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TOPIC

IDENTIFICATION OF RISK FACTORS INVOLVED IN ROAD ACCIDENTS IN GHANA. A CASE STUDY OF THE TECHIMAN MUNICIPALITY.

NAME: AWAL, MOHAMMED.

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DECLARATION

This thesis is submitted to KNUST, School of Graduate Studies through the College of Physical Science. I hereby declare that this thesis is my independent work and has not been accepted in any previous application for a degree here or elsewhere. This thesis presents results of original research undertaken by the undersigned. Information taken from other works has been specially and duly acknowledged.

………………………. ……………..   ………………………….

AWAL, MOHAMMED   DATE

(STUDENT)

……………………………………….   …………………………

MR. ISAAC AKPOR ADJEI   DATE

(SUPERVISOR)

………………………………………   …………………………..

MR. KWEKU DARKWAH   DATE

(HEAD OF DEPARTEMENT)

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DEDICATION

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ABSTRACT

The problem of deaths and injury as a result of road accidents is now acknowledged to be a global phenomenon. As a result authorities in virtually all countries of the world are now concerned about the growth in the number of people killed and seriously injured on their roads including Ghana. The study objective was to identify the risk factors that mainly contribute to accident and their impact on road accident. This study applied logistic regression to accident-related data collected from MOTOR TRAFFIC and TRANSPORT UNIT of GHANA POLICE SERVICE, TECHIMAN DIVISIONAL COMMAND traffic records in order to examine the contributing factors to accident severity. A total of 494 accident data from 2007-2011 was used. The accident severity (dependent variable) in this study is a dichotomous variable with two categories, Fatal or Non-fatal. Among the variables obtained from police-accident reports, five independent variables namely; gender, time of accident, location of accident and reasons assigned for accident were found to be statistically significant.

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ABBREVIATIONS AND ACRONYMS

W H O	World Health Organization
MTTU	Motor Traffic and Transport Unit
GDP	Gross Domestic Product
NRSC	National Road safety Commission
SPSS	Scientific Product and Service Solution
BRRI	Building and Road Research Institute
GNP	Gross National Product
ARM	Accident Risk Model
RTI	Road Traffic Injury
CEPS	Custom Exercise and Preventive Service
GPRTU	Ghana Private Road Transport Union
PROTOA	Progressive Transport Owners Association

CHAPTER 1

INTRODUCTION.

1. 1 BACKGROUND

Motor vehicle registration in Ghana is increasing rapidly as the population grows contributing to a rise in the number of road traffic injuries and fatalities. According to the National road safety Commission (NRSC) 2011, the country had 1.3 million registered vehicles, a figure which grew by 10% annually, presenting road safety concerns. However, the main source of transportation in Ghana is by road. Sarpong (2003) stated that, road transportation caters for 96% of national freight tonnage and 97% of passenger traffic.

Abissath (2012) stated in Data Journalism Application and Road Safety in Ghana that; research showed that in 2001, Ghana was rated as the second highest road traffic accident-prone nation among six West African countries, with 73 deaths per 1000 accidents. However, current statistics on annual death on road accident in Ghana is too alarming as the British Medical Journal once reported that more people die in road traffic accidents than malaria worldwide.

According to WHO (2010), globally, an average of 3,242 people lose their lives due to road traffic injury (RTI) every day. It is estimated that RTI deaths will rise to the fifth leading cause of death by 2030 resulting in an estimated 2.4 million deaths per year, unless preventive efforts are taken. In a study conducted by Odero et al (1997); and Atibu (2000), reveals that the leading causes of death among adolescents and young adults in the world is road traffic accident. Atibu (2012) in stating the plight of children, listed; (1) accidental death of children accounts for 6.7% of total such death out of which 36.3% are due to road accidents. (2) Road Traffic injuries are a leading cause of death in children. (3) Road accidents accounted for 55% of all accidental death in children and in almost all of these, the unsafe behavior of child was considered to be at fault. (4) Road accident deaths occur in healthy children who might have been expected to have had productive lives and cause immeasurable distress and guilt to the parents and other parties involved. So the prevention of accidents in children is being increasingly recognized as an important public health issues. Ghee et al (1997) added that in the developing world children under 15 forms a higher percentage of road accident victims (typically 15 per cent) compared with industrialized countries (usually about 6 per cent).

According to World Health Organization (2009); and Yankson et al (2010), over 1.2 million people died and 50 million were injured or disabled in road accidents worldwide; and that majority of these deaths (90%) occur in developing countries which have only 48% of the world's vehicles, with little or no safety measures in place. The table below gives credence to the above assertion.

Table 1.1 Estimated global road traffic injury-related deaths

	Number	Rate Per 100,000 Population	Proportion Of Total (%)
Low-Income and Middle-Income Countries	1 065 988	20.2	90
High-Income Countries	117504	12.6	10
Total	1183492	19.0	100

Source: WHO Global burden of disease project 2002, version (see Statistical Annex)

Iteke et al (2011), stated that avoidable road traffic accidents among other accidents have continued to add to morbidity and mortality in most sub-Saharan African countries and that; there have been many cases of road traffic accidents (RTAs) resulting from low construction standards and poor road maintenance in Sub-Saharan African countries. According to Odero *et al* (1997), there have been 'Dramatic increases in the proportion and absolute number of traffic fatalities in a number of developing countries; and that, of all road deaths occurring globally each year, 74% are in developing countries and there has been a 5-fold increase in traffic-related deaths in Nigeria particularly, over the last 30 years.

At the Lunch of United Nation Decade of Action for Road Safety 2011-2020, (May 11, 2011) it was revealed that if nothing is done to curb road accidents worldwide; 1.9 million lives will be lost annually by 2020. In a key note address, at the launch, David Cameroon, the U.K Prime Minister stated "Every six seconds someone is killed or seriously injured on the world's roads". The Russian President, Dimity Medvedeu stated "Experts estimate that more than a million people die on the roads each year one in five of whom is a child. More than 50 million people are hurt or seriously injured. The international community therefore has a duty to develop a common strategy and joint action to enhance road safety"

Soderland et al (1995) in a cross-sectional analysis of a data stated that, the poorest countries have highest road traffic related mortality rate, and that while the developed world seem to have instituted intervention to reduce the incidence of road traffic injuries and improved survival of the injured, the developing countries do have very minimal or no intervention at all. Iteke et al (2011) lament while many literature from other parts of the world had addressed issue of posttraumatic stress disorder complicating road traffic accidents and other traumas, such information are largely unavailable in sub-Saharan Africa. In other parts of the world, the prevalence of posttraumatic stress disorder after road traffic accidents range between 8.5% and 39% the reverse is true in sub-Saharan Africa.

A study conducted by Piece and Maunder (1998) outlined a possible cause of an increase rate of accidents in the developing countries as:

1. Rapidly urbanization process in these countries.
2. High growth rates
3. Poor road conditions
4. Reckless driving
5. Non-adherence to the traffic regulation by the motorist and the traffic officer (due to corruption).
6. The majority of the people in developing countries are dependent on public transport for their daily movement. However the minibuses have a higher accident risk in developing countries than in the developed world.

1. 2 STATEMENT OF PROBLEM.

Ghana is a coastal country located along the Gulf of Guinea. Due to the relative political stability she enjoys, her two international harbours are being used by sister land locked nations such as Burkina Faso, Mali, Chad and Niger. Statistics indicates that road transportation caters for 96% of national tonnage and a large percentage of highway accidents are caused by abandoned broken down trucks with no warning signals.

WHO (2009), stated that global losses due to road traffic injuries are estimated to be US$518billion, and developing countries lose about 1% and 3% of their GNP which is more than development aid they receive annually.

The Global Road Safety Facility (2012), stating in absolute numbers, the road-related mortality rate per capita in Africa is the highest in the world at 28.3 deaths per 100,000 at an estimated cost of US$ 3.7 billion.

The Ghana News Agency on the 10th of November, 2011 reported that road accidents exert much stress on the national budget. In a stake holders meeting, the NRSC announced that Ghana losses 1.6 percent of GDP in road traffic fatalities; and that 1.6 percent of GDP for 2004 was around 256 million dollars which was more than all government ministries budget of 200 million Ghana cedis for the 2010 financial year. Ghana does not only lose financially as a result of road accident but also her valuable labour force. The January 10, 2011 edition of the Daily Graphic reports that six thousand people nationwide have died in road fatalities within the last three years, and forty thousand people have been injured within the period.

The Global Road Safety Partnership Ghana (2010), reports that 70% of the year 2004 nationwide accidents were recorded in the following regions Brong Ahafo, Eastern, Ashanti, Central and the Greater Accra.

In an interview with the regional MTTU commander, he stated that, road accident data from the Techiman municipality is nearly 30% of the regional data annually. Therefore this study will concentrates on the number of injured people per accident in the Techiman municipality and will attempt to address the following questions:

1. What are the variables that mainly determine road accident fatality?
2. What is the impact of the variables on accident fatality?

1. 3 OBJECTIVES OF THE STUDY.

The primary objectives of this study are:

1. To identify risk factors related to motor vehicle fatality in Techiman Municipality.

2. To analyze the impact of driver and vehicle related variables on road traffic fatality.

Understanding how the risk factors are related to the occurrence of an accident is useful because risk factors potentially play a vital role in the road safety and may help in taking appropriate measures in reducing vehicular accident fatalities and injuries.

1. 4 SIGNIFICANCE OF THE STUDY

The study will add knowledge on understanding which risk factors contribute to the occurrence of road traffic accidents and related injuries in a restricted risk area in Ghana. The analysis of the data could be used by the N R S C and the M T T U to plan and evaluate road safety measures. This study can serve as baseline in future related research.

1. 5 ORGANIZATION OF THIS THESIS.

This research work is been classified in five webbed chapters. Chapter one gives the background of the study, problems statement, and the main objectives of the study and the significance of the study. Next chapter two which reviews scholarly texts on the research area describes recent trends in fatalities of vehicles and factors influencing motor traffic safety. Then chapter three discusses the sources and characteristics of accidents as well as methodology. Also discussion and analysis of the result of analysis is discussed in chapter four finally conclusion and recommendations of the study are stated in chapter five.

C H A P T E R 2

REVIEW OF LITERATURE

2.0 INTRODUCTION.

This chapter provides a review of recent trends in motor vehicular accidents, factors influencing motor traffic safety and various methodologies commonly used in traffic safety studies. The literature review focuses primarily on the type of analysis available and the importance of determining and examining risk factors in general. Numerous methodologies have been used over the years in traffic safety. Evaluations choosing the appropriate analysis type based on the available data and desired output can be a challenging task.

2.1 TRENDS IN ROAD SAFETY FATALITIES AND INJURIES IN GHANA

In a research conducted in Ghana by Yankson et al (2010), stated that in developing countries, motorization has been accompanied by rapid growth in road traffic injuries which has become a leading cause death and disability. The second African Road Safety Conference (2011) stated that, developing countries account for about 70 per cent of the world's road fatalities; and that, 28 and 32.2 per cent of deaths in Africa per 100,000 populations, hence the second leading cause of death in 5 to 44 age group of African is through road accidents. The foregoing assertion is truly reflected in the spate of accident in Ghana. The Chronicle (Monday 11 August 2008 edition) reported that Ghana records about 10,000 fatal road accidents every year out of which an average of

1600 people perish while 150 people sustain serious injuries robbing the nation of some precious lives.

