FACTORS CONTRIBUTING TO MOTOR VEHICLE ACCIDENTS AND SEVERITY OF RELATED INJURIES IN OSHANA REGION, NAMIBIA

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ABSTRACT

Motor Vehicle Accidents (MVAs) are one of the leading causes of death and disability in the world. Namibia is one of the countries with the highest MVAs fatality rate, 23.9/100 000. According to the World Health Organization (WHO), 1.25 million people die every year due to MVAs. Despite having a well-developed road network, MVAs are the third highest cause of death in Namibia. This study was conducted in the Oshana Region, Namibia to determine the factors contributing to MVAs and the classification of the severity of related injuries, to analyze them and to help inform plans to develop preventative measures.

A secondary data set was used to conduct a descriptive analytical cross-sectional study. Data on all accidents reported in the region from 2013 to 2015 were captured. Data were collected from the hard-copy files archived in the Traffic Law Enforcement department of the Oshana Regional Police station.

The study included 5296 MVAs. Of all passengers and drivers in MVAs, 86% (n=6544) were male and 14 % (n=1072) female. Furthermore, most accidents had occurred between 12h00 and 18h00. The mean age of drivers and passengers involved in accidents was identified as 38 years. A risk of serious injuries was found to be in accidents which had happened between 12H00 and 18h00, OR 1.23 (95% CI, 1.00, 1.51) P= 0.047 and risk of fatalities between 24H00 and 06H00, OR2.76 (95% CI, 1.65, 4.61) P= 0.005.

Upon reviewing the factors of MVAs, we identified that accidents are more common in the middle age group, (15 to 45 years of age). The severity of injuries increases, among

others, not having road safety awareness and not abiding by road safety rules and driving under the influence of alcohol. This study concluded that human attitudes and people between 15-45 years of age caused more MVA's, while light delivery vehicles and sedan motors were mostly involved in MVA's. It was further concluded that fatalities and serious injuries in MVAs were differently distributed among the contributing factors investigated in this study.

This study recommends road safety awareness among road all users especially drivers as well as passengers aged between 15 to 45 years.

Key words: Motor Vehicle Accidents, factors, Severity, Oshana Region

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ABBREVIATIONS AND ACRONYMS

AFDB	African Development Bank
CDC	Centers for Disease Control and Prevention
CRTS	China Road Traffic Safety
LOMP	Low Officer for Michael Pan
MOHSS	Ministry of Health and Social Services
MRTH	Ministry of Roads Transport and Highways in India
MRC	Medical Research Council
MVA	Motor Vehicle Accident
MVAF	Motor Vehicle Accidents Fund
NRSC	National Road Safety Council
WHO	World Health Organization

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DEDICATION

This thesis is dedicated to my lovely wife, Paulina Nangolo, my son Silas Maudaneko Nghishihange and daughter Sharon Magano Nghishihange. Let my achievements be your achievements and my hard work inspire you to work hard too.

DECLARATION

I, **Silas Nghishihange**, hereby declare that this study is a true reflection of my own research and that this work, or part of thereof, has not been submitted for a degree at any institute of higher education.

Silas Nghishihange: ……

Date: …….

CHAPTER ONE

ORIENTATION OF THE STUDY

1.1 Introduction and background information

Motor Vehicle Accidents (MVAs) occur when a motor vehicle collides with another vehicle, pedestrian, animal, road debris or other geographical obstacle (MOHSS, 2011). MVAs are also known as motor vehicle collisions, car accidents or car crashes. Motor Vehicle Accidents are defined as an unintended collision of one motor vehicle with another, a stationary object, or person, resulting in injuries, death and/or loss of property (Farlex, 2012).

MVAs are among the top ten leading causes of death and disability in the world. According to the World Health Organization (WHO, 2015), the total number of road traffic deaths remains unacceptably high at 1.2 million per year. About 3 400 people die every day worldwide as a result of motor vehicle accidents, of which 186 300 are under 18 years of age (WHO, 2013). MVAs death rate is three times higher in African countries than in the developed world (WHO, 2013). Therefore, MVAs can be seen as having an international, regional and national influence on societies and economies.

The African region is the least motorized of the six world regions, but suffers the highest rates of road traffic fatalities, with 37 of 44 surveyed countries having death rates above the global average of 18.0 deaths per 100 000 population (WHO, 2013). The regional average death rate is 24.1 deaths per 100 000 population, but for the 19

countries in the middle-income category, covering 44% of the region's population, the death rate is 27.8 deaths per 100 000 population (WHO, 2013).

This figure is higher than the global average for middle-income countries which is 20.1 deaths per 100 000 population (WHO, 2013). According to the Ministry of Health and Social Services of Namibia, the African region has the highest fatality for Motor Vehicle Accidents namely 32/100 000 population (MOHSS, 2011).

The Southern African Development Community (SADC) has a global burden of approximately 1.2 million fatalities and 20 - 50 million non-fatal traffic related injuries that happen annually (Ban, 2001). Zimbabwe, a southern African country, is losing its productive citizens at an alarming rate, due to road accidents. Figures released by the Zimbabwe Republic Police early this year show that Zimbabwe's roads have become death traps with an average of 2 000 people dying each year on the roads (Lazarus, 2016). The statistics also revealed that 130 people lost their lives in 345 accidents in Zimbabwe during the midyear festive season alone (Lazarus, 2016).

Deaths from road traffic accidents in Angola are worse. MVAs caused 6,684 or 2.41% of total deaths in the country. With regards to the MVA death rate, Angola is ranked number ten in the world, with a death rate of 34, 96/100 000 (WHO, 2015).

In Namibia, also in the SADC region, car crashes have killed 307 people between 1 January and 12 June 2015 (Lazarus, 2016). The annual death toll on Namibian roads continues to rise year after year, with 4 210 MVAs in 2015. These MVAs claimed 702 lives of mainly young men under the age of 36, while an overall of 7 333 people were

injured (Lazarus, 2016). Pedestrians were a major feature in MVAs in Namibia, accounting for 907 of the recorded MVAs in 2015 (Lazarus, 2016). Most MVAs take place over weekends especially night driving which is a growing concern in Namibia (Lazarus, 2016). A total of 47% of all recorded MVAs in 2015 took place between 16h00 and midnight. Lazarus (2016) further stated that of all fatalities which occurred in Namibia between January and June year 2015, 50% were caused by MVAs.
The fatality rate for MVAs in Namibia was 14/100 000 in the year 2007 (MOHSS, 2011). Despite efforts by the National Road Safety Council of Namibia (NRSC) to reduce and prevent MVAs, 2 249 people died in car accidents between 2002 - 2009 in Namibia (NRSC, 2009). Among the 14 regions of Namibia, the Oshana region recorded the highest number of MVAs and deaths, with 1350 accidents and 62 deaths in 2009 (NRSC, 2009).

The NRSC, a statutory body under the Ministry of Works and Transport, revealed that all over the world, the consequences of MVAs continue to be a drain on the scarce financial resources of nations in terms of carnage, damage to vehicles, medical costs, and most of all, unquantifiable loss of lives (NRSC, 2006). Namibia is no exception, as MVAs continue to cause untold suffering to families and rob the country of productive citizens. Recorded human factors contributing to MVAs are: speeding, drinking and driving (alcohol), non-seat-belt use, and child unrestraint (WHO, 2013).
World Health Organization (WHO) determined that a driver with 0.05% g/dl and more blood alcohol concentration can increase the risk of accidents. However strict

enforcement of drink-driving legislation can reduce the number of road deaths by 20% (WHO, 2015).

There are different causes of MVAs in general, but the main factors to be covered in this study are human, vehicles and environmental factors contributing to MVAs.

1.2 Problem statement

Namibia is among the countries with the highest motor vehicle fatalities in the world, 56% male and 44% females out of the total fatalities (NRSC, 2009). The fatality rate for MVAs in Namibia was 14/100 000 in the year 2007 (MOHSS, 2011). A total of 633 people died in Namibia, some left disabled as a result of MVAs between January and November 2015 (MVAF, 2015).

The Oshana region, which is one of the nine regions in Namibia, reported a total loss of 21 lives during the Easter festival of the year 2015 (MVAF, 2015). Furthermore, Oshana region was among the three regions in Namibia with the highest fatalities from MVAs in August 2015 (MVAF, 2015). According to the 2009 report by the NRSC, the Oshana region was the region with most MVAs at 1,350 and fatalities with a total of 62 deaths in the year 2009 (NRSC, 2009). Furthermore, the Oshana region was among the top three regions with most MVAs with a total of 1,525 in the year 2012 (NRSC, 2012).

Despite Namibia being one of the African countries with good roads, it was indicated that the MVAF organization has paid about N$ 113 million from January to May 2015 in general medical expenditures of victims (Tjihenuna, 2015). The monthly expenditure for medical treatment of persons injured and who died in MVAs in

Namibia, has increased from N$ 14 million to 22.6 million per month from January to May 2015 (Tjihenuna, 2015). The costs of fatalities and injuries due to MVAs have a tremendous impact on societal well-being and socioeconomic development. The families whose bread winners died in MVAs may be driven into poverty.

Human, vehicle and environmental factor's contributing to MVAs in Namibia might be generally known but little has been researched particularly in the Oshana region. Human, vehicles and environmental in terms of contributing to accidents and the severity of related injuries, have not yet been researched. A gap therefore exists in this area and more knowledge is needed.

1.3 Significance of the study

Motor Vehicle Accidents are a big concern in Namibia, and specific factors contributing to MVAs in the Oshana regions may not be known. This study investigated the factors contributing to MVAs in the Oshana region specifically. The findings of the study will provide relevant institutions or ministries information on the specific human, vehicle and environmental factors contributing to MVAs in the Oshana region. Identifying human, vehicle and environmental factors will also assist in the planning of remedial measures, informing laws and decisions to prevent motor vehicle accidents. The study will also inform the allocation of resources by the relevant authorities to alleviate the loss of precious human and financial resources. The findings will provide a basis for developing strategies to reduce MVAs and their effects in the Oshana region.

1.4 Purpose and objectives of the study

The purpose of this study was to analyze the factors contributing to Motor Vehicle Accidents in the Oshana region and the severity of related their related injuries.

The specific objectives of the study were to:

1. Identify and analyze human, vehicle and environmental factors contributing to Motor Vehicle Accidents in the Oshana region.
2. Classify the severity of injuries related to human, vehicle and environmental factors contributing to MVAs in the Oshana region.

1.5 Definition of key concepts

Factors: The elements contributing to a particular result or situation

Motor: A device with an internal-combustion, relatively small and powerful engine found in in an automobile, motorboat, or the likes.

Vehicle: A conveyance machine moving on wheels, runners, tracks, or the like, as a cart, sled, automobile, or tractor.

Accident: An undesirable or unfortunate happening that occurs unintentionally and usually results in harm, injury, damage, or loss; casualty; mishap.

Injuries: Harm or damage that is done or sustained

Severity: A fact of how serious something is e.g. an injury

Source :(Thesaurus dictionary, 2016)

1.5 Summary

International, regional and Namibian statistics show that Namibia has a high rate of MVAs resulting in financial loss, as well as loss of human lives. Very little is known about the factors contributing to MVAs in the Oshana region specifically. This study investigates factors involved in them. The next chapter will cover the literature review of the study.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Literature reviews are designed to provide an overview of sources explored while researching a particular topic and to demonstrate how the research fits within a larger field of study (USC, 2016). The purpose of the literature review is to convey to the reader or investigator what is currently known regarding the topic of study.

2.2 Overview

Motor Vehicle Accidents are considered to be the most common safety challenge, causing more than a million deaths worldwide annually (Mohammadi et al., 2012). Worldwide, the number of people killed in road traffic accidents each year is estimated at almost 1.2 million, while the number injured could be as high as 50 million (CRTS, 2008).

Motor Vehicle Accidents are responsible for about 1.3 million deaths and hundreds of thousands of injuries and disabilities all around the world every year (Mahammadi, et al., 2012). In addition, MVAs were the world's ninth most important health problem in 2004, but may be the fifth leading cause of death in 2030 (Mohammadi et al., 2012). Low-income and middle-income countries account for 90% of deaths in MVAs in the world, despite having only half of the motor vehicles of the world (Mahammadi, et al., 2012). MVAs have become one of the top three causes of death for populations aged 5 to 44 years (WHO, 2009). MVAs may account for about 1% loss of the gross national product in low income countries, 1.5 % in middle income countries and 2 % in high

income countries (Espitia-Herdeman, 2005). Road traffic injuries place a heavy burden on global and national economies and household finances. As a result of MVAs, many families are driven into poverty by the loss of their breadwinners (Nangombe, 2012). MVAs result in the burden of having to care for members who become disabled as a result of injuries sustained in MVAs (NRSC, 2012). Every year between half a million to a million people are killed or permanently disabled on Chinese roads, with millions of people hospitalized, leaving behind shattered families and communities (CRTS, 2008).

2.3 Factors contributing to MVAs

Road accidents are often caused by a combination of human factors, infrastructure, vehicles and weather conditions (Petre, Roșu, Viorel & Antoaneta, 2014). According to WHO (2013), the risk factors influencing MVAs are: excessive speed, alcohol and drugs abuse, fatigue and being a young male driver with young passengers (WHO, 2013). Driving under influence of alcohol risk a road crash as well as the severity of the injuries that result from it (WHO, 2013). The following is a discussion of the factors, namely human, vehicle and environmental.

2.3.1 Human related factors in MVAs

Human-related factors are defined as events contributing to a vehicle crash due to human influence, behaviour, or error. Factors such as over-speeding, alcohol-use while driving and road type are heavily influenced by the actions of individual drivers (Guarino & Champaneri, 2010).

Human or driver's attitude/behaviour

Around 90% of road accidents are caused by human error (Jose, 2011). Jose (2011) reports that these road accidents were related to bad driving behavior, such as recklessly driving and over speeding while under the influence of alcohol, changing lanes without signaling, driving on the hard shoulder and passing through red lights. In Great Britain (UK) over 20 thousand minor to fatal accident are caused by careless and reckless drivers in contrast to learner or inexperienced drivers (Marlene, 2014).

A study done in Qatari indicated that a total of 28.4% of the injured Qatari drivers were involved in MVAs caused by distraction of attention. These drivers lost their attention while eating and driving. In Qatari, the usage of mobile phones while driving has resulted in 25% of injuries while 46.6% injured drivers were due to excessive over speeding (Bener et al., 2009).

There was a significant difference found in exceeding speed limits ($p<0.001$) and parking violation ($p=0.035$) in relation to MVAs (Bener et. al., 2009). Over speeding as a behaviour or human attitude is perceived as socially acceptable, with many young drivers thinking that their peers approve of their behaviour and that there is little chance of collision or of being apprehended (Bener et al., 2009). Over speeding is widely perceived as normal and acceptable, particularly on motorways (Bener et al., 2009).

In Ghana, the most common and serious cause of MVAs is the use of a cell phone while over speeding (Haadi, Box, & Ridge, 2014). Motorists who go beyond or below

the prescribed speed limits could hit other vehicles and they could be hit as well (Haadi et al., 2014). Statistics show that about 30% of accidents on the roads of Ghana are caused by over speeding (Abu-Zidan & Eid, 2015; Haadi et al., 2014). Driving under the influence of alcohol contributes to fatal road accidents since it can affect the driver's driving skills, and it also causes general impairment of the brain and the function of the nervous system (Haadi et al., 2014). Human error was found to be the major cause of roads accidents, aggressive, distracted driving and poor driving skills cause dangerous driving (Abu-Zidan & Eid, 2015).

