



## International Journal OF Engineering Sciences & Management Research

### INVESTIGATION OF PHYSICAL LAWS OF MOTION AND HUMAN FACTORS ON ROAD ACCIDENTS IN UASIN-GISHU AND BUNGOMA COUNTIES - KENYA

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**Keywords:** Risk, Road crashes, Disability adjusted life years; Vehicle factors, Factors influencing exposure to risk, The circadian rhythm , Driver fatigu.

#### ABSTRACT

Road accidents in the Transport Industry are a threat to public health and national development in many developing countries. It contributes to poverty by deaths, injuries, disabilities, grief, lost of productivity and material damages. This study was undertaken at Uasin-Gishu and Bungoma counties, with specific focus on Uasin-Gishu (UGC) County Hospitals, Bungoma County Hospitals, (BCH), Eldoret Police Station, Bungoma Police Station, County's department of Transport / accidents and some road terminus in Uasin-Gishu and Bungoma counties. The study sought to identify risk factors for road accidents in transport industry in the two counties. The research established the effects of Geometry and environmental factors to accident and found the relationship between speed of a vehicle and road accidents by applying power model to estimate the impacts of road accidents, and the implications of physical factors. Physical and human factors on road accidents in two counties were investigated. The results obtained in this study, can be used by the road safety and county authorities for planning and evaluating road safety measures. The methodology and procedure for data collection was based on both qualitative and quantitative approach. Interviews, focus group discussions, observations and review of secondary data, were used in data collection accordingly; some data was subjected to power model to estimate the road accidents effects. The data can be used further by the stakeholders to develop interventions to mitigate road accidents in the Transport Industry. Statistical analyses of data were done by descriptive. Statistics employing the measures of central tendencies, frequency distributions, difference between a set of observed frequencies and a corresponding expected frequency. Research found that up to 38.4% of accidents on monotonous roads in Bungoma and Uasin –Gishu counties were fatigue related. Young male drivers, truck drivers, company car drivers and shift workers were the most at risk of falling asleep while driving. When vehicle was moving at 150km/h and reduced its speed to 140Km/h at accident point the chances of road accident being fatal was reduced to 65.6%. This indicated that chances that the road accident was not fatal were 34%. when the vehicle was moving at 70km/h and reduced to 60km/h at accident point, the number of fatal road accidents was estimated to go down to 48.2% the initial number, corresponding to a reduction of 51.8%.

#### I. INTRODUCTION

Road accidents in transport industry (RCTI) are one of the leading causes of death and disability worldwide. They account for more than 1.2 million deaths—3.6% percent of the global mortality burden (WHO 2009). It is also estimated that in 2004, Road accidents in transport industry injuries (RATIs) contributed to 2.7% percent of the total disability-adjusted life years (DALYs) lost globally, a proportion that is expected to rise to 4.9 percent by the year 2030 and position RCTI s as the third leading contributor to the global burden of disease (WHO,2008).

Risk is the probability of harmful consequences or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. Communities need information both on hazards and their vulnerabilities to determine priorities for reducing their risk (Peden *et al.*, 2004). In developing countries, including Kenya, accidents in the Transport Industry are increasing with time (Anh, e tal, 2008).

When taking the population figures into account, developing countries in Sub-Saharan Africa have the highest frequency of various accidents worldwide (Peden *et al.*, 2004). In this problem of accidents in transport industry, there are many agents.

Many of these roads have “evolved” from the original muram roads, rather than being properly designed for modern motor vehicles. They often contain many sub-standard curves out of character with the surrounding environment, as well as a lack of passing opportunities. Both the motoring public and road authorities have identified these as major concerns that need to be identified and ultimately remedied (MoT, 2006a).

#### A. 1.2 Statement of the Problem

The road accidents in Uasin-Gishu and Bungoma counties are alarming. The major hospitals like Moi teaching and referral hospital (MTRH) and Bungoma district hospital (BDH) have set aside special wards to handle cases of road accidents. This road accident has made many populations who are in their protective stage to be a burden to the society. The families of the victims



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spend money on the medical treatment or sale their properties to meet medical treatment and their up keep. The questions that demand desired answers to these problems are why increase in road accidents in Uasin Gishu and Bungoma counties?

Road accidents in transport industry in Kenya are expected to increase because of increase in number of vehicles on roads; these will result in increased road accidents and fatality rates in these settings (Chandran et al. 2010). Road usage has gone up for every type of vehicle (Wang et al, 2009). Motorcycle use in Kenya has also significantly increased over the last decade. A study conducted in Nairobi showed that in just 3 years, motorcycle registration rose from 4136 in 2004 to 16,293 in 2007 (Nesoba, 2010). The literature review has addressed the major factors that enhance road accidents to take place. The issue of physical, environmental features has not been adequately addressed as reason for these road accidents. The influence of physical laws of motion has not been mentioned as it's likely a main contributor to the road accidents.

Hence this study was set to identify risk factors for road accidents, the impact of geometry and environmental features of the road. The role of physical laws in road accidents and uses the existing models to evaluate the safe road designing models which can reduce road accidents. Therefore this study sought to answer the questions do the speed of a vehicle and risk factors are adequate reasons for perpetual road accidents in Kenya especially in Uasin-Gishu and Bungoma counties?

### Research objectives

- i. To determine risk factors for road accidents in Uasin-Gishu and Bungoma counties
- ii. To determine the relationship between speed of a vehicle and impacts on road accidents

### Research questions

- i. What are the risk factors responsible for road accidents in Uasin-Gishu and Bungoma counties?
- ii. Is there any relationship between speed of a vehicle and the impacts on road accidents?

### Significance

The study will add knowledge to understanding of the relationship of speed of the vehicle and road accidents. The study has identified the risk factors which enhance road accidents in transport industry.

### Scope

The study was conducted in Uasin Gishu County and Bungoma Counties. It focused on roads in Uasin Gishu county, urban roads based in Eldoret Town. It further focused on roads in Bungoma County and the urban roads in Bungoma Town.

## II. LITERATURE REVIEW

### Accidents in transport industry

Accidents in transport industry are usually caused by a number of factors. Accident factors are conditions or actions that accompany accident, whether or not they are determined to have contributed to the occurrence of the accident

This study applied the following bodies of theories in social and behavioral science, system theory, risk theory, political ecology approach, including review of literature. The geographical approach will concern with time factor, spatial variation and regional distribution was used in the study. One of the main problems of road safety evaluation research presented by (Elvik Rune,2002) in a paper titled "To what extent can theory account for the findings of road safety evaluation studies?" shows that most research on road safety does not have a strong theoretical basis, which guides the design of the studies and interpretation of such findings. According to Rune Elvik, Rune (2002), lack of a strong theoretical base for research which also means that few results of road safety evaluation studies can be ruled out on theoretical bases (Elvik, Rune, 2002).