The global Road Safety Partnership (G R S P) indicated that from 2002 – 2005, 70 per cent of persons killed in road accidents were males and 20.8 per cent are children under six years old. Pedestrians are the very vulnerable group accounting for more than 40 per cent of annual road accidents fatalities with 21% being children under 16 years of age. According to the Building and Road Research Institute (BRRI, 2001), at the national level, an average of 29% of all accidents were pedestrian accidents and the most vulnerable was the 6 – 10 years aged group accounting for 18% of all casualties. Yankson et al (2010), stated as in many other developing countries pedestrian injuries are most common road traffic death, 43% of all deaths in Ghana was due to pedestrian accident. Atubi (2012) analysis a Thirty-eight separate studies on road accidents, described casualties by the category of road-user.it came out that, Pedestrian fatalities were highest in 75% of the studies accounting for between 41 and 75%, followed by passengers (38-51%) in 62% of the studies. Drivers were third in 55% of the studies, and never ranked first in any country. Pedal and motorcyclists killed ranked first in India. Passengers ranked first amongst the non-fatal casualties reported in 14 studies.

According to Ameratunga et al (2006), the introduction of pavements (sidewalks) for pedestrians to walk separately from motorized traffic—especially at high-risk crash sites has the potential to lead to substantial reductions in pedestrian injuries. Roads that do not provide pavements, a common scenario in many low-income countries are associated with a two-fold increased risk of a crash compared with those that do. Also

Implementation of road-design measures to facilitate reductions in speed, through various traffic-calming measures, is another key strategy that can be used—with potential reductions in deaths and injuries of 11%. Although these findings from the Cochrane Injuries Review Group was not based on any reports from low-income and middle-income countries, a before-and-after investigation of the introduction of speed bumps in Ghana showed a 55% reduction in all deaths and a 51% annual reduction in crashes in which a pedestrian was hit. The researchers added, while road safety fatalities and injuries are reducing in the developed world, it is increasing at an alarming rate in the developing countries.

Amoah (2011) cited Arthur Kennedy in an article "Perishing on the road" that many of our prominent politicians have been involved in accidents including the Former Presidents of Ghana; Rawlings and Kufour and many other prominent politicians and members of the parliament of Ghana. Amoah again cited Amofa (the deputy director Health Service) stating that, "road accidents kill more Ghanaians annually than typhoid fever, pregnancy – related complications, and malaria in pregnancy, diabetes or rheumatism". He added that, the death of three Urologists of the Korle-Bu teaching Hospital on the Kumasi-Accra highway leaves a scarlet in the minds of Ghanaians. Obour 2011; and Akoto-Manu 2011, stated that, statistics of deaths on the Ghanaian roads is too alarming. In 2007, 1346 people were killed, the year 2008 recorded 1520, 2009 recorded 1587, 2010 recorded 1760 and death toll in 2011 was 2,119. Clearly, the spate of road accident in Ghana is on the ascendency.

The MTTU (2011), cautioned road users to be careful as the accidents are rampant getting to the end of years especially in the months of November and

December. According to the G R S P, road accidents kill average of four persons daily in Ghana. The Herald newspaper (November 21, 2011 edition) reported the Vice President of Ghana, Mahama as saying “the current rate of 1800 deaths through road accidents is unacceptable”. The situation is too scary as the chronicle (Monday 11 august 2008) reported a popular statement made by Akorsah that “the most deadly disease in Ghana at the moment is motor accidents”.

2.2 TECHIMAN IN PERSPECTIVE.

The Techiman municipal highways in the Brong Ahafo region are one of the busiest highways in the country and as such records high fatal road accidents (MTTU, 2010). The municipality does not only link the northern regions of the country to the rest of the regions in Ghana, but also serves as an important Tran-Ecowas route linking some landlocked Ecowas Nations.

The strategic location of Techiman as a nodal settlement makes the municipality an important market Centre which attracts people from all over the country and the Ecowas sub-region visiting the municipality purely on business. This renders the road network prone to motor vehicular accidents. The Kumasi – Techiman – Kintampo, the Kumasi – Techiman – Wenchi, the Techiman – Sunyani and Techiman - Nkoranza highways are always busy and as such record high rate of road traffic fatalities. In a single accident along the Techiman – Kintampo highway, the nation was hit with a gory report of the death of twenty-seven (27) persons, including five children aged below 10 years.

Data on road accident in Ghana just like other developing countries is under-stated because most accident cases are not reported. Mohan (1997) stated that many developing countries have insufficient data on accidents. This is particularly the case for the poorest countries, many in sub-Saharan Africa. Due to poor record keeping, Asogwa (1992), described how even "fatalities are under-reported in Africa".

A visit to the Techiman Holy Family Hospital reveals a high incidence of motor traffic cases. The hospital recorded a total of 2383 Out Patient Department (OPD) cases from 2007 to 2011 with 109 RTIs resulted deaths. A sharp contrast of OPD cases is the police reported cases for the same period is 494 reported cases with 234 spot deaths. Indeed, there is under-reporting of accident cases.

According to the Motor Transport and Traffic Unit of Police the Techiman Divisional Command, a recent concern of road accident is fatal motorcycle crashes. Motor cycle riding has become a favorite trend in modern years, attracting a new age group of fanatics consisting older and wealthy riders. However, motorcycles in developing countries are more popular for commuting or utilitarian trips as opposed to recreational trips (Quddus, et al., 2002). Obviously, motorcyclists are more at risk of being killed in road traffic accidents than any other type of motor vehicle occupants. As the number of motorcycle increase in Techiman and for that matter Ghana, a new area of concern regarding motor cyclists has emerged.

2.3 RISK FACTORS INFLUENCING ROAD TRAFFIC FATALITIES AND INJURIES.

The World Health Organization (2009) Categorized risk factors into four groups, these are;

1. Factors influencing exposure to risk (thus, social deprivation, age and sex)
2. Risk factors influencing crash involvement (thus, young male, fatigue inadequate visibility).
3. Factors influencing crash severity (thus, not wearing safety equipment, excessive speed alcohol)
4. Severity of injuries after road traffic crash (Thus, delay in detecting crash, and transportation).

In the report, developing countries have increased exposure to the risk factors of road traffic injuries due to rapid urbanization and motorization coupled with unsafe public transportation, higher speed, and a diverse vehicle mix on the roads. According to Vankirk (2001), drivers today are faced with many problems when driving in congested and overcrowded cities, specifically by having the senses overloaded by the vast amount of information that needs to be continuously processed – a condition also knows as information overload. The types of information a typical city driver may encounter and need to react upon are numerous and include traffic signs, traffic signals, information about detour, billboard and other advertisements, horns, loud music from passing vehicles, vehicle changing lanes, pedestrians and much more.

Peden et al (2004) reported that over 3000 Kenyans are killed on the road every year most of the dead are between the ages of 15 and 44 years (thus the productive age group). Road accident as a global concern, the WHO (2004) reports that , almost 16000 people die daily worldwide from all types of injuries representing 12% of the global burden of diseases and among all category of injuries, road accident related is the most. The report admits that estimating annual road deaths vary due to some limitations; it is believed that over 3000 lives are lost daily worldwide. The driver's characteristics contribute to the high percentage in cases of road traffic accidents. Odero (1997) estimated human error in road accident to fall between 64 and 95% percentage of all causes of traffic crashes in developing countries. According to Aworemi et al (2009), Statistics indicate that over 90 percent of traffic accident situations in Nigeria can be attributed to driver errors.

Risky behavour leading to road fatalities are explained in many studies. According to Reason (1990), driver behaviours can be roughly divided into two categories; *errors* and *violations*. This differentiation provided base for the development of the Manchester Driver Behaviour Questionnaire (DBQ). The DBQ showed that driver errors, violations, and slips and lapses are three empirically distinct classes of behaviour. Reason et al. (1990) defined errors as 'the failure of planned actions to achieve their intended consequences'; violations as 'deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system'; and slips and lapses as attention and memory failures. Unlike errors, violations were seen as deliberate behaviours, although both errors and violations are potentially dangerous and might lead to a crash.

Sabahaih and Fujii (2011) stated that, the effect of attitude on intentional behaviours has been explained robustly in many studies, especially as related to the Theory of Planned Behaviour (Elliot et al, 2003, Elliot, 2010, Forward, 2009) which supports those previous findings by revealing that the more motorcyclists enjoyed not wearing a helmet and speeding, the more likely they were to engage in those risky behaviors. The researchers concluded that significant proportion of the study subjects were with high risky driving behaviors. It is a common seen of families, for instance including two adults and two children, rides on a motorcycles and bicycles in developing countries. Quddus, et al (2002) described the situation in developing countries are more popular for commuting or utilitarian trips as opposed to recreational trips. However, a study conducted in the UK focusing on motorcyclist' behavior and accidents (Elliot, et al., 2004); found that speed behaviour was significantly related to involvement in a 'blame' accident. In addition, errors and not violations were the dominant predictors of motorcyclists' accident-involvement. This situation was a reverse to car accident-involvement. The explanation for this difference might be that riding a motorcycle is more demanding than driving a car, thus motorcyclists may be more prone to making errors when riding than are car drivers when driving. More importantly, given the dynamics of motorcycling, the commission of an error when riding is likely to have more severe consequences than making an error when driving. For example, it is quite possible for a car driver to recover from making an error without losing control of the vehicle. However, the recovery from an error when riding a motorcycle is potentially more difficult due to the relative instability of a two-wheeled vehicle compared with a four-wheeled vehicle.

According to Awomeri et al (2010), a small percentage of crashes are caused by mechanical failure of a vehicle, such as some form of tyre failure, brake failure, or steering failure. They however stated that, the design of a vehicle can be a contributory factor in the severity of crashes. Some of the features and recent improvements that affect the safety of a vehicle include, airbags, Antilock Braking System (ABS), back-up sensing system, crumple zone, electronic stability system, and so on. On the nature of roads as contributory factor of road accident, Awomeri et al, added that, the quality of pavements, shoulders, traffic control devices and intersections, can be a factor in the crash; and that, frictional forces between the pavement and tyres is another important factor. If the tyres lose contact with the pavement then the vehicle starts fishtailing.

Hashmi et al (2012) undertook a follow-up study proposed by Hashmi et al (2010) to developed two APMs to statistically determine the impact of the significance of vehicular and driver's characteristics of passenger cars on the number of accidents occurred during last two years by the drivers. The researchers concluded that, the *APM* developed for passenger cars can be used in Lahore and other cities of Pakistan; and that, the damaged indicators, minor damages, overall unsatisfactory condition of cars, availability of musical instruments in cars, low qualification level, accidents committed by drivers in their entire driving exposure and rare mechanical check-up of cars are the main causes of their accidents. The proportion of car accidents indicates that more than 90% accidents occurred due to human errors. The Motor Vehicle Examination Authority and Law Enforcing Agencies should periodically check the passenger cars in general and with reference to aforementioned seven variables in particular for ensuring the road safety.

2.4 MODELING OF RISK FACTORS ASSOCIATED WITH TRAFFIC SAFETY

Several statistical methodologies have become more acceptable and have been used by a number of researchers in the past who studied risk factors associated with traffic safety. Chang and Yeh (2006) studied risk factors to driver fatalities in single-vehicle crashes and compared between motorcycle riders and non-motorcycle drivers using 2000 traffic data from Taiwan's Road Accident Investigation and Reporting

System. Their objective was to investigate the risk factors to driver fatality, provided that a single-vehicle injury crash occurred. Apart from understanding the risk difference amongst these two kinds of drivers, the authors also compared the risk factors contributing to non-motorcycle drivers and motorcycle rider fatalities, and also to possible explanations as to how and why they arise. Four risk factor categories—driver's characteristics, roadway environment, vehicle type, and single-vehicle crash type—were selected as the explanatory variable categories in that study. The authors employed a logistic regression model to estimate the relative probability of fatalities for drivers and motorcyclists between specific levels of risk factors. The researchers compared the advantages of using the logistic regression method over the least-square regression method.

