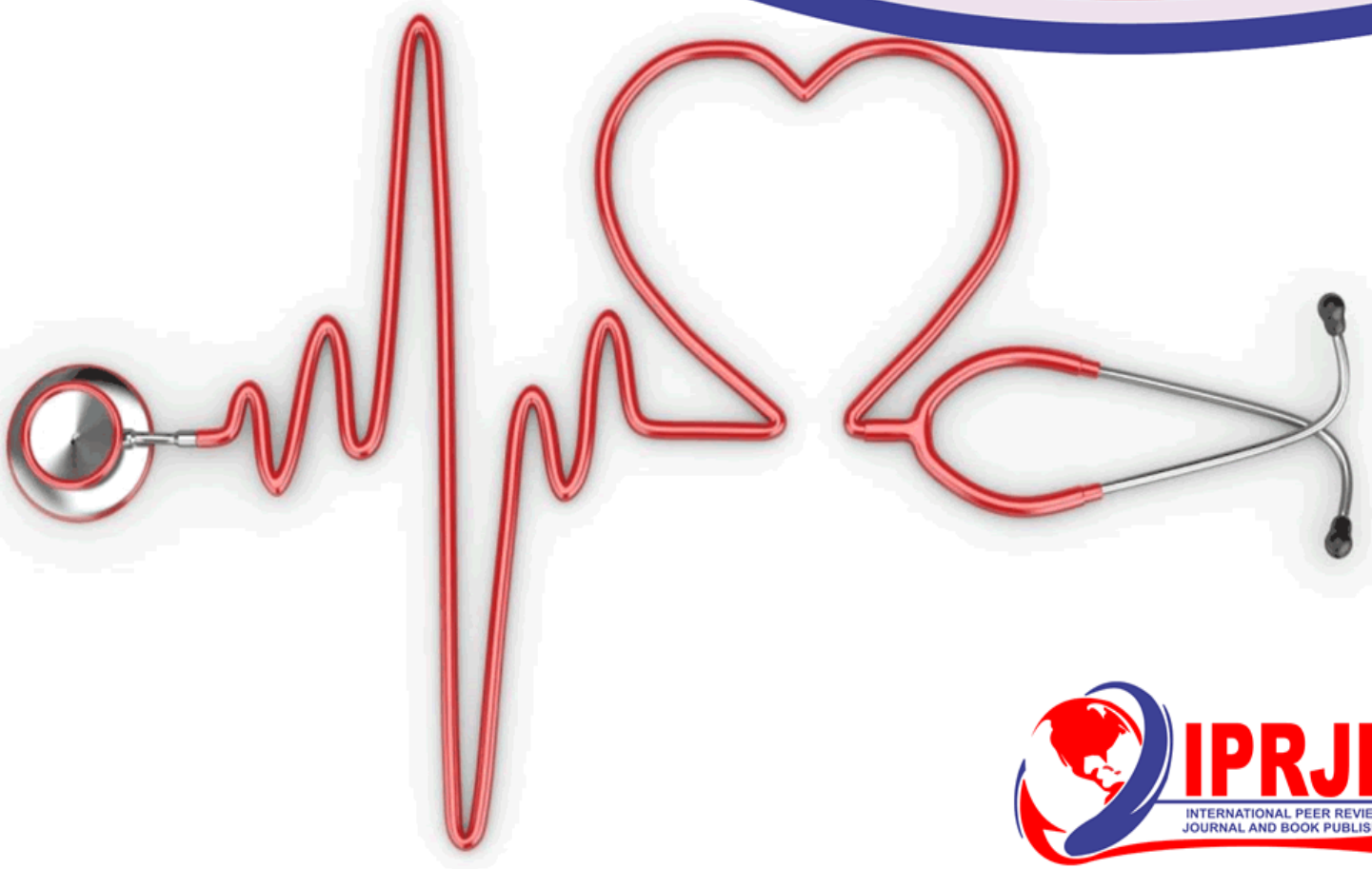
Journal of
Health, Medicine and Nursing
(JHMN)

PREVALENCE AND FACTORS ASSOCIATED WITH COMMERCIAL MOTORCYCLE ACCIDENTS IN EMBU COUNTY, KENYA

Paul Muriithi Ngari, Dr. John Gachohi and Prof. Kenneth Ngure



IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

Journal of Health, Medicine and Nursing
ISSN 2520-4025 (Online)
Vol.5, Issue 2. No.5, pp 73- 95, 2020

IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

www.iprjb.org

PREVALENCE AND FACTORS ASSOCIATED WITH COMMERCIAL MOTORCYCLE ACCIDENTS IN EMBU COUNTY, KENYA

[1*]Paul Muriithi Ngari
Post Graduate Student: School of Public Health: Jomo Kenyatta University of Agriculture & Technology
*Corresponding Authors E-mail: ngaripaul19@gmail.com

[2]Dr. John Gachohi
Lecturer: School of Public Health: Jomo Kenyatta University of Agriculture & Technology

[3]Prof. Kenneth Ngure
Lecturer: School of Public Health: Jomo Kenyatta University of Agriculture & Technology

Abstract

Purpose: The purpose of this study was to determine the causal factors associated with commercial motorcycle accidents in Embu Town, Embu County.

Methodology: A prospective cohort study design was employed to assess commercial motorcycle riders in Embu town. Baseline data were collected among 200 commercial motorcycle riders who were then followed up for three months. A semi-structured questionnaire was administered weekly to capture risk factors for motorcycle accidents. Participants were censored when they got involved in an accident. Data were entered into excel and imported to SPSS software version 24 for analysis. Descriptive statistics including mean, standard deviation and percentage of sociodemographic characteristics and motorcycle accidents were calculated. Bivariate analysis was conducted to determine factors that influence commercial motorcycle accidents. All variables significant at bivariate level were included in logistic regression model. All tests were significant at $P< 0.05$.

Findings: A total of 48 (24%) commercial motorcyclists were involved in road accident during the three months of the study. Factors independently associated with accidents among motorcyclists were use of alcohol (OR=0.45, 95%CI: 0.220-0.915, P=0.028), use of *khat* (OR=0.38, 95%CI: 0.193-0.749, P=0.005), driven the motorcycle under alcohol influence (OR=0.24, 95%CI: 0.106-0.520, P<0.001) and riding while chewing *khat* (OR=0.47, 95%CI: 0.229-0.951, P=0.036).

Unique contribution to theory, practice and policy: The findings will assist in developing feasible interventions to reduce the increasing road accidents related to motorcycle accidents both in the study area and in other areas. Therefore, there is need to have interventions programs addressing dangers of using alcohol and *khat* among riders.

Keywords: *Commercial motorcyclist, Road accidents, Alcohol, Khat*

1.0 INTRODUCTION

1.1Background of the study

Globally, road traffic injuries are the eighth leading cause of death for all ages and account for 1.35 million deaths annually (WHO, 2015; Foreman *et al.,* 2018). Nearly 3700 people die on the worlds roads every day (WHO 2015). A majority of this burden is experienced in low- and middle-income countries (LMICs) and vulnerable road users such as pedestrians, cyclists, and riders of motorcycle (Nantulya & Reich 2002). The road traffic injuries costs between 1-2% of LMICs gross national product estimated at over US$ 100 billion a year (Jacob, Aeron-Thomas & Astrop, 2000). Countries in Africa and South-East Asia are still having higher rates of road traffic deaths than global rate with 26.6 and 20.7 deaths per 100,000 populations respectively (WHO, 2015). Motorcyclists are among the most vulnerable road users accounting for 23% of the world' s road traffic deaths and have a 34 higher risk of death per mile traveled in a crash than other types of motor vehicles (Lin & Kraus, 2009).