A study done in Ethiopia has indicated that answering mobile phone calls while driving and alcohol use before/while driving are associated with MVA occurrences (Asefa, Ingale, Shumey, & Yang, 2015).

Various countries in Sub-Saharan Africa report that most of the road crashes occur due to a range of human errors, which include over speeding and perilous overtaking, alcohol and drug abuse, driver negligence, poor driving skills, vehicle overloading, poor maintenance of vehicles, non-compliance of pedestrians, and distracted attention of drivers (Peltzer, 2011).

Some MVAs are caused by bad driving habits and attitudes in different age groups, poor driving skills and understanding, driving where vehicles are prohibited, cutting roads and failure to signal one's intention (Petre et al., 2014). Namibia is among the countries with the highest motor vehicle fatalities in the world, involving 56% of male and of 44% females of the total fatalities (NRSC, 2009). A total of 633 people died in

Namibia, while others sustained disabilities as a result of MVAs between January and November 2015 (MVAF, 2015). A reduction in MVAs can be achieved by implementing measures that address risk factors such as excessive speeding and driving under the influence of alcohol (MOHSS, 2011).

Red Light jumping:

The Ministry of Roads Transport and Highways in India (2013), narrated that red light jumping is a common sight at road intersections where drivers drive through or cross without caring for the light. The main motive behind red light jumping is saving time. Some drivers seemingly believe that stopping at a red signal is wastage of time and fuel. The same study in India has shown that traffic signals followed properly by all drivers save time and commuters reach their destinations safely and timely. A driver jumping a red light not only jeopardizes his/her own life but also the lives and safety of other road users (MRTH, 2013). This act by one driver incites other drivers to follow, causing chaos at road junctions (MRTH, 2013). A study conducted in Delhi, India showed that four people were killed every day in the national capital in the year 2014 mostly due to jumping of red lights, leading to fatal road accidents (Ian, 2014). Ian (2014) further identified that most of the accidents have taken place either late at night or in the morning hours. Many Namibian drivers discard road courtesy and jump a red light or cut oncoming traffic with no regard for the safety of others (Danny, 2015)

Driver fatigue as a contributing factor to MVAs

Improvements have been made in decreasing seatbelt non-use and alcohol intoxication among drivers, but no improvement has been made in reducing fatigue related accidents (Smith, Cook, Olson, Reading, & Dean 1992-1997). Fatigue or sleepiness is associated with a range of factors (WHO, 2015). Other factors related to road traffic accidents are long-distance driving, sleep deprivation and the disruption of cardiac rhythms (WHO, 2015). Three high risk groups identified by WHO related to driver fatigue are, males, aged 16–29 years, night shift workers whose sleep is disrupted by working at night or working long, irregular hours and poor eyesight (WHO, 2015). According to the Royal Society for Accidents Prevention (RSAP, 2001) driver fatigue, which leads to falling asleep behind the wheel, is a major cause of road accidents, accounting for up to 20% of serious accidents on motorways and monotonous roads in Great Britain. The RSAP (2001) have also narrated that driver fatigue is one of the main areas of driver behavior that needs to be addressed if the target for reducing the number of people dead or seriously injured in road accidents by 40% is to be achieved. According to a report by the Law Offices of Michael Pine, driver fatigue can lead to reduced attention while driving, as well as slower reaction time (LOMP, 2015). The report further stated that in extreme cases, a driver could fall into micro sleep and briefly lose consciousness on the road (LOMP, 2015). Even a few seconds of sleep on the road, is enough to cause an accident.

A study done in South Carolina, identified that driving while drowsy is as dangerous as driving while you are drunk (Jebaily, 2016). The Carolina study findings indicated that a lack of sleep impairs one's mental and physical activeness, which make it difficult for

the driver to safely operate the motor vehicle and to escape dangerous situations (Jebaily, 2016). Fatigue mostly, is a factor in most accidents that involve commercial truck drivers (Jebaily, 2016).

In Zimbabwe driving while fatigue is common among commercial and public transport drivers due to long hours of work and long distance travelling. This is especially true among drivers of public transports (Mervis, 2012). In South Africa, about 24% of heavy vehicle road accidents were associated with sleeping while driving (Mervis, 2012).

Gender and age in MVAs

Males are involved in MVAs more than females, therefore some authors consider gender as one of the factors related to road accidents (Robertson, 2007).
Traffic accidents in China are common in adults between 26 and 60 years of age who are breadwinners in their families (CRTS, 2008). A study done in Australia indicated that all participants who were involved in MVAs, presented with high blood alcohol level were younger and a higher proportion of them were males. These occurrences usually happen after working hours and more frequently on public holidays more frequently ($P < 0.01$) (CRTS, 2008). A study done by China Road Traffic Safety (CRTS) also indicated that a total of 67% of those killed and injured on the road were young people (CRTS, 2008). A study done in Northern Ethiopia indicated that most of the drivers involved in accidents were between the ages of 25–44 years (Asefa, Ingale, Shumey & Yang, 2015).

During August 2015, a total of 56% of 46 recorded fatalities due to MVAs in Namibia were young people under 35 years of age. Losing young people in MVAs have a negative impact on the lives of families, as well as the Namibian society at large. This is because of the loss of the future generations' valuable contribution to the society and the Namibian economy (MVAF, 2015). Driver gender and age are considered to be potential factors of accidents (Guangnan, Kelvin & Guanghan, 2013). Young people (15 – 29 years) were twice as likely to be hospitalized due to MVAs with severe injuries, (Melo , Alarcão , de Oliveira, Pelloso, & Carvalho, 2016). Hassan and Mohamed (2012) also stated that a driver's age is one of the main causes contributing to the increasing number of road accidents. Young drivers are likely to perform risky maneuvers or neglect to take precautionary measures while driving (Haadi et al., 2014). The number of people under 18 years of age, who die in MVAs annually, are three times higher in the African countries than in the developed world (WHO, 2013). Deaths due to MVAs are highest among the economically active group of people (WHO, 2013). According to the African Development Bank (AFDB) males are three times more likely to be involved in MVAs than females in the 15-59 years of age (AFDB, 2013).

The economically active people aged 15–59 years are at the greatest risk of dying as a result of MVAs. At this age group, males are affected three times more than females (AFDB, 2013). Overall, 5% of deaths among males aged 15-59 years are attributable to road traffic accidents. This percentage rises to 6.5% for males in the 15-29 age groups in Sub-Saharan Africa (AFDB, 2013). Deaths due to road traffic accidents among

males aged 15–59 years in Africa far exceed deaths from malaria, diabetes mellitus, respiratory or digestive diseases (AFDB, 2013).

Time and festive seasons

During festive seasons people choose to travel more frequently and higher road volumes increases the possibility of MVAs. Road deaths have increased the annual death rate in South Africa by 220 in the year 2015, which is equivalent to 14% (Barry, 2016). At least one person is killed and 16 others injured on Namibian roads every day (Nangombe, 2012). It has been observed over the past years that in Namibia, the highest number of accidents and fatalities occur during April, August and December months (NRSC, 2006). This could be because those are festive months filled with many public holidays. The Easter holiday is in April, Heroes day is in August, and the Christmas break is in December. These events lead to higher traffic volumes during these periods, putting road users at increased risk of road crashes. Some drivers disregard road rules since they are more concerned about getting to their destinations faster than possible they could. During festive seasons there is an increased number of passengers, and public transport operators attempting to transport passengers as many as they could to take an advantage of the shortfall (Haadi et al., 2014).

According to the MVAF, a total of 633 people died in Namibia while some sustained disabilities as a result of MVAs between January and November 2015, (MVAF, 2015). The time of day also influences the occurrence of MVAs. Analyses of time in the day data suggested that the highest percentage of road traffic injuries occurred between 12h00-18h00 hours, (Ghorbanali, Mohammadi, Darius & Mohammadi, 2016). About

41 people were seriously injured in MVAs that happened between 16H00 and 18H00, while 34 were injured from 18H00 to 20H00 in Namibia (NRSC, 2013).

Over speeding as a factor in road accidents

The World Health Organization (WHO) reports that the higher the speed of a vehicle, the shorter the time for a driver to stop in order to avoid a crash (WHO, 2014). A car travelling at 50 km/h will typically require 13 meters in which to stop, while a car travelling at 40 km/h will stop in less than 8.5 meters (WHO, 2014). An average increase in speed of one km/h is associated with a 3% higher risk of a crash involving an injury. Speeding increases the risk of a car crash. The higher the speed, the higher the risks of MVAs, with a greater severity of the crash and injuries (WHO, 2014). Car occupants in MVAs with an impact speed of 80 km/h are 20 times more likely to die than they would have been at an impact speed of 30 km/h (WHO, 2014). Pedestrians have a 90% chance of surviving with an impact speed of MVAs at 30 km/h or below, but less than a 50% chance of surviving impacts at 45 km/h or above. The probability of a pedestrian being killed rises by a factor of eight as the impact speed of the car increases from 30 km/h to 50 km/h (WHO, 2014).

According to the Global Status Report on Road Safety of 2015 by WHO, speed is a critical risk factor for road traffic injuries and when an average traffic speed increases, it increases the likelihood of a crash. The report also relates the risk of death and serious injury with higher speeds, especially for pedestrians, cyclists and motorcyclists. The report also indicated that male and young drivers are more likely to over speed (WHO, 2015).

Over speeding should be a concern because:

- *"Over speed reduces the amount of available time needed to avoid a crash/to stop the vehicle"*
- *"Over speed extends the distance a vehicle travels while the driver reacts to a dangerous situation"*
- *"Over speed reduces the ability of the driver to steer safely around curves or objects on the road"*
- *"Over speed increases the likelihood of crashing"*
- *"Over speed increases the severity of a crash once it occurs"*(WHO, 2015)

In Zimbabwe, even though there is a speed limit in place, and mobilization campaigns on dangers of speeding are being carried out, speeding remains the key cause of MVAs in that country (WHO, 2011). Long-distance bus operators in Zimbabwe speed because they believe that speeding attracts hurried passengers (marketing tool), while in urban areas speeding is believed to increase bus operators' earnings (Mervis, 2011). This implies that the public has a positive perception on the benefits of speed. The chances of MVAs occurrence and the severity of the consequences are directly related to an increase in average speed (Mervis, 2011).

Alcohol abuse as a factor in road accidents

Drivers and motorcyclists with a blood alcohol content level greater than zero are at a higher risk of causing MVAs than those whose blood alcohol content level is zero (WHO, 2014). For the general driving population, as the blood alcohol content increases from zero, the risk of being involved in a crash rises significantly up to a blood alcohol level of 0.04 g/dl (WHO, 2014). Inexperienced young adults driving with a blood alcohol level of 0.05 g/dl have 2.5 times the risk of a crash compared to more experienced drivers (WHO, 2014). If blood alcohol content limit in drivers reads 0.10 g/dl, this will result in three times the risk of a crash compared to a blood content reading of 0.05 g/dl, which is the most common limit in high-income countries. Nevertheless, the risk of a MVA is twice as high even if the blood alcohol level is 0.05 g/dl (WHO, 2014). Low driver expectation of getting caught with blood-alcohol content above the legal limit has been shown to lead to an increased risk of a crash (WHO, 2014).

The risk of a road crash when a driver is alcohol-impaired varies with age. Teenagers are significantly more likely to be involved in fatal MVAs than older drivers. At almost every blood alcohol level, the risk of MVAs fatality decreases with increasing driver age and experience (WHO, 2014). Teenage drivers who are alcohol-impaired are at an increased risk of having MVAs if they have passengers in the vehicle, compared to those driving alone (WHO, 2014).

The extent to which alcohol contributes to MVAs varies between countries, and direct comparisons are difficult to make. In many high-income countries, about 20% of fatally injured drivers have illegal alcohol level in their blood (WHO, 2014). Studies in

low-income countries have shown alcohol to be present in between 33% and 69% of fatally injured drivers (WHO, 2014). Fatalities on the road as a result of alcohol were investigated by the World Health Organization. Analysis of data shows significant regional differences: Eastern Europe and Central Asia occupy top position with 18.2%, followed by Europe (16.7%) and the Americas (12.9%) (Christopher, 2014). The following regions are listed below the global average of 10.9%: Africa (8%), Asia Pacific (7.3%) and the Middle East (2.4%) (Christopher, 2014). The World Health Organization has also presented the following individual countries and their particular fatality weight in their respective regions, Belarus (51.4%), Lithuania (48.2%), Venezuela (47.1%), Namibia (43.2%), Mongolia (20.7%) and the United Arab Emirates (17.7%) (Christopher, 2014).

The Centers for Disease Control (CDC) described alcohol as the biggest challenge relative to road traffic safety (CDC, 2014). The CDC revealed that in 2014, 9,967 people were killed in alcohol-related driving MVAs, accounting for nearly one-third (31%) of all traffic-related deaths in the United States. Of the 1,070 traffic deaths among children aged 0 to 14 years in 2014, 209 (19%) were related to alcohol-impaired driving. Of the 209 child passengers aged 14 and younger who died in crashes in 2014, over half (116) were riding in a vehicle with an alcohol-impaired driver (CDC, 2014).

A study conducted in Australia has shown that of 1,323 study participants who got involved in MVAs, 667 (50%) presented with a blood alcohol concentration (Mitra, Charters, Spencer, Fitzgerald, & Cameron, 2016). The severity of MVAs fatalities increases significantly when the driver is under the influence of alcohol, a finding that persists after standardization for various confounding factors (Phillips & Brewer,

2011). Two mechanisms mediate between drunk drivers and high accident severity: firstly, compared to sober drivers, drunk drivers are significantly more likely to over speed and secondly not use seatbelts resulting in MVAs with severe injuries. Phillips & Brewer, 2011 further state that the severity of life-threatening MVAs increases significantly with increasing blood alcohol concentrations. Moreover, Phillips & Brewer indicated that lower blood alcohol concentrations could save lives, prevent serious injuries and reduce financial and social costs associated with MVAs (Phillips & Brewer, 2011). Charles, (2014) of the Medical Research Council of South Africa (MRC) found that alcohol remains a leading cause of death on South African roads. According to the Sunday Times in South Africa in 2014, data from mortuaries around the country shows that 50.1% of people killed on the road were three times over the legal alcohol limit and that 59.8% of all pedestrians killed were four to five times over the legal blood-alcohol limit (Charles, 2014).

Charles (2014), further states that six out of 10 drivers who died as a result of MVAs had high blood-alcohol levels, while one out of every seven motorists driving at night are likely to be drunk. Moreover, the MRC l points out that one drink doubles the chance of causing an accident (Charles, 2014).

2.3.2 Environmental factors

Impacts between vehicles leaving the road and solid roadside objects such as trees, poles and road signs are a major road safety problem worldwide. These collisions are usually single-vehicle crashes and frequently involve young drivers, excess or inappropriate speed, the use of alcohol or driver fatigue (WHO, 2014). Another problem related to impacts with objects off the road is the occurrence of crashes caused

by restricted visibility, resulting from poor placement of these objects on or around the road (WHO, 2014). A study done in the United Kingdom (UK) indicated that slippery roads were by far the most dangerous road environment factor in Britain (Markus & Walter, 2014). Mark also narrated that about 50 percent of MVAs in the UK were attributed to slick roads.

A study done in Montreal and Quebec, Canada revealed that a decrease in road lighting was associated with more bicycle and pedestrian accidents, which might have been explained by the decision to add or increase the amount of lighting at locations in which accidents occurred (Matin et al.,2015).

Permanent roadway hazards consist of intersections, merging lanes, bends, crests, school zones, and livestock or pedestrian crossings, while temporary hazards include road construction, parked or disabled vehicles, accidents, traffic jams, and wild animals (WHO, 2014).