### Overview of the road accidents

The road accidents in transport industry are a global health problem and its magnitude is worrying in both the developed and developing world (WHO, 2010a). Approximately 3,300 lives are lost everyday due to road accidents globally, with an estimated 20-50 million of people sustaining injuries annually (WHO, 2010b). The injuries sustained in transport industry are the leading killer of the most economically productive group who are in age bracket of 15years to 25 years, in the world (WHO, 2008).

### System of traffic laws, control and regulations.

The development of traffic law is the duty of the government. The aim of traffic regulation systems and enforcement is to ensure adequate operations in the traffic environment and system maintenance by legislation and controls. In the study of (Al-Haji, e tal 2007) observed that, traffic regulation schemes are not systematically implemented and the police service is generally less well trained, equipped and motivated to enforce moving violations, as are evident in cities in developed countries.

### Driving Behaviour

According to Turner,et al, (2004), behaviour is an intrinsic part of human being. Individuals in a unique environment like Delhi, possess' different population characteristics like age, sex, education and training (Thompson, et al 2009). Also their risk taking



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behaviour differs and this may be attributed to the population characteristics as stated above, their cultural precepts, the economic base, the social norms, in the environment they live and their individual psychology, cultural practices, roles and their mobility (Rundmo, et al, (2004). The study looked at incompetence of drivers and medical health of the drivers whose conditions can result to road accidents but this study looked at social and technological factors that are main players in road accidents.

### Speed of vehicles

Mergia et al., 2013 observed that speeding is one of the factors that contribute to motor vehicle traffic accidents and fatalities. According to, Peng and Boyle, (2012) observed that statistics show that in 2011, speeding was a contributing factor in 30% of all fatal accidents in the United States where 9,944 (31%) fatalities resulted due to speeding-related motor vehicle traffic accidents .

### The age and gender of the driver

The age of the driver is also an important factor contributing to occurrence of road accidents. The study shows that drivers who are in their adolescent stage are frequently involved in road accidents than other age groups (Bjornskau, 2000). A study by Mergia et al. (2013) found that Vehicles driven by male drivers have a higher probability of being involved in road accidents than vehicles driven by female drivers and they found that (using the 2006-2009 Ohio database found that females as vehicle occupants or drivers or passengers, have more chances of sustaining severe injuries than males when involved in traffic accident

### Relationship between speed and road accidents

In Australian Transport Safety Bureau, (2001), in their study of relationship between speed and road safety, observed that early studies suggested that variance above and below the mean speed of the traffic was the critical factor in using speed related accidents.

### The Power Model

The Göran Nilsson presented the Power model in his study as follows;

The studies evaluating the effects of these changes found that the percentage change of the number of injury accidents was proportional to the square of the relative speed change. This applied both to increases and decreases in mean speed (Nilsson, 2004A)

The Power model is then presented in equations 1 to 6 below:

$$\text{Number of fatal road accidents} = Y_1 = \left\{ \frac{V_1}{V_0} \right\}^4 Y_0 \quad (1)$$

$$\text{Number of fatalities} = Z_1 = \left\{ \frac{V_1}{V_0} \right\}^4 Y_0 + \left\{ \frac{V_1}{V_0} \right\}^8 (Z_0 - Y_0) \quad (2)$$

$$\text{Number of fatal and serious injury accidents} = Y_1 = \left\{ \frac{V_1}{V_0} \right\}^3 Y_0 \quad (3)$$

$$\text{Number of fatal or serious injuries} = Z_1 = \left\{ \frac{V_1}{V_0} \right\}^3 Y_0 + \left\{ \frac{V_1}{V_0} \right\}^6 (Z_0 - Y_0) \quad (4)$$

$$\text{Number of injury accidents (all)} = Y_1 = \left\{ \frac{V_1}{V_0} \right\}^2 Y_0 \quad (5)$$

$$\text{Number of injured road users (all)} = Z_1 = \left\{ \frac{V_1}{V_0} \right\}^2 Y_0 + \left\{ \frac{V_1}{V_0} \right\}^4 (Z_0 - Y_0) \quad (6)$$

The model can be looked in terms of six equations that relate changes in the number of accidents or in the number of road users killed or injured in accidents to changes in the mean speed of traffic. Denote speed by V, accidents by Y, and accident victims by Z. Furthermore, subscript by 0 the values observed before a change in mean speed and by 1 the values observed after a change in mean speed.

## III. MATERIALS AND METHODS

### Study site

#### Uasin Gishu County

Uasin Gishu County is a county in the rift valley province of Kenya. It has a total of 894,179; 202291. Households and covers an area of 3, 3452, SQ.KM. The population density is 267Q KM and 50% of the population lives below the poverty line (Kenya Mpya, 2012).

#### Bungoma County

Bungoma County is a county in the former Western Province of Kenya. It has a Total Population of 1,375,063 and covers an area of 3,032.2 square KM. The Population density is 453.5 people per Square. KM and 53% of the population lives below the poverty line (Sindani, 2011).

### Study population

The targeted population for the study Comprised, Four wheeled Vehicles drivers (PSV), Two wheeled vehicles(PSV) drivers, Pedestrians in Uasin-Gishu and Bungoma Counties, Victims of accidents in hospitals facilities in Uasin Gishu county (HF in Eldoret) and Hospital facilities in Bungoma county (Health facilities in Bungoma). Health workers at Health facilities in Uasin Gishu, and Bungoma traffic police officers, and Major driving schools in Uasin-Gishu and Bungoma counties.



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### Research Designs

The study employed survey, correctional and summative evaluation research designs. This enabled the researcher to collect both qualitative and quantitative data. Research Design as per the specific objectives as shown in table 1 below:

### Sampling Strategy

Multi-stage sample size was determined by use of Fisher's (2004) formula for selecting the respondents at household level. The formula was selected because it was reliable, efficient and flexible and ensured representatives.

$$N = z^2 \frac{pq}{d^2}$$

1

When n=minimum sample size to maximize precision of estimate

Z=the standard normal deviate  $\alpha=5\%$  which corresponds to 95% confidential level

P= proportion of rural uses with defined characteristics under study in Uasin Gishu county and Bungoma county.

Q=1-p

D=degree of accuracy, 0.05

### Data collection

#### Primary Data

The primary data was obtained by Interview with key informers, questionnaires, observation and focus group. In the process of understanding risk factors that contribute to accidents in Transport industry at Uasin-Gishu and Bungoma Counties, the unit of analysis for an in-depth understanding of life experience of accident victims in relation to safety measures undertaken by the Uasin-Gishu and Bungoma Counties authority to improve health and system risks in their respective counties.

