

**ROAD TRAFFIC INJURIES, DEATHS AND ITS IMPACT ON
INDIVIDUALS AND FAMILIES IN NEPAL**

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DOCTOR OF PHILOSOPHY
in
POPULATION STUDIES**

**Submitted BY
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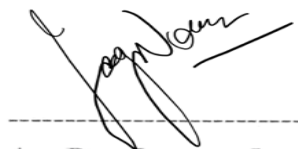
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LETTER OF RECOMMENDATION

We certify that this dissertation entitled **ROAD TRAFFIC INJURIES, DEATHS AND ITS IMPACT ON INDIVIDUALS AND FAMILIES IN NEPAL** by Bhagabati Sedain, has been prepared under our supervision and guidance. We hereby recommended this dissertation for final examination by Research Committee of the Faculty of Humanities and Social Sciences, in the fulfilment of requirements for the degree of DOCTOR OF PHILOSOPHY IN POPULATION STUDIES.

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APPROVAL LETTER

DECLARATION

I confirm that the PhD dissertation entitled **ROAD TRAFFIC INJURIES, DEATHS AND ITS IMPACT ON INDIVIDUALS AND FAMILIES IN NEPAL** which I am submitting to the Office of the Dean, Faculty of Humanities and Social Sciences, Tribhuvan University, is entirely my own original work, produced under the supervision of my supervisors. I verify that if any information has been sourced from external sources, it has been duly indicated in the dissertation. I have not presented or submitted any portion of this dissertation elsewhere for any degree or other purposes. None of this dissertation's content has been published as part of any journal article or book. I accept full responsibility for any findings that may contradict my declaration.

.....

Bhagabati Sedain

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Date: January 2025

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ABSTRACT

Background

Road Traffic Injuries (RTIs) are a major public health issue, leading to numerous deaths, injuries, and disabilities worldwide. In a low-income country like Nepal, the road safety situation is alarming. This mixed-methods study aims to: i) assess the status of road traffic deaths and injuries; ii) identify factors contributing to these deaths; and iii) explore the impact on victims and their families.

Methods

In this dissertation, the systematic review, quantitative analysis of the national level road crash information based on Nepal Police data for 2018/19, and qualitative information obtained by face-to face in-depth interviews were presented. It consists of four different analysis: a) systematic review, b) descriptive analysis of road traffic death and injuries, c) prediction of road traffic attributes by utilizing Random Forest Model, and d) qualitative analysis on the impact of road traffic crashes to the victims and their families. A mixed method of quantitative and qualitative approaches has been used to obtain information on road traffic crashes in Nepal.

Results

There is limited road safety research in the SAARC region, and studies about the impact of road crashes on victims and families are almost non-existent in this region. In 2018/19, there were 14,197 road crashes in Nepal, resulting 23,319 injuries and 2,192 deaths. The mean age of the victims was 30.89 years, and 75% of the crash incidents occurred among males, and approximately 40% of the victims were aged 15-29. The casualty rate was 96.29 per 100,000 population, with the highest number of deaths and injuries occurring between 4:00 pm and 8:00 pm, particularly on Saturdays. The months of April, October, and November also have a higher number of road crash incidents. Road traffic injuries (RTIs) were most prevalent in Bagmati Province (40%), followed by Lumbini

(19%) and Madhesh Province (17%), with the highest chances of death in Sudurpaschim. The uses of two-wheelers were found to be major contributing factor for increasing the number of road traffic deaths and injuries in Nepal. The Random Forest (RF) model predicted that tractor crashes were the most risky in causing road traffic deaths, followed by the passenger bus, two-wheeler and truck crashes. Similarly, the likelihood of road crash deaths was high in Sudurpashchim province followed by Lumbini Province.

The findings of the qualitative survey found that the pre-hospital care is limited, with most crash victims inadequately transported to the health services and very few cases transported in an ambulance. Improper transportation of the crash victim appeared as one of the causes of increased injury severity among the road crash victims. RTIs often lead road traffic crash victims to long-term health complications, financial hardship, job loss, school/campus dropout, disturbance in family relation and social problems. It was identified that there is a great need to create emergency road crash treatment fund for emergency rescue, treatment, and rehabilitation. Rehabilitation services and proper counselling can help in speedy recovery, even after hospital discharge. Additionally, sharing experiences with others in similar situations helps reduce stress and offers motivation.

Conclusion

This study provides a new dimension to mortality and morbidity research. It identifies the huge knowledge gap on road crash, deaths, injuries, and the serious impact of crashes on victims and families in Nepal. Importantly, it highlights the urgent need for road safety research to identify crash causes and impacts, enabling evidence-based prevention.

Keyword: Road crashes, deaths, injuries, impact, crash victims

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LIST OF ABBREVIATIONS, ACRONYMS

ADB	Asian Development Bank
BS	Bikram Sambat
CDPS	Central Department of Population Studies
DALYS	Disability Adjusted Life Years
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GNP	Gross National Product
HICs	High Income Countries
HICs	High Income Countries
IDIs	In-depth Interviews
IGP	Inspector General of Police
IHME	Health Metrics and Evaluation
IRTAD	International Traffic Safety Data and Analysis Group
LMICs	Low and Middle-Income Countries
MDI	Mean Decrease in Impurity
MoHP	Ministry of Health and Population
MoPIT	Ministry of Physical Infrastructure and Transport
MS	Micro Soft
NRSC	National Road Safety Council
RF	Random Forest
RTCs	Road Traffic Crashes
RTDs	Road Traffic Deaths
RTIs	Road Traffic Injuries
SAARC	South Asian Association for Regional Cooperation
SDGs	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
UK	United Kingdom
UN	United Nations
USA	United States of America

VTMA	Motor Vehicle and Transportation Management Act
WB	World Bank
WHO	World Health Organization

CHAPTER I: INTRODUCTION

1.1 Introduction to the Dissertation

Road Traffic Crashes (RTCs) have been increasing dramatically in Low-and-Middle Income Countries (LMICs) and emerging as a serious mortality and morbidity threat in population. Currently, there is limited evidence on road traffic deaths, injuries and its impact on the victim. Relatively few research have been conducted on road safety in LMICs (Haghani, Dixit, & Oviedo-Trespalacios, 2022). Nepal, as a lower income country, is largely impacted by road traffic collisions, many people died and sustain injuries that leads to permanent impairment and disability. The availability of evidence based research findings can provide important basis for policy formulation and effective program implementation. This study aimed to fill the knowledge gap on RTCs, deaths and injuries and their impact on victims and their families in Nepal.

This dissertation includes the systematic review, quantitative analysis of the national level road crash information based on Nepal Police data, and qualitative information obtained by face-to face in-depth interviews. It consists of four different analysis: a) systematic review, b) descriptive analysis of road traffic death and injuries, c) prediction of road traffic attributes, and d) qualitative analysis on the impact of road traffic crashes to the victims and their families. A mixed method of quantitative and qualitative approaches has been used to obtain information on road traffic crashes in Nepal.

This introductory chapter provides the scope of the RTCs problem, the importance of this kind of research, objectives and research questions, and the significance of this particular research.

1.2 Road Crash, Deaths and Injuries

Developing safer road transport systems can save numerous lives from early deaths and disabilities. It also improves people's economic, social, and health status in various ways. At the country level, the road network connects village people with the people residing in the central level and vice versa. It also connects industrial centers with the global market, which directly benefits the nation's economic development (Shi et al., 2019). Likewise, road networks help people by making quality health services accessible (Iimi, 2021). Developing a reliable road network helps create opportunities for national and foreign investors, which in turn improves the job market. Rural roads also play an important role in the sustainable development of agriculture (Zhou et al., 2021). A safer and more reliable road network increase peoples' mobility, capital flow, and commodity flow (Shi et al., 2019). Thus, a safer road is an integral part of the entire development process; on the flip side, poor road condition is associated with vehicular crashes resulting to the injuries, deaths and disabilities. The occurrence of road crashes results in incalculable human losses, injuries, and substantial financial burden.

Road traffic injury is defined as “a fatal or non-fatal injury incurred as a result of a road traffic crash.” Similarly, a road traffic crash is defined as “a collision or incident that may or may not lead to injury, occurring on a road and involving at least one moving vehicle” (Peden et al., 2004).

Driving is a complex process that involves mind-eye-hand-foot coordination and human interaction with a machine while moving on the roads. In addition to these factors, the role of road infrastructure, vehicle maintenance, road safety awareness among users, and comprehensive traffic safety management cannot be overstated. The growing prevalence of vehicles is closely linked to a rise in injuries, disabilities, and fatalities. A

WHO (2023) report showed that Road Traffic Injuries (RTIs) are a major cause of deaths and disabilities worldwide. It further highlighted that number of road traffic injuries has continued to increase in most LMICs, while High-Income Countries (HICs) are also experiencing a substantial number of RTIs. Enormous human resources are being lost, and it has enormous social and economic impacts besides irreplaceable loss of human life (World Bank, 2017). Road traffic injuries also cause physical, financial, psychological and social harm (WHO, 2006), all of which makes RTCs a major threat for preventable deaths and disabilities globally (The International Traffic Safety Data and Analysis Group [IRTAD], 2018) .

The world report on road traffic injuries showed that deaths from road traffic injuries account for 25 percent of deaths from all kinds of injuries (Peden et al., 2004). In 2016, it was estimated that 1.35 million people died prematurely on the world's roads annually (WHO, 2018). It has also been found that the number of people left permanently impaired due to road traffic injuries is nearly proportional to the number of fatalities. Research findings have shown that each road traffic death is equivalent to an average loss of 30 person-years of life expectancy (Barss et al., 1998). These facts demonstrate that RTCs have a devastating impact in the world.

The magnitude of the RTIs differs by economic regions of the world; death rates are more than twice in LMICs than in HICs (WHO, 2013). The global trends in road traffic deaths show that death rates have gone down in HICs, while increasing significantly in LMICs from early 1990s (WHO, 2015). Notably, the South-East Asian region accounted for one-third of the world's total road traffic injuries. Almost 60 percent of the RTI deaths are among people aged 15-44 years, and more than two-third of the deaths occur among

men (WHO, 2013). The WHO projected that unless immediate action is taken, road traffic crashes will increase from being the ninth to the fifth leading cause of death by 2030, and will then cause around 2.4 million deaths per annum (WHO, 2015). The studies of 18 countries from Latin America, East Asia, South Asia, Europe and Central Asia, Middle East, and Africa showed that 1 to 3 percent of the population from these region have been injured from RTIs (Bhalla et al., 2011).

The deaths due to RTIs are much higher among males than females in all regions (WHO, 2016). Demographic analysis has shown that males are more mobile and have a higher risk-taking behaviour compared to females (Hanson & Hanson, 2010). Most of the WHO reports showed that road traffic injury was the second leading cause of deaths among adolescents and youths aged 15-29 years (WHO, 2015), and it became the leading cause of death for this age group in 2016 (WHO, 2018, 2023). It is also very likely that a road traffic crash victim becomes an economic burden to their family since a productive family member turns unproductive: increasing the dependency ratio as a result. (European Transport Safety Council, 2007).

Recognizing the increasing burden of road traffic crashes, in September 2015, the United Nations (UN) General Assembly adopted the Sustainable Development Goals (SDGs) with a road safety target of 3.6, halving the road traffic deaths across the world by 2030 (United Nations, 2015a). WHO also proclaims the inclusion of an RTI target in SDGs as an essential component of addressing preventable deaths and disabilities globally (WHO, 2015). Further, in September 2020, the UN General Assembly adopted resolution A/RES/74/299 with the aim of improving global road safety (UN, 2021).

1.2.1 Road Traffic Crashes, Injuries and Deaths in LMICs

The impact of road traffic crashes in LMICs is more than diseases that have historically affected the population (Peden et al., 2004). The analysis of global road traffic patterns showed that in the absence of amplified efforts and new initiatives, RTIs are expected to increase rapidly in LMICs than any other parts of the world (WHO, 2015).

RTIs have high effects on the youth mortality, morbidity and disability. The death toll from road traffic injuries is higher than deaths from malaria, HIV/AIDS, and tuberculosis combined (WHO, 2018). On average, more than 3,700 people die and thousands more are seriously injured per day globally, with 93 percent of the deaths and injuries occurring in the LMICs (WHO, 2018). The data on the actual number of the RTI survivors with a disability is not available for many countries. An estimate by Peden et al. (2004) showed that every crash death is associated with 20-50 individuals living with injury. According to the Global Burden of Disease (GBD) study conducted by the Institute for Health Metrics and Evaluation (IHME) in 2018, road traffic injuries accounted for approximately 113 million Disability Adjusted Life Years (DALYs) globally. This includes both years of life lost due to premature death and years lived with a disability as a result of road traffic crashes. WHO estimated that more than 50 percent of the world's road traffic mortality occurred among people of the productive age group 15-44 years (Peden et al., 2004). About 60 percent of the DALYs lost due to road traffic injuries were also within this age group. About 45 percent of the world's road traffic deaths occur in Asia, where only 16 percent of the global vehicle fleet is in operation (WHO, 2018).

Since the number of road traffic deaths are increasing in most of the countries, the death rate relative to the world population size is stable and declined relatively with respect to the number of vehicle in recent time (WHO, 2018). Road traffic death rate is higher in the LMICs; the rate is highest in Africa (26.6/100,000 population) followed by South-East Asia (20.7/100,000 population) (WHO, 2018). The recent findings of WHO South-East Asia Regional Status Report on road safety found that there was a 2 percent reduction in the RTDs. Despite this observation for the South East Asian region, Nepal experienced a sharp increase in the RTDs.

RTIs are serious public health challenges all over the world, resulting to mortality and morbidity following life-long disability. RTIs are also the leading cause of the injuries related disabilities (Peden et al., 2004), and it has a wide and long-term impact on health that includes stress and anxiety, physical disability, cognitive or social impairment, and educational failures and loss of employment; with some of the injuries resulting to deaths. In addition to direct physical impact, injuries also leave individuals and families with social and economic hardship.

1.2.2 RTIs and its Impacts in Nepal

In Nepal, road transport is a primary means of transporting cargo and passengers (World Bank, 2020a). As in other low-income countries, Nepal is experiencing a rapid increase in motorization and RTIs also represent a leading cause of deaths and life-long disability (Karkee & Lee, 2016). In Nepal, the size of population has increased by 20 percent from 2001 to 2021 (National Statistical Office, 2023), whereas, the registration of vehicle increased by three times between 2000 to 2011 (Ministry of Physical Planning & Transport Management Nepal, 2013). With the increment in the number of vehicles and

road network, the RTIs have increased by 25 percent from 2010 to 2021. The number of fatalities per 100,000 vehicles is 17.1 in Nepal and increased to 28 in 2024, which is the highest in South Asia regional (World Bank, 2020a; WHO South-East Asia Regional, 2024).

Nepal has been experiencing a gradual shift from infectious diseases to non-communicable diseases (Joshi & Shrestha, 2009). RTIs appeared as a primary cause of injury-related deaths among young population in which male casualties are significantly higher than that of female (Jha, 2005). Due to the nature of topography, Nepal needs unique measures for RTCs prevention compared to other countries (Karkee & Lee, 2016). In hilly districts, roads are constructed in the rocky landscape, where the chances of road crash is high and victims' survival is very low. Similarly, urban roads are poorly designed and current increasing trends of non-engineering road construction further pose significant threats to road crashes.

Several hospital-based studies revealed that RTIs are the foremost cause of hospitalisation in Nepal (Karkee & Lee, 2016; Kahn & Hussain, 2015; Joshi & Shrestha, 2009; & Jha, 2005). Motorcycles and bicycles were the most common vehicles that get hit in RTCs (Mehta et al., 2015). The study further showed that head injuries were the common forms of injury in those involved in motorcycle and bicycle crashes. A study based on Prithivi Highway found that one-fourth of the RTIs related fatalities were spot-deaths (Choulagai et al., 2015).

WHO estimates showed that RTDs are the leading cause of injury related death for population aged 5-years and above (WHO, 2018). A hospital-based study also found that most of the RTIs occurred in economically productive ages (15-50 years), and loss of

primary earner of household added to the economic burden in the family (Joshi & Shrestha, 2009). The economic cost for road traffic casualties in 2017 was equivalent to USD 122.88 million per year; which is one of the largest burdens on the national economy (Banstola et al., 2020). The World Bank report further found that the annual investment benefit of economic cost of road traffic casualties was equivalent to 3.75 percent of Gross Domestic Product (GDP) in Nepal (World Bank, 2020a). Deaths and injuries from road crashes impose huge financial, health and social burden on road traffic victims and their families (World Bank, 2021).

1.2.3 Vulnerable Road Users

Road traffic injuries affect all ages, however, the young and productive (working) age group (15-44 years) are affected disproportionately. RTIs are the leading cause of deaths and injuries for the children and young adults aged 5-29 (WHO, 2018). Males accounted for the majority of the RTIs: almost two-thirds of the RTIs deaths were males. A study conducted in Bangladesh found that poor families were more likely than those better off to lose their household breadwinners in road traffic crashes. The study further identified that poor families undergo sudden economic problems because of unexpected deaths of major earning members of household from RTIs (Peden, et al., 2004). Similarly, from the global RTIs analysis findings, males are more likely to be injured than females (WHO, 2018).

The road users such as pedestrians, cyclists, and two-wheelers are the most vulnerable road users, and they are prone to high risk during a vehicular crash. More than half of the RTDs are among these vulnerable road users, i.e. pedestrian, cyclist and motorcyclists (WHO, 2018). In developing countries, pedestrians, motorized two-wheeler

users and cyclists are more vulnerable than in developed countries (WHO, 2015). The analysis of RTCs mortality among road users found that motorized two-wheelers are 26 times more likely to die in the road crashes than passengers in cars (WHO, 2006).

The WHO's Global Status Report on Road Safety, 2018 presented that the pedestrians and cyclists account for 25 percent of the all RTI deaths, and motorized two-and-three-wheelers comprised of another 28 percent (WHO, 2018). Among the continents, Africa has the highest pedestrians and cyclists mortality followed by South-East Asia. South Asian region represents the second highest ownership of motorized two-and-three-wheelers in the world and also has the highest road traffic mortality risk for two-and-three-wheeler motorized vehicles among all the vehicles (World Bank, 2020a). Similarly, in South Asian regions, the drivers of trucks and buses and their passengers are exposed to the highest risks in the world, as the road infrastructure is very unsafe for the vulnerable road users in this region. The World Bank, (2021) concluded that LMICs have distinct road safety risks and found extremely high risk compared to the high income countries.

1.3. The Statement of the Problem

Road traffic deaths and injuries have been increased dramatically and resulted numerous human injuries, disabilities and untimely deaths (WHO, 2016). A report from Institute of Health Metrics and Evaluation, (2018) showed that RTIs were the eighth leading cause of deaths in 1990, whereas it was the sixth leading cause of death in 2017. In the last ten years (2011-2020), RTDs dropped by 5 percent globally, where half of the UN member states reduced RTDs (WHO, 2023). However, many low-and-middle-income countries were experiencing an increase in both the absolute number and proportion of deaths and injuries from road traffic crash incidents (WHO,2023). Globally, RTCs accounted for 1.8

percent of total deaths in 1990, increasing to 2.5 percent in 2017 (IHME, 2018). While the incidence of road traffic mortality has decreased between 1990 and 2017 in various regions worldwide, South Asia and Latin America have seen no such change (James et al., 2020). These incidents result in significant economic losses for victims, families, and nations. Individuals from lower economic backgrounds experience higher rates of fatal and non-fatal injuries compared to wealthier population (WHO, 2013). The economic impact is substantial, accounting for about 2 percent of GDP in HICs and up to 5 percent in some LMICs. Information on the incidence of RTCs and their impact on the LMICs is limited. A case study based on India and Bangladesh showed that the burden of care for long-term illness and disability are very high for girls and women (Aeron-thomas et al., 2004).

Road traffic injury is appeared as an epidemic, occurring on the roads in Nepal, resulting to eight deaths and 71 injuries daily (Nepal Police, 2022). In 2016, WHO estimated a road traffic fatality rate of 15.9 per 100,000 population (WHO,2018). The WHO's Global Status Report on Road Safety, 2023, revealed that Nepal ranks in the bottom third among countries for failing to achieve road safety targets during the period from 2011 to 2020 (WHO, 2023). Over two decades, Nepal has experienced significant economic and social losses due to road traffic injuries, evidenced by rising fatalities, fatality rates, and motorization levels. However, research efforts into these incidents remain limited compared to the growing problem. The social, economic, and psychological hardships faced by victims and their families contribute to an estimated 6 percent loss of GDP due to RTIs in Nepal (Dalal et.al., 2013).

All the causes of death are important, and there should be an equal effort to prevent all preventable deaths. But in reality, some causes of death are more than others that

contribute to a similar or higher number of human loss. RTIs are of the latter kind, leading but neglected in terms of prevention efforts (Krug, 1999). RTIs are traumatic incidents associated with physical and mental complications; although, the actual impacts have not been explored yet.

According to a study by Haghani (2022), the amount of road safety research conducted in LMICs is disproportionately low, given that over 93 percent of road traffic fatalities and injuries occur in these countries. Specifically, the study highlighted that only less than 10 percent of road safety research have been carried out in LMIC contexts (Haghani et al.,2022). Nepal is a low-income country experiencing frequent RTCs (World Bank, 2020b), and the RTIs accounts for more than 16 percent of the total injury-related deaths in Nepal. Every succeeding year, many people die, and numerous people are seriously injured from RTCs in Nepal. These deaths and injuries have long-term impacts and further worsen the quality of life of the victims and their family members (World Bank, 2021). Despite these problems, RTIs have not been recognized as a serious public health problem in Nepal.

There is a lack of detailed understanding of the circumstances, demographics, or problems associated with RTIs in Nepal. The national estimates of RTIs are based on the information collected by the police and hospital records (Karkee & Lee, 2016), however, RTIs prevention was not the purpose of the data collected by both these agencies. Financial losses due to road traffic crashes are a great burden on the victims, and their families. Measuring the economic cost of road traffic injury supports decision-makers to guide on how best to prevent it for a better national economy. Similarly, reliable estimates of the burden of road traffic injuries have a critical role in making a case for prioritizing road

safety, developing safety strategies, setting available safety targets, and monitoring the progress.

The identification of actual problem, formulation of road safety policy, and implementing the preventive measures all require reliable evidence (Plourde, & Krueger, 2021). However, there are limited research findings on road safety status and its' consequences in Nepal (Bnastola, et al. 2020). Therefore, there is an urgent need to conduct road safety research. Accordingly, this study is anticipated to play a vital role by filling in the knowledge gaps in formulating road safety policies and implementing the programs to address the problems that exacerbate by road traffic crashes in Nepal.

1.4 Research Questions

This study examined the road traffic crash situation in Nepal, including detailed analysis of road traffic death, injuries, mortality risk factors and the impact of the crashes on the victims and their families. During the conceptualization of the study, it was identified that the impact of RTCs on victims and their families has not been adequately explored in Nepal. To address this knowledge gap and study the extent of road traffic deaths, injuries, and their consequences for individuals and families, a research concept was developed. This research achieved its aims by addressing three distinct research questions.

Research Q1. What studies have been conducted on road traffic crashes, deaths, injuries and impact of RTIs in SAARC countries?

This question was designed to identify how research has been conducted in SAARC countries. The initial phase involved conducting a systematic review of RTIs and their consequences in SAARC nations to gain insight into the situation in neighboring countries and Nepal.

Research Q2. What is the status of road traffic crashes, deaths and injuries in Nepal?

This particular inquiry focused on both fatal and nonfatal aspects of road traffic incidents. It analyzed the road traffic crashes, deaths and injuries of Nepal, and provided insight on nature of crashes, and detailed analysis of deaths and injuries by the available variables.

Research Q3. What are the predicting factors associated with the road traffic deaths?

The purpose of this research question was to gain a deeper understanding on the road traffic mortality in Nepal. A Random Forest model for fatal road crashes in Nepal was used and the attributes for fatal road crashes were predicted.

Research Q4. How have RTDs and injuries impacted the individuals and families?

Road traffic crashes have numerous impacts, ranging from infrastructures and vehicles damage to significant socio-economic, health impacts on the victims and their families and in the nation as a whole. A qualitative survey has been utilized to analyse the impact of the road crashes on the victims and families.

1.5 Objectives of the Study

The aim of this study was to fill the current knowledge gap on road traffic deaths and injuries in Nepal. This study analysed the crash details and provides insights into the impact of the RTCs for economic and social aspects of the RTIs victims and their families.

The specific objectives of the study are as follows;

- i. to assess the status of road crashes and their impact in SAARC countries through a systematic review
- ii. to examine status of road traffic deaths and injuries and predict the factors affecting road traffic deaths in Nepal, and
- iii. to explore social and economic impact of fatal and non-fatal road traffic injuries on victims and their families

1.6 Significance of the Study

Diverse population groups have their own type of exposures to road crashes risk. In low-income countries, the predominant population group in road crashes were young road users (Peden et al., 2004). It is evident that road traffic deaths and injuries are an emerging epidemic at the global, regional and the country level. The emerging road traffic crash challenges need to address at the global, regional and at the local level. In recent times, the trend of RTIs is becoming alarming in Nepal: the number of deaths and disabilities from RTIs is increasing day by day, and it is becoming a tremendous public health challenge for all concerned agencies to prevent (World Bank, 2020b). Everyday, local and national newspapers are found publishing news about road traffic crashes, loss of human life, serious and minor injuries. Despite the magnitude of RTI deaths, injury survivors, and impacts on families, it is a rather less explored subject in Nepal.

The analysis of national-level information on road traffic crashes, deaths, and injuries helps to understand actual situation of road traffic in Nepal. Similarly, findings from the national data will help to formulate evidence-based policies, and develop and implement appropriate road traffic crash preventive measures.

As highlighted above, the impact of RTI is not limited to health; it has social and economic impacts too. The findings of this study will guide for future investments in RTI prevention priority programs, prioritize crash prevention measures, effective prevention strategies, and policies addressing the road traffic crash-related challenges and socio-economic impact of the RTIs on victims and their families.

Road safety research has yet to receive priority in the social science sector. Based on the information gathered from the reviews, this type of research contributes to preventing road traffic injuries, fatalities, and disabilities within the community. Based on

the Nepal Police records, this study analyzed RTCs, deaths, and injuries in Nepal. The impact of the RTCs at the individual and family level was explored from direct interaction with the victims and their family members. This study is the first attempt to explore the socio-economic impacts of road traffic injuries at the individual and the family level. Studying economic impact analysis helps to measure the scale of problem due to RTIs. Similarly, information about the social and economic impacts of RTIs obtained from this study is anticipated to generate important evidence for policy formulations and program implementation. It is also expected that the findings of this study are useful for policymakers, road safety practitioners, and the wider community.

Previous studies has highlighted the importance and urgent need of road safety research in Nepal. The recommendations made in this study will contribute to a new dimension of research in the area of social science. In the study, Random Forest (RF) model has been used to predict the road traffic death risk in Nepal. The findings of this model has shown that RF could be utilized in other social science research for the prediction of related factors with less errors.

Therefore, this study can provide evidence on the road traffic crash risk and social and economic impacts of road traffic injuries on individuals' health, personal life, family life, and household finances, affecting individuals and family. The study will also explore social and economic impact of road traffic injuries on the deceased person's family members. The finding will help guide programs and policies for multiple sectors such as health, transportation, police, insurance companies.

1.7 Limitation of the Study

All social science studies come with certain limitations that might affect the results and conclusions of the research (Ross & Zaidi, 2019). In this study, some limitations are seen in the systematic review, record-based analysis, and the qualitative survey. These limitations have been mentioned below.

1.7.1 Limitation of the Systematic Review

Systematic review was based on the studies published in English Language between 2010 to 2020 and focusing road traffic crash, death and injury in SAARC countries. A major limitation of the systematic review was that it found only a small number of studies from all SAARC member countries. Furthermore, nationally representative studies on RTCs death and injuries studies for Pakistan and Afghanistan were not available. In case of RTCs impact review, studies were not available for Bangladesh, Pakistan and Afghanistan. Important information on the issue might have been missed due to lack of literature from these countries.

The other important limitation of the review was that the sample population made it difficult to compare the results within a particular country or with other countries. Hence, only descriptive analysis of the result was performed in the review.

1.7.2 Limitation of the Nepal Police Record-based Analysis

Nepal Police has a national-level unnatural death and injury recording system. RTCs record is one of the major data records maintained in the police's recording system. A major limitation of this study is that it was based on road traffic crash details recorded as part of incident recording. This study only analyzed the death and injury cases for which the information about the victims was available. If the number of casualties was the only

thing recorded in the dataset with other details missing, such cases were excluded from the detailed analysis. During data extraction, 24,745 injuries and 2,330 deaths were identified; however, details of 1,426 injured and 138 deceased persons were missing in the record. Thus, this study only used 23,319 injuries and 2,192 death cases in the analysis.

1.7.3 Limitation of the Qualitative Survey

The respondents of the interview were road traffic crash survivors and their families and deceased persons' family. To study the impact of road crash, family members were considered as husband or wife, father, mother and children of the victim. Respondents were identified from two hospitals located at Dhading and Kavre (two major entry points) of Kathmandu valley.

1.8 Organization of the Dissertation

This dissertation consists of nine chapters and encompasses three different studies conducted throughout the research process. This **introductory chapter** provides background of road traffic crashes, deaths, injuries, and their impact on victims and their families. **Chapter Two** is a literature review that examines key concepts such as road traffic crashes, mortality, morbidity, and their impact on victims. This chapter also explores the philosophical and theoretical background of road safety research and identifies gaps in existing road crash research, evidence, and prevention efforts. Moreover, empirical information is included to highlight the significance of road safety research in Nepal.

In **Chapter Three**, the research methods utilized in this study are outlined. The research process includes three different aspects: systematic review, quantitative analysis, and qualitative survey. The chapter provides a comprehensive explanation of each research process, including the methodological aspects of each of the study.

Chapter Four presents the outcomes of the systematic literature review, which is a review and analysis of scientific research articles from SAARC countries published between 2010 and 2020. This chapter provides an overview of the road safety research situation in these countries and information about the road traffic crashes, deaths, injuries, and their impact.

In **Chapter Five**, a descriptive analysis of road traffic fatalities and injuries is presented, utilizing secondary data source. **Chapter Six** goes further to include statistical analysis aimed at predicting the risk factors for road traffic deaths in Nepal and at the seven province level.

Chapter Seven presents descriptive qualitative findings that explored the impact of RTIs on victims. The chapter includes results from in-depth interviews and the group discussion.

Chapter Eight contains a discussion of the findings presented in Chapters 4, 5, 6, and 7. The discussion is structured around each research question and begins with a systematic review, followed by a quantitative analysis, and concludes with an in-depth examination of the qualitative findings.

The final chapter highlights the conclusion to this dissertation and provides some recommendations for addressing the challenges to improve road safety in Nepal. The chapter provides a plain language summary of finding regarding the impacts of road crashes, deaths, and injuries, and provides practical solutions for reducing them.

CHAPTER II: LITERATURE REVIEW

2.1 Introduction

Before developing methodology and presenting research findings, it is essential to present the context of research issue in a broader national, international and theoretical aspect. This chapter presents the scenario of road traffic crashes, deaths, injuries, and their impact in the global, regional and national contexts. It provides a magnitude of the road injuries outlining the global situation of road crashes, efforts to reduce road crashes, factors associated with road traffic crashes, death, injuries, and the socio-economic impact of road traffic crashes in global, regional, country levels, including in Nepal.

2.2 Philosophical and Theoretical Ground

The philosophy behind the research on road traffic crashes is to identify and understand the status of RTCs and the risk factors associated with deaths and injuries. It also intends to suggest the efforts to prevent or reduce the occurrence of road traffic crashes and associated injuries, disabilities. The philosophical theory “Utilitarianism” emphasizes the greatest good for the greatest number of people (Scarre, 1996). In the context of road traffic crash research, identification and implementing the interventions can prevent most injuries and save many lives. Similarly, the “Social Justice” theory emphasized the fairness, equity and distribution of resources to promote the well-being of all individuals and the community (Sabbagh & Schmitt, 2016). This principle underscores the importance of addressing impact of road traffic deaths and injuries that may be leading families to poverty, discrimination, and inequality and developing interventions that are accessible and effective for all the populations.

Abdel Omran’s theory on the epidemiology of population change examines the transformations in health and disease patterns, as well as the interplay between these

patterns. In addition, the theory outlines the demographic, economic, and sociological factors that influence mortality rates and their outcomes (Omran, 2005). The theory is based on five key propositions;

1. Epidemiologic transition begins with the major premise that mortality is a fundamental factor in population dynamics.
2. The long-term shift occurs in mortality and disease patterns whereby pandemics of infection are gradually displaced by degenerative and man-made diseases as the chief form of morbidity and primary cause of death.
3. The epidemiologic transition the most profound changes in health and disease patterns obtain among children and young women.
4. The shifts in health and disease patterns that characterize the epidemiologic transition are closely associated with the demographic and socioeconomic transitions that constitute the modernization complex.
5. Peculiar variations in the pattern, the pace, the determinants and the consequences of population change differentiate three basic models of the epidemiologic transition (Omran, 2005).

Proposition 2 of Omran's theory suggests that the long-term shift in mortality and disease patterns has led to the displacement of pandemics of infection by degenerative and man-made diseases (Omran, 2005). This proposition explains the increase in the burden of non-communicable diseases resulting from modernization, development, and changes in behavioral patterns associated with technological advancements and affluent living conditions. Man-made diseases such as road traffic casualties are also evolving due to motorization and road networks. Similarly, Proposition 4 clarifies that modernization has resulted in a shifting of disease patterns in the human population. The increase in road traffic deaths and injuries can be attributed to the global changes in the form mobility, i.e. a shift from a walking culture to vehicular use.

Similarly, Heinrich's Domino theory, introduced by Herbert William Heinrich in 1931, illustrates that 98 percent of crashes resulted from either unsafe actions, unsafe mechanical or physical conditions, or a combination of both, and suggests that crash can be prevented by addressing these unsafe acts or conditions (Heinrich, 1931). This theory further delineates three primary factors: social environment, individual errors, and mechanical or physical hazards that contribute to crashes resulting in injury, disability, or fatality. Heinrich's analysis of 75,000 industrial crash cases highlights the relevance of this theory, which also finds application in understanding the causes of road traffic incidents (RTIs) and fatalities. It emphasizes that reduction in human errors, improvement in road safety regulations, analysis of road crash risk, minimizing the physical hazards contribute to prevent of the majority of RTCs.

Likewise, "Public Health Ethics" emphasized the importance preventing harm and promoting the health of the people (Barrett, Ortmann, & Brown, 2015). Road traffic deaths and injuries are preventable (Peden et al., 2005), they demand recognition and addressing social, economic and environmental factors that contribute to RTCs and possible preventive measures. According to Simpson et al., (2018), the philosophy of "Pragmatism" highlights the importance of practicality and effectiveness in interventions. This implies that interventions should be designed and executed in a manner that is attainable, enduring, and results in a quantifiable improvement in health outcomes while reducing injuries. The findings of this study can be utilized in the development of effective interventions for road traffic injury prevention.

2.3 The Extent of the RTC Problem

The history of RTCs is not long compared to other diseases. Globally, motorization has three stages; concentration of personal vehicles (cars) in the US 1910-1950, the spread of cars in Europe 1950-1975, and increased vehicle mobility in the remaining world (Borowy, 2013). Road network expansion played a vital role in global economic growth and overall development (Shi et al., 2019). Rapid increase in road transport has enabled many countries to achieve development goals. The transport sector is one of the most highly invested sectors by the World Bank and the Asian Development Bank (ADB) (Melo et al., 2013). An increase in road road network and the number of vehicles increases hand in hand with an increase of RTCs globally.

It was believed that the world's first recorded Road Traffic Injury was by a car to a cyclist in New York City on 30 May 1896, followed by the death of pedestrian on 17 August 1896, in London (Toroyan, 2009). At that time, it was said, "*This must never happen again.*" Despite the early concern for preventable mortality and morbidity, a terrible increasing trend of road traffic deaths and injuries followed globally. In early 1900, RTCs were higher in the United States (US), and in United Kingdom (UK), road traffic mortality increased after the 1930s, and the RTDs record of the UK was 9,000 in 1941 (WHO, 2009). Till 1951, road crashes killed a million people in the US (Norman, 1962), the analysis further estimated that 100,000 people were killed every year in road crashes by 1962. Norman (1962) suggested improving vehicle performance, reducing speed, and implementing safety rules and regulations to reduce preventable deaths and injuries from road crashes.

Road traffic is a complicated and risky part of people's lives that people encounter in daily activities (Peden et al., 2004). It is a leading cause of unintentional injuries and the

primary cause of disability and injury-related deaths in the world with often resulting to long-term pain, disability, and mental illness (WHO, 2018). Globally, males aged 20-40 years are disproportionately victimized by road traffic deaths and injuries (WHO, 2018). A study on comparative mortality threats for various types of mobility by sex found higher mortality in males than females due to frequent travelling practice (Feleke et al., 2018). Studies also found that male drivers are more likely to involve in risky driving behaviour (Cordellieri et al., 2016; Mekonnen, Tesfaye, Moges, & Gebremedin, 2019). Not only among drivers, among the total road traffic deaths and injuries, the male population vastly outnumbered the female (WHO, 2018). WHO's global status report showed that for a single death from road traffic crashes, at least 20 people sustain injuries (WHO, 2015) and 15 people are exposed to serious injuries (World Bank, 2020b). RTIs is the first leading cause of deaths for young people and the eighth leading cause of all deaths for all ages people globally (WHO, 2018).

A research report on RTIs from 32 countries (high income countries) from the International Road Traffic Data and Analysis Group (IRTAD) revealed that RTIs fatalities in 2016 were 3.6 percent less than in 2010. If the US is excluded, the reduction in RTDs was about 15 percent (IRTAD, 2018). Among 32 countries, 26 countries were able to lower road traffic incidents during the first decade of road safety (2010-2020), and resulted in recovery of economy impacted from RTCs (IRTAD, 2018).

Deaths from road traffic injuries is rapidly growing problem of low-and-middle-income countries (WHO, 2018). Natulya & Reich (2002) have named this rapidly increasing road traffic mortality and morbidity in LMICs as an "epidemic." Another analysis of WHO showed that the European region reduced RTDs significantly in the last

decade, whereas in Southeast Asian and Western Pacific areas, deaths per 100,000 have increased noticeably (WHO, 2018).

LMICs are largely affected by RTCs: during the last decade, India and China remained in the top two positions in which India experienced a significant raise, while China reduced deaths by 35 percent (World Bank, 2021). In Brazil, fatalities increased slightly, placing it in the third position. India has about 1 percent of the world's vehicles and comprises more than 10 percent of the global road traffic deaths (World Bank, 2021). The US, Russian Federation, Iran, and China have all been able to reduce road traffic deaths remarkably in decade (2007-2016).

RTIs not only affect the financial situation and the development process, but also negatively impact the tourism industry, reducing the flow of tourists and reducing earnings from tourism subsequently (Wilks, 1999). An enormous RTI burden among the young population exacerbates challenges in human resources in the labor market; thus, RTIs do not only impact victims, but also their families, society, and the future development of LMICs (World Bank, 2017). The impact of RTIs in LMICs is likely to continue unless an effective intervention is taken to address the growing risk of road traffic injuries (Sharma, 2008).

In South Asia, the number of vehicles per 1,000 population is comparatively lower (106); the average for the World Bank Region is 172 and 759 for the HICs (World Bank, 2020b). Road traffic casualties per vehicles are significantly high in this region compared to HICs. One-fifth of the RTDs occurred in the five countries of South Asia: Bangladesh, Bhutan, India, Nepal, and Pakistan (Lozano et al., 2012). A projection from Koptis & Cropper (2003) showed that RTIs increased by 144 percent in South Asia over the period

from 1990 to 2020. This study showed an increase in fatalities of almost 92 percent in China and 147 percent in India. Further, the predicted that the fatality rate from RTIs would rise to approximately 2 per 10,000 persons in developing countries by 2020 (Kopits & Cropper, 2003). With regards to road traffic mortality risk in South Asia, motorized 2/3-wheelers are seen as the dangerous means of transport: these 2/3-wheelers were found to be the most dangerous, with the number of casualties for cyclists being ranked last. Concerning fatalities per 10,000 vehicles, motorized 2/3-wheelers are at a higher risk of mortality, and bus drivers and passengers are at a relatively lower risk of road traffic injuries in South Asia (World Bank, 2020b).

Most of the road traffic data were based on the police records (WHO, 2018). It is well recognized that the police record the crash evidences for their prosecution process. The road traffic injuries are underestimated due to the fact that police services tend to record fewer non-fatal injuries; thus the true figure of RTIs is more likely to be underreported (Sethi, Racioppi, & Mitis, 2007).

2.4 Estimates of RTCs, Deaths and Injuries by Income Groups

Every 24 seconds someone dies on the road, and it was projected that road traffic deaths will cause 3 percent of all deaths globally by 2030 (Morris, 2006). Nearly half of the people who died from the RTIs are pedestrians, cyclists and motorcyclists. This result is also justified by a study conducted in the UK; which found that motorcyclists (riders) are 36 times more likely to be killed or seriously injured than car drivers.

The global rate for RTDs is about 18 per 100,000 population (WHO, 2018); there is a huge disparity in death and injury rates by income level of the country. LMICs account for 93 percent of global deaths, despite having only 54 percent of the vehicles (WHO,

2015). The crash rates in LMIC countries are often 10-70 times higher than high income countries (Nantulya, 2002). Therefore, road safety issues in LMICs lead serious health, social and economic problems.

The number of RTDs trend in the HICs and LMICs is in the opposite direction (increasing number deaths in LMICs and slightly decrease in in HICs) (WHO, 2018). Low income countries comprise about 9 percent of the global population, but have only one percent of the registered motorized vehicles. Despite this, they account for 13 percent of the global RTDs. On the other hand, HICs comprise of 15 percent of global population, 40 percent of vehicles, while only 7 percent of the total deaths (WHO, 2018). In high-income countries, most of those killed or injured in RTCs are occupants of four-wheeled vehicles. However, this is not the case in many developing countries. Vulnerable road users; pedestrians, cyclists, motorcyclists and users of public transportation are the major victims of the RTCs in developing countries (Sethi et al., 2007). Crashes resulting to deaths are much higher in LMICs (Morris, 2006), and population groups with lower incomes are more vulnerable (World Bank, 2020b).

With the rapid development and increment in the vehicle use in the developing countries, road traffic deaths and injuries are increasing speedily (WHO, 2018). An exploratory data analysis from Nigeria showed that one-third of the road crash victims were subjected to physical disability (Juillard, Labinjo, & Kobusingye, 2010). It was also estimated that 20 serious injuries occur for every RTDs (Morris, 2006), hence beyond human death and injury toll, RTCs challenged the overall development of the LMICs. Disability and psychological problems after injuries deprive individuals and forced them to rely on others for financial help and assistance in regular daily activities (Hyder et al.,

2007). World Health Organization's report revealed that RTIs occur mostly in low income countries among the vulnerable users (WHO, 2016). South Asia is no exception to this, the road traffic injuries tend to victimize the vulnerable group of population (Hyder et al., 2006).

2.5 Factors Associated with RTCs, Death and Injury

The cause of RTCs is complex and the risk factors for RTCs vary from country to country (Peden et al., 2004). It was identified that high speed, lack of helmet use, lack of seat-belt use and child restraint use, and drinking and driving are the causes of RTIs (Wang, Rau, & Salvendy, 2010).

According to the matrix developed by William Haddon, vehicle crashes happen with the interactions between the factors related to the human, vehicle and equipment, road, and environment (Mohan et al., 2006). Haddon points out that RTCs result from an ill-designed "man-machine" system, which needs complete systemic effort for its prevention. According to a study by Mohan et al. (2006), human risk factors play a significant role in RTCs worldwide. These human risk factors include over-speeding, failure to use seat belts or child restraints, drink driving, and drug use. The study suggests that these human-related factors contribute to more than 90 percent of road crashes globally.

One of the main factors contributing to the increased road crash and injuries is the lack of road safety behaviour in the road users (Mohan et.al., 2006). The World Bank study indicated that poverty and RTIs are interlinked (World Bank, 2017). Similarly, an analysis on the effect of GDP changes on road traffic fatalities based on the 24 European countries data showed that lower economic status contribute to an increase in RTDs (Yannis, Papadimitriou, & Folla, 2014). In a policy briefing for the First Global Ministerial

Conference 2009 (Moscow), it was presented that a person in a poor country is at least twice at risk of dying on a road than a citizen of a high income country (Watkins & Sridhar, 2009). Likewise, poor infrastructures such as unsafe roads and unsafe transports are some reasons for the transport injuries (Morrow, Barnett, & Vujcich, 2014). A study by the World Bank, showed that poorer people are more likely to be involved in a RTCs (World Bank, 2017).

A study from Bangladesh revealed that factors contributing RTCs are adverse roadway and roadside environment, poor detailed design of junctions and road sections, excessive speeding, overloading, dangerous overtaking, reckless driving, carelessness of road users, failure to obey mandatory traffic regulations, variety of vehicle characteristics and defects in vehicles and conflicting use of roads (Anjuman et al., 2007). Therefore, there is a mix of human factors, environment factors and agent factors responsible for road crashes. Other RTCs risk factors include a low level of awareness of the safety problems, inadequate and unsatisfactory road safety education, lackings in safety rules, regulations and traffic law enforcement and sanctions (Anjuman et al., 2007).

Sharma (2008) analyzed the pattern of past RTCs and found a clear positive association of RTIs with increasing motorization and road networks; similar findings were found by Mohan and colleagues (2006). Nantulya and Reich (2003) found that in low-income countries, poor people represented by pedestrians, passengers in trucks, and cyclists were esubjected to a higher risk of death and injuries in road crashes. Rapid growth of motor vehicles, a larger number of casualties per crash, the poor performance of road traffic safety regulations, inadequate public health infrastructures, poor access to health services are the major contributing factors of considerable road crash mortality in LMICs

(Nantulya, 2002). In addition, evidence-based interventions is a prerequisite for RTCs prevention (Peden et al., 2004); despite the severity of the road safety situation, there has been comparatively limited research in LMICs (Staton et al., 2016).

Economic factors, particularly financial status, usually determine the choices for selecting the means of transportation (Sharma, 2008). Motorized two-wheeled vehicles are family vehicles in LMICs. This is mirrored in the substantial utilization of motorized two-wheeled vehicles in LMICs. A report published in 2020 by the World Bank showed that South Asia has 76 motorized 2-3 wheelers per 1,000 population, which is only 26 for high-income countries (World Bank, 2020b).

Broadly, RTCs occur due to a lack of road safety management and neglected road safety measures while constructing roads or road maintenance, neglected vehicle safety, not properly following road safety rules and regulations by the road users, and speeding (WHO, 2018). The analysis of RTCs in Mexican Cities found that the male population of age 20-59 years with low education having road crashes on Sunday has increased crash severity (Gómez-García et al., 2022). Similarly, a study of some hilly districts of Nepal found that pedestrians and motorcyclists were at higher mortality risk, particularly young men (Shrestha, Bhatta, & Paudel, 2017). A study conducted in Southern Thailand showed that people below 30 years, fatigue, speeding, and inexperienced drivers were common risk factors for RTCs (Klinjun, Kelly, Praditsathaporn, & Petsirasan, 2021). Similarly, a report published by WHO showed that young men, driving in the morning, poor driving skill, and long driving hours are positively associated with the higher frequency RTCs (WHO, 2018).

2.6 Global Efforts to Address RTIs

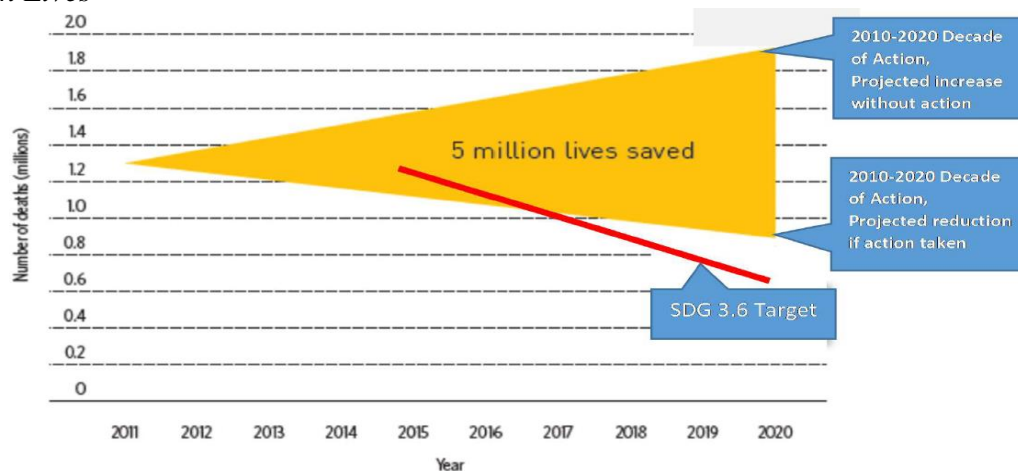
RTIs have not been considered a global public health issue till late 1900 (Borowy, 2013). To make global, regional and national leaders and common people aware of this hidden epidemic, the World Health Organization declared the World Health Day 1961 as “*Crash and Prevention*” (WHO, 1961). In 1974, the World Health Assembly acknowledged RTIs as an extensive and serious public health problem resulting from RTCs and urged national health authorities to provide leadership in the issue (World Health Assembly 27, 1974). The 19th World Health Assembly at Geneva, 1996 (3-20 May) called for the World Health Organization to intervene the heavy human and financial losses resulting from the ever increasing number of RTCs (WHO, 1966). During WHO’s 47th South-East-Asian regional meeting on August 5, 1994, the “*Crash prevention and trauma care management*” was adopted as a regional agenda. It emphasized global goals for road traffic crash injury prevention, including estimating crash situations in 60 percent of countries by 1995 and developing national policies for crash prevention in 50 percent of countries (WHO,1994).