Faded road signs, and signs obscured by foliage as roads environmental factors in MVAs, occasionally contribute to MVAs (Shope & Bingham, 2008). Of the MVAs observed, 52,000 were associated with an environment-related reason (Anapol, 2016). The second most causes of MVAs were road layout issues, such as a narrow road or a bend, which caused 549 fatal or serious accidents in 2014 (Markus & Walter, 2014)

The most common environmental factors leading to MVAs include:

- *"Slick roads"*
- *"Glare"*
- *"View obstructions"*

- *"Other highway-related conditions"*
- *"Fog, rain and/or snow"*
- *"Other weather conditions"*
- *"Signs and/or signals"*
- *"Road design"*(Anapol, 2016)

2.3.3 Vehicle factors in MVAs

The most recorded vehicle factors in MVAs are the failure of, or loss of brakes, tire blowouts or tread separation, as well as steering/suspension failure. A recent study done in South Africa on road accidents revealed that 50% of all road MVAs between December 2015 and January 2016 involved light vehicles and light delivery vehicles, which resulted into 20 percent of fatalities while motor cars caused ten percent fatalities (Barry, 2016).

Asefa et al., (2014) stated that four-wheeled taxis and mini buses have more association with MVAs compared to other types of vehicles. Similarly, four-wheeled taxis older than seven years are more prone to accidents. (Asefa et al., 2014). Pearl further stated that a high number of taxi drivers (two-thirds, 69.9% with n=498) encountering mechanical problems with their taxis include malfunctioning breaks (17.7% with n=126), steering system failure (10.7% with n= 76), lighting system problems (27.2% with n=194), and poor quality tyres (48.6% with n= 346).

With the exception of the recent impetuous of Firestone light-truck tire failures, the combined totals for all reported equipment failure account for less than 5% of all

MVAs (Shope & Bingham, 2008). Truck accidents are often caused by mechanical failures. The two biggest culprits are brake failures and defective tyres (Tomas, 2016). Most vehicles retain some degree of control over their brakes even if the main system does not work and most motor vehicles actually have two breaking systems. Even though brake failure is not common, along with tyre blowouts, brake failure is actually one of the top causes of accidents involving trucks and larger vehicles (Tomas, 2016). Brake failure is a terrifying thing, but it fortunately does not happen very often. Brake failures cause about 5% of car crashes in the United States of America out of 5.6 million car crashes every year (Law, 2015). This means that in America brake failure accounts for about 300,000 crashes per year (Law, 2015).

About 30% of summer tyres in Europe have at least one tyre showing signs of ageing or other irregularities that increases the risk of tyre failure (Seven, Antoine, Sander, Carmen, & Lars, 2014). Seven et al (2014) also remarked that only less than 10% of the vehicle population with winter tyres shows these types of damages, suggesting that winter tyres are better maintained than summer tyres.

According to a study done in Europe, roughly 6.7% of accidents are caused by tyre blowouts that cause the driver of a vehicle to lose control of the vehicle and collide with another vehicle, hit a pedestrian or crash on a property (Pearl, 2014). Truck tyre blowouts are usually more dangerous to the vehicles that happen to be nearby than they are to the truck driver when the burst occurs (Pearl, 2014).

2.3.4 General factors influencing the severity of MVAs related injuries

Variables that significantly influence pedestrian injury severity are the width of the road including lane and road shoulders, excluding the area occupied by on-street parking (Ghorbanali et al., 2013). Further influencing factors associated with severe pedestrian injuries are vehicle type, influence of alcohol on the driver, pedestrian age (65 years or older), and pedestrian alcohol consumption (Ghorbanali et al., 2013).

Ghorbanali et al., further stated that female drivers are generally found to be safer drivers than their male counterparts; male drivers have a higher involvement rate in road traffic accidents with severe injuries. Osoro et al., 2011 further stated that, increased severity of injuries are associated with male drivers, aged 65 years or older, the time of the accident (usually from midnight to dawn), weekend, wet road surfaces, delivery vehicles, accidents involving three or more vehicle.

Seven important types of environmental areas influencing injuries severity are downtown areas, compact residential areas, villages, downtown fringe, medium-density commercial areas, low-density commercial areas and low-density residential areas (Ghorbanali et al., 2013). These types of areas were found to experience significantly different injury severities. Downtown, compact residential, and medium- and low-density commercial areas generally experienced lower severe pedestrian injury than villages, downtown fringe and low-density residential areas (Sylvia, Zajaca, John & Ivanb, 2013).

Sylvia et al, further narrated that, significant factors that influence the severity of injuries are private vehicles (not public transport), the gender of drivers, age of

vehicles, time of the accident and street light conditions. For vehicles delivering goods, seat-belt usage and weekday occurrence are the only two significant factors associated with injury severity (Sylvia et al., 2013). Important factors associated with injuries related to motorcycles are the age of the motorcycle and the day and time of the accident (Sylvia et al., 2013). Identification of potential risk factors pertinent to particular vehicle type have important implications to relevant official organizations in modifying safety measures to reduce the occurrence of severe traffic accidents, promoting safer road environments (Kelvin, 2004). Kelvin further stated that when injured, vulnerable road users are at risk of sustaining more severe injury compared to vehicle occupants. These findings are consistent with other studies done in Africa and Asia. Increased risk of severe injuries to vulnerable pedestrians may be due to the reduced protection of a metal shell compared to vehicle occupants, and the speed with which vehicles travel compared to slow moving pedestrians. The MVAs recorded during rainy weathers were found to be associated with severe injury and could be due to decreased visibility and slippery roads during rainy weathers which reduces the ability to slow down and therefore increases the likelihood of a high speed MVAs (Kelvin, 2004). Night-time MVAs were also found to be associated with severe injury. Night-time driving reduces the visibility of drivers or reduces response time, causing accidents and injuries (Osoro et al., 2011).

In addition, factors that may contribute to severe injuries are accidents on roadways with four or more lanes, exceeding speed limits of (50–79 km/h) accidents in extra-long tunnels (over 3,000 m), and roads with longitudinal gradient (Jian,Yingying, Chen & Xiaonan , 2015).

Renuraj, Varathan, & Satkunananthan (2015) statistically verified that variables such as type and age of vehicles as the most influencing factors associated with accident severity. Speeding also contributes to the number of MVAs as well as the severity of injuries, the higher the speed the greater the stopping distance and the higher the risk of MVAs and severity of injuries (WHO, 2013).

2.4 Summary

Upon reviewing of different sources related to the study topic, MVAs are still a major health condition of an international concern. Human, environmental and vehicle factors are the main factors mostly researched at regional, national, continental and international levels. Based on literature review, human related factors in MVAs are the most common factors contributing to MVAs with numerous subsections. The next chapter will be on the methodology of this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology of the study and how it was carried out to meet the objectives. The following section presents an overview of the methods used in the study, namely the design, population, sampling, instrument used, data collection and analysis. It also mentions the ethics involved in the research.

3.2 Research design

This study employed a quantitative descriptive analytical cross-sectional design involving record reviews in order to investigate factors contributing to (MVAs) and the severity of related injuries in the Oshana region of Namibia. A cross-sectional study is an observational study in which exposure and occurrence of MVAs are determined at the same point in time in a given population (MacDonald, 2012). A researcher records information that emerges from a specific population without manipulating the variables (MacDonald, 2012). A cross-sectional approach can be used to estimate the population parameters of which can be totals, proportions, risk ratio or risk factors (MacDonald, 2012). The study has then quantitatively described and analyzed all road accidents records in all the Oshana region police station records from 1st January 2013 to 31st December 2015.

3.3 Study population and sampling

A population of a study is the entire group of people or subjects that is of interest to the researcher and which meet the criteria which the researcher wishes to investigate or is interested in (Miquel, 2008).

The population identified by the researcher in this study is all Motor Vehicle Accident cases reported and recorded in police records in the Oshana region from 1st January 2013 to 31st December 2015.

Sampling is the process of selecting a number of subjects from the entire population by a mathematical calculation and rationalization in accessing information and in selecting a representation of the population in an appropriate way (Miquel, 2008). Since the population of the study was known and sufficient for a quantitative analysis, no sampling was employed in this study.

3.4 Research instruments

The Namibia Road Accident Form (NRAF) was used as the unit of analysis in this study. The forms are completed by the police officer on duty who attends to an accident; the form should be completed within 24 hours of the accident occurrence. An extraction instrument was developed to fit the objectives of this study and extractions were then done from the NRAF forms. The main information extracted from the forms were demographic information of drivers and passengers, time of MVAs, type of MVAs, motor vehicle information, human attitudes, degrees of injuries as well as roads and environmental information.

3.5 Data Analysis

The data from the extraction forms were entered into public domain statistical software (Epi Info) for epidemiology and the Microsoft Excel which were used by the researcher to analyze the data. The data were cleaned and coded before statistical analysis. Frequencies related to human, vehicle and environmental factors contributing to MVAs were calculated before statistical comparisons were made through multiple logistic regressions. The multiple logistic regressions were used to estimate the influence of risk accidents factors on severity of accidents outcome.

The analysis was done based on the significance level of 5% and this reflected a p-value region of less than $\alpha = 0.05$. This is a cut off for significance. If the p-value is less than 0.05, the null hypothesis will be rejected that there's no difference between the means and one conclude that a significant difference does exist. Data were then displayed in graphs, figures and tables.

The data for this study were secondary data taken from National Road Safety Council. The data contained information on accidents involving drivers and passengers. Human, vehicle and environmental factors to MVAs and the related severity of related injuries were the main part of analysis of the study. Information on injury and fatalities are in the NRSC's datasets recorded as outcomes of accidents and are assigned to all people involved in road accidents. Accident severity was measured on each person involved in MVAs. The variables and categories extracted from the NRSC forms and studied are summarized in table one below.

The general variables of interest for the study are summarized in the below.

The table below is showing the variables that are extracted from the Namibia Road Accident Form. They are generally referred to as variable of interest for the study.

Table 1. Study Variables of interest, Oshana Region, Namibia, 2013-2015

Variables	**Categories**
Age of drivers and passengers	1-16, 16-30,31-45,46-55 and 55+
Sex of drivers and passengers	Male/Female
Date	1-31
Day	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday and Sunday
Month	January, February, March, April, May, June, July, August, September, October, November, December
Time of Accident	24H00-12H00 and12H00-24H00
Place of accident	Oshakati, Ongwediva and Ondangwa
Type of vehicle	Motor car, Light delivery, Truck, Taxi and Bus
Drivers' action during accident	Overtaking, turning right/left, U-turn
Type of road	Gravel, Tarmac, junctions, curves
Road surface	Bumpy, Sand, Potholes, Wet, Dry
Tyre burst	Yes/No
Injuries	Serious/Fatal
Seat belt use	Yes/No

3.6 Research ethics

The research study was approved by the Post Graduate Studies Committee (PGSC) of the School of Nursing and Public Health as well as by the University of Namibia Research Ethics Committee. Permission was also sought from both the National Road Safety Council (NRSC) to access the data and from the Oshana regional police commissioner to conduct the study in the Oshana region. Anonymity and confidentiality were maintained during data collection and throughout all phases of the study. No references were made to personal particulars of persons found in the NRAF forms. The findings of the study were aggregated and presented quantitatively. All information extracted was kept in a computer which was protected by a password and only accessible by the researcher.

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3.7 Summary

This chapter described the methodology of the study. It has given an overview of the manner in which the study was conducted. The four main parts of chapter three are the study design, the study population, sampling and data analysis plan. The study used a quantitative descriptive analytical cross-sectional design involving record reviews. The identified population was all police records of MVAs in the Oshana region between year 2013 and 2015. A data extraction form based on NRAF was used and descriptive analysis was done. The ethical principles of anonymity and confidentiality were adhered to. The next chapter will present the description of the study findings.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter will present the findings of the study after the data was analyzed and will reveal the contribution that this study made in providing information on factors influencing MVAs and its related injuries in the Oshana region of Namibia. Findings contained in the chapter are presented in tables, graphs and figures. This chapter will focus on the main categories of factors contributing to MVAs in the Oshana region and their-influence on the severity of injuries. The main categories of factors in the study were human, vehicle and environmental factors.

The Oshana region recorded a total of 5,296 MVAs from the year 2013 to 2015. The numbers of MVAs were captured in all police stations in Oshana namely, Oshakati, Ongwediva and Ondangwa. Out of the total number of accidents over the three years, 391 people were seriously injured while a total of 126 died. The number of people who were injured and killed included drivers and passengers. Accidents in the Oshana region occurred as a result of numerous contributing factors. Human, vehicle and environmental factors in MVAs in the Oshana region have shown different contributions to accidents.

4.2 Presentation of the findings

Since this study is a quantitative study, the results are presented in tables and figures with discussions of the data.

4.2.1 General information on MVAs

The next section will present general information regarding the distribution of MVAs in the Oshana region.

The MVAs in the Oshana region were reported in the three main police stations namely at Oshakati Ongwediva and Ondangwa police stations. The reported MVAs differed in their distribution between the three police stations.

Table 2. Distribution of MVAs by the three police stations, Oshana Region, Namibia, 2013- 2015

Police station	MVAs	%
Ondangwa	2026	38.25%
Oshakati	1907	36.01%
Ongwediva	1363	25.74%
TOTAL	**5296**	**100%**

MVAs were stratified by police station, and the stratification analysis showed that Ondangwa police station reported more cases compared to Oshakati and Ongwediva police stations. Ondangwa had 2026 (38.25%) cases which are roughly two percent more than the Oshakati police station cases. Even though Oshakati hosts the Oshana regional police station it reported less than Ondangwa, a total of 1907 (36.01%) cases but, above Ongwediva police station that reported ten percent less than Oshakati and

roughly 12% below Ondangwa police station records. Ondangwa police station might not be a regional police station but it provides services to other nearby small towns such as Onayena, Okatope and places that lie between Ondangwa and Oshikoto such as Omutele, Etope and others. This could be the main reason the Ondangwa police station reported more cases than Oshakati police station. The Oshakati police station catchment population is being shared with Ongwediva police station since they are located within ten kilometers from each other. The short distance between Oshakati and Ongwediva police station means that MVAs reporting is shared between these two stations.

The table below indicates the different types of MVAs that have happened in Oshana region within the study period. The table shows individual cases that had information on accident type captured in the records.

Table 3. MVAs distributed by type, Oshana Region, Namibia, 2013-2015

Accident type	Frequency	Percent
Approach at angle: both travelling straight/turning	180	3.69
Approach at angle: one or both turning	160	3.28
Head on	99	2.03
Head/rear end	1118	22.91
Other/unknown	575	11.79
Passenger fell off vehicle	10	0.20
Sideswipe: opposite directions	225	4.61
Sideswipe: same direction	419	8.59
Single vehicle overturned	267	5.47
Turn right in face of oncoming traffic	208	4.26
Went off the road without rolling	19	0.39
With animal	746	15.29
With Bird	11	0.23
With Fixed Object	462	9.47
With pedestrian	333	6.83
With Stones	45	0.92
With train	2	0.04
Total	**4879**	**100**

Considering the data in the table above, head/rear end accidents, 1118 (22.91%) were found to be the dominant type of accident, 1118 (22.91%) that happened across Oshana region during 2013-2015. The second most common type of accident that occurred in Oshana region was with animals totaling 746 (15.29%). Side swipe MVAs whether in the same or opposite direction happened 644 times, representing (14.06%) of all types

of accidents. Following the third most type of MVAs were vehicles that crashed against fixed or immobile objects such as poles or trees. Fixed object MVAs occurred 462 times (9.47 %). MVAs caused by animals are also significant because most of the main roads in the region are passing through communal land. Other significant types of MVAs recorded in the Oshana region were MVAs involving pedestrians 333 (6.83%) and single vehicle overturning 267 (5.47%). The least type of accident recorded, involved a train 2 (0.04%). A total of 575 (11.79%) were not known, which may show a shortcoming in the recording of information by police officers in the NRSC forms on MVAs.