#### Secondary Data

In the study the secondary source of data which were collected in the field is the review of hospital records of patients admitted to the hospital as accident victims of all accidents happened in Uasin-Gishu and Bungoma counties from 2008 to 20013, Accidents records from the traffic police officers in Uasin-Gishu and Bungoma traffic police offices and Accidents records from departments of Uasin-Gishu and Bungoma Counties. The method involved the search of information in records, published books, journals, maps, dissertation, newspapers as well as available government policy document.

- **Study inclusion criteria:**

To be included in the meta-analysis, a study had to provide the following information:

- Mean speed before the adoption of a measure affecting speed
- Mean speed after the adoption of a measure affecting speed
- The number of accidents, or accident victims, by severity, before the adoption of a measure affecting speed
- The number of accidents, or accident victims, by severity, after the adoption of a measure affecting speed
- An identification of the measure which was introduced

- **Police Fatal Accident Reports**

The database comprises of police fatal road accident reports and detailed information in addition to that available from accident database.

The database contains information on:

- Causation factors,
- details of the vehicles involved (and the impacts they experienced), and
- Details of occupant injuries (much of which is based on post-mortem reports).

### Reliability and validity of Data instruments

The data were generated from both primary and secondary sources. For primary data, questionnaires, Interview schedules and focus group discussion were used. The data were recorded and tabulated in tables for analysis.

#### Validity

To test the validity of the instrument, pilot studies were conducted in 50 motor vehicles psv and 40 road users. The aim of a pilot study was to assess the clarity of the wording of the questionnaires, interview schedule, focus group discussion guide and observation check list and items which failed to meet the anticipated data were discarded. A pilot study is important in testing the validity of the instruments and clarity of language (Mugenda and Mungenda, 1999).

#### Reliability

To test the reliability of instruments the researcher was used the test re-test method. Test re-test reliability was used to establish the correlation co-efficient. The reliability was ascertained by first assigning values to the items in the questionnaires for purposes after it had been administered. The items were split into two equal halves using odd versus even plan. The reliability co-efficient for the half items were estimated using the Pearson product correlation formula. To obtain the self-correlation of the whole questionnaire using the reliability of the half, an estimate were made using spearman Brown prophesy formula.

**Data analysis processes**

The Kenya traffic police department routinely collects data on road traffic patterns, injuries, and fatalities. The researcher requested data from 2008 to 2013 to be made available for the study. These data provide information on the number of road traffic accidents, injuries, and fatalities at the national and provincial levels especially in Uasin-Gishu and Bungoma Counties in Kenya, as well as the type of road users involved in road traffic accidents. Additionally, data from Kenya’s death registration system were made available to the researcher and providing a count of all registered traffic deaths in the country for the year 2008-2013. Using these data and population estimates from 2008 to 2013, the rates of accidents, injuries, and fatalities were calculated. The number of events that occurred during the study period was assumed to follow a Poisson distribution. A Poisson regression model was used to analyze trends of injuries and fatalities over the 6 years. Data were managed and analyzed using STATA (Stata Corp, 2009) and MS Excel.

**Limitations of the study**

The field work came under some constraints such as

- i. The recording system of road traffic accidents in Health facilities in Uasin Gishu and Bungoma Health counties were expected to be good; some of the information were missing especially those pertaining to referred cases.  
Solutions: Used interview approach to obtain the data
- ii. Those who were not seriously injured and decided to go away without reporting at ay police station or hospital their records Were not be found.

**Assumptions.**

The research considered the following assumptions:

- i. It was assumed that the records at hospitals were available.
- ii. The traffic police were to avail the data as required.
- iii. The target motors drivers and pedestrians were cooperative in giving the data

The drivers of private and PSV vehicles both Two and four wheel were to be cooperative

**IV. RESULTS**

**Age of the drivers and accidents**

It was found that 38.5% of sleep related accidents involved drivers aged 25 years or younger, with the peak age being 20 years. The study has identified three main risk groups among drivers: male drivers aged 16 - 29 years, shift workers, people with sleep problems, People on medicines/drunks

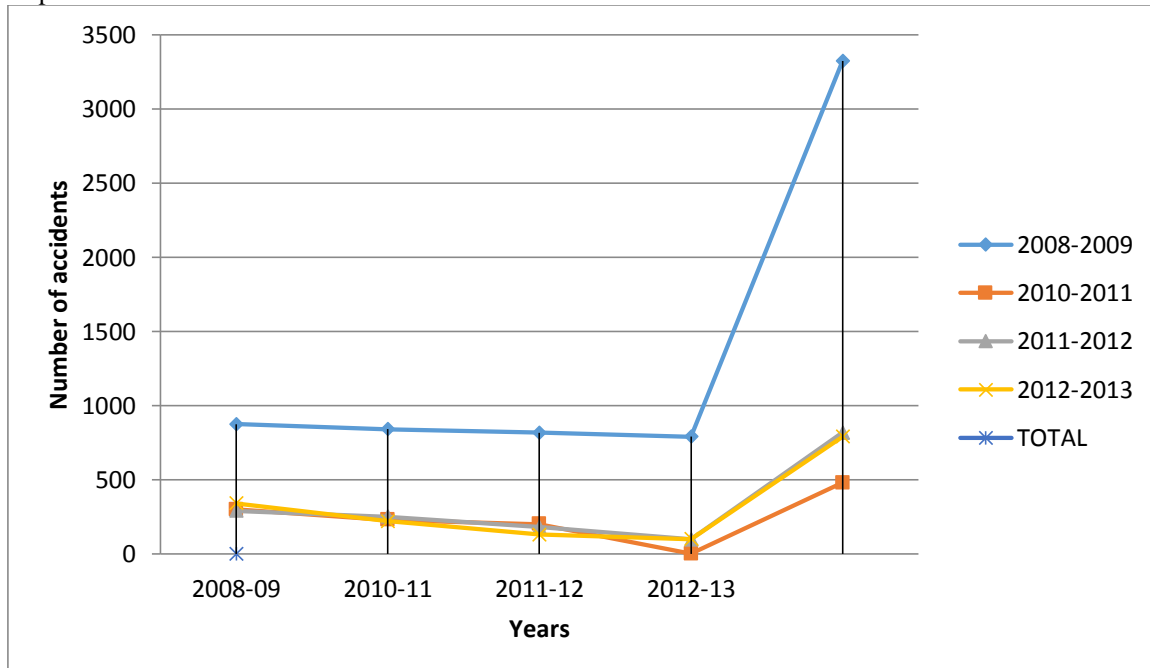


Figure 4.1 Age of drivers and accidents five years

**Main risk factors for road accidents in UGC & BC**

It was found that the main risk factors for road accidents in Uasin Gishu and Bungoma counties were; drivers age, Shift workers, people with sleep problems, people on medicines and truck