The logistic regression analysis can be used to predict a binary outcome from a set of explanatory variables that may be continuous, categorical, or a mixture of the two unlike the least-squares regression where the dependent variable in the logistic regression analysis can violate the assumptions of continuous or normal distribution, and conditional constant variances.

Study conducted by Al-Ghamdi (2002) applied logistic regression to investigate the influence of accident factors on fatal and non fatal accidents for motor vehicle in Saudi Arabia. The study found that accident location and cause of accident significantly associated with fatal accidents. Accident factors used in the study including accident location, accident type, collision type, accident time, accident cause, driver age at fault, vehicle type, nationality and license status.

Furthermore, logistic regression has been considered as an appropriate method of analysis in a study conducted by Dissanayake (2004) to compare severity of affecting factors between young and older drivers involved in single-vehicle crashes. The study findings informs that almost all the common identified factors influenced both driver groups in the same manner except in the case of alcohol and drug usage in the case of crash severity of older drivers. Speeding and non-usage of a restraint device were the two most important factors affecting towards increased crash severity for both driver groups at all severity levels. Additionally, ejection and existence of curve/grade were determinants of higher young driver crash severity at all levels. For older drivers, having a frontal impact point was a severity determinant at all levels.

Liu and Dissanayake (2009) examined the Factors affecting crash severity on gravel roads. The authors focused on the characteristics of crashes that were reported on gravel roads with the objective of identifying factors affecting severity of injury crashes on gravel roads. Crash data from Kansas over a 10-year period (1996-2005) was used in the analysis. Logistic regression models were developed to estimate the probability of having an injury crash of different levels of severity for a given set of explanatory variables. The regression modeling considered about thirty candidate factors related to driver, road, environment, and collision types from the police reports. It was found that multiple factors were very significant in these models, such as safety equipment usage, driver ejection, alcohol involvement, speed limit, and some driver-related factors. The existence of these factors was very likely to result in high severity injury crashes, compared to the circumstances without them. The magnitude of such contributing effects was also estimated by computing the conditional odds ratios for individual predictors.

A study conducted by Johnson and Walker (1996) shows that helmets and safety belts are effective in reducing fatalities and injuries. Safety belt and helmet use in the seven Crash Outcome Data Evaluation System (CODES) states (i.e., Hawaii, Maine, Missouri, New York, Pennsylvania, Utah, and Wisconsin) could save millions of dollars in direct medical costs. Logistic regression was used to estimate the effect of being belted on the odds of sustaining various levels of injury. They compared odds ratios to risk ratios and presented safety-belt analyses of injury, cost of injury, alcohol and drug use, age factors, types of safety belts, and geographic patterns in crash characteristics.

Pickrell and Starnes (2008) analyzed motorcycle helmet use for motorcycle riders 21 years and older who were involved in fatal crashes. Their analysis was based on data from the National Highway Traffic Administration's Fatality Analysis Reporting System (FARS) over the years 1997-2006. Crashes were separated into two categories: (a) single-vehicle motorcycle crashes and (b) two-vehicle crashes involving one passenger vehicle and one motorcycle. A logistic regression model was used to perform a multivariate analysis that examined the relationship between a motorcycle rider's helmet use and many other factors. The authors found that the odds of a motorcycle rider in a single-vehicle fatal crash wearing a helmet were seventy-two percent less in states lacking a universal helmet law than states with a universal helmet law.

Hassen et at (2011) using the logistic regression model analysis a cross-sectional studies of risky driving behaviors of drivers in Mekelle town, North Ethiopia. The study revealed that drivers with secondary or high school educational status had higher risky driving behaviors than drivers with university or college educational status. However, drivers with lower/primary educational status had no significant statistical difference in risky driving behavior with university or college educational status drivers. This may be related with drivers with lower educational status had more years of driving experiences as they got their driving license with old legislation. The study noted that drivers who had more driving experience were found to exercise more risky behaviors. In contrary, a study in Tanzania showed that drivers who were not having driving experience found to be with high risky driving behaviors. However, study showed that driving experience was not found as a predictor variable for risky driving behavior which needs further investigation for explanation. Conversely a study conducted in Turkey, stated that most drivers perceive traffic accident as a result of fate. This assertion needs further investigation.

Case-control study of risk factors for fatal and non-fatal injury in crashes of rotary-wing aircraft was conducted by O'Hare et.al (2006). The objective of this study was to identify the potentially modifiable risk factors for injury in civil rotary-wing aircraft crashes in New Zealand. The authors performed two separate univariate analyses on all records from 1988 to 1994 that were reported on civil rotary-wing aircraft crashes in New Zealand. The first univariate analysis compared pilots-in command who were fatally injured in a rotary-wing air crash and pilots-in-command who were involved in a crash but not fatally; this analysis was restricted to pilots-in-command to avoid any confusion due to numerous flight crews and seating positions. The second univariate analysis compared pilots-in-command who were injured seriously (fatal or non-fatal) in an air crash to pilots-in-command who were involved in a crash but not hospitalized with an injury. To estimate the unadjusted odds ratios for each of the factors, a set of unconditional univariate logistic regression analyses were conducted. Then multivariate logistic regression analyses were performed to adjust the effects of off-airport location and post-crash fire for each identified significant factor in the analysis.

Rodgers (1997) evaluated the factors associated with the crash risk of adult bicyclists. A multiple logistic regression analysis was employed to quantify the risk factors, simultaneously controlling a number of bicyclists' characteristics and bicycle use patterns. The relationship between a set of explanatory variables and a dichotomous dependent variable was examined by using the logit function in the regression model. The logit specification was used to determine the risk factors after adjusting for the potentially complex relationships between rider characteristics and crash risks.

A study by Lardelli-Claret et al. (2004) in Spain evaluated driver dependent factors and the risk of causing a collision for motorcycles. A multivariate analysis using an unconditional logistic regression model was used in this study. The condition of infraction was the dependent variable used in the model and the independent variables included the vehicle, driver, and crash related factors. This analysis estimated the odds ratios for each category of all driver related variables, adjusted by the effect of the remaining factors included in the model. A separate stratified analysis was done using speed related infractions as a dependent variable for two groups of cases: drivers who committed only other types of infractions and drivers who committed only speed-related infractions.

The study concludes that inappropriate speed is the variable with the greatest influence on the risk of causing a collision followed by driving under the alcohol influence. Other factors that were associated with higher risk of causing collisions were younger and older drivers, alien drivers, and driving with an invalid license. On the other end being female, longer time in possession of a driving license and helmet use were associated with lower risk.

A study by Dandona et al. (2005) reported the risky behavior of drivers of motorized two wheeled vehicles in India. They performed univariate analysis for the determination of outcome variables with other characteristics, and reported chi-square tests for significance. Driving violations were categorized into traffic violations for the analyses (e.g., violation of red light, driving in inappropriate direction, driving while using a mobile phone, entering a no-traffic zone), violating documents (e.g., vehicle registration documents, lack of driver license), vehicle violations (e.g., no horn, no functional head lights, no rear-view mirror) and parking violations.

According to Nassar (1996), Risk factors are used to explain accident involvement and accident severity. Risk factors in road accident models play two roles:

1. Improve overall model fit and reduce the amount of unexplained variation. Care must be taken that these models and are not over-specified (i.e. do not include unnecessary variables).
2. Provide a means for evaluating the effectiveness of alternative safety measures.

Many countries do not see road safety as a national health problem. The 2009 global status report states that, pedestrians, cyclists, and drivers of motorized two-wheelers and their passengers account for almost half of global road traffic deaths, only about 9% of the world countries have a comprehensive law on speed limit regulation, less than half of countries worldwide have drink-driving laws base on blood alcohol concentration limit that is equal to or less than 0.05g/dl, also only 38% of low-income and 54% of middle income countries have seatbelts in cars both at front and rear seats. The World Health Organisation states that majority of the world countries do not have robust data on nonfatal traffic injuries.

In general, risk factors related to traffic and road section characteristics were found to be essential in analyzing accident injury severity. Risk factors such as accident dynamics/speed, seat belt use, and occupant age were found to be most important in explaining accident severity.

2.5 SUMMARY OF REVIEW OF LITERATURE.

In the forgoing chapter, the trends in road safety fatalities and injuries in Ghana were discussed. The profile and nature of road networks in Techiman. Additionally, risk factors influencing road traffic fatalities and injuries were looked at. And the modeling of risk factors associated with traffic safety.

CHAPTER 3

METHODOLOGY

3.0 INTRODUCTIONS

The chapter mainly explains how the study was conducted, the applied methods and techniques in data collection, the reasons for which they were used according to the research aims and objectives and statistical tools used to analysis the study.

3.1 DESCRIPTIONS OF VARIABLES SELECTED FOR ANALYSIS

A structured questionnaire, entirely based on the forms of the motor transport and traffic unit of police (MTTU) Techiman command, included information about the following covariates: 1) type of road traffic accident (fatal vs. non-fatal event – the later referred to as injury, as determined by the MTTU Department at the time of event, regardless of hospital care); 2) year of event in the study period; 3) socio-demographic determinants (age and sex) of the responsible driver; 4) reason of road traffic accident as recorded in the police forms (human error, mechanical fault, obstruction by others, accidental); 5) location of event (highway, within city roads); 6) time of the event (morning hours, afternoon, or overnight); and 7) the type of vehicle involved (commercial, private, motorbike).

All statistical analyses were performed with Scientific Product and Service Solution, version 17.0 (SPSS Inc., Chicago, IL, USA).

3.2 LOGISTIC REGRESSION MODEL

The logistic regression model is used in this study to predict the relative likelihood of being killed in a road accident. The goal of logistic regression is to identify the best fitting model that describes the relationship between a binary dependent variable and a set of independent or explanatory variables. The dependent variable is the population proportion or probability (p) that, the resulting outcome is equal to 1. Parameters obtained for the independent variables can be used to estimate odds ratios for each of the independent variables in the model. For the binary response variable y, denotes its categories by 1 and 0. It uses the generic term success and failure for the two outcomes.

According to Agresti (2007), logistic regression is the most preferred where the independent variables are categorical or mix of continuous and categorical. In this study, we code $y=1$ (non-fatal) and $y=0$ (fatal). The specific form of the logistic regression model is:

$$\pi(X) = p = \frac{e^{\beta_0+\sum_{i=1}^{n}\beta_i x_i}}{1+e^{\beta_0+\sum_{i=1}^{n}\beta_i x_i}} \qquad \textbf{(1)}$$

However, the logit transformation of the odds, or likelihood ratio that, dependent variable is 1, such that;

$$\log it(p) = In\left(\frac{p}{1-p}\right) = \beta_0 + \sum_{i=1}^{n}\beta_i \cdot x_i \qquad (2)$$

Where

β_0 : The model constant.

β_i : The parameter estimates for the independent variables.

x_i : The set of independent variables (i =1, 2… n)

p : Probability ranges from 0 to 1

$In\left(\frac{p}{1-p}\right)$: The natural logarithm ranges from negative infinity to positive infinity.

According to Lee (2003), there are two important reasons that make logistic regression popular;

1. The range of the logistic function is between 0 and 1; that make it suitable for use as probability model, representing individual risk.
2. The logistic regression curve has an increasing s-shape with a threshold; that makes it suitable for use as statistical model, representing risk due to exposure.

