Associations between Socio-Demographic Factors, Training, Ownership, Licensing and Violation of Traffic Regulations by Commercialized Three-Wheelers in Mbeya City, Tanzania

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ABSTRACT
African countries have experienced a rapid growth in commercialized three-wheelers business in which there is also an increase of accidents involving, causing loss of property, injuries and deaths. Accidents involving three-wheelers are attributed to traffic regulation non-compliance. This paper analyses interaction between traffic regulation violation and socio-demographic factors, training, licensing and ownership. The study on which the paper is based adopted a cross-sectional research design, and data were collected from three-wheelers operating in Mbeya City Council. The study included a sample size of 362 respondents who were randomly selected along various parking areas in the area of study. The interaction between the factors and traffic violation was analysed using multivariable logistic regression. Results showed that licensing, ownership of a three-wheeler and traffic safety training were associated with traffic violation. Unlicensed riders, employed riders and untrained riders had more chances of violating traffic regulations more than licensed riders, owner rider and trained riders. Therefore, the study concludes that violation of traffic regulation is still a major problem for three-wheelers. It is imperative that enforcement of relevant regulations is made to ensure that three-wheeler riders are adequately trained. Moreover, law enforcement organs are urged to impose stricter punishments to the offenders, including impounding of the three-wheelers.

Keywords
Traffic Regulation Violation, Three-Wheelers, Over-speeding, Overloading, Reckless Overtaking.
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1. Introduction

The motor
cycle business is growing fast in many developing African countries (Mbegu & Mchome, 2019) due to the weakening of organized public transport (Kumar, 2011). It is an emerging mode of transport for passengers and light goods all over the developing world and more so in Africa (Amadi & Ombisa, 2016). Motorcycle taxis are two- or three-wheeled vehicles used to move people and goods. Motorcycles with two wheels are called "Bodaboda" in East Africa (Transaid, 2015) whilst three-wheeled motorcycles are known as "Bajaji" in Tanzania. Bishop and Amos (2015) reported that motorcycle taxis provide business opportunities and employment to thousands of people in many areas of Tanzania. Many youths who were jobless, are now being self-employed, and others are being employed as motorcyclists. This business is helping them to afford their daily needs and others to care for their families (Kinyaga, 2017; National Bureau of Statistics (NBS), 2018).

In Cameroun, Ghana, Kenya, Nigeria, Rwanda, Sierra Leone and Tanzania; motorcycle taxi services have developed and spread rapidly. For instance, in Tanzania, motorcycle taxis increased from under 10,000 to 800,000 just in a period of ten years (Starkey, 2016). Like in other regions in Tanzania, motor cycle riders do operate the business of transporting people and goods in order to make profits to reduce unemployment and income poverty in Mbeya Region. In Mbeya Region, there were 7,315 registered Bodaboda in 2015 (NBS, 2018). The motorcycle business has been growing year after year, following an increase of traffic jams in major cities like Dar es Salaam, Mwanza, Mbeya and Arusha which delay deliveries (Mugarula, 2014). Despite being a solution to traffic congestion, the motorcycle business has some challenges whereby there is no guarantee on safety and security (Mugarula, 2014). The security challenge has led relevant authorities to ban the motorcycle business in some cities in Africa. For instance, Kiluga (2019) reported that the authority in Addis Ababa banned the business of using bodaboda in its vicinity due to high numbers of violent crimes which had frequently been happening by using motorcycles. The commercialization of motorcycle transport has also led to increased road accidents, traffic management problems, and sound (noise) and air pollution (Kumar, 2011). According to Mbeya Regional Police Office, a total of 1,463 accidents were recorded in 2015 in the region. Out of that, 516 involved motor vehicles and motor cycles versus pedestrians, followed by motor vehicles versus motor cycles (414) and motor vehicles only (391) (NBS, 2018).