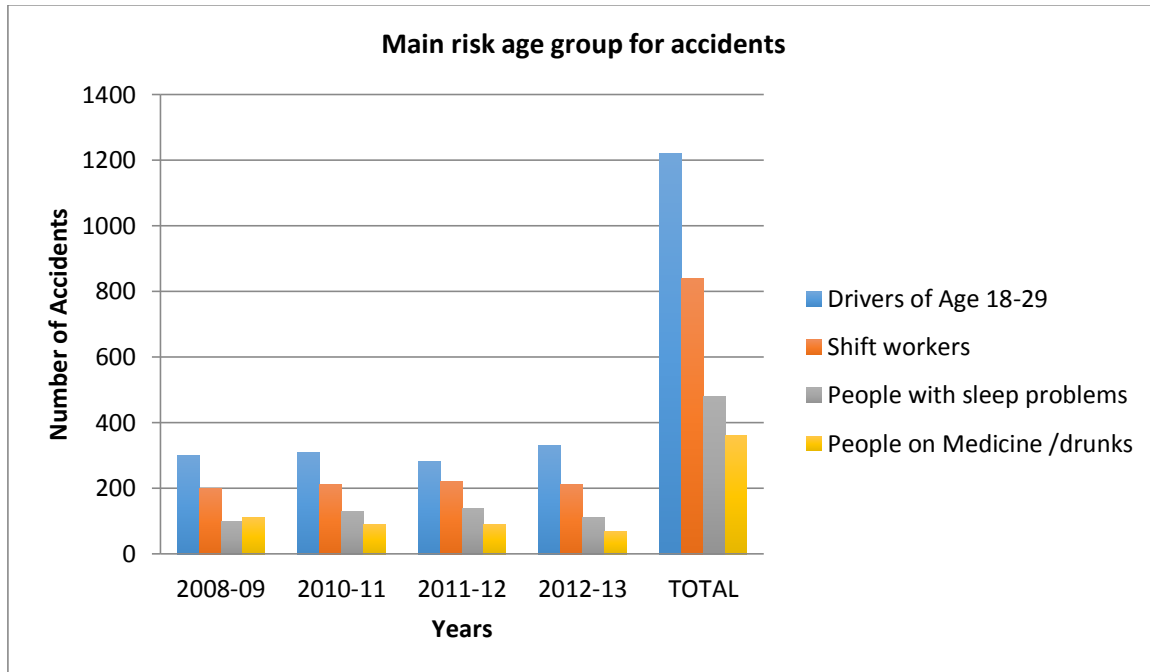


Figure 4.2 Main risk age group for accidents

**Time of Day of accidents**

Sleep related road accidents peak in the early hours of the morning, between 2:00 and 6:00 am, and in the mid afternoon, between 3:00 and 4:00 pm, due mainly to circadian rhythms. The study has shown that drivers are 50 times more likely to fall asleep at the wheel at 2:00 am than at 10:00 am.

The risk is three times as great between 3:00 - 4:00 pm than at 10:00 am

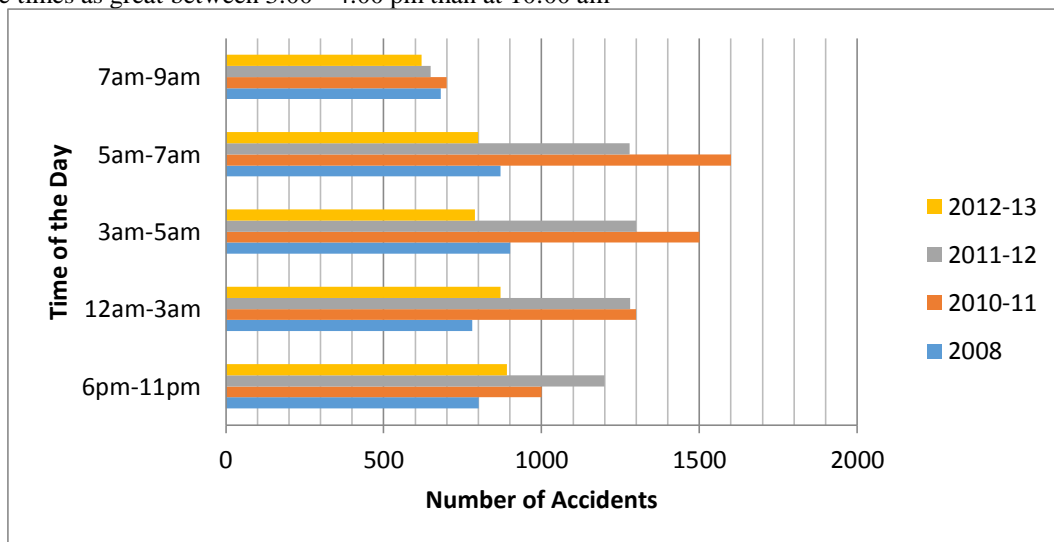


Figure 4. 3 Time of day accidents

**Drivers’ tactics to avoid falling asleep**

Given that drivers are usually aware that they are feeling sleepy, many employ a range of strategies to help themselves fight sleep and to stay awake