A simple transformation of equation (1) yields;

$$In\left(\frac{p}{1-p}\right) = \exp^{\beta_0 + \sum_{i=1}^{n} \beta_i . x_i} = \exp^{\beta_0} . \exp^{\sum_{i=1}^{n} \beta_i . x_i} \tag{3}$$

The fundamental equation for the logistic regression shows that when the value of an independent variable increases by one unit, and all other values are held constant, the new probability ratio $\left[p/(1-p) \right]$ is given as follows:

The fundamental equation for the logistic regression shows that when the value of an independent variable increases by unit one, all others are variables are held constant; the new probability ratio is given as follows:

$$In\left(\frac{p}{1-p}\right) = \exp^{\beta_0+\sum_{i=1}^{n}\beta(x_i+1)} = \exp^{\beta_0}.\exp^{\sum_{i=1}^{n}\beta_i.x_i}.\exp^{\sum_{i=1}^{n}\beta_i} \tag{4}$$

3.3 FITTING THE MODEL

Suppose the model contains s explanatory effects (terms variables specified in the model). For the j^{th} observation, let π be the estimated probability of the observed response. The three goodness-of-fit test criteria usually used for comparing different models for the same data in LOGISTIC procedure are;

- 2LLC: -2 Log Likelihood Criterion
- Cox & Snell Pseudo-R^2
- Nagelkerke Pseudo-R^2
- Wald Statistic

According to Bickel (2007), the deviance (-2log likelihood) is sometimes constructed as a measure of lack of fit, i.e. the larger the deviance the less well the model fits the data. The deviance becomes interpretable when we use the deviances from competing model to compute the deviance difference. The -2log likelihood statistics includes no disincentives for using additional parameters. It is computed as shown in Equation:

$$-2\log L = -2\Sigma_j w_j f_j \log \pi \tag{5}$$

Where,

w_j = weight

f_j = frequency values of the j^{th} observation, and

π_j = estimated probability of the observed response.

For binary responses models this relation is developed as shown in Equation

$$-2\log L = -2\Sigma_j w_j f_j \left[r_j \log(\pi) + (n_j - r_j)\log(1-\pi_j) \right] \tag{6}$$

Where,

r_j = number of events and

n_j = number of trials

There is no true R^2 value in logistic regression, as there is in Ordinary Least Squares (OLS) regression. Alternatively, Pseudo-R^2 can be a proxy of an R^2 including Cox & Snell Pseudo-R^2 and Nagelkerke Pseudo-R^2 (Charnkol, et.al, 2007).

$$Cox\,\&\,SnellPseudo - R^2 = R^2 = 1 - \left[\frac{-2LL_{null}}{-2LL_k} \right]^{2/n} \tag{7}$$

The null model includes only the constant while the *k* model contains all explanatory variables in the model. Cox & Snell R^2 value cannot reach 1.0, so that Nagelkerke R^2 is used to revise it.

$$Nagel\ker kePseudo - R^2 = R^2 = \frac{1 - \left[\frac{-2LL_{null}}{-2LL_k} \right]^{2/n}}{1 - (-2LL_{null})^{2/n}} \tag{8}$$

Wald Statistic (W) which follows a standard normal distribution under the null hypothesis that $\beta_1 = 0$. This statistic is computed by dividing the estimated value of the parameter by its standard error as:

$$W = \frac{\hat{\beta}_1}{S\hat{E}\left(\hat{\beta}_1\right)} \tag{9}$$

It should be mentioned that Wald test sometimes fail to reject when the coefficient was significant, and hence, the likelihood ratio test should be used in suspicious cases.

3.4 ODDS RATIO

The odds ratio (OR) is a ratio of two odds. Odds ratio can be used to give us an idea of how strongly a given variable may be associated with the outcome of interest compared other variables. For a probability of success π, the odds (likelihood) of success (in our case with risk factors) are defined as shown in the equation:

$$odds = \frac{\pi}{1-\pi} \tag{10}$$

Essentially, odds are nonnegative values. When the odds less than one, the probability of success is less than that of failure; when the odds are greater than one, the probability of success and failure are equally likely; and when the odds are than one, the probability of success is greater than that of failure. However, when analyzing a variable of interest, GENDER, the odds ratio compares the odds of success(fatality) for Group 1(female) to the odds of success proportion (fatality) for Group 2 (male). In general, the odds ratio compares the odds of success proportion in row 1 to the odds of success proportion in row 2 of a 2 X 2 contingency table as in the equation;

$$\text{OR} = \frac{odds_1}{odds_2} = \frac{\pi_1/(1-\pi_1)}{\pi_2/(1-\pi_2)} \tag{11}$$

Table 3.1 contingency table describing the formation of odds ratio formula

Injury type(binary options For dependent variable)	Independent variable : Gender	
	Probabilities of binary options	
	Group 1 (female)	Group 2 (male)
Fatality (success)	π_1	π_2
Non-fatality (failure)	$1-\pi_1$	$1-\pi_2$

An odds ratio of one indicates that the success or desired event under study is equally likely in both groups. An odds ratio greater than one indicates that the successful event is event is more likely to occur in the first group than in the second group and an odds ratio less than one indicate that the successful event is less likely in the first group.

According to Agresti, (2007), the farther odds ratio values are from 1.0 in either direction, the stronger the association among the variables.

3.5 SUMMARY OF METHODOLOGY

Chapter 3 presents the summary of variables which may be the possible cause of road fatality in Techiman municipality. Also, the review of previous work using logistic regression model. Then the fitness of the model and the odds ratio of the data are discussed.

CHAPTER 4

DATA ANALYSIS AND RESULTS

4.0 INTRODUCTION

A Road safety concern in Techiman is bothered by many of the same problems faced throughout the Country. The results of this study unveiled risk factors which might be possible causes of fatalities in motor vehicle crashes in Techiman and can be isolated when attempting to prevent fatal injuries. Out of a total of 494 accident cases reported 203 cases were fatal killing 234 people and injuring a total of 629 persons within the Techiman municipality from the year 2007 to 2011.

Accident related factors were employed as the predictor variables in this study. Data availability has also been primary considered in determining predictor variables for this study. All variables mentioned in appendix B were produced by Police, MTTU. These were also used as a basis for constructing the classification for predictor variables including accident types and reasons for accident. This study, however, attempted to consider all relevant factors which influencing fatal accidents.

4.1 DESCRIPTIVE STATISTIC

The outcome of the recorded road accident on the roads of the Techiman municipality during the period of study is shown in statistics below.

Out of a total of 494 accident cases 291 cases were not fatal representing 58.9 per cent and 203 cases were fatal representing 41.1 per cent

Table 4.1 consequence of accident

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	non-fatal	291	58.9	58.9	58.9
	fatal	203	41.1	41.1	100.0
	Total	494	100.0	100.0	

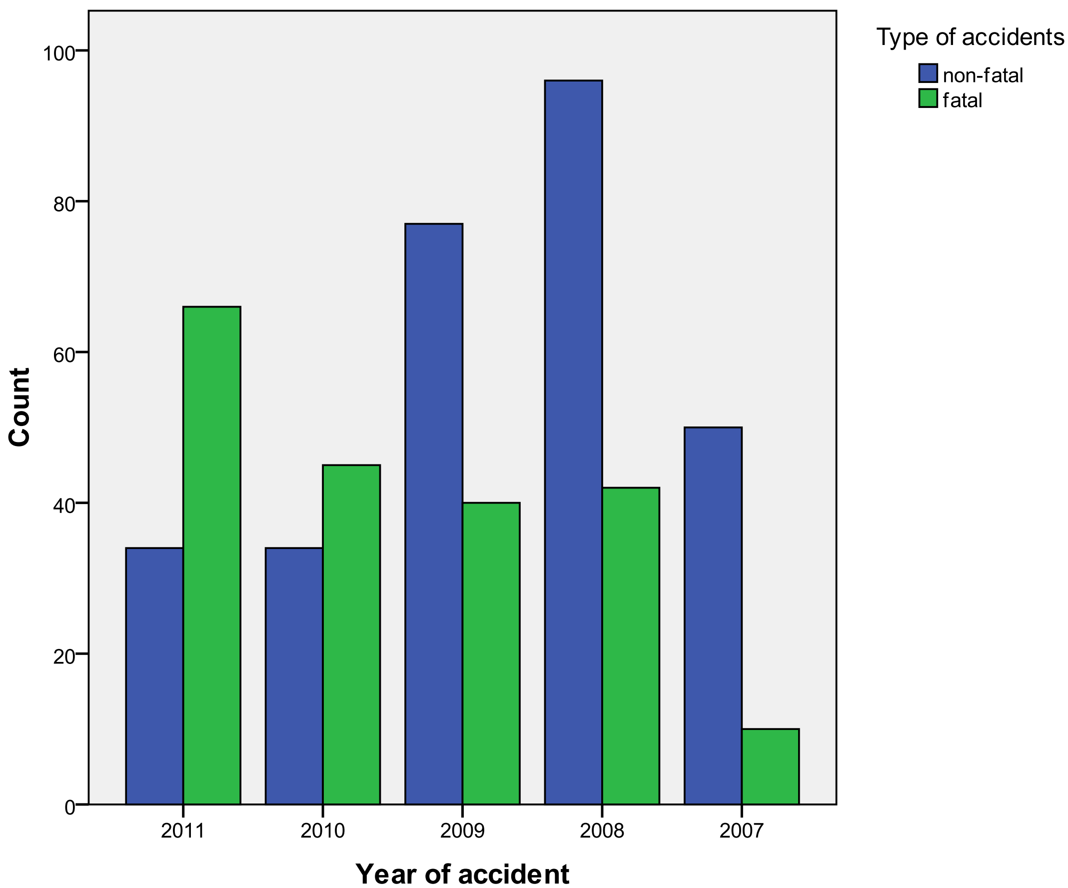

Figure 4.1.a. the above displays a bar chart showing the extent of fatality in the municipality from 2007 to 2011.

4.1.1 Age of driver (DA) at fault.

Drivers' age is categorized into two thus, below 25 years old and above 25 years. 54.7 per cent of drivers below the age of 25 were involved in accident while 45.3 per cent were drivers above 25 years.

Table 4.2 Age of driver (DA) (at fault)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 25 years	270	54.7	54.7	54.7
	above 25 years	224	45.3	45.3	100.0
	Total	494	100.0	100.0	

Although age is not statistically significant in the logistic analysis, age of driver show a positive relationship of fatal events with younger age of drivers in accordance with reports from other countries that young drivers/riders have a higher crash risk and a higher fatality rate than older drivers/riders.

