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Factors Contributing to Road Traffic Accidents in Tanzania. The case of Morogoro Municipality and Dar es salaam City

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Abstract
The study investigated factors, contributing to road accidents in Tanzania. Most of the previous studies on causes of road accidents in Tanzania were done descriptively using frequencies and percentages. However, this study attempted to examine such causes using a statistical model. The study was done in two regions of Morogoro and Dar es Salaam. The study population consisted of drivers in different working places and different car parking centers of Morogoro municipality and Dar es salaam City. A sample of 386 drivers was randomly selected from the working offices and the car parking centers of Morogro Municipality and Dar es salaam City. Questionnaires were used to collect the information from the drivers. The main questions were on number of accidents which a driver has faced since starting driving, drivers' demographic characteristics such as age, education and drinking behavior. Data were analyzed in STATA 13 using a Poisson regression. The results indicated that road traffic accidents are associated with male gender, young age, not attending a driving school, inexperience, lack of marriage, and drinking behavior. The study recommends that together with traffic law enforcement public car drivers should be mainly women or married aged men so as to minimize accidents.

Keywords: accidents, driving school, sex

1. Introduction

Road traffic accident is a global phenomenon. Road traffic accidents which are generally unintended and preventable are a common risk to everyday life that can happen to almost every one, anywhere. The problem of road traffic accident is increasingly becoming a threat to public health and national development in many less and least developing countries (Komba, 2006). Its consequences are crosscutting and affect both the individual, families and the country in general. It reduces country man power or population that could contributes to social and economic development (Rassool, 2007). The most economically active people (aged 15–59) are at the greatest risk of dying as a result of road accidents. For this age group, road traffic accidents affect more than three times as many males as females in Africa (AFDB 2013).

The British Medical Journal of 11th May 2002 indicated that more people die on the road traffic accident(all accidents occurred on the road) than from other diseases such as Typhoid and malaria worldwide, and that traffic accident cause about 1.2 million deaths and injury 10 to 15 million people a year in the world. Also, it is estimated that road traffic accidents cause over 1.24 million death and probably more than 25 million severe injuries per year in the world (WHO, 2013).

According to the World Health Organization (WHO, 2004), approximately 16,000 people die every day worldwide from all types of injuries. Deaths from traffic injury are a very significant part of the problem accounting for 25% of all deaths from injuries and most of them occur in African continent especially sub-Saharan countries.

In Africa road traffic accidents account for about one-quarter of injury-related deaths in the continent overall, in the North African countries of Egypt, Tunisia, and Morocco, they caused more than half of all injury-related deaths in 2008 (Egypt, 64%; Tunisia, 58%; Morocco, 51%). In Libya, Djibouti, Mauritius, Namibia and Niger, road traffic accidents also

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exacted a heavy toll, accounting for more than one-third of injury-related deaths (Libya, 43%; Djibouti,42%; Mauritius, 37%; Namibia, 36% and Niger, 34%.) (WHO, 2010). These figures reveal how the road traffic accidents occurr in African countries contributing to high mortality rate especially in sub-Saharan countries.

In Tanzania road traffic accidents is also a big problem killing and injuring a considerable number of people. According to the latest WHO data published in May 2014 road traffic accidents deaths in Tanzania reached 10,740 or 3.00% of total deaths. The age adjusted Death Rate is 29.12 per 100,000 of population ranking Tanzania as number 21 in the world. According to Tanzania safety policy report (2009) there is increase in numbers of vehicles at the same time the number of accidents is still increasing. The Tanzanian government committed to solve this problem by implementing and developing different program like development of road safety policy, but still the road traffic accidents continue to occur which contributes to high mortality rate and injuries (Chiduo et al 2001). The same observation is made by Zimmerman et al (2011) who asserts that road traffic accidents in Dar es Salaam city are major sources of disability in the city. Also study by Boniface et al (2016) confirms that road traffic injuries in Tanzania are an important public health problem, predominantly in adult males, mostly due to motorcycle crashes.