Figure one below shows how serious injuries and fatalities have been distributed in the three years period of the study.

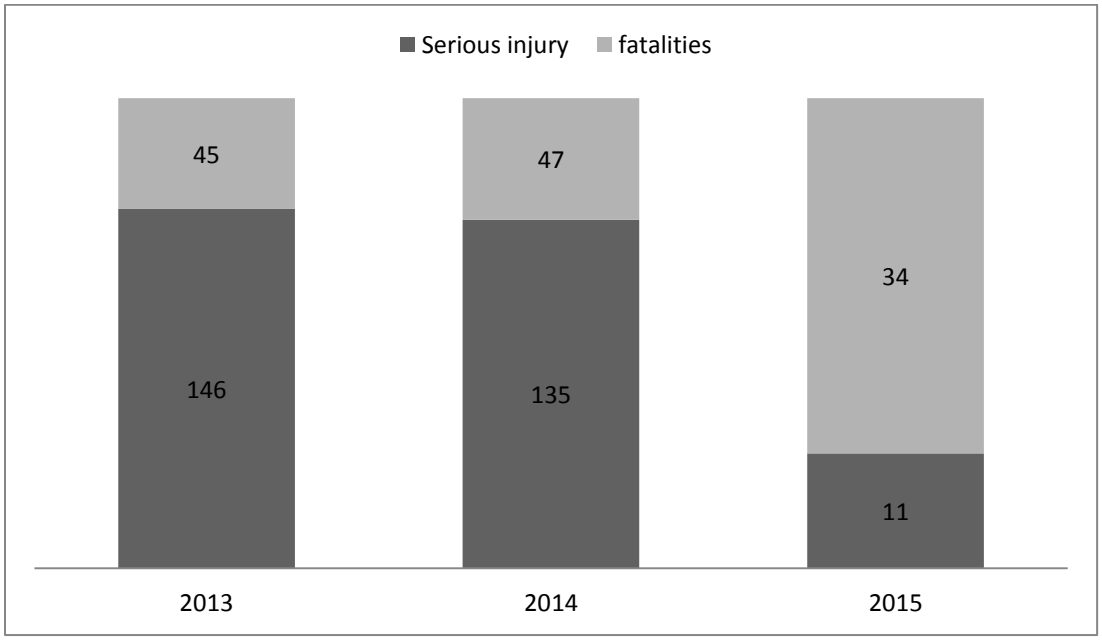

Figure 1. Injury severity distributed by year, Oshana Region, Namibia, 2013-2015

The year 2013 recorded more serious injuries than any other year, with a total of 146 (37.3%) injuries recorded. In the year 2014 the number of serious injuries decreased with 11 cases (2.8%). However, the number of fatalities rose in 2014 with two cases. The Oshana region had a dramatic decrease in both the number of serious injuries and fatalities in 2015. Serious injuries decreased from 35 cases to 11 cases and fatalities went down from 135 cases to 11 respectively.

A decrease in MVAs will naturally result in a decrease in the number of fatalities. The reason for this decrease in MVAs in 2015 might be the MVA prevention initiative undertaken in Namibia. Namibia recognized the resources (human and financial) lost through MVAs and started a Road Safety Initiative that constantly attempts to lower MVA incidences in Namibia. Lowering MVAs in Namibia will naturally lower the injuries and deaths caused by these accidents (Figure one).

4.2.2 Environmental, season and time factors in MVAs

The next section will present the analysis of factors related to environments, seasons and time in general. Their relation to injuries will also be presented.

Table four below shows how MVAs have been distributed in the three years period of the study.

Table 4. Distribution of MVAs by year, Oshana region, Namibia, 2013-2015

Year	Number of MVAs	Percent
2013	1800	34
2014	1785	34
2015	1711	32
TOTAL	**5296**	**100**

There were no significant differences observed in MVAs occurrences throughout the three years period observed in the Oshana region. The year 2013 has recorded 1800 MVAs which represent 34% of all MVAs in the Oshana region of Namibia. The same applies to the year 2014, with 17685 MVAs which is 34% of all MVAs in the Oshana region. The year 2015 recorded 1711 accidents, 32% of all MVAs in the Oshana region during the period. This is an indication that the occurrence of MVAs in the Oshana

region has been consistent between the years 2013 to 2015. The findings are presented in Table four above.

Time of the year is a study variable which can be observed and analyzed on how it contributes to MVAs and how it influences the severity of injuries. Following is the distribution of MVAs in the Oshana region according to reported months in the years 2013 – 2015.

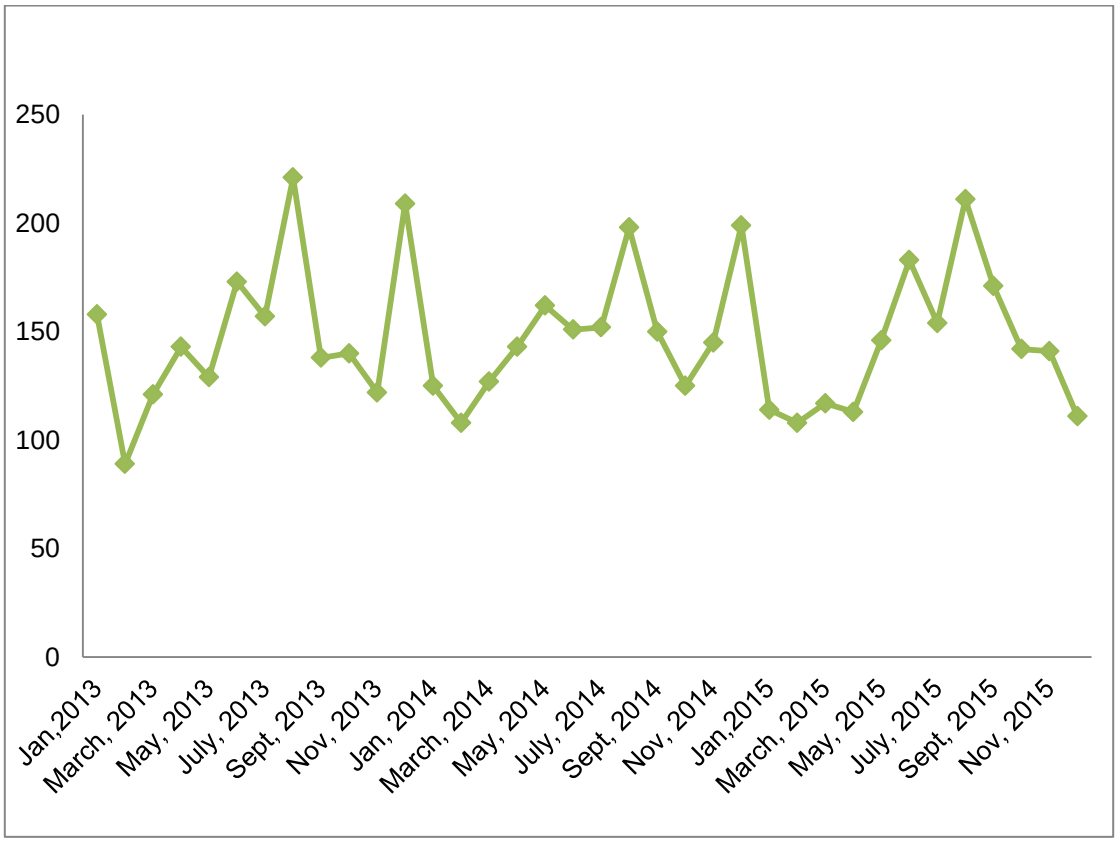

Figure 2. Overall MVAs distributed by year and month, Oshana Region, Namibia, 2013-2015

More MVAs occurred around January and December, July and August in all the years recorded. More than 200 MVAs occurred between July and August in the years 2013 and 2014 and a similar number of MVA cases are observed in the year 2015. A decrease in MVAs was observed between January/February and March 2013 and 2014 respectively. August and December are months of festivals across Namibia. Oshana region is the central region of the whole northern part of Namibia and it hosts the capital town (Oshakati). Many Namibians commute from the central and coastal regions to Oshana and other northern regions during festive periods and the likelihood of MVAs increase exponentially. It is therefore no surprise that MVAs tend to peak in those months. The increase of MVAs during festive periods correlates with the findings of the NRSC which states that Namibia has the highest number of accidents and fatalities during April, August and December months (NRSC, 2004).

Figure two shows an analysis of MVA incidences according to the days of the week in the Oshana region.

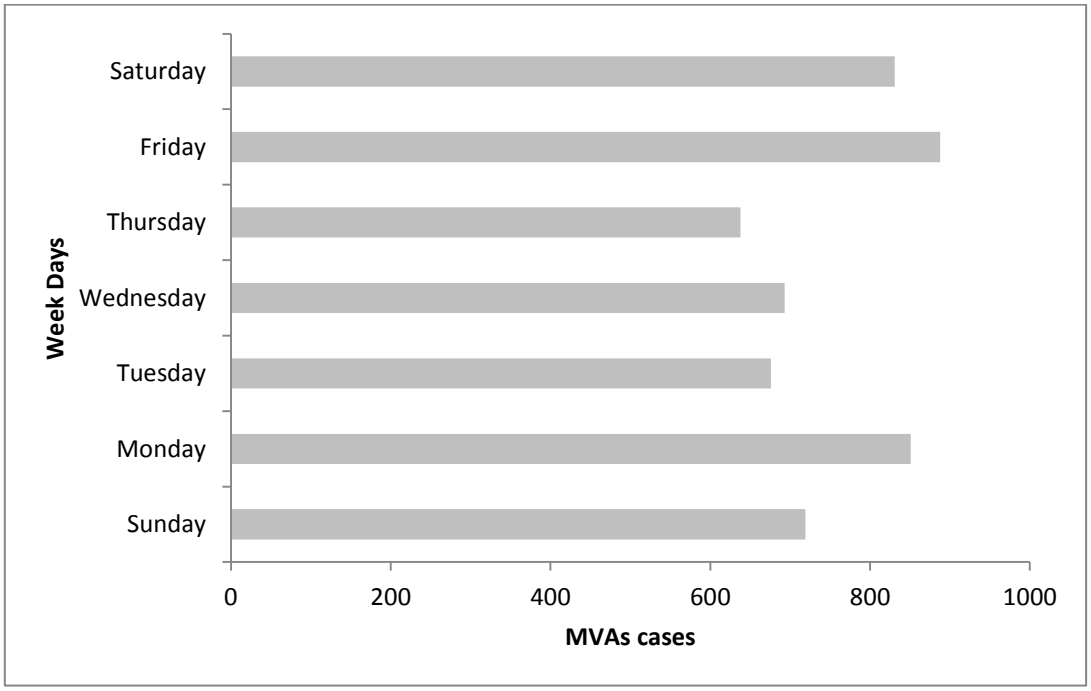

Figure 3. Overall MVAs distributed by their occurrence during days of the week, Oshana Region, Namibia, 2013-2015

Of all the MVAs that occurred in the Oshana region, the majority of the MVAs took place on Fridays with a total of 888 (16.33%), followed by Mondays 851 (16.07%) and Saturdays 831(14.74%) respectively. The minority of MVAs occurred between Tuesdays and Thursdays in the week. During weekends people have more free time to drive around since many people do not work during weekends. Increased in the number of motor vehicles could be the reason that a majority of accidents happen on Fridays, Saturdays and Mondays. During the weekend, most people have enough time to take alcohol. Therefore, some drivers may drive under the influence of alcohol which is a

risk factor for MVAs. This may be one of the reasons there are more MVAs on weekends.

It is not only some days of the week, but also the time of the month that may influence the MVA rate in Oshana region, Namibia. Figure 4.4 shows the distribution of MVAs according to the day of the month.

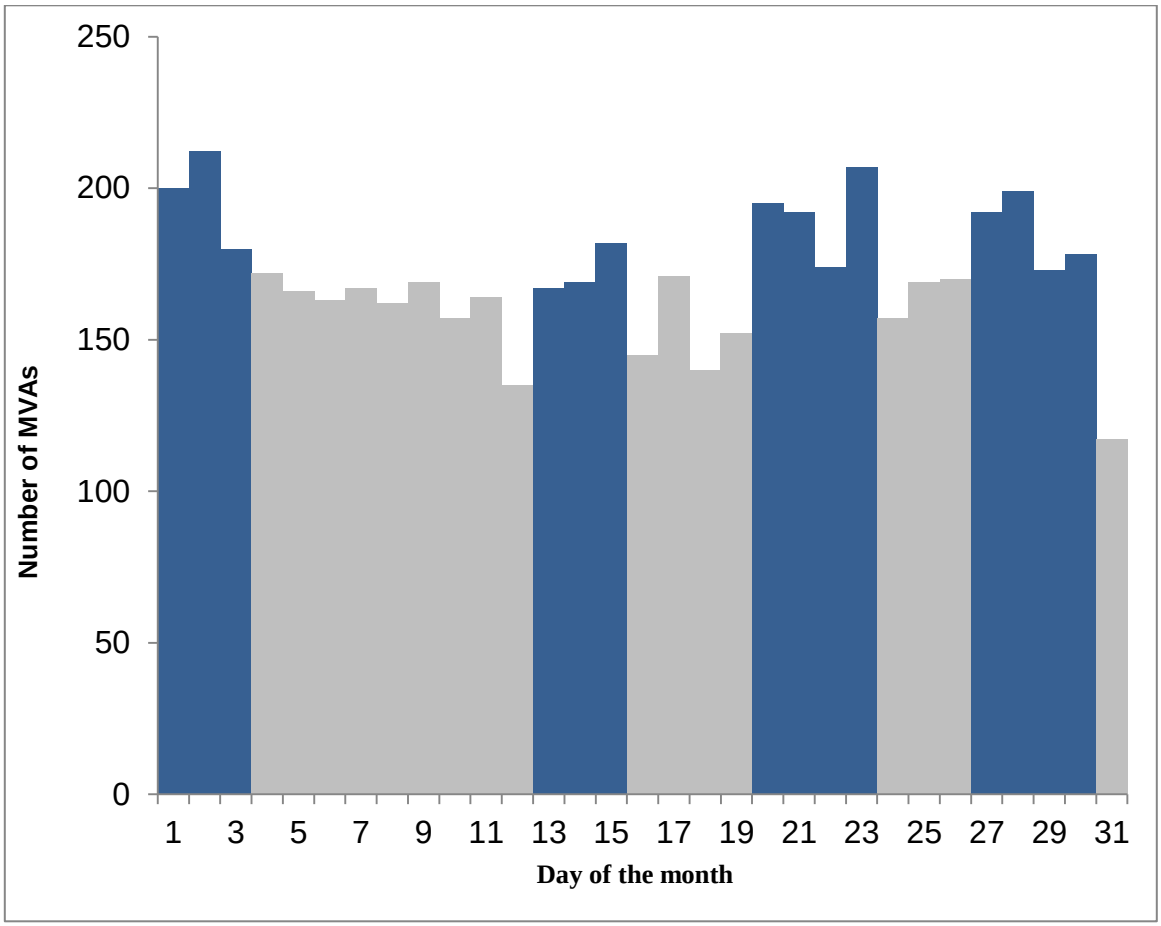

Figure 4. Overall MVAs distributed by day of the month, Oshana Region, Namibia, 2013-2014

MVAs rise during the first to the third day of the month and then decrease between day four and day 12. A peak in MVAs occurs from day 13 to 15, between days 19 and 23 and also rises between day 28 and day 30. The rise in MVAs during these days of the

month might be associated with the days people receive their salaries and are more likely to be commuting to shops and outlets and to pay their bills, increasing the volume of vehicles on the roads. The availability of money enables people to buy alcohol that exacerbate the incidence of drunk driving and speeding, which increases the risk of MVAs. Therefore the main reasons of increased MVAs during pay days could be driving under the influence of alcohol and increased road use due to increased public and individual activities during these times of the month.