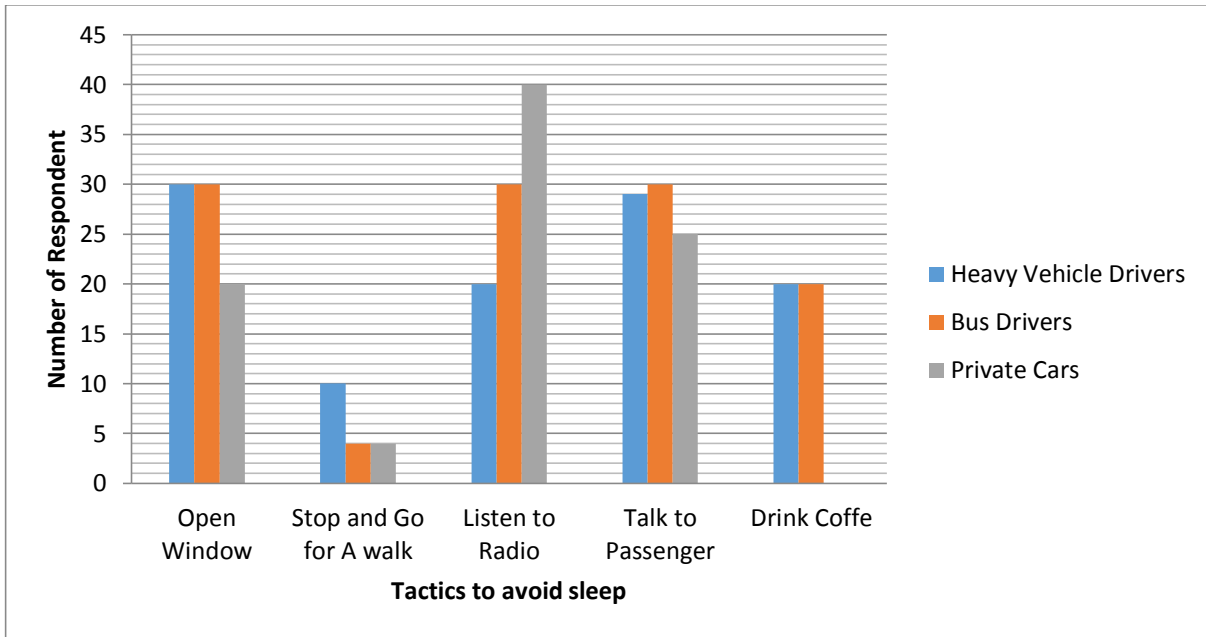


Figure 4.5 Drivers’ Tactics to Avoid Falling Asleep

**(a) Listening to the Radio**

Drivers who had been restricted to five hours sleep the night before drove on a driving simulator for 2.5 hours on monotonous roads. Listening to the radio had no significant effect in reducing sleepiness or in reducing ‘incidents’ (i.e. drifting out of lane), other than for an initial, very short, 10 to 15 minutes.

**Factors influencing exposure to road accident risks**

In road traffic, risk is a function of four elements. The first is the exposure – the amount of movement or travel within the system by different users or a given population density. The second is the underlying probability of an accident, given a particular exposure. The third is the probability of injury, given accident. The fourth element is the outcome of injury. Economic factors, including social deprivation Demographic factors Land use planning practices which influence the length of a trip or travel mode choice Mixture of high-speed motorized traffic with vulnerable road users

Insufficient attention to integration of road function with decisions about speed limits, road layout and design.

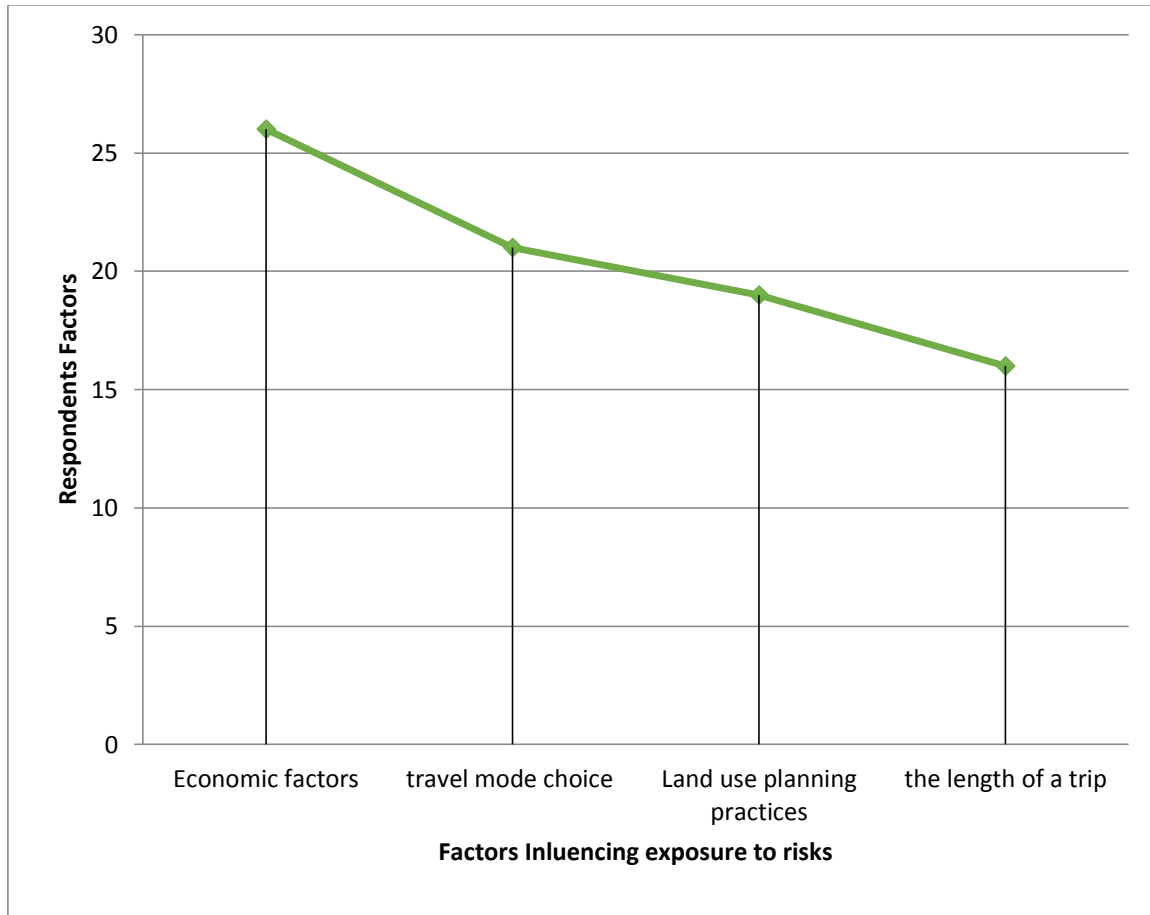


Figure 4.8: Factors influencing exposure to risk

Basing on three focus group about their opinion on Factors influencing exposure to risk

Economic factors: 26/30 =87% had the opinion that economic factors influence exposure to road accident. Travel mode choice Mixture of high-speed motorized traffic: 21/30 =70% had the opinion that travel mode of travel, high speed motorized are key to exposure to road accidents. Land use planning practices: 63% held the opinion that land use planning are responsible for road accidents.

The length of a trip: 53% had the opinion that the length of the a trip are responsible for road accidents

**Risk factors influencing accident severity:**

- i. Human tolerance factors: 80% had the opinion that human tolerance is one of the factors that influencing accident severity
- ii. Excessive speed: 86% had the opinion that Excessive speed is one of the factors that influencing accident severity
- iii. belts and child restraints not used: 67% had the opinion that belts and child restraints not used is one of the factors that influencing accident severity
- iv. Accident helmets not worn by users of two-wheeled vehicles: 90% had the opinion that Accident helmets not worn by users of two-wheeled vehicles is one of the factors that influencing accident severity:
- v. Roadside objects not accident protective: 60% had the opinion that Roadside objects not accident protective is one of the factors that influencing accident severity
- vi. Insufficient vehicle accident protection for occupants: 67% had the opinion that Insufficient vehicle accident protection for occupants is one of the factors that influencing accident severity
- vii. Those hit by vehicles Presence of alcohol and other drugs: 60% of had the opinion that those hit by vehicles Presence of alcohol and other drugs: is one of the factors that influencing accident severity

**Risk factors influencing severity of post-accident injuries**

Delay in detecting accident Presence of fire resulting from collision Leakage of hazardous materials Presence of alcohol and other drugs Difficulty rescuing and extracting people from vehicles Difficulty evacuating people from buses and coaches involved in accident Lack of appropriate pre-hospital care Lack of appropriate care in the hospital emergency rooms.