Injuries to the lower-extremity and head are most common among motorcyclists (Lin & Krauss, 2009). Other motorcycle injuries range from minor abrasions to fractures and spinal deformations (Schwellnus & Derman, 2005; Michon, 2013). Motorcyclist face higher dangers from several road hazards such as potholes, dead animals, slick pavement conditions, uneven heights between lanes, and other irregularities or unexpected objects in the road posing a serious safety threat due to the smaller size and less stable nature of the motorcycles than other motor vehicles; as the motorcyclist is not surrounded by a metal case and is likely to be thrown far and hard, such crashes are more deadly than those involving other vehicle types. (Berecki-Gisolf *et al.,* 2015; Koornstra *et al*., 2003).

Factors that influence motorcycle crashes include age, ethnicity, income, education, motorcycle license, insurance status, self-reported alcohol consumption in the 12 hours preceding the crash, years of on-road riding experience, kilometers travelled on the specific motorcycle at interview, posted speed limit, and weather conditions (Slesak *et al*., 2015; Woratanarat *et al*., 2013; Mullin *et al*., 2000; Langley *et al*., 2000; Wells *et al*., 2004; Cheng, Wang & Lu, 2014). Other factors are engine size, time of day, ownership, speed and risk-taking behaviour (Lin & Kraus, 2009).

In Kenya, fatalities that are attributed to road traffic accidents in Kenya have been seen to increase steadily over the years and is one of the highest road fatality rates with about 68 deaths per 10,000 registered vehicles with about 45-60% of admissions to surgical wards being due to road traffic injuries (WHO, 2008). This is accompanied by several implications to health, with increasing mortalities and disabilities; and increasing associated economic costs as well as diminished productivity (Odero, Khayesi, & Heda, 2003).

Motorcycle use in Kenya has also significantly increased over the last decade filling the transport

system gap due to their relatively low cost, ease of use, availability and flexibility (Nesoba, 2010; WHO, 2011). According to NTSA statistics, the number of registered motorcycles by the year 2014 rose to about 111,124 (NTSA, 2015). Over the years, motorcycles have also been a major contributor to Road Traffic Injuries (RTI' s) (Nesoba, 2010). A total of 3055 road traffic deaths were reported by the Kenya traffic police and of these, approximately 7% were motorcyclists (WHO, 2011). A study at Naivasha hospital revealed that 36% of patients who presented to the emergency department because of road traffic crash (Road Traffic Crash) were motorcyclists and 75% of these patients were not wearing a helmet at the time of the crash (WHO, 2011).

1.2 Problem statement

Motorcycle injuries constitute a major but neglected public health concern in rapidly motorizing Kenya. As a result of rapid motorization without sufficient improvement of road safety strategies and poor implementation of preventive measures has increased the number of RTIs in Kenya (Chandran, Hyder & Peek-Asa, 2010; Peden *et al*., 2004; Odero, 2009). A majority of this burden are vulnerable road users such as pedestrians, cyclists, and riders of motorcycle (Nantulya & Reich 2002). In 2019 there have been 724 fatalities, 1337 serious injuries and 341 minor injuries related to motorcyclist (NTSA 2019). Road traffic crashes, injuries and deaths involving motorcycles have increased noticeably and is putting a heavy burden on families, communities and health system in general (WHO, 2011). Motorcycle injuries contribute to a substantial number of deaths and hospital admission in Kenya especially among productive age. This translates to approximately 68 deaths per 10,000 registered vehicles and motorcycles, which is 30 - 40 times greater than in highly motorised countries (Odero, 2009). This has significant social and economic implications to the country as it costs approximately 5% of country's Gross Domestic Product. Embu Town is estimated to have over 1,200 registered commercial motorcycles and the number is expected to grow since the *Boda Boda* are the cheapest means of transport in the region and especially for short distances. A growing number of motorcycle accidents as reported by police and other local source is expected to change the pattern of injuries and hence influence the treatment in future. So far this information has not been documented in Embu County and constitutes a gap in the epidemiological understanding of commercial motorcycle accidents in the study area.

1.3 Research Questions

1. What socio-demographic characteristics are related to commercial motorcycle riders in Embu town, Embu County?
2. What are the road safety practices among the commercial motorcycle riders in Embu Town, Embu County?
3. What is the prevalence of commercial motorcycles related road traffic accidents in Embu

Town, Embu County?

4. What are the factors associated with commercial motorcycle accidents in Embu Town, Embu County?

2.0 LITERATURE REVIEW

2.1 Motorcycle Transport

Motorcycle usage as a form of public transportation globally is an ancient thing. In fact, the application of motorbikes as a method of public transportation dates back to the 1930s in Kaolack Senegal and the 1960s in Kenya, Uganda and Benin where bicycles, the predecessor to today' s motorcycle, would carry both people and goods. Motorbike taxis were launched in Nigeria in the 1970s however a steep growth in their usage was recorded in the mid-1980s in Niger, Cameroon, Togo, Benin, Uganda and Kenya as a development from the bicycle taxi (Mutiso & Behrens, 2011). Its increased usage led popular names for these motorbike taxis e.g. Boda boda in Uganda and Kenya and other different names like zemidjan, bendksin, kabu-kabu and Okada in Benin, Cameroon, Niger and Nigeria respectively (Mahlstein, 2009). Piki-piki is a Swahili term being used also to describe motorcycles (Howe & Maunder, 2004). The usage of commercial motorcycles is mostly linked to three factors which include the increased level of production, shortage of transport and loose regulatory frameworks (Olvera *et al.*, 2012).

Additionally, commercial motorcycles are convenient solutions for transport issues that affect private vehicles and public transport e.g. poor road infrastructure and traffic jams. The purchase of personal vehicles is also expensive and due to the low-income levels of the general population as such the household ownership rates are still low. A majority of the population rely on public transport to commute (Olubomehin, 2012). Some regions also lack roads while others are in a poor state which makes it hectic and costly for motor vehicles to operate through. Urban transport is also insufficient and public transport is inadequate in major cities and there are usually limited public transport in smaller towns (Goodfellow & Titeca, 2012).

Proliferation of motorcycles as a means of commercialized transport is triggered by socioeconomic policies that are unfriendly that have manifested themselves in the rate of high unemployment rates, decayed social infrastructure, and poverty (Michael, Usman, & Eke, 2013). Also, inadequate transport systems in developing nations have sparked interest in motorcycles (Goodfellow & Titeca, 2012). Moreover, the Structural Adjustment Programme (SAP) and other unfriendly economic policies have caused many to lose their jobs and move into looking for alternative sources of transportation (Peden *et al.*, 2004). Ownership and use of motorcycles as means of transport is common in South and East Asia (Tang *et al*., 2008; Zhang *et al*., 2004). In Kenya, bicycles were replaced by motorcycles taxis (*boda bodas*). The government of Kenya

move to zero rate duty on the imports saw an increase in the number of persons adopting motorcycle use as a replacement of the bicycles (WHO, 2004). The number of motorcycles in Kenya leaped from 3,759 in 2005 to 140,215 in 2011 (KNBS, 2012). This shift naturally saw an increase in the indices attributed to motorcycle related accidents that impacted cost of the economy in excess of US$ 50 million exclusive of the actual loss of life (Bachani *et al.*, 2012).

