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Survival pattern of first accident among commercial drivers in the Greater Accra Region of Ghana

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ABSTRACT

In this study, the average accident risk of commercial drivers in the Greater Accra region of Ghana and its associated risks were examined based on a survey data collected using paper-based questionnaires from 204 commercial drivers from the Greater Accra Region of Ghana. The Cox Proportional Hazards Model was used for multivariate analysis while the Kaplan-Meier (KM) Model was used to study the survival patterns of the commercial drivers. The study revealed that the median survival time for an accident to happen is 2.50 years. Good roads provided a better chance of survival than bad roads and experienced drivers have a better chance of survival than the inexperienced drivers. Age of driver, alcohol usage of driver, marital status, condition of road and duration of driver's license were found to be related to the risk of accident.

1. Introduction

Road traffic accidents are common everyday life phenomenon, which can happen to almost everyone anywhere and can result in loss of life or injuries. The problem of road traffic accident is progressively becoming a threat to public health and national development in most developing countries (Afukaar et al., 2006). An estimated 1.2 million people die every year and 50 million are injured or disabled in road accidents worldwide where majority of these deaths (90%) occur in developing nations (World Health Organization, 2013). The statistics on the rate of death annually from road accident is alarming as the British Medical Journal once reported that more people die in road traffic accidents than malaria worldwide (Broughton and Walter, 2007). Road accident is now seen as a global phenomenon and as a result, virtually every country including Ghana is concerned about the increasing number of deaths and injury on roads (World Health Organization, 2013). The increase in vehicle registration in Ghana is contributing to a rise in the number of road traffic fatalities. The number of registered vehicles grows by 10% annually, presenting road safety concerns (Sarpong, 2003). The major source of transportation in Ghana is by road which accounts for 96% of national freight tonnage and also 97% of passenger traffic (Sarpong, 2003). Research has shown that in 2001, Ghana was ranked as the second highest road traffic accident-prone nation among six West African countries, with 73 deaths per 1000 accidents (Abissath, 2012).

Case studies of traffic accidents have shown that vehicle factors such as mechanical failures were the direct and primary causes of the accidents (Ghana National Road Safety Commission, 2005). The nature of road driving and driver experience was also found to be related to accidents (Ghana National Road Safety Commission, 2005). Other studies have also revealed that age of driver and alcohol consumption of the driver were directly related to accidents on the roads (Zewerling et al., 2005). The region with the highest rate of road accidents in Ghana is Greater Accra. In 2015, Greater Accra accounted for 4313 road accidents out of the 10,852 cases reported (Yankson et al., 2010). Commercial drivers from developing countries such as Ghana contribute significantly to these accidents. This is attributed to the fact that they are very exposed to accidents on daily basis as a result of the nature of their job (World Health Organization, 2013).

Increase in population growth coupled with rapid urbanization and motorization are among the factors driving traffic accident related issues in the country (Teye-Kwadjo, 2011). The growth in motor vehicles attributed to economic growth of a country results in increased road accidents (Kopits and Cropper, 2003). Increase in the number of cars must be because either (a) population is increasing or (b) car ownership per capita is rising or both (Obeng-Odoom, 2010). The rapid rate of car growth in Ghana is attributed to government policies and road construction (Obeng-Odoom, 2010). The common mode of transport in Ghana is by road hence, the poor nature of the public transport system has compelled Ghanaians to find a way out by acquiring their

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own vehicles (Teye-Kwadjo, 2011). Almost all vehicles used for commercial purposes in Ghana are used **cars** (Obeng-Odoom, 2010). These cars are popularly referred to by Ghanaians as "home used". These so-called "home-used" cars are predominantly accident cars or used vehicles shipped into Ghana from other countries mainly the United States, Canada, Germany, Italy, France, United Kingdom and Japan. These cars are then worked on by mechanics known in Ghana as "fitters" and transformed into public transport vehicles. Using such cars on Ghanaian roads is very risky in a sense that (1) the car is old and (2) the condition of the car is bad. These issues usually contribute to a lot of road accidents in Ghana.

Another cause of road accidents is the use of locally manufactured brake pads. Locally manufactured brake pads do not meet international standards because they are made out of inappropriate materials. Most commercial drivers prefer them because they are cost-effective as compared to the genuine brake pads. Slightly used tyres can also be considered as one of the major causes of road accidents. Majority of commercial drivers patronize used tyres shipped from other countries because they are cheaper. These tyres usually come in grades and can be classified into two groups − "commercial" and "private". The "commercial" are the ones used by commercial drivers and the "private" are the ones used by private car owners. Since most of these tyres are not brand new, they mostly explode at top speed and result in road accidents. Furthermore, some of the tyres are not meant for African roads because of the intense heat such as snow tyres, yet commercial drivers purchase them anyways knowingly and unknowingly. One other interesting cause of road accidents which is mostly overlooked is the frequency of servicing for commercial vehicles. Majority of commercial vehicles in Ghana are not serviced regularly or not serviced at all. Drivers are always eager to make money and pay less attention to their vehicle(s). They barely check on the water level in the radiator, the brake fluid, the engine oil etc. The only time the vehicle is taken for servicing is when it is faulty.