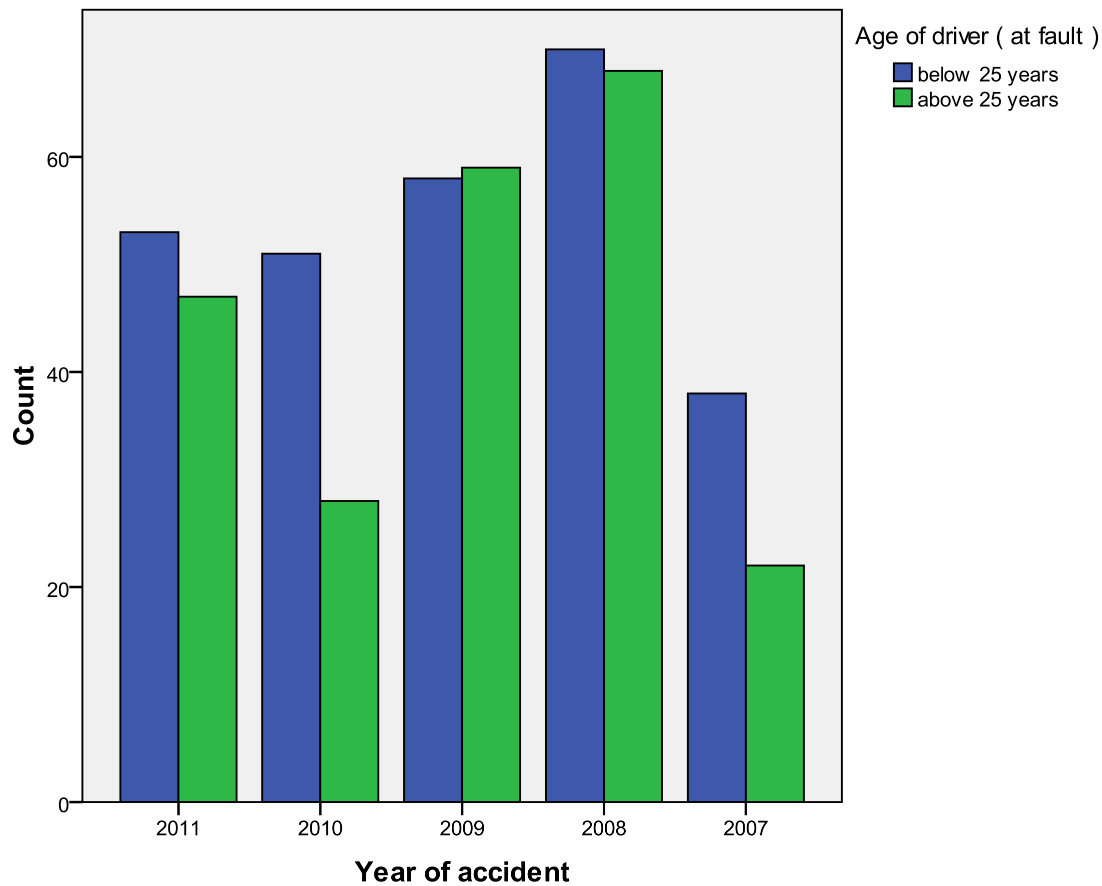

Figure 4.1.b. a bar chart showing the age groups of drivers at fault during the period of study

4.1.2 Gender of driver (DG) (at fault).

Considering the reported cases male drivers involved in accidents were 459 representing 92.9 per cent while female drivers were as few as 35 representing 7.1 per cent.

Table 4.3 Sex of driver (at fault)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	459	92.9	92.9	92.9
	female	35	7.1	7.1	100.0
	Total	494	100.0	100.0	

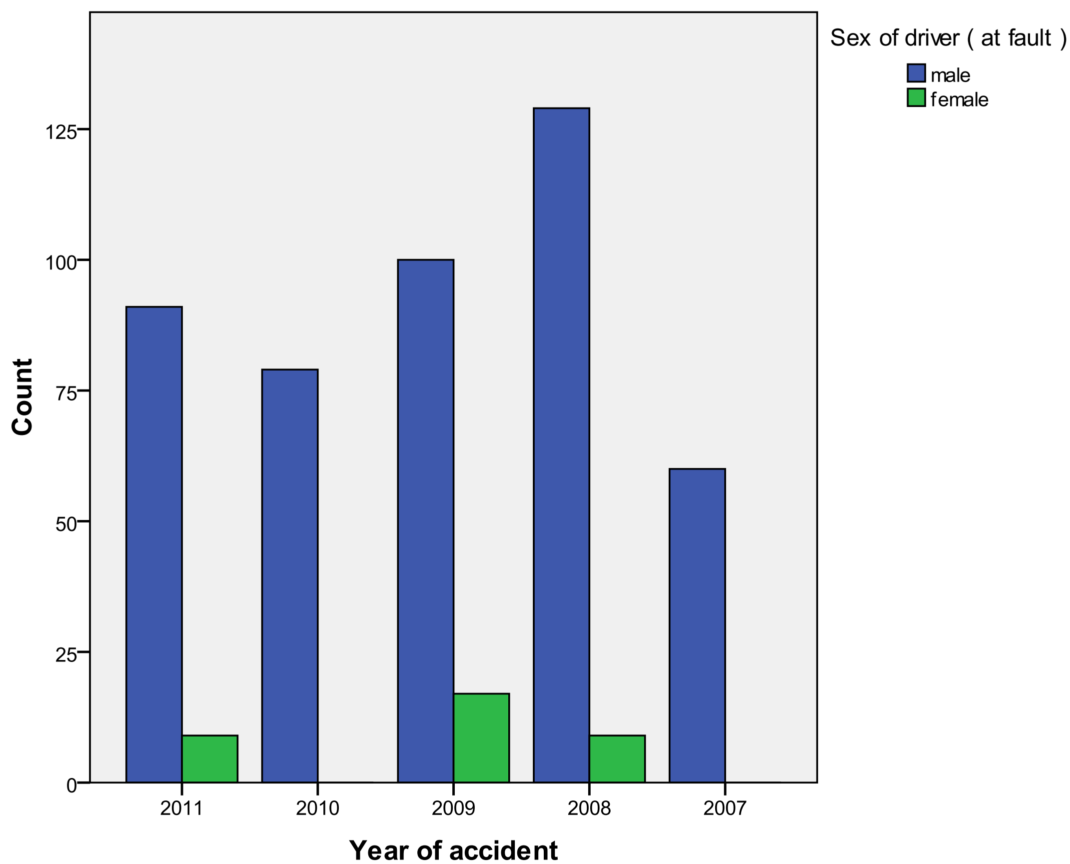

Figure 4.1.c. a bar chart showing the gender of drivers at fault from 2007 to 2011. This result is consistent with accident risk assessment.

4.1.3 Location of accident (LA).

For purpose of the study, accident spot is categorized into two such as highway accident and within city accident. Under the period of study 284 accidents were recorded on the Techiman highways constituting 57.5 per cent while 210 accidents occurred within the city representing 42.5 per cent of all accidents cases.

Table 4.4 Location of accidents (LA).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Highway	284	57.5	57.5	57.5
	within city	210	42.5	42.5	100.0
	Total	494	100.0	100.0	

The crash case-fatality rate was significantly higher on highways than within the city. In the logistic regression analysis above, this variable is statistically significant. This is to be expected given the inappropriate design of highway roads, inadequate or absence of road sign, presence of potholes in Ghana, which place both drivers and pedestrians at a particularly high risk for traffic injuries.

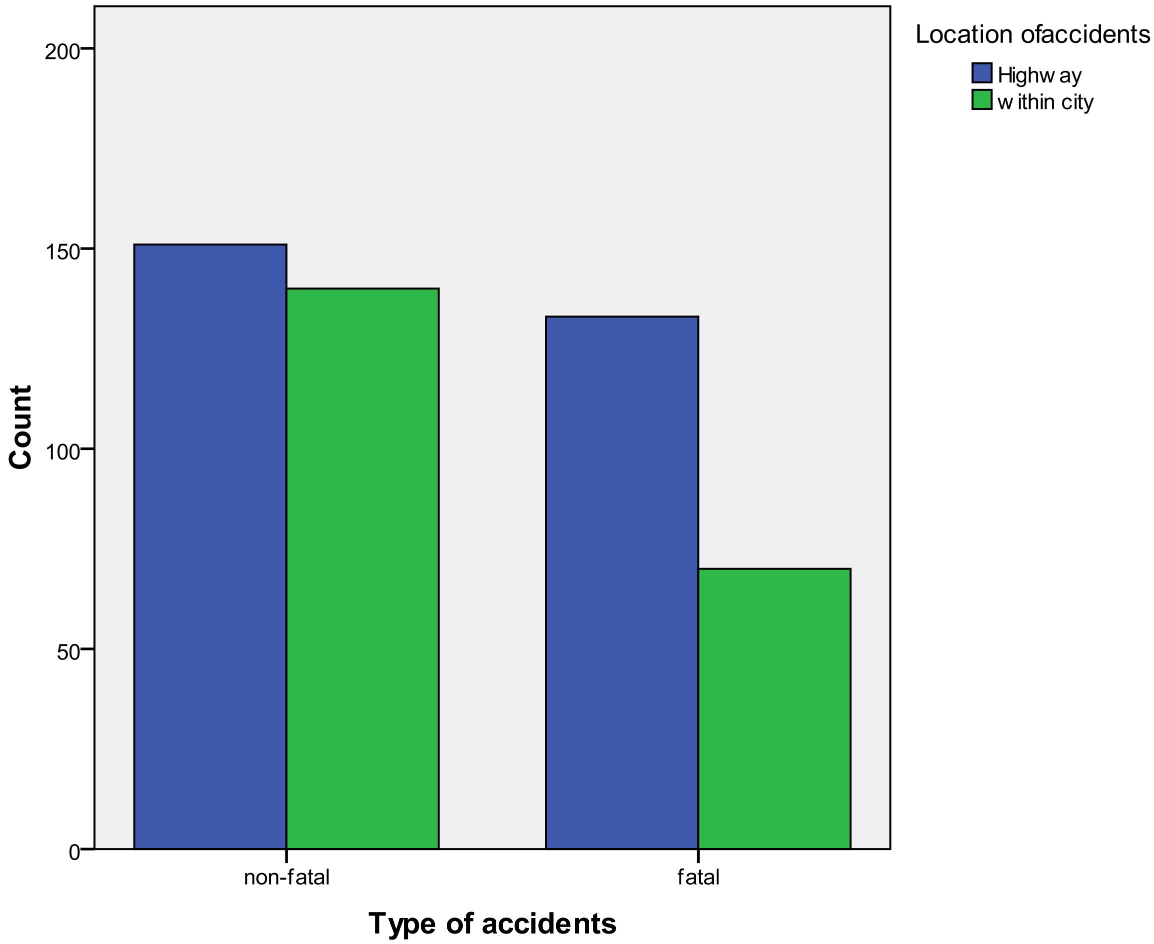

Figure 4.1.d. a bar chart showing types of vehicle at fault during period of study (2007 to 2011). Clearly, fatality on the highway is higher.

4.1.4 Time of accident.

Time of accident was categorize into three namely, the accidents at morning hours records 151cases representing 30.6 per cent, accidents reported in the afternoon were 206 presenting 41.7 per cent, and accidents occurred overnight were 137 representing 27.7 per cent.

Table 4.5 Time of accident

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	morning hours	151	30.6	30.6	30.6
	afternoon	206	41.7	41.7	72.3
	overnight	137	27.7	27.7	100.0
	Total	494	100.0	100.0	

The time of accident was significantly associated with case-fatality rate, there was an excess risk for road traffic accidents occurring overnight, this study have shown a higher case fatality in early morning hours which could be as results of fatigue.

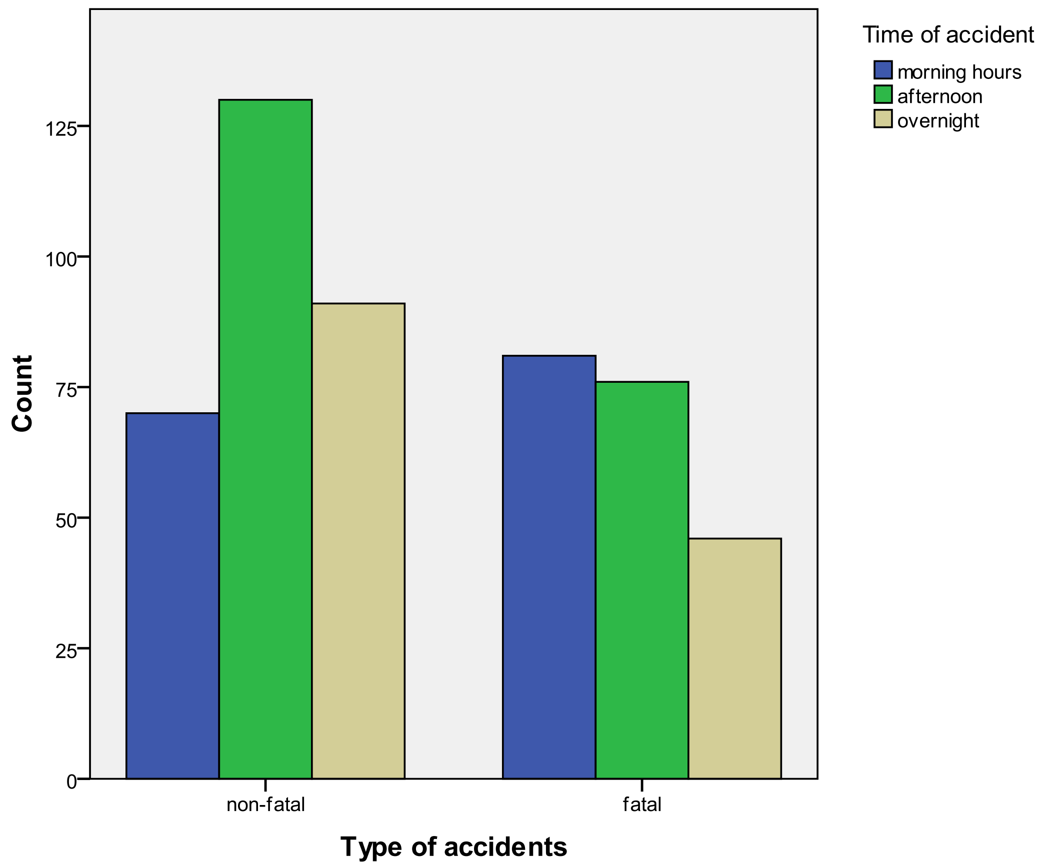

Figure 4.1.e. a bar chart showing the times when accident could be fatal.