The tendency of motorcycle taxis involvement in accidents is shocking, and almost all users involved in accidents experienced severe injuries (Mbegu & Mchome, 2019). Most of the accidents and injuries are due to non-compliance with the road transport and traffic regulations like lack of or non-use of mandatory safety gears, among causes (Starkey, 2016). For instance, Starkey (2016) and Bray and Holyoak (2015) reported the wearing rate of helmets for motorcycle users to be low, and the helmets used were of low quality, something which made riders and their respective passengers vulnerable to injuries whenever accidents occurred. Additionally, Odhiambo (2018) noticed that the age of riders had contributed much to the accidents and injuries to users since most of them were youth who were trying to experiment with the machines. Other causes reported were reckless driving, over-speeding, lack of formal training, and overloading. It seems that all the causes of accidents and injuries in motorcycle transport emanate from non-compliance with the respective regulations (Kinyaga, 2017; Othiambo, 2018).

Compliance with the safety regulations is generally low as many motorcycle taxi drivers do not have a driver's license, and very few have had any training relating to safe driving, traffic regulations or road safety. Nevertheless, authorities in many countries find it difficult to fully regulate motorcycle taxis as there is insufficient enforcement staff, and many different self-employed, interdependent riders are highly mobile; enforcement regulations in one area simply displaces the riders to other areas. On the other hand, people do not like to wear a helmet which has been in use by others (Starkey, 2016).

The governments of Kenya, Tanzania and Uganda have introduced new laws to regulate this transport business to curb crashes. The new laws require riders to have driving licenses, insurance, and helmets, and training in safety and first aid, but there has been little success to date (Poon, 2016). Many studies regarding motorcycle transport have been conducted covering different related areas. For instance, Odhiambo (2018) researched on training and regulation compliance, Kumar (2011) on emerging roles of motorcycles, Nyaga (2017) on the impact of bodaboda on accessing Kenyan rural areas, Bishop and Amos (2015) on opportunities to improves safety, Mbegu and Mchome (2019) on the poverty cycle, Luvinga and Kilasara (2020) on the financial implications of the bodaboda business among youth, Tarimo (2013) on the challenges faced by youth in the bodaboda business, Urioh (2020) on contribution of the bodaboda business to living standards. The conclusions among all the aforesaid studies indicate that the chief causes of accidents and injuries, traffic problems, etc. are non-compliance or violation of the traffic and transport regulations.

Most of the problems which occur as a result of violation of road traffic regulations are accidents and injuries (Asamoah, Kombonaah & Atiemo, 2019). So, as part of measures to mitigate road accidents, various deliberate efforts have been made to ensure compliance with traffic regulations. However, the efforts are misguided because they might be directed to a wrong end. Therefore, this paper seeks to understand the factors that are associated with violation of traffic regulations so as to encourage channelling of the right course of action to the appropriate class of riders.

2.0 Literature Review

2.1 Traffic Regulation Violation

There are numerous factors that compel three-wheeler riders to violate traffic regulations. According to Agustin (2019), knowledge of the driver on traffic regulations and the intensity of action in the form of legal action cause violation of traffic regulations. Lack of knowledge on traffic rules, carelessness and not focusing on driving are other causes of violation of traffic regulations (Lady, Mulyo & Kumino, 2020). Other factors that influence traffic regulation violation include the use of alcohol and drugs by riders, shorter riding experience, more extended period of riding and riding till late in the night (Konlan and Hayford, 2022). Nasir et al. (2011) and Nadimi et al. (2021) argue that the key cause of traffic regulations violation is motorcyclists' characteristics whereby the majority are of young age, with low income and education. The majority of motorcycle riders who violate traffic regulations and increase their chances of suffering from accidents did not receive formal training, but rather received informal training in the form of backstreet training (Nyachieo, 2020).

2.2 Overloading of Three-Wheelers

The safety concerns of motorcycle and tricycle riding include the issue of excessive loading of both passengers and cargo. It has become common to see two or more passengers being carried on a motorcycle. Also, motorcyclists do sometimes carry freight bundles that even included live animals, forcing the rider to assume a cramped position which causes hazardous driving (Starkey, 2016). The issue of overloading passengers and cargo in motorcycle and tricycles is reported by Shadrack (2017) who argue that it is common in Kenya to see an overloaded motorcycle and tricycle which may lead to accidents. The problem of overloading in motorcycles and tricycles isn't only confined to Africa; it is also reported in Jakarta where motorcyclists carry more than two passengers and sometimes carry goods that are wider and higher (Sunggiardi and Putranto, 2009).