In 1996, The United Nation’s resolution was “prevention of traffic crashes”. In 2003 the UN General Assembly recognized road traffic deaths and injuries as a epidemic, and in May 2004, a special session of General Assembly was dedicated to road safety crises (WHO, 2004). For the first time, road safety issues were discussed in the 2004 World Health Day (Morris, 2006) and the World Report on *Road Traffic Injury Prevention* was published. In 2010, in response to the growing epidemic of RTIs, the UN general assembly adopted resolution 64/255, and declared the period of 2011–2020 as the “Decade of Action for Road Safety” (WHO, 2011a). It was projected that if the target was achieved, a

cumulative total of 5 million lives, 50 million serious injuries and US\$ 5 trillion could be saved over the decade (WHO, 2011b).

Figure 2.1

SDG Target 3.6, 2011-2020 Decade of Action Halving Road Traffic Deaths and Saving 5 Million Lives



Source: Wismans, Jac, Thynell & Lindberg, 2017.

SDGs also consider road safety as the condition for people's well-being, healthy life, safe and sustainable cities and set two targets that (SDG) 3 (on health), and SDG 11 (on transport for sustainable cities). The SDG target 3.6 to halving RTDs by 2030 (United Nations, 2017) and the target 11.2 providing access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, and children, persons with disabilities and older persons (United Nations, 2017).

Similarly, the Global Plan for the Decade of Action for Road Safety 2011- 2020 identified five pillars of priorities: 1) road safety management capacity, 2) infrastructure safety, 3) vehicle safety, 4) road user behaviour, and 5) post-crash care (WHO, 2011a). At the mid-term of the first decade of road safety (2011-2020), the Second Global High-Level Conference on Road Safety was held on 18-19th November 2015 in Brasilia, Brazil. The conference was held in the middle of the first decade of action for road safety and

suggested possible measures to achieve the goal. The conference adopted Brasilia declaration, a guiding effort to achieve the goal set for the first decade of action (United Nations, 2015b).

At the end of the first decade of action for road safety, the Third Ministerial Conference on road safety was held on 19-20th February 2020 in Stockholm and the conference released the 16-point Stockholm declaration for road safety (United Nations, 2020). In 2017, the 12 voluntary global road safety performance targets and 18 points declarations were established to guide the global road safety policy and related activities up to 2030. In the 76th session of the UN General Assembly, resolution 74/299 was declared, along with the Global Plan for the Decade of Action for Road Safety 2021-2030 which was developed by WHO. This plan provides detailed guidelines for the governments and related agencies to support them achieving road safety goals (United Nations, 2021). The plan mentioned the requirements to achieve the 2021-2030 road safety targets and called on the governments and partners to implement an integrated safe system approach for road safety (United Nations, 2021). In response to a request from the United Nations General Assembly, the member states reached a consensus on 12 global road safety performance targets on November 22, 2017 (United Nations, 2021). However, growing international recognition on the road traffic problem has not yet been matched with allocation of the resources to address the increasing road safety problems (Morris, 2006).

2.7 Road Safety Policies in Nepal

Nepal Government started the paperwork for road safety from the early 1970s, and the government introduced road safety plan in 1974 (Government of Nepal, 6 Oct. 1974). The number of vehicles and road networks increased rapidly after the 1990s in Nepal

(Department of Transport Management, 2015). Along with the increment of vehicular mobility, the Government of Nepal amended and enacted the Motor Vehicle and Transportation Management Act (MVTMA) in 1993 (Government of Nepal, 1997). Similarly, during 2000 to 2010, the government put some effort into national road safety through the preparation of the various policies, act and regulations:

- i. National Transport Policy, 2001 (Ministry of Physical Planning and Works, 2002);
- ii. Road Board Act, 2001 (Government of Nepal, 2002)
- iii. Road Board Directives 2004 (Roads Board Nepal, 2004)
- iv. Master Plan for Strategic Road Network,
- v. Policies , acts, directives and the master plans.

In 2002, the 27th Meeting of the Council of Minister (Cabinet) launched the National Transport Policy (Ministry of Physical Planning and Works, 2002). After the UN announcement of the Global Decade of Action for Road Safety in 2010 (WHO, 2011b), Nepal Government also prepared a road safety action plan (Ministry of Physical Planning & Transport Management Nepal, 2013). In May 2011, Nepal announced the Decade of Action for Road Safety 2011-2020, and subsequently finalised the road safety action plan in 2013 (Ministry of Physical Planning & Transport Management Nepal, 2013). The guiding principles for Decade Plan followed a “safe system approach” originated from Sweden’s Vision Zero and the Netherlands’ Sustainable Safety strategies (Loo & Anderson, 2020). The action plan was aligned with the five pillars (Road safety management, Safer roads and mobility, Safer vehicles, Safer road users, and Post-crash response) of the global plan for the first decade (Ministry of Physical Planning & Transport Management Nepal, 2013).

In 2016, a revised penalty structure for violating road traffic rules was also amended to improve the road safety status of Nepal (Pant et.al, 2021). Ambulance Service Operation Guideline, 2016; Bus Body Building Directives, 2018; Driving Training Centre Operation Directives, 2018; Driving Training Curriculum, 2018; Five-year Strategic Plan for Transport Development, 2016-2021; Medium & Light Motor Vehicle Inspection Manual, 2018; Medium & Small Vehicle Testing Manual, 2018; Route Determining Directives, 2018; School Bus Directives, 2018; The Department of Roads Strategy, 1995; Workshop & Garages Operation Directives, 2018 were developed after the endorsement of the road safety action plan in Nepal (Pant et al., 2021). Similarly, National Health Policy, 2015; National Health Policy, 2019; 14th Periodic Plan, 2016/17-2018/19; 15th Five-year Plan, 2019-2024 also incorporated the issues addressing road safety in Nepal. According to the Road Safety Global Report (2023), Nepal lacks best practice of legislations for all five road safety risk factors, including speeding, helmet use, drink driving, seatbelt use, and child restraint use, which make the situation even worse. Nepal has many laws concerning road safety management but is significantly lacking in the laws related to safer roads and mobility, safer vehicles, motorcycle helmet standards, drug driving, and mobile phone use during driving. Table 2.1 presents information on road safety legislation in Nepal.

Table 2.1
Road Safety Legislation, Nepal

Institutional framework	
• Presence of national lead agency to implement national road safety strategy	• Yes • No
• National road safety strategy	• Partially funded
• Funding to implement strategy	• Yes 50% by 2030
• Fatality reduction target	
Safer road infrastructure	
• Presence of systematic approaches to assess/audit new roads	• No
• National law requiring a formal road safety inspection/assessment	• Yes
• Target for roads to meet technical safety standards for all users (year)	• 2030
• Investment to upgrade high risk locations	• Yes
Safer vehicles	
• Seat-belts	• No partial
• Front and side impact protection	• No
• Electronic stability control	• No
• Pedestrian protection	• No
• National law on anti-lock braking system	• No
National speed law	
• Maximum urban speed limit	• 40km/hr
• Maximum rural speed limit	• 80km/hr
• Maximum motorway speed limit	• 80km/hr
• Available type of enforcement	• Manual
National drink-driving law	
• National law on drink driving	• Yes
• BAC limit-general population	• No
• BAC limit- young or new coming drivers	• No
• Random breath testing	• Yes
• Testing of driver after crash	• Yes all drivers are tested
National motorcycle helmet law	
• For rider and pillion-rider	• Yes
• Helmet fastening required	• No
• Helmet standard referred/specified	• No
• Helmet wearing rate (Driver, Passenger)	• 98%, <1%
National law on mobile phone use during drive	
• Ban on hand-held mobile phone use	• --
• Presence of targets to reduce distracted driving nationally	• National
National drug-driving law	
	• Yes

Source: (WHO, 2023).

With the list of these road safety indicators and current road crash situation, it can be said that Nepal has documented some policies in place to ensures road safety. Now, the time has come to adequately implement the already established policies and introduce remaining road safety measures.

2.8 Support System to the RTCs Victims in Nepal

The government of Nepal introduced a compulsory third-party insurance system on Sept 1, 2009 to compensate for deaths, serious injuries, other types of injuries, or property loss due to vehicle crashes (Government of Nepal, 1997). The compensation scheme was introduced to provide support and benefits to all people injured and the dependents of people killed in road crashes. In the case of third-party insurance, the vehicle owner deposits the prescribed amount every year. At the maximum level, insurance companies provide NRs. 5,000,000 for death, serious injuries in mass casualties, and another NRs. 5,000,000 to compensate for the property loss. In case of third-party fatal crashes, the vehicle owner should immediately provide NRs. 25,000 to the victim's family members for cremation, the last rites of the deceased person, and the insurance company will reimburse the vehicle owner according to the established terms.

The Social Security Act (2075) 2018 revised legal provision of disability allowance as specified by the Government of Nepal (Government of Nepal, 2018 b). The government categorized disability in two broad groups: a) completely disabled, and b) partially disabled. Partially disability is further classified into four different categories: i) Group *Ka*, ii) Group *Kha*, iii) Group *Ga*, and iv) Group *Gha*. According to Nepal Government's 2075 decision among these four categories, only the first two category of disabilities are eligible to get a disability allowance (Government of Nepal, 2018b). A person with a complete disability and Group *Ka* disability receives NRs. 3,000 per month, and Group *Kha* disability receives NRs. 1,600 as a disability allowance from the government. Recently most of the banks started up to NRs.500,000 crash insurance to their depositors. In the case of deaths, some banks initiated a scheme to provide NRs. 500,000 as an insurance payout to the kin of the deceased account holder.

2.9 Impact of RTCs

Motorization improves many individuals and communities' lifestyles and quality of life; however, deaths, disability, and injuries associated with road crashes increase the huge expenses in preventable deaths and illnesses (Sharma, 2008). This impact review section reviews the relevant studies on the consequences of a road traffic crash on the victims and their families. Road traffic crashes have physical, social, health, emotional and economic implications, particularly on world economics. Besides, the burden of road crashes is significantly higher on injuries than deaths from the road crashes.

2.9.1 Health Impact of RTIs

Injuries resulting from road crashes can be grouped into two broad categories; a) injury with temporary disability and b) injury with a permanent disability. In 2010, among the road traffic victims, 9.2 million people required hospital admission globally (Wismans et al., 2019). A person injured by a road crash undergoes various health complications. Road traffic crash survivors mainly report pains in their limbs, neck, back, and shoulders. Similarly, survivors mention that they have a problem walking and moving their body parts. RTI survivors also report long-term psychological stress and body pain, resulting in activity, limitation, financial problems, and this was found to be limiting victims and their family members from community participation (Kellezi et al., 2017). Hours et al. (2013) also studied the long-term health complications of road traffic victims. They found that most of the victims were experiencing body pain and other health complications which impact regular life, particularly those who were seriously injured. Even after recovery from physical injuries, the victims reported a loss of confidence because of the trauma they experienced (Selveindran et al., 2021). Similarly, road traffic survivors of UK reported that

they were not fully recovered from injury and had regular pain after injury (Mayou & Bryant, 2003). Further, the study identified that RTCs survivors have phobic anxiety about travel. Hours et al. found that three-fourth of all road traffic victims have continuous pain, and one-fourth felt lower self-esteem. Similarly, the study found that half of the victims' health status was not restored back to the normal.

A longitudinal qualitative study conducted in Victoria, Australia, by Braaf et al., (2020) found that traumatically injured survivors have physical and mental health problems. Similar, a study from UK conducted from June 2010 to June 2012 among the road crash victims showed that a third of the them were not able to return to their workplace, and only 6.6 percent fully returned to their work (Kellezi et al., 2017). In Nigeria, a large number people become disabled from RTCs, and 13.5 percent were not able to return to work (Juillard, Labinjo, Kobusingye & Hyder, 2010). A study on lost working days among occupants involved in motor vehicles crashes in the United States found that on average, people lost 28 days from work following an RTC. on average (Ebel et al., 2004). Similarly, a cohort study of 866 road traffic victims living in the Rhone administrative department of France found that half of participants could not return to regular work (Hours et al., 2013). The hospital-based road safety study of northern Ethiopia from 2015 to 2017 found that half of the participants had permanent disability and the median time of recovery of road traffic victims was 15 days (Tesfay et al., 2019).

2.9.2. Socio-economic Impact RTIs

According to the World Report on RTI Prevention (2004), the estimated cost of RTIs was roughly one percent of gross national product (GNP) in low-income countries, 1.5 percent in middle-income countries and 2 percent in high-income countries. Further,

the global cost was estimated to be US\$18 billion annually (Peden et al., 2004). Among this \$18 billion, a loss of 6.5 billion was observed in the LMICs. Every year the loss from road crashes increases; in 2015, the GDP loss from the RTCs in LMICs was estimated to be 5 percent and 3 percent globally (WHO, 2015). Using DALY and Gross Domestic Product, Dalal and his team (2013) estimated a loss of US\$167,752.4 million from road crashes in the world in 2005, and mentioned that 96 percent of the losses were in LMICs (Dalal et al., 2013). A study conducted in Ghana found that over 40 percent of the families with injury victims experienced a decline in family income, with about 20 percent being forced to borrow money and suffering from debt to pay for medical treatment (Juillard et al., 2010). Similarly, a quarter of families stated a decline in their food consumption as a result of the injury in Iran (Ahadi et al., 2015). An analysis by World Bank indicated that the loss from RTCs impedes the overall economic development of developing countries (World Bank, 2017). We can reduce such a huge financial loss by preventing road traffic crashes and addressing the risk factors associated with RTCs.

Studies on RTCs from LMICs and its impact on victim and their family are limited (World Bank, 2017). Those who are injured in RTCs are disproportionately affected in their economically productive years (World Bank, 2017). Road traffic victims and their family members also subjected to decreased living standard (Selveindran et al., 2021). In serious injuries, the days of hospitalization increased. The victim and their family experienced financial hardship due to prolonged absences from their paid job. Over the last 20 years, RTCs have consistently killed major family wage earners; consequently pushing households into poverty, while also limiting the ability of victims to cope with the consequences (Melhuish, 2005). The compensation schemes were generally less to cover

the required expenses (Gabbe et al., 2014). A study conducted with road traffic crash survivors in Sweden reported that road traffic victims felt hopelessness due to loss of job and poor financial situation after crash (Hasselberg et al., 2019). Similarly, a study conducted in UK found an overwhelming majority of the road traffic victims (89%) suffered from decrease of their regular earnings. Those victims hospitalized for an extended period resulted in a substantial reduction in their quality of life (Kellezi et al., 2017). A two year follow-up study by Tournier et al. (2014) found that road traffic victims suffered from financial difficulties, negative consequences on regular works, education, and social life.

The impact of RTIs on the household level is not understood properly and remains largely unreported (World Bank, 2017). A study conducted in Europe showed that 90 percent of the deceased person's families and 85 percent of disabled person's families suffered from the permanent decline in the quality of life (Weijermars et al., 2018). The study further revealed that females generally experienced more physical and psychological impact of RTIs than their male counterparts. Similarly, a research on economic consequences of injury and resulting family coping strategies in Ghana found a decrease in household food consumption after the road crash of the household members (Mock et al., 2003).

Thus, these RTCs related deaths and injuries lead to profound distress to the victims, their families and community which directly and indirectly impact the overall development. This is because it makes people disabled, damages/destroys their properties, adds psychological trauma and makes a waste of productive time. The loss of productivity due to death and disability from the injuries represent a significant loss of economic

opportunity in all countries. The treatment and rehabilitation of the injured people account for a large proportion of the national health budgets in many countries. The loss of family member due to RTCs is immeasurable in monetary terms.

2.9.3 Economic Cost Estimates of RTIs by Region

Globally, the economic cost of RTIs is about US\$518 billion, with low-and-middle-income countries accounting for US\$65 billion (WHO, 2015). The cost lies between 1 to 3 percent of their gross national production, which is more than the total development aid received by these countries from all bilateral and multilateral agencies combined (Cameron, 2004).

A study from Brazil found that the total economic cost of RTIs was 1.6 percent of national GDP in 2010 (Pan American Health Organization, 2010). A cost analysis of RTIs of 17 countries found that total cost of RTCs is 2.7 percent of GDP in the HICs and 2.2 percent of GDP in LMICs (Wijnen & Stipdonk, 2016). The study also revealed that the share of the costs of fatal injuries is 23 percent in HICs and 30 percent in LMICs. Research on the impact of RTIs on child victims of eight countries (Argentina, Brazil, Chile, Spain, France, India, Italy, and Puerto Rico) estimates that the socioeconomic cost as a result of RTIs involving children is \$21.8 billion (Foundation Abertis, 2019).

Chen, Kuhn, Prettnner, & Bloom (2019) estimated road injuries' effect on economic output for 166 countries. The global macroeconomic loss of RTIs to be \$1.797 trillion over 2015–30. The highest loss was estimated for East Asia and Pacific (\$560 billion) followed by North America (\$515 billion) and Europe and Central Asia (\$345 billion). The South Asian region, which has 10 percent of the world's vehicles (World Bank, 2020), was estimated to have an economic loss of \$121 billion from 2015-30 (Chen et al., 2019).

Generally speaking, all regions have similar burden in the gross domestic product when percentage loss is used as the metric.

The burden of road traffic injuries' is not only present in global and national economies but also at the household level. Many families are suddenly pushed into poverty due to the loss of economically active household member(s). Taking care of disabled members also places a great burden to the victims' family. A study conducted in the Rhone region of France found that three quarters of the RTIs are not fully recovered three years after the crash (Weijermars et al., 2017).

Analysis of World Bank's Country level data revealed that countries are losing up to 6 percent of their GDP due to RTIs (Dalal et al., 2013). In Nepal's case, a cross-sectional study based on the Palpa district found that 30.4 percent RTI victim had health care expenses in excess of NRs. 20,000 (Weijermars et al., 2017).

RTI survivors may incur catastrophic medical expenses, consequently making them unable to work or perform daily life activities. RTCs also add substantial negative impacts on social life, quality of life, and pose significant financial loss to survivors and their families (WHO, 2015). A community based study on the socioeconomic impact of road traffic injuries in West Africa found that about 90 percent respondents with RTIs suffered with reduction in earnings (Juillard et al., 2010). RTIs predominantly affect young people, and their impact is also considerable among the working age population.

Consequently, the impact of RTI related morbidity and mortality on the economically productive segment of the population is likely to depress GDP growth rates. It has a major impact on the survival and livelihood of people, backing them up to poverty (WHO, 2015). It also affects education among children, and the productivity of

economically active population (World Bank, 2021). Many families have been pushed into a poverty-ridden situation due to the loss of a family breadwinner as well as the costs associated to funeral and prolonged medical care.

2.10 Motorisation in Nepal

The first motorable road was constructed in Kathmandu Valley in 1924, and the first car entered in Kathmandu in 1942 on the shoulders of workers. Public transport service was started in 1959 in Kathmandu Valley, with different vehicles, namely Tempo, micro bus, mini bus, and large bus in operation on the valley's roads (JICA, 2017). Until the fiscal year 2018/19, about 3.5 million different types of vehicles were registered in Nepal. Government reports showed that Bagmati province has the highest number of registered vehicles, followed by Madhesh province. The number of motorised vehicles in Nepal has increased rapidly after the 2018/19, coinciding with very high migration for people working abroad. About eighty percent of the total motorized vehicles in Nepal are motorcycles (Government of Nepal, 2018a), Light vehicles (cars/jeep/van) share the second highest (6.7%) proportion, whereas the public utility vehicles (mainly bus and mini bus share a small percent of the total vehicles. With this current growth rate, the number of vehicles in Nepal is expected to double in the next ten years.

Motorisation in Nepal has continuously increased after 1991/92; the increment being the highest for motorcycles followed by cars/jeeps/vans. The largest increment in vehicle registration occurred after 2004/05. E-vehicle registration, on the other hand, was increased after 2014/15. The number of motorcycles registered account for an overwhelming majority; 79 percent of the vehicles were motorcycles, followed by cars/jeeps/vans (7%). It was further found that number of the tractors also increased notably in

the same timeframe in Nepal, and by the end of 2015/16 about 3.5 million vehicles have were registered in the Department of Transport (Government of Nepal, 2018a).

2.11 Growth of Motor Vehicles and RTC Casualties in Nepal

The number of vehicles registered is increasing alarmingly in Nepal, which can also be attached with an increase risk of RTCs in the country. This is backed by the finding that an increase in vehicle registration also causes the number of fatalities and injuries to increase. This relation, however, is not true for developed countries (WHO, 2018). According to Nepal Police, on average, 7 people died per 1,000 vehicles in Nepal, indicated a sharp increase in road traffic crashes, deaths, and injuries. In the last eight years, the number of crashes and injuries increased by almost three times. Death cases also increased by 47 percent in the same period.

2.12 RTCs, Death, Injuries and its Impact in Nepal

Nepal's road safety situation, as highlighted by the MoPIT in 2013, is one of the poorest globally, and traveling on its highways remains hazardous. Unfortunately, Nepal has not adequately addressed this significant issue. This not only indicates the serious road safety challenges but also has a substantial impact on the country's economy, considering that tourism is an important sector for its national economy.

Nepal lacks a reliable data source for road traffic statistics. In 2021, the nationally reported road traffic death count was 2,883 (according to the Police), while the WHO estimated the number to be significantly higher at 8,479 (WHO, 2023). According to the Ministry of Health and Population's annual report for 2022/23, road traffic crashes accounted for 4.11% of all deaths and 26.99% of injury-related mortality (MoHP, 2023).

However, the absence of an integrated road traffic data system poses a major challenge for formulating, designing, and implementing effective road safety policies in Nepal.

Most of the information on RTCs are available from Police records (Thapa, 2013). Due to a lack of other reliable sources of road traffic data, Nepal's road safety analysis is entirely based on police data (Sedain & Pant, 2021). Road traffic crashes are mainly recorded by Nepal Police in each district, and overall country level information is compiled in the National Police Headquarters (Thapa, 2013). Nepal Police often records crash information as part of crime investigation for adjudication purpose, meaning that these records do not usually undergo correction in the mistakes, behaviour, operation, and crash management. What's more, crashes with minor injury and small damages to the vehicles may be settled at the crash site with mutual understanding and may not be reported to the police (Thapa, 2013). A Tanzanian population-based study by Zimmerman et.al (2012) also found that the police reported RTDs were six times underreported than the nationally recorded data from the other data sources. However, such a comparison of road crash data with different data sources is not available in Nepal.

The estimates of economic costs of RTIs vary by the methods applied. Government sources estimated the economic cost was at least 0.8 percent of the GNP equivalent to 2007 price annually (Thapa, 2013). Another study found that Nepal has the highest percentage (6.30%) of GDP loss due to RTI (Dalal et al., 2013). The estimated cost of RTCs for the year 1994/95 was US\$12.06 million in Nepal (Thapa, 2013). For the year 2001-2002, the cost of RTCs for the country was estimated at least \$4.2 million. Similarly, the estimated economic loss for 2007 from RTIs was at least \$163.84 million annually at 2007 market

price. These figures provide evidence to how road traffic crashes are significantly draining nation's resources.

2.12.1 RTCs by Age and Sex

In Nepal, young adults aged 15-49 years are at the highest risk of road traffic death and injury (Government of Nepal, 2018a; Karkee & Lee, 2016; & Shrestha et al., 2017). RTIs are the second leading cause of fatality among men aged 15-49 years, and more than 40 percent of the RTI deaths occurred in 2017/18 were among the people under 26 years of age (World Bank, 2020a). An analysis of motorcycle crashes in Kathmandu found that the 20-30 year age-group was the most vulnerable to road crashes among motorized two-wheeler users (Sapkota et al., 2016). A RTI study of Morang district found that 33 percent of the victims were pedestrians and cyclists (Poudel, Dhungana, & Dahal, 2021). It also found that majority of the drivers and 80 percent of the victims were aged below 40 years. Other studies have also shown that the population between 20-40 years age-group comprised a larger proportion of RTIs in Nepal (Shrestha et al., 2017; Poudel et al., 2021). Male two-wheeler users and pedestrians aged 16-30 years are the two most RTC-vulnerable groups in Nepal (Karkee & Lee, 2016). Similar to global estimates, gender and road traffic injury pattern are similar in Nepal; the males are at higher risk of road traffic casualties compared to females (Nepal et al., 2015). The 10-year road traffic death pattern found that males comprised more than three-fourths of the total road traffic deaths, and the increment of the number of male deaths is markedly larger than females (Atreya et al., 2021).

2.12.2 Causes of RTCs

There are various reasons of RTCs, but they can generally be grouped in three broad reasons:

- i) driver-related (speeding, drink-driving, overstuffing, and neglecting working hours),
- ii) vehicle-related (machine-related problems and old vehicles), and
- iii) road-related (narrow, steep, graveled, not timely maintained) (Karkee, 2020).

In general, poor road conditions and a lack of basic safety features result in significant numbers of crashes and fatalities. In most crashes, driver's behavior has been reported as the cause of the RTCs (Thapa, 2013). Prominent causes of RTCs such as mechanical factors, road conditions, weather conditions were less reported in Nepal because most of the causes were reported by traffic police without a detailed investigation (Khadka et al., 2022). The study by Thapa (2013) further revealed that about half of the nationwide crashes occur in Kathmandu, but the severity was lower than the rural areas. Small area analysis of RTCs at three villages of Makwanpur district found that 85 percent of cars, buses, and motorized two-wheelers often exceed 40km/hr (Khadka et al., 2022). This is also justified by the qualitative study on adolescents' perception of road risk, where adolescents revealed that they were scared to walk on sidewalks (Gautam et al., 2021). A status paper on road safety also highlighted that passenger's fault, driver carelessness, drunk driving, haphazard roadside parking, reckless pedestrian crossing, and poor road situation were the major factors responsible for the crashes in Nepal (Thapa, 2013). A study analyzing 10 years' trend in RTCs in Nepal pointed out driver negligence and speeding as the two major reasons (Atreya et al., 2021). A government report also showed that majority of RTCs occur due to negligence of drivers and over speeding, accounting for

43.7 percent and 18.7 percent respectively (Government of Nepal, 2013). Similarly, the World Bank's report presented that 60 percent of RTCs take place by driver-related causes such as violating traffic laws, drink-driving, overloading and speeding (World Bank, 2020a). A cross-sectional study on the pattern and causes of RTCs in Morang district also found that more than half of the RTCs occurred due to negligence another third of the crashes were a result of speeding (Poudel, Dhungana, & Dahal, 2021). The analysis of RTCs in Nepal highlighted that crucial factors contributing to such crashes include the presence of hilly and rocky roads, old vehicles, overloading, careless driving, and the lack of road maintenance (Karkee, 2020). Karkee further mentioned that similar types of RTCs have been recurrent due to neglected road safety issue (Karkee, 2020).

2.12.3 Vehicle Types and Crash Casualties

Two-and-three-wheelers constitute more than two-thirds of the motorized vehicles in Nepal (Government of Nepal, 2018a). According to the proportional share of motorized two-wheelers, motorcycles/scooters are the most common vehicle types involved in RTCs (Huang et al., 2017). Even during the COVID-19 lockdown, motorized two-wheeler crashes represented about 22 percent of the total crashes, indicating a significant contribution of two-wheelers in the RTC count. (Sedain & Pant, 2021). In urban areas, most of the crashes involved two-wheelers, whereas trucks and buses/jeep/vans crashes were more common in the rural roads (Government of Nepal, 2013). Another population-based study also found that motorcycle crashes were the most common RTIs, followed by car, truck, or bus crashes, and pedestrian injuries (Nepal et al., 2015). A World Bank's report showed that vulnerable road users (pedestrians, cyclists, and motorized two-wheelers) represented 72 percent of the total vehicle crashes in Nepal (World Bank, 2020).

A qualitative study conducted among school children also found that pedestrian crossings were lacking on most roads, and vehicles parked randomly on the roadsides, which are the major contributing factor for crashes involving pedestrians in urban streets (Gautam et al., 2021). A similar finding was obtained when analysing the records of 4,361 casualties from Kathmandu valley occurred in the year 2014/15, in which 51 percent of the victims were pedestrians followed by passengers (36%) (Choulagai et al., 2015). According to a study conducted in Prithivi Highway, the number of RTCs were higher in highways during the major festivals (Dashain and Tihar) or in the month of October (Choulagai, Ling, Sharma, & Mishra, 2015).

2.13 Agencies Working for Road Safety in Nepal

UN has called for the establishment of a dedicated road safety authority in every country, which would be responsible for decision-making, resource management, adopting a multi-sectoral approach, and implementing targeted legislation to enhance the overall road safety status (Peden et al., 2004). In line with this, Nepal Government has taken some actions for making safer roads. The Government formed the National Road Safety Council (NRSC) led by the Secretary of the Ministry of Labour and Transport Management, however, the NRSC was not functional until 2019 (Ministry of Physical Planning & Transport Management, 2013). After the Third Ministerial Conference (2020), the NRSC was revived and led by the Ministry of Physical Infrastructure and Transport (MoPIT) to coordinate all institutions (government and private) working in the fields of road safety in Nepal (Schafer, 2021). The NRSC has a lot of responsibilities and the ultimate objective was to promote road safety in Nepal; however, the council is not able to work independently as envisaged by the Global Plan for the Decade of Action.

Road safety promotion needs multi-sectoral collaborative efforts. The ministries directly related to road safety are Ministry of Physical Infrastructure and Transport, Ministry of Home Affairs, Ministry of Health and Population, Ministry of Education and Ministry of Federal Affairs and Local Development. The Department of Roads, and Department of Transport Management under the Ministry of Physical Infrastructure Transport, are directly involved in the road construction and maintenance works. Road Boards Nepal has also been working on planned maintenance of roads for the last two decades. Similarly, Nepal Police is responsible for traffic rule enforcement.

2.14 Road Safety Research in Nepal

During the last decade, some research has been conducted to explore road crashes, deaths, injuries, review of policies related to road safety, and the factors related to RTCs in Nepal (Huang et al., 2017; Adhikari, 2016). Among these researches, Sapkota et al.'s (2016) article was related to the two-wheelers crashes and the economic loss from these crashes. However, most of the studies (Huang et al., 2017; Mishra et al., 2010; Prakash, Yadav, & Das, 2017) were hospital-based or a small area research. Road traffic studies by Banstola et al., (2020); Karkee & Lee (2016); Sedain & Pant (2021) discussed the national level road traffic situation; however these studies were based on the secondary data. A study conducted on the road traffic crashes during lockdown showed that road traffic deaths and injuries are a major mortality and injury-related problem in Nepal. The study further pointed out that even when vehicle mobility was very low, the road crash cases were significant in Nepal (Sedain & Pant, 2020). These limited studies could not explain the actual situation of RTCs in Nepal, though. The dearth of evidence challenged the government to initiate the road injury prevention initiatives in three tiers (federal, state and

local level). Thus, this study aims to add some evidence to explain the situation of RTCs and its impact in Nepal.

2.15 Operationalization of the Terms Used in the Study

In this study, the outcomes of the road traffic casualties accounted for both the deaths and injuries. RTDs refer to the fatalities that occur as a result of a result of injuries sustained in traffic crashes involving vehicles, pedestrians, cyclists, and other road users on the roads (WHO, 2023). Similarly, RTIs means the physical damage to the body resulting from RTCs (Rahman, 2021). In this study, deaths that occurred either at the spot, while transferring victims from the crash location to the hospital, or at the hospital were considered road traffic fatalities. Spot deaths are deaths that occur immediately at the scene of the crashes due to serious trauma as a result of the road crash (Singh & Gupta, 2020). The term fatal and non-fatal road crash incidents refers to deaths and injuries resulted from the road traffic crashes.

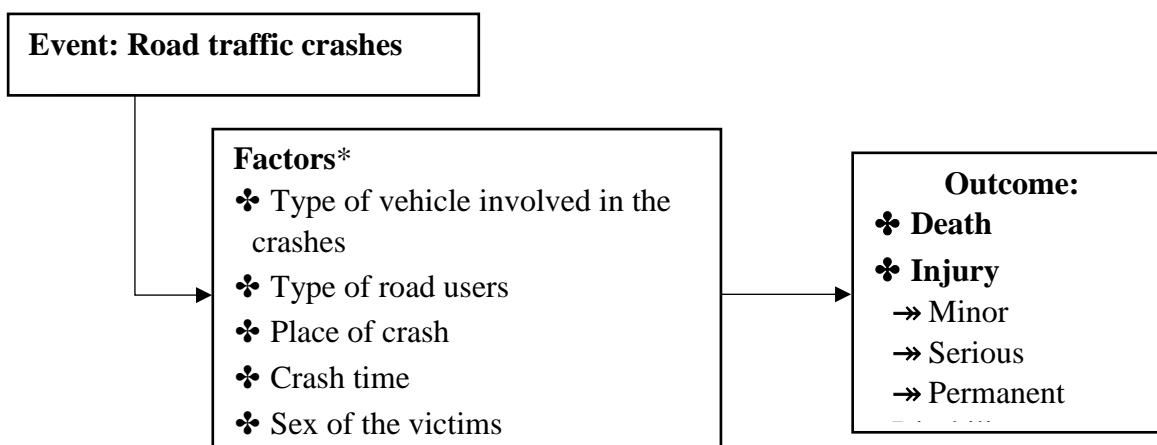
2.16 Conceptual Framework

As Omran (2005) stated, RTIs fall on the third stage of the epidemiology transition and is preventable. Based on this theoretical background, this study has been conceptualised. RTIs can vary in severity, ranging from minor to severe. Unfortunately, in many cases, minor and serious injuries are often not accurately categorized. Therefore, this study aims to analyze fatal cases through the examination of various independent variables (type of vehicle involve in the crash, type of road user, place of crash, crash time, sex of victims, month of crash). The following Figure 2.2 is the framework outlining the independent variables that predict road traffic fatalities. It illustrates that when RTCs

occurred, there are some independent variables that can predict the death of the person involved in the crash.

Figure 2.2

Conceptual Framework on the Prediction of Road Traffic Deaths by Different Independent Variables in Nepal

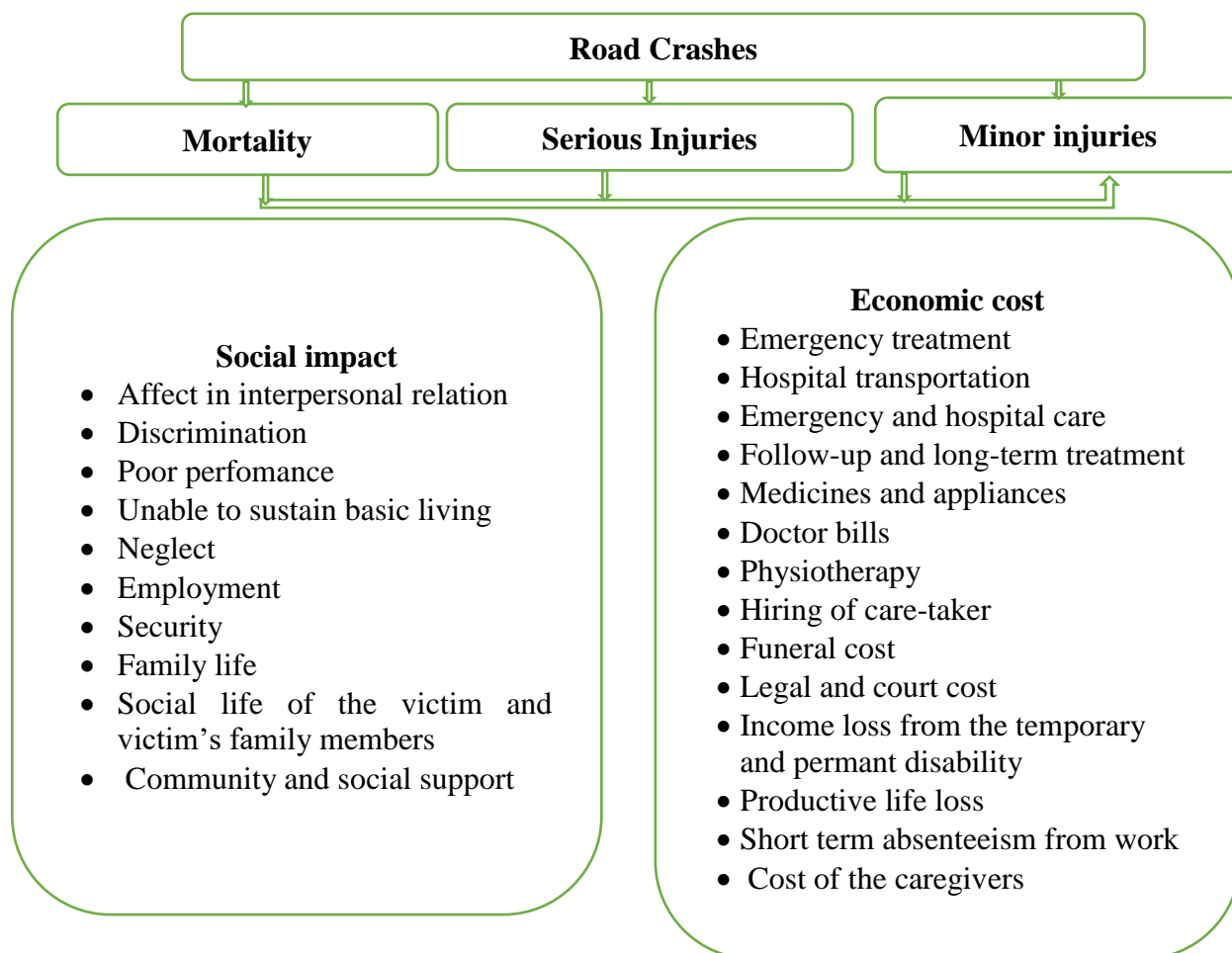


**Other variables could also be used to predict the road traffic death in case of road crash. But due to limited data, this study used only these variables.*

In most cases, road traffic crashes result to human injuries and deaths, where the injuries were categorised into minor and serious injuries. This study analyzed road crashes that resulted into fatalities, serious injuries, and minor injuries, while also assessing its impact to the injured people and their families' social and economic life. The critical analysis on the impact of RTIs shows that there is a direct negative relationship between road traffic injuries and the social and economic status of the RTI survivors and related families (Weijermars et al., 2016). Based on the review, the conceptual framework has been developed (Figure 2.3).

Figure 2.3

A Conceptual Framework on the Socio- economic Impact of the Road Traffic Crashes



Source: Adopted from; Silcock, Silcock, Mall, & Silcock, R. (2003)

CHAPTER III: METHODOLOGY

3.1 Introduction

This chapter presents the details of the methods used in this research. The selection of research design, data collection tools, methods of analysis, and ethical considerations applied to the study are presented in this chapter. The relevant literatures were reviewed initially, which showed that RTCs, death, and injuries are increasing dramatically in most parts of the world; and Nepal is not an exception. This study used RTC related records of Nepal Police for the quantitative analysis of the crashes, deaths, and injuries. The qualitative research was designed to explore the impact of the RTCs. The impacts of road traffic injuries and deaths to the victims and their families have been explored from in-depth interviews and a group discussion.

In both types of interviews, participants were the victims of RTCs and their family members. In both interview processes, semi-structured open-ended questions were used to guide the conversation. The primary objective of this qualitative research was to explore the impacts of the injury/death on the victim and their family members.

3.2 Philosophical Ground

The concept of research philosophy encompasses the formulation of research assumptions, its epistemology, and characteristics (Creswell, 2011). The field of social science research philosophy is generally characterized by two main perspectives: objectivism and constructivism (Zukauskas et al., 2016). These two ontological perspectives provide a framework for understanding knowledge, encompassing aspects such as its source and significance (Zukauskas et al., 2016; Bryman, 2008). Objectivism relates certain similarities with the positivist approach to understand knowledge, frequently

observed in the exploration of natural sciences (Creswell, 2011). However, Bryman (2008) advises against exclusively associating positivism with the natural sciences.

In contrast, constructivism adopts a distinct view on knowledge, positing that significance is shaped by context and is a product influenced by diverse viewpoints, including those of the individual engaging with the information (Sabbagh & Schmitt, 2016). This viewpoint is impacted by people's values, level of development in the society, communal dynamics, and the individual's interaction with their surroundings (Sabbagh & Schmitt, 2016). As a consequence of the broad spectrum of meanings attributed to knowledge within the constructivist framework, it is more frequently employed in research undertaken in the social sciences as opposed to the natural sciences (Creswell, 2011).

The road safety research is typically grounded in a combination of both objectivism and constructivism (Guba & Lincoln, 1994; Bryman, 2008). Objectivism provides a basis for identifying and measuring physical risks and hazards, developing standardized protocols and interventions, and conducting quantitative evaluations of their efficacy (Creswell, 2011). On the other hand, constructivism recognizes that a road crash is influenced by multiple factors, including individual behaviours, cultural norms, level of development, and social and environmental contexts (May, 2011). This approach emphasizes the importance of subjective experiences, quantitative and qualitative research methods, and community engagement to identify and address the underlying causes of RTCs. Thus, road safety research draws on both objectivist and constructivist philosophical perspectives to develop effective prevention strategies while considering the complex, context-dependent nature of road crashes.

To understand the interaction between objectivism and constructivism, quantitative and qualitative tools are used. Quantitative tools were used for the descriptive analysis of road traffic crashes, deaths and injuries, while qualitative tools were used to explore the impact of the RTCs to the victims and their family members.

3.3 Research Design

This study employs a research design that encompasses descriptive, explanatory, and exploratory aspects. Its primary objective is to depict the current state of road traffic fatalities and injuries in Nepal. The explanatory component aims to identify the factors associated with RTDs. However, both the descriptive and explanatory approaches have limitations in addressing how road traffic fatalities and injuries impact the victims and their families. To delve into this aspect, an exploratory research design was conducted using a qualitative survey to explore the impact of RTCs on the victims and their families.

As discussed above, this research is a combination of multiple philosophical grounds and multiple designs. The study aspires multiple types of data that should be acquired from multiple methods or sources of data. The systematic review was conducted to set the background for this research. The quantitative analysis was needed for the second objective (death and injury analysis). Similarly, qualitative information was required to explore the impact of the RTCs to the victims and their families. Thus, this study comprised of three different research methods: a) systematic literature review, b) quantitative analysis, and c) qualitative analysis.

Systematic Review: A systematic review is a research method, and it is similar to a survey in which a review involves a survey of the literature, not of people (Petticrew, & Roberts, 2006). It is a method of mapping out areas of uncertainty, identifying where little

or no relevant research has been done and where studies are needed (Petticrew, & Roberts, 2006). The systematic review is also considered an important technique for identifying the existing evidence within a subject area. A systematic review of road traffic injuries and their impact in SAARC countries was conducted to identify the area of RTI research, and to study the status and impact of road traffic injuries in SAARC countries. The details regarding the systematic review is presented in Chapter Four. The aim of this systematic review was to achieve the first objective of this study: to assess the status of road crashes and impact in SAARC countries based.

Quantitative Analysis: Descriptive research questions inquire about the pattern and characteristics of the issue being studied in the social world (Remler, & Van Ryzin, 2014). The second objective of this study was to describe the road traffic deaths and injuries and predict the risk factors for road traffic deaths. Nepal Police records deaths and injuries through the Operation and Crime Investigation Department as part of their regular official investigation process (Sedain & Pant, 2021). With this information, the records for the fiscal year 2018/19 that were in the form of narratives, were obtained for this study. Data on the injury severity (deaths, serious injury, minor injury) and other possible variables were then extracted from these road traffic case narratives records. Based on the narrative records, this study has presented quantitative evidence of road traffic crashes, deaths, and injuries in Nepal.

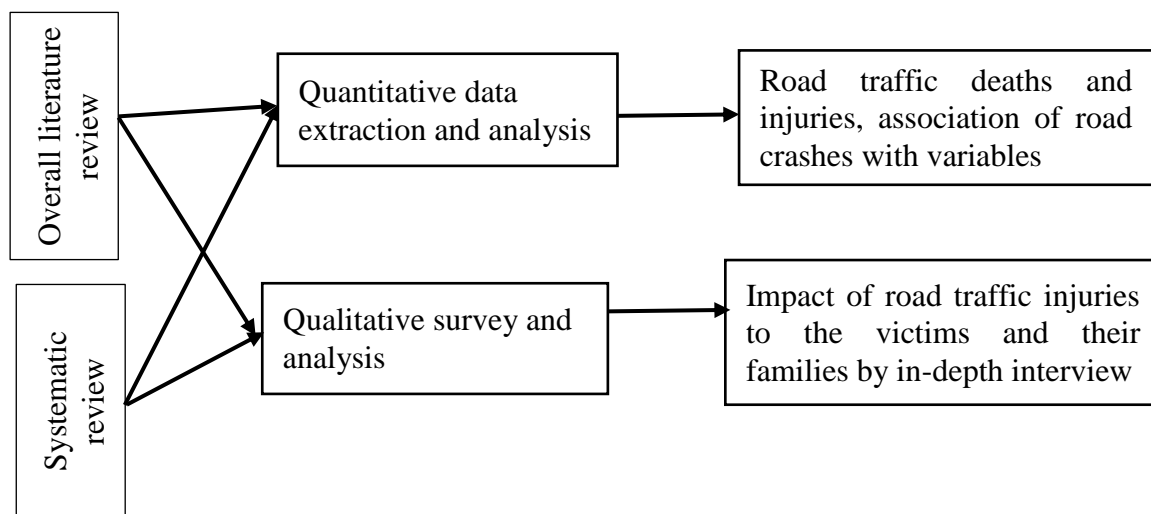
Qualitative Analysis: Creswell, (2011) stated that the research that seeks answers to the "How" question often well fits with qualitative methods and would be classified exploratory research. Cresswell also listed that using qualitative methods makes it easier to understand the circumstances and impact of injuries on trauma survivors and their

caregivers and the existing injury prevention activities. Police records often do not include information on the impact of road traffic injuries on the victims and their families.

Similarly, they stated that the injury research field will benefit immensely by integrating qualitative and quantitative methods. The third research objective of this study was to explore the impact of road crashes, deaths and injuries to the victims and their families. The nature of this research objective has matched with the qualitative research approach. The impact was obtained from the in-depth interviews with the road traffic victims and their families. Thus, this study was a retrospective and prospective research. This study used both quantitative and qualitative methods for the deeper understanding to this serious issue of RTCs in Nepal. Hence, this study was explanatory sequential mixed method research (Creswell & Creswell, 2018).

Mixed-methods research combines qualitative and quantitative data in which one database could be further elaborated by the use of the other database (Creswell & Creswell, 2018). The mix-methods approach is also considered practical, where a researcher looks into the what and how part of the research issue, often utilizing quantitative and qualitative research approaches (Creswell, 2011). In this research, a quantitative study was conducted, followed by the analysis of data. Finally, the results were presented to explain the road traffic deaths, injuries and its relation to the other variables. The qualitative study was designed to understand social impacts of the RTCs in-depth. The strength of this research is that it was possible to bring detailed RTC information regarding deaths and injuries in Nepal. Figure 3.1 reveals how the mixed method approach was developed after the overall literature review and systematic review.

Figure 3.1
Study Methods Framework



3.4 Systematic Review

The review comprised of research articles released in English language from January 2010 until December 2020. January 2010 was selected as the starting point because the promotion of road safety was prioritized after the First Ministerial Conference Held in Russia in 2009, and especially after United Nations’ announcement of the “First Decade of Action for Road Safety” and launch of the Global Plan for the Decade of Action for Road Safety 2011-2020 by WHO (Heydari et al., 2019; United Nations, 2010).

3.4.1 Review Procedure

During the process of article selection for review, multiple factors were considered, including the comprehensive assessment of road injuries’ overall status and their diverse impacts on social, economic, and other related factors.

3.4.2 Searching of the Relevant Papers

Cross-sectional studies, reviews, research notes and original research articles focusing on the road traffic deaths, injuries and its social and economic impact in SAARC

countries, published in peer review journals were systematically searched, reviewed, and analysed in this study.

3.4.3 Article Screening

Once the electronic search was completed, the list of selected articles were listed in MS-Excel. This was followed by the screening of all the studies by reading the titles, through which all duplicate and irrelevant papers were removed. The abstracts of all remaining articles were also screened to identify and select eligible full-text papers.

The studies presenting the nationally representative information on road traffic deaths and injuries were reviewed to explore the status of RTIs in the selected countries. On the other hand, the studies related to the socio-economic impacts of the RTIs were reviewed to explore the impact of the injuries at the national, community or individual level.

3.4.4 Inclusion Criteria

The following inclusion criteria were utilized in the review:

- a. national road traffic injury related topics from the SAARC country (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka)
- b. published in English language.
- c. articles that analysed national level data for road traffic deaths and injuries that identified social and economic impacts of road traffic injuries of the SAARC countries; and
- d. primary research article which analysed primary or secondary data of road traffic injuries, deaths and its impacts for the period between January 2010 and December 2020.

e. published in peer-reviewed journal with any of the following study designs (qualitative, quantitative or mixed methods).