2.2 Determinants of motorcycle accidents

Motorcycle accidents are largely associated with gender in that males are highly likely to be engaged in accidents contrary to females. This is largely due to the fact that males are highly exposed to use alcohol and other drugs while driving contrary to their counterparts (Singoro, Wakhungu, & Obiri, 2016). Most male motorcycle riders are exposed to multi-occupant motorcycle accidents (Oluwadiya *et al*., 2016; Sanusi & Emmelin 2015). Also male commercial motorcycle riders engage in more risk-taking activities related to dangerous riding which eventually result into the causation of accidents (Sanusi & Emmelin, 2015). Commercial motorcycle riders use acquired revenue for their daily expenses contrary to the repair and maintenance of the motorcycles (Tumwesigye, Atuyambe & Kobusingye, 2016). Similarly, the young riders her mostly utilized the revenue to purchase khat and alcohol while riding as they had minimal expenses as a majority of them spent most of their revenue on inhalants and other psychoactive substances largely due to the fact that a majority of the respondents had fathers who used these substances (Gudaji & Habib 2015). Marital status has significant correlation between road traffic accidents (RTAs) and the marital status of the commercial motorcycle riders (Ogunmodede & Emeahara, 2016). Single commercial motorcycle riders are highly likely to be engaged in motorcycle accidents (Gudaji & Habib, 2015).

Age is also considered to be a major risk factor of motorcycle accidents in the world. Younger riders are usually engaged in risky riding behaviours and speeding which usually result in the causation of accidents (Gudaji & Habib, 2015). Tumwesigye *et al*., (2016), points out that RTAs were most common among riders of younger age groups and that these accidents were mostly attributed to that lack of knowledge on the traffic. Young commercial motorcycle riders lack resources which hinder them from purchasing protective equipment (Kamulegeya *et al*., 2015). Those who possess helmets rarely use as they believe upon immunity to injury and accidents (Olusayo *et al*., 2015).

2.3 Motorcycle Safety Measures

According to da Silva et al., (2012) ignorance of the road traffic rules also significantly contributes to the increased level of RTAs. Additionally, efforts to educate the public on proper road traffic rules are deemed to be ineffective. In relation to the Accident Cause Code Classification, the Kenya police reports that at least 85.5% of the crashes are attributed to poor

driver behaviours thus leading to the death of pedestrians (44.4%), passenger (33.9%) and pedal cyclists (7.2%) (Odero et al., 2003). Other factors include vehicle defects (5.1%), and poor road infrastructure (2.9%) (Macharia *et al*., 2009). Riding at high speeds could result in the causation of accidents especially due to slippery roads (Matheka *et al*., 2015). Maneuverability of the motorcycle is limited when carrying heavy luggage or more than one passenger, especially where the road conditions are poor (Bagenda *et al*., 2017). A study conducted in Nigeria revealed that most of the road traffic accidents were mainly associated with poor road safety rules adherence and young age (Olumide & Owoaje, 2015). Another study conducted in Thailand among teenage commercial motorcycle riders revealed a significant association between the RTAs and failure to wear helmets, riding at speeds higher than 60km/hr and alcohol consumption (Tongklao, Jaruratanasirikul & Sriplung, 2016).

The state of the motorcycle can also result in the causation of accidents due to the frequency of motorcycles servicing and the date of the motorcycle accidents Motorcycle accidents can also be attributed to poor road conditions like sharp bends, potholes and poor lighting which can limit the riders' capacity to carefully pass through the roads. Reduction in the number of RTAs is associated with the geographical scale of a particular area (Mohtasham-Amiri *et al*., 2016). The extent to which land is used, road networks, local business and system risks are associated with the causation of accidents in a particular area (Komba, 2007).

3.0 METHODOLOGY

The study was conducted in Embu town located in Embu County. This study employed a prospective cohort study of commercial motorcycle riders that were followed for three months. At the beginning of the period, 200 motorcycle riders had not experienced prior accidents were recruited into the prospective study and the rate of motorcycle accidents during the three months' period was measured. The motorcyclists were further censored when involved in an accident. The study utilized a two-stage cluster sampling technique. The first step involved the researcher to undertake a reconnaissance a week prior to starting data collection. It was observed that the commercial motorcycle riders congregate at designated points to wait for passengers. The designated passengers waiting points were treated as clusters for the purpose of sampling. The clusters were identified within the central business district. The second step was listing of riders in the identified clusters. Simple random sampling was used in selection of the commercial motorcycle riders in the identified clusters. A semi-structured questionnaire was used to record data. The questionnaire was pretest on 10 commercial motorcycle riders in Meru County which has similar conditions to the study site. Expert advice was sought to ensure the validity of the questionnaire and the Lee Cronbach alpha test was used in the determination of the reliability of the questionnaire. Data was analysed by computerized methods with the aid of scientific

calculations, SPSS version 24 and presented using tables, pie charts, and graphs. Bivariate analysis was used to check for the association between the dependent and independent variables, the significant at ($p < 0.05$) were then entered into a multivariable logistic regression model. Those with $p< 0.05$ indicated that they were statistically significant.

4.0 FINDINGS

4.1 Socio-demographic characteristics of the participants

A total of 200 commercial motorcycle riders aged 18-55 years were enrolled in the study and consisted 195 (97.5%) males and 5 (2.5%) females with a mean age of 30± (10SD). A high proportion (n= 100, 50%) was aged between 25-34. A majority of the respondents were married (n=131, 65.5%) with a majority being Christian (n=190, 95%). Nearly half of the respondents had acquired at least a secondary education (n=96, 48%) and 94 (47%) did not have any other form of employment. Majority of the respondents had monthly incomes ranging from KES 15,000- 24,000 (n=69, 34.5%) and a daily income of KES 500-1000 (n=90, 45%).

Table 1: Socio-demographic characteristics of Commercial Motorcycle riders

Characteristic	n	%
Age		
<24	65	32.5
25-34	100	50.0
35-44	23	11.5
>45	12	6.0
Sex		
Male	195	97.5
Female	5	2.5
Marital status		
Single	69	34.5
Married	131	65.5
Religion		
Christian	190	95.0
Muslim	10	5.0
Education level		
No formal education	6	3.0
Primary education	52	26.0
Secondary education	96	48.0
Tertiary education	46	23.0
Employment		
Yes	106	53.0
No	94	47.0
Monthly income (KES)		
<10000	29	14.5
10000-15000	34	17.0
15000-24000	69	34.5
>24000	68	34.0
Daily income (KES)		
<500	44	22
500-1000	90	45
1000-1500	52	26
>1500	14	7
Total	**200**	**100**

Source: Survey data (2018)

4.2 Road Safety practices of study participants

A majority of the study participants had valid license (n=147) and had undergone motorcycle riding training (n= 133, 66.5%). A high proportion own a reflector jacket and a helmet at 138 (66.5%) and 127(63.5%) respectively. A small proportion of the participants use alcohol (n=47, 63.5%) and *khat* (n=59, 29.5%). The same was witnessed in driving under influence of alcohol (n=32, 16%) and riding while chewing *khat* (n=48, 24%). A majority of the study participants ride their motorcycle at a speed between 50-80 Km/h as shown in Table 2.