There are many studies done in Tanzania and around the globe to investigate the causes of road traffic accidents. According to Asongwa (1992) in Nigeria, road traffic accidents is contributed by the fact that a sizeable proportion of drivers who possesses driving licenses never showed up in any driving school or went through a driving test but simply bought their licenses.

Lemming (1969) in India argues that a driver's ability and the condition of a car could be key causes of road traffic accidents. Giving out an example, Lemming (1969) argues that in emergence conditions, stopping distance is also important which depends very much on the driver's reaction time, speed of the vehicles, quality of tyres, and the condition of the road. Concurring with Lemming (1969), Odero et al, (2009) ascertain that lack of certified driver training and valid licensing, speed and reckless driving – moving between lanes and vehicles are some of the causes of road traffic accidents. Further to these, Odero et al(2009), adds other factors as poor regulation and law enforcement, non-helmet use by riders and their passengers, non-use of conspicuity measures - wearing of reflectors, daytime headlights, overload – carrying 2 or more passengers and possible use of alcohol and drugs.

Barengo et al (2006) in Tanzania did a study in Kinondoni and Temeke districts to find out causes of road traffic accidents. Using descriptive analysis, the study concludes that the main causes to road traffic accidents include speeding, careless driving, mechanical defeat, overtaking, crossing pedestrians and bad road conditions. Ngeleja (2015) in Tanzania, did a study in Temeke district by interviewing victims of traffic accidents, drivers, and traffic polices, nurses, medical doctors as well as the driving schools. The study again using descriptive statistics, concludes that major causes of road traffic accidents include bad driving behavior, alcoholism and bad roads, overloading, uninspected vehicles, poor road signs, poor vehicle design. SUMATRA (2017) reported the major

causes of accidents in 2013 as surveyed from key stakeholders as careless motorcyclists, careless drivers, dangerous driving, excessive speed, and mechanical defeat and overtaking. A study by Mnzava(2013) in Morogoro Tanzania found more or less the same reasons as identified by the mentioned scholars. The study, using stakeholders' opinions, identified, lack of formal training in motorcycle driving, availability of sub-standard motorcycle, poor infrastructure, use of electronic devices while driving, speeding, traffic irresponsibility as some of the causes of motorcycle accidents in Morogoro Municipality

Based on the reviewed literature one could summarize the causes of road traffic accidents as including but not limited to reckless driving, alcoholism, bad roads, poor road signs, poor vehicles, mechanical defeat, lack of certified driver training and valid licensing, speeding and overtaking.

It is quite clear that studies done in Tanzania have investigated the causes of road traffic accidents descriptively and most of their conclusions are based on what the stakeholders (passengers, drivers, traffic polices etc.) perceive to be the causes of road traffic accidents. Of course, the studies' findings are quite true, but one's perception might be correct or incorrect depending on among other things, his experience and his/her level of education/analysis. To avoid such problems, one could capture the magnitude and relative influence of causes of road traffic accidents using a statistical model which generalize the results beyond the studied sample. It is also clear that among the studies done in Tanzania few have examined the role of a driver's gender in influencing road accidents.

This study unlike previous studies done in Tanzania seek evidence-based information by not asking stakeholders opinions on causes of road traffic accidents, but rather studying the drivers' social demographic characteristics and relate them to accidents' occurrence by seeking an appropriate statistical model which could capture such a relationship. Such a model would not only make the results scientific but also generalizable beyond the studied sample. In addition to the use of a model, the study would also examine the influence of gender in accidents occurrence.