This review also used Google Scholar to identify national, regional or SAARC level articles from journals not listed on PubMed: only the articles published between 2010 and 2020 were considered in both search approaches. The data were extracted with their authors, name of the paper, date of publication, and country. The papers that did not meet the inclusion criterion were excluded from the review list.

3.4.5 Data Extraction

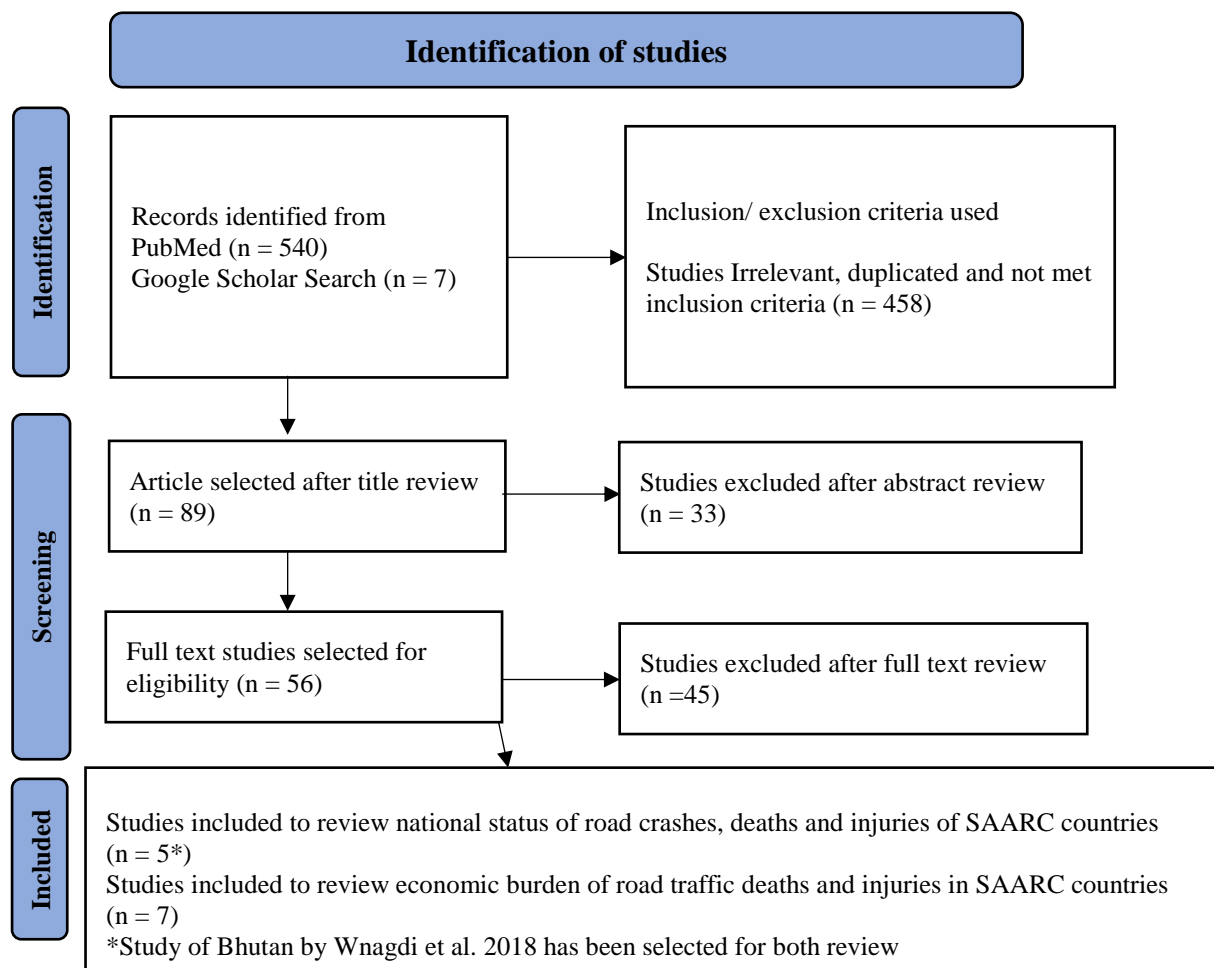
Initially, the data extraction form was developed, which included the author's name, year of publication and the aim and type of the study. The methodology used by the research, the variables examined, and the key findings were also manually extracted. In the case of national level RTI status studies, duration of data collection, its sources of data, methodology, and detail results were extracted. Available information on the costs of the road traffic crashes, and social impact at individual, household, community and national level were also retrieved from selected papers for RTI impact review.

3.4.6 Search Strategy

PubMed was searched using the criteria :(Nepal OR India OR Bangladesh OR Pakistan OR Maldives OR Sri Lanka OR Bhutan OR Afghanistan) AND (Road traffic crash OR Road traffic crashes OR traffic crash OR Road Traffic Crash OR RTA OR Road Traffic collision OR Road Traffic Injury OR RTI) AND (Injury OR Death OR Fatality OR Injuries OR Fatalities OR Disability OR Morbid OR Mortal OR Survivor OR Victim) AND (Economic OR Social OR Burden OR Consequence OR Trend OR Survey OR Impact OR Cost).

Figure 3.2

Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) flow diagram of papers selection for review



3.4.7 Data Quality Assessment

This review included various types of study designs such as time series, police registered data-based study, cross-sectional, systematic review, and incidence-based cost of-illness approach). The quality of every study was assessed by using STROBE Statement checklists (Von Elm et al., 2007). For each of the full text reviewed studies, title, abstract,

introduction, methods, results, discussions and conclusions were matched with the checklists.

In the national RTI status, only the studies presenting national level RTI information were selected. Due to the limited publication on the national level RTI impact in SAARC countries, small area-based or hospital-based, or national level data-based peer-reviewed studies were also selected for this review.

3.5 Quantitative Study

The quantitative component of this study comprised two main analyses: descriptive and statistical. The descriptive analysis is presented in Chapter Five, while Chapter Six focuses on the statistical analysis.

3.5.1 Quantitative Data

Data is an elementary description of reality, and it is in the form of measurable values or qualitative criteria (Larini, & Barthes, 2018). The quantitative approach of this study incorporates road traffic deaths, injuries and association of deaths with time/day/month of crash, type of vehicle involve in the crash, type of road users, crash province, districts as independent variables.

3.5.2 Reason for Using Police Records in Quantitative Study

The major sources of mortality and morbidity data are health care provider-based data, population-based data and other sources of data (Chen, & Warner, 2012).

Regarding injury related data, common sources can be categorised into two groups; data collected from administrative or medical records at crash location or health care provider based data and data collected from people referred as population-based data (Chen, & Warner, 2012). Nepal Population and Housing Census collected information on the

mortality and morbidity status of (Joshi, 2014). However, the census did not explore all causes of injury-related deaths. In addition, hospitals and insurance companies record road traffic victims' information during their service delivery process – albeit on a more limited scale. Similarly, Demographic Health Survey (DHS) only provides information on maternal health related mortality.

In a small sample population-based study, the statistical average is inadequate evidence to guide actual problem of road safety in Nepal. While dealing with national-level road traffic deaths and injury data, it is better to consider a large sample population which is challenging for small-scale academic research. Literature (Peden et al., 2008; National Rural Roads Development Agency, 2016; WHO, 2018) suggests that the best source of the secondary road crash data was Traffic Police records collected directly at the crash scene. Like in most developing countries (WHO, 2018), Nepal Police Department is the government authority responsible for collecting road traffic deaths and injuries in Nepal. Hence, a nationally representative dataset was chosen for this study, with the aim of generating nationally representative RTI evidence to contribute for its prevention in Nepal.

3.5.3 Quantitative Data Collection

On behalf of the Central Department of Population Studies, the researcher officially requested road traffic deaths and injury information from the Nepal Police Headquarters. The secretariat of Inspector General of Police (IGP) office provided detailed road traffic crash incidents in the form of narratives. This dataset of the quantitative information for the road traffic deaths and injuries were obtained from the police record for the year 2018/19. The data extraction format was developed to extract the possible variables from the

narrative information. The aim of the detailed extraction of the police record was to find out national level road traffic deaths, injuries and crash details.

3.5.4 Data Extraction

This study used MS Excel to extract the quantitative data from the narrative record. The data entry format was developed to extract possible variables from each road traffic crash incident recordings.

From the narratives following variables were extracted:

- Date of crash
- Day of crash
- Month of crash
- Time of crash
- Name of province by crash occurrence
- Name of the district by crash
- Place of vehicle registration
- Vehicle that instigate crash
- Vehicle or any object that hit in the crash
- Type of crash
- Name of the victim
- Age of the victim
- Sex of the victim
- The temporary address of the victim
- The type road user
- Type of road injury
- Injury severity
- Number of injuries
- Number of deaths
- Name of the medical facility that victim was taken to initially
- Name of the medical facility that victim was referred to

3.5.5 Analysis of Data

Data analysis was perform in two different ways:

- Descriptive analysis
- Statistical analysis

3.5.5.1 Descriptive Analysis

The nature of data, and the detailed data extraction process is presented in descriptive analysis section. Extracted information was analyzed and is presented in Chapter Four. The variables analyzed include age, sex, time, months, day, injury severity immediately after crash, road user type, and the type of vehicles involved in crash. With this information, RTI mortality rates and injury rates per 100,000 population have been calculated. The deaths and injuries by province, top ten districts and Kathmandu valley (Kathmandu, Lalitpur and Bhaktapur districts) have also been analyzed separately. Data analysis identified the most vulnerable groups by road user, type of vehicles, age group, time, day of a week, month, and places by districts and province.

The frequencies, percentages, mean and median were calculated for the continuous variables. In case of categorical study, variables frequencies and percentages were used. The analysis of the data identified the most vulnerable groups by sex, age, type of road users. Similarly, road traffic death and injury risk by type of vehicle, district, province, time, day, month, were also identified. Descriptive analysis has been used to identify the pattern of road traffic deaths and injuries and severity of road crashes in Nepal.

3.5.5.2 Statistical Analysis

Random Forest (RF) model has significant predictive power over traditional regression analysis in analyzing multiple variables (Best, Gilligan, Baroud, & Carrico, 2020), as Random Forest can be applied even for uneven and missing data (Suarez-lledo & Alvarez-galvez, 2019; Cutler et al., 2007), displaying a high-level predictive accuracy. Additionally, RF models can determine variable importance, and can model complex and non-linear interactions among the variables.

Initially, RF models were developed to apply in computer science; however, in recent times, this model has been widely used in social sciences, epidemiology and public health research (Suarez-Iledo & Alvarez-galvez, 2019). Random Forest is an ensemble-based machine learning algorithm that uses a large number of decision trees and makes the prediction based on majority votes. In this analysis, RF has been used to predict the occurrence of RTDs in Nepal based on variables such as age, sex, crash time, crash day, provinces, type of road users, and vehicle type.

In the RF model, RTDs were taken as the outcome variable, while age, sex, crash time, crash day, provinces, type of road users, and vehicle type were the independent variables in the analysis.

In addition, this study made use of the Gini importance (also known as Mean Decrease Impurity [MDI]) as the feature importance metric to highlight key variables that had a higher tendency to cause road traffic deaths. For context, Gini importance is a computationally efficient method that calculates the reduction in impurity or loss caused by all independent variables for a dependent variable (Li et al., 2019).

Mathematically, the Gini Importance for a particular feature is calculated in the following steps:

1. Calculate the Gini impurity for the overall dataset based on that individual feature through the formula

$$\text{Gini}(d) = 1 - \sum_i (p_i)^2$$
 where d specifies the entire dataset as the scope and p_i is the proportion of data points that belong to class i (in our case, the occurrence of death).
2. Then, calculate the Weighted Gini after splitting a particular feature into individual classes with the formula

$$\text{Weighted Gini After Split}(j) = \sum_j (p_j) * \text{Gini}(f_j),$$

where p_j represents the proportion of data points belonging to class j and $Gini(f_j)$ represents the Gini impurity value of class j based on the formula in point 1.

3. For non-categorical features (like age), suitable ranges are chosen to divide them into categories for classification.
4. Then, calculate the reduction in impurity for each feature through a simple reduction procedure as follows:
Reduction in Impurity(j) = Gini (d) - Weighted Gini After Split(j).
5. Finally, upon calculating the reduction in impurity for all features, computed the Mean Decrease in Impurity (MDI)

MDI = Reduction in Impurity / Number of Features. This gives us the Gini importance value for a particular dataset.

This reduction in impurity value (obtained from the computation in Step 3) helps us infer which feature has the highest impact on the final result (occurrence of death). For each variable, the values range from 0 to 1, where values close to 0 indicate a weak contribution of the variable to the RF model's prediction abilities, while values close to 1 suggest a strong influence.

At first, bootstrap data was formed from the existing data file. From each bootstrap data, decision trees were created. In this model, 207 decision trees were trained, and the decision trees were used to predict the outcome. During classification of trees, it builds a rule by recursive binary partitioning into homogeneous regions called node. In every process in fitting a classification of tree, an optimization is carried out to select the node. Splitting process was run and stopping condition is determined based on five-fold cross validation and grid search of the hyperparameter. RF fits the number of classification trees to the dataset, then utilize predictions from all trees to achieve better prediction.

3.5.5.3 Pre-process of Data for Random Forest Analysis

Data extracted from Nepal police records contained 25,511 road traffic victim's details. Each victim's details consists of various information including age, sex, place of crash, time of crash, month of crash, day of crash, type of vehicle involve in the crash, type of road users. The data entered in MS-Excel was edited by removing the variables having too many missing values. For categorical variables, each item is converted to additional columns. In this study, it was tried to identify the attributes which cause the fatal injury at a granular level. For example, instead of understanding whether the vehicle type is an important attribute or not, it was tested which particular vehicle is more predictive of fatal crashes. Hence, on- hot encoding based approach to represent the feature was used. Once one hot encoding was performed, the road user column is expanded to (road_user_Pedestrian, road_user_driver,road_user_passenger...etc.). Value in road_user_Pedestrian column is set to 1 if the road user is pedestrian else the value is set to 0. Same has been done for all other categorical variables. This is the preprocessing step which makes the data ready for the RF Model to use. Once the data is ready it was given as input to the Random Forest model. As the main objective of the work is not to improve the predictive power of the model but to identify which attributes are important from all the available features and then used Feature importance to determine which variable is more important.

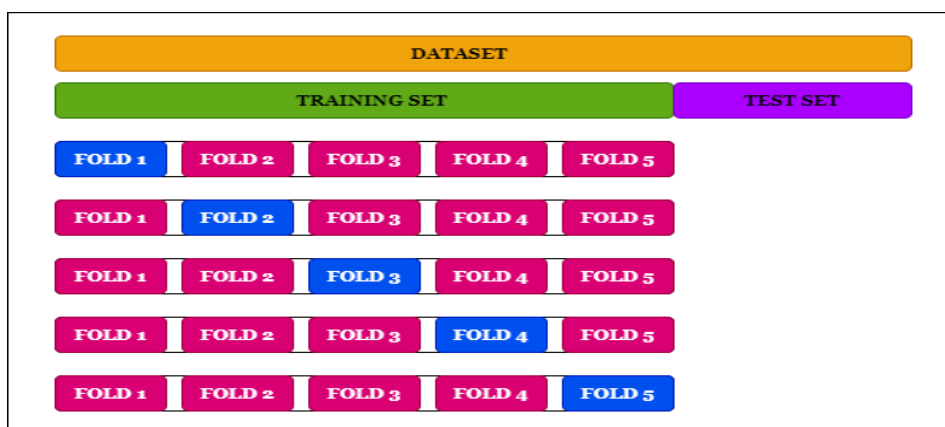
3.5.5.4 Random Forest Analysis

During model training, all data were randomly divided into a number of folds and each fold contained equal number of cases. The first fold was used as the validation set, and the rest is for the training set. The accuracy to predict road traffic deaths in Nepal was

calculated using RF analysis model on the studied database. This process was repeated to validate the different folds. In the analysis, the hyper-parameters used were: the number of decision trees, the minimum number of samples required to create a new branch in the decision tree, and the maximum depth of the decision tree.

Figure 3.3

Data Split and Five-fold Validation



3.6 Qualitative Data

Qualitative data is a valuable resource that brings a new viewpoint to existing data (Ritchie, 2003). This study used in-depth interviews and group discussion with the road traffic victims and their family members.

3.6.1 Study Population

Road traffic crash incidents registered in the Nepal Police's data recording system was considered as the study population for the quantitative study. This study also incorporated road traffic crash survivor and person who lost their family or have injured family member in the study sample population of qualitative research.

Bagmati Province records the highest number of vehicular crashes in the country (Nepal Police, 2019). This province also has more than 20 percent of the total length of

national road network (Province Policy and Planning Commission, 2018). Kavre and Dhading are the two districts with major highways to enter Kathmandu. In many cases, road traffic victims are initially taken for immediate treatment to the Highway Community Hospital and Dhulikhel Hospital. In order to explore the participants for qualitative information, the sample population were listed from the patients' register maintain in Highway Community Hospital at Dhading Malekhu and Dhulikhel Hospital, Dhulikhel. An in-depth interview technique was chosen to study the social impact of road traffic injuries for victims and their family members. The family members were the spouse of the road traffic victims, or their parents and their children.

3.6.2 Sampling

In qualitative research, selection of the respondents was determined according to the need of the research question (Patton, 2015). Global Status Report on Road Safety revealed that road traffic crashes occur in all age and sex groups (WHO, 2018). Hence, the sample frame for the qualitative study were the patients of all ages from Highway Community Hospital at Malekhu (Dhading) and Dhulikhel Hospital at Dhulikhel (Kavre). Participants in this in-depth interview were road traffic victims and their family members who had experienced a RTC two years prior to the interview. All types of road users exposed to serious injury and the family members of the deceased or injured person resulting from a traffic crash were eligible for qualitative study. Eligible participants were identified from the hospital records. In the participant selection, emphasis was given to get good representation of the major issue of the study rather than to provide representative sample of the country level.

Participants were contacted by the researcher personally, and the people willing to participate were scheduled for the interviews. The interview schedule was fixed through telephone calls; once the contact has been established, the participants were visited by the researcher at their own place of residence. Participation in the interview was voluntary and it was conducted in accordance with ethical guidelines; a verbal consent was obtained from each of the participants before proceeding to an interview. Participants were also informed about the ethical approval from Institutional Review Committee. The eligibility criteria of the participants were being injured from the road crashes and the family member of injured victim or deceased person. Participants were included on the basis of following criteria:

- a. all participants to have sustained road traffic injuries 1-2 years before the survey
- b. all types of road users
- c. able to talk about the issue
- d. family member of victim including spouse, parents and children

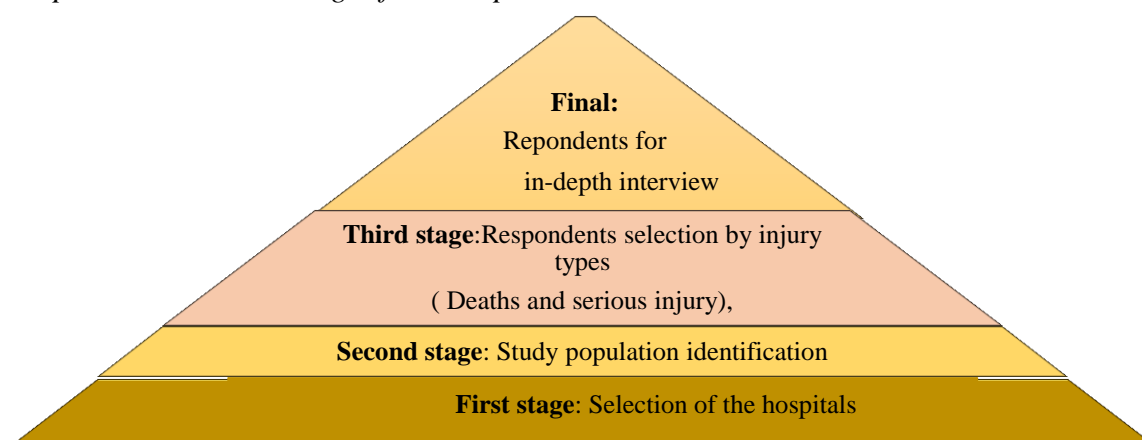
3.6.3 Selection of Sample Population

As mentioned above, the qualitative sample frame of this study were the RTCs victims registered in the Highway Community Hospital and Dhulikhel Hospital. Similarly, family members of the road crash victims were also included in the sample respondents. Road traffic injuries are often categorized into deaths, minor injuries, and the serious injuries (Peden et al., 2004). In studying the impact of road crashes, this study has considered seriously injured crash survivors (admitted in hospital), their family members, and deceased persons' family members. The purpose of in-depth interviews and group discussion was to obtain information on the impact of road crashes from the participants who are directly victimized in the road crashes.

In sample selection, maximum heterogenous respondents of different age groups, sex, and place of residence were selected to ascertain the impact of road traffic deaths and injuries. Qualitative samples are usually in small size (Jane, 2006). This study used saturation method for in-depth interviews and a group discussion was conducted to find out the impact of the road traffic injuries and deaths on the victims and their family members. The in-depth interviews were conducted until the new data (information) was redundant to the information already collected from the previous interviews. In road traffic crashes, the number of injuries are significantly higher than the deaths. Among the participants of the in-depth interviews, three-fourths were seriously injured victims and their families and rest were deceased people's family members. In this study, face-to-face interviews with all the participants was performed. Due to the sensitivity of the study topic, the researchers stopped or postponed the interview every time the participants felt distressed. Interviews were conducted at the participants' preferred location and they were also requested to choose a time suitable for them.

Figure 3.4

Respondent Selection Stages for In-depth Interview



3.6.4 Social Impact of RTIs

This study has ascertained the impact in interpersonal relations, discrimination, unable to sustain basic living, neglect, safety and security, family life, quality of life, psychological stress, health complications, social life of the victim and their family members as social costs of the RTIs. The age, sex, place of crash were considered as socio-demographic variables and time of crash, day/month of crash, type of vehicle involved in the crash, type of road users, crash province, districts were also used in the analysis.

3.6.5 Qualitative Information Collection

Based on the available literature of social impact of road traffic deaths and injuries, a checklist for the issue to be discussed during in-depth interview was developed. The terms, issues, and the contexts of the discussion were developed from the findings of the systematic review. The in-depth interview explored the overall impact of road traffic injuries to the victim, and their families. The qualitative study findings presented in this study were based on qualitative surveys to provide the detailed impact of road crashes on the victims and their families.

3.6.5.1 Interview Procedures

In-depth interviews were conducted individually with road traffic victims and their families in private places where the participants felt comfortable. The overall objective of the interviews was to explore the impact of road traffic crashes to the victims and their family members. Some demographic information such as age, education level and sex of the participants were recorded during interviews. The researcher conducted all the

interviews, transcribed the content, and performed coding of information. The interview checklist was prepared as per study objective and most of the questions were semi-structured.

3.6.5.2 In-depth Interviews (IDIs)

An in-depth interview is often described as a method of collecting qualitative data by a conversation with a purpose (Legard, Keegan, & Ward, 2003). The in-depth interview aimed to understand the breadth and depth of road traffic crash impact on the survivors and their family members. In this study, in-depth interviews were intended to combine semi-structured interviews with flexibility. The interview was more interactive, and the interviewer used probes to achieve depth answers on the social impact of road crashes on the victims and their families. The researcher explained the objectives of the discussion to all the participants. The researcher also guaranteed the confidentiality of the provided information and anonymity of the participants. A group discussion and in-depth interviews were conducted in July/August 2022. The interviews were generative in which knowledge on the social impact of road crashes to the victims and their families was explored.

3.6.5.3 Inclusion and Exclusion Criteria to Select Participants for IDIs

Road traffic crash victims and their family members (the spouse of the road traffic victims, parent and their children) were included as a respondents for the qualitative survey.

Inclusion criteria

1. all types of road traffic victims
2. attended emergency and inpatient departments of Dhulikhel Hospital or Highway Hospital at Dhading.
3. all ages

4. victim's family member including parents, spouse, and children
5. willing to participate in in-depth interview

Exclusion criteria

Those unwilling/unable and not providing consent to participate have been excluded

3.6.5.4 Recording of the IDIs

A mobile phone was used to record the in-depth interviews and group discussion. During the recording session, mobile phones were set on airplane mode. Individual written consent was obtained from the in-depth interview participants. The in-depth interviews were based on the standard checklist prepared with the review of the relevant literature. The main topics of discussion in the interviews were: impact on regular daily life, interpersonal, family and community relations, employment status, education, financial, societal effects, household income, living standard of the household, psychological effects, working pattern, and changes in lifestyles. Immediately after completing an interview, notes were prepared, ensuring that no information was left behind.

3.6.5.5 Note Making During a Group Discussion and IDIs

An experienced note-taking person was hired to take notes during group discussions and in-depth interviews. The researcher facilitated the discussion and interviews. The note-taker appeared as an observer during discussion and interviews and just took notes. After the interviews, the researcher and the note-taker discussed briefly to identify the critical information provided by the participants.

3.6.5.6 Transcription of IDIs

In this study, the researcher was involved in qualitative data collection, transcribing interview records, and coding information. All interviews were recorded; on average, the

interviews lasted 45 to 60 minutes. All records were transcribed, thoroughly read, and coded during transcription. The sub-terms of the qualitative analysis (road crash and hospitalization, direct and indirect expenses, lost output, health complications, and social impacts) were fixed, and the transcribed information was listed according to the sub-categories.

3.6.5.7 Qualitative Data Analysis

The records of the interviews and group discussions were listened to carefully, and transcribed in English. The notes taken during interviews and discussions were also used while transcribing the recorded information. The researcher transcribed all the information on the same day of the interviews or discussion. Irrelevant information to the study objectives were removed and confidentiality was properly maintained in the analysis. The analysis of terms, issues, or contexts analysis would be a truly realistic method, as it would provide the readers with a better understanding on the respondents' reality (Braun & Clarke, 2006). It is a widely used approach of qualitative data analysis in which information is presented under different terms (Frattaroli, 2012). Data from both in-depth interviews and group discussions were analyzed with confidentiality properly maintained in the analysis.

Terms, issues or context analysis has been used to reflect the reality on the impact of road traffic victims and their family members in this study. The six-step framework developed by Braun and Clarke (2006) has been used in data analysis followed:

1. Generating initial codes,
2. Searching for terms, issues or contexts,
3. Reviewing terms, issues or contexts,,
4. Defining and naming terms, issues or contexts,

5. Producing report, and
6. Application

With regards to the six-step framework, Maguire & Delahunt (2017) mentioned that it is the most effective approach if confidentiality was properly maintained in the analysis. The researcher coded the transcribed data manually. At first, the transcribed information was highlighted to indicate potential terms, issues or contexts. Similarly, field notes were also coded, and all possible measures were applied to explore the possible impacts of road traffic injuries on the victims and their families. Terms, issues, or contexts were developed both from the information obtained from in-depth interviews and group discussion and researcher's prior theoretical understandings (Braun & Clarke, 2006; Bernard, Wutich, & Rayan, 2006). An inductive approach was used in the analysis. All the results were based on the information that has been extracted from the in-depth and group discussion. Quotes were assigned a unique number to reflect the quotes to the original interview. After coding the texts, they were subsequently added in the relevant terms.

3.7 Group Discussion

During the research design phase, the researcher planned to conduct interviews personally with victims and their families to gather information on the impact of road crashes. However, after conducting in-depth interviews, it was learned that the impact of road crashes was similar across respondents and privacy was not a major concern among the road crash victims. As a result, the researcher decided to conduct a group discussion to further explore the challenges and problems faced by victims after a road crash. The discussion took place at the Spinal Injury Care Center, Sanga and involved a total of seven participants. Among them, four individuals had spinal injuries, while the remaining three had injuries to their limbs or head, and were invited from external sources outside the

centre. The same questions that were asked during the in-depth interviews were used during the group discussion. Data management and analysis procedures for the group were the same as those for the in-depth interviews.

3.8 Ethics

There are issues of confidentiality, and the need to ensure adequate and informed consent. Confidentiality is the most important aspect of this kind of research. Therefore, an ethical approval was received from Institutional Review Committee (IRC), Institute of Science and Technology, Tribhuvan University, and approval was obtained from both the respective hospitals. Moreover, the participants were requested to consent to participating in the study. The printed informed consent form was given to the respondents for their written consent. In the case of the respondents with lower literacy, they were supported by the interviewer. Information about the interview process, assurance of confidentiality, and anonymity were clearly discussed with the respondents beforehand.

CHAPTER IV: ROAD TRAFFIC DEATHS, INJURIES AND ITS IMPACT IN SAARC COUNTRIES: A SYSTEMATIC REVIEW

4.1 Introduction

The South Asian Association for Regional Cooperation (SAARC) countries (Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan and Sri Lanka) comprise of 3 percent of the world's land area, and about 24 percent of the overall global population. But here, the number of vehicles make up 10 percent of the world's vehicles (World Bank, 2020a). In these countries, Road Traffic Crashes (RTCs) are an increasing public health challenge. Over the last three decades, this region was projected to have 144 percent increment in road crash fatalities by 2020 (Kopits & Cropper, 2003). These eight SAARC countries alone represent about 25 percent of the global RTDs (World Bank, 2020a), which can be attributed to increased number of vehicles on the road due to speedy economic and technological advancements in the region (Thapa, 2021). The latest estimate WHO (2018) is different for the year 2019, where slightly lower death rates are observed in the eight SAARC member countries: the values were ranging from 13.0 to 19.7 per 100,000 population across the different countries with exception of Maldives (0.7). Motorized two-and-three-wheeler users, truck drivers and passengers, car and light vehicle passengers, and pedestrians were at the highest risk among road users in the region (World Bank, 2020b).

RTIs do not just take lives and injure people to the point of disability; they also impose considerable socioeconomic burdens on the victims, their families and the entire nation (European Transport Safety Council, 2007; World Bank, 2017). RTIs are the leading cause of deaths and injuries among young adults aged 5-29 years (WHO, 2018); they disproportionately affect adults during their prime years of working and raising a family. In

India, the socioeconomic impact of road crashes is found to be higher in low-income households, which experienced up to 75 percent decline in the regular income (World Bank, 2021). Further, the report revealed that death rates were three times higher in the low-income households than in high-income households. The impact of RTIs is felt almost instantaneously at the household level while carrying out different activities, which also affects the quality of life (Leon, Cal, & Sigua, 2005). Most of the road crash victims are males but within the households, females tend to suffer from the added double burden of labour and mental loads due to injury or loss of a male family member (World Bank, 2021).

The GBD study has found that South Asia alone accounts for 23.8 percent of the disability-adjusted life-years (DALYs) and 6.7 percent of the total economic loss from road traffic injuries (Chen, Kuhn, Prettner, & Bloom, 2019). According to the World Bank estimates, on average, RTCs led to the loss of 3 to 5 percent of GDP in South Asian countries every year (World Bank, 2020b).

Systematic review is the way of answering the question, since a single study taken in isolation can be misleading (Petticrew, M., & Roberts, 2006). Therefore, the available evidence was reviewed from published literatures in the journals on the topics of motorized vehicle crashes, deaths, injuries and assess its impact in the SAARC region. This review aimed to explore the existing literature on nationally representative road traffic crashes, fatalities, injuries, and the overall impact within SAARC countries. The findings of this review would be value added to prioritize road safety programs by particularly the government agencies. Similarly, this review would also be beneficial for the decision-makers of national road safety activities.

4.2 Results

540 studies were identified from the PubMed database, and seven additional articles from non-indexed journals were retrieved from Google Scholar. At first, 458 articles with road safety titles but a mismatch with the inclusion criteria, along with irrelevant studies were removed from the list, which meant that 89 studies were selected for abstract review and 56 articles were selected for full-text review. On full article review, some of the listed studies did not meet inclusion criteria (e.g., methodological issues, did not contain data specific to SAARC countries, discussed about health impact and mental health), and they were removed from the selection list. Therefore, only studies satisfying all the inclusion criteria (11 studies) have been selected for this review. Among the final selected eleven studies, ten were country-specific from five SAARC countries (Bangladesh, Bhutan, India, Nepal and Sri Lanka), and the remaining study calculated overall impact of the RTIs of some South Asian countries.

Following the full article review, five studies (Dharmaratne, & Jayatilleke 2015; Hsiao et al. 2013; Karkee & Lee 2016; Ul Baset et al. 2017; & Wangdi et al. 2018) were selected for the national RTI status review. Seven studies (Alam & Mahal, 2016; Banstola, et al. 2020; Bhavan, 2019; Bora et al., 2018; Kumar et al., 2012; Sapkota, Bista, & Adhikari 2016; & Wangdi et al., 2016) were selected to review the impact of RTIs in SAARC countries. An article by Wangdi et al. (2018), presenting both national-level RTI status and its economic impact were used for exploring both the issues in Bhutan.

4.2.1 Status of RTIs in SAARC Countries

All the five nationally representative studies (Dharmaratne, & Jayatilleke 2015; Hsiao et al. 2013; Karkee & Lee 2016; Ul Baset et al. 2017; & Wangdi et al. 2018)

presented road traffic death and injury status of selected SAARC countries. A household survey from India identified that RTI deaths comprised 2 percent of all total deaths in India (Hsiao et al., 2013). The analysis showed that the RTD rate was the highest in India (26.2/100,000 population), followed by Bhutan (11.2/100,000 population), Sri Lanka (10.8/100,000 population), Nepal (7/100,000 population), and then Bangladesh (6.8/100,000 population). Similarly, the injury rate was highest for Bangladesh (UI Baset et al. 2017), followed by Sri Lanka 98.6/100,000 population (Dharmaratne et al., 2015) and Bhutan 80.8 per 100,000 (Wangdi et al., 2018).

When viewing RTIs by age group, most of the RTIs were found to have occurred in the adult age group (25-64 years in Bangladesh; 30-59 years in India, 25-44 years in Bhutan, 20-40 years in Nepal). A nationally representative study of Bangladesh reported the highest mortality rate (14/100,000) among the population 65+ aged population (UI Baset et al., 2017). Similarly, Hsiao et al., (2013), reported that the male population had a 2.1 percent risk of dying from RTI before 70 years in India.

Road traffic deaths and injuries are markedly higher among men than women. In Bhutan, about 80 percent of the road traffic victims were male (Wangdi et al., 2018). Similarly, a study of Bangladesh by UI Baset et al. (2017) calculated injury and deaths rates by gender and found that the mortality rate was 9.2/100,000 for male and 4.7/100,000 for females. Regarding injury, it was 1551.4/100,000 for males and 264.3/100,000 for females in Bangladesh. The most considerable variation in the male-female RTI mortality was observed in India (26.2/100,000 for males and 5.7/100,000 for females) (Hsiao et al., 2013).

Among these studies, four of them (Hsiao et al., 2013; Karkee et al., 2016; Ul Baset et al. 2017; & Wangdi et al., 2018) stated that transport workers, pedestrians, passengers, and two-wheeler riders were at the greatest risk of road traffic crashes. The study by Hsiao et al., (2013), revealed that men living in urban areas had slightly higher age-standardized mortality and risk of RTI deaths. Similarly, compared to non-pedestrian RTI deaths, pedestrian deaths occurred to less educated people in India (Hsiao et al., 2013). The 75-year-long trend of road traffic crashes in Sri Lanka showed that even though the number of road crashes in different periods fluctuated, the overall trend was still increasing (Karkee & Lee, 2016). Table 4.1 presents the characteristics and details of the studies on nationally representative RTI issues (published during last decade).

Table 4.1

Characteristics and Details of Studies on Nationally Representative Road Traffic Injuries (RTIs) Issues Published During 2010-2020 (Number of studies =5)

Author, Year, Country	Aim of study	Data source and data collection period	Methodology used	Results
Ul Baset et al. 2017, Bangladesh	• To generate knowledge on the RTI epidemiology and risk factors among all population in rural Bangladesh	Household survey (2013 to 2015)	<ul style="list-style-type: none"> • The survey covered 1.2 million people in 270,387 households from 993 villages of 51 units. • A face-to-face interview was conducted with individuals over 18 years. • Injuries were classified into low, medium, and highly severe. • Data were collected in two stages first round collected information on socioeconomic and demographic factors (sex, age, level of education, socioeconomic status), household environment, child and birth history, and health-seeking behaviour to understand the household and family status. Detailed information was collected in the second round in case of specific injury mortality or morbidity identification in the first 	<ul style="list-style-type: none"> • 6,303 deaths and 119,669 non-fatal RTI were identified • Adults aged 25-64 years represent the greatest number of road crashes injuries and also highest number of mortalities. • Highest mortality rate (14/100,000) was observed for people aged 65+ years • Mortality and morbidity due to RTI were 6.8 and 889/100,000 population respectively. • Mortality rate was (9.2/100,00 for male and 4.7/100,00 for females) • Injury rate for male 1551.4/100,000 and for female 264.3/100,000 • Transport workers have the highest RTI rate (46.1/100,000) • Passengers, pedestrians and motorcyclists were the common RTI risk road users • 50% cases were low severe and 20% were

		round.	highly severe.
		<ul style="list-style-type: none"> • The fatal RTI rates per 100,000 population was calculated. • Fatal and non-fatal outcomes were calculated, and the recall period was six months. • Logistic regress was used to study the associations. 	<ul style="list-style-type: none"> • 40% if the individuals encountered RTI crashes while they are on their way to work and 21.5% individuals were wandering on the streets. • Low socioeconomic and educational status were associated with higher risk of RTIs. • RTI is a major public health challenges in Bangladesh.
Dharmaratne et al., 2015, Sri Lanka	<ul style="list-style-type: none"> • To describe the trends in road traffic crashes, injuries and fatalities in Sri Lanka from 1938-2013 • Identify the factors associated with the road 	Traffic police database, (1938 to 2013)	<ul style="list-style-type: none"> • Crashes were classified into four types: fatal, serious, minor and none • Data extracted manually from the police record • Census data was used to calculate the rate • Long term trend of RTI was plotted by using Joint Point Regression program • Descriptive and analytic study • Study presented 75 years road crashes trend • Road crashes increases from 61.2 to 183.6 per 100,000 population
			<ul style="list-style-type: none"> • Road crashes increases from 61.2 to 183.6 per 100,000 population respectively in 1938 and 2013. • Road traffic fatalities increase 3.0 to 10.8 per 100,000 in 1938 and 2013 respectively. • Fluctuating road traffic crashes trend in Sri Lanka, in overall it was increasing. • Road traffic injuries increased from 35.1 to 98.6 per 100,000 population during 75 years

	crashes, deaths and injuries		<p>respectively from 1938 to 2013.</p> <ul style="list-style-type: none"> • Road traffic serious injuries increased 3.0 to 32 per 100,000 population • Road traffic fatalities increased from 3.0 to 10.8 per 100,000 population during the study period 	
Hsiao et al., 2013, India	<ul style="list-style-type: none"> • To quantify and describe the mechanism of road traffic injury deaths in India 	Household survey (2001 to 2003)	<ul style="list-style-type: none"> • A nationally representative household survey was conducted • The physicians coded Non-medical field staff's verbal autopsy reports • Age and sex-specific proportion of RTI deaths for 2001-2003 was calculated • 2005 UN deaths estimates were used to correct the undercount reported deaths total 	<ul style="list-style-type: none"> • Estimated 183,600 RTI deaths for 2005 in India • Majority of deaths occurred in men. • RTI mortality rate for men and women were 26.2/100,000 and 5.7/100,000 respectively • RTI deaths were about 2% of all deaths • An RTI mortality was 16.2/100,000 for all population • Age group 30-59 at the greater risk of RTI • Male had a 2.1% risk of dying from RTI before age 70 years • Men living in urban areas had slightly higher age-standardized mortality and risk of RTI deaths. • Vulnerable road users (pedestrians, motorcyclists, bicyclists, and three-wheelers comprised 68% of RTI deaths. • Commonly other vehicles collide with heavy

				transport and buses.
				<ul style="list-style-type: none"> • Most RTI deaths occurred at the scene of the collision • Compared to non-pedestrian RTI deaths, pedestrian deaths occurred to less educated people • Estimated RTI death was 50% greater than police reported • Three-fourth of the RTI deaths in India were of the pedestrian. • RTIs cause a substantial number of deaths in India
Wangdi et al., 2018, Bhutan	<ul style="list-style-type: none"> • To explore the pattern and causes of RTI and describe demographic characteristics of people injured or died in road traffic crashes 	Traffic police record (2013 to 2014)	<ul style="list-style-type: none"> • Descriptive cross-sectional study • Number, rate of road traffic crashes, RTI deaths, and injuries were calculated per 100,000 population 	<ul style="list-style-type: none"> • In one year, 1,866 road traffic crashes, 157 deaths and 1,143 injuries were recorded. • 25–44 years population were most likely to be killed or injured • The death rate was 11.2 and 10.5 per 100,000 in 2013 and 2014, respectively. • The injury incidence rate was 73.8 and 80.8 per 100,000 population in 2013 and 2014 respectively. • The injury incidence rate was 79.6 and 87.6 per 10,000 vehicles for 2013 and 2014,

<p>during 2013 to 2014</p>	<p>respectively.</p> <ul style="list-style-type: none"> • Male comprised the higher proportion of the RTI, about 80 % • Drivers and passengers were the common road users risk group. • The human factor was the common cause of road traffic crashes.
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<p>Karkee et al., 2016, Nepal</p> <ul style="list-style-type: none"> • To investigate epidemiology of RTI for 2001 to 2013 	<p>Traffic police record (2001 to 2013)</p> <ul style="list-style-type: none"> • The study used two approaches: secondary data analysis and systematic review • The number of crashes, deaths, injuries, and deaths and injuries rate were calculated 	<ul style="list-style-type: none"> • In 12 years, 95,902 crashes, 100,499 injuries, and 14,512 deaths were recorded • The mortality rate was increased sharply from 4/100,000 in 2001-02 to 7/100,000 in 2011-12 • Age group 20–40 years were at the risk of RTIs. • The majority of RTI occurred among motorcyclists and pedestrians • Nepal is suffering from a rapid increase in road traffic deaths and injuries.
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4.2.2 Impacts of RTIs in Some SAARC Countries

Studies reporting economic impact of RTI were very limited. Even though we intended to examine the impact of RTIs from all SAARC countries, studies from Afghanistan, Bangladesh, Pakistan, and Maldives did not meet the inclusion criteria. The selected articles were from India (2), Nepal (2), Bhutan (1), and Sri Lanka (1) and a study that assessed the impact of RTIs of some South Asian countries (Bangladesh, India, Nepal, Pakistan and Sri Lanka).

Among the seven selected economic impact-related studies, only one study (Bora, Landge, & Dalai, 2018) entitled Socio-economic impacts of RTIs analysed the social impact, whereas the other studies (Banstola et al. 2020; Bhavan, 2019; Sapkota, Bista, & Adhikari 2016, Kumar et al. 2012; & Wangdi et al. 2018) were about economic costs of the RTIs. The study by Alam and Mahal, (2016) has presented some social impacts of road traffic injuries for some South Asian countries such as Bangladesh, India, Nepal, Pakistan and Sri Lanka. Table 4.2 presents the characteristics and details of all studies on the impact of Road Traffic Injuries (RTIs) published during 2010-2020.

Table 4.2

Characteristics and Details of Studies on Impact of Road Traffic Injuries (RTIs) Published During 2010-2020 (Number of studies =7)

Author, Year, Country	Aim of study	Data source and data collection period	RTI economic cost calculation	Results	Methodology used
Bora et al., 2018, Nepal	<ul style="list-style-type: none"> • To calculate and build the crash model and RTIs cost • To provide the cost variation with the severity level • To calculate the GDP loss in Nagpur city due to RTIs 	Traffic police record (2010 to 2015)	<ul style="list-style-type: none"> • Human capital cost** • Human suffering cost • Resource costs 	<ul style="list-style-type: none"> • Human capital costs for fatal or physical disability was 77% of injury costs • The human suffering cost was 22% • Administrative costs was 1% • 0.09% GDP loss due to road crashes • Two-wheelers claimed 80% of the fatalities and 77% of the total costs 	<ul style="list-style-type: none"> • Secondary data from police • Using system dynamics approach, road traffic crashes cost calculated
Alam & Mahal,	<ul style="list-style-type: none"> • To assess the economic 	World health Household	<ul style="list-style-type: none"> • Spending on drugs 	<ul style="list-style-type: none"> • RTI affected household experienced a significantly higher 	<ul style="list-style-type: none"> • Used Coarsened exact matching for economic cost calculation

2016, South Asia	<p>impact of non-fatal road traffic injuries of South Asian Countries</p> <ul style="list-style-type: none"> • To link the road traffic injuries and household level economic outcomes 	Survey (2003-2003)	<ul style="list-style-type: none"> • Spending on hospitalization • Non-medical consumption expenditure 	<p>level of out-of-pocket health spending</p> <ul style="list-style-type: none"> • The selling of household assets was higher due to road traffic injuries. • RTI broadly impact female than male • Road traffic injuries reduced the earnings • Rural households with female RTIs were at the more tremendous financial stress than urban households 	<ul style="list-style-type: none"> • Linear regression model relating to road traffic injury-affected and presence of depression • Comparison of rural and urban household economic outcomes
Bhavan, 2019, Sri Lanka	<ul style="list-style-type: none"> • To calculate crash – related indices and investigate impact of road crashes on economic performance of Sri Lanka 	Government annual time series road crashes data (1977 to 2016)	<ul style="list-style-type: none"> • Calculated total casualty related costs 	<ul style="list-style-type: none"> • Calculated fatality index • Highest RTI fatality observed in 1989 • Sri Lanka experiencing a decline in road traffic fatality index by 2001, however the number of RTI fatality is increasing • Increase in health expenditure per capita by 0.87 per cent associated with every 1 per cent increase in 	<ul style="list-style-type: none"> • Augmented Dickey– Fuller (ADF) unit root analysis and Johansen’s maximum likelihood estimator of the parameters of an integrating vector error correction model (VECM) are employed

					total casualties by road traffic crashes	
					<ul style="list-style-type: none"> • Every One per cent increase in fatality index is negatively associated with the change in economic growth rate by 0.79 per cent in Sri Lanka. 	
Kumar et al., 2012, India	<ul style="list-style-type: none"> • To estimate risk and intensity of catastrophic out of pocket total and medical expenditure due to RTIs 	RTI cases reported in the emergency department of three hospital (Nov 2005 – June 2006)	<ul style="list-style-type: none"> • Medical and non-medical costs • Distress financing 	and	<ul style="list-style-type: none"> • RTI constitute a significant health burden in India • Medical expenses in private hospital was very high than public hospitals • Average medical and non-medical expenditure was USD 170 and USD 162, respectively • 22% had medical insurance • Expenses increase with in-patient days and severity of the injury. 	<ul style="list-style-type: none"> • Follow-up study conducted after six months of the first survey • Medical cost includes the cost of consultation, diagnostics, medicines, surgery, hospital charges, autopsy charges, rehabilitation/physiotherapy, ambulance costs, and medical costs after discharge from the hospital • Non-medical costs comprise expenses from food, phone, transportation, repair vehicle, legal expenses, compensation paid to other party involved in the crash, costs of obtaining a death certificate, funeral, and bribes paid • Distress financing was calculated from borrowing money from

					relatives/friends, loans from the bank or other lenders, or selling assets.
Banstola, et al., 2020, Nepal	•To estimate the economic burden of RTIs	Traffic police record (2017)	<ul style="list-style-type: none"> •Direct medical and non-medical costs •Productivity loss •Cost of pain and grief and sufferings 	<ul style="list-style-type: none"> •Total economic burden of RTIs was USD 122.88 million in 2017 •Total direct medical costs was 10.58% of the total costs •Total nonmedical costs was 9.36% of total costs •Indirect costs was 89.42% of total costs •Economic burden of RTIs increased by three-fold in a decade •Economic cost was 1.3% of the GNP 	<ul style="list-style-type: none"> •Hospital-based cross-sectional study •Used a structured and semi-structured questionnaire •Information collected from injured person/caretaker/ responsible family member •Secondary data from police •Average days of hospital stay was taken 20 for serious injury and three days for minor injuries •Number of days spent by caregivers eight days •Direct cost included in-patient service, outpatient service, diagnostic service, medical expenses, and doctor's fee •Indirect non-medical costs include transportation costs, care giver's food costs, vehicle damage costs, and administration costs •Productivity loss was the income loss

					from short term absenteeism from work, long term disability, and premature deaths due to RTIs
					<ul style="list-style-type: none"> • Pain, grief, and sufferings were taken as 20% of the total costs
Wangdi et al., 2016, Bhutan	<ul style="list-style-type: none"> • Access the burden of RTI in Bhutan • Identify the cause of road crashes • Estimate lost output due to RTI 	Traffic police record (2013 to 2014)	Lost output costs due to RTIs	<ul style="list-style-type: none"> • Lost output from road traffic mortality was 16.8 million USD • Lost output from road traffic crashes was 1% of the GDP 	<ul style="list-style-type: none"> • Descriptive cross-sectional study • Information on the cause of crashes, type of vehicle involved in the crash was obtained. • GDP per capita, life expectancy, discount rate, and annual GDP growth value was taken to estimate the costs • Using GDP per capita of Bhutan to be USD 2380.9, a discount rate of 5%, and the annual GDP growth of 7.7% (average of the last ten years), the estimated lost output from road traffic death
Sapkota et al., 2016, Nepal	<ul style="list-style-type: none"> • To estimate total cost and disability life years due to 	Traffic police records and primary information	<ul style="list-style-type: none"> • Economic cost of motorbike crashes • Direct cost and 	<ul style="list-style-type: none"> • The majority of the victims were of productive age 25-40 years. • 11% of the motorbike crash injury was fatal, and 14% have different 	<ul style="list-style-type: none"> • Retrospective cross-sectional study • Semi-structured questionnaire was used • The human capital approach was used

motorbike crash	from purposely selected 100 motorbike crashes victims (Nov 15, 2014 May 15, 2015) (6 months)	indirect costs • Lost output	types of functional impairment. • The average direct costs of the minor and fatal injuries were USD 263.79 and USD 103.31, respectively. • Productivity loss of serious and minor injuries was USD 404.17 and USD 42.88, respectively. • The average total costs of serious and minor injuries were USD 1161 and USD 306.67, respectively. • Productivity loss due to fatalities was USD 907.57 • The average life lost was 36 years. •	• Average direct cost includes average medical costs and average non-direct medical costs • Lost output was calculated for both the caretaker and victims • Disability-adjusted life years taken as the sum of years of life lost and years life lived with disability.
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*** The human capital cost approach estimates the economic impact of road traffic crashes by calculating the present value of lost productivity due to socio-demographic factors and other relevant aspects that affect human life (Watson & Armstrong, 2019).*

All seven articles emphasized that the economic loss resulting from RTI places a substantial burden on the national economy. In most cases, two-wheelers claimed the largest share of the RTI costs (Bora et al. 2018 & Sapkota, Bista, & Adhikari, 2016). The article by Bora et al., (2018) identified that human capital costs for fatalities or physical disabilities comprised 77 percent of the injury costs and that RTIs contribute for a 0.09 percent of GDP loss in the study area. Alam and Mahal (2016) calculated the household-level economic cost for five South Asian countries (Bangladesh, India, Nepal, Pakistan and Sri Lanka), where they showed that RTI-affected households' out-of-pocket expenditure was significantly higher than their non RTI-affected counterparts. Due to RTIs, it was found that many people had to sell household assets, all the while their regular household earnings reduced (Kumar et al., 2012).