Table five below is showing the cases of MVA given by days of the month stratified by serious injuries and fatalities.

Table 5. Distribution of MVAs by days of the month and number of injuries and deaths, Oshana Region, Namibia, 2013-2015

Date	MVAs	Serious injuries	Fatalities
1-10	1763	134	41
11-20	1615	117	43
21-31	1918	140	42
Total	**5296**	**391**	**126**

Throughout the 31 days of the month of the three years this study covered, the injuries sustained and the fatalities that occurred were distributed according to three periods in the month. Data were analyzed according to three intervals of 10 days each in the month. Day 21 to 31 recorded more MVAs compared to the other two periods with a

total number of 1918 (36.2%). MVAs in Oshana region are associated with month-end and the beginning of the month. The data shows increase in MVAs during these two interval periods, which are 1763 (33.2%) and 1918 (36.2%) respectively. Midmonth days recorded the least number of MVAs, i.e. 1615 (30.4%) compared to the other two interval periods. However there was a significant difference in associations between the interval periods in MVAs and the severity of injuries. The majority of the serious injuries happened between day 21 and 31, 140 (35%) followed by day one and 10 interval 134 (34%). Consistent incidents of fatalities were observed over all intervals.

The next figure is showing the MVAs in the Oshana region and the distributed time of occurrence.

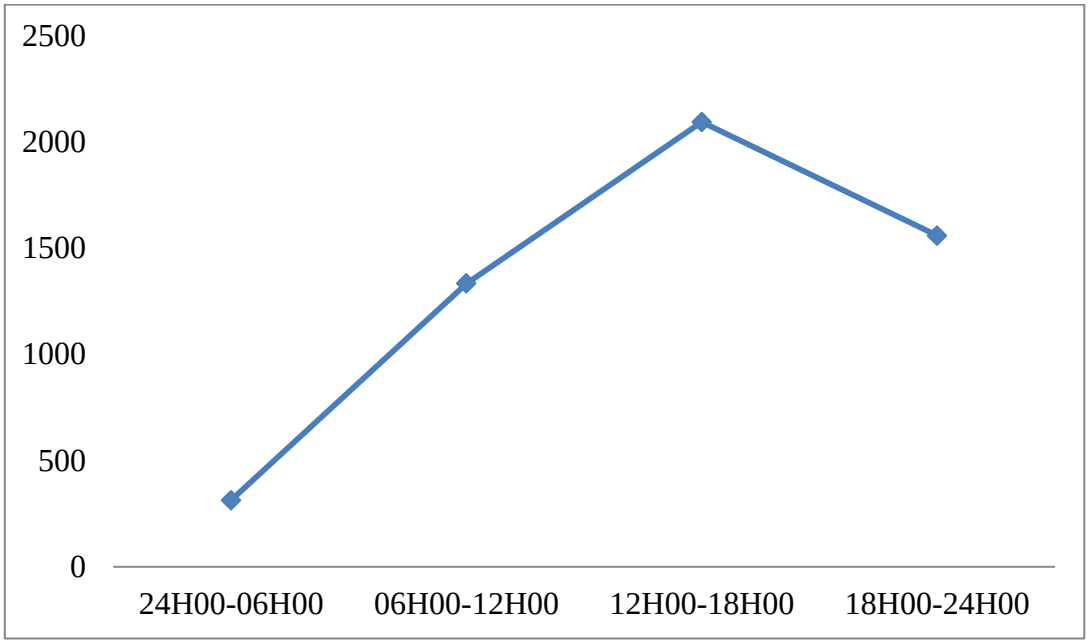

Figure 5. Overall MVAs distributed by time over a period of 24 hours, Oshana Region, Namibia, 2013-2013

The majority of MVAs 2093 (40%) happened between 12H00 and 18H00. A study done by Ghorbanali et al., 2016) also found that most MVAs happen between 12H00 to 18H00 and also at night time. The second most MVAs occur between 18H00 and 24H00, namely 1558 (29%), while the third most MVAs take place between 06H00 to 12H00, i.e. 1333 (25%). The lowest incidents of MVAs were observed around 24H00 to 06H00 in the morning, i.e. 312 (6%). More MVAs occur from 6h00 to 18h00; which, coincidentally is the busiest time of the day for persons traveling to work, traveling during working hours (including transport of goods) and travelling back home after work. Between 18h00 and 24h00 other factors may influence the occurrence of MVAs. The study results are consistent with the findings of the NRSC which also indicated that most of the MVAs in Namibia occurred from 12H00 to 24H00. At least 63% of all MVAs recorded happened from 12H00 to 24H00 (NRSC, 2013). Between 24h00 and 06h00 most people are sleeping with a decrease in the volume of vehicles on the roads resulting in the lowest possibility of MVAs within that period of time.

Table six below shows how time influences the severity of injuries when MVAs took place.

Table 6. Influence of time on accidents severity of injuries, Oshana Region, Namibia, 2013-2015

Serious injuries					**Fatalities**			
Time	Number of cases	OR	(95 % CI)	p-value	Number of cases	OR	(95% CI)	P-value
24H00-06H00	29	1.30	(0.87,1.94)	0.183	18	2.76	(1.65,4.61)	0.005
06H00-12H00	66	0.58	(0.44,0.76)	0.009	17	0.45	(0.27,0.76)	0.002
12H00-18H00	173	1.23	(1.00,1.51)	0.047	34	0.55	(0.37,0.83)	0.003
18H00-24H00	123	1.10	(0.88,1.38)	0.357	57	2.01	(1.41,2.88)	0.008
Total	**391**	**-**	**-**	**-**	**126**	**-**	**-**	**-**

(OR=Odd Ratio) (n = 5296)

The time of the day can influence the frequency of MVAs as well as the severity or degree of injuries sustained in MVAs. Regarding the severity of injuries and fatalities, MVAs were analyzed based on one quarter (¼) of the time in a full day, constituting four, six hour intervals. There is a significance association between serious injuries with driving or getting into an accident between 12H00 to 18h00 OR= 1.23 (95% CI, 1.00, 1.51) P= 0.047.

Even though there was a slight association between serious injury with driving or getting into an MVA between 06H00 and 12H00, this was not a statistical significant

association because the 95% confidence interval includes one (1) OR= 0.58 (95% CI, 0.44, 0.76) P= 0.009. The analysis indicates that serious injuries as an outcome of MVAs can be equally distributed within the six hours between 06h00 and 12h00. This study found that driving from 24H00 to 6h00 has significant increases the risk of being involved in an MVA and sustaining fatal injuries by 2.8 times more compared to any other time of the day OR= 2.76 (95% CI, 1.65, 4.61) P= 0.005.

Driving or getting into MVAs from 18H00 to 24H00 (midnight) was found to have significant association with fatal MVAs OR= 2.0 (95% CI, 1.41, 2.88) P= 0.008. A significant association exists between fatality and serious injuries with MVAs occurring during night times. Visibility at night time is constrained; therefore drivers will have a lesser chance to avoid an accident that could be fatal. Driving at night and poor vision increase the risk of crashing against both domestic and wild animals on the roads.

Both Lazarus (2016) and WHO (2016) found that most MVAs with serious injuries and deaths happen at night. Lazarus stated that, of all recorded MVAs in 2015, 47% took place between 16h00 and midnight.

Table seven below presents study findings on the relationship between the roads environments and serious injuries.

Table 7. Multiple logistic regressions on roads and environments and serious injuries, Oshana Region, Namibia, 2013-2015

Outcome: Serious injuries	**OR**	**(95% CI)**	**co-efficient**	**SE**	**Z statistic**	**P-value**
Bumpy roads	3.3	(1.91,5.91)	1.21	0.28	4.2	0.00
Corrugated roads	3.9	(0.40,3.64)	1.30	1.08	1.26	0.20
Tarmac roads	3.4	(1.70,6,63)	1.21	0.34	3.51	0.04
Pot hole roads	2.0	(0.86,4.50)	0.68	0.42	1.62	0.01
Invisible road signs	2.1	(1.02,4.30)	0.74	0.36	2.02	0.04
Slip way junction	5.0	(0.95,25.6)	1.60	0.83	1.91	0.05
T-Junctions	2.0	(1.10,2.90)	0.58	0.24	2.35	0.01
Curving roads	3.0	(1.82,4.01)	0.99	0.20	4.94	0.00

Scientific road design and the road environment can also be factors that contribute to MVAs. Multiple logistic regressions determine the association between the road and the road environment in MVAs and the severity of injuries. The highest risk of serious injuries in MVAs victims is associated with slip way junctions. The slip way junction scored an OR= 5.0 (0.95, 25.6) P= 0.05, which through a statically significance indicates that individuals who are involved in accidents at slip way junctions are five times more at risk of serious injuries in comparison to the other environmental factors listed in the table above. The second highest significant risk of sustaining serious

injuries in MVAs is associated with tarmac road with a risk factor of OR= 3.4 (1.70, 6, 63) P= 0.04. Bumpy roads are the third highest risk factor associated with severe injuries with a risk of three times more compared to the other environmental factors namely, OR= 3.3 (1.91, 5.91). The risk of curving roads was two times higher among MVAs victims who were seriously injured in comparison to those who were not seriously injured OR= 3.0 (1.82, 4.01) P=0.00. Invisible road signs were found with a two point one (2.1) times more risk of causing serious injuries in MVAs. Corrugated roads have some risk that seem to be high but which are not statistically significant OR= 3.9 (0.40, 3.64) P=0.20. The least risk of severe injuries to persons involved in MVAs were pot holes in roads OR= 2.0 (0.86, 4.50) P=0.01. Slipway junctions and bumpy roads are especially dangerous while driving at night time, and despite the statistical insignificance of pot holes on roads, these pot holes are extremely dangerous because drivers may lose control of motor vehicles and cause MVAs.

Table eight below is showing the findings of logistic regression on other road types and fatalities.

Table 8. Logistic regression on other road type and fatalities, Oshana Region, Namibia, 2013-2016

Factor: Outcomes	**OR**	**95% CI**	**co-efficient**	**SE**	**Z statistic**	**P-value**
Tarmac: fatality	2.4	(0.97,6.05)	0.88	0.46	1.9	0.05
Curves on road: fatality	3.0	(1.54,5.53)	1.07	0.32	3.3	0.01

MVAs that happened at curves in the roads, either normal or sharp curves, presented a three times higher risk of causing fatal MVAs compared to other studied factors OR= 3.0 (1.54,5.53) P= 0.01. Curves in roads require some discipline from drivers, and they need to adhere to the speed limit and take control of the movement of the vehicle to reduce the risk of an accident. Findings by Mark (2014) support the findings in this study that curves in roads may cause fatalities in MVAs (Mark, 2014).

4.2.3 Human factors

The general human factors associated with MVAs studied were the age and sex of persons involved in MVAs. The attitudes of drivers and non-compliance to road signs and traffic rules related to the severity of injuries will also be presented.

Age and sex

Figure six below is showing the distribution of age while figure seven shows sex of persons involved in MVAs.

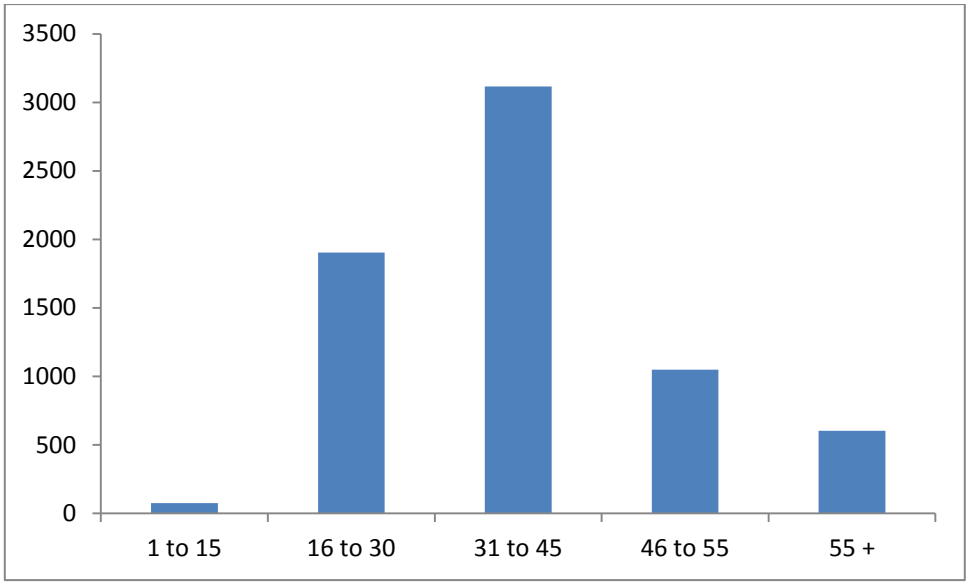

Figure 6. Distribution of MVAs by age of victims, Oshana Region, Namibia, 2013 - 2015

The total number of persons involved in MVAs whose ages were captured was 6747; this number includes drivers, passengers and pedestrians. The majority of MVAs victims recorded, 3116 (46%), were aged between 31 and 45 followed by the 16 and 30 age category, 1905 (28%) of whom were recorded. These findings are consistent with the NRSC (2009) findings according to which MVAs were observed to be low in the age group 1 to 16 years of age. Furthermore, the NRSC study (2009) revealed that even though individuals of various ages face road accidents, the main victims were found to be those in the age group between 16 to 30 years. Statistical analysis of the age of

persons involved in MVAs indicated the mean age of the drivers and passengers involved in MVAs in the Oshana region to be 38 years of age.