Table 2: Road safety practices of study participants

Variables	Frequency	Percent
Valid license		
Yes	147	73.5
No	53	26.5
Formal motorcycle riding training		
Yes	133	66.5
No	67	33.5
Own a reflector		
Yes	138	69
No	62	31
Own a helmet		
Yes	127	63.5
No	73	36.5
Use of alcohol		
Yes	47	23.5
No	153	76.5
Use of Khat		
Yes	59	29.5
No	141	70.5
Driven under influence		
Yes	32	16
No	168	84
Ride while chewing khat		
Yes	48	24
No	152	76
Average riding speed		
<50	52	26
50-80	123	61.5
>80	25	12.5
Transport passengers with their heavy luggages		
Always	55	27.5
Often	34	17
Sometimes	48	24
Rarely	32	16
Never	31	15.5
Total	**200**	**100**

Source: Survey data (2018)

4.3 Prevalence of commercial motorcycle-related road traffic accidents among the study participants.

A total of 48 (24%) commercial motorcycle accidents occurred in Embu during the study period among the study participants as shown in Table 3**.**

Table 3: Prevalence of commercial motorcycle

Response	Frequency	Percent
No accident	152	76%
Had accident	48	24%
Total	200	100%

Source: Survey data (2018)

4.4 Bivariate analysis

The sociodemographic characteristics i.e. age in years, sex, marital status, religion, educational level, employment, monthly income and daily income were not significantly associated with motorcycle related accidents as shown in Table 4. The rate of accidents was higher in males (97.9%) compared to female (2.1%) but their difference was not significant (OR=0.787, 95% CI: 0.085-7.22, *P*=0.83).

Table 5 represents motorcycle related accidents in relation to road safety practices. Factors independently associated with accidents among motorcyclists were use of alcohol (OR=0.45, 95% CI: 0.220-0.915, *P*=0.028), use of khat (OR=0.38, 95% CI: 0.193-0.749, *P*=0.005), driven the motorcycle under alcohol influence (OR=0.24, 95% CI: 0.106-0.520, *P*<0.001) and riding while chewing khat (OR=0.47, 95% CI: 0.229-0.951, *P*=0.036). Factors that were not associated with motorcycle related accidents include having a valid license (OR=0.90, 95% CI: 0.428-1.901, *P*=0.787), formal motorcycle riding training (OR=0.89, 95% CI: 0.444-1.790, *P*=0.746) , owning a reflector jacket (OR=1.02, 95% CI: 0.504-2.046, *P*=0.966) , owning a helmet (OR=1.19, 95% CI: 0..601-2.317, *P*=0.611) , riding speed (*P*=<0.05)and carrying passengers together with their heavy luggages (*P*>0.05).

Table 4: Relationship between sociodemographic characteristics and motorcycle related accident

Variables	Accident occurred	No Accident	OR	95% CI		P-value
	n (%)	n (%)		Lower	Upper	
Age groups						
<24	17(35.4)	48(31.6)	0.980	0.611	1.573	0.93
(25-34)	19(39.6)	81(53.3)	0.676	0.317	1.443	0.31
(35-44)	9(18.8)	14(9.2)	1.890	0.557	6.417	0.31
>45	3(6.25)	9(5.9)	REF			
Sex						
Male	47(97.9)	148(97.4)	0.787	0.085	7.22	0.83
Female	1(2.1)	4(2.6)	REF			
Marital status						
Single	21(43.8)	48(31.6)	0.593	0.305	1.154	0.31
Married	27(56.3)	104(68.4)	REF			
Religion						
Christian	44(91.7)	146(96.0)	1.487	0.773	2.862	0.24
Muslim	4(8.3)	6(4.0)	REF			
Education level						
No formal education	1(2.1)	5(3.3)	1.254	0.594	2.645	0.55
Primary education	9(18.8)	43(28.3)	0.835	0.166	4.2	0.83
Secondary education	25(52.1)	71(46.7)	1.120	0.4332	2.898	0.82
Tertiary education	13(27.1)	33(21.7)	REF			
Employment						
Yes	29(60.4)	77(50.7)	0.672	0.348	1.301	0.24
No	19(39.6)	75(49.3)	REF			
Monthly income (KES)						
<10000	11(22.9)	18(11.8)	0.796	0.582	1.087	0.15
10000-15000	6(12.5)	28(18.4)	0.441	0.157	1.236	0.12
15000-24000	15(31.3)	54(35.6)	0.718	0.347	1.487	0.37
>24000	16(33.3)	52(34.2)	REF			
Daily income (KES)						
<500	13(27.1)	31(20.4)	0.984	0.632	1.533	0.44
500-1000	22(45.8)	68(44.7)	0.784	0.369	1.664	0.53
1000-1500	9(18.8)	43(28.3)	0.515	0.175	1.512	0.23
>1500	4(8.3)	10(6.6)	REF			

Source: Survey data (2018)

Table 5: Relationship between road safety measures and motorcycle related accident

Variables	Accident occurred	No Accident	OR	95% CI		P-value
	n (%)	n (%)		Lower	Upper	
Valid license						
Yes	36(73.0)	111(73.0)	0.9	0.428	1.901	0.787
No	12(25.0)	41(27.0)	REF			
Formal motorcycle riding training						
Yes	33(68.8)	100(66.2)	0.89	0.444	1.79	0.746
No	15(31.2)	51(33.8)				
Own a reflector						
Yes	33(68.8)	105(69.1)	1.02	0.504	2.046	0.966
No	15(31.2)	47(30.9)	REF			
Own a helmet						
Yes	29(60.4)	98(64.5)	1.19	0.61	2.317	0.611
No	19(39.6)	54(35.5)	REF			
Use of alcohol						
Yes	17(35.4)	30(19.7)	0.45	0.22	0.915	**0.028**
No	31(64.6)	122(80.3)	REF			
Use of Khat						
Yes	22(45.8)	37(24.3)	0.38	0.193	0.749	**0.005**
No	26(54.2)	115(75.7)	REF			
Driven under influence						
Yes	16(33.3)	16(10.5)	0.24	0.106	0.52	**<0.0001**
No	32(66.7)	136(89.5)	REF			
Ride while chewing khat						
Yes	17(35.4)	31(20.4)	0.47	0.229	0.951	**0.036**
No	31(64.6)	121(79.6)	REF			
Average riding speed						
<50	13(27.1)	39(25.7)	0.87	0.484	1.55	0.628
50-80	30(62.5)	93(62.2)	1.12	0.548	2.279	0.76
>80	5(10.4)	20(13.1)	REF			
Transport passengers with their heavy luggages						
Always	12(25.0)	43(28.3)	1.18	0.929	1.512	0.173
Often	6(12.5)	28(18.4)	0.65	0.234	1.798	0.405
Sometimes	10(20.8)	38(25.0)	0.67	0.287	1.572	0.359
Rarely	9(18.8)	23(15.1)	0.84	0.322	2.204	0.728
Never	11(22.9)	20(13.2)	REF			

Source: Survey data (2018)

4.5. Multivariate analysis

Multivariate analysis was performed to identify independent factors of motorcycle related accident among the participants. Four factors associated with motorcycle related accident at P<0.05 were consider for multivariate analysis. They include; (1) Use of alcohol, (2) use of *khat*, (3) Driving motorcycle under alcohol influence and (4) Riding while chewing *khat*. Upon fitting the factors using binary logistic regression and specifying ' *background conditional*' method with removal at P<0.05. One factor was retained in the final model as shown in Table 6.