RTIs were also found to largely impact females; as rural households female had to undergo a lot of financial stress in South Asia (Alam & Mahal, 2016). A study of Bangladesh by Ul Baset et al., (2017) pointed out that low economic and educational status was associated with the higher RTIs.

A hospital-based study of India (Kumar et al., 2012) calculated the median out-of-pocket medical and non-medical expenditure due to RTIs; which were almost similar (USD 169 & USD 163 respectively). The study not only revealed that 22 percent of the RTI patients had medical insurance, but also explained how RTIs expenses increased with the increment of in-patient days and the severity of the injury.

A time-series study on annual RTC data collected from government sources revealed a positive association between road traffic fatalities and economic loss of Sri Lanka (Bhavan, 2019). Further, the study identified that every percentage point increase in

fatality index was negatively associated with the change in economic growth rate by 0.79 percent in Sri Lanka. The result of the economic cost of RTIs in Nepal showed that the total economic burden of RTIs in Nepal was US\$ 122.88 million in 2017 (Banstola et al., 2020). Moreover, the direct medical and non-medical costs were 10.58 percent and 9.36 percent, respectively. The economic costs of RTIs were increased by almost threefold in a decade and because of RTIs, 1.3 percent of the GDP was lost in 2017. A similar pattern of direct costs of the minor injury (USD 263.79) and fatal injuries (USD 103.31) in the motorbike crashes in Nepal was calculated by Sapkota et al (2016). The study also estimated that the average total costs of serious and minor injuries were US\$ 1,161 and US\$ 306.67 respectively. The study further revealed that on average, motorbike crashes resulted in the loss of 36 years of life. Additionally, these crashes led to an average productivity loss of approximately US\$ 907.57.

Similar to the experiences of other South Asian countries, Wangdi et al., 2018 mentioned that road traffic crashes contributed to a notable economic loss in Bhutan. Due to RTCs, US\$ 16.8 million was lost, which was 1 percent of the national GDP loss in Bhutan for 2013-14. Overall, the common findings of these studies were that South Asian countries have a heavy economic burden from RTIs, and a large number of people lose their lives on their road.

The methodological review presented in Table 4.1 & 4.2 showed that among the eleven selected studies, seven studies were based on traffic police record data (Banstola et al., 2020; Bhavan, 2019; Bora et al., 2018; Dharmaratne et al., 2015; Karkee et al., 2016; Sapkota et al., 2016; & Wangdi et al., 2016), three were based on household surveys (Alam

& Mahal, 2016; Hsiao et al., 2013 & UI Baset et al. 2017), and one study was a hospital-based survey (Kumar et al., 2012).

Even though the eligible paper publication dates were between 2010 and 2020, the data collection period varied significantly. For example, the time frame was 2017 for Banstola et al., (2020), whereas it was to 1938-2013 for Dharmaratne et al (2015). Most of the studies classified road traffic injuries in three categories: minor injury, serious injury and fatal. The nationally representative RTI studies were descriptive, where Dharmaratne et al., (2015); Hsiao et al., (2013); UI Baset et al. (2017) and Wangdi et al., (2018) estimated road traffic deaths rate per 100,000 population. The studies estimating the economic impact of RTIs applied various methods such as human capital approach, coarsened exact matching, and direct and indirect cost. Statistical models such as Johansen Tests for Cointegration (Dharmaratne et al., 2015) and logistic regression (Kumar et al. 2012; & UI Baset et al. 2017) were also used to explore the association between the studied variables. Bora et al., (2018) used a system dynamics approach to estimate human capital costs, human sufferings and resources costs; the human capital costs include the income and consumption of the victims.

Bhavan (2019), used three different statistical models: Augmented Dickey Fuller, unit root analysis, and Johansen's maximum likelihood estimator of the parameters of an integrating vector error correction model and estimated the health expenditure per capita in Sri Lanka.

The costs of resources incorporated road damage, vehicle damage, administrative expenses and medical expenses. Since human sufferings cannot be quantified, this was considered an arbitrary value that depended on resource costs. A hospital-based cross-

sectional study by Kumar et al., (2012) estimated the medical and non-medical costs of RTIs, as well as the distressed financing (borrowing money from relatives/friends, taking a loan from banks/other lenders or selling assets) of the studied Indian population.

Similarly, Banstola et al. (2020) estimated direct medical and non-medical costs, productivity loss and cost of pain, grief, and sufferings by using the RTI cost components guidelines to estimate the costs of road crashes in low and middle-income countries (Silcock, 2003). The guidelines suggested a human capital approach for economic cost calculation in low-middle income countries. Likewise, Sapkota et al. (2016) estimated direct and indirect costs and lost output due to two-wheelers crash using the human capital approach. The review of the methodologies used in the selected studies showed that authors often calculated both the direct and indirect economic costs of road traffic injuries.

4.3 Discussion

Scientific studies/publications on national-level RTCs, deaths, injuries, and their impacts over a ten-year period in SAARC countries remains relatively limited.

Additionally, quantifying the precise status and impact of RTIs in these countries is challenging. Nevertheless, available evidence indicates that RTCs are a significant public health issue in the SAARC region.

Vulnerable road users (pedestrian, cyclist, & motorcyclist) are at a greater risk of RTIs (WHO, 2018). The results of the selected nationally representative RTI studies from the five countries (Bangladesh, Sri Lanka, Nepal, Bhutan, & India) also showed that two-wheelers are the major threats to road safety in SAARC countries. Similarly, all vulnerable road users such as pedestrians, passengers, riders and drivers were involved in most RTIs in this region. Within the gender group, men comprise a notably larger proportion of the

RTIs. As the Global Status Report on Road Safety reported that road traffic deaths are the leading cause of children and young adults (WHO, 2018), our review also revealed that higher rate of road traffic casualties occurred among the young and economically active population group.

Eight regional/provincial hospital-based studies (Saeed, Rasooly, Safi, Alkozai, & Ahadi, (2016) also explicated the prevalence of early age (10-30 years) road traffic mortality for the vulnerable road users in Afghanistan. The study presented that cars and motorized two-wheelers were the main vehicles involved in road crashes in Afghanistan. Similarly, a Pakistani study on the burden of road traffic injuries (Ghaffar, Hyder, & Masud, 2004) reported that most RTIs were observed among people aged 16-45 years, which imposed a significant burden on Pakistan's national health system in 1997. However, these two studies (Saeed, Rasooly, Safi, Alkozai, & Ahadi, 2016; Ghaffar, Hyder, & Masud, 2004) did not meet the inclusion criterion (not a national level research finding).

Within SAARC countries, India has the highest rate of road traffic deaths, whereas Nepal is also experiencing a larger early age road traffic deaths and injuries. A systematic review and meta-analysis on the burden of road traffic crashes, injuries and deaths in Africa found that population-based studies consistently report high road traffic mortality (Adeloye et al., 2016). Similarly, a verbal autopsy-based nationally representative study in India reported that the estimated RTI deaths were more than 50 percent greater than the deaths recorded by the police for the same timeframe (Hsiao et.al., 2013). Though, most of the studies selected in this study were based on official police data. Police record-based studies cannot give the socio-economic status of the road traffic victims and the reasons

behind the road user's exposure to crash. Thus, a large-scale community-based study can only explain the actual national and regional status of the RTIs.

The impact of the RTIs is substantial in the South Asian countries (World Bank, 2020). The findings of the economic costs of RTIs review indicated that there is indeed a huge economic burden of RTIs in SAARC countries, which resulted in a 0.9 percent to 3 percent national GDP loss; these estimates may differ from the official World Bank estimates (World Bank, 2020). The World Bank's report further infers that a 50 percent reduction of crash-related deaths generates an estimated gross benefit of about US\$ 1.2 trillion.

Two-wheelers were the major contributors of RTIs-related economic loss in the selected countries. Same as this finding, a study by Mohan & O'Neil, (2020) presented the challenges created by the two-wheelers' crash in India. The findings of this review (direct, indirect costs, loss output and borrowing money from relatives/friends, taking a loan from banks/other lenders, or selling assets) point out that the RTIs have considerably impacted the economic condition of the SAARC countries. Another report from India also showed that post-crash impact was severe in the low-income households: post-crash household income was declined by 75 percent. In addition to the financial burden, low-income households experience a deterioration of quality of life. Women from such households are subjected to caring for post-crash family members, children, and the entire household management (World Bank, 2021). However, among the reviewed studies, only one study of South Asia (Alam & Mahal, 2016) analysed RTIs' impact from gender perspective and revealed that female suffer more from RTIs.

Medical expenses for RTI hospital treatment are markedly higher in the private hospitals than in public hospitals, and the cost increases significantly with increased number of days of hospital stay. Similar findings were observed in the prospective study of the respondents from New South Wales with mild to moderate road traffic injuries (Gopinath, Jagnoor, Elbers, & Cameron, 2017). As limited number of studies have calculated the national-level economic impact of RTIs, the actual economic burden of RTIs is not known for the SAARC region as well.

Most of the studies included in the review were based on police records; however, it is widely recognized that not all road traffic injuries are reported to the police (Dandona, Kumar, Ameer, Reddy, & Dandona, 2008). Due to a lack of high level nationally representative studies, it is difficult to explain the actual situation of the road deaths and injuries and its impact in the SAARC region. Similarly, reliable and accurate road traffic data is an urgent need to identify problems, risk factors and priority areas, and to formulate strategies, set targets and monitor performance (WHO, 2011a). Thus, the review points out the urgent need for nationally representative RTI research activities in SAARC countries.

4.4 Strengths and Limitations

To the best of my knowledge, this is the first systematic review reporting the evidence on road traffic injuries, and their impact in the SAARC countries. A particular strength of this review is that the included studies represent the population of SAARC countries. Through this study, it was possible to gather a significant amount of nationally representative evidence on road traffic deaths, injuries, and their impact in SAARC countries. Hence, this road safety study review is expected to help relevant authorities to work and invest in road safety for the South Asian region (World Bank's classification).

However, due to time constraints, grey literature and peer-reviewed articles of SAARC countries published before 2010 were not included here.

4.5. Conclusion

This review found that SAARC countries are experiencing problems and challenges associated with road traffic injuries: despite the significant threat to human life and socioeconomic problems from road crashes, RTIs remain neglected. A review of the studies also revealed that the impacts of RTIs was the most neglected area. This review was able to reach a conclusion that the socioeconomic impact of the RTIs should be considered in future research.

Similarly, very few studies have explored the national status of road traffic injuries in the SAARC countries. Most of the studies were based on the police data collected for the purposes other than its prevention, that usually undercount RTI cases (Hsiao et al., 2013). Additionally, this review has been able to infer that the actual burden of road traffic injuries is not known in the SAARC countries, and that there is an urgent need to explore the status of RTIs and its impacts. Overall, this review identified the dearth of road safety studies in SAARC region, and demands for reliable road traffic evidences for effective intervention of the Stockholm declaration (halving the road traffic deaths and injuries by 2030) (United Nations, 2020).

CHAPTER V: ROAD TRAFFIC DEATHS AND INJURIES IN NEPAL

5.1 Introduction

Deaths or injuries are the final outcomes of RTCs, so this information is often used to evaluate the road safety performance of a country. This chapter presents the analysis of road crashes, death, and injury data extracted from the Nepal Police records, exhibiting road crashes results for the year of 2018/19. In some crash narrative recordings, the victim's details were missing, only mentioning the crash location and number of deaths and injuries. In total, about 9.5 percent of the total crash incidents were missing, and these cases were not incorporated into this analysis.

The information of road crash victims for the entire country, the top ten districts and Kathmandu valley (Kathmandu, Lalitpur and Bhaktapur) were separately presented. The death and injury cases were analysed by age, sex, time, day, month, vehicle type and road user type. Similarly, road traffic casualties were analysed separately for different vulnerable road user classes (pedestrian, motorized two-wheelers). A total of 25,511 RTCs victims (about 9% deaths and 91% injuries) were analysed for the year 2018/19.

Key information was identified and relevant indicators were calculated by reviewing past records of RTCs from the Nepal Police. These findings are summarized in Table 5.1. The data revealed that the number of deaths per vehicle has been decreasing over the past five years. The death rate per crash, however, shows variability, peaking in 2017-18 at 23 deaths per 1,000 crashes, while for other years, it ranged between 20-21 deaths per 1,000 crashes. Additionally, injuries per crash have decreased, and the number of crashes per 1,000 vehicles has declined, with the exception of 2018-19. Table 5.1 also

displays the fatality rate, indicating an increase in the death rate in other years, reaching 9.9 deaths per 100,000 population in 2018/19.

Table 5.1

Some Indicators of Road Traffic Crashes, Deaths, Injuries, Nepal

Year	Crashes per 100 vehicles	Injury per 100 crashes	Deaths per 100 vehicles	Deaths per crashes	Deaths per 100,000 population
2014-15	4.61	133.19	1.01	21.91	7.3
2015-16	4.17	123.91	0.83	20.03	7.8
2016-17	2.96	123.20	0.69	21.74	7.4
2017-18	2.46	113.01	0.57	23.17	9.2
2018-19	3.05	110.24	0.63	20.86	10.6

Source: Nepal Police Mirror, 2015,2016, 2017,2018; MoPIT, 2013

5.2 Road Traffic Death and Injury Case Extraction from Nepal Police Record

Nepal Police records the road traffic crash details in the form of case-narrative, and often includes information such as the time of crash, name of the victim(s), age, sex, place of residence of the victim(s), crash location, type of vehicle involved in the crashes, and the type of road users. Initially, the crash data for 2018/19 was recorded in the form of descriptions in Nepali language in a MS Word File. These Word files were received electronically from Nepal Police and imported into a MS Excel file. The MS Excel spreadsheet has a column for each variable i.e., name, age, sex, victims' permanent and temporary residence, crash location, district, province, and reporting time, day and month. All death and injury cases were extracted manually with their respective demographic and other variables in the spreadsheet. This chapter includes a descriptive analysis of all road crash incidents available with the victims' details. The crash cases missing victims' details were not included in this result section.

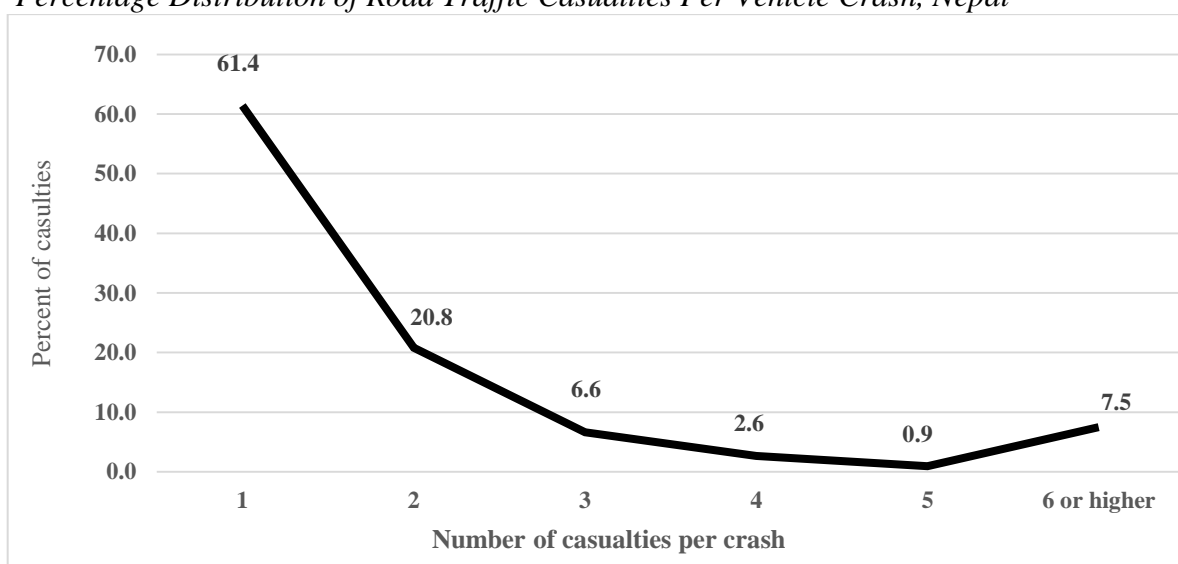
5.2.1 Casualties Per RTC in Nepal

Road traffic crashes associated with human casualties were considered as crash incidents in the analysis. This study identified 14,197 road traffic crashes with single or

multiple casualties in various parts of the country. In a single road crash, up to 53 people were injured or died in 2018/19. More than 60 percent of the RTCs resulted to a single casualty, and about 20 percent of the crashes had two casualties. Similarly, 6.6 percent of the crashes resulted in 3 casualties, and 11 percent of the road crashes had four or more casualties. Most motorized two-wheelers, cycles, and pedestrian-associated crashes caused one or two casualties (Figure 5.1).

Figure 5.1

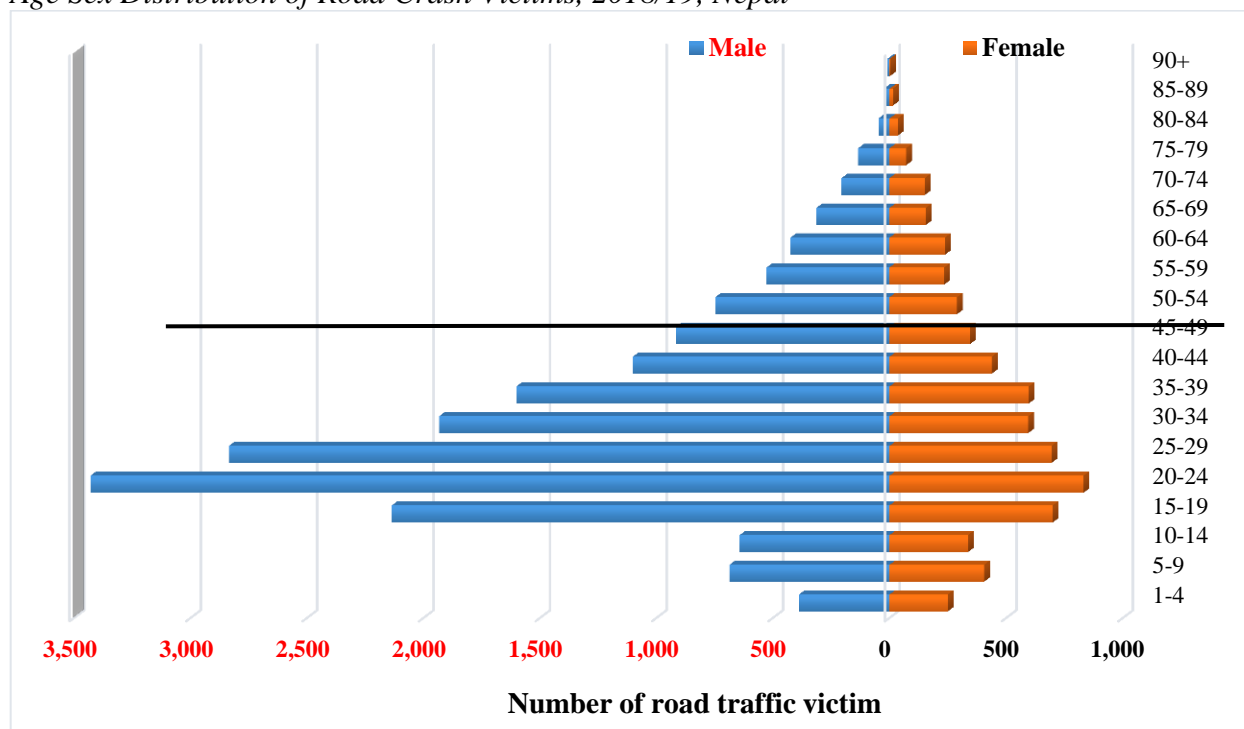
Percentage Distribution of Road Traffic Casualties Per Vehicle Crash, Nepal



Source: Researcher extracted data from Nepal Police record 2018/19

5.2.2 RTCs Victim by Age and Sex

The mean age of the total RTC victims was found to be 31 years: with the mean age of the female victim (32) slightly higher than male road traffic victim (31). Male traffic victims largely outnumbered female; the sex ratio (male to female ratio) was 2.83:1. Figure 5.2 describes the age and the sex structure of the road traffic victims. The population pyramid shows that most of the road traffic victims were young population in which people in the 15-29 age group represent 41.7 percent of the total road crash victims. The population pyramid compares the crash casualties by sex and age group.

Figure 5.2*Age Sex Distribution of Road Crash Victims, 2018/19, Nepal*

Source: Researcher extracted data from Nepal Police record 2018/19.

5.2.3 Road Traffic Death and Injury in Nepal

The majority of the road traffic victims were male (male injury=72.8%, male death=79.9%) (Table 5.2). Children under five years represent 2.5 percent of the casualties, and 5-14 years comprised 8.1 percent of the road traffic deaths and injuries. The young-aged population (15-29 years) was the most vulnerable to road crashes (n=10,633, 41.7%) of the total cases, followed by the 30-44 years age population (n=6,267, 24.6%). Table 5.2 further shows that 23 percent of the road traffic deaths and injuries occurred to people above 45 years. Accordingly, the highest number of fatalities (n=788) was in 15–29-year age group and the children below 5 years has the least number of fatalities comprised 2.8 percent followed by age group 5-14 years (6.3 percent).

A higher ratio of injuries to deaths indicates a lower risk of dying in RTCs. The death risk was higher for males (9.7 injuries per death), while for females, there were 14.1 injuries per death. Regarding age groups, the number of injuries per death varied from 7.3 to 14. Analysis showed that risk of dying was higher for young population (9.5 injuries per death). Similarly, there are 7.3 injuries per death for the 60+ age group, and 7.8 injuries per death for the 45-60 age group. People aged 15-44 years comprised the majority of road traffic deaths and injuries (injuries = 66.6% and death = 62% among total cases). The mean and median age of the road traffic victim was 30.89 and 27.00 years respectively. The total road traffic casualties per 100,000 population was 96.29 in Nepal.

Table 5.2
Road Traffic Injury and Death by Age and Sex 2018/19, Nepal

Background	Injury		Death		Total	Injuries/death
	N	%	N	%	N	
Sex						
Male	16,975	72.8	1751	79.9	1,8726	9.7
Female	6,071	6.0	431	19.7	6,502	14.1
Unknown	273	1.2	10	0.5	283	27.3
Age group						
1-4	578	2.5	61	2.8	639	9.5
5-14	1,933	8.3	138	6.3	2,071	14.0
15-29	9,845	42.2	788	35.9	10,633	12.5
30-44	5,694	24.4	573	26.1	6,267	9.9
45-60	3,090	13.3	396	18.1	3,486	7.8
60+	1,234	5.3	170	7.8	1,404	7.3
NR*	945	4.1	66	3.0	1,011	14.3
Mean age of the victim	30.62		33.82		30.89	
Median age of the victim	27.00		30.00		27.00	
Total	23,319	100.0	2192	100.0	25,511	10.6
Casualties per 100,000 population**					96.29	

Source: Researcher extracted data from Nepal Police record 2018/19.

*Not recorded

$$**\text{Casualties per 100,000 population} = \frac{25,511}{2,649,4504} \times 100,000 = 10.6$$

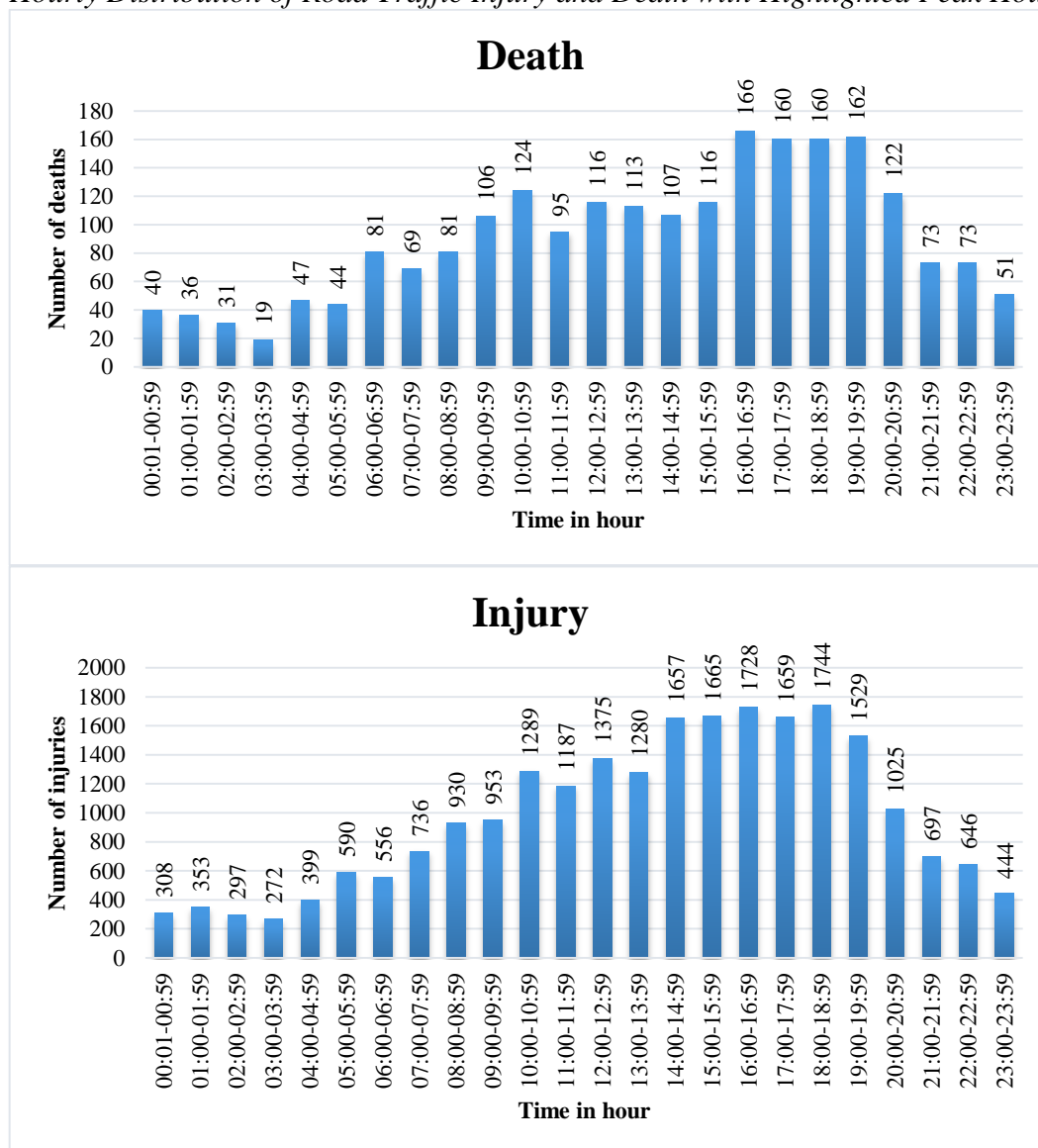
5.2.4 Road Traffic Casualties by Crash Time

A clear peak in RTCs was seen between 14:00 and 19:59 (mid-day to the early evening rush hour), a fact displayed in Figure 5.3a. Similarly, at 9:00-10:59 AM, both the

death and injury cases were higher; this can be attributed to the fact that this is a conventional time to go to school, work and other activities.

Figure 5.3 a

Hourly Distribution of Road Traffic Injury and Death with Highlighted Peak Hour



Source: Researcher extracted data from Nepal Police record 2018/19.

Table 5.3 highlights that the crash severity was higher in the evening and night-time. The highest percent (42.53%) of crashes occurred during 14:00 to 19:59 time.

Similarly, 10:00-13:19 time of the day comprised about 20 percent of the total casualties.

The risk of dying (injuries/death) at night-time (20:00-00:01) is higher than of other times

in the day. It has been identified that 06:00-06:59 has the highest risk of dying (6.9%) followed by 00:01-00:59 (7.7%). This analysis found that when the casualties were higher, the risk ratio was lower. The injuries per death was highest at 03:00-03:59, in which injuries per death was 14.3 percent.

Table 5.3

Road Traffic Casualties and Crash Severity by Time of Crash, Nepal

Time	Injuries	Deaths	Casualties		Injuries/death
			N	%	
00:01-00:59	308	40	348	1.4	7.7
01:00-01:59	353	36	389	1.5	9.8
02:00-02:59	297	31	328	1.3	9.6
03:00-03:59	272	19	291	1.2	14.3
04:00-04:59	399	47	446	1.8	8.5
05:00-05:59	590	44	634	2.5	13.4
06:00-06:59	556	81	637	2.5	6.9
07:00-07:59	736	69	805	3.2	10.7
08:00-08:59	930	81	1,011	4.0	11.5
09:00-09:59	953	106	1,059	4.2	9.0
10:00-10:59	1,289	124	1,413	5.6	10.4
11:00-11:59	1,187	95	1,282	5.0	12.5
12:00-12:59	1,375	116	1,491	5.8	11.9
13:00-13:59	1,280	113	1,393	5.5	11.3
14:00-14:59	1,657	107	1,764	6.9	15.5
15:00-15:59	1,665	116	1,781	7.0	14.4
16:00-16:59	1,728	166	1,894	7.4	10.4
17:00-17:59	1,659	160	1,819	7.1	10.4
18:00-18:59	1,744	160	1,904	7.5	10.9
19:00-19:59	1,529	162	1,691	6.6	9.4
20:00-20:59	1,025	122	1,147	4.5	8.4
21:00-21:59	697	73	770	3.0	9.5
22:00-22:59	646	73	719	2.8	8.8
23:00-23:59	444	51	495	1.9	8.7
Total	23,319	2,192	25,511	100.0	11.6

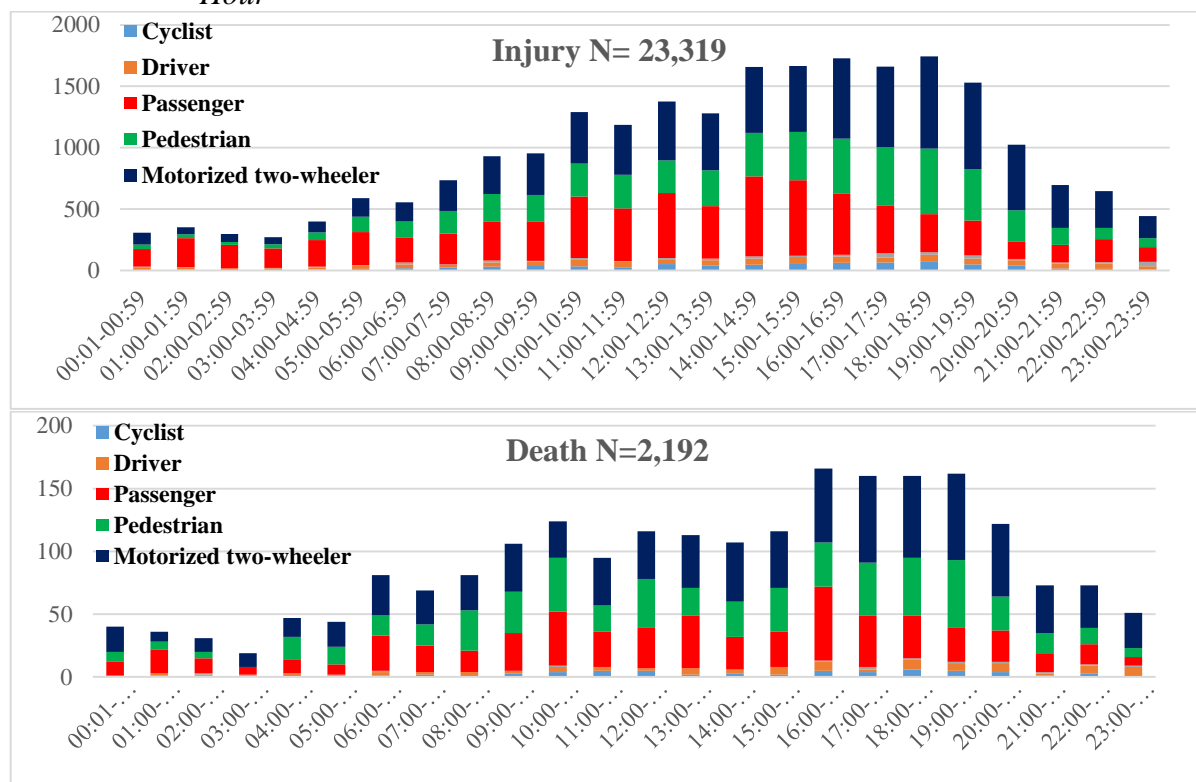
Source: Researcher extracted data from Nepal Police record 2018/19.

Road traffic casualties among motorized two-wheelers were higher throughout the day; however, it peaked between 14:00 to 20:00. Casualties among pedestrians, passengers, and motorized two-wheelers started to increase from 7:00 AM and reached the peak at 16:00, and the number of casualties lowered from 21:00 (Figure 5.3b). Figure 5.3b shows that road traffic casualties were higher in office/school hours 10:00–10:59 AM and 16:00–

16:59. In the case of pedestrians, the number of death and injuries were highest at evening time (18:00–19:00).

Figure 5.3b

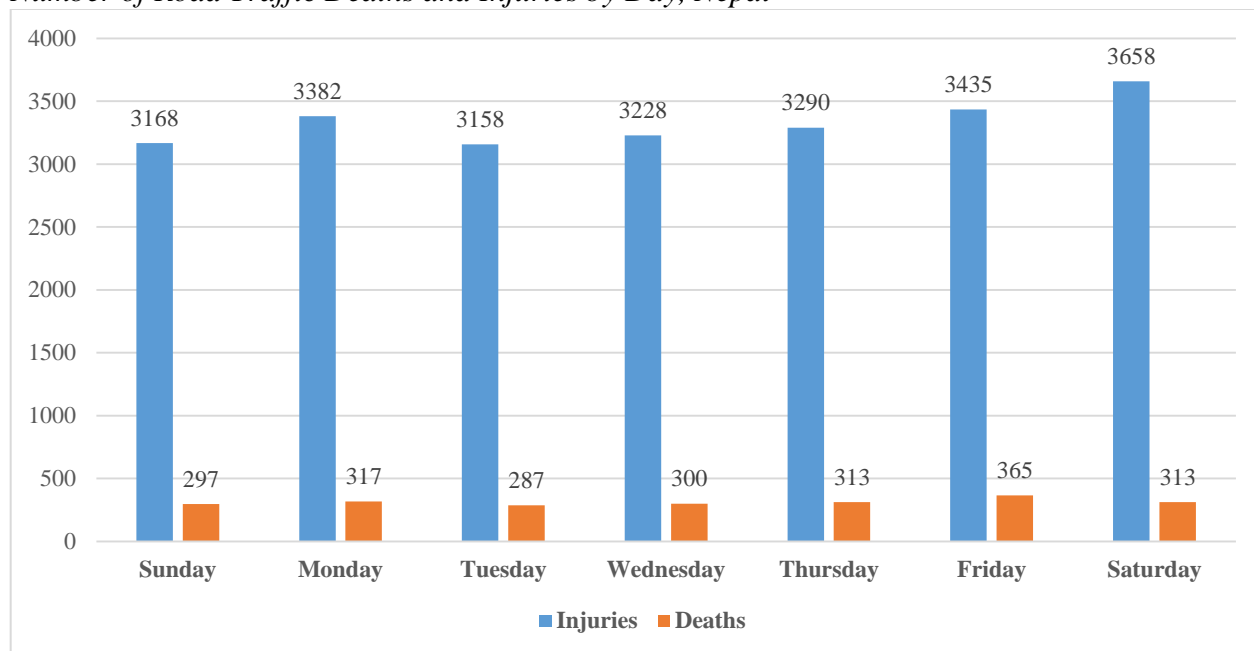
Distribution of Road Traffic Injury and Death among Types of Road Users by Time in Hour



Source: Researcher extracted data from Nepal Police record 2018/19.

5.2.5 Road Traffic Casualties by Crash Day of a Week

Casualties were higher on Saturday (3,971 crash incidents), followed by Friday (3,800) (Figure 5.4a). Similarly, Sunday and Tuesday have relatively a lesser number of RTC incidents. It has been found that road traffic crash incidents increase every successive day after Tuesday.

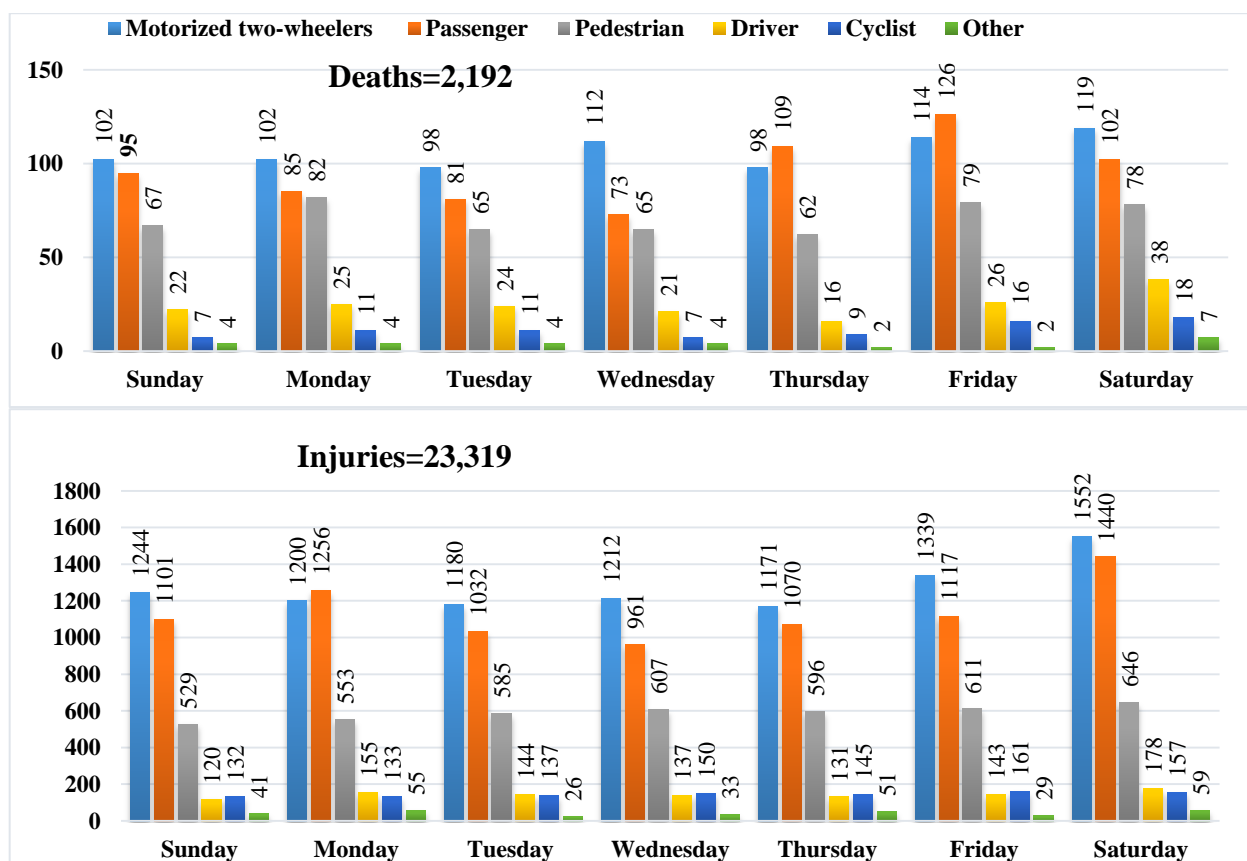
Figure 5.4a*Number of Road Traffic Deaths and Injuries by Day, Nepal*

Source: Researcher extracted data from Nepal Police record 2018/19.

Road traffic casualties can differ by the days of the week among the various road users motorized two-wheelers, passengers, pedestrians, cyclists, and drivers. Road traffic casualties among pedestrians, motorized two-wheelers, and passengers are distributed in similar pattern in all days. Comparatively, more fatalities and injuries for pedestrians, motorized two-wheelers, and passengers happened on Friday, Saturday, and Monday. Due to the relatively lesser deaths and injuries in cyclists and drivers, the cases are not markedly displayed in Figure 5.4b.

Figure 5.4b

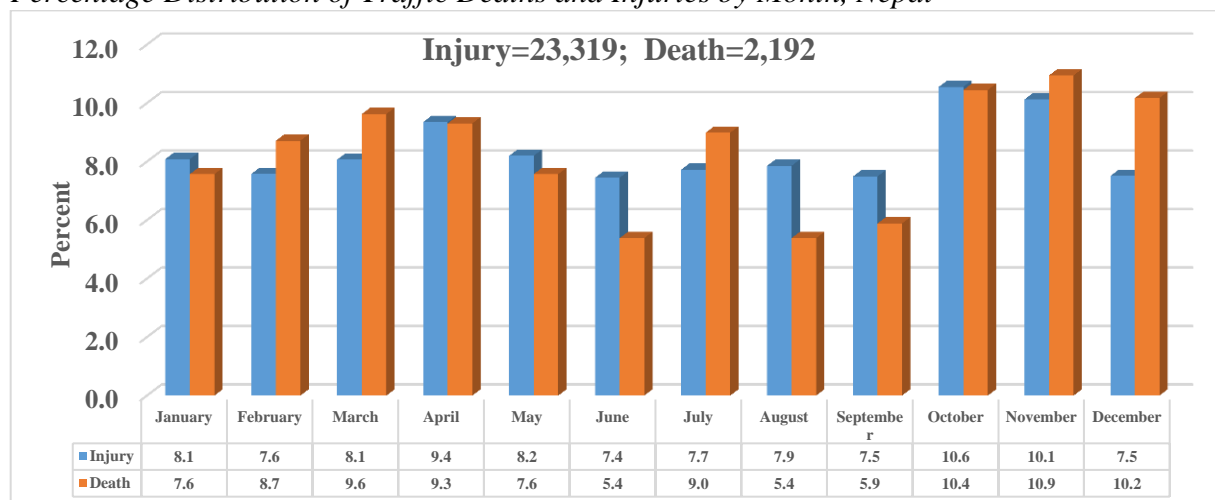
Road Traffic Deaths and Injuries in Different Days by Type of Road users, Nepal



Source: Researcher extracted data from Nepal Police record 2018/19.

5.2.6 Road Traffic Casualties by Month of Crash

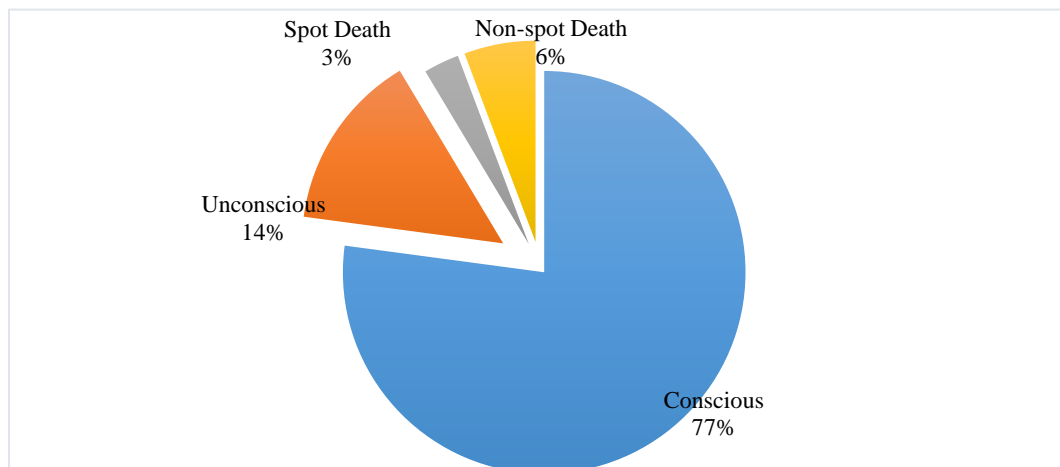
The monthly pattern of road traffic casualties appeared to fluctuate in Nepal, with the highest occurrence being on April, October and November. Figure 5.5 shows the percentage distribution of road traffic deaths and injuries by month in Nepal for 2018/19. In overall, road traffic casualties were higher in April, October, and November, than in other months. The percentage of death is relatively high in December than injuries. Both death and injury cases were the highest in November, followed by October and April.

Figure 5.5*Percentage Distribution of Traffic Deaths and Injuries by Month, Nepal*

Source: Researcher extracted data from Nepal Police record 2018/19.

5.3 Extent of Injury Status of Victim

Among the total road traffic crash incidents, 77 percent of the victims were conscious immediately after the crashes or during the rescue time (Figure 5.6). It has been found that 14 percent of the victim were unconscious immediately after the hits or during the time of rescue. Further, 3 percent of the road traffic victims died on the spot, and 6 percent of the victim were non-spot death. This large number of injury cases tends to increase the long-term injury and disability in the community.

Figure 5.6*Percentage Distribution of Road Traffic Crash Injury Status of Victim, Nepal*

Source:
Researcher

extracted data from Nepal Police record 2018/19.

Road traffic injury status (conscious, unconscious, spot death and non-spot death) presented in Table 5.4 was based on the police reporting immediately after the vehicle crash/rescuing the crash victims. Table 5.4 shows that in overall, 13.1 percent of tractor crash victims died on the spot, and for tipper crashes that number was 7.6. Similarly, deaths and injuries resulted from heavy equipment, truck, and jeep/van crashes were at a relatively higher risk of on-the-spot death and unconscious immediately after the vehicle crash. The risk of fatalities and injuries in the bus and tempo crashes were somewhat lower than the other vehicle crashes. Though, the number of death and injury cases were markedly higher for the two-wheelers, injury and death ratio is comparatively lower than other vehicle users. Table 5.4 shows that spot death from the motorized two-wheeler crash was lower than the other vehicle crashes. The number of unconscious crash victims immediately after the crash was highest for tractors and heavy equipment crashes; (27.4%) and (28.3%) respectively. Bus, tempo, and small private vehicles were comparatively at a lower-risk than other vehicles regarding serious injury and spot death cases.

Table 5.4
Percentage Distribution of Road Traffic Casualties Status by Vehicle Type, Nepal

Vehicle type	Conscious	Unconscious	Spot Death	Non-Spot Death	Total N
Ambulance	69.2	19.2	3.8	7.7	52
Bicycle	74.0	17.6	2.6	5.7	227
Small Private Van	83.2	10.8	1.4	4.6	1,460
Heavy equipment	61.3	16.0	6.7	16.0	75
Jeep/van	75.2	14.1	4.7	6.1	2,820
Bus	81.2	12.0	1.7	5.0	5,12
Motorized two-wheeler	79.3	15.1	0.9	4.6	10,668
Tempo	83.9	12.7	1.0	2.3	982
Tractor	55.7	17.6	13.1	13.6	1,329
Tipper	68.0	16.4	7.6	7.6	712
Truck	69.5	15.3	6.2	9.0	1,929
Unknown	55.5	22.6	12.4	9.5	137
Total	71.3	15.8	5.2	7.6	25,511

Source: Researcher extracted data from Nepal Police record 2018/19.

5.4 Road Traffic Casualties by Type of Road Crashes

Crash may occur in unique circumstances; there are different causes of road crashes. The road crashes that result in death and injury are grouped into 11 different categories. Among 23,319 injuries and 2,192 deaths, about one-third were injured or died from vehicle collision, and pedestrian crashes caused about one-fifth of the total crash incidents. Table 5.5 shows that more than a third of the road traffic death and injury cases resulted from vehicle collisions. About 36 percent of the crashes were direct collision between motorized vehicles. Pedestrian crashes, overturns, and plunges were common types of crashes for road traffic deaths and injuries. Among the total deaths, 21.4 percent resulted from the pedestrian crash, and 20.5 percent of the deaths were due to plunges. Among the various types of crashes, a larger proportion of deaths resulted from hitting pedestrians and plunging (falling off the road). Further, road traffic deaths and injuries also resulted from hitting cyclists, objects on the roadside, a parked vehicle, or animals.