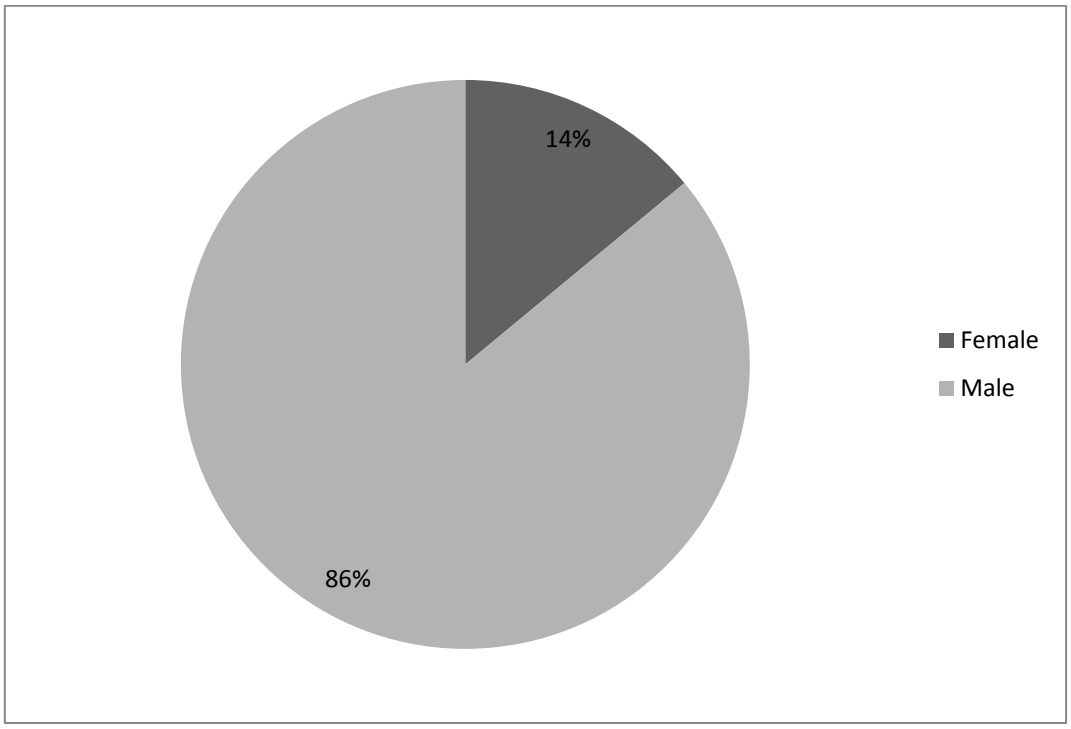

Figure 7. Illustration of persons' sex involved in MVAs, Oshana Region, Namibia, 2013-2015

Of all the 7616 accident victims whose gender data were captured, the majority were males namely, 6544 (86%) while 1072 (14%) were females. Robertson (2007) confirmed that males are more involved in MVAs than females. In Namibia men are most likely to drive under the influence of alcohol which may also increase their risk of getting into MVAs compared to females. Generally, the majority of drivers are male and fewer females are driving license holders in Namibia.

Table nine below shows the significance between the severity of injuries and drivers' adherence to road traffic rules and signs, indicating the attitudes of drivers on the roads.

Table 9. Drivers' attitudes/non-adherence to traffic rules and signs and the severity of injuries contributed, Oshana Region, Namibia, 2013-2015

Road Signs	MVAs	**Serious injuries**	OR	(95% CI)	P-value	**Fatalities**	OR	(95% CI)	P-value
Stop signs	169	11	3.3	(2.57,22.4)	0.001	8	6.1	(2.73,13.6)	0.000
Traffic lights	342	19	3.0	(1.744,6.48	0.001	3	0.9	(0.26,2.85)	0.180
Speed humps	28	4	7.6	(1.80,5.18)	0.000	1	3.7	(0.49,28.5)	0.167
Yields	146	12	4.4	(2.33,8.37)	0.004	3	2.9	(0.66,7.2)	0.371
Perilous overtaking	209	12	3.0	(1.57,5.54)	0.004	13	9.9	(4.92,19.1)	0.000
Junctions	209	20	5.8	(0.71,3.43)	0.000	7	3.9	(1.75,9.42)	0.000
U-turn	23	1	2.0	-	0.494	0	1.000	-	1.000
Total	**1126**	**79**	**-**	**-**	**-**	**35**	**-**	**-**	**-**
								n=3522	

A total of 1126 (21%) of all MVAs were caused by poor human attitudes towards the usage of the road. MVAs happened by non-adherence to road control signs. Not complying with traffic rules and signs has also influenced the degree of severity of injuries which contributed to fatalities. Of all MVAs police records only 3522 (67%) had information on whether the road had a controlling sign or not at the time of the accident. If every driver could comply with all controlling signs on the roads lesser MVAs as due to not complying to traffic rules and signs might occur on Namibia's roads. MVAs happening because of poor driver attitudes caused a total of 35 fatalities which is 28% of all fatalities recorded in the Oshana region for the period 2013 to 2015. A total of 79 (20%) serious injuries sustained in MVAs were caused by drivers not complying with road traffic signs. MVAs caused by ignoring traffic lights totaled

342, followed by crossing roads/four ways stop and perilous overtaking which caused 209 accidents. Not observing stop signs caused 169 MVAs, while not abiding to yields tolled 146 MVAs. A high risk of serious injury was found to be associated with MVAs that happened at speed hump road signs OR= 7.6 (1.80, 5.18) P= 0.000. Drivers not abiding to junction signs caused MVAs six times more risk of serious injuries compared to other MVAs OR= 5.8 (0.71,3.43) P= 0.000. Drivers not observing yield signs caused MVAs that had four times more risk of causing serious injuries compared to other MVAs OR= 4.4 (2.33,8.37) P= 0.004. Not complying to yield signs were found to have a significant association with fatalities as an outcome of MVAs OR= 3.9 (1.75, 9.42) P= 0.000. Perilous overtaking and overtaking at prohibited overtaking zones had nine times more chance or risk of fatality OR= 9.9 (4.92, 19.19) P= 0.000. Road traffic signs are important indicators which are there to assure safe driving, and drivers should observe and comply with these rules and signs. Pedestrians should have a basic understanding of road signs that are applicable to them.

In the next section the type of motor vehicles involved in MVAs in the Oshana Region will be presented.

4.2.4 Motor vehicles

The type of motor vehicles and their association with MVAs will be presented underneath.

A relationship between vehicle type and severity of injuries will also be presented in this section. Table ten presents the distribution of types of motor vehicles involved in MVAs in Oshana region, Namibia.

Table 10. Distribution of MVAs by type of vehicle, Oshana, Region, Namibia, 2013-2015

Vehicle type	MVAs	%
Buses	159	3.07
Light delivery vehicle	2359	45.51
Motor car	2119	40.88
Motor Cycle	23	0.44
Sedan Taxi	273	5.27
Trucks	172	1.32
Others	79	1.52
TOTAL	**5184**	**100**

The majority of MVAs that occurred in the Oshana region during the period of this study, were associated with light delivery vehicles, i.e. a total of 2359 (45.51%) of all MVAs. Motor cars followed as having the second highest frequency of accidents, namely 2119 (40.88%). Sedan taxis were involved in MVAs 273 (5.27%) times. Motor cycles were involved in accidents the least, i.e. 23 (0.44%) times during the period 2013 to 2015. Light delivery vehicles, motor cars and sedan taxis are in high demand in the region and their volume is increased compared to buses and other types of vehicles. It is therefore not strange that these types of vehicles are involved in MVAs more than other vehicles.

The table below illustrates how the type of motor vehicle affects the severities of injuries during MVAs in Oshana region.

Table 11. Distribution of MVAs by type of vehicle and the related effects on injuries severity, Oshana, Region, Namibia, 2013-2015

Vehicle type		Serious Injuries				Fatalities			
	MVAs	Cases	OR	95%CI	P-value	Cases	OR	95%CI	P-value
Buses	159	11	1.0	(0.48,0.69)	0.76	2	0.5	90.14,2.34)	0.434
Light delivery vehicle	2359	193	1.9	(0.96,1.45)	0.11	48	0.9	(0.62,1.33)	0.628
Motor car	2119	141	0.8	(0.64,0.99)	0.044	45	0.9	(0.67,1.49)	0.942
Motor Cycle	23	2	1.2	(0.18,4.35)	0.833	0		-	-
Sedan Taxi	273	20	1.0	(0.60,1.54)	0.889	4	0.7	(0.24,1.82)	0.42
Trucks	172	9	0.7	(0.33,1.31)	0.24	10	3.0	(1.53,5.85)	0.007
Others	79	15	2.9	(1.66,5.22)	0.001	2	1.2	(0.288,4.98)	0.809
TOTAL	**5184**	**391**				**111**			

There was no difference found between the severity of injuries and the type of vehicle. However, the study found that vehicles indicated under the type of "others" in the records had a risk of serious injuries when involved in an accident OR= 2.9 (1.66, 5.22) 0.001. This indicates that those types of vehicle have roughly a three times higher risk of serious injuries in comparison with other types of vehicles mentioned in Table 11 above. These "other" or uncommon vehicles can be caravans, trailers, panel vans and donkey carts. These findings on the uncommon types of vehicles posing a higher risk for severe injuries are found to be consistent with a study done on human and vehicle

factors in MVAs in Iran where it was also found that uncommon types of vehicles such as trains and carts are associated with severe injuries (Mahdi et al. 2012).

The risk of death was almost equally distributed amongst all types of vehicles with the exceptions of the death rates related to MVAs in which trucks were involved. Drivers and passengers involved in truck accidents were found to be three times more at risk of death compared to any type of vehicle OR= 3.0 (1.53,5.85) 0.007. The Mid-American Transportation Center also found that statistics clearly demonstrated that large-truck-crashes contribute to a significant percentage of high-severity injuries (Kotikalapudi, 2012), correlating those findings with the findings noted in the Oshana Region.

Table 12 below is showing the findings of logistic regression on tyre burst and fatalities.

Table 12. Logistic regression on tyre bursts related to fatalities and injuries, Oshana Region, Namibia, 2013-2016

Factor: Outcomes	OR	95% CI	co-efficient	SE	Z statistic	P-value
Tyre burst: fatality	6.0	(2.32,15.54)	1.79	0.48	3.69	0.02
Tyre burst: injury	9.0	(4.66,16.8)	2.18	0.32	6.65	0.00

The risk of fatality was higher in MVAs that had a tyre burst OR= 6.0 (2.32, 15.54) P= 0.05. This means that driving in a vehicle with tyres worn out, old or having some irregularities which may cause a tyre burst indicated a six times higher risk of death

compared to the factors shown in Table 12 Bursting of tyres that end in MVAs indicated a very high risk of causing severe injuries to people OR= 9.0 (4.66, 16.8) P= 0.00 which relates well with the findings of a study done in Europe on tyre burst (Pearl, 2014).

4.3 Summary

A quantitative cross-sectional study was conducted on selected factors influencing MVAs and the severity of related injuries in the Oshana region, from 2013 to 2015. The factors were categorized as human, environmental and vehicle as major categorical factors. Most of the MVAs that happened in the Oshana region were influenced by the attitude of drivers on the road. Drivers do not adhere to the rules and signals which contribute to the number of MVAs in the Oshana region. MVAs in the Oshana region were also influenced by the type of vehicle. The light delivery vehicles were seen to have been involved in crashes more frequently than any other type of vehicles (45.51%). Tyre bursts have caused most of the severe injuries in the Oshana region. The majority of MVAs occurred at slip way junctions.

The following chapter is the last chapter of the study. It will present the three main parts namely, conclusion, recommendations and the study limitations.

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

5.1 Introduction

The study revealed three main factors that were found to have caused MVAs in the Oshana region namely, human, vehicle and environmental factors. In addition, the same factors contributed to the severity of injuries. This concluding chapter will recapture the aims and objectives of the study, provide recommendations and address the limitations of the study.

The purpose of this study was to analyze factors contributing to Motor Vehicle Accidents in the Oshana region of Namibia during the period of 2013 to 2015 as well as the severity of related injuries.

The specific objectives of the study were to:

1. Identify and analyze human, vehicle and environmental factors contributing to Motor Vehicle Accidents in the Oshana region.
2. Classify the severity of injuries related to human, vehicle and environmental factors contributing to MVAs in the Oshana region.

5.2 Conclusion

Based on the analysis of the data extracted from the Namibia Road Accidents forms, the following conclusions drawn from the results of this study regarding the contribution of human, vehicle and environment factors to MVAs in Oshana region, as well as the severity of injuries related to these factors is as follow:

5.2.1 Study objective 1: Identify and analyze human, vehicle and environmental factors contributing to Motor Vehicle Accidents in the Oshana region.

The study identified that human attitudes have caused the majority of MVAs in the region. Drivers did not adhere to road traffic signs which resulted in more vehicle accidents. People between the ages of 15 and 45 years involved more in MVAs than any other age group investigated.

Light delivery vehicles and sedan vehicles were mostly involved in MVAs, compared to other types of vehicles such as buses and trucks that involved in less than 200 MVAs.

Different environmental factors contributed to MVAs. MVAs in Oshana region during the study period occurred most frequently at different types of junctions and vehicles crashed against fixed objects along the road. The time of day and days of the week also influenced MVAs because MVAs occurred more frequently on Fridays, Saturdays and Mondays. MVAs were also reported more frequently at night, or in the early morning

hours. Festive season months such as April, August and December have shown an increase in MVAs throughout the study period.

The data regarding human, vehicle and environment factors and their contribution to MVAs indicated that these factors have different contributions to MVAs in the Oshana region during the study period.

General information of the MVAs that occurred in Oshana region during the period of the study indicated that: Ondangwa police station has recorded the majority of cases over the study period; least cases were recorded by Ongwediva police station. The majority of accidents considering the type in the Oshana region were head/rear end crashes, also side swipe in the same direction and least crashes had involved a train. The number of severe injuries has decreased between the year 2013 and 2015 while only a slight decrease in a number of fatalities.

Weekends, months end, festive seasons as well as night driving contribute mostly to MVAs, severe injuries and fatalities.

5.2.2 Study objective 2: Classification of the severity of injuries related to human, vehicle and environmental factors contributing to MVAs in the Oshana region.

Logistic regression results revealed that driving at night was more likely to cause MVAs that resulted in serious injuries sustained by accident victims. Human error or nonadherence to traffic signs had a risk of causing serious injuries in MVAs. The risk of serious injury also increased by nine times more in the event of a tyre burst in MVAs.

The odds of fatalities and serious injuries in MVAs were differently distributed among the contributing factors investigated in this study. Dangerous overtaking was ten times more likely to cause fatalities when it caused a MVA. This was also the highest risk of fatality found in fatalities compared to other factors. MVAs of trucks posed the highest risk of fatalities on the roads. Nonadherence to traffic signs and night time driving (18h00 to 06h00) had a high association with fatalities in MVAs in the Oshana region during the study period.

With regards to the environment, curved roads had a three times higher risk of MVAs with fatal injuries occurring in these instances compared to other road environment factors. The risk of serious injuries increased in MVAs occurred on bumpy roads, pot holed road, corrugated roads. Slip way junctions MVAs has the highest risk of serious injuries sustained by the accident victims.

5.3 Recommendations

A lot still needs to be done to address the issue of traffic safety in Namibia as there is no significant reduction in the number MVAs, serious injuries and fatalities recorded between 2013-2015. The study recommends an ongoing monitoring and evaluation of traffic and road users regarding safer road use needs to be strengthened in the region. It is further recommended that awareness in the in the reduction of MVAs should be made in tertiary education institutes such as Universities, Vocational training Centers where young people stays.

Accurate data collection and recording of all information related to MVAs on the Namibia Road Accident Form by police officers is needed to establish the risk factors

contributing to MVAs and for designing preventive strategies. Refresher trainings courses are also needed. Training should be given to all road users including the pedestrians, while the Namibia Road Accident form needs to be revised and adapted according to the newest available data on MVAs.

Consecutive studies should be conducted to establish knowledge gaps on all factors associated with MVAs. Regular educational/awareness campaigns for all road users should be organized by NRSC. The awareness campaigns should be done in all regional languages across Namibia. The awareness can include factors such as safe time to drive; speeding and alcohol use and driving. Every driver and possibly all passengers should be given a leaflet on motor vehicle accident awareness when they visit centers for traffic services such as the National Road safety Council (NRSC), Namibia Traffic Management Solution (NTMS), Namibian Traffic Information System (NaTIS) and the MVA fund. More studies need to be done on possible solutions to decrease MVAs apart from what is currently in action. Drivers need to be given special training on ethics in driving. A course or training aimed at providing more understanding to all drivers on how to behave while driving, and extending on the basic skills of driving drivers receive currently, need to be in place. Awareness and prevention campaigns should target the most vulnerable age group between 18 and 45 years of age, who are most likely to be involved in MVAs.

A heavy penalty should be imposed to all drivers who cause an accident as result of no adherent to road signs and traffic rules. Age limit for obtaining a driver's license for heavy vehicle and public vehicles should be raised to 25 years.