There was a significant association between motorcycle related accident and driving under the influence (OR=0.23, 95% CI: 0.502-0.111, P=0.002). A motorcyclist driving under the influence of alcohol were 0.23 times more likely to be involved in an accident compared to those who drive without under the influence of alcohol.

Table 6: Factors associated with motorcycle related accident

		95% CI		
Variables	**OR**	**Lower**	**Upper**	**P- value**
	Full model			
Use of alcohol				
Yes	1.30	-0.130	0.221	0.609
No	1.00			
Use of Khat				
Yes	0.33	-0.439	0.001	0.051
No	1.00			
Driven under influence				
Yes	0.23	-0.502	-0.111	0.002
No	1.00			
Ride while chewing Khat				
Yes	1.58	-0.135	0.339	0.396
No	1.00			

Source: Survey data (2018)

5.0 DISCUSSION

5.1.1 Socio-demographic characteristics of study participants

A majority of the commercial motorcycle riders were male. Studies elsewhere show the commercial motorcycle transport is a male dominated business (Konings, 2006; Mahlstein, 2009). This is due to the physical demands of riding and may not be an occupational option that females will like to venture into. Furthermore, society perceives commercial motorcycle riding

as realm of men (Mahlstein, 2009). Globally, being male is associated with risk factors for RTA compared to females due to use alcohol and other drugs while driving (Singoro, Wakhungu & Obiri, 2016). According to a study conducted by Sanusi & Emmelin (2015), a majority of the motorcycle riders who were involved in RTAs were mostly male. Similarly, another study found that most male commercial riders were highly likely to be exposed to multi-occupant motorcycle accidents (Oluwadiya et al., 2016). In another study, it was also noted that a majority of the affected were men who were the most commercial motorcycle riders and lacked resources hiders to purchase protective equipment (Kamulegeya et al., 2015). It has long been observed that males engage in more risk-taking activities related to dangerous driving (Sanusi & Emmelin, 2015).

Young riders aged 25-34 years were the highest age cohort likely to cause accidents in Embu County likely due to failure to observe traffic rules. The findings agree with a study that was conducted in Kitengela where majority of boda boda operators were young people aged 20-29 years (Nyachieo, 2013). This also concurs with a study conducted in Nigeria revealed that majority of commercial motorcycle riders were aged 20-39 years and there were at least 2 cases which occurred every hour in Kano metropolis (Badaru, Lawal & Muhammad, 2017). According to a study conducted in Uganda, RTAs were most common among riders of younger age groups (Tumwesigye, Atuyambe & Kobusingye, 2016). Younger riders ride under influence of drug, over-speeds and exercise risky riding behaviours. This combination of risk factors and behaviours likely placed them at an increased likelihood of being involved in accidents, which in certain cases, were serious. (Badaru, Lawal & Muhammad, 2017). Another study noted that a majority of the young commercial motorcycle riders had helmets in their possession however, they rarely used as they believed upon immunity to injury and accidents (Olusayo et al., 2015). In addition, young riders spent most of their revenue on inhalants and other psychoactive substances largely (Gudaji & Habib, 2015).

Regarding level of education almost a half of the motorcyclist had at least secondary education. This finding agrees with other studies that found motorcycle riders were not illiterate (Mahlstein, 2009; Ngim & Udosen, 2007). This also concurs with a study that found that commercial motorcycle riders were reasonably educated (Kumar, 2011). This implies that most educated people have slim chances in the formal employment market hence most of them have settled for commercial motorcycle business as a source of income.

5.1.2 Road safety measures among study participants

In this study, prevalence of helmet use was high among motorcyclists. The findings differ with those of studies done in Cambodia and two towns in Kenya where helmet usage remains low (Bachani et al., 2012b; Bachani et al., 2017). This increase in helmet can attributed to the enforcement of National motorcycle helmet-wearing laws by the traffic police. The law requires

mandatory helmet wearing by both drivers and passengers. Motorcycle helmets have been consistently found to be effective in reducing the risk of death and head injury among motorcyclists in crashes (Liu et al., 2008). Most of deaths among motorcyclists involved in road traffic crashes is as a result of head injuries which accounts for over 80% of the fatalities in low- and middle-income countries (Hyder, 2013). Study conducted in Taiwan concluded that non-helmeted motorcyclists were more than 4 times likely to have head injuries and 10 times as likely to have brain injuries compared to helmeted motorcyclists (Yu et al., 2011). Correct use of standard helmets when riding a motorcycle is highly important (Passmore et al., 2010; Ackaah et al., 2013).

The study findings indicated a majority of the motorcyclists used reflector jackets which made them conspicuous to other road users. This differs from studies done in Kenya and New Zealand that found 27.9% and 10.6% motorcyclist wore reflector jackets respectively (Karau et al., 2015; Wells et al., 2004). Low motorcycle conspicuity, or the inability of the motorcyclist to be seen by other road users is associated with risk of motorcycle crashes (Williams & Hoffmann 1979). This is attributed to several factors, including size of motorcycle, irregular outline, low luminance or contrast with the background environment, and the ability to travel in unexpected places in the traffic stream. Adoption of inexpensive measures for example adding a light source and the use of light, bright, reflective, or fluorescent colours can potentially enhance conspicuity of motorcyclists (Wells et al., 2004). Wearing a high visibility upper torso garment reduces in involvement in crashes (Hurt, 1981).

The study findings of those motorcyclists who reported having used alcohol concurs with studies conducted in Kangundo where 17.4% had intoxicated alcohol (Karau et al., 2015). Alcohol consumption impairs motorcyclist judgement and this explains the correlation with road injury. A majority of the motorcyclists were male who were more likely to report alcohol use. This is in agreement with a study that reported that males were more likely to be involved in alcohol-related crashes (Romano et al., 2012). Stiffer penalties and enactment of new traffic codes of conduct can reduce incidence of alcohol-related crashes. This has worked in Brazil where there was reduction in alcohol use following enactment of a new traffic code of conduct was observed (Liberatti, Andrade & Soares, 2001).

Khat chewing offers euphoria and excitement because of its amphetamine-like properties. The riders pursue the alertness effect to remain active and " high" for long working hours. However, this long-period alertness is counterproductive as it subsequently increases the level of exhaustion that affects their ability to work effectively (Karema et al., 2017). The proximity of khat production around Embu region in Kenya increases its use given that the community around has embraced its wider production and use. Focusing efforts on the reduction of the use of Khat is key in minimizing RTAs. For example, local community-level interventions which attempt to

counter negative personal and social factors, including emotional stress, financial stress and peer pressure that are putative predictors of youths' use of substances (Singoro, Wakhungu & Obiri, 2016).