2.3 Riders' Behaviour at Traffic Junction Lights

Putranto and Sucipto (2007) observed that motorcycle and tricycle riders tend to manoeuvre and find gaps so that they can close gaps even where vehicles ahead of them are close to road intersections. Sometimes they find ways to stop in front of leading vehicles and move before the traffic lights turn green. One of the reasons that motivate young motorcyclists to overload their motorcycles and tricycles is to ensure quick returns (Oltaye, Geja and Tadele, 2021). The red lights jumpers usually do so at high speed so as to avoid crashes which affect their ability to judge the on-going traffic, but they end up crashing (Juma, 2019). The waiting propensity at traffic junctions is related to number of riders waiting to cross and peak hours travelling. It is argued that an increase in number of riders waiting to cross traffic lights will influence other motorcyclists to wait for green lights prior to crossing the traffic lights. Also, during peak hours, there are high chances for motorcyclists to violate traffic regulations, especially jumping red lights (Yang et al., 2012).

2.4 Risky Overtaking and Over-Speeding

Motorcyclists have a tendency to always drive at high speeds exceeding by far the acceptable traffic speed limits (Yousif, Sadullah and Kassim, 2019). Quite frequently, motorcyclists suffer fatal crashes that are attributed to one wheeling, drifting and speeding (Pervez, Lee and Huang, 2021). Over-speeding is documented as the major cause of motorcycle related accidents, and strikingly most motorcyclists are unaware that they exceeded normal speed limits when driving, which prompts creation of an over-speeding detector (Obiso et al., 2020).

2.5 Drivers' Profiles Prone to Violating Traffic Regulations

Motorcycle riders driving aggressive tendency occurs when the drivers find it difficult to control their emotions when driving. The factors that contribute to driving aggression include personality, age, gender, lifestyle, driver's attitude and mood. Driving aggression is mostly notable amongst teenage drivers and is characterized by over-speeding and jumping red-lights. This aggression in driving is motivated by impatience, hostility and efforts to save time (Halim et al., 2020). Married commercial motorcyclists have higher odds of complying with traffic regulations as compared to unmarried ones (Nzuchi, Ngoma and Meshi, 2022). Motorcycle riders who do not own their own motorcycles are more likely to violate traffic regulations in comparison with their counterparts. Also, younger riders aged less than 29 are likely to violate traffic regulations whilst smokers were found to have high chances of violating traffic regulations (Hagan, Tarkang and Aku, 2021). Ndagire et al. (2019) argue that commercial riders who

did not receive prior formal training are leading traffic regulation violators and often get embroiled in crashes.

3. Methodology

3.1 Study Design and Sampling

A descriptive cross-sectional study design using quantitative approaches was conducted in collection and analysis of data. The design was utilized so as to describe the issues pertaining to traffic regulations violation at a given point in time when the study was conducted. The data for the study were collected from respondents who were three-wheeler riders based in Mbeya City Council. The council was selected as the study area because it had experienced a rapid increase in the number of both three-wheelers and traffic violation cases. There was a need to establish the motives for traffic violations amongst three-wheeler riders. It was established that at the time of data collection there was a total of 3,848 registered three-wheeler commercial riders, who constituted the population for the study. From this population, the Slovin's formula for sample estimation with a 95% confidence interval, a sample size of 362 three-wheeler commercial riders was selected. The commercial riders were randomly selected from various parking areas and stations within Mbeya City Council.

3.2 Data Collection Methods

The study utilized a self-administered questionnaire to collect data from selected commercial riders. Using the questionnaire, pertinent demographic details of the respondents and the propensity of violation of various traffic regulations when driving were collected. The questionnaire comprised close-ended questions that were prepared on the basis of the reviewed literature. The questions in the questionnaire were for both dependent variables and independent variables.

The independent variables for this study included socio-demographic information and riding related information. The socio-demographic information encompassed age of respondent and marital status. The riding related information included information such as ownership status, riding license and rider training. The dependent variable was traffic regulation violation. The traffic regulation violation was measured using a Likert scale with statements to which the respondents were required to answer 1- Strongly Agree, 2- Agree, 3- Neither Agree or Disagree, 4- Disagree or 5- Strongly Disagree. The indicators of traffic violation included jumping red lights, over-speeding, risky overtaking and overloading of passengers and cargo.