Table 5.5
Distribution of Road Traffic casualties by Type of Road Crashes, Nepal

Type of road crash	Injury		Death		Total casualties	
	N	%	N	%	N	%
Collision	8,638	37.0	575	26.2	9,213	36.1
Hit pedestrian	4,352	18.7	468	21.4	4,820	18.9
Overturned	4,127	17.7	348	15.9	4,475	17.5
Plunge	3,218	13.8	449	20.5	3,667	14.4
Hit cyclist	1,240	5.3	70	3.2	1,310	5.1
Hit and run	341	1.5	38	1.7	379	1.5
Hit object on roadside	325	1.4	24	1.1	349	1.4
Hit object in the road	175	0.8	20	0.9	195	0.8
Hit parked vehicle	140	0.6	24	1.1	164	0.6
Hit animal	106	0.5	9	0.4	115	0.5
Others	657	2.9	167	7.6	824	3.2
Total	23,319	100.0	2,192	100.0	25,511	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

5.5 Road Traffic Casualties by Type of Vehicles that Instigate Crash

The majority of crashes were instigated by the two-wheelers (41.8%), followed by bus crashes (20.1%) and jeep crashes (11.1%) (Table 5.6). Tractors and trucks represent a comparatively lower proportion in total vehicles instigating road crashes; however, the tractor and truck instigating crashes' casualties were notably higher (5.2%) and (7.6%) of the total deaths.

The number of injuries per death varied between 2.7 to 28.8 among various types of vehicles that instigate road crashes. Similarly, crash severity was extremely high among crashes instigated by tractors (2.7), followed by heavy equipment (3.4), trucks (5.6), and tippers (5.5), excluding unknown vehicle instigated crashes. The number of casualties were lower in the heavy equipment crash, but the injury severity (number of injuries per deaths) was higher. The speeds of a tempo is comparatively lower than of other motorized vehicles, which is also reflected in the injury severity result; injury per death (28.8). The highest number of casualties among the two-wheelers shows the increased disability in our society.

Table 5.6
Road Traffic Casualties Caused by the Crash Instigated Vehicle Type, Nepal

Vehicle type	Injury		Death		Total	Injuries/Death
	N	%	N	%		
Ambulance	46	0.2	6	0.3	52	7.7
Heavy equipment	58	0.2	17	0.8	75	3.4
Unknown	108	0.5	30	1.4	138	3.6
Bicycle	208	0.9	19	0.9	227	10.9
Tipper	601	2.6	111	5.1	712	5.4
Tempo	949	4.1	33	1.5	982	28.8
Tractor	974	4.2	355	16.2	1,329	2.7
Small PV	1,371	5.9	88	4.0	1,459	15.6
Truck	1,636	7.0	293	13.4	1,929	5.6
Jeep/van	2,517	10.8	303	13.8	2,820	8.3
Bus	4,774	20.5	346	15.8	5,120	13.8
Motorized two-wheeler	10,077	43.2	591	27.0	10,668	17.1
Total	23,319	100.0	2192	100.0	25,511	10.6

Source: Researcher extracted data from Nepal Police record 2018/19.

5.6 Top Ten Districts by Road Traffic Casualties

Road traffic casualties are higher among the two-wheelers, tractor, truck, bus, jeep-van, and tempo instigating crashes. Road traffic casualties by all districts in Nepal is given in the Appendix D. The top ten districts for the road traffic casualties regarding these crash-instigating vehicle types were analysed in Table 5.7 a, b, and c. In this section, the word casualty represents both the deaths and injuries.

Regarding crashes instigated by tractor, Table 5.7 a shows that Morang has the highest percentage of casualties (6.9%), followed by Saptari (4.6%), and Udayapur (4.1%). The top ten districts were selected for detailed analysis; however, three districts (Mahottari, Nawalpur, and Sunsari) appeared in 10th rank in tractor crashes. Among the ten districts with the highest road casualties, the percentage representation for casualties of tractor instigating crashes ranges from 2.5 percent to 6.9 percent. The injury severity for the tractor crash was highest in Dang (1.1 injuries per death), followed by Sunsari (1.2). Six districts have three or less injuries per death, three districts have 3- 5 injuries per death, and the remaining three districts have more than five injuries per single death from tractor-instigated crashes.

Table 5.7a also presents the top ten districts with road traffic casualties from crashes instigated by truck. Dhading has the highest share of casualties from the truck-instigated crashes, followed by Chitwan and Nawalpur. Kathmandu district also represents 8 percent of casualties from road crash instigated by truck and Bara, Morang, Makwanpur and Nuwakot were in 7th, 8th, 9th and 10th rank for the crash instigated by truck respectively. The injuries per death were lowest in Nuwakot (1.1), Chitwan (4.0), and Bara (6.9). Among the ten districts, injuries per death was highest in Kapilvastu.

Table 5.7a

*Top Ten Rank Districts with Road Traffic Casualties Caused by the Crash Instigated by Tractor and Truck, Nepal**

District	Injuries/death in tractor crash	Casualties among tractor user		District	Injuries/death in truck crash	Casualties among truck user	
		N	%			N	%
Morang	4.8	92	6.9	Dhading	8.2	175	10.2
Saptari	4.1	61	4.6	Chitawan	4.0	151	8.8
Udyapur	6.9	55	4.1	Nawalpur	7.1	145	8.4
Sarlahi	2.5	49	3.7	Kathmandu	8.2	138	8.0
Kapilvastu	13.3	43	3.2	Kapilvastu	14.2	76	4.4
Rupandehi	3.7	42	3.2	Kavrepalanchowk	13.6	73	4.2
Sindhuli	2.8	38	2.9	Bara	6.9	71	4.1
Dang	1.1	37	2.8	Morang	7.9	71	4.1
Surkhet	11.3	37	2.8	Makawanpur	7.7	61	3.6
Mahottari	2.7	33	2.5	Nuwakot	1.1	55	3.2
Nawalpur	2.3	33	2.5				
Sunsari	1.2	33	2.5				
Total truck and tractor casualties	2.7	1329	100.0			1,718	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

*All districts deaths and injuries is presents in annex

Kathmandu has the highest percentage of casualties (8.5%), followed by Nawalpur (6.4%) and Chitwan (5.9%) (Table 5.7b). Among the top ten ranked districts, the percentage representation of bus-instigated casualties in the national level ranges from 3.4 percent to 8.5 percent. The injury severity for bus crashes was highest in Chitwan (12.1 injuries per death), followed by Tanahu (13.4 injuries per death). Injuries per death for bus crashes were highest in Surkhet (46.8 injuries per death), followed by Sunsari (21.0 injuries per death).

Further, Table 5.7b reveals that crashes instigated by jeep/van was highest in Kathmandu (9.5%) ,followed by Sindhuli (5.3%), Dang, Morang, Syangja, Kavrepalanchowk, Tanahu, Bara, Makwanpur, and Rupandehi. The crash severity was highest in Bara (5.9 injuries per death), followed by Kavrepalanchowk (9.9 injuries per death). The highest injuries per death were in Syangja (48 injuries per death), followed by Kathmandu (28.8 injuries per death) in crashes instigated by jeep/van.

Table 5.7b

Top Ten Rank Districts with Road Traffic Casualties Caused by the Vehicle Instigated by Bus and Jeep/Van

District	Crash severity =Injuries /death		Total bus casualties		District	Crash severity =Injuries /death		Total jeep/van casualties	
			N	%				N	%
Kathmandu	21.7		435	8.5	Kathmandu	28.8		268	9.5
Nawalpur	19.2		328	6.4	Sindhuli	15.7		150	5.3
Chitawan	12.1		301	5.9	Dang	14.3		107	3.8
Dang	15.9		238	4.6	Morang	13.1		99	3.5
Saptari	14.9		222	4.3	Syangja	48.0		98	3.5
Morang	15.9		209	4.1	Kavrepalanchowk	9.9		87	3.1
Dhading	20.2		192	3.8	Tanahu	11.0		84	3.0
Sunsari	21.0		180	3.5	Bara	5.9		76	2.7
Surkhet	46.8		183	3.6	Makawanpur	13.6		73	2.6
Tanahu	13.4		173	3.4	Rupandehi	17.0		72	2.6
Total	13.8		5,120			8.3		2,820	

Source: Researcher extracted data from Nepal Police record 2018/19.

Kathmandu has the highest percentage of casualties from crashes instigated by two-wheelers (18.2%), followed by Morang (9.7%) and Rupandehi (8.4%) (Table 5.7c). Among the top ten ranked districts, the percentage representation for casualties from the crash instigated by two-wheeler ranges from 2.6 percent to 18.2 percent. The crash severity for the two-wheeler crash was highest in Dhanusha (7.7 injuries per death), followed by Dang (18.9 injuries per death). The injuries/deaths caused by two-wheeler crashes was highest in Morang (48.4 injuries per death), followed by Rupandehi (30.9 injuries per death).

Table 5.7c reveals that crash instigated by tempo was highest in Morang (16.7%) followed by Kathmandu (8.0%). Rupandehi, Dang, Bara, Surkhet, Bardiya, Rautahat, Mahottari, and Makwanpur are the other remaining districts with the highest number of casualties instigated by two-wheelers. The injury severity (10.0 injuries per death) was highest in Makwanpur, followed by Surkhet.

Table 5.7c

Top Ten Districts with Road Traffic Casualties Caused by The Crash Instigated by Two-Wheeler and Tempo, Nepal

District	Injuries/death	Total two-wheelers casualties		District	Injuries/death	Total tempo casualties	
		N	%			N	%
Kathmandu	30.8	1,937	18.2	Morang	53.7	164	16.7
Morang	48.4	1,037	9.7	Kathmandu	No death case	79	8.0
Rupandehi	30.9	893	8.4	Rupandehi	No death case	63	6.4
Saptari	27.1	561	5.3	Dang	No death case	61	6.2
Bhaktapur	21.8	479	4.5	Bara	48.0	49	5.0
Lalitpur	27.1	477	4.5	Surkhet	10.0	44	4.5
Sarlahi	26.9	390	3.7	Bardiya	42.0	43	4.4
Kapilvastu	28.2	380	3.6	Rautahat	No death case	43	4.4
Dang	18.9	319	3.0	Saptari	41.0	42	4.3
Dhanusa	7.7	279	2.6	Makawanpur	10.0	33	3.4
Total	17.1	10,688		Total	28.8	982	

Source: Researcher extracted data from Nepal Police record 2018/19.

5.7 Road traffic Deaths and Injuries by Type of Road User

The highest casualties were among two-wheelers, followed by vehicle passengers and pedestrians (Table 5.8). Both the road traffic injuries and deaths were higher for motorized two-wheelers (37.8% of the total casualties), followed by passengers of different vehicles (33.9%) and pedestrians (18.1%). Among total deaths, motorized two-wheelers have the highest mortality (34.0%), and cyclists have the lowest road crashes deaths. The risk of dying was higher for drivers (5.9 injuries per death) followed by 8.3 injuries per death for pedestrians and 11.9 injuries for both motorized two-wheelers and passengers of any vehicles.

Table 5.8

Road Traffic Injury and Death by Road User for 2018/19, Nepal

Type of road user	Type of road crash victim						
	Injury		Death		Injuries per death	Total	
	N	%	N	%		N	%
Motorized two-wheelers	8,898	38.2	745	34.0	11.9	9,643	37.8
Passengers	7,977	34.2	671	30.6	11.9	8,648	33.9
Pedestrians	4,127	17.7	498	22.7	8.3	4,625	18.1
Drivers	1,008	4.3	172	7.8	5.9	1,180	4.6
Cyclists	1,015	4.4	79	3.6	12.8	1,094	4.3
Others	294	1.3	27	1.2	10.9	321	1.3
Total	23,319	100.0	2,192	100.0	10.6	25,511	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

5.8 Casualties by Road Users and Type of Vehicles that Instigate the Crashes

For ambulance crashes, 3.8 percent of cyclists were injured or dead, and 13.5 percent of drivers of any vehicle were victimized in the road crashes (Table 5.9A). It has been found that the highest percent (36.5%) of motorized two-wheelers died or were injured by crashes instigated by the ambulance, followed by passengers (30.8%) and pedestrians (15.4%). Heavy equipment crashes mostly victimized motorized two-wheelers (37.3%), followed by pedestrians (24.0%) and passengers (21.3%) of any motorized vehicles. In the case of bicycle crashes, majority of the victims were on motorized two-wheelers (44.9%), followed by the pedestrians (20.3%) and cyclists themselves (17.6%).

Similarly, for the crash instigated by tippers, 30.9 percent of the two-wheelers, 17.1 percent of the pedestrians were injured or dead. In tempo crashes, it was mostly the passengers of the same tempo or the passengers of other vehicles who were victimized (51.7%), followed by two-wheelers (23.7%) and pedestrians (19.9%). Likewise, 5.1 percent were the drivers of the same tempo or other vehicles, and 3.9 percent of road users were cyclists. Table 5.9a shows alarming results, stating that 37.8 percent of the victims were passengers in tractor crashes. The results for truck crashes is almost similar to the crashes instigated by the tractor: 43.1 percent of the crash victims were passengers, followed by motorized two-wheelers, and pedestrians (16.8%).

Further, 30.9 percent of the motorized two-wheelers injured or died from the crash instigated by the tractor crashes, and 20.2 percent were pedestrians. In the small PV crashes, mainly motorized two-wheelers (39.1%) were injured or died, followed by a passenger of any vehicle (27.3%) and pedestrian (21.9%). In the jeep/van and bus crashes, most of the victims were passengers followed by motorized two-wheelers and pedestrians.

In two-wheeler crashes, more than half of the victims were two-wheelers themselves (54.7%), followed by pedestrians (25.4%).

Table 5.9a

Percentage Distribution of Road Traffic Incidents by Road Users and Type of Vehicle Instigate Crashes, Nepal

Type of vehicle instigate crash	Type of road users						Total
	Cyclist	Driver	Motorized two-wheeler	Passenger	Pedestrian	Other	
Ambulance	3.8	13.5	36.5	30.8	15.4	0.0	52
Heavy equipment	6.7	6.7	37.3	21.3	24.0	4.0	75
Bicycle	17.6	5.7	44.9	10.1	20.3	1.3	227
Tipper	3.9	5.6	30.9	40.9	17.1	1.5	712
Tempo	3.9	5.1	23.7	51.7	14.9	0.7	982
Tractor	3.8	6.1	30.9	37.8	20.2	1.2	1,329
Small PV	4.6	6.1	39.1	27.3	21.9	0.9	1,460
Truck	3.9	6.5	28.1	43.1	16.8	1.6	1,929
Jeep/van	2.9	5.0	21.9	56.3	13.2	0.7	2,820
Bus	1.9	3.3	15.1	67.8	9.8	2.1	5,120
Motorized two-wheeler	5.6	4.1	54.7	9.2	25.4	1.0	10,668
Unknown	4.3	8.7	44.9	18.1	21.7	2.2	137
Total	1,094	1,180	9,643	8,648	4,625	321	25,511
Daily casualties	3.0	3.2	26.4	23.7	12.7	0.9	69.9

Source: Researcher extracted data from Nepal Police record 2018/19.

More than one-fifth of the total road crash victims were pedestrians (27.3%) from Kathmandu valley (Table 5.9b). Overall, about 12.6 pedestrians are injured or died daily in road crashes in Nepal, among which 4.1 pedestrians were injured or dead in Kathmandu valley. A large proportion of the pedestrians were victimized by motorized two-wheelers both in Kathmandu (62.95%) and out of Kathmandu (56.49%). In Kathmandu valley, a larger percent of pedestrians got injured or died from small van crashes (12.27%) than at the national level (6.57%). Pedestrians victimized by trucks were higher at the national level (6.48%) than in Kathmandu valley (5.18%), and out of Kathmandu it was 6.98%. Table 5.9b also shows that pedestrians injured or died from tipper crashes (1.79%) were less in Kathmandu valley than at the national level (2.23%), while for crashes outside Kathmandu it was 2.39 percent.

Table 5.9 b

Distribution of Road Traffic Casualties among Pedestrians by the he Vehicle Instigating Crash in Kathmandu, out of Kathmandu and at National Level

Vehicle Type	Kathmandu valley*		Out of Kathmandu		Total	
	N	%	N	%	N	%
Motorized two-wheeler	1,021	63.0	2,325	54.1	3,346	56.5
Bus	166	10.2	427	9.9	593	10.0
Jeep	78	4.8	373	8.7	451	7.6
Small PV	199	12.3	190	4.4	389	6.6
Truck	84	5.2	300	7.0	384	6.5
Tractor	6	90.4	308	7.2	314	5.3
Tempo	9	0.6	171	4.0	180	3.1
Tipper	29	1.8	103	2.4	132	2.2
Bicycle	14	0.9	40	0.9	54	0.9
Heavy Equipment	5	0.3	18	0.4	23	0.4
Ambulance	2	0.1	8	0.2	10	0.2
Unknown	9	0.6	38	0.9	47	0.8
Total	1,622	100.0	4,301	100.0	5,923	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

* Kathmandu valley-Kathmandu, Bhaktapur and Lalitpur districts

Among all types of road users, nearly half of the road traffic victims were two-wheelers (riders and pillion riders). Table 5.9c shows that about one-fourth of the two-wheelers (24.75%) were from Kathmandu valley. An overwhelming majority of the motorized two-wheelers were injured or died in the road crashes instigated by motorized two-wheelers, both in the (61.99%) national level and (64.71%) in Kathmandu valley. Outside Kathmandu, the percentage is almost equal to national proportion. In Kathmandu valley, among two-wheelers, 14.91 percent of victims were injured or died by the crash instigated by buses and trucks; out of Kathmandu it was 13.98 percent. At the national level, 8.89 percent of the two-wheelers were injured or dead from the crash instigated by bus. The numbers for jeeps, small vans, and trucks were 4.81%, 11.42%, and 5.02% respectively. In Kathmandu valley, 0.39 percent of the total motorized two-wheelers road crash victims were injured from the crash instigated by tractors. At the national level, however, it was almost double (2.37%), and in out of Kathmandu it was 5.68 percent (Table 5.9c).

Table 5.9c

Distribution of Road Traffic Casualties among Motorized Two-Wheeler Users by the Vehicle Instigating Crash in Kathmandu, out of Valley and Nepal

Type of vehicle	Kathmandu valley*		Out of Kathmandu		Total	
	N	%	N	%	N	%
Motorized two-wheeler	1,507	64.7	4,326	61.1	5833	62.0
Bus	207	8.9	565	8.0	772	8.2
Jeep	112	4.8	505	7.1	617	6.6
Truck	117	5.0	425	6.0	542	5.8
Small Private van	266	11.4	305	4.3	571	6.1
Ambulance	1	0.0	18	0.3	19	0.2
Bicycle	16	0.7	86	1.2	102	1.1
Tractor	9	0.4	402	5.7	411	4.4
Tempo	13	0.6	220	3.1	233	2.5
Tipper	54	2.3	166	2.3	220	2.4
Unknown	23	1.0	39	0.67	62	0.7
Heavy Equipment	4	0.2	24	0.3	28	0.3
Total	2,329	100.0	7,081	100.0	9,410	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

* Kathmandu valley-Kathmandu, Bhaktapur and Lalitpur districts

Among injured or dead passengers, 28.25 percent were victimized by the crash instigated by buses in Kathmandu valley, and it was 43.45 percent at out of Kathmandu districts (Table 5.9 d). In Kathmandu valley, 22.41 percent of the passengers were died or injured by the crash instigated by two-wheelers, which was 8.10 percent at the national level and 6.75 percent in out of Kathmandu districts. In Kathmandu, 16.81 percent of the passengers had died or were injured by crashes instigated by jeep, with the proportion being 19.18 percent outside Kathmandu. Comparatively, more passengers were dead or injured from tractor, tipper, and truck crashes at national level than at Kathmandu valley (Table 5.9 d).

Table 5.9d

Distribution of Road Traffic Casualties Among Passengers by Types of Vehicles Instigating Crash in Kathmandu, out of Kathmandu and at National Level, Nepal

Type of vehicles	Kathmandu valley*		Out of Kathmandu		Total	
	N	%	N	%	N	%
Bus	198	28.5	3,223	43.5	3,421	42.2
Jeep	117	16.8	1,423	19.2	1,540	19.0
Truck	42	6.0	765	10.3	807	10.0
Motorized two-wheeler	156	22.4	501	6.8	657	8.1
Small PV	92	13.2	279	3.8	371	4.6
Tempo	59	8.5	431	5.8	490	6.0
Tractor	3	0.4	477	6.4	480	5.9
Tipper	14	2.0	271	3.7	285	3.5
Bicycle	5	0.7	15	0.2	20	0.3
Ambulance	0	0.0	16	0.2	16	0.2
Heavy Equipment	2	0.3	10	0.1	12	0.2
Unknown	8	1.2	7	0.1	15	0.2
Total	696	100.0	7,418	0.0	8,114	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

* Kathmandu valley-Kathmandu, Bhaktapur and Lalitpur districts

5.9 Casualties among Vulnerable Road Users by Time

Cyclists, pedestrians, and motorized two-wheeler users are known as vulnerable road users (WHO, 2018). For all three vulnerable types of road users, a ten-fold increase was observed in the number of injuries if the crashes occurred from 16:00 – 19:59. A similar observation was found for deaths as well, but there was a three-fold increase in the case of deaths in the same time period (Table 5.10). Road traffic casualties are substantially lower after midnight, i.e., during less vehicle fleet. In the peak hours (9:00-11:00 hours and 16:00-19:59 hours), road traffic casualties were markedly higher among vulnerable road users than in another time period.

Table 5.10

Road Traffic Injury and Death among Cyclist, Pedestrian and Motorized Two-Wheeler by Time, Nepal

Time of crash	Cyclist			Pedestrian			Motorised two-wheeler		
	Injury	Death	Total	Injury	Death	Total	Injury	Death	Total
00:01-00:59	3	0	3	12	7	19	126	23	149
01:00-01:59	2	0	2	15	6	21	61	7	68
02:00-02:59				13	4	17	72	8	80
03:00-03:59	1	1	2	27	6	33	55	5	60
04:00-04:59	10	1	11	48	16	64	83	14	97
05:00-05:59	23	1	24	108	11	119	140	16	156
06:00-06:59	24	4	28	91	18	109	171	24	195
07:00-07:59	29	3	32	147	11	158	245	27	272
08:00-08:59	58	1	59	185	25	210	314	24	338
09:00-09:59	38	2	40	179	37	216	333	28	361
10:00-10:59	55	6	61	183	27	210	437	34	471
11:00-11:59	55	4	59	191	24	215	423	28	451
12:00-12:59	55	4	59	193	23	216	524	36	560
13:00-13:59	43	5	48	235	22	257	468	30	498
14:00-14:59	56	7	63	282	20	302	568	44	612
15:00-15:59	76	1	77	283	30	313	567	30	597
16:00-16:59	76	8	84	335	37	372	680	44	724
17:00-17:59	93	7	100	415	42	457	665	49	714
18:00-18:59	130	10	140	425	40	465	769	57	826
19:00-19:59	86	6	92	371	35	406	697	67	764
20:00-20:59	62	3	65	188	36	224	568	49	617
21:00-21:59	21	2	23	115	12	127	372	28	400
22:00-22:59	14	1	15	48	4	52	359	46	405
23:00-23:59	5	2	7	38	5	43	201	27	228
Total	1,015	79	1,094	4,127	498	4,625	8,898	745	9,643

Source: Researcher extracted data from Nepal Police record 2018/19.

There were no notable differences in the number of casualties by days of the week. Table 5.11 shows that many of the cyclists, pedestrians, and motorized two-wheelers were injured or died from road crashes on Saturday. Comparatively fewer casualties have been seen on Sunday.

Table 5.11
Road Traffic Casualties among Cyclist, Pedestrian and Motorized Two-Wheeler by Day, Nepal

Time of crash	Cyclist				Pedestrian				Motorised two-wheeler			
	Injury	Death	Total	%	Injury	Death	Total	%	Injury	Death	Total	%
Sunday	132	7	139	12.7	529	67	596	12.9	1,245	102	1,347	14.0
Monday	135	11	146	13.3	562	84	646	14.0	1,214	105	1,319	14.7
Tuesday	146	11	157	14.4	593	66	659	14.2	1,203	99	1,302	13.5
Wednesday	157	8	165	15.1	637	68	705	15.2	1,274	121	1,395	14.5
Thursday	150	11	161	14.7	615	66	681	14.7	1,222	102	1,324	13.7
Friday	162	16	178	16.3	614	79	693	15.0	1,353	116	1,469	15.2
Saturday	133	15	148	13.5	577	68	645	13.9	1,387	100	1,487	15.4
Total	1,015	79	1,094	100.0	4,127	498	4,625	100.0	8,898	745	9,643	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

Looking at deaths and injuries by month, the lowest number of road traffic casualties occurred in June, and the highest was in January (Table 5.12). Similarly, since big festivals (*Dashain* and *Tihar*) are celebrated in October and November, this in turn tends to increase people's mobility largely in these months. This study also found that deaths and injuries were comparatively higher in these two months.

Table 5.12
Road Traffic Casualties among Cyclist, Pedestrian and Motorized Two-Wheeler by Day, Nepal

Time of crash	Cyclist				Pedestrian				Motorised two-wheeler			
	Total				Total				Total			
	Injury	Death	N	%	Injury	Death	N	%	Injury	Death	N	%
January	98	4	102	9.3	344	40	384	8.3	712	70	782	8.1
February	63	8	71	6.5	312	40	352	7.6	640	57	697	7.2
March	93	10	103	9.4	371	50	421	9.1	825	85	910	9.4
April	89	8	97	8.9	339	46	385	8.3	757	71	828	8.6
May	81	9	90	8.2	346	35	381	8.2	733	62	795	8.2
June	73	4	77	7.0	279	23	302	6.5	691	42	733	7.6
July	84	9	93	8.5	310	36	346	7.4	708	62	770	8.0
August	98	3	101	9.2	355	36	391	8.4	678	38	716	7.4
September	71	5	76	6.9	302	35	337	7.2	726	51	777	8.1
October	102	8	110	10.1	380	47	427	9.2	912	76	988	10.1
November	95	4	99	9.0	391	50	441	9.5	853	67	920	9.5
December	68	7	75	6.9	398	60	458	9.9	663	64	727	7.5
Total	1,015	79	1,094	100.0	4,127	498	4,625	100.0	8,898	745	9,643	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

The highest number of deaths and injuries occurred among people aged 15-19 and 30-44 years (Table 5.13). In 15-29 years of age, 31.5 percent of casualties were cyclists,

18.7 percent were pedestrians, and 56.0 percent were motorized two-wheelers.

Comparatively, fewer casualties have occurred among the children and elderly population.

However, this might be attributed to the fact that children under 5 years and older people do not commonly use bicycles and other motorized two-wheelers.

An overwhelming majority (85.9%) of vulnerable road users were male. The proportion of female casualties was markedly higher for pedestrians at 40.5 percent. Besides, 15.9 percent of the casualties were female cyclists, and another 28.9 percent of the casualties were motorized two-wheelers.

Table 5.13

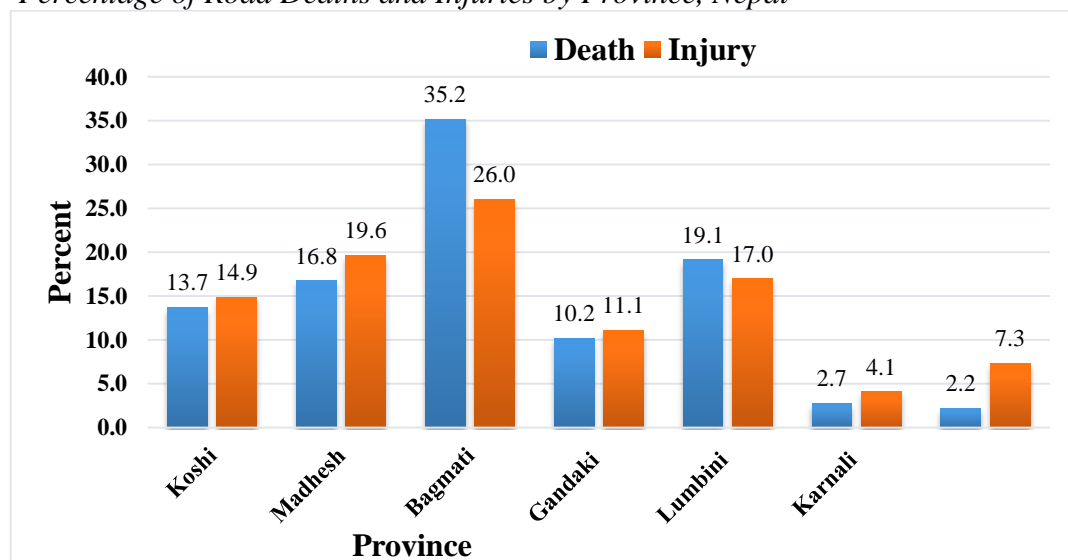
Road Traffic Injury and Death among Cyclist, Pedestrian and Motorized Two-Wheeler by Age, and Sex, Nepal

Age and sex	Cyclist		Pedestrian				Motorised two-wheeler					
	Injury	Death	Total		Total		Total		Total			
			N	%	Injury	Death	N	%	Injury	Death	N	%
0-4	4	2	6	0.5	316	38	354	7.7	65	5	70	0.7
5-14	127	12	139	12.7	873	70	943	20.4	183	9	192	2.0
15-29	329	14	343	31.5	802	64	866	18.7	526	377	5,403	56.0
30-44	190	16	206	18.8	639	79	718	15.5	321	231	2,552	26.5
45-60	244	24	268	18.8	784	135	718	15.5	321	94	897	9.3
60+	102	8	110	10.5	620	104	724	15.7	133	14	147	1.5
NR	19	3	22	2.1	93	8	101	2.2	367	15	382	4.0
Sex												
Male	847	69	916	83.7	2398	335	2,733	49.1	628	664	8,292	85.9
Female	166	9	175	15.9	1715	159	1,874	40.5	225	80	1,305	13.53
Unknown	2	1	3	0.3	14	4	18	0.1	45	1	46	0.5
Total	1,015	79	1,094	100.0	4,127	498	4,625	100.0	898	745	9,643	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

5.10 Death and Injury by Provinces

Bagmati province has the highest road traffic casualties, followed by Lumbini province (Figure 5.7). Madhesh province has the second-highest number of road traffic deaths, followed by Lumbini. As Karnali and Sudurpashchim provinces have fewer road networks and vehicle fleets, road traffic casualties were lower. The percentage of death relatively higher Sudurpashchim, and injury cases were higher in Bagmati province.

Figure 5.7*Percentage of Road Deaths and Injuries by Province, Nepal*

Source: Researcher extracted data from Nepal Police record 2018/19

While it was attempted to discuss the top ten districts, two districts (Bhaktapur and Sarlahi) have an equal proportion of the road traffic casualties; thus, 11 districts were considered (Table 5.14). These 11 districts represent more than half of Nepal's total road traffic casualties (53%). Among the 11 districts, four were from Bagmati, three were from Lumbini, two were from Madhesh, and one was from Koshi Province and Gandaki province each. Kathmandu comprised the highest proportion of road crash-related deaths and injuries in Nepal (13.8 percent), followed by Morang (7.4%).

Similarly, Rupandehi contained 5.5 percent of the casualties, and other districts comprised 2 to 4 percent of the total casualties of Nepal. The crash severity was highest (lower number of injuries per death) in Chitwan district (7.5 injuries per death) followed by Nawalpur (9.8 Injuries per death) and Dang (11.5 injuries per death). The number of injuries was notably higher in Kathmandu (25.7 injuries per death), followed by Morang (21.1 injuries per death), and Lalitpur (20.9 injuries per death) (Table 5.14).

Table 5.14

Road Traffic Injuries Per Death and Total Casualties by Top 11 Districts for 2018/19, Nepal

District	Province	Injuries/death	Total casualties	Percentage in total casualties
Kathmandu	Bagmati	25.7	3529	13.8
Morang	Koshi	21.1	1,877	7.4
Rupandehi	Lumbini	17.8	1,407	5.5
Saptari	Madhesh	14.1	1,084	4.2
Nawalpur	Gandaki	9.8	907	3.6
Chitawan	Bagmati	7.5	893	3.5
Dang	Lumbini	11.5	889	3.5
Lalitpur	Bagmati	20.9	809	3.2
Kapilvastu	Lumbini	19.5	759	3.0
Bhaktapur	Bagmati	16.0	699	2.7
Sarlahi	Madhesh	14.0	677	2.7
Total of 11 districts		16.3	13,530	53.0
National total casualties	Nepal	10.6	25,511	100.0

Source: Researcher extracted data from Nepal Police record 2018/19.

Among all age groups, people aged 5-14 represent the lowest, and 30-44 years represent the highest percent of road traffic casualties in all the provinces (Table 5.15). In Sudurpashchim province, the proportion of road traffic death and injuries among under-five-year-old children was higher (8.6%), followed by Karnali (6.3%). Comparatively, a lower percent of children died (3.4%) or were injured (3.6%) in the road crashes in Bagmati Province. The data shows that huge sex differences in road traffic deaths and injuries in all provinces. More than two-thirds (76.8%) of the victims were male in Madhesh Province, Koshi Province (73.9%), and Lumbini (73.3%). In Karnali Province, about one-third of road traffic victims were female (31.7%), and less than 2 percent of the victim's sex was not reported.

Table 5.15*Percentage Distribution of Road Traffic Casualties in Provinces by Age and Sex, Nepal*

Background	Koshi	Madhesh	Bagmati	Gandaki	Lumbini	Karnali	Sudurpashchim
Age group							
0-4	3.6	4.5	3.4	3.7	4.0	6.3	8.6
5-14	2.1	3.3	2.4	2.0	2.6	3.2	1.8
15-29	8.2	10.3	6.3	7.0	9.0	12.9	10.2
30-44	37.1	36.6	45.9	44.2	40.6	41.0	41.9
45-60	27.2	23.9	24.4	24.8	24.0	21.5	23.0
60+	15.6	15.9	12.5	12.8	13.7	10.8	10.2
NR	6.1	5.5	5.1	5.6	6.1	4.3	4.3
Sex							
Male	73.9	76.8	72.7	71.4	73.3	65.6	74.9
Female	25.1	22.6	26.2	26.9	25.7	31.7	22.9
Unknown	1.0	0.6	1.0	1.7	1.0	2.7	2.2
Total	3,528	4,337	8,780	2,625	4,835	729	677

Source: Researcher extracted data from Nepal Police record 2018/19.

Besides drivers, the crash severity (injury/death) was high for pedestrians and motorized two-wheelers (Table 5.16). In Sudurpashchim, in every motorized two-wheeler user's death, 1.5 injuries happened, and in Karnali, it was 3.9 injuries per death. In most of the provinces, number of injuries per death was higher for passenger in crashes.

In Province 1, crash severity (injuries/death) was highest for drivers (6.2 injuries/death), followed by 7.6 injuries per death in pedestrians and 9.4 injuries per death for motorized two-wheelers. In Madhesh, crash severity was highest for motorized two-wheelers (8.1) and (8.3) for pedestrians. Similarly, in Bagmati crash severity was highest for pedestrians (13.0), followed by motorized two-wheelers (13.9). In Gandaki, 8.1 people were injured per each motorized two-wheeler's death. Overall, Table 5.16 revealed that pedestrians and motorized two-wheelers have a greater risk of dying. On the other hand, more injuries per death means larger number of people living in disability.

Table 5.16

Road Traffic Injuries Per Death by Type of Road User in Different Provinces by Road User, Nepal

Province	Koshi	Madhesh	Bagmati	Gandaki	Lumbini	Karnali	Sudurpashchim	Total
Cyclist	15.8	10.2	13.9	12.6	16.6	4.3	5.8	12.5
Driver	6.2	8.8	21.1	6.3	8.6	4.4	7.3	9.6
Passenger	12.8	12.7	15.5	13.0	14.1	11.2	5.1	12.8
Pedestrian	7.6	8.3	13.0	7.5	10.1	4.7	1.9	9.3
Motorized two-wheeler	9.4	8.1	13.9	8.1	11.9	3.9	1.5	9.8
Other	13.0	7.5	46.5		24.0			25.8
Total	9.8	9.1	14.4	9.8	12.0	7.2	3.2	10.6

Source: Researcher extracted data from Nepal Police record 2018/19.

Karnali and Sudurpashchim provinces pose a greater threat of fatalities due to vehicle crashes, with buses being relatively riskier in Sudurpashchim. Surprisingly, bicycles and tempos were the safest mode of transportation across all provinces, while tractors were considered the most hazardous. Although motorized two-wheelers are generally considered risky, the data in table 5.17 reveals a higher number of injuries per death for two-wheelers compared to other modes of transportation.

Table 5.17

Road Traffic Injuries Per Death in The Provinces by Type of Vehicle Instigate Crashes

Vehicle type	Koshi	Madhesh	Bagmati	Gandaki	Lumbini	Karnali	Sudurpashchim
Ambulance	1.0	No death	11.0	No death	No death	1 death	No death
Bicycle	8.4	9.0	52.0	No death	8.8	No death	4.0
Small PV	13.1	7.5	27.9	18.0	9.9	3.0	2.0
Heavy equipment	11.0	0.0	6.8	6.0	2.3	0.0	0.2
Jeep/van	6.9	6.3	14.5	13.0	7.2	4.1	4.5
Bus	16.3	10.5	15.9	15.6	16.2	18.2	4.4
Motorized two-wheeler	16.2	14.6	21.7	13.5	21.7	5.5	3.5
Tempo	36.5	31.3	42.8	16.0	31.9	11.5	4.0
Tractor	2.8	2.3	4.2	2.5	3.0	5.9	1.0
Tipper	5.7	3.9	7.2	1.9	7.7	No death	1.0
Truck	4.3	4.5	5.8	6.7	6.4	2.6	7.3
Unknown	2.0	2.4	6.9	0.8	4.6	No death	2 Death
Injuries/Death	9.8	9.1	14.4	9.8	12.0	7.2	3.2

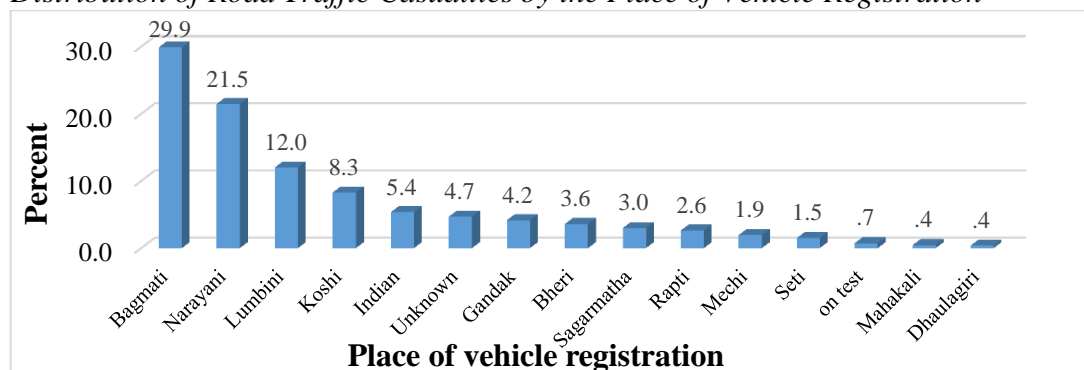
Source: Researcher extracted data from Nepal Police record 2018/19

5.11 Casualties by Place of Vehicle Registration

This study identified that the vehicles registered from 13 different places were exposed to road crashes in Nepal. In some vehicle crash records, the place of registration were not mentioned. Similarly, 0.7 percent of the casualties occurred from vehicles on test. Most of the vehicles involved in the crashes were registered in Bagmati (30 percent of the total vehicles involve in the crashes), followed by the vehicles registered in Narayani (21.5%). Similarly, the vehicle registered in Lumbini and Koshi combined represents (20%) of casualties. Figure 5.8 presents an alarming result: in Nepal, the vehicles registered in India caused the fifth-largest proportion (5.4%) of road crashes.

Figure 5.8

Distribution of Road Traffic Casualties by the Place of Vehicle Registration



Source: Researcher extracted data from Nepal Police record 2018/19

5.12 Chapter Summary

Road traffic crashes were a serious cause of mortality in 2018/19, with a death rate of 10.6 per 100,000 population. In 60% of the crashes, one person was killed per incident, while 7% were involved more than six fatalities. Two-wheelers accounted for the majority of crashes, followed by buses and small private vans. Most victims were young, with a mean age of 31 years. Deaths and injuries peaked between 4:00 PM and 7:00 PM, and

casualties were higher on Saturdays compared to other days. Seasonally, traffic casualties were most frequent in April, October, and November.

In 3% of crashes, victims died on the spot, while 7% died on the way to or at a hospital. Crashes involving heavy equipment and tractors posed a higher risk of on-the-spot deaths. Collisions, pedestrian hits, and plunges resulted in particularly high casualty rates.

Crash severity varied by region: Dang district had notably high death risk, while truck crashes in Nuwakot were especially deadly. Drivers had the highest risk of death, followed by pedestrians. Bagmati Province recorded the highest number of casualties, whereas the risk of death was greater in other provinces. While this chapter provided the descriptive analysis of quantitative information, the next chapter provides the findings of the statistical model for this quantitative data.

CHAPTER VI: PREDICTION OF ROAD TRAFFIC DEATHS

6.1 Introduction

In the previous chapter, descriptive data analysis was used to understand the status of road traffic crashes, deaths and injuries. In this chapter, Random Forest (RF) model was used to predict the factors and identify the most predictive factors associated with road traffic deaths. This model also calculates a Feature Importance value based on the attributes and number of crashes resulting in death. A higher Feature Importance value implies greater chances of fatalities compared to the total number of crashes involved in the attribute of interest. Thus, the Random Forest analysis model has been used to understand the factors predicting road traffic deaths in Nepal.

In the analysis, a total of 98 attributes were used. Each of these attributes fell under one of these broad categories, namely place of crash, demographic (type of road users, sex of victims), vehicle related, and time (Table 6.1) .

Table 6.1 List of Variables and their Attributes Used in the Analysis

Province	Type of crash	Type of road users	Vehicle related	Time related Days of week
• Koshi	• Collision	• Cyclist	• Ambulance	• Sunday
• Madhesh	• Plunge	• Driver	• Bicycle	• Monday
• Bagmati	• Overturned	• Passenger	• Small private van	• Tuesday
• Gandaki	• Hit and run	• Pedestrian	• Heavy equipment	• Wednesday
• Lumbini	• Hit animal	• Motorized	• Jeep	• Thursday
• Karnali	• Hit cyclist	two-	• Bus	• Friday
• Sudurpashchi	• Hit object on the road	wheelers	• Motorized two-	• Saturday
m	• Hit object on the road side	• Others	wheeler	
	• Hit parked vehicle		• Tempo	
	• Hit pedestrian		• Tractor	
	• Passenger in crash		• Tipper	
	• Others		• Truck	
			• Unknown	
Time related		Sex	Place of vehicle registered	Month of crash
• 01:00-01:59	• 12:00-12:59	• Male	• Bagmati	• January
• 02:00-02:59	• 13:00-13:59	• Female	• Bheri	• February
• 03:00-03:59	• 14:00-14:59	• Unknown	• Dhaulagiri	• March
• 04:00-04:59	• 15:00-15:59		• Gandaki	• April

• 05:00-05:59	• 16:00-16:59	• Indian	• May
• 06:00-06:59	• 17:00-17:59	• Janakpur	• June
• 07:00-08:59	• 18:00-18:59	• Koshi	• July
• 09:00-09:59	• 19:00-19:59	• Lumbini	• August
• 10:00-10:59	• 20:00-20:59	• Mahakali	• September
• 11:00-11:59	• 21:00-21:59	• Mechi	• October
• 12:00-12:59	• 22:00-22:59	• Narayani	• November
	• 23:00-23:59	• On test	• December
		• Rapti	
		• Sagarmatha	
		• Seti	
		• Unknown	

It was found that vehicle type, sex of the victims, type of road users, time of crash, age of the victims were likely to be important factors in determining that road traffic crash can be fatal. According to the nature of the data (having large number of categorical variables), it is very difficult to accurately identify the factors which contribute to the fatal injury and rank them. Furthermore, all the variables considered were not independent. For example, the type of the vehicle and province are moderately related: a higher number of people are likely to be riding motorcycles in Kathmandu but bicycles in Madhesh. Thus, the dependent relationship between the variables makes the analysis of each independent variable less inferential. To address this limitation, Feature Importance (FI) approach has been used which is a more systematic measure.

Only fatal injuries (deaths) are included in the analysis because of the limitation of injury data. Non-fatal injuries are of a broad spectrum - from minor wounds to serious head and spinal injuries - which was not clearly recorded in the incident records. Therefore, crashes with injuries were labelled (0) and crashes with death cases were labelled (1), a standard classification of data for RF analysis was formed. There were altogether 2,192 deaths cases included in this analysis. As mentioned in Table 6.1, there were 98 attributes used in the analysis to predict the death in the road crash. Since most of the attributes were

categorical, the Random Forest algorithm was used which is robust model in handling categorical data.

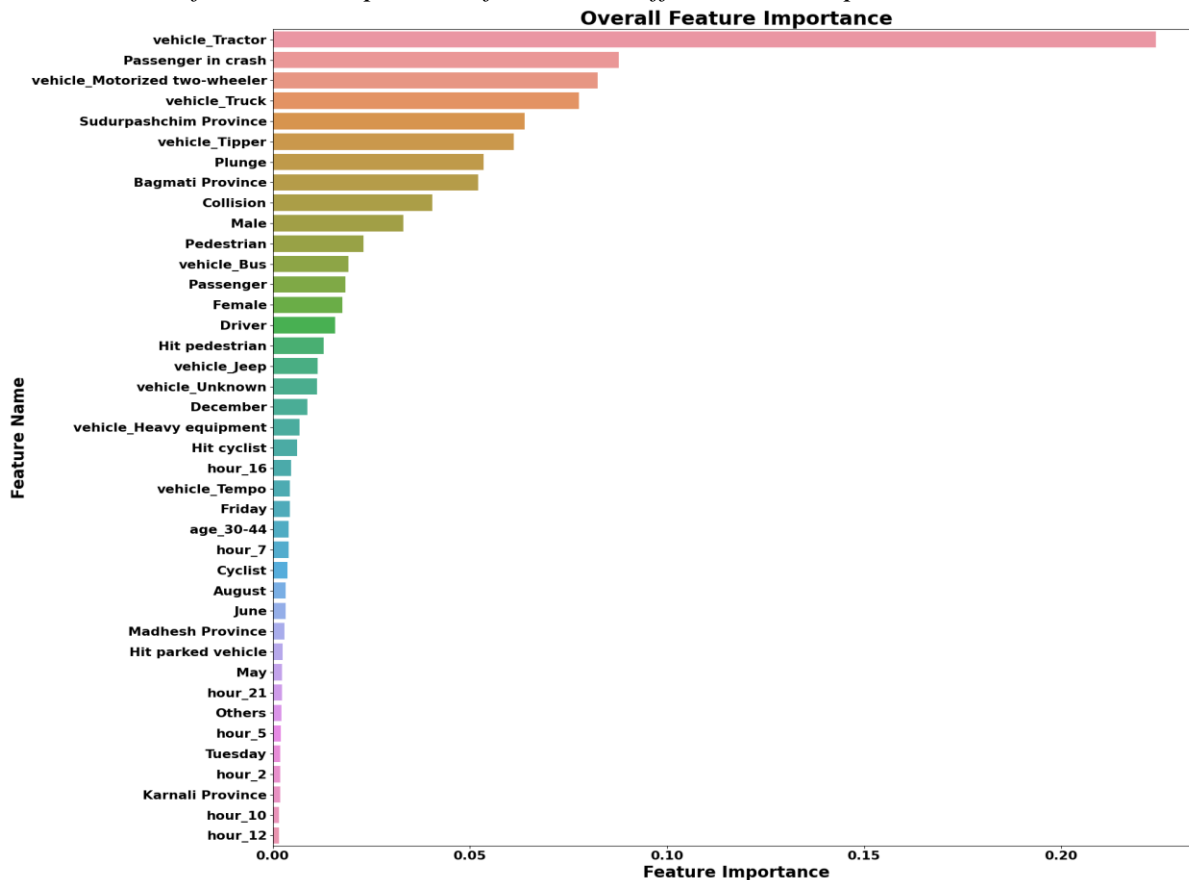
6.2 Prediction of Attributes for RTDs in Nepal

This analysis identified three critical factors associated to road traffic deaths in Nepal: 1) Type of vehicles, 2) Place of crashes (province), and 3) Type of road users. Among these, the attributes related to the types of vehicle were the major factors as indicated by the Feature Importance value. Figure 6.1 visualizes the factors for road traffic deaths by different predictive variables.