5.1.3 Prevalence of motorcycle-related road traffic accidents in Embu town

Traffic accidents involving motorcyclist are quite prevalent (Oliveira & Sousa, 2012). Motorcycle accidents are inherently more dangerous than motor vehicle accidents for drivers and occupants because riders are not protected by steel and are typically thrown from the motorcycle during a collision (Berecki-Gisolf et al., 2015). This study confirms the high burden of motorcycle road accidents in the country as has been documented by other studies and this is linked to the liberation in the acquisition of motorcycle by the government (Odero & Garner, 1997). The proportion of motorcycle related accidents reported in the study is higher than 15% reported in STEPs survey conducted in Kenya (Gathecha et al., 2018). This is also higher than what has been reported in developed countries such as Germany with 10.7% (Sass & Stang, 2013) and developing countries such as Sierra Leone with 12.4% (Stewart et al., 2013) and Uganda with 14% (Lett Kobusingye & Ekwaru, 2006). The proportion is almost closer to 28.3% accidents of commercials motorcyclists with either pedestrian or motor vehicle in Niavasha town (Odiwuor, Nyamusi & Odero, 2015). The rate is lower than 63.6% of motorcycle taxi drivers were involved in at least one motorcycle accident in Brazil (de Almeida et al., 2016). The proportion is very high and needs to be addressed as injuries have far reaching effects on individuals, societies and healthcare systems (WHO, 2014; Schuurman et al., 2015). The risk of death involving motorcyclists is evident and most fatal cases occur at the site of accident or within 24 hours of such event and it is a public health problem that results in high social and economic costs (Oliveira & Sousa, 2014b).

5.1.4 Factors associated with motorcycle related road traffic accidents

The study measured many factors thought to be associated with motorcycle accidents including road safety measures and non-modifiable characteristics i.e. age, sex, education level, employment, marital status, monthly income and daily income in a developing country where motorcycle accidents are common. In the current study, factors independently associated with motorcycle accidents were alcohol consumption, Khat use, driving under alcohol influence and chewing Khat while riding.

Alcohol use is a higher risk factor for road traffic accidents and fatal injuries (Jou, Yeh & Chen, 2012; Mir et al., 2012). The findings are consistent with other studies that found alcohol and drug use is associated with increased incidences of motorcycle accidents (Tumwesigye, Atuyambe & Kobusingye, 2016, WHO, 2014; Schuurman et al., 2015). Others studies have shown a strong link between drink driving and involvement in accidents by motorcyclists (Owino, 2018). This

is attributed to alcohol impairment of judgement and their ability to interpret events correctly which is magnified when combined with fatigue (WHO, 2013b; Ngim & Udosen 2007). It has been reported that alcohol consumption significantly increases accident severity risk because of over-speeding and other safety violations (Albalate & Fernández-Villadangos, 2009).

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following are the findings of this study:

The rate of commercial motorcycle accidents (24%) in Embu is higher than 15% reported in STEPs survey conducted in Kenya. Major factors independently associated with road traffic accidents among motorcyclists include use of alcohol, use of khat, riding while chewing khat and riding under the influence of alcohol

6.2 Recommendations

Enforcing road traffic rules especially among commercial motorcycle riders in order to capture the offenders for example random drinking-driving checks for motorcyclists by traffic police. Ministry of Transport should come up with public health interventions that advocate for behaviour change among motorcyclist such as stoppage of alcohol drinking and chewing khat must also be heightened. This can be done through sensitization seminars with motorcyclists that can be held regularly. Encouraging young commercial riders to be vigilant of the road traffic rules in order to reduce the number of accidents. It is also critical to sensitize the commercial motorcycle riders to be vigilant of the riders and their behaviours and to discourage such risky behaviors that would expose them to harm.

REFERENCE

Ackaah, W., Afukaar, F., Agyemang, W., Anh, T. T., Hejar, A. R., Abdul, G., ... & Inclán-Valadez, C. (2013). The use of non-standard motorcycle helmets in low-and middle-income countries: a multicentre study. Injury prevention. BMJ Publishing Group Ltd, 19(3), pp. 158– 163.

de Almeida, G. C. M., de Medeiros, F. D. C. D., Pinto, L. O., de Oliveira Moura, J. M. B., & Lima, K. C. (2016). Prevalence and factors associated with traffic accidents involving motorcycle taxis. Revista brasileira de enfermagem, 69(2), 359.

Bachani, A. M., Tran, N. T., Sann, S., Ballesteros, M. F., Gnim, C., Ou, A., ... & Hyder, A. A. (2012). Helmet use among motorcyclists in Cambodia: a survey of use, knowledge, attitudes, and practices. Traffic injury prevention, 13(sup1), 31-36.

Bachani, A. M., Koradia, P., Herbert, H. K., Mogere, S., Akungah, D., Nyamari, J., ... & Stevens,

K. A. (2012b). Road traffic injuries in Kenya: the health burden and risk factors in two districts. Traffic injury prevention, 13(sup1), 24-30.

Bachani, A. M., Hung, Y. W., Mogere, S., Akunga, D., Nyamari, J., & Hyder, A. A. (2017). Helmet wearing in Kenya: prevalence, knowledge, attitude, practice and implications. Public health, 144, S23-S31.

Badaru, U. M., Lawal, I. U. and Muhammad, A. U. (2017) ' Pattern of neurologic, orthopaedic and soft tissue injuries sustained in commercial motorcycle accidents in Kano metropolis' , Archives of Physiotherapy & Global Researches, 21(3).

Bagenda, B., Ahimbisibwe, A., Tusiime, W., & Moya, M. (2017). Regulation of Boda Boda Operators and Road Accident Reduction in Uganda: A Case of Kampala City Council Authority. ORSEA JOURNAL, 5(1).

Berecki-Gisolf, J., Yiengprugsawan, V., Kelly, M., McClure, R., Seubsman, S. A., Sleigh, A., & Thai Cohort Study Team. (2015). The impact of the Thai motorcycle transition on road traffic injury: Thai Cohort Study results. PloS one, 10(3).

Chandran, A., Hyder, A. A. and Peek-Asa, C. (2010). The global burden of unintentional injuries and an agenda for progress. Epidemiologic reviews. Oxford University Press, 32(1), pp. 110– 120.

Cheng, L. P., Wang, C. and Lu, J. (2014) ' Examine Factors Associated with Motorcycle Injury and Fatality' , in Applied mechanics and materials. Trans Tech Publ, pp. 1045– 1054.

Foreman, K. J., Marquez, N., Dolgert, A., Fukutaki, K., Fullman, N., McGaughey, M., ... & Brown, J. C. (2018). Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016– 40 for 195 countries and territories. The Lancet, 392(10159), 2052-2090.

Gathecha, G. K., Ngaruiya, C., Mwai, W., Kendagor, A., Owondo, S., Nyanjau, L., ... & Kibachio, J. (2018). Prevalence and predictors of injuries in Kenya: findings from the national STEPs survey. BMC public health, 18(3), 1222.

Goodfellow, T. and Titeca, K. (2012) ' Presidential intervention and the changing " politics of survival" in Kampala' s informal economy' , Cities. Elsevier, 29(4), pp. 264– 270.

Gudaji, M. I. and Habib, Z. G. (2015) ' Socio-Demographic factors associated with psychoactive substance use among commercial motorcycle operators in Kano, Nigeria' , Open Journal of Psychiatry. Scientific Research Publishing, 6(1), pp. 76– 85.

Howe, J. and Maunder, D. (2004) ' Boda Boda-Lessons from East Africa' s Growing NMT Industry' , in 10th World Conference on Transport ResearchWorld Conference on Transport

Research SocietyIstanbul Technical University.