2. Methodology.
2.1 Research Design, Study Area, Sample Size, Sampling Method and Data collection
The study was done in June 2016 as a cross-sectional study involving 386 drivers found in Dar es -salaam and Morogoro regions. A sample of size 386 was reached based on the formula for sample size for proportion at 5% level of significance and at 0.05 level of precision which led to a minimum of 384 people. Cluster of different working places as well as clusters of different streets in Dar es salaam and Morogoro regions were created. The use of clusters was necessited with a lak of sampling frame of the drivers in Tanzania. Infact even if it would have been there contacting them would have been very hard. Thereafter random sample of 20 working offices and 10 car parking centers were selected in Dar es salaam City while a random sample of 6 working offices and 6 car parking centers were selected in Morogoro municipality. From each cluster a minimum of 10 drivers were visited for data collection. Expectedly 420 respondents were targeted, but due to non-responses, 386 respondents were captured. Questionnaires were used to collect the data from the respondents where

the questions were based on two aspects: number of accidents a driver succumbed to since starting driving and drivers' social demographic characteristics such as age, sex, education, drinking behavior, marital status, experience and attending a driving school.

2.2 The Analytic Model

The study related number of accidents occurrences against an individual driver's social demographic characteristics. Number of accidents is a count variable which is very unlikely to follow under normal distribution. Therefore, the study proposed a Poisson regression model to explain the factors contributing to road accidents in Tanzania.

According to Long (1997), number of events y (in this case number of accidents) has a Poisson distribution with a conditional mean that depends on an individual's characteristics. That is $\mu = E(y_i /x_i) = \exp(x_i\beta)$ which implies that $\log\mu = x_i\beta$. In respect of the variables under this study we could write this model in much more detail as follows

$$\log\mu = \beta_o + \beta_1 age + \beta_2 sex + \beta_3 edu + \beta_4 region$$
$$+ \beta_5 drinking + \beta_6 ms + \beta_7 experience$$
$$+ \beta_8 driving\ school + \varepsilon_i$$

Where μ is the expected number of accidents

Age is the age of a driver measured in years

Sex is equal to 1 if a driver is a male and is 0 if otherwise

Edu is the education level of a driver measured in terms of years of schooling

Region is the region where a driver operates and is equal to 1 if a driver is in Dar salaam and is 0 if a driver operates in Morogoro region

Drinking is equal to 1 if a driver take alcohol and is 0 otherwise

Marital status is 1 if a driver is married and is 0 if otherwise

Experience is the years of driving a driver has been driving

Driving school is 1 if a driver attended a driving school and is 0 if otherwise

2.3 The Relationship between the Explanatory Variables in Section 3.2 and the

Dependent Variable (the expected number of accidents)

Based on the discussion in section 1 the relationship between the dependent variable and the independent variables is given in Table 1.

Table1: Relationship between the independent variables and the Dependent variable

variable	Direction
age	-
sex	+
education	-
region	+
drinking	+
Marital status	-
experience	-
Driving school	-

3.0 Results and Discussion
3.1 Demographic Characteristics of the Respondents

Table 2: Demographic characteristics of the Respondents

Sex	Frequency	Percentage
male	193	50%
female	193	50%
Marital status		
married	165	43%
single	221	57%
Region		
Dar es salaam	267	69%
Morogoro	119	31%
Drinking		
Drinking	257	67%
Not drinking	129	33%
Driving school		
Attended	90	23%
Not attended	296	77%
Education level		
Primary school	30	8%
Secondary school	175	45%
Above secondary	181	47%

Source: From study survey

Table 1 indicates the demographic characteristics of the respondents. The study involved 386 respondents where half of them were male drivers and half were female drivers. Majority of them were unmarried and majority were found in Dar es salaam city. This was to be expected that there are more vehicles in Dar es salaam region than in Morogoro region. The table revels that majority of the rivers are drinking and majority have not attended a driving school. These results imply that driving license at the time of this study were being obtained improperly irrespective of whether a driver passed through a driving school. The same scenario was observed in Nigeria by Asongwa (1992). As regards education level, 8% had primary school education and majority (92%) had at least a secondary school education. Half of the post-primary education drivers had above secondary school education (diploma, degree etc.)

3.2 The Distribution of Number of Accidents

The minimum number of accidents was 0 and the maximum was 13. Zero accidents did not take much part of the data, only 4% of total observations. This scenario did not necessitate the use of zero inflated Poisson regression. The mean number of accidents was 5.4 with a standard deviation of 3.6 suggesting that the variance exceeds the mean which could necessitates the use of negative binomial regression. However, when a negative binomial regression was applied its results were identical to those of a Poisson regression. Therefore, the study opted to use a Poisson regression model.