In this analysis, a higher feature importance value means that the feature has a larger effect on the model to predict the fatal road traffic injuries. Each bar of the graph represents the mortality characteristics in the event of road crashes. Figure 6.1 displays that there is a greater likelihood of road traffic crash deaths when an incident involves a tractor. Similarly, being a passenger on a bus is predicted as strong attribute in the event of a crash. The other top 5 attributes included motorized two-wheelers, truck crashes, and the crashes occurring in the Sudurpaschim Province. Notably, the time of crash has not appeared as a strong predicting feature for deaths.

Figure 6.1.

Visualization of Variable Importance for Road Traffic Deaths, Nepal



Source: Researcher extracted data from Nepal Police record 2018/19.

6.3 Prediction of Attributes for RTDs in Provinces

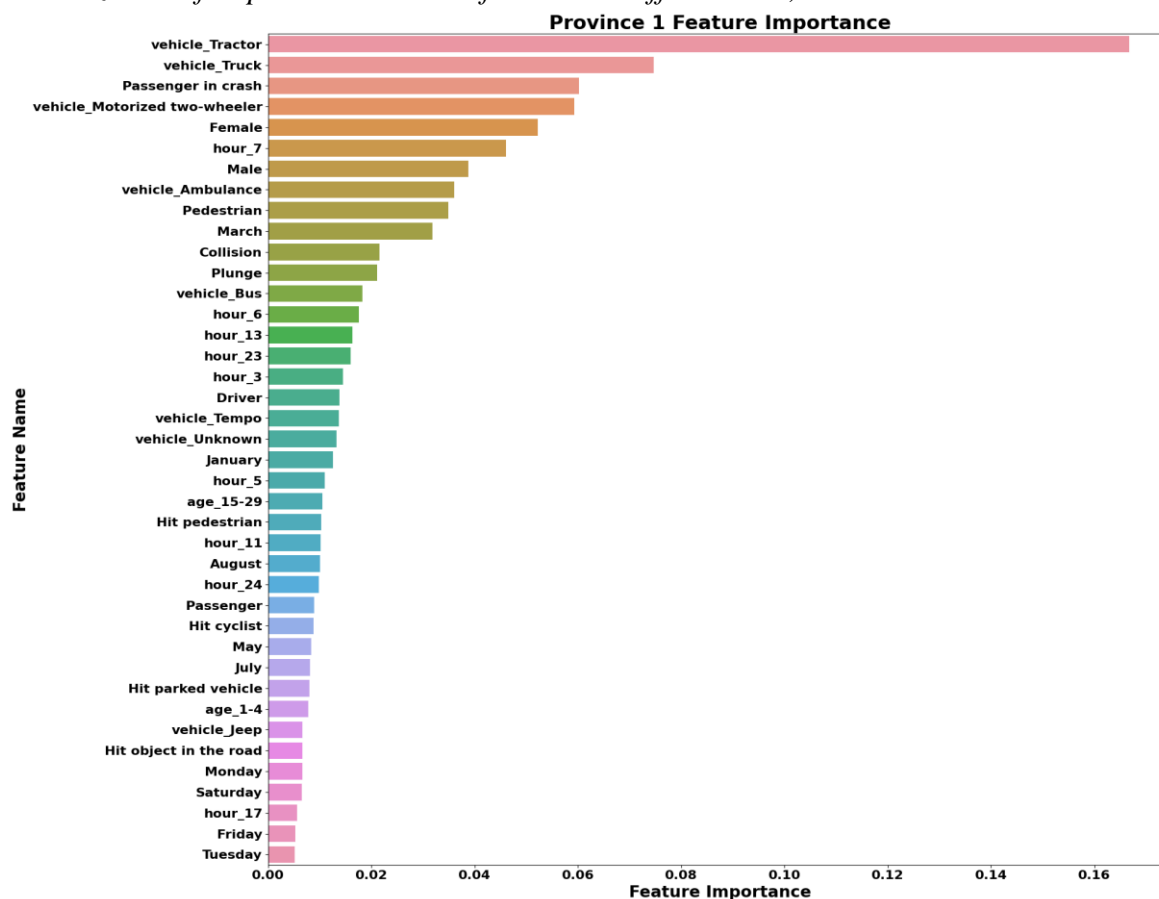
6.3.1 Koshi Province

In Koshi province, there are mixed findings: the type of vehicles, type of road users, sex of the victims, time of crash occurrence were some important variables contributing to fatal crashes. Similar to national level road traffic deaths, tractor crashes were found to have a greater likelihood of deaths in the crashes in this region (Figure 6.2a). Truck crashes, on the other hand, appeared as the second strongest attribute leading to fatal crashes. Likewise, when passengers were physically exposed to their environments, the crashes were more likely to result to deaths. Being a motorized two-wheeler user or a male

road user also appeared as a strong predictor for road traffic crash death. Figure 6.3a further displays that the vehicle type is an important predictor for road traffic death among the analysed variables of the study.

Figure 6.2a.

Visualization of Important Variables for Road Traffic Deaths, Koshi Province



Source: Researcher extracted data from Nepal Police record 2018/19.

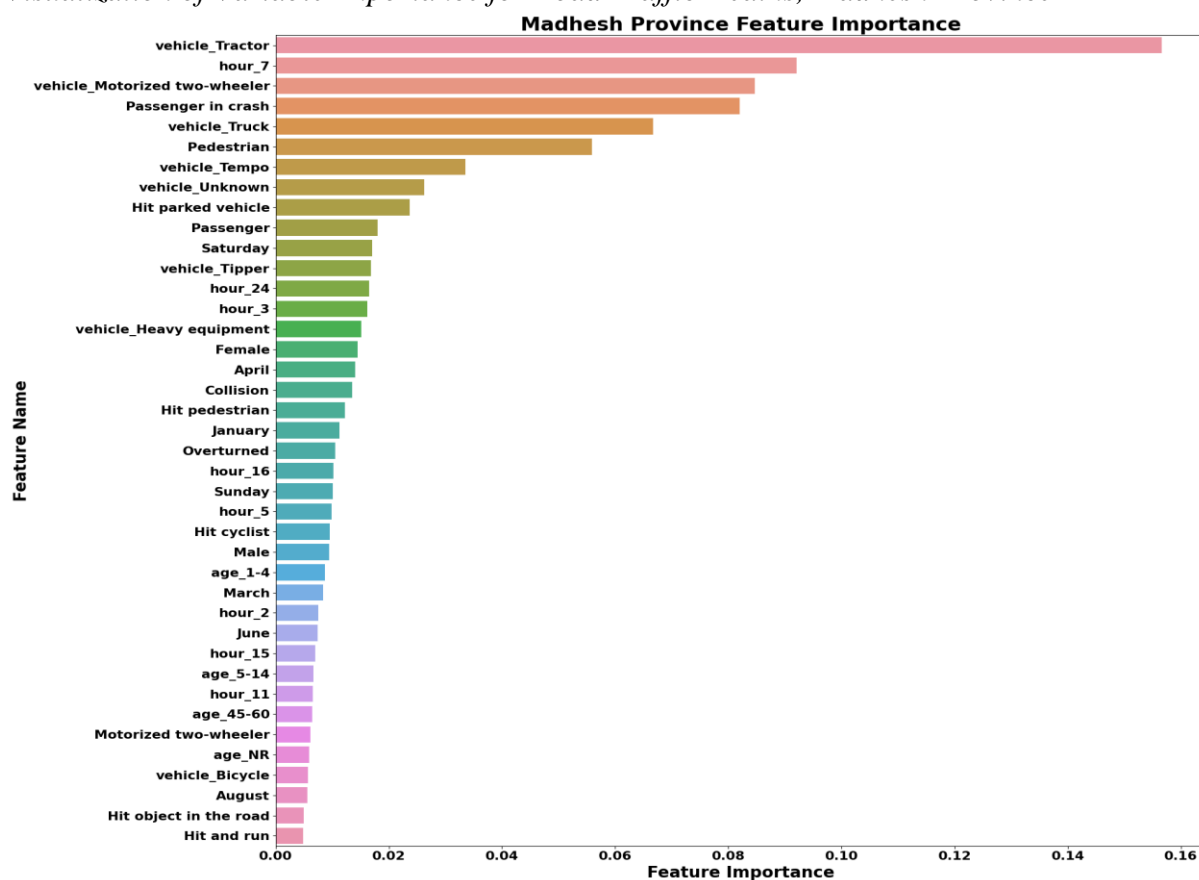
6.3.2 Madhesh Province

Figure 6.2b displays the predicting attributes for road traffic deaths in Madhesh Province. Similar to Koshi Province, tractor crashes seem to be the strongest predictor of death when a road user is involved in an RTC in Madhesh. This is followed by crashes occurring in the morning time (7:00). Similarly, the motorized two-wheeler crash was

identified as an important identifying attribute for fatal incidents. Similarly, passengers involved in truck crashes, pedestrians, and exposed crashes appeared in the 4th, 5th and 6th rank in the likelihood of road crashes respectively.

Figure 6.2b.

Visualization of Variable Importance for Road Traffic Deaths, Madhesh Province

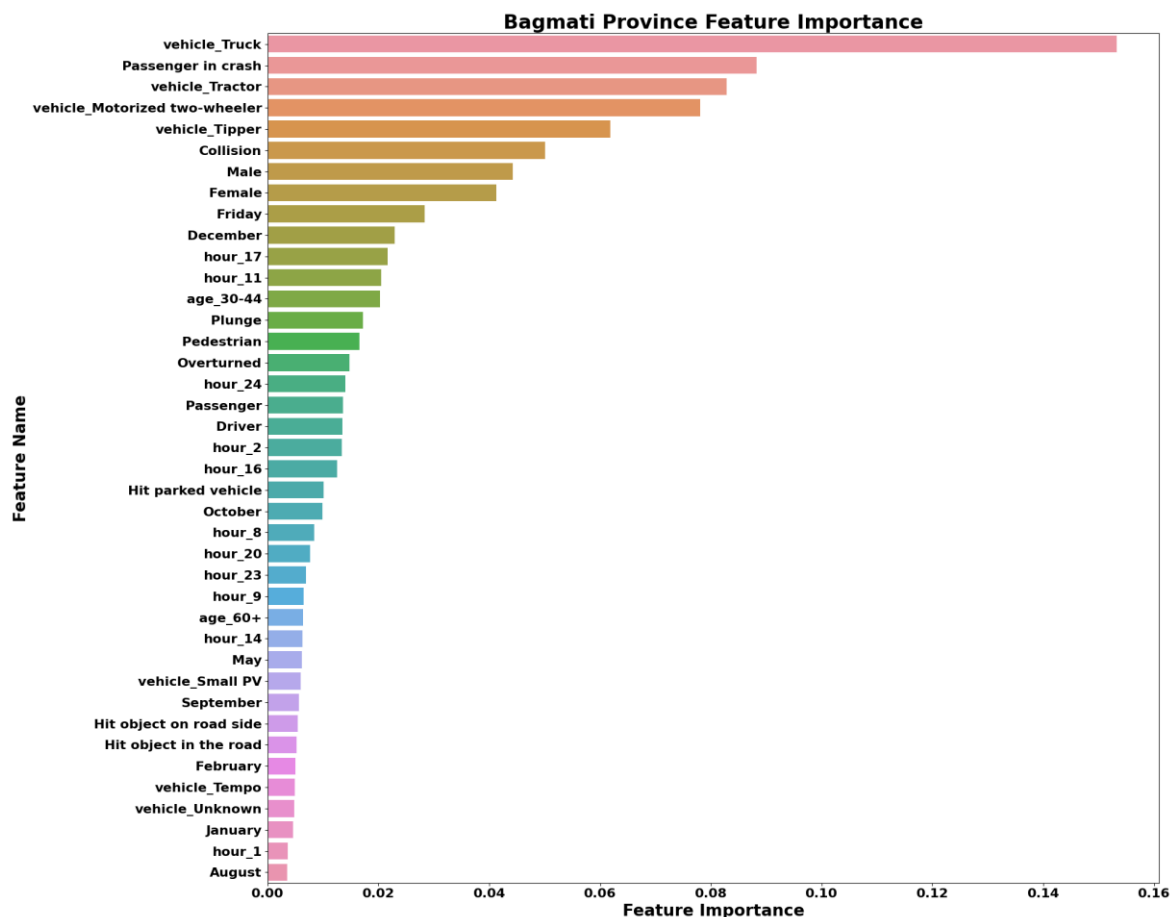


Source: Researcher extracted data from Nepal Police record 2018/19.

6.3.3 Bagmati Province

In Bagmati Province, the type of vehicles, sex of the victims, type of road users and time related factors were found as the critical variables for road traffic deaths. Among all attributes, truck crashes appeared as the best predicting factor for the road traffic deaths. Being a passenger in a tractor crash, and motorized-two wheelers crashes were identified as the second and the third-best predictive attributes in the traffic crashes.

Figure 6.2c.
Visualization of Predictive Variables importance for Road Traffic Deaths, Bagmati Province



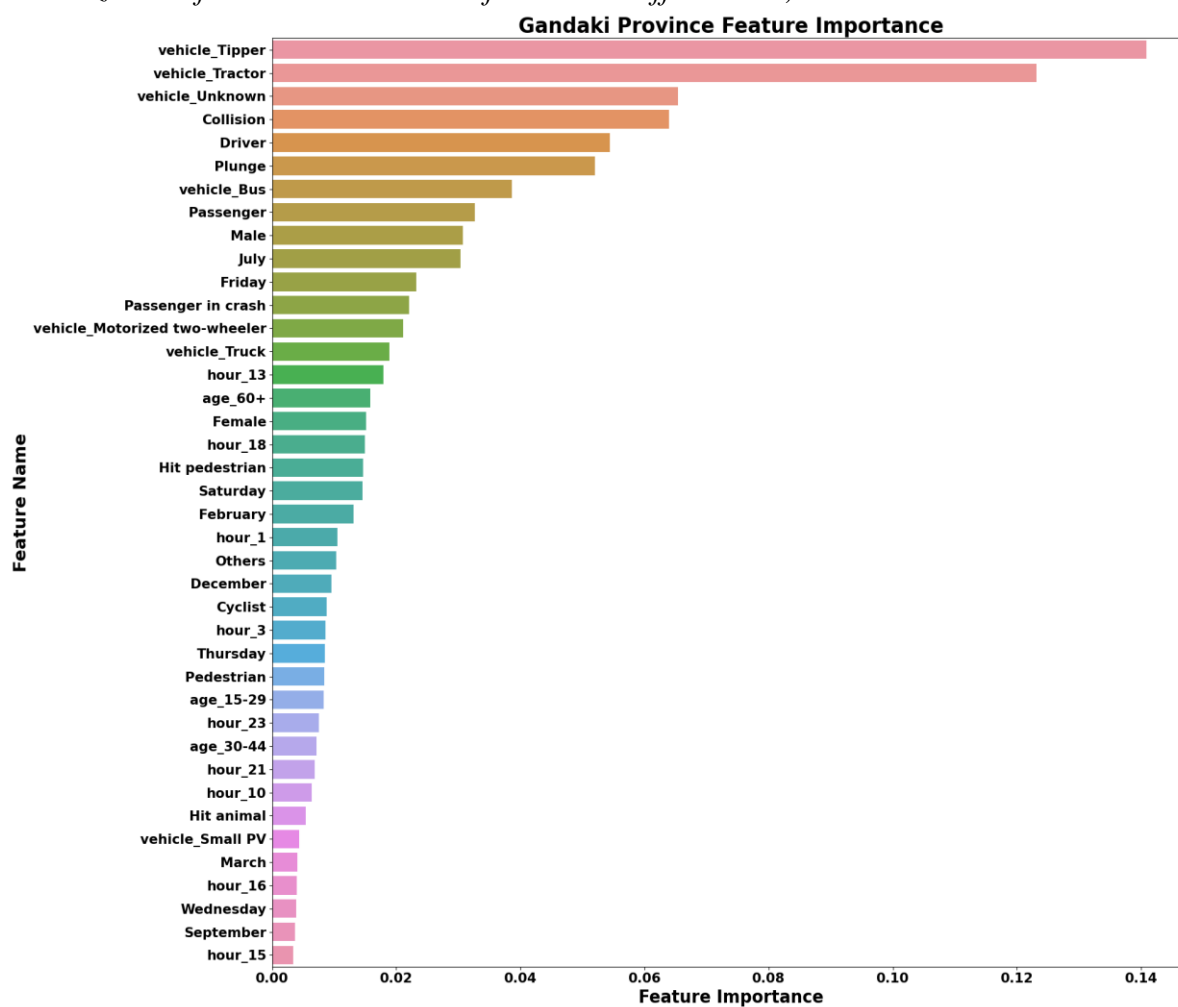
Source: Researcher extracted data from Nepal Police record 2018/19.

6.3.4 Gandaki Province

Figure 6.2d displays the predicting attributes for traffic deaths in Gandaki Province. It demonstrates that the type of vehicle and the type of road users were the most predictive variables for fatal road traffic crashes in this province. More specifically, the risk of human loss was highest in tipper crashes, followed by tractor crashes. It has been identified that in many fatal crashes, the type of vehicle involved were not reported to the police; however, deaths of road users from these unknown vehicle crashes were more heightened.

Figure 6.2d.

Visualization of Predictive Variables for Road Traffic deaths, Gandaki Province



Source: Researcher extracted data from Nepal Police record 2018/19.

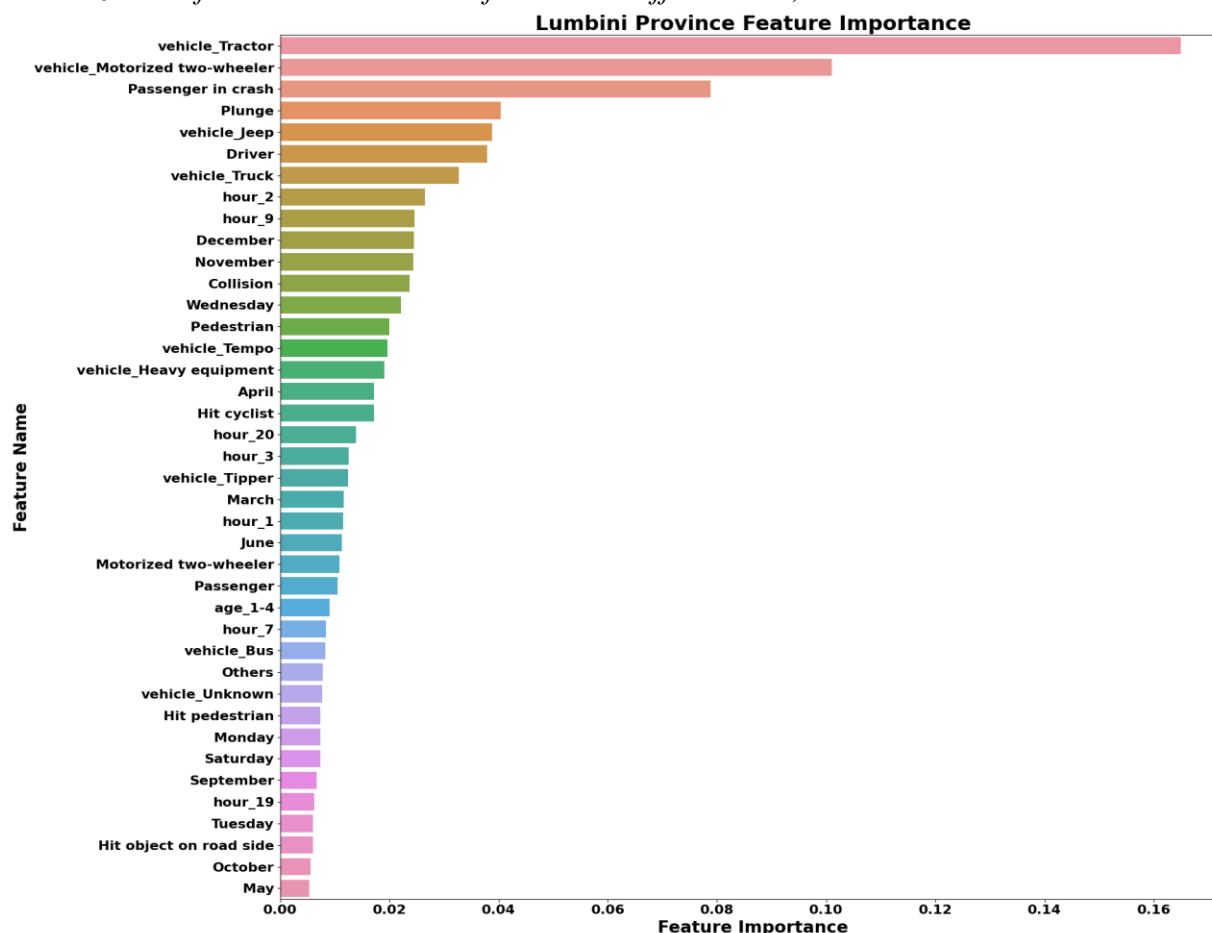
6.3.5 Lumbini Province

In Lumbini Province, the risk of death was the highest in tractor crashes, followed by passenger bus and motorized two-wheeler crashes. Figure 6.2e displays that among all attributes, there is a greater chance of road traffic crash death when an incident involves a tractor, followed by motorized two-wheeler crash. Similarly, being a passenger rather than the driver in a crash is predicted as the third most predictive attribute in the event of a

crash. The other remaining top 5 attributes include: plunge crashes and jeep crashes. In overall, vehicle type, type of road users, type of crash, month of crash, time of crash appeared as important predictive variables for fatal road crashes in Lumbini Province.

Figure 6.2e.

Visualization of Predictive Variables for Road Traffic Deaths, Lumbini Province



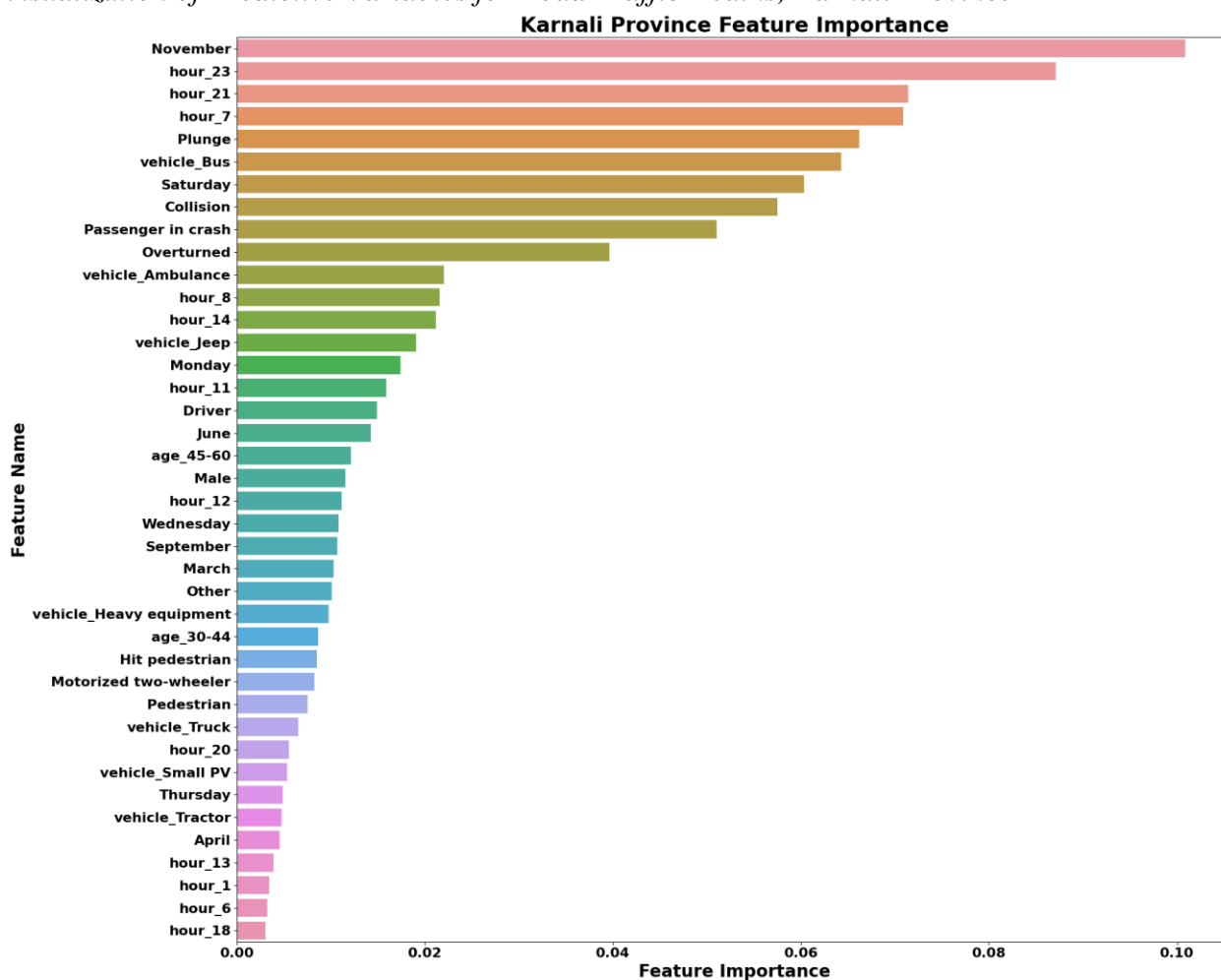
Source: Researcher extracted data from Nepal Police record 2018/19.

6.3.6 Karnali Province

The findings of the Karnali Province slightly differ from those of other provinces and also from the national level risk factors. Figure 6.2f shows that the festive month (*Dashain & Tihar*) of November appeared as first predictive attribute among the tested attributes in the analysis. The time of the crash also heavily influenced whether a crash was associated with more fatal incidents. The analysis found that in the morning (7:00 am), the

road crashes were rather dangerous, resulting in high mortality. Plunge crashes appeared in the fifth rank. In this province, passenger bus crashes appeared as an important predictor for fatal incidents. Overall, crash type, vehicle type, type of road users, and time of the crash occurrence were identified as key predictive factors for fatal crashes in Karnali Province.

Figure 6.2f.
Visualization of Predictive Variables for Road Traffic Deaths, Karnali Province

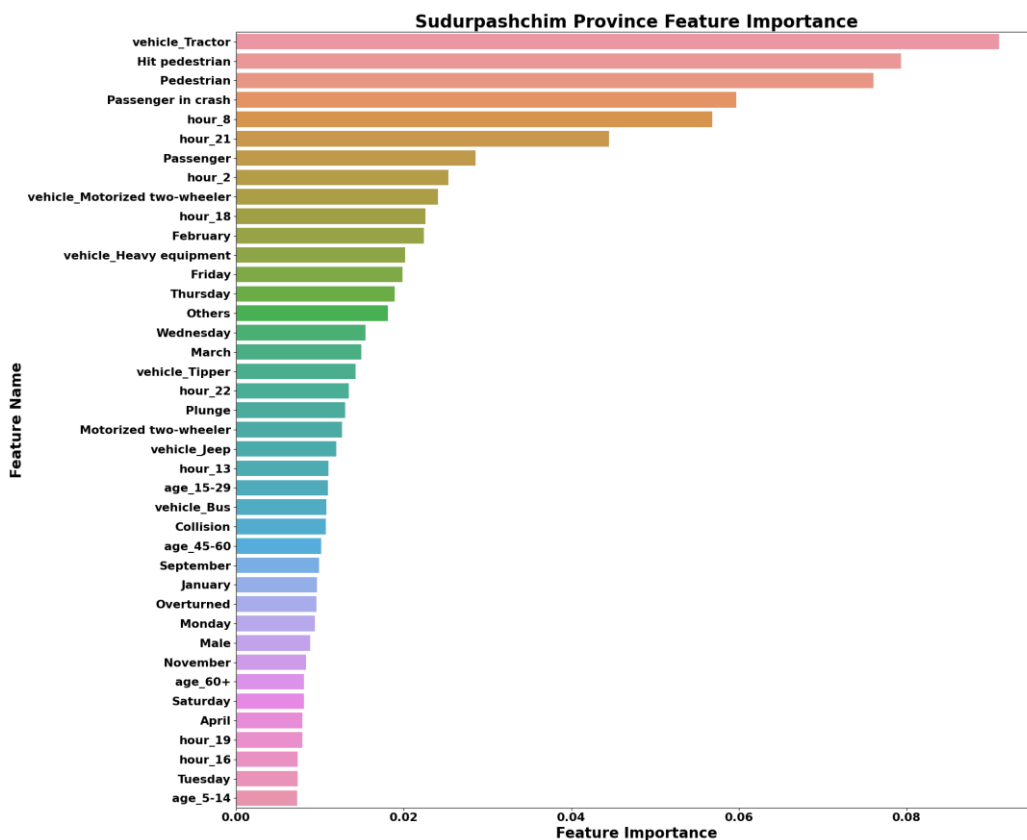


Source: Researcher extracted data from Nepal Police record 2018/19

6.3.7 Sudurpashchim Province

Figure 6.3g visualizes the road traffic deaths by predictive variables in Sudurpashchim Province. If the road users were passengers of public vehicles, there was a higher likelihood of death (Fig 11.5g). Similarly, the chance of death was higher in cases when a pedestrians for hit, followed by cases when a driver was accompanied by a passenger in crash. The remaining of the top 5 attributes was the time of the crashes. The feature importance value is comparatively higher for all the variables in this province, implying that there are multiple variables that make a significant impact in the number of road traffic deaths in this province.

Figure 6.2g. Visualization of Predictive Variables for Road Traffic Deaths, Sudurpashchim Province



Source: Researcher extracted data from Nepal Police record 2018/19.

6.4 Chapter Summary

A multitude of features were included while training the RF model. These include: the type of road users, vehicle type, month of crash, time of crash, day of crash, crash location by province, age of victims, time of the crash, and the type of road crash. The Random Forest analysis found that travelling by tractors was more likely to lead in road traffic deaths in the crash. In the previous descriptive analysis (Chapter Five), it was also identified that proportion of injuries to death was low in case of tractor crashes. While categorizing major attributes for road traffic deaths, it has been identified that when crashes occurred in Sudurpashchim Province, the chances of death was particularly high, followed by the cases when there was a passenger bus crash. Chapters 5 and 6 provided a descriptive analysis of road traffic crashes, including the prediction of deaths by making use of some background variables. However, due to limited information, these chapters did not provide the impacts of road crashes. Chapter 7 presents the findings from a qualitative study that explores the impacts of road traffic crashes in greater detail.

CHAPTER VII: SOCIO-ECONOMIC IMPACT OF ROAD TRAFFIC CRASHES

7.1. Introduction

In-depth interviews were conducted to explore the socio-economic impact of road traffic injuries and deaths on the victims and their families. The findings of the in-depth interviews are presented in this chapter.

7.2 Information of the Study Participants

In-depth interviews were held at the participant's usual place of residence. The demographic information of road crash victims who participated in the interview is presented in Table 7.1. Out of the eight injured participants, only one was a female. The majority of the participants were under 40 years old and had an education level below high school. The results were varied when it came to their employment status, with some survivors being employed before the incidents but lost their job after the being injured. Young survivors showed a high level of motivation to continue their education and engage in income-generating activities. It was particularly inspiring to see that some survivors were able to start a new career (either employed or self-employed) after recovering from the road crash injury. This was a result of the counselling and vocational training they received in the rehabilitation centre. Motorcycles were the most common vehicle involved in road traffic crashes, followed by buses (Table 7.1). The majority of participants had limb injuries, followed by spinal and head injuries.

Table 7.1

Demographic Information of the In-Depth Interviewed Participants, Type of Vehicle Involved in the Crash, Employment Status After the Crash, and Injury Type

Participants*	District permanent district	Age in years at crash time	Sex	Time of crash	Education level	Type of vehicles involved	Employment prior to crash	Employment after crash	Injury outcome
I-1	Kavre	37	Male	12:00	High School	Motorbike and car	Yes (employee)	No, lost job	Spine and different parts of body
I-2	Dhading	35	Male	10:30	5 Grade	Motorbike and microbus	Yes (employee)	Self employed	Hands and legs
I-3	Dhading	18	Male	18:30	11 Grade	Both motorbike	Student	Student	Leg
I-4	Chitwan	72	Male	12:30	No education	Bus and passenger	Agriculture	Cannot work	Both legs
I-5	Gorkha	21	Male	5:00	No education	Heavy truck and bus	Driver	Driver	Hand and leg
I-6	Dhading	53	Male	5:00	Bachelor Level	Motorcycle	Teacher	Got self-retirement	Head
I-7	Sindhupalch owk	27	Male	14:00	10 Grade	Bus (Plunge)	Daily labour	Employed	Spinal injury
I-8	Doti	25	Female	1:40	Bachelor Level	Bus	Student	Employed	Spinal injury
<hr/>									
Death									
D-1*	Kavre	38	Male	17:00	8 Grade	Cycle and jeep	Businesspers on		Dead
D-2*	Dhading	52	Male	2:00	No	Bus and worker on the roadside	DoR employee		Dead
D-3*	Dhading	27	Male	1:40	Bachelor Level	Bus	Teacher		Dead
D-4*	Doti	1.5	Child	1:40	No	Bus			Dead

Note: **I and D refers to injured and death person

* In case of death cases interviewed with decease person's family member

7.3 Terms, Issues and Contexts Used for Impact Analysis

This section describes the information obtained from the participants. The different headings and sub-headings presented here discuss the terms that were developed after reviewing the literature. The in-depth interviews were semi-structured and some important issues found in the in-depth interviews were further discussed. The Table 7.2 below summarizes these terms, issues and contexts.

Table 7.2

The Major Terms, Issues, and Contexts and Sub-categories Obtained from In-Depth Interviews with Participants

Major terms, issues and contexts	Sub-categories
Road crashes	Circumstances Types of crash, injury and deaths Rescue process
Health condition and treatment of the victim	Treatment support immediately after crash Follow-up and long-term treatment Current mental health status of the victim and family members Consequent changes in the lifestyle
Direct financial expenditure	Transportation and challenges for transportation Treatment cost Follow-up Rehabilitation Extra expenses on food Other expenses Insurance Borrowing / Sales of land and jewelleryes
Indirect financial expenditure	Reduction in income Income loss Time spent/ no. of persons involved for caring the victim Need for social support Social Impacts Peer-support Behaviour of the families, relatives and neighbour after road traffic crash
Economic impact	Overall financial impact of road crash to the victim and families
Functional changes	Self confidence Mobility and physical activities Roles and responsibilities Returning to the work Other functional limitations
Gatherings and celebration	Participation in gatherings and celebration Changes in social roles and responsibility Social support Family relation

Source: Based on the literature review

7.3.1 RTCs, Type of Injury and Rescue Process

The terms, issues, and contexts discussed in this section align with the quantitative findings described in the fifth and sixth chapters, which presented information on road traffic deaths and injuries categorized by the types of road users, crash type, and vehicle type. In line with the quantitative analysis, the researcher asked the following questions to

the survivors of road traffic crashes victims and the family members of those who died in the crash.

Interviewer: How did the road crash incident happen? How were you or the deceased person rescued and transported to the hospital?

Out of the 12 participants (including the injured and deceased person's family member) who took part in the in-depth interviews, the majority (over 50%) had been injured in motorcycle crashes. During the interviews, only a small number of road crash injury survivors (2 out of 8) acknowledged their own mistakes, while most victims and their family members stated that the crashes occurred due to carelessness, poor roads and other road users' mistakes. Some motorcycle users reported on the dominating nature of larger vehicles on the road, while the truck driver reported about the poor road safety behaviour of the motorcyclist. The study found that few victims were transported to the hospital in an ambulance and most of the victims were transported to the health facilities with any kind of vehicles available at the crash location.

Participant I-1 did not sustain any external injuries but lost consciousness following the incident. He was transported to the hospital by the same car that was involved in the crash, as the vehicle owner was well acquainted with the hospital. He further said, "Instead of taking me to the relevant hospital near the crash location, they took me by the same car that caused crash to the hospital where the car owner's relative used to work."

The second participant (I-2) had multiple (three) road crashes experiences and was injured on his limbs. According to him, the first and third crashes were caused by others, while the second crash was due to the poor vehicle conditions. Additionally, while recalling the first motorcycle crash, I-2 explained that it occurred when-

I was on a motorbike, a speeding microbus approached from behind and collided with my bike while attempting to overtake me. That caused me to fall onto the road, and as I looked up, I noticed the driver reversing the microbus with the apparent intention of running me over. Fortunately, I was able to roll away and avoid being hit by the vehicle, but unfortunately, I ended up falling into a nearby roadside drainage. (Participant I-2)

During I-2's second crash, the handbrake of the motorcycle allegedly malfunctioned while riding back home from a vegetable shop, causing the motorcycle to collide with a truck. This crash resulted in I-2 fracturing their right hand and sustaining minor injuries. In the third crash, he said "I was able to save my children but could not save myself from the motorcycle crash injury".

In all three crash incidents where I-2 was taken to hospital, an ambulance was not used: instead he was transported by any vehicle near the crash site.

During the interview participant, I-3's mother reported that

When my son had a motorcycle crash on the highway with leg injury, the local people sent him alone in the "C" grade ambulance (without a person to take care of him in the ambulance) to the local hospital. So, his injury status worsens while transporting from the crash location through bumpy road to the hospital. (Participant I-3's mother)

Similarly, the truck driver involved in the crash (I-5) had lower limbs injury and he was transported to the hospital by the tractor. He reported that he had extreme pain due to the jolting of the tractor during travel from crash location to the hospital. He mentioned that his fractured leg further worsened due to the use of the unsafe vehicle to transport from the crash location to the hospital. After a week, he knew that the lower part of the leg (below the knee) needed to be amputated. He said it was all because of the use of a tractor to transport a severe road crash victim to the hospital.

It is hard to get an ambulance at the crash location, having good quality ambulance is beyond our imagination, and most road crash victims are transported to the hospital inappropriately on any vehicle available at the crash location. (Participant I-5)

In the study site, it was found that many of the children rode their parents' motorcycles without having a driving license. In one of the crashes, four boys (siblings) from the same family were riding on two motorcycles and were competing. Unfortunately, while overtaking each other the motorcycles, they crashed on the busy highway. Only the riders were wearing helmets and pillion riders were without helmet. Among them, one pillion rider had a serious head injury, and the other three had limbs (hand and leg) injuries. Immediately, the victims were rescued and transported by the ambulance for emergency care to the community hospital; all four were then referred to a hospital in Kathmandu. Participant I-3 said, "We were not aware about road crash risks, just excited to ride on the bike in high speed. Our negligence on the road led to life threatening motorcycle crash on the highway. The crash was happened near to the community hospital and received immediate emergency treatment".

An old (72 years) road crash survivor (passenger of public bus) stated that the bus driver was young and was driving recklessly. As a result of the driver's actions and negligence, they had injuries in their leg. They said -

When I was helping my son to load the rice sack [on the bus], one leg was on the bus, and the other was on the ground; at that time the driver immediately moved the bus, and I was severely injured. With the help of passengers, I was taken to the community hospital by the same bus for emergency treatment, then referred for further treatment and on the next day my family took me to the big hospital in Kathmandu by an ambulance. (Participant I-4)

Participant I-6 mentioned that it was his mistake where he travelled on the motorbike driving by the person drank alcohol. He said:

It was a night-time motorcycle ride for door to door election campaign; the driver had consumed alcohol and motorcycle in high speed. The motorcycle was almost out of control of the driver. After riding 3 km, the motorcycle banged on a big roadside rock, as I was not wearing a helmet, I had a serious head injury. (Participant I-6)

He further mentioned,

I was unconscious after the crash and the rider escaped from the crash location, and I fell into the roadside drain. One Dalit young man of my community saw me and thought that I was dead. The Dalit did not rescue me due to the belief of untouchability to the dead body by a Dalit. Then that young man informed about my status to my family and neighbours. I was rescued by my family and neighbour after 10 hours of crash then reached to hospital in Kathmandu after four-hour drive. (Participant I-6)

He also said, "Priority should be given to the proper rescuing of the victim on time; due to some religious belief, my rescue was delayed; I was rescued many hours after the crash." (Participant I-6)

The I-7 participant was on a holiday trip by bus to the *Tatopani Khasa (China border)* with his friends. The bus driver was not familiar with the road; he was only used to driving a public bus on the ring road route in Kathmandu. The bus was also in high speed; so while turning, the driver could not control the skid, causing the bus to plunge from the road about 40 meters into the *Bhotekoshi River*. He did not have an external injury, but after investigation, the doctor identified a severe spinal injury. He said that-

We should not travel in vehicle driven by a driver unfamiliar to the road, and the responsible authority also should check the vehicle's condition and monitor the driving speed. Most of the crash victims with minor injuries were rescued first and I was rescued at last. (Participant I-7)

During festive season, public buses are usually overloaded; a participant (I-8) with a similar crash history as participant I-7 stated in her interview. Participant I-8 mentioned that she was travelling by bus from the bus park with about 35 passengers. On the way, the number of passengers increased, and finally, there were 130 passengers with heavy baggage. The bus was returning from the remote village of *Doti* district after the biggest festival (*Dashain*). According to her, the road was poor and steep, and the crash occurred due to an overloaded bus. In the crash, 29 people died on the spot, and 15 died on the way to hospital/at the hospital. Among the 44 death cases, two of them were her husband and her daughter (16 months). She had severe injury (internal) and was taken to India by ambulance for treatment. She said, “only one cause of the bus crash was overloading, which is common in remote areas where there are limited bus services. The government should strictly regulate it [overloading of buses]”.

As per the participant’s opinions, all the death cases included in this study occurred in the crash location and injured person were transported to the hospital by any type of vehicle available in the crash location.

7.3.2 Treatment and Health Condition of the Victim

The participants shared the challenges they faced during the rescue, treatment process and importance of rehabilitation facilities after treatment. In the majority of cases, the victims were initially taken to local health services, and those with serious injuries were referred to larger hospitals in Kathmandu. Many of the participants mentioned that they were taken to private hospitals in Kathmandu, which they found to be too expensive. The victims and their family members stated that they followed the suggestions of their friends,

relatives, doctors or ambulance drivers in taking the injured person to the hospital. Most of the participants reported that they did not received rehabilitation services.

7.3.2.1 Emergency treatment

Interviewer: Did you receive emergency care immediately after the crash? What was the treatment process?

The majority of the individuals who had injuries in road crashes reported not receiving immediate first-aid at the site of the crash. Among the 8 survivors who participated in the study, only 3 received emergency treatment at a nearby health services. Given the limited availability of medical facilities and equipment, the victims were subsequently referred to a bigger hospital in Kathmandu for further medical treatment.

According to the results of the in-depth interviews, road crash victims preferred to seek medical care at government hospitals initially. However, due to delayed services, some were forced to go private hospitals instead. Some participants also noted that they had to visit private clinics for MRI, CT scans and some other diagnostics processes because the medical equipment at the government hospitals were not available/working. This resulted to expensive treatment cost compared to government hospitals. Additionally, a few participants reported encountering numerous challenges at government hospitals.

After the road crash, I was taken to a government hospital. With some investigations the doctor informed me that my kidney was damaged and told that my treatment was not possible. Upon receiving this news, I felt completely hopeless about the prospects for my future. However, after a few days of receiving treatment and undergoing diagnosis, I remained dissatisfied with the process and sought out further medical assistance in India. After undergoing several investigations, the doctor in India reported that my health condition was not as severe as the initial diagnosis in Nepal had and the doctor in India

suggested for some surgeries. I subsequently underwent surgeries and took a two-month period of complete rest in India before returning to near-normal health. I am now eager to resume my work. (Participant I)

An elderly road crash victim said-

I found helpful physicians and supportive hospital personnel at the local community hospital close to my crash site. Unfortunately, my treatment could not be carried out there due to lack of medical equipment, which led to my referral to a big hospital in Kathmandu. In the big hospital, there were experienced doctors, advanced medical technology, medical equipment, and the big building; however, their heart was too small, and the facilities and services they provided depend on the size of the bundle of money. (Participant I-4)

Participant I-3's situation was almost similar to participant I-4, he stated, "Due to limited health personnel and facilities, I did not receive proper emergency care at local hospital, as a result my one leg was amputated".

It has been observed that road traffic victims were more likely to receive satisfactory health services and adequate treatment facilities from government hospitals if they had a strong network with the hospital staff, doctors or nurses, and/or political leaders. Conversely, those who lack such a network often face significant difficulties in obtaining timely and appropriate healthcare. A statement by the participant I-6 justified the health services in the government hospital-

Fortunately, the senior doctor, leading my treatment at that hospital happened to be a childhood friend of mine. He and his team of medical professionals worked tirelessly to provide me with the best possible care. Despite the seriousness of my health condition, their expertise and proper treatment ultimately saved my life. (Participant I-6)

Nepal still lacks a reliable emergency rescue system, making it difficult to provide timely assistance to victims. The government's system is also inadequate, exacerbating the problem. A significant number of road crash victims who suffer from spinal paralysis have reported inappropriate rescue methods from the crash site to the hospital. They emphasized that proper post-crash management is crucial for reducing injury severity and minimizing long-term health complications. Similarly, they highlighted the importance of availability of rehabilitation facilities after hospital treatment.

The participant I-7 experienced a bus crash near a densely populated community settlement at 4:00 pm. However, he was not rescued until approximately four hours after the crash occurred. He mentioned –

Humanity has almost disappeared, and people do not have hearts. People took me to the nearest government hospital, but the emergency department refused my treatment and referred me to a private hospital in Kathmandu. My wife begged for my treatment and explained our poor economic status. The hospital authority admitted me after 2 hours of hospital arrival and did spinal surgery four days after the admission which was too late. When I came to the rehabilitation centre, I knew that due to late surgery, my injury had worsened. (Participant I-7)

Further he added that -

Initially, only victims with minor injuries were taken to the hospital, and my rescue process began around four hours after the crash. Although I was conscious and listening responders' conversation after the crash, I was unable to speak or ask for help. They carried me from the riverbank to the roadside, holding my hands and legs. As the responders assumed I was dead, they rescued me at last and did so improperly. Given that the bus had fallen into the river, it was difficult to take me from the water and onto

the road. Unfortunately, due to the delayed and inadequate rescue, my internal injuries worsened. (Participant I-7)

He also said that-

As I was unable to call for assistance, people did not prioritize my immediate rescue and treatment. I was left on the road side more than two hours. After my family was notified of the crash, they arrived at the crash site and took me to the hospital in a microbus, it was six hours after the crash had occurred. (Participant I-7)

The challenges associated with rescuing victims following a road crash, the emergency treatment process, and the discriminatory practices faced by road crash victims during mass casualties were identified. Participant I-8 narrated her experience of sustaining an internal injury during a bus crash involving number of casualties. She stated,

Despite of injury severity, victims were rescued based on their connections with political leaders and other high-level authorities. Moreover, bus passengers with minor injuries were prioritized over those who were seriously injured. In my case, I was rescued at last and taken to a private hospital in India, likely due to the larger commission that the agent received from the hospital agencies. (Participant I-8)

7.3.2.2 Follow-up and Long-term Treatment

Interviewer: Please share about your follow-up and long-term treatment.

The findings revealed that many survivors of road crashes encountered difficulties in their follow-up treatment process. Survivors who sustained complex injuries to their upper or lower limbs, head, spine, or those who used wheelchairs expressed challenges in accessing follow-up check-ups and surgeries. From the in-depth interviews, it was found that in case of serious injury, the money received from insurance claims, household savings, and other monetary resources were usually spent during the initial treatment

process. It was, therefore, difficult to fund the follow-up treatment and rehabilitation. In addition, vehicle-related associations were usually unsupportive after the first hospital discharge. Some victims were also neglected by their families in terms of follow-up and further check-ups, which further aggravated their injuries, leading to the loss of limbs or other severe complications. One participant explained the challenges faced by road crash victims during long-term treatment.

After undergoing three surgeries, a metal plate was implanted to treat my fractured legs. Unfortunately, I had post-surgery infection and had to visit a community hospital for dressing every other day, which took over a year to fully recover. A local doctor suggested follow-up visits with the surgeon who performed my surgery in Kathmandu, but I was unable to visit doctor. Presently, I feel that my family members are ignoring my treatment needs, and I cannot attend follow-up treatment alone. I have not had a restful night's sleep since the crash. (Participant I-4)

He also said-

I feel like I am trapped in a never-ending nightmare, confined me to my bed for days and nights. The injury I sustained has left me unable to bend my legs and walk. To make matters worse, the driver was responsible for the crash has disappeared and my family was burdened with debt from my treatment. (Participant I-4)

The study revealed that the crashes typically involved trucks, buses, and minibuses; their respective committees (*Samitis*) were responsible for managing the financial process, including insurance claims. These *Samitis* typically set aside special funds for potential vehicle crashes and utilize them for immediate treatment, enabling them to quickly treatment process. However, the situation was different for cases involving

drunk driving, hit-and-runs, and crashes caused by unlicensed drivers or riders, who were not eligible for an insurance claim. One participant stated that:

While riding my motorcycle on the highway, I was involved in a crash and had a leg injury. Unfortunately, I did not have a valid driving license, so I was disqualified to apply for an insurance claim. My family had to use their savings to pay for my medical treatment. If my family did not have enough money, it would have been impossible for me to receive treatment. Therefore, I want to suggest for establishing national emergency fund for the road crash victims who cannot afford and claim insurance. (Participant I-3)

The interviewer's statement indicated that when the crash victims were children, their parents took care of the treatment expenses until recovery. However, the situation was more challenging for elderly victims who were often neglected in daily care and regular follow-up treatment. Participant I-4's Son stated, "The son of an elderly crash victim expressed that he had dedicated over two years to his father's treatment, which had also disrupted his studies. He now wishes to continue his education and does not have the time to take his father to the hospital for further treatment."