Hurt, H. H. (1981). Motorcycle accident cause factors and identification of countermeasures (Vol.2). The Administration.

Hyder, A. A. (2013) ‘ Injuries in low-and middle-income countries: a neglected disease in global public health’ , Injury. Elsevier, 44(5), pp. 579– 580.

Jacobs, G., Aeron-Thomas, A., & Astrop, A. (2000). Estimating global road fatalities. Retrieved from: http://trl.demo.varistha.co.uk/uploads/trl/documents/TRL445.pdf

Jou, R. C., Yeh, T. H., & Chen, R. S. (2012). Risk factors in motorcyclist fatalities in Taiwan. Traffic injury prevention, 13(2), 155-162.

Kamulegeya, L. H., Kizito, M., Nassali, R., Bagayana, S., & Elobu, A. E. (2015). The scourge of head injury among commercial motorcycle riders in Kampala; a preventable clinical and public health menace. African health sciences, 15(3), 1016-1022.

Karau, P. B., Ogeng’ o, J. A., Okoro, D., Muia, M., & Saumu, M. W. (2015). Risk factor profile of motorcycle crash victims in rural Kenya. Annals of African surgery, 12(1).

Karema, F. M., Irandu, E. M., & Moronge, J. M. (2017). The role of commercial motorcycles in alleviating poverty in rural areas: a case study of Laikipia East Sub-County, Kenya. World Review of Intermodal Transportation Research, 6(2), 155-176.

KNBS, R. (2012) ‘ Kenya National Bureau of statistics’ . Nairobi: Government printer. Retrieved from: https://www.knbs.or.ke/.

Komba, D. D. (2007). Risk factors and road traffic accidents in Tanzania: a case study of Kibaha District (Master's thesis, Fakultet for samfunnsvitenskap og teknologiledelse).

Konings, P. (2006). Solving transportation problems in African cities: innovative responses by the youth in Douala, Cameroon. Africa today, 35-50.

Koornstra, M. K. (2003). Transport safety performance in the EU. Brussels, European Transport safety council, Transport accident statistics Working party.

Kumar, A. (2011). Understanding the emerging role of motorcycles in African cities. Sub-Saharan Africa Transport Policy Program (SSATP) discussion paper; no. 13.’ World Bank, Washington, DC. Available at: http://documents.worldbank.org/curated/en/391141468007199012/Understanding-the-emerging-role-of-motorcycles-in-African-cities-a-political-economy-perspectiv.

Langley, J., Mullin, B., Jackson, R., & Norton, R. (2000). Motorcycle engine size and risk of moderate to fatal injury from a motorcycle crash. Accident Analysis & Prevention, 32(5), 659-663.

Lett, R. R., Kobusingye, O. C., & Ekwaru, P. (2006). Burden of injury during the complex political emergency in northern Uganda. Canadian Journal of surgery, 49(1), 51.

Liberatti, C. L. B., Andrade, S. D., & Soares, D. A. (2001). The new Brazilian traffic code and some characteristics of victims in southern Brazil. Injury Prevention, 7(3), 190-193.

Lin, M. R., & Kraus, J. F. (2009). A review of risk factors and patterns of motorcycle injuries. Accident Analysis & Prevention, 41(4), 710-722.

Liu, B. C., Ivers, R., Norton, R., Boufous, S., Blows, S., & Lo, S. K. (2008). Helmets for preventing injury in motorcycle riders. *Cochrane database of systematic reviews*, (1).

Macharia, W. M., Njeru, E. K., Muli-Musiime, F., & Nantulya, V. (2009). Severe road traffic injuries in Kenya, quality of care and access. African health sciences, 9(2).

Mahlstein, M. (2009). Shaping and being shaped. The regulation of commercial motorcycle operation and social change in Calabar, Nigeria. Unpublished MA Thesis submitted to the Institute of Social Anthropology, University of Basel.

Matheka, D. M., Omar, F. A., Kipsaina, C., & Witte, J. (2015). Road traffic injuries in Kenya: a survey of commercial motorcycle drivers. Pan African medical journal, 21(1).

Michael, C. E., Ojedoku, U. A., & Chinwokwu, E. C. (2013). Abolition of commercial motorbikes and its implication on transportation and criminality in Calabar metropolis. Int'l J. Soc. Sci. Stud., 1, 206.

Michon, K. (2013). Motorcycle Accidents: Roads Hazards. Available at http://www.legal-encyclopedia/motorcycle-accidentsroad-hazards-30331-2html, retrieved on 6th Oct. 2013

Mir, M. U., Khan, I., Ahmed, B., & Razzak, J. A. (2012). Alcohol and marijuana use while driving--an unexpected crash risk in Pakistani commercial drivers: a cross-sectional survey. BMC Public Health, 12(1), 145.

Mohan, D. (2002). Road safety in less-motorized environments: future concerns. International journal of epidemiology. Oxford University Press, 31(3), pp. 527– 532.

Mohtasham-Amiri, Z., Dastgiri, S., Davoudi-Kiakalyeh, A., Imani, A., & Mollarahimi, K. (2016). An epidemiological study of road traffic accidents in Guilan Province, Northern Iran in 2012. Bulletin of Emergency & Trauma, 4(4), 230.

Mullin, B., Jackson, R., Langley, J., & Norton, R. (2000). Increasing age and experience: are both protective against motorcycle injury? A case-control study. Injury Prevention, 6(1), 32-35.

Mutiso, W. and Behrens, R. (2011). ‘ Boda Boda’ bicycle taxis and their role in urban transport

systems: case studies of Kisumu and Nakuru, Kenya' , SATC 2011. Document Transformation Technologies.

Nantulya, V. M., & Reich, M. R. (2002). The neglected epidemic: road traffic injuries in developing countries. Bmj, 324(7346), 1139-1141.

Nesoba, D. (2010). Motorcycle boom tied to increase in road accidents in Kenya. Kenya News Desk Retrieved from: http://globalpressjournal. com/africa/kenya.

Ngim, N. E., & Udosen, A. M. (2007). Commercial Motorcyclists: Do they care about road safety?. Nigerian Medical Practitioner, 51(6), 111-113.

Nyachieo, G. M. M. (2013). Creating Employment through Transport; The Youth and Motorcycle (bodaboda) in Kitengela, Kajiado County-Kenya. Research Journal in Organizational Psychology & Educational Studies, 2(4), 154-157.

NTSA. (2015). 2015 Road Safety Status Report. Retrieved January 15, 2017, from http://www.ntsa.go.ke/index.php?option=com_content&view=article&id=203&Itemid=551

NTSA. (2019). 2019 Road Safety Status Report. Retrieved May 15, 2020, from http://www.ntsa.go.ke/index.php?option=com_content&view=article&id=213&Itemid=706

Odero, W., Garner, P., & Zwi, A. (1997). Road traffic injuries in developing countries: a comprehensive review of epidemiological studies. Tropical Medicine & International Health, 2(5), 445-460.

Odero, W., Khayesi, M., & Heda, P. M. (2003). Road traffic injuries in Kenya: magnitude, causes and status of intervention. Injury control and safety promotion, 10(1-2), 53-61.