Figure 1 below portrays the distribution of number of accidents which clearly shows that the number of accidents is not normally distributed and hence supports the use of a count data model such as a Poisson regression.
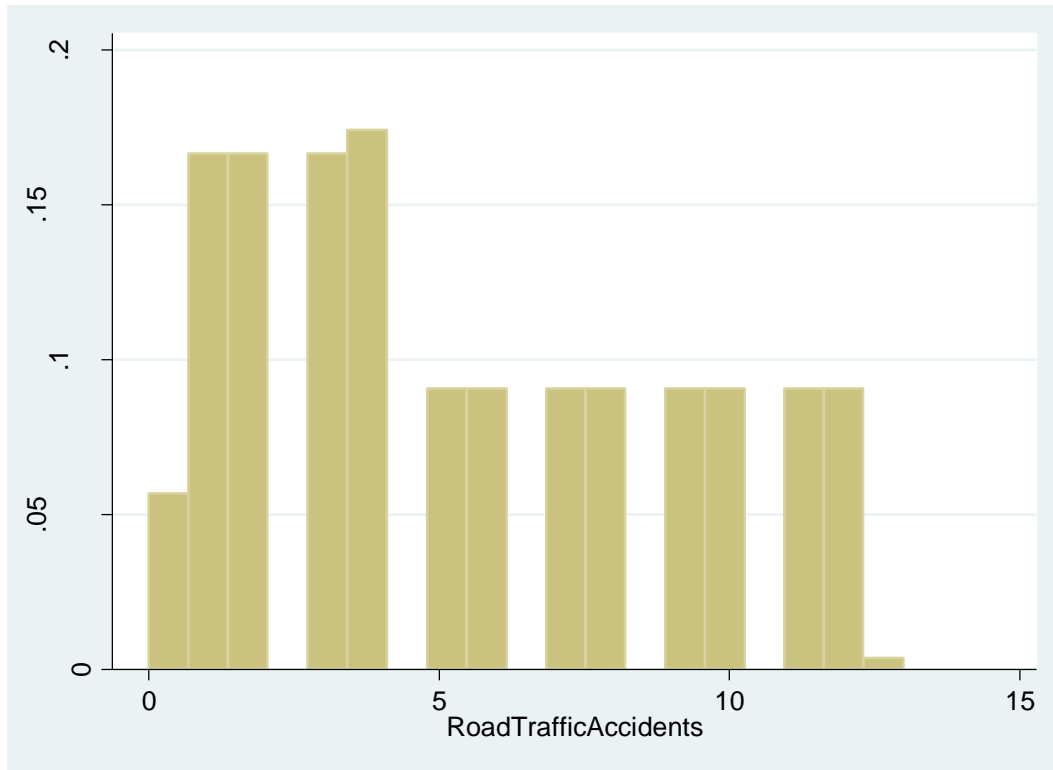
Fig. 1: The Histogram of Number of Accidents
Source: Author's drawing based on survey data.

3.3 Results of the Poisson Regression Model
Results from the Poisson regression are displayed in Table 3 below.

Table 3: Poisson Regression Results

variables	Coef.	Std. Err.	z	P>z
age	-0.024***	0.003	-7.340	0.000
sex	0.390***	0.054	7.200	0.000
educ	0.001	0.005	0.260	0.792
region	0.070	0.059	1.190	0.235
drinking	0.125**	0.050	2.490	0.013
marital status	-0.235***	0.056	-4.220	0.000
experience	-0.008**	0.003	-2.370	0.018
driving school	-0.267***	0.089	-3.010	0.003
_cons	2.305	0.159	14.490	0.000
n=386				
LRchi2(8) =590.12				
p=0.000				
Pseudo R2=0.262				
Pearson goodness -of-fit=370.2021 Prob>chi2(376) =0.5746				