Some participants expressed that those with a regular income could manage continuous treatment from the beginning until their recovery. For instance, a government school teacher (I-6) was involved in a motorcycle crash caused by drink-driving and did not receive financial support from insurance or any other sources. He stated:

I underwent a total of five surgeries during my treatment process, with the first two surgeries at the beginning, another third surgery after six months, and fourth and fifth after a year. Throughout the treatment process, my family provided their full support to me. I am especially grateful to my wife for her tireless efforts to care for me, round the clock, day and night. (Participant I-6)

The situation can become quite complex when it comes to married women who are road crash victims. Maternal and husband's families tend to neglect them, especially if the parents of the female victim are elderly. Their condition is usually worse than what one can imagine. A female road crash victim who lost her husband in the same crash further revealed:

The public bus crash caused the tragic loss of my husband and daughter; I was left with spinal paralysis. Despite this, none of my husband's family and relatives visited me during my hospital stay, and they even used a portion of the insurance claim for my hospital expenses. Moreover, my maternal family also gradually began to neglect me. Feeling powerless and abandoned, I am immensely thankful to the Spinal Injury Rehabilitation Centre for providing me with the necessary support and care to recover. (Participant I-8)

7.3.3 Current Health Status of the Victim

Interviewer: What is your current health status?

During in-depth interviews, all survivors of road crashes reported that they were experiencing current bodily health issues. Specifically, those who suffered from serious injuries such as head trauma, spinal injury, and fractures in their hands or legs spoke about the numerous physical health-related complications they faced. These included continuous pain, increased blood pressure and blood sugar levels, speech difficulties, urinary infections, bedsores, and constipation. The respondents also mentioned feeling discomfort, dizziness, and fatigue due to persistent pain. Those with extended hospital stays reported more health problems than those with shorter stays. Participants who spent over six months in the hospital indicated they had chronic pain and frequently relied on painkillers. Almost all participants noted that their pain intensified during cloudy, rainy days and in the winter

season. One participant, I-6, specifically mentioned experiencing several physical health problems.

Before sustaining a head injury, I was known as one of the strong men in my community. However, my physical health has been significantly impacted since the injury. I now face difficulty in carrying out my daily activities, struggle to walk, experience speech impediments, and cannot turn my body while sleeping. Occasionally, I experience excruciating pain in my back, which could be due to a lack of physical activity. Moreover, I have noticed that my muscles are becoming progressively weaker. (Participant I-6)

I have been experiencing weakness in my hands, which has greatly impacted my ability to move them properly. As a result, I find it is challenging to perform basic tasks such as holding objects and washing my face. I am heavily reliant on others for assistance with these activities. (Participant I-6)

Participant I-2 shared that following five months of physiotherapy, he gradually began to see improvement in his ability to walk. Additionally, his fingers moved more freely, allowing him to hold utensils and open and close his hand. He can now eat slowly, wash his face, and take showers independently.

Participant I-3 had motorcycle crash at the age of 18 years, which resulted in a severe fracture in his right leg. He relied on crutches for a year and a half, and it took more than a year for the injury to heal. Participant I-3 said that, "I am facing two major issues - functional limitations and persistent pain. My grandmother has said to me that the pain may worsen as I age, so deeply concerned about my future health status".

The spinal injury generally damages the spinal cord and causes paralysis. Paralysis can involve loss of personal control, feeling, and limb sensation. Participants (I-7 and I-8) mentioned that they recovered after about one year of treatment, but their daily activity has

changed and the wheelchair became their part of body. They reported the challenges of accessibility in our society; instead of regular health facilities, they demanded wheelchair-accessible roads and services.

During interview participant I-4's wife also stated that "During my husband's hospital treatment, I was attacked by a buffalo, but I could not receive medical treatment for my injuries. As a result of the neglect, I now suffer from severe back pain".

7.3.4 Other Health Condition

In addition to the typical physical health problems, some participants also reported experiencing negative psychological symptoms, such as anger, irritability, stress, hopeless and helplessness. Furthermore, two participants even expressed having suicidal thoughts during and after their recovery. As such, during the interviews, they stated the importance of immediate and long-term psychological counselling for road traffic victims.

Interviewer: What type of thoughts came during treatment and after recovery?

Participants who had survived in road crashes and were interviewed reported experiencing mental health issues following their injuries. Those with severe injuries, such as fractures in both legs, the hand, and spine, shared their emotions during the interviews. The most seriously injured participants even stated that, after a few days or months of their crash, they did not want to live for many more years. They spent most of their time confined to their bed, experiencing continuous pain, shedding tears, and struggling with stress. Some participants mentioned that their tears eventually dried up after a few months or years of being injured. This study explored that most survivors did not receive any psychological support after their injuries. However, participants I-7 and I-8 did mention receiving counselling services at the rehabilitation centre, and they felt the benefits of the

psychological support they received. During the interviews, many of the victims demanded proper counselling services after road crash injuries. For instance, Participant I-1 had a severe road crash experience, and he expressed that:

I frequently experience disturbing dreams and struggle with sleep. My viewpoint on life has become extremely pessimistic, and I often have fluctuating moods and flashbacks of the traumatic road crash incident. When alone, I would cry day and night, and when my wife noticed my tears, she would ask me are you crying? I would respond by saying that I was trying to finish all my tears before she arrived, although it was not possible. This would lead to moments of silence between us. (Participant I-1)

During the survey, several participants reported experiencing depression. One participant's wife (I-5) mentioned that her husband would often scream in terror that a truck was approaching him and would cause his death.

After my husband's road crash experience, a fear of traveling by vehicle was developed. It became a challenge for us to take him to the hospital for regular dressing and follow-up check-ups. To transport him to the community hospital for his regular dressing, my brother-in-law and I had to take him by tractor. We held his hands tightly to ensure that he remained in the vehicle. (Participant I-5's wife)

Similarly, participant I-3 shared his experience of a motorcycle crash where he sustained a severe leg injury and was disabled for six months. At the time of the crash, he was studying in the 11th grade in the Science faculty. Due to his injury, he had to miss his classes and eventually dropped out of school that year. He expressed feeling hopeless about his education and his future during his time at home. He said, "I used to wonder why I should continue living my life since I couldn't return to my normal routine. Therefore,

prolonging my survival seemed unnecessary. However, I never shared my feelings to anyone”.

Similarly, spinal paralysis participant reported that-

Due to my spinal paralysis, I have lost the ability to move my lower body. When, I first found out about my injury, I felt hopeless and constantly searched for a rope or sharp object to end my life, but I was unsuccessful. I even tied a pipe used for transferring saline liquid around my neck and hands in an attempt to harm myself.

Participant I-7: At that time, the fear of uncertainty in my marital life was major as my wife was very young, and my children were only five and two years old. The mental torture caused by the insecurity in my relationship was far greater than the physical pain caused by my injury. (Participant I-7)

Participant I-8, who lost her husband and 16 months daughter in the same crash, stated that- “I was unconscious for four days, and when I became conscious started to ask about my husband’s and daughter’s health status. I knew about the death of my husband and daughter four months after the road crash. Then, I started to think about how to die rather than how to recover from the injury.

Participant I-7 transferred directly to rehabilitation centre from the hospital. He mentioned that he did not receive counselling facilities at the hospital and got counselling facility at rehabilitation. He stated that-

During my hospitalization, I had suicidal thoughts, but after receiving counselling and vocational training at the rehabilitation centre, my perspective on life changed. Despite my spinal paralysis, I have my hands, brain, family, and wheelchair to support me. I am determined to live a fulfilling life and serve as an example that individuals with spinal paralysis can still thrive. (Participant I-7)

In contrast to the previous accounts, participant I-2, who had experienced multiple road crashes, reported feeling depressed and had a prolonged recovery period that lasted over a year. Although he received counselling services at the hospital in Kathmandu, he felt that the counsellor did not understand his situation and the support he received was not helpful. During his interview, shared that he received care and assistance from his wife and mother, who understood his needs better. He emphasized that his family provided him with the support and services he required. In summary, he expressed that “Most importantly, injury survivors need proper family support and care. I got all the possible support and care from my mother and wife and could pass my worst days without extra mental stress”.

The majority of participants who reported mental health issues (I-1, I-7, and I-8) had severe injuries and came from impoverished backgrounds. Furthermore, they did not receive significant support from their families. Participant I-3, a young high school student, compared his health status to that of his friends and became anxious about his future. Although most participants initially experienced fear when traveling, this fear decreased after 1-2 years. None of the participants mentioned engaging in drug or alcohol use following their road crash injuries.

Some of the participant reported about their family member’s emerging health complications. Participant I-1 mentioned that “As a result of my crash injury, my wife experiences constant stress, loss of appetite, and noticeable changes in her facial expressions. There were many days where she remained without food and sleep”.

7.3.5 Financial Issues of The Road Traffic Victims

One of the significant areas of focus in this study is the examination of the financial implications and expenses associated with road crashes for both the victims and their

families. To investigate the economic consequences of road crashes, the researcher posed the following inquiry:

Interviewer: What are the economic impacts that you and your family experienced after the road crash?

Despite receiving financial support from insurance and the vehicle owner responsible for the road crash, the victims of these crashes and their families reported suffering from financial hardship. In-depth interviews explored that economic hardship following a road crash often led to family conflict, interrupted education, loss of employment, and a decline in the victims' and their families' quality of life. Many participants shared that they fell into poverty after a family member's road crash, and some had to sell their land and jewellery to pay for treatment. Participants also highlighted the need for more financial assistance for long-term treatment costs, as well as the development of a government fund for road crash victims who cannot afford extended medical care. Notably, participants who reported mental health issues often came from needy backgrounds and lacked adequate family support were in the need of such kind of help. Additionally, participant I-3, a high school student, compared his health status with that of his peers and became anxious about his future.

Table 7.3 portrays that the participants had multiple hospital admissions for their treatment. The duration of their hospital-stay during the first admission varied from 13 to 185 days, whereas for the second admission, it ranged from 37 to 102 days. Furthermore, participant I-1 and I-8 had to undergo treatment for a third time in India. Participant I-1 stated that he was neglected by the government hospital management, but with the financial and logistical support of his neighbours and a friend from India, he was able to receive better treatment and recover from his injury within a month.

Similarly, participant I-8 reported that she was taken to a private hospital in India by the ambulance driver due to commission issues. Her treatment was satisfactory for the first three months, during which the bus owner paid for her treatment. However, the bus owner stopped sending money, and her treatment and provision of food stopped. She was also not allowed to leave the hospital. Following meetings between the Government of Nepal and hospital management, she was discharged after being hospitalized for 185 days. Nonetheless, her treatment was not complete, and her family had to admit her to the provincial hospital in Nepal for further treatment.

Table 7.3

*Summary on the Number of Hospital Stay Days, Cost of Medical Treatment, and Expenditure for Food and Other Items Obtained from an In-Depth Interviews with Road Crash Survivors**

Participant	Body part injured	Hospitalisation (days)			Cost of treatment paid by (In NRS)		Cost for food and other Self (NRS)	Total cost (In NRS)
		1 st	2 nd	3 rd	Insurance and other companies	Self		
I-1	Spine and different parts of body	13	37	18 (India)	150,000	950,000	250,000	1350,000
I-2	Hands and legs	97	35	-	4,00,000	-	300,000	700,000
I-3	Leg	93	41		300,000	1400,000	200,000	1900,000
I-4	Both legs	95	15		2500,000	250,000	145,000	2895,000
I-5	Hand and leg	60	25		1700,000	800,000	350,000	2850,000
I-6	Head	67	90		Did not receive due to drink driving crash	1500,000	400,000	1900,000
I-7	Spinal Paralysis	14	102		3,38,000	150,000	40,000	5,28,000
I-8	Spinal Paralysis	185 (India)	17	37 (India)	3280,000	430,000	1,50,000	3860,000

** Table 7.3 presents a summarised qualitative study's results. The primary objective of the Table is to present information on the types of injuries sustained, duration of hospital stays, and expenses incurred by victims for medical costs and food. However, it should be*

noted that this table does not provide a comprehensive overview of the victims' total expenses.

a. Treatment Cost

During their hospitalization and follow-up treatments, many survivors of road crashes experienced financial difficulties. Although victims who were injured by buses, trucks, and minibuses received medical treatment costs covered by the respective committees (*Samiti*), those who were injured in other types of crashes faced challenges in managing the unexpected costs of medical treatment following the death or injury of a family member.

Interviewer: How did you manage the medical costs?

I am paying myself all treatment cost- Participant I-1

Interviewer: So, you did not receive any insurance claim?

In November 2021, at noon, I was on my way to the office on my motorbike when a private car coming from the opposite direction collided with me. The impact of the collision threw me approximately 4 meters away from the road. Although I was conscious for a few minutes, I lost consciousness shortly after. I received treatment at two different hospitals in Kathmandu, but unfortunately, it did not improve my health condition. Eventually, I decided to seek treatment in India. The car owner paid for the admission cost of the first hospital, which was one lakh fifty thousand. However, after my second hospital admission, I found out that my crash history had been completely changed in the record. The document stated that I was a pedestrian who was hit by an unknown motorbike, and the car took me to the hospital. This false information in the police document prevented me from being eligible for an insurance claim. (Participant I-1)

According to the findings, the participant I-1 had to spend over NRs.750,000 on medical treatment alone. Additionally, they had to bear travel costs of over NRs. 2 100,000

for multiple visit to India, and expenses for food and other necessities amounted to over NRs. 250,000. At first, the victim used their own savings and sold some gold jewellery to cover the expenses. However, their immediate family and relatives did not provide any financial support. It was only when their neighbour knew about the victim's financial hardship for treatment that they collected funds and offered them to the victim at a minimal interest rate. Some of the neighbours even provided financial assistance without any interest. The victim further mentioned that, "The false crash reporting not only prohibits me from an insurance claim for my treatment but also prevents me from obtaining my motorcycle maintenance insurance claim for which I paid insurance premium regularly".

Participant I-1

According to the participant I-2, the insurance company covered approximately 80 percent of his medical treatment costs, while the remaining 20 percent was paid from their family's savings. The direct medical cost amounted to over NRs 4,00,000, and his family took care of the food and other expenses. The victim also noted that, "During my second surgery and follow-up treatment my mother sold buffalo and her golden jewellery".

The third participant (I-3) revealed that his bike collided with the other bike and both of driver did not have driving license, but my father had good connection with government authorities and political leaders. Thus, I got around three lakhs insurance amount. The entire medical treatment cost, which amounted to NRs.1700,000. He said that- "My father has good earning from his business, otherwise my treatment would have been impossible despite having nominal assistance from insurance".

Participant I-4 explained the difficulties he faced in obtaining compensation from the bus company after his road crash. The company was located in other district from

where the crash occurred, and it was difficult in reaching them over the phone. He had to travel to the company's location for all financial procedures, which was time-consuming and inconvenient. Since, his wife was unable to leave the house due to their livestock, his son had to take care of him and also attend meetings with the bus committee, which was challenging. He stated that, "I have no words to explain the problems that I have faced in obtaining money from the bus committee".

Further he said that-

We had to go to the bus company's office in another district to request the money they had committed to providing us, but the staff there behaved rudely towards us. My father's treatment is still ongoing, but I doubt that they will fulfil their commitment to provide the agreed amount in the presence of authority. (Participant I-4's son)

Participant I-6 had head injury and he was pillion rider and the rider drank alcohol. He said that –

The rider was under the influence of alcohol, so we were not eligible to apply for an insurance claim. Therefore, my family had to bear all the expenses for my treatment. Even now, I have to undergo regular follow-up check-ups, and I am managing the expenses from my earnings. If I were not a government employee, my situation would be unimaginable. (Participant I-6)

Further he mentioned that-

I had purchased a small piece of land in Kathmandu from my lifelong earnings before my injury, but I had to sell it at a minimum price for my treatment. My monthly medication expenses exceed five thousand rupees, and if any other member of my family falls ill, there will be no means to afford their treatment. (Participant I-6)

Participant I-8 encountered a road crash in a remote district near the Indian border and was admitted to a private hospital in India for treatment. According to her, the hospital

provided good treatment and canteen facilities at first, but the behaviour of the hospital staff and canteen staff became rude when the bus companies delayed the payment. Due to payment issues between the bus owner company and hospital management, she had to stay an extra four months in the hospital. She mentioned that-

I come from a low-income family and unfortunately, I lost both my husband and 16-month-old daughter in the same crash. The crash was not my fault as I was just a passenger on the bus. Initially, there were only a few passengers on the bus but the driver tried to add more people on bus and eventually there were 130 passengers on the bus. I was victimized multiple times due to the crash; I lost my family, suffered serious injuries, and did not receive adequate treatment due to the dispute between the bus owner and the hospital administration. If they had taken me to a government hospital, I would have received better treatment. (Participant I-8)

Within these sad stories there were good practices for follow-up and long-term treatment of road crash victims. One of the participants (road crash victim's wife) said-

Initially, we received financial assistance for my husband's treatment from the truck owner. However, after my husbands' discharge from the hospital, the truck owner stopped providing support. Being from a very poor and marginalized Dalit community, it was challenging for us to seek financial help from other community groups. We reached out to various organizations and local governments for assistance, but we didn't receive any support. At that moment, we realized that our community should come together and support each other in times of need. We raised funds for my husband's follow-up treatment within our community, and this network still operates, providing support to community members facing serious financial issues related to treatment. (Participant I-5's wife)

b. Transportation Cost and Challenges

Interviewer: How you were transported to the health services and what are the challenges?

Many of the participants highlighted the challenges of transporting crash victims from the crash location to medical facilities. The victims or their family members reported that ambulance services were often unavailable, and only a lucky few were able to access them. As shown in Table 7.4, many participants were transported to medical facilities in private vehicles, such as vans or taxis, or in any available vehicle at the crash site. The few participants who were fortunate enough to be transported by ambulance (I-2, I-4, and I-5) received support from community hospital doctors and staff members. Although the cost of using an ambulance was relatively lower, road crash victims are often left with no choice but to use any available means of transportation. According to Table 7.4, the emergency transportation costs for victims ranged from NRs 5,000 to NRs 15,000. Participants were asked about transportation costs for follow-up treatment, but they were unable to provide such information.

Table 7.4

Type of Vehicle Used and Transportation Cost to Transport Injured Victim from Crash Location to the Health Services

Participants	Type of vehicle involved	Type of vehicle used to transport victim	Cost of transportation	Distance from health facility (In km)
I-1	Motorbike and car	By the same car which caused the crash	No cost	225
I-2	Motorbike and microbus	Ambulance	8,000	70
I-3	Both motorbike	Private van	10,000	75
I-4	Bus and passenger	Bus - community hospital Ambulance- Hospital at KTM	No cost 5,000	70
I-5	Heavy truck and bus	Ambulance	5,000	
I-6	Motorcycle	Taxi	8,000	102
I-7	Bus	Local van	No idea	67
I-8	Bus	Ambulance	15,000	Not stated
Death				

D-1	Cycle and jeep	Truck	5,000	210
D-2	Bus and roadside working person	Tractor	No cost	55
D-3	Bus plunged from the road	Don't know	No idea	Not stated
D-4	Bus plunged from the road	Don't know	No idea	Not stated

In the interviews, questions were asked regarding the transportation of the victims immediately after the crash and during the follow-up check-ups.

Interviewer: How you were transported to the health services immediately after the crash and during follow-up check-ups?

The majority of the participants noted that they had to rely on any available vehicles in the crash location for transportation to the health services due to the limited availability of ambulance services. They stated that “I was transported to the hospital by the same car that caused the crash. When they took me to the hospital, I was unconscious and brought to the nearest government hospital. During my follow-up check-ups, I used a taxi and went to India by flight”. Participant I-1

Participant I-2 also discussed on difficulties he faced regarding transportation to the hospital from the crash site, as well as the means of transportation used for his follow-up check-ups.

The crash happened near my residence, and a person who recognized me informed my family members about the incident without delay. My father and friends rushed me to the nearest hospital for an emergency check-up and later transferred me to the National Trauma Centre in Kathmandu by ambulance. For my subsequent medical appointments, I relied on taxis and public transportation. (Participant I-2)

Participant I-4 reported road crash that occurred approximately 30 minutes away from his home, which was located near a community hospital. He stated that

I had exposed to the road crash by the same bus from which my son was travelling to Kathmandu. I was initially taken to the community hospital in the same bus and later transferred to Kathmandu hospital via ambulance arranged by the community hospital.

(Participant I-4)

Further he stated that

After being discharged from the hospital, I had an infection in my fractured leg. The doctor at the community hospital advised me to dress the infected area every alternate day. I used an ambulance for the first few visits but I could not pay ambulance charge, later switched my follow-up transportation to a tractor and a motorbike to reach the hospital. I still had to pay the tractor owner more than 20 thousand rupees for follow-up transportation. (Participant I-4)

The son of D-2 reported that his father was involved in a serious crash on the highway and was severely injured. One of his father's friends brought him to the hospital on a tractor, and the doctor identified that the improper post-crash rescue process was one of the contributing factors to his father's death.

c. Provision of financial support for other indirect expenses

Interviewer: How do you manage the other (beside medical) expenses?

During the interviews, the victims and their family members were asked about their strategies for managing indirect costs such as caregivers' expenses, food, transportation, and communication. Some participants reported receiving treatment costs from the vehicle owner or committee, but in addition to that, all the victims had to cover their expenses themselves from personal savings or other sources. Participants I-4 and I-5, whose crashes involved a large bus and a truck respectively, mentioned that these companies had their own committee (*Samiti*), which provided NRs.600 rupees per day for care givers during

their hospital stay. Moreover, those who received treatment at government hospitals were given three meals per day (morning, afternoon, and evening) from the hospital canteen. Some of the participants mentioned that it was difficult to manage money for extra expenses.

During my hospitalization and recovery at home, my wife was my only caregiver. We utilized our savings initially, but later had to borrow from my neighbours. The hospital canteen provided me with meals, but there were many days when my wife remained without food. (Participant I-1)

Another participant mentioned that

I received all the treatment expenses from the microbus owner and their committee. To cover other expenses, we had to sell our buffalo and my mother's jewellery. Since we had nothing else to sell, my mother had to ask for financial support from her maternal family and we received some money from my grandparents. (Participant I-2)

According to the findings of this study, having strong community ties can make it easier to cope with challenging situations. For instance, participant I-6, a school teacher, expressed that:

As the sole breadwinner for my family, I had to use my personal savings to cover my medical and other expenses since I didn't receive financial compensation from the insurance company because of my drunk driving case. Fortunately, my students were very supportive and even volunteered to take care of me in the hospital. They also raised funds to support my treatment costs. Additionally, I had to sell my land to pay for my medical expenses. (Participant I-6).

d. Challenges for Insured amount Obtaining Process

Interviewer: How did you get your road crash insurance claim amount?

Most of the participants expressed their frustrations with the complicated insurance claim process and the behaviour of the insurance company staff when claiming for medical treatment and vehicle maintenance. They reported facing hurdles during the claim process and felt that the system in Nepal is not working properly, and it depends on the victim's level of exposure to authority. Some participants shared their experience of waiting for a long time to receive compensation from the vehicle owners/companies. They also mentioned that timely financial and other support from local leaders or active members of the society played a crucial role in their recovery. The following statements illustrate the challenges faced by road crash victims.

Interviewer: How did you get money from insurance?

“It was like eating iron bitten rice”. (Participant I-2)

“I was further victimized by the false registration of my crash history, and the insurance company failed to understand my actual condition”. (Participant I-1)

“My wife visited the insurance company to explain the actual details of the crash, but no one was willing to listen to her”. (Participant I-2)

The insurance premium is paid yearly to ensure safety after any incident, but the insurance staff seemed to be focused solely on earning money without considering the victim's condition. While paying the premium, they were friendly, but after the crash, they became hostile. (Participant I-2)

It is difficult to obtain an insurance claim, as insurance companies have included many regulations and clauses that hinder victims from receiving the full stated amount from the insurance company. (Participant I-2)

It was distressing to hear about the difficulties faced by road crash victim I-7 (who suffered from spinal paralysis) during the insurance claim process. According to him

While I was disabled, I made requests directly or over the phone for assistance with my insurance process, but my appeals went unanswered. Eventually, I regained enough strength to use a wheelchair and with my wife's assistance, who carried me on her back due to our road's lack of accessibility for wheelchairs, I made repeated visits to the insurance company's office, which was also not wheelchair-friendly. I made more than 12 visits, enduring many days without food, water, or access to a restroom. The insurance representatives often claimed that my file was missing. Despite the numerous obstacles, I refused to give up, and after eight months of continuous struggle, I finally received the NRs. 5,00,000 insurance pay out. (Participant I-7)

The interview Participant I-7 further added that an insurance agent visited him to assist in the insurance claim process and proposed to settle for NRs. 300,000. However, he was aware that the agent was attempting to obtain NRs. 200,000 from his insurance amount. As per his statement, he mentioned that "During times of adversity, we often find ourselves without support from family, friends, and relatives, as they tend to stand by us only in times of prosperity".

Participant I-8 mentioned that the difficulties encountered by female victims are comparatively more severe than those faced by male victims.

After the crash, my husband's family did not visit me, and my sisters-in-law were too exhausted to take care of me in the hospital for more than six months. I did not receive any help from my family, friends, or relatives during the insurance process. A broker offered to assist me with the insurance process, but he deceived me by saying that the insurance company gave less due to the late process.

As a result, I only received NRs. 1,00,000 instead of the NRs. 5,00,000 that I was entitled to.

(Participant I-8)

7.3.6. Financial Impact to the Victim and Family

Interviewer: How this road crash injury financially impacted you and your family?

Although there are provisions for insurance compensation for victims of road traffic crashes, the majority of survivors and families of victims still suffer from financial hardship. This is especially true for those in lower income groups, who are largely impacted by sudden road crashes and experience a significant reduction in household income. Many road crash survivors were unable to work due to their injuries; some were not allowed to continue working by their employers, while others had difficulty doing so because of their poor health. Most of the victims were family breadwinners, and after their injuries, they became dependent members of the family.

While I was recovering, I found myself at a loss for words and remained silent for most of the time. During this period, I simply observed the situation of each of my family members and their struggles. (Participant I-1)

Prior to the road crash, I earned a monthly salary of NRs. 30,000, while my wife's monthly income from sewing was around NRs. 25,000. However, presently I am without a job, and my wife's sewing business has significantly decreased.

Participant I-2: After the crash, I lost my job at the meat shop where I was earning a monthly salary of NRs. 8,000. (Participant I-1)

Prior to the crash, my family relied on agriculture as our main source of income. We owned two buffaloes and 17 goats, but after the crash, we no longer have any animals left in our household. (Participant I-4)

Son of D-1 said "We had to switch from a business activity (clothing store) to agricultural work for our family's livelihood".

My aspirations of becoming a government employee after completing my university education were cut short by the road crash injury. Despite being a good student, the injury shattered all my motivation, and I was unable to pursue my education further. These were once my cherished dreams, but now they remain unfulfilled. (Participant I-8)

As a result of my injury, I was unable to pay my sons' school fees, and they had no choice but to switch from a private school to a local government school. Participant I-5

The majority of road crash survivors faced challenges in obtaining employment or continuing their previous activities after sustaining injuries. A number of participants were unable to return to work and those who worked in the private sector were prohibited from continuing their job. According to the survivors, they felt discriminated against by their employers. Participant I-1, for instance, received only two months' salary and was subsequently terminated from his job. Despite repeatedly requesting the office manager after his recovery, he was not granted a stay. Similarly, participant I-3 was also not allowed to continue working after recovering from their injury. The participants noted that the primary cause of difficulties faced by people with disabilities is that employers are not willing to hire them. Furthermore, some of the employed participants mentioned that their working environment was not conducive to their needs, with buildings and toilets not being designed to accommodate individuals with disabilities.

The majority of seriously injured victims were unable to resume their previous employment, especially those who worked in the informal sector such as meat shops, security, daily labour, or part-time work. These individuals were not only prevented from returning to their former jobs but also faced difficulties securing new employment opportunities. The study participants were young individuals who were engaged in income-generating activities. Out of all the participants, only three were able to return to their

previous employment. Most survivors experienced physical challenges, which impacted their work performance. Despite some survivors expressing confidence in their ability to work as they did before, even with physical complications, employers did not trust them.

A participant highlighted the government's neglect for individuals with disabilities and emphasized the role of government to improve employment opportunities for road traffic victims with disabilities. The participant also called for the protection of the rights of individuals with disabilities as stipulated in national and international documents. In addition, the victims who participated in the interview expressed their belief that the government's reservation policies for individuals with disabilities are often exploited by individuals with connections to political leaders and high-level bureaucrats, while the true victims remain marginalized. In line with the saying that problems are not stop signs, but rather guidelines, almost all of the victims shared that they discovered new ways of living or working after recovering from their injuries.

According to Participant I-7, there is a lack of assistance available when individuals are facing difficulties, but both victims and their families should not lose hope. Instead, they must persevere and advocate for their rights. Initially, Participant I-7 felt hopeless, but after receiving counselling at the rehabilitation centre, he gained the motivation to work towards a better life within society. He shared a success story that

Before the road crash, I worked as a daily waged worker and carpenter. However, I received valuable counselling and vocational training at the rehabilitation centre, which enabled me to become a peer educator there. Additionally, I learned skills such as sewing, knitting hats, sweaters, gloves, socks, and repairing shoes. My wife also secured a job at the rehabilitation centre. Despite being affected by spinal paralysis, we are now leading a

happy life with our family. Furthermore, I find fulfilment in serving other individuals with spinal paralysis at the rehabilitation centre. (Participant I-7)

The experiences of government employees differ, as stated by the positive support received by participant I-6 from his office. Participant I-6 was able to resume his position as a math teacher in a school seven months after the road crash. Initially, the school management assigned him only two classes every other day, but after six months, he was given three classes. He eventually resumed taking full courses two years after returning to the school. I-6 was a popular teacher and had the support of his co-workers in the school.

Most of participants experienced a shift in their family roles, from being the primary breadwinner to becoming dependent on others for support. Despite facing a multitude of challenges, it was observed that many participants attempted to improve their circumstances over time. Participant I-7, who was affected by spinal paralysis, stated that: “Despite my physical health condition, I am determined to move forward. With a functioning hand to work, a sharp brain to think, the ability to speak with my mouth, and a wheelchair to move around, I am confident that I can lead a better life”.

7.3.7 Functional Limitation of Crash Victims and Families

Individuals who have sustained severe injuries from road traffic crashes are prone to experiencing functional impairments. According to a survey, those who suffered from limb loss, long-term head injury trauma, and spinal paralysis have reported facing challenges in performing their daily activities. Victims who lost their limbs during the crash expressed feeling like a burden to their families and compared their situation to that of being lifelong prisoners. The Participant I-2 mentioned that “Assistance is required for me to stand up. On

numerous occasions, I have had to sit for extended periods due to the absence of someone to help me stand”.

The participants stated that although seats are reserved for individuals with disabilities in public transportation, the vehicles often do not stop when disabled individuals request to travel.

I am from low-income family living in a remote village, my spinal paralysis has made it impossible for me to travel back to my hometown. When my parents fell seriously ill last year, I waited by the highway for two days, hoping to catch a bus to my village.

Unfortunately, none of the bus drivers offered me a chance to travel, and I was unable to see my mother before she passed away. The pain of missing the opportunity to be with my mother in her final moments is more agonizing than the pain from my injury. (Participant I-7)

I am using a four-wheeled scooter, but other vehicle users consider my scooter as like a normal scooter. They neglect the space needed for this type of scooter. Every moment I feel unsafe while riding on the road. (Participant I-8)

The participants noted that public transportation is not accommodating for individuals with disabilities. Additionally, they mentioned that taxi services are often not financially feasible for them, and drivers frequently refuse to transport passengers using wheelchairs. The participants also indicated that they do not have the financial means to afford taxi fares.

7.3.8 Community/ Social Support

Interviewer: Did you get any support from your community after road crash injury?

The research found that in cases where child victims were involved, they generally received round-the-clock care and assistance from their parents and relatives. Moreover,

people often provide loans to cover their medical expenses. However, if the head of the household becomes a victim of a road crash, receiving financial support is nearly impossible. A significant number of survivors who were interviewed revealed that they felt socially isolated. Some participants shared that the experience helped them recognize their genuinely caring family members, relatives, and friends. However, most participants reported that their loved ones did not visit or even phone them.

After the crash, neither my nor my wife's family provided us with any financial or moral support. Although I sought emotional support more than financial support, most of my friends and relatives were afraid to visit me, fearing that I would ask for money to cover my medical expenses. (Participant I-1)

Wheelchair users, in general, reported a weakening in their social life compared to victims with other types of injuries. Similarly, the son of D-1 expressed that if the family's primary breadwinner were to suddenly pass away, they would not receive any support during their time of need. After D-1's passing, despite being a businessperson, the family received little support from the community and instead faced numerous challenges from family members. Within a month of D-1's death, people began asking for the money he had borrowed, although he had not informed his family about his business dealings. Consequently, the family had to sell their land to repay the debts. They were then forced to transition into agricultural work and began raising others' buffalo, with half the milk consumed by the family and the other half given to the buffalo owner. Due to the scarcity of food, it became difficult to rear the buffalo, and the owner eventually took them back. The son also shared that due to their poor family status, one of their neighbours accused them of stealing a radio and searched their entire house but found nothing. He believes that

his neighbour mistreated them due to the death of his father (the household head/breadwinner).

I-4 expressed a dislike towards the term "community/social support", as he believes that such support is only available during happy moments or when one achieves success.

I have a painful experience to share. My neighbour was a prominent political leader and a minister at that time. I requested him for financial assistance for my second surgery, but although he responded positively in words, he did not follow through with any concrete action. Now, I am left feeling hopeless about being able to afford my next surgery.

(Participant I-4)

Participant I-6 reported receiving both financial and emotional support from his students and colleagues at school. They helped raise funds for his treatment and provided daily care and emotional support during his difficult time. I-6 expressed his gratitude towards these individuals for their help and support. "After the crash, I was left without support as my aging parents were unable to assist me during my hospital stay. Prior to the crash, I used to support my two sisters financially, however, they did not visit me in the hospital or during my rehabilitation".

The study revealed that male victims generally receive support from their family and their wife's maternal relatives. However, it is difficult for female victims to receive assistance from their husband's family. Moreover, if the parents of the female victim are elderly and financially unstable, they also do not receive support from their maternal side.

In the crash, I lost my husband, 16 months daughter, and I had a serious spinal injury. The crash location was near the Indian border, and I was taken to India for treatment. My husband's family members and relatives did not come to visit me. My own sisters and brother-in-law take care of me in the hospital. I did not get support from my relatives and

community people from both the maternal and husband's side. When I returned from the hospital, I found that most people wanted to remain out of contact/away from me. I had spinal paralysis, and people, I felt they, were trying to escape from me instead of counselling me or giving me strength to live my life. (Participant I-8)

Further she added that

Following my discharge from the hospital, I went to stay at my maternal home for some months. While my parents were concerned for my health, my younger brother was hesitant to take on the responsibility of caring for me. Eventually, my brother moved out and began living separately. I spent every moment during those days with a heavy heart and the experience was truly terrible. (Participant I-8)

There are some positive changes in the community after road crash injury. The participant I-1 stated that, "there were some individuals who were previously unfamiliar with me and only knew of my health condition, yet they provided both financial and emotional support. Additionally, one of my neighbours offered me an interest-free loan". Further the participant I-2 mentioned that he got his re-birth and realized the value of life. Similarly, participant I-5 shared that during their illness, they observed those around them to be constantly upset, but after recovering they were pleasantly surprised to see how loving and caring people could be.

7.3.9 Social Impact

The participants of the study stated their recent social problems to the financial losses incurred as a result of a road crash. They explained that spending their savings on medical treatment, the loss of the family's breadwinner's employment, and other related issues led to various social problems for both the victim and their entire family.

Furthermore, some participants noted that the sudden financial difficulties prevented them from participating in social gatherings and celebrations.

Interviewer: How often you/your family participate in the gatherings and celebrate the events?

Celebrations and gatherings are often associated with joyful and prosperous moments, but for my family and me, they have been limited in our two rooms since my injury. As a result, we did not participate in any events or celebrations following my injury. (Participant I-1)

Further he said that-

We are frequently invited to weddings, *bratabandhas*, birthdays, and other events that require us to give gifts. However, due to our current financial situation where we struggle to afford even basic necessities like food and medicine, we cannot afford to participate in these events. (Participant I-1)

In the interview participants parents provided some information “Due to the family’s emotional turmoil, we did not celebrate our major festivals, *Dashain* and *Tihar*, following the incident. Despite having good financial status, we chose not to celebrate the festivities”.

Participant I-3

D-1’s son mentioned that their family had become disconnected from community gatherings, celebrations, and festivals. He explained that they had stopped participating in such events. “The sudden and unexpected death of our father brought about numerous challenges, and as a result, my mother and grandparents have not experienced joy or happiness in many years”. Son of D-1

Similarly, a participant mentioned that

The physical and mental pain from the road crash has made it difficult for me to sleep and enjoy social gatherings. I used to be a skilled dancer and would participate in every gathering, festival, and celebration. However, after my spinal injury, I am no longer able to attend such events as I am unable to control my movements. (Participant I-8)

One participant's opinion was different than others he stated that

Prior to the crash, I would often spend more time with friends and less time with family, rarely participating in social gatherings and celebrations. However, since my crash and second chance at life, I have realized the importance of being social and involved in the community. Despite my injury, I have started to celebrate not only my own birthday but also the birthdays of my family members. (Participant I-2)

7.4 Findings of Group Discussion

As mentioned in the methodology section, after conducting in-depth interviews, it was determined that a group discussion with survivors of road crashes would be conducted. Similar information obtained in the in-depth interviews are not repeated in this section. The participants in this discussion represent a wide range of age groups, spanning from adolescents to individuals over 60 years old. Each participant has their own history of being involved in a road crash, with a majority of them having been motorcycle users driving under the influence of alcohol, speeding, or using poorly maintained vehicles. Additionally, some of the participants had been involved in road crashes while abroad in Qatar and Malaysia and were subsequently treated before being taken back to Nepal.

The study revealed that victims who had been involved in road crashes while abroad expressed satisfaction with the post-crash response and treatment that they received at the hospitals in their respective countries. However, participants who had experienced road crashes in Nepal reported instances of extreme negligence during post-crash response,

as well as poor and costly health services following their injuries. One participant who had sustained a spinal injury was taken on a two-hour motorbike ride from the crash location to the hospital, which is a true example of a victim being further victimized due to improper rescue processes that ultimately caused full-body paralysis.

During the discussion, participants were observed to be more expressive, with some initially displaying signs of stress and being less forthcoming. However, as the discussion progressed, these participants began to open up and share their problems. Conversely, some participants were found to be more positive about their experiences, with some even stating that it was similar to being reborn. In the in-depth interviews, those who were initially stressed maintained that behaviour throughout the session. However, during the group discussion, it was noted that some participants were motivated by the thoughts and experiences shared by other similarly-injured participants. Most importantly all the participants demanded for the road safety awareness in that community and in case of injuries suggested for appropriate rescue and the treatment from the government.

7.5 Chapter Summary

This qualitative study investigated the road traffic crashes and their effects through in-depth interviews with injured victims and their family members. Approximately half of the interviewed victims were motorcycle users, with most sustaining serious injuries. Tractors were commonly used for transporting crash victims despite their risks, and ambulance services were limited, reflecting broader challenges in pre-hospital care seen in other. Many victims expressed dissatisfaction with the rescue process and inadequate treatment in government hospitals, often needing private healthcare despite its high costs.

Young victims displayed risky driving behaviours and reported a lack of awareness about road safety prior to crashes. Psychological impacts were significant, including stress, depression, and suicidal thoughts, with many victims not receiving adequate counselling. This aligns with the fact that rehabilitation services were inadequate, with only one spinal injury centre in Nepal, leaving most survivors without access to needed care. Victims emphasized the importance of community-wide awareness campaigns and societal support.

Financially, road crashes severely disrupted victims' lives. Breadwinners became dependents, and families faced challenges such as selling property to cover treatment costs. Insurance claims were difficult to access, often involving corruption or incomplete payouts. Survivors from low-income backgrounds were disproportionately affected, and many were unable to return to their previous jobs. Vocational training and rehabilitation were found effective in helping survivors regain livelihoods and reduces trauma.

Functional limitations hindered survivors' mobility and social interactions, exacerbated by poor infrastructure and inaccessible public transport. Victims often faced neglect from their communities and families, particularly elderly or female survivors. Social isolation and societal blame added to their hardships, although some communities showed solidarity in supporting affected families. Educational disruptions, economic hardships, and dependency on caregivers were common impacts on families of crash victims. Lastly, societal attitudes and infrastructure challenges contributed to long-term difficulties for survivors. Improved accessibility, comprehensive rehabilitation services, job opportunity and mental health support were recommended to enhance survivors' quality of life and reintegrate them into society.

CHAPTER VIII: DISCUSSION

8.1 Introduction

This study consists of three different analysis: the first part being a systematic review of the literature from SAARC countries. In the review, the articles published during the ten-year period from 2010-2020 on road traffic deaths, injuries and impact of the crash were reviewed. The quantitative analysis was the second part of the study, where road traffic deaths and injuries based on Nepal police narrative records were assessed for the fiscal year 2075 (2018/19). In this part, road traffic deaths and injuries have been analysed by age and sex of the victims, time of the crash, type of the crash, type of road users, and type of vehicle involved in the crash in the national, provincial, and the separate analysis for Kathmandu valley. Further, the attributes for the road traffic crash mortality were predicted for national and provincial level. The third part comprises analysis of qualitative information obtained from the in-depth interviews with road traffic victims and their families.

The quantitative and qualitative analysis results have been discussed separately in Chapters 5, 6 and 7). Their respective findings are discussed concurrently and generalized in this discussion chapter by comparing them with the other studies' findings.

8.2 Systematic Literature Review

An analysis of global burden disease findings of 369 diseases and injuries of 204 countries for 1990-2019 found that the first cause of disability-adjusted life-years (DALYs) for people aged 10-49 years was road traffic injury (Abbafati et al., 2020). South Asian countries comprised the largest share (1.9 billion, 23.7%) of the world's population (World Bank, 2021a), while being the fastest economic growing region in the world (Asian

Development Bank, 2006). As World Bank stated that road safety is a developmental challenge, South Asian countries are in the greatest risk of road traffic crashes, injuries and deaths (World Bank, 2020). Regarding the road safety challenges in South Asian countries, a systematic review on the road traffic crashes, injuries, deaths and its impact was conducted.

The systematic review found that there is limited reliable information on road traffic deaths, injuries, and especially the impact on the victims and associated families is a less researched issue in SAARC countries. Available information from the literature review showed that RTCs are increasing sharply in India, Bangladesh, Pakistan, Sri Lanka and Nepal, and these countries have high rates of road traffic deaths and injuries. It also showed that RTCs in SAARC countries significantly impact the region, both in terms of human losses and economic cost. Among SAARC countries, India has the highest road traffic death rate, while Bangladesh has the highest injury rate. Globally, road traffic mortality rate is the highest among young adults aged 15-29 years, followed by older adults aged 50 and above (WHO, 2018). In South Asian countries, the pattern is almost similar but with some variations. In this region, children and young adults are at a higher threat of road traffic deaths compared to other age groups, particularly in India, Bangladesh and Nepal. Additionally, the findings of review showed that the proportion of older adults who die from road traffic crashes is also higher in SAARC region compared to other regions of the world, except some African countries (WHO, 2018). A higher older adult mortality may be influenced by factors such as the type of road users (pedestrians, cyclists, motorcyclists, etc.), the type of roads, road safety behaviour of other road users, and the availability of effective road safety measures.

The review found that road traffic crashes in SAARC region impose a significant financial burden on individuals, families, and society. These findings also match with World Bank's findings, in which the cost of road traffic crashes in the region was estimated to be around 1-3 percent of the Gross Domestic Product (GDP) (World Bank, 2020). Most studies included in the review calculated the direct and indirect cost of the road traffic crashes; but costs like pain and suffering, loss of quality of life, and emotional trauma for crash survivors and their families was less explored.

It was found that the out-of-pocket expenditure for households affected by road traffic crashes was significantly higher than for non-impacted households. Due to RTIs, many people had to sell household assets, and their regular household earnings was also reduced (Kumar et al., 2012). For households affected by road traffic crashes, the costs can include medical expenses, rehabilitation costs, vehicle repair or replacement costs, and loss of income due to injury or death (World Bank, 2021b).

Regarding socio-economic impact, road traffic crashes have a greater impact on female due to various factors, including the fact that the majority of the deaths were males, their role as primary care providers for their families, and their lower earning potential compared to men (Yan & Job, 2021). This can result in long-term financial hardships for affected families and the overall development of entire family members. This review also found that females were largely impacted and that females from rural households suffered particularly from serious financial hardships. In case of Nepal, a majority of the studies were based on police records, which basically presented the number of deaths and injuries, while leaving the impact of the crash to the victims and their families relatively unexplored.

8.3 Discussion on the Quantitative Analysis Findings

As presented in the literature review, road traffic crash-related deaths and injuries are a serious public health challenge in Nepal. The quantitative study's descriptive results revealed that road traffic crashes pose significant challenges, resulting in numerous fatalities and injuries.

8.3.1 Road Traffic Crashes, Injuries and Deaths

As discussed in the literature review, the lack of proper data recording system is the problem of most of the low-and-middle-income countries, and Nepal is not an exception. The findings from the quantitative study showed that 14,197 road crashes occurred in 2018/19 and caused 23,319 injuries and 2,192 deaths. The number of deaths cases presented in this study is less than the number of road traffic deaths published in the article entitled "Epidemiology of Road Traffic Crashes in Nepal: A 10 Year Study" (Atreya et al., 2021). The evidence presented in this research article was based on the summary reporting of the road traffic evidences by Nepal Police. This study extracted the road crash case details from the raw data. The cases reported without victims were not included in the analysis, which is one of the reasons why there are fewer deaths in this study in comparison to Atreya et al.'s study. Based on the review of road crash studies of Nepal, this is the first kind of research providing the details of each victim who died or were injured in the study period from all over the country.

The number of road traffic deaths and injuries per crash varies greatly depending on several factors such as the crash location, type of road, type of vehicle involved, number of vehicles involved in the crash and the speed of the vehicles involved. As already

highlighted in the literature, Nepal has one of the highest rates of road traffic deaths and injuries in South Asia, and road traffic crashes are a leading cause of death and disability among Nepalese citizens (World Bank, 2020a). This study found that up to 53 people were injured (including death) in a single crash, and about 61 percent of the road crashes had one injury per crash. 20 percent of the crashes resulted in 2 injuries, and 7.5 percent of the crashes caused 6 or more injuries (including death) per crash.

8.3.2 Age and Sex

Road traffic crashes have a significant impact on the health and well-being of people of all ages (Racioppi et al., 2004). Children and young people (aged 5-29 years) account for the largest number of road traffic deaths globally and are at the greatest risk of road traffic injuries (WHO, 2018). A hospital-based study of Nepal calculated the mean age of the road crash victim as 26.9 years (Bhatta et al., 2016). However, this study found the mean age of the victim to be relatively higher (30.89 years), with the mean age of female slightly higher than that of males. In terms of the absolute number of people, the results show that the 20-24 years age group population represents the largest number of people involved in road crashes. Approximately half of the deaths and injuries occurred among individuals aged 15 to 29, with an average of 12.5 injuries per death.

Examining the incidence of road traffic injuries among both male and female victims is beneficial for government and other agencies working for road traffic crash prevention by sex. In particular, the disaggregated data can aid in the development of specific measures aimed at reducing fatalities and injuries resulting from road traffic crashes.

Road traffic crashes are a leading cause of injury and death in both young males and females (Abbafati et al., 2020), and generally, men are more likely to be involved in road traffic crashes and to sustain serious injuries or die (Regev et al., 2018; Cullen et al., 2021; Nutbeam et al., 2022). Globally, the crude death rate due to road traffic injuries in males is 28 per 100,000 population, which is 2.8 times higher than for females (10 per 100,000). In many countries, men are overrepresented in road traffic deaths and injuries, accounting for approximately 80 percent of road traffic deaths globally (WHO, 2018). This study also showed that majority of the road crash victims were male (73.4%), and among the total death cases, males accounted for (79.9%) of deaths.

8.3.3 Road Traffic Deaths and Injuries by Time of the Crash

Analysing road traffic deaths and injuries by the time of the crash occurrence is important for identifying high risk periods, evaluating effectiveness of road safety measures, and planning for road safety interventions (Borucka et al., 2021). According to the crash incidents analysis, approximately 64 percent (16,349) of the road crash incidents took place within the time frame of 06:00-17:59 (daytime). Results also displayed that there was a higher incidence of road traffic deaths and injuries during the mid-day to evening period (14:00 to 19:59), which coincides with the time when people typically return from work or office. Plainis, Murray, & Pallikaris, (2006) found that deaths cases were higher at nighttime, this study also found similar results that death ratio was relatively higher during the night hours (20:00-00:59), as compared to the other time of the day. Additionally, the findings indicated that the early morning period (06:00-06:59) and office/school time (09:00-09:59) was one of the more unsafe times of the day, with a ratio of one death for every 6.9 injuries and 9 injuries per death respectively. The study on the

crash severity at night-time conducted in Egypt revealed that speeding was a significant contributor to road crashes (Zhang & Hassan, 2019). Similarly, an analysis of crash incidents in India demonstrated that inadequate lighting was the primary cause of the elevated risk of severe injuries and fatalities (Vipin & Rahul, 2021; Mandal et al., 2022). In Nepal, the reasons for high mortality risk at nighttime could be speeding, drivers in rush, lack of sufficient light, and driver fatigue. However, this study could not analyse these variables due to limited information on the crash details. The findings regarding the occurrence of road traffic fatalities and injuries throughout the day suggest that the hour of the day can have a certain influence on the severity of the road crashes. This finding demanded to explore the reasons behind the time specific elevated road traffic deaths.