4.1.5 Type vehicle (TV) at fault.

Vehicles involved in the accidents were categorized into commercial, private and motorbikes. The accident cases reported were recorded for the vehicle at fault. 59.7 per cent (295 cases) of vehicles at fault were commercial, the private vehicles 18.8 per cent (93 cases) and surprisingly 21.5 per cent (106 cases) vehicles at fault were motorbikes.

Table 4.6 Type of vehicle (at fault)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	commercial	295	59.7	59.7	59.7
	private	93	18.8	18.8	78.5
	motorbike	106	21.5	21.5	100.0
	Total	494	100.0	100.0	

It was observed that, a higher case-fatality rate for commercial vehicles than for motorcycles. This finding, which deserves further investigation, points to an urgent need for improving the safety measures of such means of transportation. It has been reported that buses and trucks are frequently involved in traffic accidents in low-income and middle-income countries. In such countries, second-hand buses and trucks are often imported without the crash-protective equipment. Furthermore, such vehicles have a poor crash worthiness performance and a poor stability when overloaded, as it is frequently the case in Ghana. The figure below 4.1.f clearly demonstrates the above assertion.

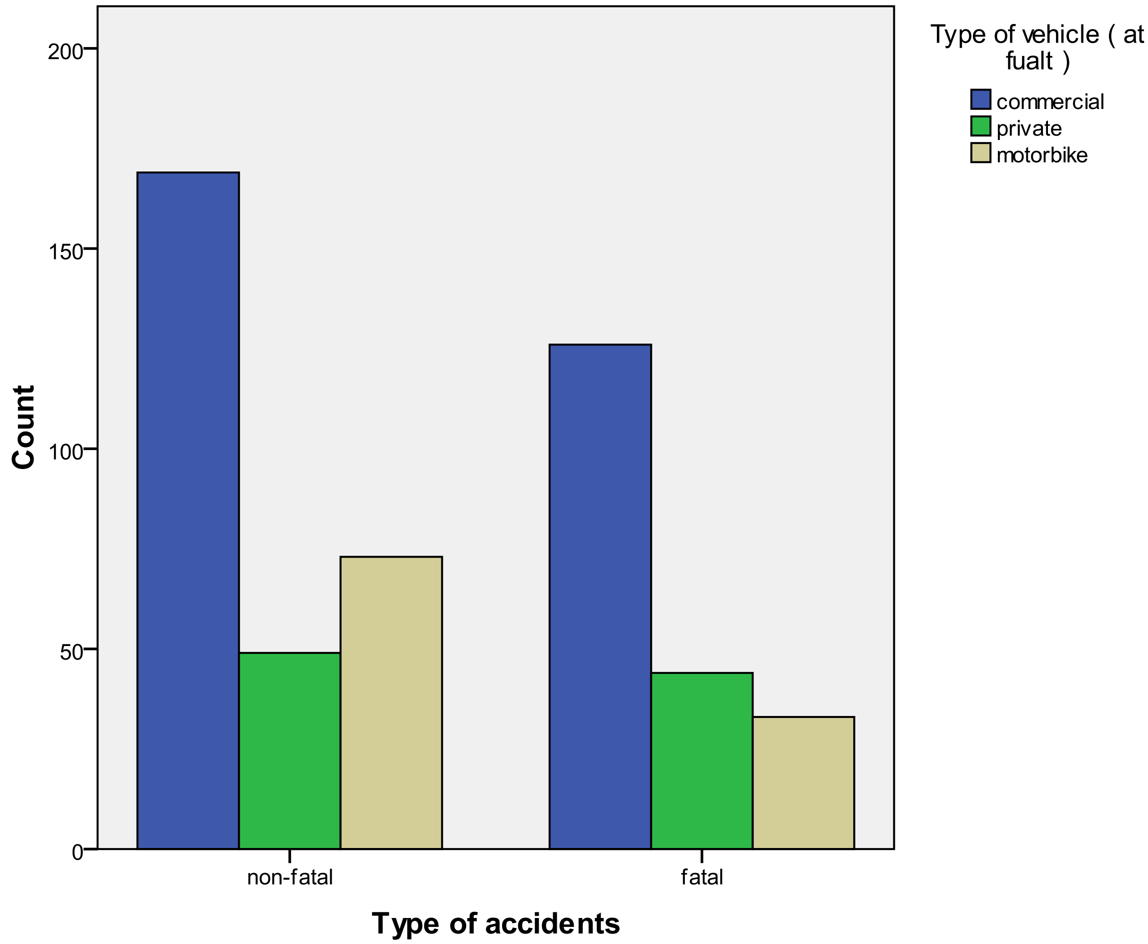

Figure 4.1.f a bar chart using the types of vehicle (at fault).

4.1.6 Reason for accident

So many reasons were assigned to any accident recorded. Largely many accidents were attributed to human error 76.3 per cent (377 cases).Obstruction by others as reason constitute the second with 10.9 per cent (54 cases). Accidental and mechanical fault recorded 6.5 (32 cases) and 6.3 (31 cases) per cents. Estimated human error in road accident to fall between 64 and 95% percentage of all causes of traffic crashes in developing countries (Odero, 1997)

Table 4.7 Reasons for accident

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Human error	377	76.3	76.3	76.3
	Mechanical fault	31	6.3	6.3	82.6
	Obstruction by others	54	10.9	10.9	93.5
	Accidental	32	6.5	6.5	100.0
	Total	494	100.0	100.0	

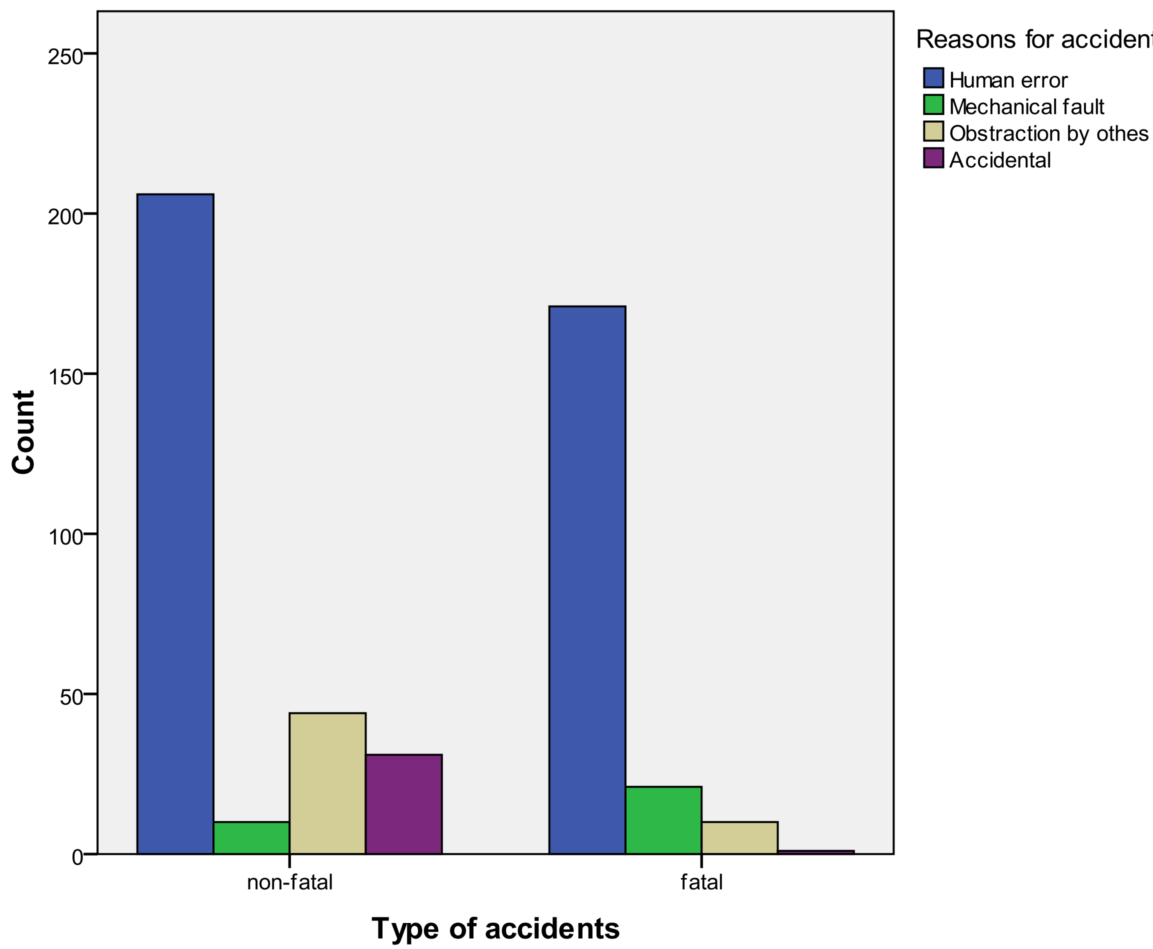

Figure 4.1.g. a bar chart showing the frequency of reasons assigned for accidents.

Human error is not only high in the accidents since 2007 to 2011, but also the highest cause of fatal accident in the period under study. This is consistent with previous studies, which have indicated a strong relationship between fatality and risky driver behavior.

4.2 VARIABLE SELECTION.

The analysis began by testing the significance of the association each explanatory variable could have with the dependent variable. For this purpose the entering selection process of logistic regression was followed in this study. Out of the six explanatory variables, four were statistically significant. From the table below, clearly, explanatory variables such as gender, type of vehicle at fault, location of accident and reasons assigned as responsible for the accident were significant effect on the dependent variable.

Table 4.8 Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Year			68.130	4	.000	
	Year(1)	4.194	.782	28.761	1	.000	66.309
	Year(2)	2.492	.736	11.459	1	.001	12.081
	Year(3)	-1.169	.616	3.600	1	.058	.311
	Year(4)	-1.615	.597	7.312	1	.007	.199
	DA(1)	-2.747	.705	15.174	1	.000	.064
	DG(1)	-8.685	1.391	38.974	1	.000	.000
	Raccident			66.908	3	.000	
	Raccident(1)	18.020	2.227	65.468	1	.000	6.698E7
	Raccident(2)	14.710	2.065	50.757	1	.000	2447292.397
	Raccident(3)	8.745	1.429	37.443	1	.000	6279.688

LA(1)	3.580	1.400	6.538	1	.011	35.866
Time			44.361	2	.000	
Time(1)	1.558	.995	2.452	1	.117	4.747
Time(2)	-2.102	.753	7.800	1	.005	.122
TV			12.480	2	.002	
TV(1)	-4.700	1.339	12.318	1	.000	.009
TV(2)	-.660	.882	.560	1	.454	.517
Constant	-6.278	1.316	22.740	1	.000	.002

a. Variable(s) entered on step 1: Year, DA, DG, Raccident, LA, Time, TV.