Odero, W. (2009, December). Motorcycle injuries in East Africa: Magnitude, risk factors and prevention. In Road Traffic Injuries Research Network (RTIRN) Workshop, Accra, Ghana (pp. 1-18). Retrieved from: http://rtirn.net/PDFs/3_Wilson_

Odiwuor, C. W., Nyamusi, E., & Odero, W. (2015). Incidence of road traffic crashes and pattern of injuries among commercial motorcyclists in Naivasha Town. Int J App Res, 1(11), 541-549.

Ogunmodede, T. A., & Emeahara, E. N. (2016). Influence of demographic variables on the use of road safety information by commercial motorcycle riders in Nigeria. In The African Symposium (TAS) (Vol. 15, No. 3, pp. 44-51).

de Oliveira, N. L., & de Sousa, R. M. (2012). Risk for injuries among motorcyclists involved in traffic incidents. Rev Esc Enferm USP, 46(5), 1133-40.

de Oliveira, N. L., & de Sousa, R. M. (2012b). Factors associated with the death of motorcyclists in traffic accidents. Revista da Escola de Enfermagem da USP, 46(6), 1379.

Olubomehin, O. O. (2012). The development and impact of motorcycles as means of commercial transportation in Nigeria. Research on Humanities and Social Sciences, 2(6).

Olumide, A. O., & Owoaje, E. T. (2015). Young age as a predictor of poor road safety practices of commercial motorcyclists in Oyo state, Nigeria. Traffic injury prevention, 16(7), 691-697.

Olusayo, A. I., Oyetunde, O. B., Okeibunor, O. L., Adedokun, O. S., & Adedeji, A. S. (2015). Road traffic injury immune delusion syndrome among commercial motorcycle riders in Ogbomoso, Nigeria. Global Advance Research Journal of Medicine and Medical Science, 4(2), 092-097.

Oluwadiya, K. S., Ojo, O. D., Adegbehingbe, O. O., Mock, C., & Popoola, O. S. (2016). Vulnerability of motorcycle riders and co-riders to injuries in multi-occupant crashes. International journal of injury control and safety promotion, 23(2), 189-196.

Owino, J. O. (2018). Factors associated with accidents involving commercial motorcycle operators in Migori town, Kenya (Doctoral dissertation).

Passmore, J. W., Nguyen, L. H., Nguyen, N. P., & Olivé, J. M. (2010). The formulation and implementation of a national helmet law: a case study from Viet Nam. Bulletin of the World Health Organization, 88, 783-787.

Peden, M., Scurfield, R., Sleet, D., Mohan, D., Hyder, A. A., Jarawan, E., & Mathers, C. (2004). World report on road traffic injury prevention. World Health Organization.

Romano, E. O., Peck, R. C., & Voas, R. B. (2012). Traffic environment and demographic factors affecting impaired driving and crashes. Journal of safety research, 43(1), 75-82.

Sanusi, A. A., & Emmelin, M. (2015). Commercial motorcycle drivers' perceptions of risk and road safety in urban Nigeria: an explorative study. International journal of injury control and safety promotion, 22(4), 328-339.

Sass, A. C., & Stang, A. (2013). Population-based incidences of non-fatal injuries-results of the German-wide telephone survey 2004. BMC public health, 13(1), 376.

Schuurman, N., Cinnamon, J., Walker, B. B., Fawcett, V., Nicol, A., Hameed, S. M., & Matzopoulos, R. (2015). Intentional injury and violence in Cape Town, South Africa: an epidemiological analysis of trauma admissions data. Global health action, 8(1), 27016.

Schwellnus, M. P., & Derman, E. W. (2005). Common injuries in cycling: Prevention, diagnosis and management. South African Family Practice, 47(7), 14-19.

da Silva, D. W., Andrade, S. M. D., Soares, D. F. P. D. P., Mathias, T. A. D. F., Matsuo, T., & de Souza, R. K. T. (2012). Factors associated with road accidents among Brazilian motorcycle couriers. The Scientific World Journal, 2012.

Singoro, B. W., Wakhungu, J. and Obiri, J. (2016). Causes and trends of public transport motorcycle accidents in Bungoma County, Kenya. International Journal of Multidisciplinary Academic Research, 4(1), pp. 36–42.

Slesak, G., Inthalath, S., Wilder-Smith, A., & Barennes, H. (2015). Road traffic injuries in northern Laos: trends and risk factors of an underreported public health problem. Tropical Medicine & International Health, 20(11), 1578-1587.

del Sol, D. A., & Fernàndez-Villadangos, L. (2009). Exploring Determinants of Urban Motorcycle Accident Severity: The Case of Barcelona. Documentos de trabajo (XREAP), (2), 1.

Stewart, K. A. A., Groen, R. S., Kamara, T. B., Farahzad, M. M., Samai, M., Cassidy, L. D., ... & Wren, S. M. (2013). Traumatic injuries in developing countries: report from a nationwide cross-sectional survey of Sierra Leone. JAMA surgery, 148(5), 463-469.

Tang, S., & Lo, H. K. (2008). The impact of public transport policy on the viability and sustainability of mass railway transit– The Hong Kong experience. *Transportation Research Part A: Policy and Practice*, *42*(4), 563-576.

Tongklao, A., Jaruratanasirikul, S., & Sriplung, H. (2016). Risky behaviors and helmet use among young adolescent motorcyclists in Southern Thailand. Traffic injury prevention, 17(1), 80-85.

Tumwesigye, N. M., Atuyambe, L. M., & Kobusingye, O. K. (2016). Factors associated with injuries among commercial motorcyclists: evidence from a matched case control study in Kampala City, Uganda. PloS one, 11(2).

Wells, S., Mullin, B., Norton, R., Langley, J., Connor, J., Jackson, R., & Lay-Yee, R. (2004). Motorcycle rider conspicuity and crash related injury: case-control study. Bmj, 328(7444), 857.

Williams, M. J., & Hoffmann, E. R. (1979). Motorcycle conspicuity and traffic accidents. Accident Analysis & Prevention, 11(3), 209-224.

Woratanarat, P., Ingsathit, A., Chatchaipan, P., & Suriyawongpaisal, P. (2013). Safety riding program and motorcycle-related injuries in Thailand. Accident Analysis & Prevention, 58, 115-121.

World Health Organization. (2008). The global burden of disease: 2004 update. World Health Organization. Available at: https://apps.who.int/iris/bitstream/handle/10665/43942/9789241563710_eng.pdf.

World Health Organization. (2011). Motorcycle Related Road traffic Crashes in Kenya facts and

figures. Retrieved from: https://www.who.int/violence_injury_prevention/road_traffic/countrywork/factsheet_kenya.pdf

World Health Organization. (2014). Injuries and violence: the facts 2014. Retrieved from: https://apps.who.int/iris/handle/10665/149798.

World Health Organization. (2015). Global status report on road safety 2015. World Health Organization. Retrieved from: https://www.who.int/violence_injury_prevention/road_safety_status/2015/en/

Yu, W. Y., Chen, C. Y., Chiu, W. T., & Lin, M. R. (2011). Effectiveness of different types of motorcycle helmets and effects of their improper use on head injuries. International journal of epidemiology, 40(3), 794-803.

Zhang, J., Norton, R., Tang, K. C., Lo, S. K., Jiatong, Z., & Wenkui, G. (2004). Motorcycle ownership and injury in China. Injury control and safety promotion, 11(3), 159-163.