** significant at 5%, *** significant at 1%

Results in Table 3 indicates that the model is significant (p=0.000) with most of the explanatory variables being significant. Even though the pseudo R2 indicates that only 26% of the variation in the depend variable is accounted by the independent variables, the pearson test of goodness of fit indicates that the observed dependent values and predicted dependent values are in agreement as the test doesn't not reject the null hypothesis of equality between the observed and the predicted data. This diagnostic test justifies the use of the model results for further discussions. Table 3 indicates that as age of the respondent increases the expected number of accidents also decreases suggesting that accidents are more associated with young age than old age. Young age is associated with most illicit behaviors in a society such as drug use, excessive drinking and not surprising also win reckless driving. The current law in Tanzania allows youth of 18 years old to possess driving license. Probably now is the time to consider increasing the minimum diving age for youths' in Tanzania alongside with laws enforcement. The influence of age on occurrence of accidents is clearly seen in boda-boda motorcyclists who frequently falls victims of road traffic accidents (Boniface et al., 2016). Al-balbissi (2300) also confirmed the influence of age on road traffic accidents as the study found that drivers over age 50 had the lowest accident rates.

The sex of a driver has also been found to have a

significant influence on number of accidents occurrence. According to the model equation in section 2.2, it implies that if a driver is a male then he is associated with high expected number of accidents than if the driver is a female. It is unclear why this is the case. One could argue that it is because most drivers countrywide are males, but in this study, sex was deliberately balanced, yet still male drivers are associated with high number of accidents occurrence. Probably one possible explanation is that females are less confident and very much worried of accidents than males and this makes them extra careful during driving to the extent that they minimize accidents. The negative influence of female drivers on risk of accidents occurrence was confirmed by other authors including Al-balbissi (2003).

Education of the driver and the region of operation were not significant. For education it can be visualized that few of the drivers were standard seven, majority of them had a secondary education and above. One could expect difference between a primary school leaver and a secondary education holder to be significant towards driving but certainly not among holders of secondary education or above. As for the region of operation one would expect a driver in Dar es salaam City to likely face more accidents due to car congestion than a driver in Morogoro. Nevertheless, this expectation may also not be realistic because car congestion implies traffic jams which may necessitate slow speed driving leading to fewer accidents.

As expected, results in Table 1 indicates that drivers who drink are associated with high accidents occurrences. Several authors both within Tanzania and outside Tanzania have long before confirmed this fact. Ngeleja (2015) in Tanzania, Baruah et al (2015), are some of those authors who have accounted for influence of alcohol on number of accidents. According to Baruah et al (2015) alcohol consumption by a driver leads to misadventure on the road which not only harms him but also the poor ones on the road. The only solution to this problem is increase punishment for all the drivers who will be found to have taken above the minimum required amount of alcohol for a driver.

Married drivers, experienced drivers and the ones who passed through a driving school they all had a significant and negative influence on the number of accidents occurrence. As for married drivers, there is probably no clear link with number of accidents. Marriage could reflect maturity which is in most case against most illicit behaviors including reckless driving. But marred drivers probably have children and spouses which could be a concern for a careful driving unlike unmarried drivers who are mostly young with no children and spouses to look over. Whitlock et al (2004) also found evidence of unmarried drivers being associated with high risk of car accidents as compared to married drivers.

As regards experienced diver, this is a fact of reality and there is nothing much of policy implication. Experience implies the importance of having proper and sufficient driving knowledge which is captured in driving schools. Fortunately, driving passing in a driving school had a significant and negative influence on number of accidents which was expected. Similar observation on the importance of training in reducing accidents was made by Odero *et al*, (2009). These results remind those people with a conception that a driving school is not important to change their attitude.

4. Conclusion and Recommendation

The study examined factors contributing to road traffic accidents in Tanzania using a Poisson regression model which was used because number of accidents is a count variable. Overall 8 explanatory variables were hypothesized to be causing factors. These included drivers' age, sex, education, region of operation, drinking marital status, experience, and having gone through a driving school. Results indicate all the variables to be significant except education level and region of a driver's operations. It is recommended that law enforcement be strengthened to avoid accidents and that public transport drivers be females and/or married aged drivers.