4.3 LOGISTIC REGRESSION ANALYSIS

As mentioned in chapter 3, Logistic Regression is the selected method for analyzing the accident data. Only the explanatory variables found significantly associated with the dependant variable as per the Wald's test result are considered in the Logistic regression analysis. These variables are gender, reason for accident, location and the type of vehicle (at fault) will be included in the logistic regression model.

4.3.1 The Logit Model

From the analysis, the logit model with the significant variables is:

$$\log it(p) = -6.278 + 4.194 year_{(1)} \ldots - 1.615 year_{(4)} - 2.747 DA_{(1)} - 8.685 DG_{(1)}$$
$$+18.020 Raccident_{(1)} \ldots + 8.745 Raccident_{(3)} + 3.580 LA_{(1)} + 1.558 Time_{(1)} - 2.102 Time_{(2)}$$
$$-4.700 TV_{(1)} - 0.660 TV_{(2)} \ldots\ldots 4.1$$

It was however observed that, Time (1) [thus afternoon hours] and Type of Vehicle (2) [private] are not statistically significant to the study. Therefore another model was fitted by excluding these variables. The new model is given by:

$$\log it(p) = -6.278 + 4.194 year_{(1)} ... -1.615 year_{(4)} - 2.747 DA_{(1)} - 8.685 DG_{(1)}$$
$$+18.020 Raccident_{(1)} ... + 8.745 Raccident_{(3)} + 3.580 LA_{(1)} - 2.102 Time_{(2)} - 4.700 TV_{(1)} ....4.2$$

4.4 MODEL INTERPRETATION

The interpretation of any fitted model requires the ability to draw practical inferences from the estimated coefficients. Comparing the difference in impact or risk among the levels of each variable by looking at the regression coefficients. The interpretation of the estimated parameter coefficients is that, for a one unit change in the predictor variable, the difference in log-odds for a positive outcome is expected to change by the respective coefficient, given the other variables in the model are held constant. Accordingly, those predictors with positive coefficients cause an increasing tendency to result into fatalities. Similarly, negative coefficients indicate decreasing tendency for those significant predictors. Consider reasons assigned for accident, other variables being controlled.

$$\text{Reason for accident 1vs 2} = \exp(-6.278 + 18.020) / \exp(-6.278 + 14.710) = 27.3851$$

$$\text{Reason for accident 1vs 3} = \exp(-6.278 + 18.020) / \exp(-6.278 + 8.745) = 10667.95$$

$$\text{Reason for accident 2vs 3} = \exp(-6.278 + 14.710) / \exp(-6.278 + 8.745) = 389.7156$$

These figures show that the impact of fatality due to reasons assigned for the accident and that human error is 27.4 times more than fatality due to mechanical fault and; 10668 times higher than fatality due to obstruction-by-others. The impact of fatality due to mechanical fault is 389.7 times higher than fatality due to obstruction-by-others.

Odds Ratio is defined as the ratio of the odds for the independent variable being present to the odds of not being present. The following subsections give illustrations for interpretation for the model developed in this study.

The odds of driver's age below 25years being a factor for fatal accident is shown as $e^{-2.274} = 0.1029$. Thus, fatality due to driver's age below 25years is 10 per cent higher than driver's age above 25years.

The odds ratio of fatality on the highway is $e^{3.580} = 35.874$ .thus; the odds ratio of having a fatal accident on the highways is 35.9times higher than within city.

Also the odds ratio of fatal accident occurring during afternoon hours is $e^{-2.102} = 0.122$, representing 12 per cent as compared with overnight.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.0 INTRODUCTION

This thesis examined the risk factors involve in road accident in Techiman from 2007-2011. This study applies logistic regression technique to investigate the risk factors involved in fatal accidents on the Techiman roads. Based on MTTU accident data, seven predictor variables were employed in the model development. Explanatory variables such as type of accidents, age, gender, time of accident, location, reasons assigned for the accident and type of vehicle (at fault) were tested and these variables gender, time of accident, location of accident, reasons assigned for accident type of vehicle were found to be statistically significant.

5.1 CONCLUSION

It may be concluded that there is an urgent need to address the epidemic of carnage on the roads. Many cases of fatality are caused by human errors which are preventable.

Using the concept of Deviance together with Wald Statistic, the study variables were subjected to statistical testing. Five variables were statistically significant and the observed level of significance for regression coefficients for the variables were less than 5% suggesting that those variables were indeed good explanatory variables. The result also indicates a high goodness of fit.

The significance of gender in this study is consistent with past studies findings that road user attributes such as gender and age should be considered in accident risk assessment (Al-Ghamdi, 2002, Dissanayake, 2004).

5.2 RECOMMENDATIONS

Following the outcome of the above analysis I make the following recommendation for consideration in an attempt to reduce the carnage on our roads.

- The Ghana Highways Authority should embark on routine road maintenance, ensure proper road design labels, erect road signs and warning signals, and the construction of bumping at appropriate locations and remove all unauthorized bumping on the roads. The absence of road maintenance especially on the highways places road users at a high risk for traffic injuries.
- The police should prevent heavy duty vehicles from travelling overnight. this is because my study has shown a higher case fatality in early morning hours which could be as a result of fatigue or sleeping.
- The CEPS should enforce the law banding the importation of over-aged vehicles and also ensure that all imported vehicle have crash protective equipment such as air bag, seat belts, and the like. Also the GPRTU and PROTOA should regularly inspect their vehicles road worthiness before they embark on journey.

- All accident cases whether fatal or not should be reported to the police so as to update the police (MTTU) accident records. These will the stakeholders in plan preventive strategies on road accidents.

- Road stakeholders should embark on traffic rules awareness to cultivate road traffic sense in the public. My study result on human error is consistent with other studies as a variable in accident risk assessment. Hence all road users should be encouraged to report any driver who drives carelessly on the road to the nearest police barrier for punitive measures taken against such a reckless driver.

However, road safety is the responsibility of all not a group of persons since its occurrence affects all. Moreover, the recommendations from the world report on Road Traffic Injury Prevention should be considered and promptly implemented by all countries.

REFERENCE

- Abissath M. (2010) Data Journalism Application and Road Safety in Ghana. http//www.ghna.gov.gh/index.php/features/17343-data-journalism-application-and-road-safety-in-ghana. Accessed on Friday, 02 November, 2012.

- Agresti, A. (2007). "*An Introduction to categorical data analysis."* 2nd Edition, John Wiley and Sons, Inc., New York.

- Al-Ghamdi, A.S. (2002) Using Logistic Regression to Estimate the Influence of Accident Factors on Accident Severity, Accident Analysis and Prevention, Vol. 34, 729-741.

- Ameratunga S, Hijar M, Norton R (2006); *Road-traffic injuries: confronting disparities to address a global-health problem. Lancet 2006;367:1533–40.*

- Atubi A. O. (2012), Determinants of Road Traffic Accident Occurrences in Lagos State: Some Lessons for Nigeria. *International Journal of Humanities and Social Science Vol. 2 No. 6.Accessed on 15th November 2012.*

- Bickel, R. (2007). ―*Multilevel analysis for applied research."* The Guilford Press, New York.

- Chang, H. and T. Yeh (2006). ―Risk factors to driver fatalities in single-vehicle crashes: comparisons between non-motorcycle drivers and motorcyclists.‖ *Journal of Transportation Engineering*, 132, 227-236.
- Charnkol, T., Hanaoka, S., Tanaboriboon, Y. (2007) Emergency Trip Destination of Evacuation as Shelter Analysis for Tsunami Disaster: A Case Study in Phuket, Thailand,**Journal of the Eastern Asia Society for Transportation Studies, Vol.7**, 853-868.

- Daily Graphic (2011), The Ghana Police, road carnage and vehicular criminality. Retrieved http://www.ghanaweb.com. Accessed on 7th February, 2011.

- Dissanayake, S. (2004) Comparison of Severity Affecting Factors Between Young and Older Drivers Involved in Single Vehicle Crashes, **IATSS Research Vol.28 No.2**, 48-54.Elliott, M.A., C.J. Baughan, and B.F. Sexton (2007). "Errors and violations in relation to motorcyclists' crash risk". *Accident Analysis and Prevention*, 39, 491-499.

- Dandona, R., K.G. Anil, and D. Lalit (2006). ―Risky behavior of drivers of motorized two wheeled vehicles in India.‖ *Journal of Safety Research*, 37, 149–158.

- Ghee, C., Astrop, A., Silcock, D., and Jacobs, G., (1997), Socio-economic aspects of road accidents in developing countries. Transport Research Laboratory (TRL) Report 247

- Global Road Safety Facility (2012), Africa: Scaling-up Efforts to Address the Road Safety Challenge. Retrieved from; http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTTRANSPORT/EXTTOPGLOROASAF/0,,contentMDK:23269811~menuPK:2582251~pagePK:64215757~piPK:64215756~theSitePK:2582213,00.html on the 10th December, 2012.

- Global Road safety partnership "Road safety situation in Ghana. http://www.grsproadsafety. Org/page – Ghana-21. (Accessed on September 2, 2011).

- Hashmi, Q. N., Qayyum, T.I. and Rehman, Z. (2012). Accident Prediction Model for Passenger Cars. Academic Research International .Accessed on www.Savap.Org.Pk

- Indupuru, V. K. (2010), Identification Of Factors Related to Motorcycle Fatal Injuries in Ohio. Master of Science Thesis in Civil Engineering, University Of Dayton; Dayton, Ohio (May 2010).

- Iteke**,** O.**,** Bakare M. O., Agomoh, A. O., Uwakwe, R., **and** Onwukwe, J. U., (2011), Road traffic accidents and posttraumatic stress disorder in an orthopedic setting in south-eastern Nigeria: a controlled study. Retrieved from http://www.sjtrem.com/content/19/1/39 accessed on 19th November, 2012.
- Johnson, S.W. and J. Walker (1996). **―***The Crash Outcome Data Evaluation System (CODES).*‖ Technical Report. National Highway Traffic Safety Administration, United States Department of Transportation, Washington, D.C.

- Labinjo, M, Juillard C, Kobusingye O. C., Hyder, A A, (2009), the burden of road traffic injuries in Nigeria: results of a population-based survey. http//www. injury prevention.bmj.com on December 14, 2012 - Published by group.bmj.com

- Liu, L. and S. Dissanayake (2009). ―Examination of factors affecting crash severity on gravel roads.‖ Paper #09-0512, *Transportation Research Board* 88th Annual Meeting 2009, Washington, D.C.

- Lord D. and Persaud B. N. (2000). "Accident Prediction Models with and Without Trend: Application of the Generalized Estimating Equations (GEE) Procedure", *Transportation Research Board, 79th Annual Meeting*, Washington, D.C.

- N R S C (2011): Road accidents cost more than budget. Retrieved from http://www. ghananews agency. Org accessed in 3rd December 2011

- Obeng M R. (2008): Another look into road accidents in Ghana. Retrieved on 3rd September, 2011 from http://www. modernghana. Com/columnist/the Chronicle.

- Odero W, Garner P., Zwi A. (1997): Road traffic injuries in the developing countries. Comprehensive review of epidemiological studies. Journal of Tropical Medicine and International Health 2(5), 445 – 460.