3.3 Data Processing and Analysis

Descriptive analysis was conducted for demographic information and determination of normality and reliability of the data. Reliability assessment was done using the Cronbach's Alpha, Keiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. Normality test was conducted using the Kolmogorov-Smirnov (K-S) test of normality because the sample was greater than 50. Further, a multivariable logistic regression was conducted to determine the groups that were more likely to violate traffic regulations. This was used so as to ascertain the variables for which there were higher odds ratios of violating traffic regulations. To determine the groups that were more likely to violate traffic regulations, the odds ratios (OR) were computed and interpreted in relation to a relevant reference group. The comparison of groups was made using the adjusted odds ratios (AOR).

4. Results

4.1 Socio-Demographic Characteristics of Commercial Riders

The socio-demographic characteristics of the commercial riders that were interviewed are summarised in Table 1 and show that the majority of the three-wheeler riders that were interviewed were male (92.3%). In terms of age, 83.9% of them were below 30 years. In terms of education, 83.4% of them had at least secondary education. In terms of owning three-wheelers, the majority of the riders (61.3%) did not own the three-wheelers; they were working on a hired basis.

Table 1: Socio-Demographic Characteristics of Commercial Riders

Description	Frequencies and per cents
Gender	
Male	334 (92.3%)
Female	28 (7.7%)
Age (years)	
13 to 18	41 (11.3%)
19 to 24	137 (37.8%)
25 to 30	126 (34.8%)

Description	Frequencies and per cents
31 to 36	43 (11.9%)
Above 36	15 (4.1%)
Marital status	
Single	179 (49.4%)
Married	171 (47.3%)
Widowed	12 (3.3%)
Education level	
Primary Education	60 (16.6%)
Secondary Education	224 (61.9%)
Ordinary Diploma	49 (13.5%)
Bachelor Degree	28 (7.7%)
Other	01 (0.3%)
Ownership status	
Rider Owner	140 (38.7%)
Rider Hired	222 (61.3%)

4.2 Reliability and Normality Tests

4.2.1 Reliability Tests

To measure reliability, the study assessed the internal consistency of the studied items using Cronbach's Alpha. As a rule of thumb, an Alpha value greater than 0.70 signifies that there is good internal consistency which means the reliability of the studied items. It was found that the reliability scores for the studied items as follows: jumping red lights (0.796), overloading (0.744), risky overtaking (0.837) and over-speeding (0.793). Because all the items had a score higher than 0.70, this signifies that the studied data were reliable.

Table 2: Cronbach's Alpha Value

Variable	Number of items	Cronbach's Alpha value	Remarks
Jumping red light	3	0.796	Reliable
Overloading	3	0.744	Reliable
Risky overtaking	4	0.837	Reliable
Over-speeding	4	0.793	Reliable

Further, KMO and Bartlett's Test of Sphericity were used to determine the reliability of the data by assessing sample adequacy and relatedness of the observed variables. Principal component analysis (PCA) was run, and a KMO value of 0.896 was obtained, which is closer to 1, thus suggesting that the sample was adequate. The Bartlett's test of sphericity showed significant results ($p = 0.000$), which suggests that the observed variables were correlated.

4.2.2 Normality Tests

To test for normality of the studied data, a Kolmogorov-Smirnov Test of Normality was used. The K-S test was used because the sample size was greater than 50. The K-S test determined that observed data are not normally distributed ($p < 0.05$) because they violated the assumption of normal distribution of data. This means that the study proceeded with analysis that is less restrictive and aligns with the data that is not normally distributed.

Table 3: Kolmogorov-Smirnov Normality Test

Variable	Statistic	Df	Sig.
Jumping red light	0.175	362	0.000
Overloading	0.168	362	0.000
Risky overtaking	0.167	362	0.000
Over-speeding	0.158	362	0.000

4.3 Factors Associated with Traffic Regulations Violation

A multivariable logistic regression was used to determine statistical significant variations of factors associated with traffic regulations violation. The association was determined by disassociating the indicators of traffic regulation violation that

were jumping red lights, overloading, risky overtaking and over-speeding. It was found that there was non-significant statistical association between jumping red lights at traffic intersection and age, marital status and ownership status. However, there was a statistically significant (p = 0.000) association between jumping red lights, overloading, risky overtaking and over-speeding with licensing of riders. The unlicensed riders were 2.686, 5.573, 1.949 and 2.019 more likely to jump red lights, overload, do risky overtaking and over-speed than licensed riders respectively. Further, there was a statistically significant association (p = 0.000) between unlicensed riders and overloading of three-wheelers. The statistical significant association between factors and violation as well as the corresponding odds ratio are shown in Table 4.