The study recommends the strengthening of vehicle road worthiness check at all traffic road block in Namibia. This includes inspecting of tyres, vehicle brakes and lights. Worn tyre treads can have disastrous consequences on the road. A sudden flat tyre at high speed could send your car into an uncontrollable swerve off the road or into other vehicles or immovable objects.

5.4 Limitations of the study

Since the study was only conducted in the Oshana region, which is only one of the 13 regions of Namibia, the study data cannot be generalized to the entire country.

The study only covered three major factors contributing to MVAs which are; human, vehicle and environmental factors and therefore did not address all the possible factors contributing to MVAs in the Oshana region.

Some of the MVA records for the Oshana region were incomplete, especially information on passengers and vehicle faults such as breaks and light failures. The incomplete records may have deviated the results of the study as the representativeness of the study could also be affected. Incompleteness of accident forms was also a limitation in the sense that some of the required variables for the study were missing in the records and this affected proper identification of the factors of interest in the study investigation.

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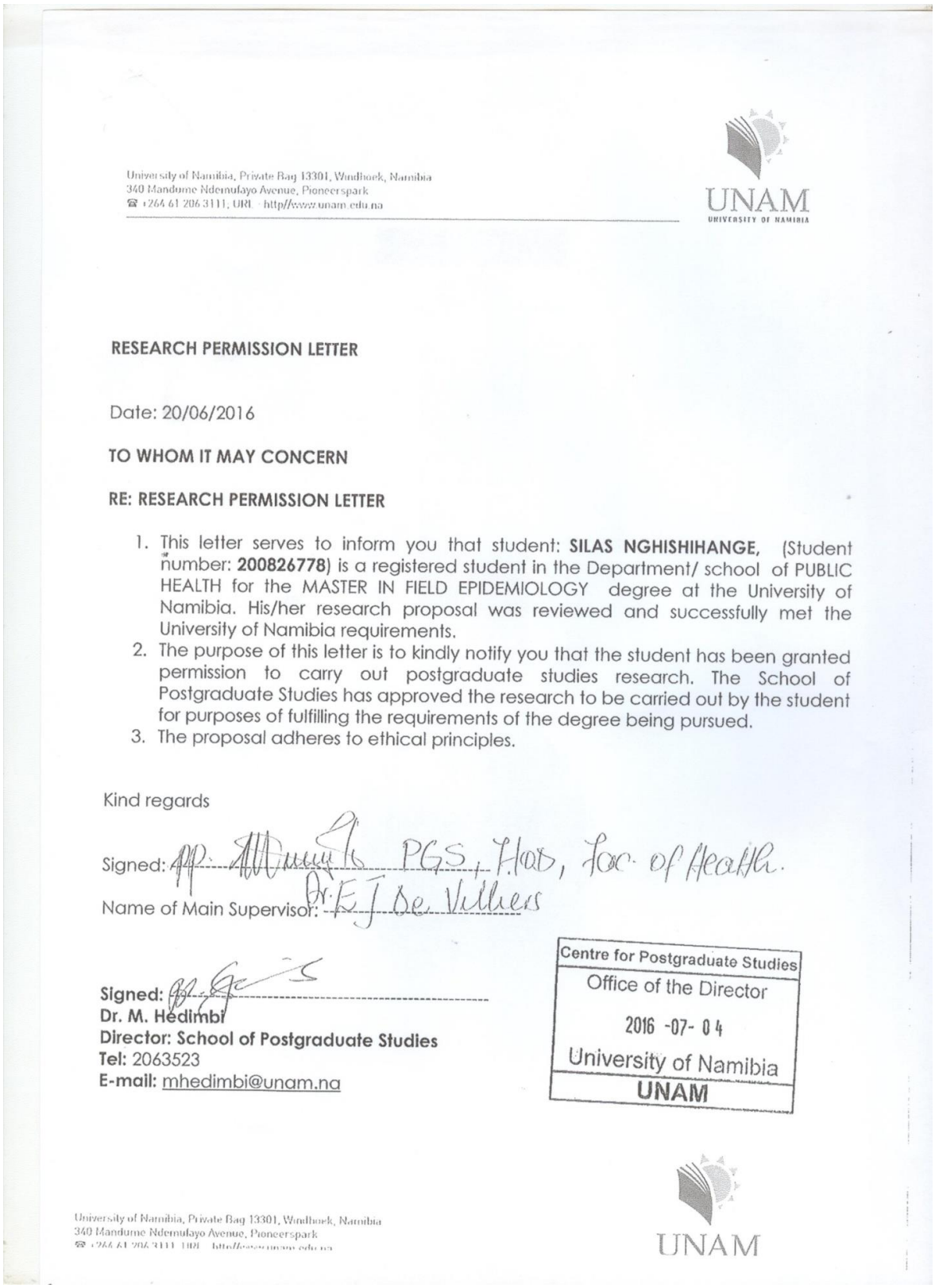
ANNEXURES

Annexure A: Letter of approval from the post Graduate Studies Committee-University of Namibia



University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneerspark
☎ +264 61 206 3111; URL - http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

RESEARCH PERMISSION LETTER

Date: 20/06/2016

TO WHOM IT MAY CONCERN

RE: RESEARCH PERMISSION LETTER

1. This letter serves to inform you that student: **SILAS NGHISHIHANGE,** (Student number: **200826778**) is a registered student in the Department/ school of PUBLIC HEALTH for the MASTER IN FIELD EPIDEMIOLOGY degree at the University of Namibia. His/her research proposal was reviewed and successfully met the University of Namibia requirements.
2. The purpose of this letter is to kindly notify you that the student has been granted permission to carry out postgraduate studies research. The School of Postgraduate Studies has approved the research to be carried out by the student for purposes of fulfilling the requirements of the degree being pursued.
3. The proposal adheres to ethical principles.

Kind regards

Signed: ..... PGS, HOD, Fac. of Health.

Name of Main Supervisor: Dr. E.J. De Villiers

Signed: .....
Dr. M. Hedimbi
Director: School of Postgraduate Studies
Tel: 2063523
E-mail: mhedimbi@unam.na

Centre for Postgraduate Studies
Office of the Director
2016 -07- 04
University of Namibia
UNAM

University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneerspark
☎ +264 61 206 3111; URL - http//www.unam.edu.na

UNAM

Annexure B: Letter of approval from the National Road Safety Council of Namibia

National Road Safety Council

Wednesday, 03 August 2016

Enquiries: Johannes Shekeni
E: Johannes@nrsc.org.na | C: +264 81 143 3911

Silas Nghishihange
P. O. Box 11004
0shakati, NAMIBIA

Dear Mr Nghishihange

RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH ON FACTORS CONTRIBUTING MOTOR VEHICLE ACCIDENTS (MVAS) AND SEVERITY OF RELATED INJURIES IN OSHANA REGION

The subject matter above in your correspondence dated 18 July 2016 refers.

Kindly note that we have no objection with you conducting the study. Furthermore, we do not necessarily expect you to make a presentation to us as the study is not commissioned by our office. However, we accept the opportunity to receive a copy of the study once completed.

Sincerely yours,

EXECUTIVE SECRETARY
03 AUG 2016
NATIONAL ROAD SAFETY COUNCIL

Eugene Tendekule
Executive Secretary

DECADE OF ACTION FOR ROAD SAFETY 2011-2020

C/O Harold Pupkewitz & Independence Avenue • P O Box 113 Windhoek, Namibia
Tel: +264 61 231 717 • Fax: +264 61 239 745
Website: www.nrsc.org.na

Annexure C: Ethical clearance certificate from the University of Namibia

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: SONPH/121/2016 **Date: 9 September, 2016**

This Ethical Clearance Certificate is issued by the University of Namibia Research Ethics Committee (UREC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the Faculty/Centre/Campus Research & Publications Committee sitting with the Postgraduate Studies Committee.

Title of Project: Factors Contributing To Motor Vehicle Accidents and Severity of Related Injuries in Oshana Region Namibia'

Nature/Level of Project: Masters

Researcher: S. Nghishihange

Student Number : 200826778

Faculty: School of Nursing and Public Health

Supervisor : Dr. J.E. de Villers (Main);Ms. L. van der Westhuizen

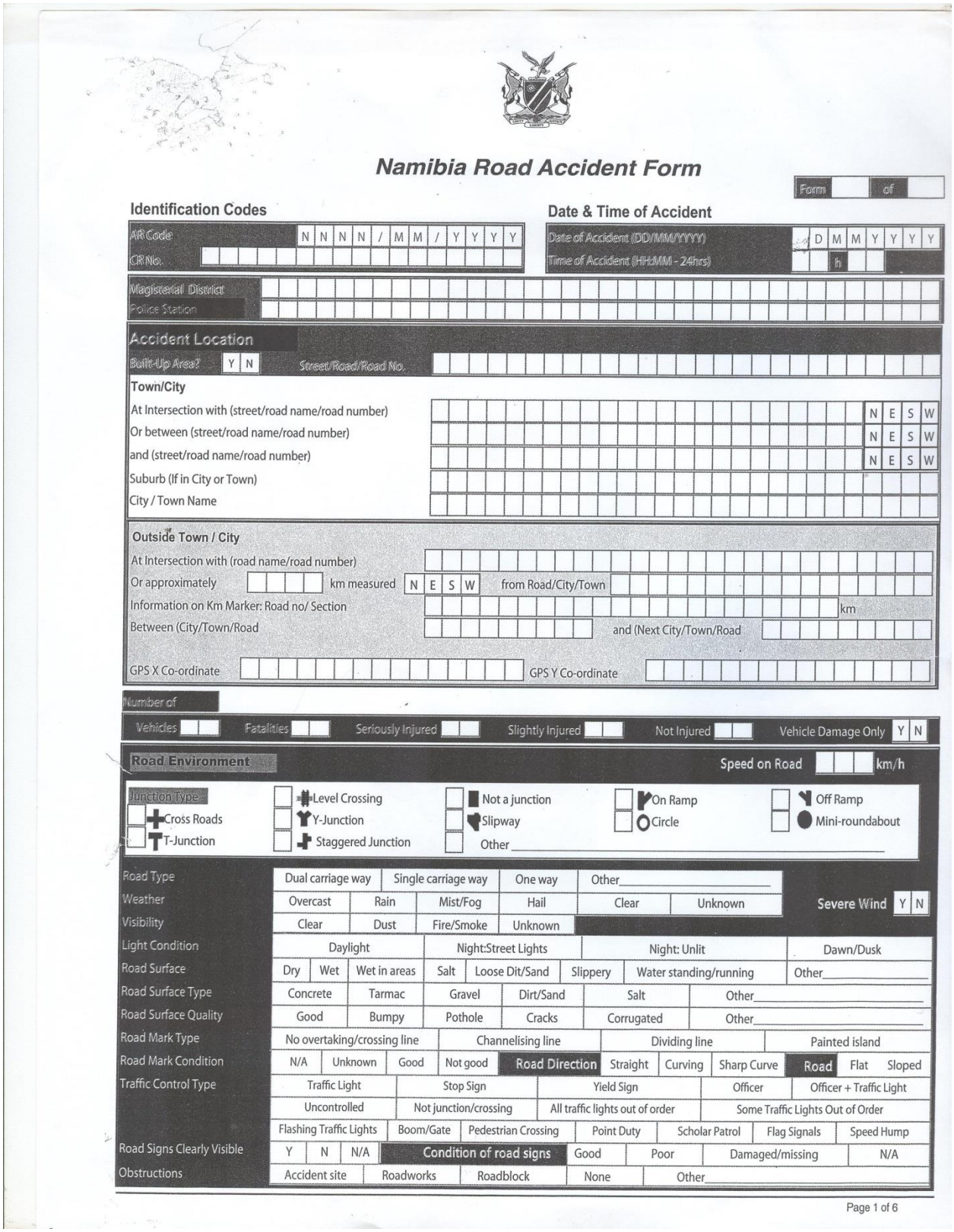
Take note of the following:

(a) Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the UREC. An application to make amendments may be necessary.
(b) Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the UREC.
(c) The Principal Researcher must report issues of ethical compliance to the UREC (through the Chairperson of the Faculty/Centre/Campus Research & Publications Committee) at the end of the Project or as may be requested by UREC.
(d) The UREC retains the right to:
  (i). withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
  (ii). request for an ethical compliance report at any point during the course of the research.

UREC wishes you the best in your research.

Dr. H. Kapenda
Director –Centre for Research and Publications
ON BEHALF OF UREC

Annexure D: Namibia Road Accident Form



Namibia Road Accident Form

Form ____ of ____

Identification Codes

AR Code: N N N N / M M / Y Y Y Y

CR No.:

Date & Time of Accident

Date of Accident (DD/MM/YYYY): D D M M Y Y Y Y

Time of Accident (HHMM - 24hrs): ____ h ____

Magisterial District:

Police Station:

Accident Location

Built-Up Area? Y N Street/Road/Road No.:

Town/City

At Intersection with (street/road name/road number) N E S W

Or between (street/road name/road number) N E S W

and (street/road name/road number) N E S W

Suburb (If in City or Town)

City / Town Name

Outside Town / City

At Intersection with (road name/road number)

Or approximately ____ km measured N E S W from Road/City/Town

Information on Km Marker: Road no/ Section ____ km

Between (City/Town/Road ____ and (Next City/Town/Road

GPS X Co-ordinate GPS Y Co-ordinate

Number of

Vehicles ____ Fatalities ____ Seriously Injured ____ Slightly Injured ____ Not Injured ____ Vehicle Damage Only Y N

Road Environment

Speed on Road ____ km/h

Junction Type:

- Cross Roads
- T-Junction
- Level Crossing
- Y-Junction
- Staggered Junction
- Not a junction
- Slipway
- Other _____
- On Ramp
- Circle
- Off Ramp
- Mini-roundabout

Road Type	Dual carriage way	Single carriage way	One way	Other_____			
Weather	Overcast	Rain	Mist/Fog	Hail	Clear	Unknown	Severe Wind Y N
Visibility	Clear	Dust	Fire/Smoke	Unknown			
Light Condition	Daylight	Night:Street Lights	Night: Unlit	Dawn/Dusk			
Road Surface	Dry	Wet	Wet in areas	Salt	Loose Dit/Sand	Slippery	Water standing/running / Other_____
Road Surface Type	Concrete	Tarmac	Gravel	Dirt/Sand	Salt	Other_____	
Road Surface Quality	Good	Bumpy	Pothole	Cracks	Corrugated	Other_____	
Road Mark Type	No overtaking/crossing line	Channelising line	Dividing line	Painted island			
Road Mark Condition	N/A	Unknown	Good	Not good	Road Direction	Straight	Curving / Sharp Curve / Road / Flat / Sloped
Traffic Control Type	Traffic Light	Stop Sign	Yield Sign	Officer	Officer + Traffic Light		
	Uncontrolled	Not junction/crossing	All traffic lights out of order	Some Traffic Lights Out of Order			
	Flashing Traffic Lights	Boom/Gate	Pedestrian Crossing	Point Duty	Scholar Patrol	Flag Signals	Speed Hump
Road Signs Clearly Visible	Y	N	N/A	Condition of road signs	Good	Poor	Damaged/missing / N/A
Obstructions	Accident site	Roadworks	Roadblock	None	Other_____		

Form of

Vehicle Information

Vehicle Reference A or

Number Plate No.
Chassis Number
Color
Make e.g.BMW
Series e.g. 3 Series
Vehicle Model e.g. 328i
Licence Disk No.
Licence Valid? Y N
Dangerous Goods? Y N
Breakdown Company
Breakdown Reg.No
No.Passengers (excl Driver)
Tyre Appears to Have Burst Y N Unknown