- O'Hare, D., D. Chalmers, and P. Scuffham (2006). ―Case-control study of risk factors for fatal and non-fatal injury in crashes of rotary-wing aircraft.‖ *Journal of Safety Research*, 37, 293–298

- Peden M, Scurfield R, Sleet D, (2004), world Report on road Traffic injury prevention World Health organization. Retrieved on the 4th December 2011 from http://www.cdc.Gov/ncipc/rohd 2004.Geneva, Switzerland.

- Pierce, Q. and Maunder, P. (1998) Road and Traffic Authority Statistical report "Road Traffic Accidents in NSW-1997" (Motor Accidents Authorities of NSW 1998).
- Pickrell, M.T. and Starnes, M. (2008). ―*An analysis of motorcycle helmet use in fatal crashes*. *National* Highway Traffic Safety Administration, United States Department of Transportation, Washington, D.C.

- Quddus, M.A., Noland, R.B., Chin, H.C. (2002) An Analysis of Motorcycle Injury and Vehicle Damage Severity Using Ordered Probit Models, Journal of Safety Research Vol. 33, 445-462. Retrieved on the 10th October, 2012.

- Rodgers, G.B. (1997). ―*Factors* associated with the crash risk of adult bicyclists.‖ *Journal of Safety Research*, 28, 233-241.

- Sarpong, S (2003); Road accidents on the increase. Retrieved from http://www.newsfromafrica.org/newsfromafrica/articles/art_594.html on 17th december, 2011.

- Smink B. E, et al, (2005) Drug use and the severity of a traffic accident. Accident Analysis and Prevention 37 (2005) 427–433.

- Soderlund, N. and Zwi, A. B. (1995). Traffic-related mortality in industrialized and less developed countries. Bulletin of the World Health Organisation 73 (2), 175-182.

- Wedagama D. M. P. and Dissanayake, D. (2009); The Influence of Accident Related Factors on Road Fatalities Considering Bali Province in Indonesia as a Case Study. Journal of the Eastern Asia Society for Transportation Studies, Vol.8, 2009.

- WHO (2009), GLOBAL STATUS REPORT ON ROAD SAFETY; TIME FOR ACTION.

- WHO, (2009), Pedestrians, cyclists among main road traffic crash victims. Half of 1.27 million people who die in road traffic crashes every year are pedestrians, motorcyclists and cyclists, finds new WHO study. News release accessed on http://www.who.int/mediacentre/news/releases/2009/road_safety_report_20090615/en/index.html. Retrieved on 14th November, 2011.

- World Health Organization (2010), United Nation Decade of Action for Road Safety (2010-2011).

- Yankson, I.K., Browne, E.N.L., Tagbor, H., Donkor, P., Quansah, R., Asare, G.E., Mock, C.N., Ebel, B.E., (2010); Reporting on road traffic injury: content analysis of injuries and prevention opportunities in Ghanaian newspapers. Downloaded from http//www. injury prevention.bmj.com on December 14, 2012 - Published by group.bmj.com

APPENDIX A

Variable description

1. Type of accident
    - Fatal – reported death.
    - Non fatal – no death reported
2. Year of accident
3. Age of driver (at fault)
    - Below 25 years old
    - Above 25 years old
4. Gender of driver (at fault)
    - Male
    - Female
5. Reason for the accident
    - Human error
        - ♦ Excessive speeding
        - ♦ Inattention, confusion of lack of judgment of driver
        - ♦ Drivers careless at road junction and cutting corners
        - ♦ Improperly overtaking or cutting in
        - ♦ Inexperience of driver
        - ♦ Intoxication
        - ♦ Other recklessness or negligence by drivers
        - ♦ Over loading
    - Mechanical fault

- Mechanical defects
- Defective lights
- Dazzling lights

- Obstruction by others
  - Abandon truck on the road
  - Tree or mounting close to the road
- Accidental
  - Falling object on the road
  - Passengers faults
  - Animals not under control

6. Location of accident

- Highway
- Within the city

7. Time of accident

- Morning hours
- Afternoon hours
- Overnight

8. Type of vehicle (at fault)

- Commercial
- Private
- Motorbike

The selected variable for analysis above is coded in the table below.

Table 3.1 variable selected for the study.

No.	Variable Type	Classifications and coding
1.	Accident type	0 = Non-fatal 1 = Fatal
2.	Vehicle type	0 = Commercial 1 = Private 2 = motorbike
3.	Reason for accident	0 = Human error 1 = Mechanical fault 2 = Obstruction by others 3 = Accidental
4.	Accident location	0 = Highway 1 = Within city
5.	Time of accident	0 = Morning hours 1 = Afternoon 2 = Overnight
6.	Gender of driver (at fault)	0 = Male 1 = Female
7.	Age of driver (at fault)	0 = Below 25 years 1 = After 25 years

APPENDIX B

SPSS OUTPUT RESULTS

[DataSet5] C:\Users\AWAL\Documents\dataa.sav

Frequencies

Statistics

		Type of accidents	Age of driver (at fault)	Sex of driver (at fault)
N	Valid	494	494	494
	Missing	0	0	0

Frequency Table

Type of accidents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	non-fatal	291	58.9	58.9	58.9
	fatal	203	41.1	41.1	100.0
	Total	494	100.0	100.0	

Sex of driver (DG) (at fault)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	459	92.9	92.9	92.9
	female	35	7.1	7.1	100.0
	Total	494	100.0	100.0	

Type of accidents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	non-fatal	291	58.9	58.9	58.9
	fatal	203	41.1	41.1	100.0
	Total	494	100.0	100.0	

Reasons for accident

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Human error	377	76.3	76.3	76.3
	Mechanical fault	31	6.3	6.3	82.6
	Obstraction by othes	54	10.9	10.9	93.5
	Accidental	32	6.5	6.5	100.0
	Total	494	100.0	100.0	

Location of accidents (LA)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Highway	284	57.5	57.5	57.5

	within city	210	42.5	42.5	100.0
	Total	494	100.0	100.0	

Time of accident

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	morning hours	151	30.6	30.6	30.6
	afternoon	206	41.7	41.7	72.3
	overnight	137	27.7	27.7	100.0
	Total	494	100.0	100.0	

Type of vehicle (TV) (at fualt)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	commercial	295	59.7	59.7	59.7

private	93	18.8	18.8	78.5
motorbike	106	21.5	21.5	100.0
Total	494	100.0	100.0	

```
LOGISTIC REGRESSION VARIABLES TA
  /METHOD=ENTER Year DA DG Raccident LA Time TV
  /CONTRAST (Year)=Indicator
  /CONTRAST (DA)=Indicator
  /CONTRAST (DG)=Indicator
  /CONTRAST (Raccident)=Indicator
  /CONTRAST (LA)=Indicator
  /CONTRAST (Time)=Indicator
  /CONTRAST (TV)=Indicator
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) CUT(.5).
```

Logistic Regression

[DataSet1] C:\Users\AWAL\Documents\dataa.sav

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	494	100.0
	Missing Cases	0	.0

	Total	494	100.0
Unselected Cases		0	.0
Total		494	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
non-fatal	0
fatal	1

Categorical Variables Codings

		Frequency	Parameter coding (1)	(2)	(3)	(4)
Year of accident	2007	100	1.000	.000	.000	.000
	2008	79	.000	1.000	.000	.000
	2009	117	.000	.000	1.000	.000
	2010	138	.000	.000	.000	1.000
	2011	60	.000	.000	.000	.000
Reasons for accident	Human error	377	1.000	.000	.000	
	Mechanical fault	31	.000	1.000	.000	

	Obstraction by othes	54	.000	.000	1.000
	Accidental	32	.000	.000	.000
Type of vehicle (at fualt)	commercial	295	1.000	.000	
	private	93	.000	1.000	
	motorbike	106	.000	.000	
Time of accident	morning hours	151	1.000	.000	
	afternoon	206	.000	1.000	
	overnight	137	.000	.000	
Age of driver (at fault)	below 25 years	270	1.000		
	above 25 years	224	.000		
Location ofaccidents	Highway	284	1.000		
	within city	210	.000		
Sex of driver (at fault)	male	459	1.000		
	female	35	.000		

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Type of accidents		Percentage Correct
	Observed		non-fatal	fatal	
Step 0	Type of accidents	non-fatal	291	0	100.0
		fatal	203	0	.0

	Overall Percentage	58.9

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.360	.091	15.508	1	.000	.698

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Year	57.415	4	.000
		Year(1)	32.132	1	.000
		Year(2)	9.783	1	.002
		Year(3)	3.020	1	.082
		Year(4)	8.987	1	.003
		DA(1)	2.763	1	.096
		DG(1)	.870	1	.351
		Raccident	42.353	3	.000
		Raccident(1)	11.961	1	.001
		Raccident(2)	9.704	1	.002
		Raccident(3)	12.764	1	.000

	LA(1)	9.086	1	.003
	Time	14.522	2	.001
	Time(1)	14.149	1	.000
	Time(2)	2.575	1	.109
	TV	6.150	2	.046
	TV(1)	.793	1	.373
	TV(2)	1.830	1	.176
Overall Statistics		201.294	14	.000

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	299.137	14	.000
	Block	299.137	14	.000
	Model	299.137	14	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	369.933[a]	.454	.612

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			Type of accidents		Percentage Correct
	Observed		non-fatal	fatal	
Step 1	Type of accidents	non-fatal	264	27	90.7
		fatal	59	144	70.9
	Overall Percentage				82.6

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Year			68.130	4	.000	
	Year(1)	4.194	.782	28.761	1	.000	66.309
	Year(2)	2.492	.736	11.459	1	.001	12.081
	Year(3)	-1.169	.616	3.600	1	.058	.311
	Year(4)	-1.615	.597	7.312	1	.007	.199
	DA(1)	-2.747	.705	15.174	1	.000	.064
	DG(1)	-8.685	1.391	38.974	1	.000	.000
	Raccident			66.908	3	.000	
	Raccident(1)	18.020	2.227	65.468	1	.000	6.698E7

Raccident(2)	14.710	2.065	50.757	1	.000	2447292.397
Raccident(3)	8.745	1.429	37.443	1	.000	6279.688
LA(1)	3.580	1.400	6.538	1	.011	35.866
Time			44.361	2	.000	
Time(1)	1.558	.995	2.452	1	.117	4.747
Time(2)	-2.102	.753	7.800	1	.005	.122
TV			12.480	2	.002	
TV(1)	-4.700	1.339	12.318	1	.000	.009
TV(2)	-.660	.882	.560	1	.454	.517
Constant	-6.278	1.316	22.740	1	.000	.002

a. Variable(s) entered on step 1: Year, DA, DG, Raccident, LA, Time, TV.

APPENDIX C

MONDAY, NOVEMBER 28, 2011

PRICE: GH

Quarter of sex workers HIV positive

Story: Kwame Asare Boadu, Kumasi

TWENTY-FIVE per cent of female sex workers (prostitutes) in the country are HIV positive, a latest survey by the Ghana AIDS Commission has revealed.

The commission has consequently cautioned men against patronising their activities as they face a high risk of infection.

At a media briefing in Kumasi last Friday in connection with this year's national celebration of the World

• Continued on Page 3

• People at the accident scene. INSET: Some of the casualties.

Accident on Tamale-Bolga road

26 PERISH

Story: Zakaria Alhassan, Tamale

TWENTY-SIX persons died in a horrific accident on the Tamale-Bolgatanga highway last Saturday morning.

The deceased included the drivers of the two vehicles and the Upper Regional Correspondent of *The Enquirer* newspaper, Mr Samuel Abaane.

Abaane also stringed for the *Daily Graphic* and the *Graphic Sports* from Tamale and Bolgatanga a few years ago.

The bodies of the deceased have been ed at the morgue of the Tamale Teaching (TTH) that was turned into a scene of m ing and grief by family members and sympath

• Continued on Page 3