5. Reference

1. AFDB (2013). Mortality in Africa: The Share of Road Traffic Fatalities. Chief Economist Complex
2. Al-balbissi, A.H (2003). Role of Gender in Road Accidents. *Traffic Injury Prevention*, 4 (1): 64-73,
3. Asongwa, S.E. (1992). Road traffic accidents in Nigeria: A review and a reappraisal. Accident Analysis and Prevention*: Abuja publications. Nigeria* 23 (5), 343-35.
4. Barengo, N; Mkamba, M; Mashana,S.M and Miettola,J(2006). Road Traffic Accidents in Dar es salaam, Tanzania during 1999 and 2001. *International Journal of Injury Control and Safety Promotion* 13(1):52-4
5. Baruah, A.M and Chaliha, R (2015). A Study of Incidence of Alcohol Use in Fatal Road Traffic Accidents. J *Indian Acad Forensic Med*. Jan-March 2015, Vol. 37, No. 1
6. Boniface, R; Museru, L; Kiloloma, O and Munthali, V (206). Factors associated with road traffic injuries in Tanzania. *The Pan African Medical Journal.*
7. Chiduo, C. W. and Minja, P. (2001); Road Safety in Tanzania: What Are the Problems? Ministry of Works, Tanzania.
8. Komba D.D, (2006), Risk Factors and Road Traffic Accidents in Tanzania: A Case Study of Kibaha District. Unpublished thesis in Development Studies, Specializing in Geography. Norwegian University of Science and Technology (NTNU)
9. Lemming J.J. (1969). Road accidents, Prevent or punish? Definitions, facts and figures. London, Cassell. Muhlrad N, Lassarre S. (2005) Systems approach to injury control. New Delhi, Macmillan India Ltd.
10. Long, S.J (1997). Regression Models for Categorical and Limited Dependent Variable. SAGE publications, Inc. 2455 Teller Road, Thousand oaks, California 91320
11. Mnzava, E.G. The Impact of Motorcycle Accidents in Tanzania: A case study of Morogoro Municipality. Unpublished Master of Health Systems Management (MHSM). Mzumbe University
12. Ngeleja, P.E (2015). Examining Factors Contributing to Road Traffic Accidents in Dar es salaam Region, Tanzania: A case of Temeke district. Unpublished Master dissertation. Open University of Tanzania.
13. Odero, W, Garner. P and Zwi, A. (2009). Road traffic injuries in the developing countries: a comprehensive review of epidemiological studies. *Journal of Tropical Medicine and International Health*. 2(5), 445-460.

14. Rassool, S.B, (2007), Psychological trauma and road traffic accidents: Doctorate of clinical psychology, University of Hertfordshire
15. SUMATRA (2017). Study on Road Accidents in Mainland Tanzania; Bureau for Industrial Cooperation College of Engineering and Technology University of Dar es Salaam:
16. SUMATRA (2017). Improvement of Road Safety in Tanzania Mainland, Final Report.
17. The United Republic of Tanzania, (2009). National Road Safety Policy; Ministry of Infrastructure Development Dar es Salaam
18. Whitlock, G; Norton, R; Clark, T; Jackson, R and MacMahon, S (2004). Motor vehicle driver injury and marital status: a cohort study with prospective and retrospective driver injuries. *Injury Prevention* 10(1)
19. WHO (2010). "Status Report on Road Safety in Countries of the WHO African Region, 2009"; WHO Regional Office for Africa, Brazzaville, Republic of Congo's
20. WHO (2013*). Global Status Report on Road Safety: Supporting a Decade of Action. WHO, Geneva.*
21. WHO (2004). "World report on road traffic injury prevention"; Geneva.
22. Zimmerman, K; Mzige, A; Kibatala, p; Museru, L and Guerrero, A (2011). Road traffic injury incidence and crash characteristics in Dar es Salaam: A population-based study. Accident Analysis and Prevention xxx (2011) xxx-xxx