Table 4: Multivariate logistic regression on factors associated with violation of traffic regulation

Variables	OR [95% CI]	P-Value	AOR [95% CI]	P-Value
Violation by jumping red lights at traffic intersection				
Age (years)				
Less than 24 (R)	1.00		1.00	
More than 24	0.489 [0.322-0.744]	0.001	1.158 [0.647-2.073]	0.621
Marital status				
Single (R)	1.00		1.00	
Married	0.384 [0.249-0.590]	0.000	0.682 [0.378-1.231]	0.204
Widowed	1.954 [0.511-7.466]	0.327	2.093 [0.517-8.478]	0.301
Ownership Status				
Rider owner (R)	1.00		1.00	
Employed rider	3.413 [2.185-5.311]	0.000	1.670 [0.943-2.956]	0.079

Variables	OR [95% CI]	P-Value	AOR [95% CI]	P-Value
Traffic regulation training				
Trained rider (R)	1.00		1.00	
Untrained rider	3.543 [2.272-5.527]		1.607 [0.930-2.776]	0.089
Rider license status				
Licensed rider (R)	1.00		1.00	
Unlicensed rider	4.385 [2.823-6.812]		2.686 [1.581-4.564]	0.000
Violation of traffic regulation by overloading the three-wheeler				
Age (years)				
Less than 24 (R)	1.00		1.00	
More than 24	0.622 [0.410-0.943]	0.025	1.411 [0.784-2.646]	0.239
Marital status				
Single (R)	1.00		1.00	
Married	0.491 [0.320-0.752]	0.001	0.700 [0.380-1.289]	0.252
Widowed	3.108 [0.661-14.609]	0.151	3.862 [0.737-20.251]	0.110
Ownership Status				
Rider owner (R)	1.00		1.00	
Employed rider	2.756 [1.783-4.260]	0.000	1.312 [0.727-2.367]	0.367
Traffic regulation training				
Trained rider (R)	1.00		1.00	

Variables	OR [95% CI]	P-Value	AOR [95% CI]	P-Value
Untrained rider	0.376 [0.242-0.583]	0.000	0.949 [0.528-1.706]	0.862
Rider license status				
Licensed rider (R)	1.00		1.00	
Unlicensed rider	5.951 [3.769-9.395]	0.000	5.573 [3.155-9.845]	0.000
Violation of traffic regulation by engaging in risky overtaking				
Age (years)				
Less than 24 (R)	1.00		1.00	
More than 24	0.500 [0.329-0.760]	0.001	1.055 [0.592-1.878]	0.856
Marital status				
Single (R)	1.00		1.00	
Married	0.444 [0.289-0.681]	0.000	0.899 [0.498-1.622]	0.723
Widowed	3.411 [0.726-16.025]	0.120	3.830 [0780-18.807]	0.098
Ownership Status				
Rider owner (R)	1.000		1.00	
Employed rider	0.277 [0.177-0.432]	0.000	2.139 [1.215-3.768]	0.008
Traffic regulation training				
Trained rider (R)	1.00		1.00	
Untrained rider	3.342 [2.145-5.207]	0.000	1.722 [0.997-2.974]	0.051

Variables	OR [95% CI]	P-Value	AOR [95% CI]	P-Value
Rider license status				
Licensed rider (R)	1.00		1.00	
Unlicensed rider	3.511 [2.278-5.412]	0.000	1.949 [1.147-3.310]	0.014
Violation of traffic regulation by over-speeding				
Age (years)				
Less than 24 (R)	1.00		1.00	
More than 24	0.512 [0.337-0.777]	0.002	1.131 [0.633-2.019]	0.678
Marital status				
Single (R)	1.00		1.00	
Married	0.434 [0.283-0.666]	0.000	0.872 [0.482-1.579]	0.652
Widowed	1.333 [0.387-4.592]	0.648	1.353 [0.369-4.963]	0.649
Ownership Status				
Rider owner (R)	1.00		1.00	
Employed rider	3.368 [2.159-5.254]	0.000	1.854 [1.051-3.268]	0.033
Traffic regulation training				
Trained rider (R)	1.00		1.00	
Untrained rider	3.983 [2.539-6.247]	0.000	2.211 [1.284-3.807]	0.004
Rider license status				
Licensed rider (R)	1.00		1.00	