Another cause of accidents in Ghana is attributed to driver stress. Commercial vehicles used in Ghana, mostly taxis, are given out to drivers using a mechanism called "work-and-pay" which is also known as hire purchase (Teye-Kwadjo, 2011). This hire purchase system demands that drivers make daily payments to car owners depending on the brand of car and the condition of the car between 1–3 years to become the new owners of the cars. This puts a lot of stress on drivers because they have to make daily payments to their car owners and themselves. This is extremely tiresome and can result in stress and fatigue which in turn, can cause road accidents (Enu, 2015). Road accidents have a strong social, health and economic implication on society. Most of the casualties affected are economically active persons which could have a crippling effect on their dependents, resulting in hardship and poverty. Crash victims tend to stay longer in hospitals longer than average patients because of the degree of injuries sustained (Odero et al., 1997). The main objective of this research is to model the average risk of accident for commercial drivers in the Greater Accra Region, Ghana using a survival model.

2. Materials and methods

The research considered road accident cases involving commercial drivers living in the entire Greater Accra Region of Ghana. The type of accident or severity being investigated was accidents that the commercial drivers themselves encountered. The study was, therefore, looking at the first time a commercial driver is involved in an accident. The study further looked at some conditions under which these accidents occurred and to ascertain if any of the conditions had a significant impact on the event of interest. These conditions included the gender of the driver, duration within which the driver had acquired a driver's license at the time of accident, nature of the road on which the accident occurred, the level of severity of the accident, the age of driver at the time of accident, type of vehicle used by the driver at time of accident, the age of vehicle, the state of vehicle and whether the driver was on alcohol at the time of accident.

Random censoring was used in this study where there is a single termination time, but entry times vary randomly across individuals (Allison, 2010). The entry time was the estimated date a driver starts driving and the study was terminated on a single date, June 30, 2016. A driver is said to have experienced the event of interest if he/she is involved in an accident within the period. Drivers who had not experienced the event of interest within the study period were censored and time till event was measured in days. The study was retrospective in nature. That is, drivers were asked to recall the dates of events like the date they started driving and date of first accident. Survey data was collected using paper-based questionnaire from 204 commercial drivers from the Greater Accra Region and analysed using Microsoft XLSTAT.

Commercial drivers were asked to provide the date they started driving as well as the date they first had an accident. Those who could not recollect these dates were excluded from the study. The difference between the dates was consequently computed as the survival times. The Non-Parametric Kaplan-Meier (KM) Model was used to study the commercial drivers' survival patterns, from which the probability of survival after each day was estimated. The group variables estimated were condition of vehicle and age of drivers' license. Survival function is the probability of an individual surviving at least to time "t". The Survival function of the Kaplan-Meier (KM) Model is given by:

$$S(t) = \Pi_{t < t_i}\left(1 - \frac{d(t)}{n(t)}\right) \tag{1}$$

The hazard function is the instantaneous rate at which an event occurs given that no previous event has occurred. The Cox Proportional Hazards Model was used for the multivariate analysis of the explanatory variables. The Cox Proportional Hazards Model is given by

$$h(t, X) = h_0(t)\exp\left(\sum_{i=1}^{k} \beta_i X_i\right) \tag{2}$$

Where h_0 is the baseline hazard and the β's are the parameters with $i = 1–3\ldots$, p.

3. Results and discussions

The study was conducted on a group of commercial drivers in the Greater Accra Region of Ghana. Of the 204 drivers studied, 4 (2%) were females and 200 (98%) were males. Drivers who were involved in fatal accidents were 23 (11%), 35 (17%) were involved in major accidents and 146 (72%) were involved in minor accidents. A fatal accident in the context of this study is an accident which resulted in death. The paper further conceptualises a major accident is an accident resulting in severe non-fatal injuries whilst a minor accident is linked to an accident with no severe injuries or no injuries at all. Findings from the study revealed that drivers who take alcohol were 74 (36%) and 130 (64%) do not take alcohol. Drivers who use taxis were 96 (47%) and those who drive buses were 108 (53%). Drivers who were married were 77 (38%) and those who were not married were 127 (62%). The analysis further revealed that drivers with vehicles in bad condition were 108 (53%) and those with vehicles in good condition were 96 (47%). Drivers with driving license of above five years were 104 (51%) and those with drivers' license less than five years were 100 (49%).

Fig. 1 shows the survival function with 95% confidence band. The "+" on the curve indicates censoring; commercial drivers who are yet to experience the event of an accident. The Kaplan-Meier method was employed in estimating the average time till the event of interest occurred. The probability of an accident occurring in the first 32 days was 0.955. The 50th percentile, which is the median survival time was 911 days which has a 95% lower confidence limit of 679 days and an upper confidence limit as 1132 days. This finding implies that a commercial driver in Greater Accra is involved in an accident after