Year Model
Spillage? Y N Gas Emission? Y N
Length of Skid Marks (m)

Vehicle Information

Vehicle Reference B or

Year Model
Gas Emission? Y N Spillage? Y N
Length of Skid Marks (m)

Vehicle Type

Write vehicle reference (A,B,C etc.) in the blocks

Passenger Vehicles
- Motor car/station wagon
- Sedan Taxi
- Minibus
- Minibus Taxi
- Midibus
- Bus

Goods Vehicl
- Light delivery vehicle
- Panelvan
- GV M>3500kg
- Truck: Articulated
- Truck: Articulated Multiple

Motor Cycles
- 125cc and Under
- Above 125cc
- Tri-cycle
- Quadru-cycle

Other Vehicles
- Bicycle
- Mobile Equipment
- Caravan/Trailer
- Tractor
- Animal Drawn Vehicle
- Other_____

Position of Vehicle Before Accident — Write vehicle reference (A,B,C etc.) in the blocks

Correct road lane | Wrong road lane | Wrong side of road | Road Shoulder | On-road parking bay | Off-road parking bay

What Was Driver/s Doing

Write vehicle reference (A,B,C etc.) in the blocks

- Turning Right
- Diverging
- Sudden Start
- Slowing Down
- Turning Left
- Overtaking (R)
- Sudden Stop
- Avoiding Object
- U-Turn
- Overtaking (L)
- Busy Parking
- Stationary e.g.waiting
- Enter traffic flow
- Travelling straight
- Changing lane
- Parked
- Merging
- Reversing
- Swerving
- Other_____

Accident Type

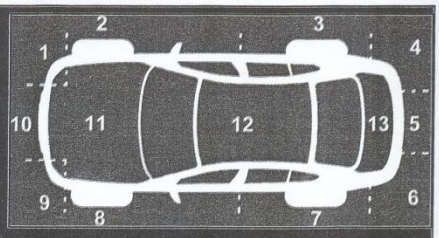
Only one Accident Type per Accident should be specified. Tick the appropraite box

- Head/rear end
- Head on
- Sidewipe:opposite directions
- Sideswipe:same direction
- Turn right in face of incoming traffic
- Approach at angle-both travelling straight
- Approach at angle-one or both turning
- With fixed object (Specify)_____
- Single vehicle overturned
- With pedestrian
- With train
- Other (Specify)_____
- With animal Specify _____
- With Bird
- With Stones
- Passenger Fell off Car
- Went off road without rolling

Vehicle Damage

Write vehicle reference (A,B,C etc.) in the blocks

- 1. Right front
- 2. Right mid-front
- 3. Right mid-back
- 4. Back right
- 5. Back center
- 6. Back left
- 7. Left mid-back
- 8. Left mid-front
- 9. Left front
- 10. Front center
- 11. Bonnet
- 12. Roof
- 13. Boot
- 14. Multiple
- 15. Caught Fire
- 16. Rolled
- 17. Damage (undercarriage)
- 18. Damage (no detail)
- 19. Windscreen/windows
- 20. No damage



Y N Damage to Public Property? Specify_____

Form of

Persons Involved	Person Reference P1 or		Persons Involved	Person Reference P2 or
		Name / Surname		
		Phone Number at Home		
		Phone Number at Work		
		Cell Phone Number		
Person is (Tick appropriate box/es)			Person is (Tick appropriate box/es)	
Driver / Passenger / Pedestrian / Cyclist	In vehicle? (Vehicle Reference e.g. A) / Witness / Injured		Driver / Passenger / Pedestrian / Cyclist	In vehicle? (Vehicle Reference e.g. A) / Witness / Injured

Complete this Section if ticked: Driver or Injured		Complete this Section if ticked: Driver or Injured
	ID Number	
Age / Male / Female	Gender	Male / Female / Age
Y N	Employed?	Y N
	Nationality	
Y N	Foreigner?	Y N
	Residential/Home Address	
	Work Address	
No Injury / Slight / Serious / Dead	Severity of Injury	No Injury / Slight / Serious / Dead
D D M M Y Y Y Y	Date of Death	D D M M Y Y Y Y
	Ambulance Service	
	Paramedic Name/Surname	
	Paramedic ID	
	Paramedic Contact No.	
	Case Ref No. / Hospital	
Y N	Tested for Drugs?	Y N
Tested for Alcohol? Y N	Liquor/Drug Use Suspected?	Y N / Tested for Alcohol? Y N
	Seal/Breath Evidential Ref.No.	
Y N	Seatbelt/Helmet Used	Y N

Complete this Section if ticked: Driver		Complete this Section if ticked: Driver
	Driving Licence Number	
A1 / A / B / C1 / C / BE / C1E / CE	Driving Licence Code	A1 / A / B / C1 / C / BE / C1E / CE
D D M M Y Y Y Y	Driving Licence Expiry	D D M M Y Y Y Y

Complete this Section if ticked:Pedestrian/Cyclist		Complete this Section if ticked:Pedestrian/Cyclist
Roadway / Sidewalk/Verge / Shoulder of Road / Median	Position	Roadway / Sidewalk/Verge / Shoulder of Road / Median
Not at Crossing / Within 50m of Crossing	Location	Not at Crossing / Within 50m of Crossing
Within marked pedestrian crossing		Within marked pedestrian crossing
Facing Traffic / Back To Traffic / Crossing Road	Manoever	Facing Traffic / Back To Traffic / Crossing Road
Walking / Running / Standing / Playing	Pedestrian Action	Walking / Running / Standing / Playing
Sitting / Lying / Working / Jaywalking		Sitting / Lying / Working / Jaywalking
Light / Dark / Light and Dark / Reflective	Clothing	Light / Dark / Light and Dark / Reflective

Additional Witness	Person Reference	Additional Witness
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Description of Accident

Form ____ of ____

Description of Road User A or ____

Description of Road User B or ____

Signature

Signature

Rough Sketch of Accident

In case of prosecution, a detailed sketch has to be provided. The sketch should only be the view of the Investgating Officer

OFFICIAL DETAILS

☐ Particulars have been recorded at ___ h ___

☐ A plan of the collision was available on D D M M Y Y Y Y

☐ The collision was investigated on D D M M Y Y Y Y

Recording Officer

Official No.

Rank

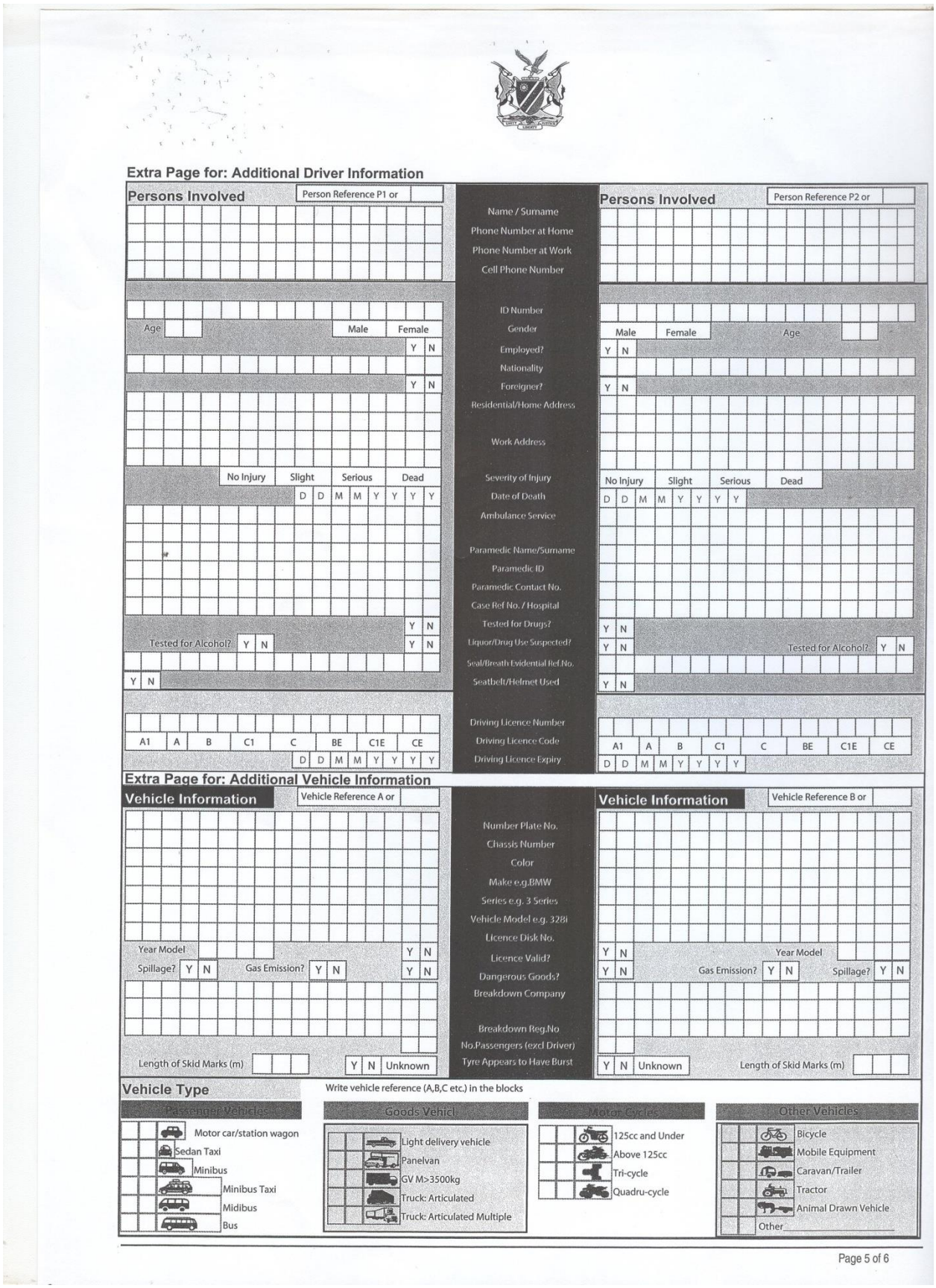
Investigating Officer

Official No.

Rank

Date Stamp

Signature



Extra Page for: Additional Driver Information

Persons Involved — Person Reference P1 or

Name / Surname
Phone Number at Home
Phone Number at Work
Cell Phone Number
ID Number
Age
Gender — Male / Female
Employed? Y N
Nationality
Foreigner? Y N
Residential/Home Address
Work Address
Severity of Injury — No Injury / Slight / Serious / Dead
Date of Death — D D M M Y Y Y Y
Ambulance Service
Paramedic Name/Surname
Paramedic ID
Paramedic Contact No.
Case Ref No. / Hospital
Tested for Drugs? Y N
Tested for Alcohol? Y N
Liquor/Drug Use Suspected? Y N
Seat/Breath Evidential Ref.No.
Seatbelt/Helmet Used Y N
Driving Licence Number
Driving Licence Code — A1 A B C1 C BE C1E CE
Driving Licence Expiry — D D M M Y Y Y Y

Persons Involved — Person Reference P2 or

Male / Female
Age
Employed? Y N
Foreigner? Y N
Severity of Injury — No Injury / Slight / Serious / Dead
Date of Death — D D M M Y Y Y Y
Tested for Drugs? Y N
Tested for Alcohol? Y N
Liquor/Drug Use Suspected? Y N
Seatbelt/Helmet Used Y N
Driving Licence Code — A1 A B C1 C BE C1E CE
Driving Licence Expiry — D D M M Y Y Y Y

Extra Page for: Additional Vehicle Information

Vehicle Information — Vehicle Reference A or

Number Plate No.
Chassis Number
Color
Make e.g.BMW
Series e.g. 3 Series
Vehicle Model e.g. 328i
Licence Disk No.
Licence Valid? Y N
Year Model
Dangerous Goods? Y N
Spillage? Y N
Gas Emission? Y N
Breakdown Company
Breakdown Reg.No
No.Passengers (excl Driver)
Tyre Appears to Have Burst Y N Unknown
Length of Skid Marks (m)

Vehicle Information — Vehicle Reference B or

Licence Valid? Y N
Year Model
Dangerous Goods? Y N
Gas Emission? Y N
Spillage? Y N
Tyre Appears to Have Burst Y N Unknown
Length of Skid Marks (m)

Vehicle Type

Write vehicle reference (A,B,C etc.) in the blocks

Passenger Vehicles
- Motor car/station wagon
- Sedan Taxi
- Minibus
- Minibus Taxi
- Midibus
- Bus

Goods Vehicl
- Light delivery vehicle
- Panelvan
- GV M>3500kg
- Truck: Articulated
- Truck: Articulated Multiple

Motor Cycles
- 125cc and Under
- Above 125cc
- Tri-cycle
- Quadru-cycle

Other Vehicles
- Bicycle
- Mobile Equipment
- Caravan/Trailer
- Tractor
- Animal Drawn Vehicle
- Other

Extra page for persons not injured

Ar No.

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Additional Person	Person Reference	Additional Person
	Name / Surname	
	Phone Number at Home	
	Phone Number at Work	
	Cell Phone Number	

Annexure E: Data abstract form

UNIVERSITY OF NAMIBIA

SCHOOL OF NURSING AND PUBLIC HEALTH

FACTORS CONTRIBUTING TO MOTOR VEHICLE ACCIDENTS AND SEVERITY OF RELATED INJURIES IN OSHANA REGION, NAMIBIA

DATA ABSTRACTION FORM FOR FACTORS CONTRIBUTING TO MOTOR VEHICLE ACCIDENTS AND SEVERITY OF RELATED INJURIES

Introduction

This data extraction form will be used to assist, Silas Nghishihange (Mr.): a University of Namibia student studying toward a Master of Public Health to collect data on factors contributing to Motor Vehicle Accidents (MVAs) in Oshana region 2011-2015. This will be done by extracting study variables from Namibia Road Accident Form (NRAF).

No reference will be made to names of drivers or passengers in this form. Study results will only present quantitative data of factors and related injuries. Information extracted will be on a computer which will be protected by a password and only accessible by the researcher.

STUDY VARIABLES EXTRACTION FORM

1. Accident's information

1. Accident no
2. Day of week
3. Date of Accident
4. Time of Accident
5. Place of Accidents

2. Type of Accident

Head on collision

Overturn

With Pedestrian

With fixed Object

With an animal

3. Vehicles particulars

Number of vehicle in Accident ☐

Type of vehicle		Vehicles faults	
Motor car	☐	Break faults	☐
Sedan taxi	☐	Lights faults	☐
Bus	☐	Tyres faults	☐
Light delivery vehicle	☐		
Truck articulated	☐		

Age/model of vehicle ☐

4. Human attitudes (Drivers)

Over speeding ☐

Alcoholic influence ☐

Prohibited U-turn ☐

Prohibited overtaking ☐

No seat – belt ☐

Usage of cell phone ☐

5. Environmental conditions

Roads environments

4 ways stop	☐	One way	☐
T- Junction	☐	Single way	☐
Y-Junction	☐	Free way	☐
Curve	☐	Dual carriage way	☐
Sharp curve	☐	Tired road	☐
Unclear road sign	☐	Gravel road	☐

Weather

Severe wind	☐
Rain	☐
Overcast	☐
Clear	☐

6. Injuries and driver's particulars

Age of driver ☐

Sex ☐

Driver licensed

Yes ☐

No ☐

Degrees of injury for a driver

Serious injury ☐

No injury ☐

Driver died

Yes ☐

No ☐

Degree of injury for passengers

Number of serious injuries ☐

Number of uninjured ☐

Number of passengers died

Male ☐

Female ☐

Total ☐