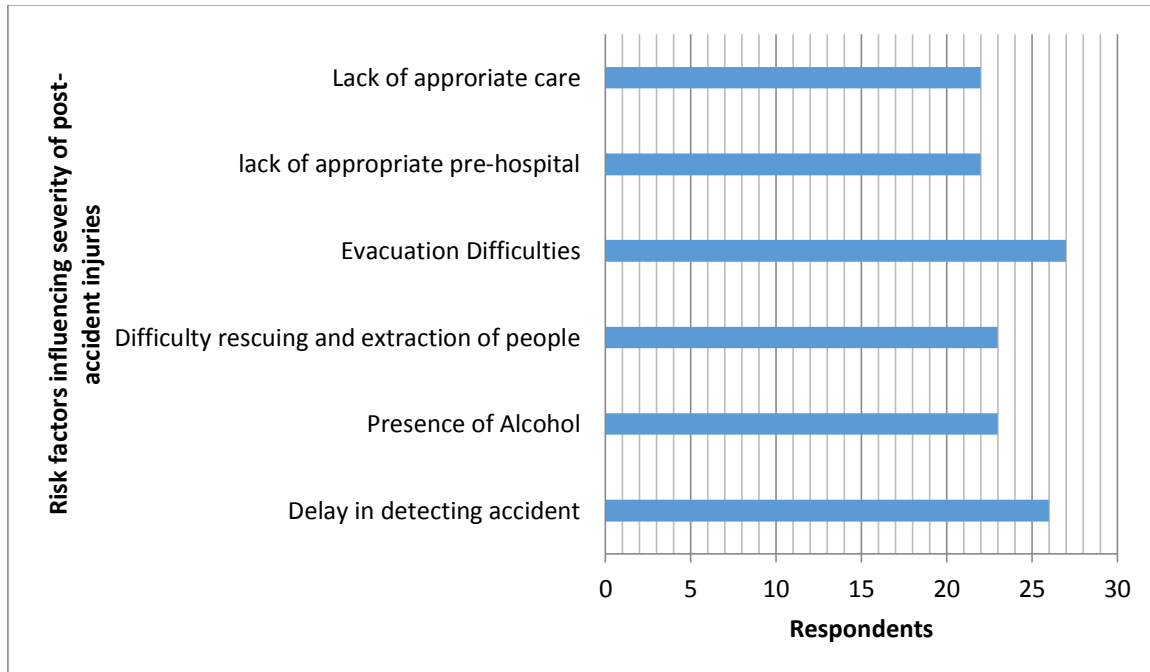


Figure 4.10 Risk factors influencing severity of post-accident injuries

**The Relationship between Speed of a Vehicle and impacts of road accidents**

**Introduction**

The background of the model comes from the various changes in the speed limits, which were derived from data collected from the field both from secondary data and primary in Bungoma and Uasin Gishu counties- Kenya. In the study, evaluating the impacts of these changes of speed was found that the percentage change of the number of injury road accidents was proportional to the square of the relative speed change. This was seen applied both to increases and decreases in mean speed. The model was put in terms of six equations that relate changes in the number of Road accidents Road users killed Injured in a road accident to changes in the mean speed of vehicle.

**Estimating Fatal Road Accidents Using Power Model Equation  $e^4$**

Fatal road accidents =  $(V_1 / V_0)^4 = e^4$

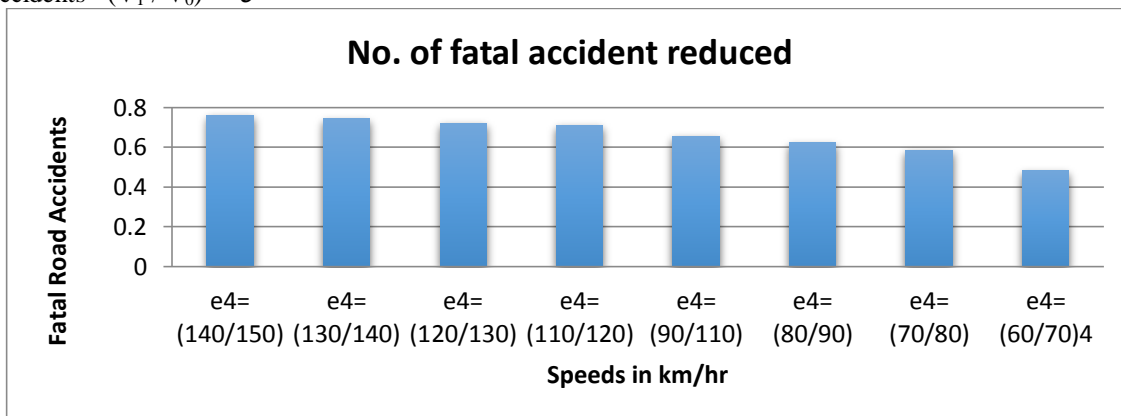


Figure: 4.20 Estimating Fatal Road Accidents  $e^4$

Speed after and before accidents

**Interpretation:**

If speed is reduced from 150 km/h to 140 km/h, the ratio speed after/speed before equals  $(140/150)^4 = 0.656$ . This means that the number of fatal road accidents is estimated to go down to 0.656 times the initial number, corresponding to a reduction of **34.4%**

Whereas when the vehicle is moving at 70km/h and reduced to 60km/h at accident point, this means that the number of fatal road accidents is estimated to go down to **48.2%** the initial number, corresponding to a reduction of **51.8%**.

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Interpretations; Therefore if the vehicle is moving at 150km/h and reduces its speed to 140km/h at accident point the chances of road accident being fatal road accidents is reduced to **65.6%**. This shows that chances that the road accident will not be fatal is **34%**.

Whereas when the vehicle is moving at 70km/h and reduced to 60km/h at accident point, this means that the number of fatal road accidents is estimated to go down to 48.2% the initial number, corresponding to a reduction of **51.8%**.

A chi-square test of independent conducted on the response indicated that there was a highly significant  $p > 0.05$ , association ( $\chi^2_{5.0123} = 10.245$ .) between the speed of the vehicle and the number of accidents on the roads. This indicated that the leading source of accidents on roads is over speeding of the vehicles. The result therefore shows that there is relationship between speed of a vehicle and effects on road accidents.