Variables	OR [95% CI]	P-Value	AOR [95% CI]	P-Value
Unlicensed rider	3.778 [2.445-5.837]	0.000	2.019 [1.193-3.416]	0.009

OR: Odds Ratio; AOR: Adjusted Odds Ratio; CI: Confidence Interval; R: Reference Category

5. Discussion

The findings showed that there was statistically significant association between jumping red lights and riders being unlicensed. Unlicensed riders had 2.686 more chances of jumping red lights in comparison to licensed riders. This implies that unlicensed riders are prone to violating the red light traffic signal. These findings are in line with the findings by Konlan and Hayford (2022) who reported that most riders do not possess a valid driving license which affects compliance with traffic regulations. About the propensity of unlicensed riders violating traffic regulations, Nguyen et al. (2018) argue that it is imperative that stricter enforcement is implemented to ensure riders are licensed to reduce violations and associated accidents. The study also found that unlicensed riders are inclined to overload the three-wheelers by carrying more passengers and cargo than the capacity of the three-wheelers. There were 5.573 more chances that unlicensed riders would excessively overload three-wheelers than licensed riders. These findings are in line with findings by Agustin et al. (2018) who, in their review of traffic regulations, reported that three-wheelers were committing the overloading traffic offense.

Three-wheeler riders tend to be more involved in risky overtaking when driving on roads. This risky overtaking includes overtaking vehicles ahead of them even in places where overtaking is prohibited. The findings revealed that riding by employed riders had a statistically significant association with making risky overtaking; the chances of doing so were 2.139 higher times than chances of three-wheeler owner riders doing so. Also, unlicensed riders had higher chances of making careless overtaking. Careless overtaking increases the chances of riders getting major and minor accidents as a result of violating indicated speed limits. These findings are in line with findings by Ayinla et al. (2012) who found that that wrong overtaking is the second highest ranked form of traffic violation and cause of accidents. Likewise, the study found statistically significant association between over-speeding and employed riders as well as unlicensed riders. Employed riders may drive recklessly because they aren't owners of the three-wheelers; hence they are not directly responsible for any damages that may

happen from their reckless driving. These finding are in line with findings by Yousif et al. (2020) who reported that over-speeding is a major violation that causes crashes.

6. Conclusions and Recommendations

The findings from this study demonstrated that traffic regulations violation is still prevalent. There exists an association between licensing of riders, training of riders and ownership of three-wheelers with correspond to traffic regulations violation. The violations are in terms of jumping red lights, overloading, risky overtaking and over-speeding. Notably, unlicensed riders are associated with more than one category of traffic regulations violation. Due to the unlicensed status, it can be argued that they haven't received formal training that guides them to comply with existing traffic regulations. This suggests that the problem of traffic regulations violation is directly attributed to lack of proper system that would ensure three-wheeler riders are trained and adequately licensed prior to starting commercial transportation operations. Therefore, efforts should be made to compel three-wheel riders to be licensed they ride the three-wheelers. The requirement to license the riders of three-wheelers should be accompanied by the need to prove obtainment of traffic regulation compliance training. Also, it is imperative that police force, local governments and road safety boards conduct frequent training to three-wheelers so as to equip them with an understanding of the traffic regulations. Further, owners of three-wheelers, when hiring riders, should ensure that they enter into contracts with them stipulating consequences of traffic regulations violation instead of only focusing on revenue generation. This will ensure that traffic regulations are abode by and thus reduce accidents that bring about loss to properties, injuries and fatalities. Also, law enforcement officers should adopt stricter punishments to three-wheelers who violate traffic regulations regardless of whether they possess driving licenses or and of whether they have undergone relevant training or otherwise. This is important because stricter punishments like impounding of the three-wheelers licenses can discourage the ever-increasing violations of traffic regulations.

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