### Estimating Fatal Road Accidents Using Power Model Equation $y_1 = e^4 y_0$

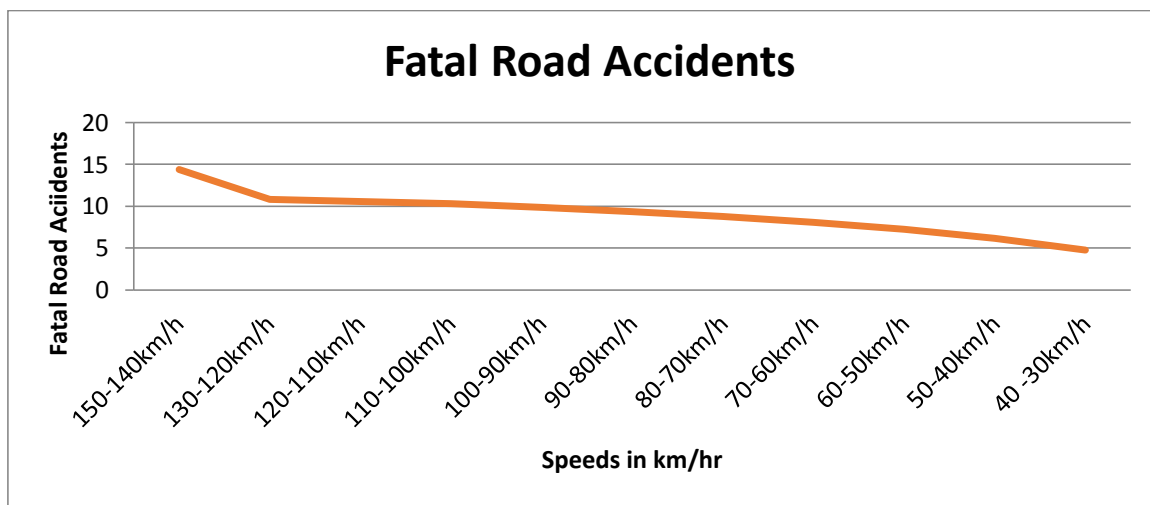


Figure 4.21 Fatal Road accidents

If speed is reduced from 150 km/h to 140 km/h, the ratio speed after/speed before equals  $(140/150)^4 = 0.76$ . This means that the number of fatal road accidents is estimated to go down to 76% times the initial number, corresponding to a reduction of 24%.

But the estimated number of fatal road accidents considering Value observed before change of mean accidents =  $Y_0$  as 15, is 11.4. This means that 11.4 accidents will be fatal. Whereas if speed of a vehicle is reduced from 40km/h to 30km/h,  $(30/40)^4 = 0.320 \times 15 = 4.7$ . This means that the number of fatal road accidents is estimated to go down to 4.7. This corresponding to a reduction of 68.4%.

### Interpretation of the findings:

Interpretation is when a vehicle moving at speed of 150km/h and reduced to 140km/h at point of accident, the percentage of accident being fatal is 76% and only 24% chances that it will not be fatal.

When a vehicle is moving at speed of 40km/h and reduced to 30km/h at point of accident, the percentage of accidents being fatal is 32% and only 68.4% of accidents will not be fatal.

The higher the speed of a vehicle the higher the fatality

### Accident victims

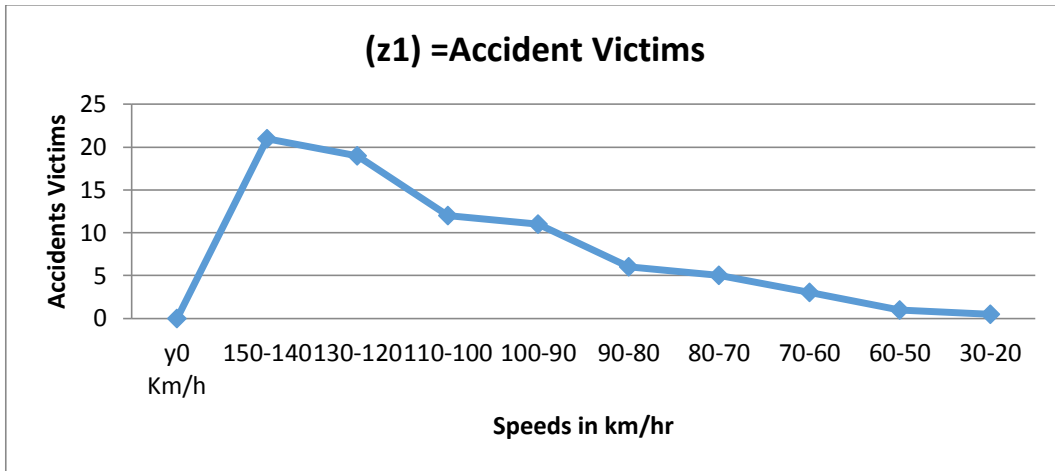


Figure 4.22 Values of (Z<sub>1</sub>) accident victims

(a) Interpretations;

When vehicle is carrying 30 people and is moving at speed of 150km/h and reduce it to 140km/h in case of road accident environment, the chances of people fatally injured is 21. And when at a speed of 70km/h and reduces to 50.

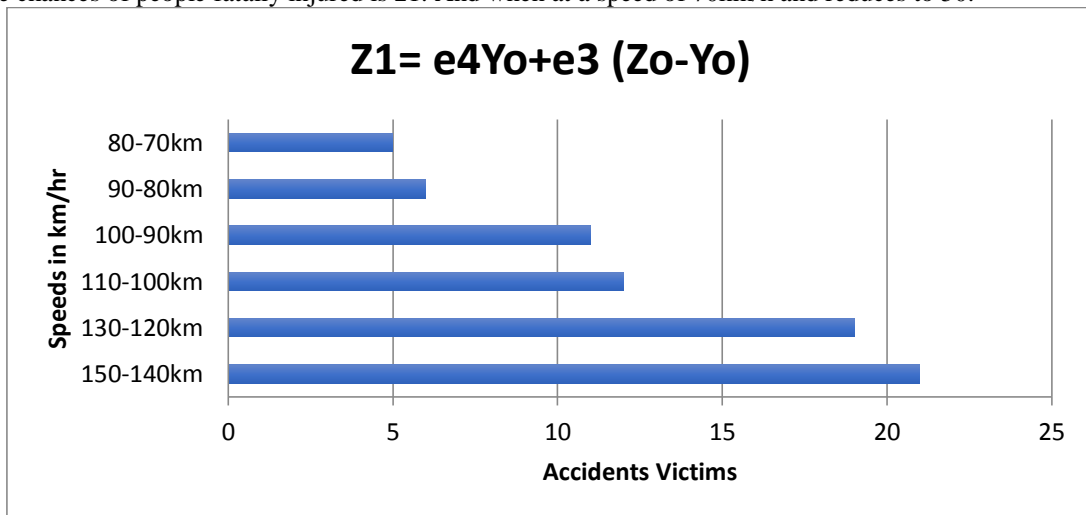


Figure 4.23 Accidents Victims

Z<sub>1</sub> =accident victims

When accident occurs the numbers of people fatally injured are 3.

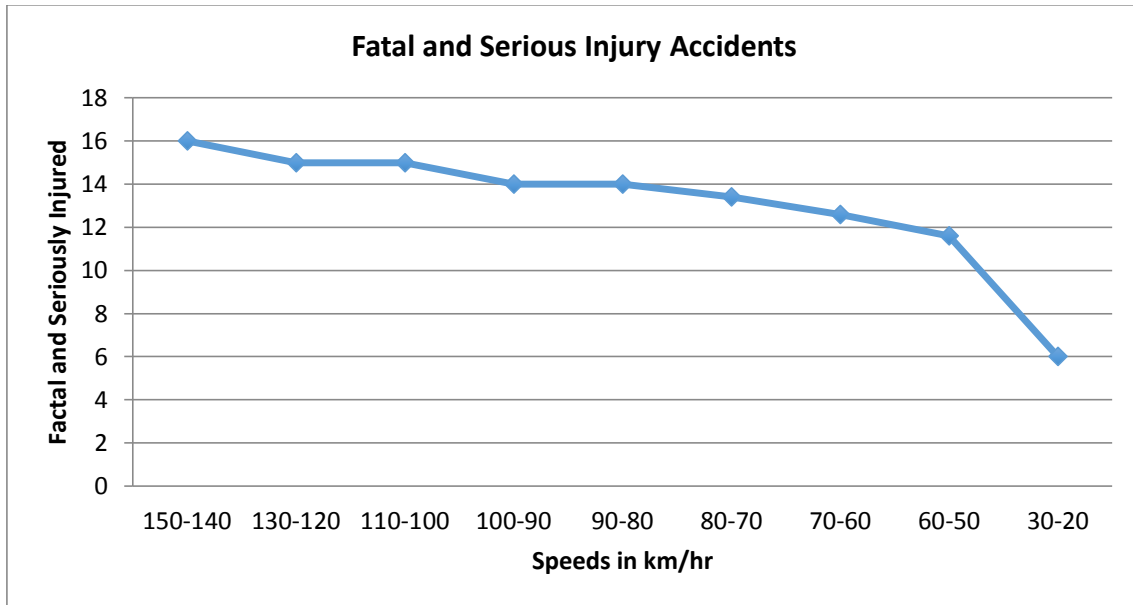


Figure 4.24 Fatal and Serious Injury Accidents

**Accident victims**

Data presentation and analysis Number of fatal and serious injury accidents =  $z_1$

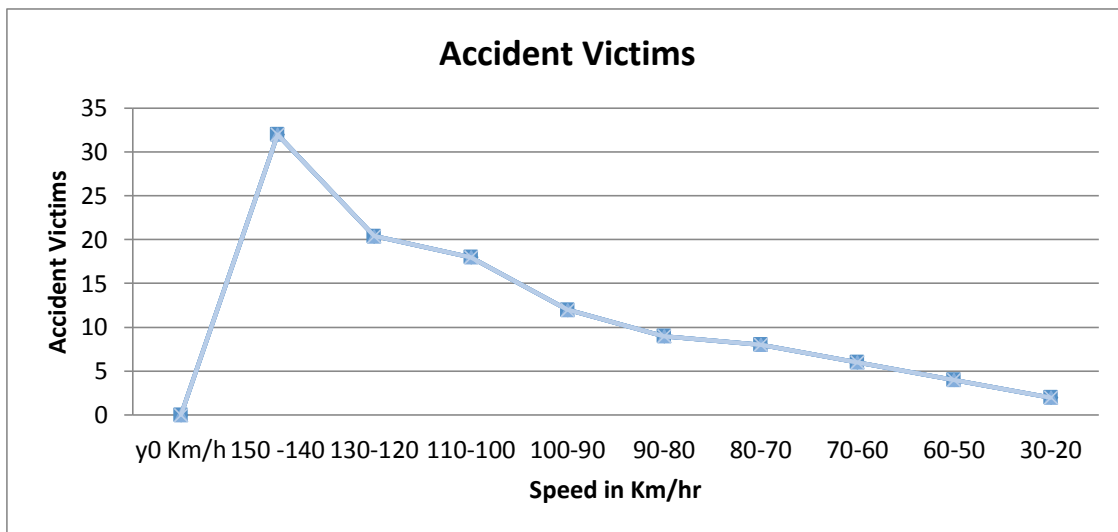


Figure 4.25 Accidents Victims

From Table 4.27 these results show that there is a strong statistical association between speed and road safety. As an example, it can be estimated that a 10.7 percent reduction in the mean speed of traffic will result in a 15 reduction of the number of fatalities. The results show the statistical relationship between speed and road safety. The study concludes that the relationship is indeed causal. There is a relationship between speed of the vehicle and road accidents

This is based on the following reasoning:

- i. There is a very strong statistical relationship between speed and road safety. It is a major risk factor and its powerful impact on road accidents or injuries.
- ii. The statistical relationship between speed and road safety is very consistent. When speed goes down, the number of road accidents or injured road users also goes down in 95% of the cases. When speed goes up, the number of road accidents or injured road users goes up in 71% of the cases. Whereas it may be to some extent be possible to offset the impacts of higher speed by introducing other road safety measures, a reduction in speed will almost always improve road safety.
- iii. The causal direction between speed and road safety is clear. Most of the evidence reviewed in this study comes from before-and-after studies, in which there can be no doubt about the fact that the cause comes before the effect in time.



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- iv. There is a clear close-response relationship between changes in speed and changes in road safety. The larger the change in speed, the larger the impact on road accidents or accident road victims

The relationship between speed and road safety can be explained in terms of basic laws of physical laws of motion. The physical laws motion enhances the determination of the stopping distance of a vehicle and the amount of energy released when an impact occurs. Indeed basing on this objective of the study is that there is a law-like and causal relationship between speed and road accidents and the effects.

### V. CONCLUSIONS

#### Risk Factors for Road Accidents

Driver fatigue is a serious problem resulting in many thousands of road accidents each year. The research suggests that up to 38.4 of accidents on monotonous roads in Bungoma and Uasin –Gishu counties are fatigue related.

Young male drivers, truck drivers, company car drivers and shift workers are the most at risk of falling asleep while driving. However, any driver travelling long distances or when they are tired is at risk of a sleep related accident. The early hours of the morning and the middle of the afternoon are the peak times for fatigue accidents, and long journeys on monotonous roads, particularly motorways, are the most likely to result in a driver falling asleep.

A power function is a mathematical function that relates two variables to each other by raising values of one of the variables to a power in order to obtain values for the other variable. Therefore there is relationship between speed of a vehicle and effects on road accidents.

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