An analysis of road traffic crashes involving vulnerable road users such as pedestrians, motorized two-wheelers, and cyclists by time of crash revealed that the incidence of crashes was higher during morning and evening commute hours, which is consistent with the findings of similar kind of road safety research (Orlan & Goktolga, 2018; Vipin & Rahul, 2021)

8.3.4 Road Traffic Casualties by Crash Day of a Week and Month

Analysing the road traffic crashes by day of the week can provide some insights for improving road safety and reducing the number of road crashes, which is why this topic was explored in this study. A study of Eskisehir city of Turkey found that in Tuesdays and Saturdays, the number of road crashes were comparatively lower than other weekdays, and that Sundays had the larger number of road crashes (Karacasu et al., 2011). Turkey observes Sunday as a weekly holiday, while in Nepal, Saturday is weekly a holiday, which back the finding that road traffic crashes tend to be more frequent during weekend

compared to other days of the week. There were no significant differences observed in the frequency of road crash incidents for various types of road users, including motorized two-wheelers, passengers, pedestrians, cyclists, and drivers across all days of the week.

A study of Uttar Pradesh found that January had the highest number of crashes with a percentage of 12.5 percent, while the month of October records the lowest with a percentage of 6.0 percent (Kumar et al., 2020). According to the results of this study, there is a higher proportion of road crash fatalities and injuries in the months of October, November, and December. October and November are festive months (*Dashain, Tihar* and *Chhait*) in Nepal. During this time, a large number of people travel to visit their family and friends, attend events, and participate in religious celebrations. The increased traffic and higher number of people on the roads increases the risk of crashes during this period. Similarly, during festive season, people may be drinking excessively and driving, speeding, and generally driving recklessly, which can be the reason leading to more crashes on the roads.

8.3.5 Road Traffic Crash Injury Status of Victim

Research conducted on the effects of road injuries revealed that injuries are strongly linked to subsequent impairment, reduced work capacity, increased reliance on support, heightened functional dependency, and a greater need for support from family and community (Batailler et al., 2014). This study also found that 3 percent of the road crash victims died immediately, while 14 percent were unconscious, 6 percent died elsewhere, and overwhelming majority were injured. The study's results indicated that the documentation of severe injuries was inadequate and that the extent of injury severity may exceed what is typically comprehended. There are some efforts that were initiated to

strengthen the emergency response and pre-hospital care system, but they are not sufficient, albeit in its early stages (Shrestha & Pathranarakul, 2018). Thus, transporting victims from crash locations and early treatment of the road crash victims remains challenging, which can result in a higher likelihood of increased severity of injuries sustained by the victims. The evidence presented in this study suggests that 14 percent of the individuals who were unconscious after a road crash were more likely to experience extended illness and a greater number of disabilities, indicating that a larger proportion of road crash victims may be at risk of similar outcomes.

The analysis of the severity of road crash injuries based on the type of vehicle involved yielded noteworthy results. The study identified that heavy equipment and tractor crashes had the highest incidence of on-site fatalities. Additionally, the analysis revealed tractor crashes were relatively more severe than other types of vehicle crashes. These findings are consistent with a similar study conducted in Turkey, which examined deaths and injuries resulting from high-speed motorcycle and tractor crashes (Eraybar et al., 2019). Although motorcycle users are typically viewed as vulnerable users (WHO, 2018), this study showed a lower incidence of fatalities in motorcycle crashes. However, further investigation is required to identify the root causes of road traffic injuries. The study indicates that public buses and private vans are relatively safer modes of transportation compared to other vehicles.

8.3.6 Road Traffic Deaths and Injuries Type of Road Crashes

Eleven different types of road crashes were identified in this study, with collisions between vehicles accounting for more than one-third of all road crashes. According to a report by the WHO in 2015 and 2020, pedestrian deaths comprised about 22 percent of

global road traffic deaths, and in South Asia, it is the second leading cause of death among road users. This study's findings were consistent with those of the WHO, with pedestrian deaths accounting for approximately 21 percent of all road traffic deaths in Nepal. In hilly regions, plunge crashes are the most dangerous in term of severe injuries and deaths. This study also found numerous plunge crashes in Nepal, where vehicles fall off about 300-400 meters from the road; these were the most dangerous type of road crashes, accounting for 14 percent of all crash incidents. These crashes resulted in a notably high number of deaths, representing 20 percent of all road traffic deaths in Nepal. As a result, the installation of crash barriers on the roadside is necessary. A study on the performance evaluation of crash barriers on highways also highlighted that the absence of crash barriers on highways is a major contributor to a large number of deaths and serious injuries in Nepal (Bati & Shahi, 2020).

8.3.7 Road Traffic Casualties by Type of Vehicles that Instigate Crash

Heinrich Domino's theory states that crashes are a result of man and machine relationship, unsafe act, and lacking management (Heinrich, 1931); this study also found that a machine (vehicle type) has an important role in causing road traffic crashes, injuries and deaths. Among different types of vehicles, two-wheelers crashes were higher. According to the WHO, in 2018, approximately one-third of all road traffic deaths occurred in crashes involving powered two-and-three-wheelers. However, this analysis found that the incidence of road traffic incidents was significantly higher for motorized two-wheeler crashes, accounting for 41.8 percent of all crash incidents. This highlights the need for safety interventions prioritizing motorized two-wheelers in Nepal. A study that examined the status of road crashes and measures to reduce incidents in low-and-middle income

countries also identified two-wheeler crash as a serious road safety challenge in low-income countries. The study suggested that increasing the use of helmets could reduce fatalities in such crashes (Neki et al., 2023). The results regarding the types of vehicle crash deaths and injuries revealed that heavy equipment was responsible for more deaths than injuries. Additionally, tractor crashes were identified as another significant cause of fatalities on the road.

8.3.8 Road Traffic Deaths and Injuries by Type of Road Users

Describing the types of road crashes is vital; some crashes are riskier than others and are consequently associated with a greater proportion of severe injuries and deaths. Pedestrians, cyclists, and motorized two-wheelers are considered vulnerable road users (WHO, 2018), and the World Bank's findings showed that these road users represent 72 percent of all road crashes deaths in Nepal (World Bank, 2020b). This study also analysed road traffic deaths and injuries by the type of road users. The pedestrians, cyclists and the motorized two-wheelers represent 60 percent of all road crashes deaths. The study's findings revealed that motorized two-wheelers (37%), passengers (33.9%), and pedestrians (18.1%) accounted for the majority of road traffic crash incidents. These results have important implications for enhancing road safety in Nepal, particularly for the safety of these specific types of road users.

The WHO's 2018 Global Status Report on Road Safety indicates that motorcycle crash fatalities and injuries are the most prevalent in low-and-middle-income countries. Specifically, South Asia accounts for around 316,000 fatalities each year (WHO, 2018). This study also found that motorized two-wheeler users represent 38 percent of all road traffic crash incidents. This huge number of motorized two-wheeler crashes, deaths and

injuries is alarming because these crashes kill many people, particularly the youth, while also increasing the number of disabilities in the country. Given the high incidence of casualties among motorized two-wheeler users, an urgent road safety intervention is necessary with a particular focus on reducing motorcycle crashes.

Ensuring the safety of pedestrians is a serious aspect of addressing the challenges related to road safety. This study identified that about 18 percent of the road crash victims were pedestrians, which was adjacent to the global pedestrian deaths (22%) (WHO, 2018). The study's findings aligns with the research findings published by the World Bank relating to countries in South Asia (World Bank, 2020a). In fact, the high number of pedestrian crash is one of the reasons Nepal has large number road traffic deaths and injuries (Karkee & Lee, 2016). The findings of this study emphasize the need to prioritize and act to improve pedestrian safety in Nepal. Similarly, a larger proportion of the passengers of the vehicles were also exposed to the road crashes. The evidence suggests that significant investments are required in public vehicle safety for road crash prevention, as this would help save lives and the economy.

8.3.9 Road Traffic Crash by Districts/Provinces

Studies (Hazaymeh et al., 2022; Wang et al., 2021; Zhang et al., 2020) revealed that the risk of road traffic deaths and injuries differs with the administrative/geographical/spatial /rural/urban locations of the crash. Road crashes can vary in terms of rules/regulations enforcement, frequency, and severity depending on the location/administrative region where they occur. There is a need to understand the vulnerability by the regional and the local level. A study of District of Columbia, and Puerto Rico showed the occurrence of fatal crashes was over twice as high in rural areas

compared to urban areas (Zwerling et al., 2005). On the other hand, some studies showed that road injuries were more common in urban areas with high traffic density and congestion, compared to rural areas with less traffic (Cabrera-Arnau et al., 2020). In addition, certain types of roads such as highways or intersections may have a higher risk of crashes due to their design and traffic flow. The severity of road crashes can also differ by location, as crashes that occur in remote or hard-to-reach areas may result in delayed emergency response and medical attention, leading to higher rates of fatalities or serious injuries.

The descriptive quantitative analysis in Section 5.8 focused on the road traffic crashes categorized by location, specifically the different provinces. According to the data analysis, the highest number of road traffic fatalities and injuries were recorded in Bagmati Province, and a majority of road users in all provinces were involved in road crashes in this province. This finding is not unexpected, given that Bagmati Province has the highest population and vehicle density. Relatively fewer road crashes incidents happened in the Karnali Province followed by Sudurpashchim, however, the chances of death in the crash was comparatively high in these provinces. These findings can be described by the fact that these provinces had lower vehicle flow, the lowest population density and a low coverage of traffic police to record the road traffic deaths (Government of Nepal, 2022).

The analysis of deaths and injuries by the percentage distribution in the provinces showed that Bagmati and the Lumbini provinces represent a larger proportion of injuries than others. In Madhesh, Koshi, Gandaki, Karnali and Sudurpashchim provinces, the percentage of death was comparatively higher than injuries; this can be explained by the underreporting of the road crash injury cases. Higher death rate may be attributed to the

presence of major highways, poor road condition, vehicles and lack of proper enforcement of road safety rules and regulations.

Among the 77 districts in Nepal, Kathmandu had the highest number of road traffic incidents, followed by Morang, Rupandehi, and Saptari, Nawalpur. Chitwan also had a significant number of incidents, and Sarlahi was ranked tenth among the districts with a higher number of road crash incidents. Out of the top ten districts ranked by the number of road crash incidents, Chitwan had a comparatively higher proportion of death with 7.5 injuries per death, whereas Kathmandu had 25.7 injuries per death. While having fewer deaths is a positive aspect, larger injuries can result in a higher number of disabilities, presenting a potential downside.

In the analysis, if the injuries per death was low, it was considered a higher risk. An analysis of road traffic fatalities and injuries in high-risk vehicles across various districts revealed that certain districts had a higher risk of fatalities compared to injuries. These results indicate a pressing need for district-specific interventions aimed at improving road safety and saving lives from road crashes. For tractor crashes, Dang district had a higher risk (for every 1.1 injuries one death), but for truck crashes, Nuwakot was found to be the highest risk district.

According to statistics from the National Highway Traffic Safety Administration (NHTSA), buses are involved in fewer fatal crashes per passenger mile travelled than other vehicles (Stewart, 2023). Among all type of vehicles, this study found bus and private vehicles were comparatively the safest mode of transport; findings of Sri Lanka was also alike (Dharmaratne & Stevenson, 2006). Regarding jeep/van crashes and injuries per deaths ratio, the risk of death was comparatively higher in Bara district than the other

districts (5.9 injuries per death). The popular culture of two-wheeler uses have experienced since 2000, which was significantly escalated after 2010, following the introduction of soft bank loan provision. The capital city Kathmandu comprises of the highest number of two-wheelers in Nepal; and the crash results also showed that about one-fifth of the two-wheelers crashes happened in Kathmandu. The risk of fatality in two-wheeler crashes was found to be higher in the Dhanusha district.

An analysis of the age distribution for road traffic incidents in various provinces revealed that Sudurpashchim province had the highest risk of death for 5-14 years age group population, accounting for 1.8 injuries per death. In all provinces, the risk of death was higher for 5-14 years age group population. Road crash incidents were comparatively higher for 30-44 years age, however, risk of deaths was comparatively lower in all the provinces.

This study found out that drivers, among all road users, faced a high risk of road crash deaths, particularly in Karnali. The risk of deaths for passenger in crash was comparatively higher in Karnali and Sudurpashchim. Sudurpashchim also had a higher occurrence of pedestrian death. Overall, Sudurpashchim and Karnali provinces posed significant challenges in terms of road crash death risk. Due to the limited accessibility and marked disparities in higher level public health facilities in Karnali and Sudurpashchim provinces, there could be a higher mortality risk when comparing the number of deaths to the number of injuries (Cao et al., 2021). Similarly, speeding, poor vehicle condition, muddy and slippery roads, and hilly road could be the reasons behind the crashes and high mortality in these provinces (Bhagat, 2017). These discrepancies in the risk of death between the different districts/provinces highlighted the needs of providence/location

specific road safety interventions and strengthen of pre-hospital and emergency health services in Nepal.

In the case of ambulance and heavy vehicles crashes, the number of deaths were notably high. These findings also match with the results of a road crash study conducted during the COVID-19 period in Nepal (Sedain & Pant, 2021). Two-wheelers were considered as the riskier means of transport, however, this research findings showed comparatively more injuries per deaths than the other vehicles while considering the proportion of injuries to the deaths. However, these findings suggest for the comprehensive two-wheeler crash research analysis.

8.3.10 Casualties by the Type of Vehicle Instigating Crash in Nepal and Kathmandu Valley

Kathmandu valley (Kathmandu, Bhaktapur and Lalitpur) comprise about one-third of the total vehicles in Nepal and death, and the injury status was also found to be almost proportional to the number of vehicle fleet. Thus, road safety status of Kathmandu valley was analysed separately. To the best of reviewer's knowledge, this study is the first instance of a research analysis road crash incidence by instigating vehicles in Nepal. The findings of this study could be useful to identify which vehicles instigated crashes on the road. An analysis of road traffic crash incidents involving different types of vehicles revealed that the majority of crashes victimized motorized two-wheelers, followed by passenger bus/van and pedestrians. The findings of this study was almost similar to the World Bank's publication on road safety in Nepal (World Bank, 2020b). The overall result suggests that targeting road safety interventions towards motorized two-wheelers and bus/small private vans could potentially address road safety promotion in Kathmandu valley.

The results indicate that pedestrians in the Kathmandu Valley were most commonly killed or injured in collisions involving motorized two-wheelers, followed by small vans. Regarding two-wheeler users, a majority (about 70%) were injured or killed by similar kind vehicle (two-wheelers) followed by bus and truck. The majority of passenger fatalities occurred in small vans, while injuries sustained by passengers were primarily the result of bus crashes in Kathmandu Valley.

8.4 Random Forest Analysis and Findings

The results of the random forest analysis in Chapter Six predict the attributes road traffic deaths across Nepal as at the province level. This analysis was used to identify the most important predictors of road crash death chance and build a model to predict the likelihood of a fatal crashes based on attributes included in the analysis (Cutler et al., 2007). In this analysis, this technique predicts the complex relationship between the attributes that contribute to road crash death; which helps to develop measures that can reduce road traffic deaths. According to the data plot, the Feature Importance (FI) of the attributes decreases in a descending order from top to bottom.

Usually road traffic deaths were assessed by the number of deaths and injuries at a national or regional level (Karkee & Lee, 2016b; Atreya et al., 2021). Based on the findings of literature review, this is the first study to employ an effective statistical model like Random Forest (Suarez-lledo & Alvarez-galvez, 2019; Best et al., 2020) to rank the factors associated with road traffic deaths in Nepal and at the province level.

The features considered in the RF model include: type of road users, vehicle type, month of crash, time of crash, day of crash, crash location by province, age of victims, time of the crash, type of road. Random Forest analysis found that travelling by tractors made it

more likely for road users to die in crashes. In the previous descriptive analysis (Chapter Five), it was also identified that proportion of injuries to death was also low in case of tractor crashes. Descriptive analysis and random forest predictions showed that the likelihood of death occurrence in tractor crashes was statistically significant. This is primarily because passengers are more vulnerable to being thrown from the vehicle. The increased probability of fatalities in tractor crashes can also be attributed to the comparatively limited protection to its occupants, in contrast to those in other types of closed vehicles. The practice of the developed countries has indicated that tractors are used for agricultural purposes, few deaths and injuries occurred during farm work (Rashighi & Harris, 2018; Moreschi et al., 2017). This study did not consider deaths resulting from tractor crashes during agricultural work. The analysis was only based on crashes involving tractors while transporting loads or passengers on the road. These findings have sparked a debate on whether tractors should be banned to carry people and heavy loads on public roads.

While categorizing major attributes for road traffic deaths, it has been identified that when crashes occurred in Sudurpashchim Province, the chances of death was high followed by passenger bus crashes. Epidemiological study of road traffic crashes of the Western part of Nepal also identified passenger crash death was significantly high in Sudurpashchim (Mishra et al., 2010). Similarly, truck crashes were in the fourth rank and motorized two-wheelers were in the fifth ranked in road traffic crashes associated with death. Despite the fact that motorcyclists are often considered as vulnerable road users, the results of the random forest analysis indicated that their chances of death were comparatively lower. Therefore, the analysis has some limitations due to the utilization of

police records and findings are not comprehensive enough; it demands further rigorous research.

Among seven provinces, tractor crashes were appeared as the first rank predictor for the death of the road crash victims (Koshi Province, Mahesh, Gandaki and Lumbini). The primary predicting attribute for crash fatalities in the Bagmati province was found to be truck crashes, whereas in Karnali, among predictors assessed, passenger in crashes were identified as the top. Specifically, when passengers were involved in a road crash, the likelihood of fatalities was higher than for any other variable. Similarly, in Sudurpashchim province, if the crash occurred in November, there was highest chance of death in the road crash than the other variables examined for the death prediction. Thus, this RF model predicted that the likelihood of death in the road crashes differs by the provinces. In Bagmati Province, it has been identified that driving on a Friday was in the third highest rank among the chosen factors attributing to road traffic deaths.

The RF analysis conducted in this study was done with a limited set of variables obtained from police records. However, if a more comprehensive or prospective crash data were available, this model could be better employed to determine the major factors associated with road crashes, fatalities, and injuries. These findings highlight the importance of detailed study of road traffic crashes to save lives from preventable deaths. The results of this study would serve as a guide to work for preventing the road traffic crashes and reduce RTI deaths and injuries in Nepal.

The results undoubtedly indicate that the likelihood of road traffic deaths varied by vehicle type, location of the crash, type of road user, crash type, month and time of the incident, and age of the victim. These findings are consistent with those published in studies

conducted in different regions and countries (Ghaffar et al., 2004; World Bank, 2020; Chang et al., 2020; Ackaah et al., 2020). During this research process, it became evident that the Nepal Police was the sole agency having national road crash data records with a limited number of variables. As stated by Abdulhafedh (2017), it is urgent to integrate scientific data collection methods into the crash recording system of the Nepal Police.

8.5 Qualitative Study Findings

The impact of road traffic crashes on the socio-economic status of victims and their families was examined through a qualitative study (in-depth interviews and a group discussion). This study's quantitative and qualitative findings were interlinked, with the quantitative data focusing on the incidence of road crashes, fatalities, and injuries, while the qualitative data explored into impact of the crashes to the victims and their families.

8.5.1 Road Crashes, Injury Types and Rescue Process

In the in-depth interviews, majority of the participants were injured road crash victims. The main objective of the study was to investigate the road traffic crashes and its impacts. The vast majority of the participants who were admitted for treatment had sustained serious injuries. Of those who were interviewed, approximately half were motorcycle users. The study revealed that human error was the primary cause of the road crashes, yet many of the participants stated the fault to others. Similarly, speeding, drink driving, unfamiliar driving route, overload and vehicle condition were some reported causes of the road crashes; which are consistent with the findings of the other research (Gómez-García et al., 2022; Gautam et al., 2021; Zhang et al., 2020 & Bhagat, 2017). It is commonly known that in some cases, drivers involved in a vehicle crash deliberately attempt to commit the inhumane action of killing the injured victim to avoid the cost of

medical treatment for the injured victims. One participant in this study also reported such an incident after sustaining a minor injury.

While tractors were a dangerous means of transport, many of the participants were transported from the crash location or for follow-up treatments using. This study revealed that only a small number of victims were transported to healthcare facilities by ambulance, this evidence also mirrored with the reviewed article on EMS in LMICs (Suryanto, et al., 2017). The majority were transported via taxis, buses, or vans from the crash sites. In Iran, Khorasani-Zavareh et al. (2009) also found that the poor crash management was a serious challenge in saving lives and preventing disabilities in the road crashes; where many of the crash victims did not receive ambulance services.

The younger victims of road crashes were found to be less aware of the RTI risks, and they often adopt risky road crash behaviour. It has been found that young participants realized the importance of adopting traffic rules only after experiencing a crash. A study of high income countries also identified that risky driving behaviour among adolescents was largely associated with the road traffic crashes (Lastrucci et al., 2022). Both the road crash victims and the families of those who had died in the crash emphasized the importance of community-wide awareness of road safety. Findings from South Asia showed that community-based awareness was found to be impactful in improving the road safety behaviour of the people (Verma & Tewari, 2004). Furthermore, the analysis of respondents' opinions indicated that crashes were more likely to occur during rainy periods, festivals, elections, and at night. These findings are consistent with the quantitative results, which indicate a high frequency of road crash incidents during the months of October and November. Similarly, road traffic crash scenario, pattern forecasting in

Bangladesh found that festive seasons are associated with the increase risk of road traffic crash, injuries and death (Hossain & Faruque, 2019).

8.5.2. Treatment and Health Condition

Pre-hospital care facilities were almost impossible to get in the crash scene; all the participants in the study were not rescued in the presence of health personnel. Similar situation of the pre-hospital care has been identified by the study conducted in Uttar Pradesh, India (Chowdhury & Chakraborty, 2017). Individuals who become injured in road crashes frequently encounter difficulties to get an ambulance to transport from the crash locations to the health centre. Timely and appropriate rescue operations and treatment can save numerous lives and reduce the likelihood of long-term or permanent disabilities (Rembalovich et al., 2020). Nevertheless, a majority of the victims and their relatives expressed dissatisfaction with the rescue process and the medical care received in hospitals. According to interviews with crash victims, those with minor injuries got rescued immediately, while those with more severe injuries were rescued later on.

When road crash victims were taken to the government hospitals, it has been mentioned that some of the necessary health services were not available and majority of the participants were compelled to go to private health facilities for MRIs or CT scans. A few participants who received treatment from the government hospital mentioned that they received timely required investigations and treatment. Nonetheless, individuals who reported being satisfied with the quality of health facilities cited having a connection or known someone in a position of authority within the hospital.

While immediate rescue process is challenging, none of the participants were satisfied with their rescue process after crash. A majority of the participants did not receive

adequate healthcare services in the first hospital they were transported to. It was found that participants often moved/transferred to other hospitals within country or India for better treatment. According to the participants' opinions their injury status worsened due to lack of appropriate and timely treatment facilities.

Most of the victims were taken to the community hospital at first for their treatment. However, the limited health facilities hindered them to obtain immediate health services. Additionally, the victims who were taken to big private hospitals in urban areas also reported the cost of treatment made them re-think further treatment in that hospital.

Providing adequate care and support for road crash victims during the treatment and recovery phase is very important (Rembalovich et al., 2020). Findings highlighted that children and young victims received satisfactory care and support from their families. However, elderly victims often do not receive adequate care from their family members, resulting in miserable conditions during the recovery period. Furthermore, married females largely neglected by their families compare to male.

Private hospitals were more accommodating when it came to admitting crash victims, but the treatment process posed difficulties due to the challenge of arranging money for hospital bills. While private hospitals are exorbitantly expensive, government hospitals lack the necessary resources to provide victims with the required health services (Marasini, 2020). Despite the difficulties encountered in government hospitals, it has been discovered that victims have faith and are demanding the provision of all necessary treatment facilities for road crash victims. On the other side, establishment of an immediate treatment fund through community coordination was discovered to be an effective practice when any member encountered unexpected incidents, such as road crashes.

In interviews with injury survivors, a majority of them reported experiencing health issues associated with their road injuries. Those who suffered more serious injuries, particularly spinal injuries, reported a range of health complications, such as frequent bedsores. Likewise, individuals who sustained relatively minor injuries also reported experiencing persistent pain as a major issue. The results indicating prolonged health issues among road crash victims align with research conducted in high-income countries, such as Sweden (Rissanen et al., 2020). There are a number of road crash research conducted in Nepal; however, no previous research has investigated the long-term health effects of road crash injuries to the victim, and thus, it is not possible to compare the present study's results with those of others. The qualitative analysis matched with the quantitative results, and revealed that participants (7 and 8) were exposed to be hazardous in situations where serious injuries occur, leading to prolonged medical treatment and disability.

It has been identified that availability of rehabilitation services to the road injury survivors is important. The World Health Organization's report on disability recommends that all governments develop, enhance, and extend comprehensive rehabilitation services to enhance the quality of life for individuals with disabilities (WHO, 2011b). Nonetheless, rehabilitating road crash victims in Nepal comes with a challenge, as individuals other than those with spinal paralysis do not typically receive rehabilitation services. There is only one Spinal Injury Rehabilitation Centre in Nepal, which is operated by the private sector, which provides services to individuals with spinal paralysis from all over the country. However, accommodating all needy victims is challenging. Most of the victims demanded the establishment of rehabilitation facilities after road crash trauma in all the provinces of Nepal.

8.5.3 Other Health Conditions

This study not only explored the physical health complications; participants also reported the feeling of down, stress, anger, helpless, hopeless, reduced willpower, isolated, and flashback of crash. Similarly, the impact of the road crashes to the victims' families was analysed from the qualitative information obtained from the participants. This study also revealed that a sense of insecurity within marital relationships was a prevalent issue among the victims. Likewise, certain participants in the interviews reported experiencing suicidal thoughts resulting from the stress that were compounded by the road crash. The long-term effect of road crashes on victims is a topic that has received little global research attention, and the systematic review undertaken in this study (chapter four) has also determined that not much specific investigations on the subject have been conducted in South region. The findings of this study matched with finding of the African experiences (Iteke et al, 2011) and in the global settings (Weijermars et al, 2016), in which it was found that the road traffic injuries caused short-term and long-term psychological complications. Similarly, a meta-analysis aimed at determining the psychological effects of road traffic injuries found that there is an increased likelihood of experiencing psychological distress following an RTIs (Craig et al., 2016; World Bank, 2021). From the group discussion, it has been found that sharing of similar problem in the similar population group helps to minimize victims stress level. This finding suggested for the formation of the road traffic victim society in the community, state and the federal level.

Most of the road crash survivors mentioned that they did not share their stress to anyone. This research has revealed that the tendency to withhold stress, and personal problems is not limited to males and is equally applicable to females as well. This research has shown that psychological support is crucial for individuals recovering from serious

injuries. Those who received counselling services following road crash injuries were found to experience less stress and were more motivated to improve their quality of life. This research has also shown that the counselling services provided to victims in government hospitals often do not meet their individual needs.

8.5.4 Financial Issue

It has been identified that majority of the victims turned from being the breadwinners to the dependent members of the family. Most of the participants indicated that they were experiencing significant financial difficulties as a result of their road crash injuries. In-depth interviews revealed that economic struggles following a road crash often led to family conflict, interrupted education, loss of employment, inability to participate in social gatherings, celebrations, and a decline in the victims' and their families' quality of life. Of all the victims (injured or deceased), 80 percent were primary earners for their families and reported that the road crash injuries had a significant impact on their families compared to before the incident. This study included individuals who were seriously injured in road crashes and according to their opinion, approximately 2 million NPR had been invested in their immediate and follow-up treatment. It has also been identified that the victims from lower financial background were seriously impacted than others; similar findings have been obtained from the study of India conducted by the World Bank (2021). The World Bank report also showed that post-crash situation was worst in low income households.

The qualitative findings found that in some cases, the hospitals provided food to the road crash victims while their caregivers remained without food due to financial constraints. It was found that around half of the expenses incurred for food and treatment

were covered by insurance, while the remaining expenses were self-funded. While self-funding for unexpected road crash incidents, most of the victims were compelled to sale their land, buildings, jewellery, or livestock. Following their treatment, road crash victims and their families found themselves at a loss of both movable and immovable property, causing them immense grief and hardship. The study revealed that initially obtaining medical treatment was easier for cases involving vehicles having third-party insurance compared to those that did not have such insurance coverage and were involved in crashes. On the other hand, even in cases where the vehicle responsible for the crash had third-party insurance, it was still challenging for the crash victims to receive financial assistance once they were discharged from the hospital.

The majority of victims were unable to resume their previous employment, especially those who worked in the informal sector such as meat shops, security, daily labour, or part-time work. Likewise, road crash victims who had a permanent job received financial assistance from their employer and colleagues. The living standard of the road crash victim was found to be drastically changed; families involved in business sector forced back to the complete agricultural work.

According to Rana et al. (2022), people with disabilities in Kathmandu faced problems in obtaining employment. Qualitative findings also showed that a large proportion of road crash survivors who sustained injuries are facing unemployment problem after the incident. Among those who were employed before the injury, the majority reported being terminated from their job and some of the victims took self-retirement. Similarly, those who continued their work faced discrimination in their workplace. On the other hand, the crash survivors having some physical disability who got

an opportunity to continue their job could not continue their job because of a lack of disabled-friendly infrastructure (buildings and toilets). Some participants' statements were distressing, particularly regarding the fact that in many cases, government job reservations for disabled were being taken by individuals who have good network with the authority.

It is worth noting that seriously injured victims who received rehabilitation services and proper counselling were able to explore new job opportunities and found satisfaction in their current employment status and earnings. Incorporating vocational skill training in addition to rehabilitation services was found to be more impactful for survivors. The vocational training program for the people with disability equips them with the necessary skills and abilities to engage in the workforce. These programs aim to either develop or restore their capabilities, enabling them to contribute to the labour market. Enhancing the skill and educating the people with disability help to the achieve the sustainable development goal Four (United Nations, 2017). Participants also revealed that those who received vocational training experienced reduced trauma and were more inspired for better days ahead.

The process of obtaining insurance claims was found to be challenging, the process of obtaining the insured amount further victimized the crash victims. Some victims gave up on the process, while others struggled to obtain their claims despite their health condition. On the other hand, it was observed that victims with good connections to political leaders were able to receive their insurance amounts in a timely manner. The study also uncovered instances where individuals involved in road crashes, who were not eligible to receive insurance pay-outs, were able to obtain compensation from insurance companies through the use of their influence and power. It was found that there were agents involved in the

insurance claim obtaining process, but they acted dishonestly towards the victims. Some victims allegedly only received half of the claimed amount while the agents took the rest for themselves. The family's financial situation was severely impacted following the road crash. In case of insurance availability, it covered less than half of the total treatment cost, and for the road crash injury to a family member, it was nearly impossible to obtain a loan or financial support. As the majority of the victims were the family breadwinners, this highlights the significant financial challenges they faced after the crash.

The financial situation of family members also found to be severely impacted by road crash incidents involving a family member. Due to road crash injuries, a family member had adjusted their time for taking care and their daily routine was disturbed. If a husband was injured, it could result in his wife's regular earnings being stopped (*Participant I-1's wife*). Similarly, if the children are injured, both parents' income may be affected (*Participant I-3's parents*). However, if the primary breadwinner of the family is injured, the entire family's financial situation found to crash (*findings of Participant I-7, I-8, D-1*).

8.5.5 Functional Limitation

The qualitative findings showed that those survivors having mobility problems have serious challenge of transportation. Most of such participants expressed their problems in their daily life. Some of the participants relate their life with the prisoners. Inaccessible infrastructure prevented them to the social functions and the gatherings. One participant's statement effectively highlighted the obstacles faced by disabled survivors in accessing transportation services. He mentioned that "a bus driver refused to take me to the village due to which I was unable to meet my critically-ill mother before she passed away".

Similarly, it has been identified that other road users generally perceived four-wheeled scooters simply as bigger-sized normal scooters. As a result of such neglect/lack of knowledge, a number of four-wheeled scooters ended up crashing on the roads. Thus, it has become apparent that the infrastructure, vehicles, and common practices of individuals are not conducive to the needs of people with physical disabilities and restrict their daily activities.

8.5.6 Other Impact of The Road Crashes

Families of road crash victims are often faced with numerous difficulties. Some family members may be forced to discontinue their studies or switch from private to government schools. Additionally, some individuals may have to quit their jobs in order to provide care for the injured family member.

A majority of the participants revealed that they were socially isolated and neglected in the society. In case of aged participants, it has been found their close relatives did not visit or even contacted them during the treatment and recovery period. Some of the participants' opinion indicated that due to the death of family breadwinner, their neighbours started dominating them, facing unwarranted blame or punishment. In most of the cases, it was found that relatives and friends were only supportive and caring in the time of prosperity but not in the bad time. However, in some cases, neighbourhood/communities were found to be united to support the family in the problem. A systematic review on social relationships, mental health and wellbeing in physical disability conducted by Tough et al. (2017) also found that the health and survival of individuals with disabilities can be significantly influenced by their social relationships. The impact of these relationships can be substantial. The inaccessibility to public transportation, public places,

and buildings were the primary reasons cited for the inability to engage in social interactions. The study conducted on the accessibility of public spaces for individuals with disabilities in Kathmandu Metropolitan City has presented comparable results to these findings (Wagle, & Tiwari, 2020). Due to the injured family member's functional limitations, some of the family members were also barred to participate in social events and from travelling.

8.6. Chapter Summary

This discussion chapter critically discussed the findings obtained from the systematic review, quantitative analysis, and the qualitative analysis. It was found that nationally representative studies on road safety in SAARC countries was limited, and the impact of the road crashes were less explored.

Secondly the findings of the descriptive were discussed in relating with other scientific references. The analysis of road traffic crashes revealed a significant number of fatalities and injuries, with most casualties resulting from two-wheeler crashes, followed by passenger vehicle crashes. Heavy equipment and tractors were identified as the riskiest modes of transport in Nepal.

In the eighth chapter, the impacts of road traffic crashes was presented, which were categorized into five key areas. The findings showed that crash victims were profoundly affected, experiencing persistent physical pain, financial hardships, and mental health challenges.

CHAPTER IX: CONCLUSION AND RECOMMENDATIONS

9.1 Introduction

This study provides evidence on road traffic crashes, which are a major public health concern and a leading cause of injury-related mortality, and morbidity in Nepal. Despite the scale of the problem and the preventable nature of these deaths and injuries, it continues to be a neglected issue in Nepal. This study focused on the road traffic crashes, deaths, injuries and its impact on the victims and families.

This research idea was shaped to fill the knowledge gap on the preventable road traffic crashes, injuries and deaths. According to the review presented in this study, this is the first kind of research with complete documentation of the road traffic crashes, death, injuries, predicting mortality and the post-crash socio-economic impact on the victims and their families.

The absence of specific data on the crash-related injury and death of individuals is a notable gap at the national level. This research is conducted with hopes that the outcomes of this research will fill the knowledge gap regarding the road crash analysis by age groups, types of road users, vehicle types, and other variables. The quantitative analysis presented the status of road traffic crashes deaths and injuries and risk factors for road traffic mortality. Since the data was based on the police records, it was generally not able to provide the impacts of the road crash onto the victims. These qualitative findings provide the consequences of road crash injuries to the individuals and families. Thus, it helps in the development of strategies to address the challenges faced by road crash survivors and families.

This chapter presents how the research questions raised in the chapter one has been addressed. Additionally, a summary of this dissertation's contribution is presented, and recommendations for policy, practice, and potential areas of further research are provided.

9.2 Contribution to Knowledge

The dissertation reasonably addressed all the research questions raised in chapter one. The first chapter presents an overview of the severity of road traffic crashes, fatalities, and injuries in Nepal. It highlights that despite causing numerous deaths and injuries, this sector remains largely neglected. The statement of the problem section emphasizes the consequences of road crashes on victims and their families, where it was found to be profoundly overlooked and require further research. It is expected that the findings will be useful in improving data recording system and analysing available road traffic data. Further, it will guide authorities to develop policies addressing the challenges of the road crash victims and their families.

Research Q1.

What studies have been conducted on road traffic crashes, deaths, injuries and impact of RTIs in our neighboring countries? (Systematic review)

This systematic review searched and studied the road safety research articles published in the SAARC countries during 2010-2020. It summarised the facts for road traffic crashes, deaths, injuries, and their social and economic impact presented in the selected articles. Eleven studies were reviewed among the selected studies; ten were country-specific from Bangladesh, Bhutan, India, Nepal, and Sri Lanka, and one study analysed South Asian countries as a whole. The road traffic death rate was highest (26 per 100,000 population) in India, and the injury rate was maximum in Bangladesh. Compared to other countries, Nepal exhibits a distinct pattern of road traffic fatalities and injuries,

with a higher proportion of young individuals representing such incidents. Although comparing evidence from SAARC countries was challenging due to difference in study periods, this review identified an alarming situation of road crashes, leading to preventable deaths and loss of valuable lives. In this region, two-wheelers were the major contributors to road traffic death, injury, and economic loss.

When examining the social and economic impact of road traffic injuries in SAARC countries, the primary concern was the victims and their families. It is unfortunate that only a limited number of studies were published on the national-level economic impact of road crash injuries, and the impact on the victims their families was not a research priority. This study showed that females were comparatively more impacted than males. With regards to methods used, this study used a Random Forest model in the quantitative analysis to predict the likelihood of road traffic deaths based on various background variables. Compared to other statistical methods, this approach has less errors and has potential for application in similar predictive analyses. It was also identified a huge economic burden of RTIs in SAARC countries, which resulted in a 0.9 percent to 3 percent national GDP loss. Overall, this review identified the dearth of road safety studies in the SAARC region and demanded more study publications to generate reliable road traffic evidence for effective road crash prevention intervention.

Research Q2**What is the status of road traffic crashes, deaths and injuries? (Quantitative study)**

Road traffic deaths and injuries were analysed by the age and the sex of the victim, crash location, time of crash, day, month of the crash, type of the road users, and type of the vehicle involved in the crashes. The mean age of the victim was found to be 31 years. From a gender-centric lens, the number of deaths and injuries were overwhelmingly high for male. For different users, motorized two-wheeler users represent about 40 percent of the cases of injuries and deaths followed by passengers of public transport and pedestrians.

Vulnerable road users such as cyclists, pedestrians, and motorcycle riders were analysed separately for their deaths and injury situations. These findings help design the prevention strategy accordingly. Furthermore, the study analysed road traffic deaths and injuries by province, district and identified the provinces having higher road crash mortality, along with the ten districts with the most crashes. This information can be utilized to design and implement district/ province-specific road safety interventions.

Further, this study found that some vehicles - like tractor, truck and even public buses - were riskier means of transport. While the number of road crash incidents were the highest for the motorized two-wheelers, the risk of death was comparatively lower than for tractor and trucks. The findings of this study on two-wheeler crashes are insufficient to draw decisive conclusions regarding their risk. More extensive nationwide research is necessary to validate these findings.

The data analysis relied on the Nepal Police's road traffic death and injury record. However, during data management and analysis, it became apparent that the data was

recorded as case narratives. A more detailed and efficient data recording system that separates data by variables would be preferable instead of the case narrative form.

Research Q3

What are the attributes associated with the road traffic deaths? (Random forest analysis)

The Random Forest model was used to predict attributes for road traffic death at the national and provincial levels. It identified the tractor as a dangerous vehicle in causing death in the crash in Nepal. This was true for Koshi Province, Madhesh, Gandaki, and Lumbini province. Since passengers of public vehicles are considered comparatively safer than other road users, this analysis identified likelihood of death of passengers ranked third among the variables included in the analysis.

The analysis revealed that in Bagmati province, the top contributing attributes for road crash death was truck crashes, followed by crashes in the evening. Moreover, in this province, crashes occurring on Fridays were more likely to result in death. In Karnali Province, the highest chance of death was in November, followed by plunge crashes and crashes early in the morning. Additionally, the chances of passenger death were relatively high in this province. Sudurpashchim Province had similar associated factors for crash death, with passenger crashes identified as the top-ranked top rank, followed by tractor crashes. Pedestrian death was also comparatively high in this province compared to others. However, this study used single-year road crash data; using five or ten years of road crash data can predict more precise factors causing death in the road traffic crash.

The primary objective of using the Random Forest model was to predict the attributes for road traffic deaths in Nepal. However, some crucial variables were missing due to the limited variables available in the dataset. If the essential variables on road traffic deaths and injuries were available, the model could better predict the factors contributing to

road crashes, fatalities, and severe injuries. Such insights would be invaluable in developing prevention strategies, action plans, and activities.

Research Q4

How do road traffic deaths and injuries impact the individuals and families? (Qualitative study)

The findings of the qualitative studies explored the impact of road traffic injuries and deaths on the victims and their families. The analysis specifically enquired how the road crash victims were rescued and treated from the crash site and throughout the recovery process. Additionally, it explored some of the socio-economic and health impacts of the crashes on the victims and their family members.

The analysis revealed that pre-hospital care was almost absent during the rescue process. Additionally, many of the victims faced further difficulties during the rescue process, and the availability of ambulance services was also challenging. The immediate hospital services on the highways were inadequate due to limited facilities, and most road crash injury victims had to be transported to Kathmandu for treatment. Furthermore, because of the ulterior interest of doctors, ambulance drivers, and other individuals involved in the rescue process, victims were often taken to private hospitals, which resulted in increased treatment costs. These findings underlined the need for pre-hospital care, proper rescue and response, availability of ambulance services, and improved health services in government hospitals.

Similarly, road traffic crash victims often experience long-term physical and other health complications. Therefore, providing adequate counselling services to these victims during their treatment and recovery is essential. Similarly, availability of rehabilitation facilities for the needy victims also can reduce the long-term impact. Additionally, victims demanded vocational training to develop new skills, generate hope, and recover from their

trauma faster. It has been observed that many crash victims lost their jobs due to their injuries, the vocational training can help them start a new career or find a new job in the market.

Financial difficulties were found to be a major issue for both RTI victims and their families, which largely impacted general household function. Therefore, it is necessary to establish dedicated RTI treatment facilities, and to improve and strengthen the insurance process. RTI affects not just the individual victim's but also the entire family's lifestyle and standard of living. Preventing further victimization of family members, road traffic victims' specific programs should be designed by the government and other agencies. It has been found that sharing problems among RTI victims can help reduce the stress caused by the injury. Therefore, it is important to establish a road crash victim society to work with and support RTI victims. Such a society of victims has already been established and is working to improve the crash victims in different parts of the world.

9.3 Implication for Policies and Practice

For policymakers to develop successful policies, having precise and reliable data on road crashes, injuries, fatalities, and their consequences is essential. The importance of setting targets and designing programs based on evidence has also been highlighted in the WHO's Global Plan for the Decade of Action for Road Safety 2021-2030 (United Nations, 2021). The current situation regarding road safety information in Nepal highlights specific recommendations. Based on the review, it can be concluded that road safety research is not given a high priority in Nepal. Although some evidence has been produced individually, more is needed. Certain funds should be allocated to conduct road safety research and the

findings of the research should be incorporated in the policy design and the program implementation.

Additionally, road traffic deaths and injury information recording is challenging in low-income countries like Nepal. This analysis found important findings addressing the challenges that can reduce road traffic crashes. Although there are some factors associated with road crashes, such contributing factors needs to prevent/minimize and to minimize deaths and injuries.

9.4 Recommendations

This study presents different information on road traffic death, injuries, and impact on the victims and families. Similarly, it has been identified that road safety issue has been getting limited research priority, and that the factors related to road traffic deaths at the national and provincial level has not been explored. The findings of this study can inspire policy makers to formulate appropriate policies, establish a system for recording road traffic crashes, and reduce the crash occurrences. Consequently, this will reduce traffic deaths and injuries and support to achieve SDGs 3.6 and 11.2. As Nepal is a signatory of the UN's Second Decade of Action for Road Safety 2021-2030, this research highlights that there are numerous actions need to be taken to accomplish the set targets. These actions include generating evidence, working for crash prevention and addressing the needs of road crash victims and their families. The recommendation based on this research findings will be framed under the "safe system" approach developed by WHO for the achievement road safety target set for first road safety decade 2011-2020 (WHO, 2011a).

Recommendations for Safer Mobility

Recommendations were made in line with the road safety pillars one, three, four and five: road safety management, safer vehicles, safer road users and post-crash response.

A. Recommendation for Road Safety Management

- a. Establish scientific road crash data recording system, which can be initiated by improving the Nepal police data recording system. Ultimately, a road crash data surveillance system is suggested to be established. The given problem of underreporting crash incidents will be reduced by linking police, health and other data sources. It is necessary to provide unrestricted access to the data for the purpose of analysis and research.
- b. Although some road safety project works were conducted and report prepared, these report findings were not made publicly available. As presented in the review, very limited road safety research has been conducted. Thus, road safety research needs to be prioritized by allocating research fund and encouraging to publish findings in the scientific papers.
- c. As highlighted in the review, our road safety sustainable goals were not evidence based. Therefore, policies and programs must rely on evidence, and the results of this kind of studies must be considered.

B. Recommendations for Safer Vehicles

- a. Tractor crashes have been appeared as a serious issue in killing numerous people. Thus, the use of tractor as a means of transportation should be prohibited and strictly enforced by the Nepal Government.

- b. It has been found that passenger-carrying public vehicles are dangerous means of transport, especially in Madhesh, Lumbini, Karnali and Sudurpashchim provinces. Thus, a strong commitment from the government and the action for its safety improvement is urgent.
- c. Motorized two-wheelers are found to be the challenging means of transport in leading to numerous injuries and deaths (more than one third of total incidents). Therefore, the safety of two-wheeler users should be in top priority of road safety initiatives.
- d. Considering the high risk of death in plunge crashes, the Nepal Government must relate it with the World Bank's findings (World Bank, 2021) and apply proven effective road safety measures to prevent such crashes.

C. Recommendation for Safer Road Users

- a. The study found that many two-wheeler users are the major contributors to the raising of road traffic deaths and injuries in Nepal. In collaboration with related stakeholders, the government should initiate a comprehensive road safety awareness campaign for two-wheeler safety. It can be emphasized by promoting the mandatory use of helmets, reducing speed limits, preventing drink-driving, and respecting traffic rules. In addition to promoting safety awareness, the government must work to improve and increase the coverage of public transport systems in the country to reduce two-wheelers uses.
- b. According to this study, pedestrians are at a higher risk of being involved in road crashes, yet the government has neglected their safety. When pedestrians should have the first right to use the road among all road users, it is ironic that roads are constructed without sidewalks. To ensure pedestrian safety, it is recommended that roads with accessible sidewalks should be constructed.

- c. The study revealed that bus passengers have a high mortality risk in road crashes. Considering these findings, public bus passenger safety needs to be given priority. It is suggested that the government should strictly enforce policies to improve passenger safety, and passengers must also be responsible for ensuring traffic safety.
- d. In Nepal, individuals in the 15-45 age group are at a higher risk of death from road traffic crashes than neighbouring countries. Therefore, there is a need to create awareness among young people through practical learning in schools and campuses to reduce this risk.
- e. The study has revealed that the festive season, which falls in October and November, is a high-risk period for road traffic crashes. Therefore, special attention must be given to these months to reduce the risks of road traffic crashes.

D. Recommendations for Pre-Hospital Care, Emergency Care, Transport of the Victim, Treatment and Access to Rehabilitation and other Support for the Crash Survivors

- a. This study identified the absence of pre-hospital care and improper rescue processes, which has a significant impact on the injury status of victims. In light of this, the government, Health Emergency Operation Centre (HEOC), trauma specialists, trainers and trained personnel must work collaboratively to enhance emergency medical services (EMS) across the country. This collaborative effort can save numerous lives and prevent serious injuries that may lead to disability.
- b. This study has revealed that a significant number of victims did not receive adequate health services near the crash locations, and were forced to be transported to Kathmandu. Therefore, enhancing the capacity of local hospitals and ensuring the

availability of skilled human resources can improve the chances of survival for crash victims.

- c. Providing follow-up treatment for road crash victims is highly challenging. Therefore, it is crucial to establish a dedicated network that encourages and facilitates the victims and their families to seek long-term treatment. An app can be developed specifically to remind and motivate survivors and their families to attend necessary treatment sessions.
- d. To provide rehabilitation services to survivors from a distance, the use of information and communication technology such as video appointments via phone should be incorporated.
- e. Counselling services are currently scarce for survivors of road crashes. Provision of adequate counselling services by trained personnel can minimize other health complications that may arise due to injuries sustained in road crashes. In Nepal, female community health volunteers (FCHVs) are conducting door-to-door visits, therefore building the capacity of these human resources can help identify other health conditions and can serve as referral agents.
- f. It has been found that the process of obtaining an insurance claim is complicated, making it nearly impossible for crash victims to receive their entitled amount. Therefore, the government should establish a system that works for the benefit of the survivors during their time of distress.
- g. Efforts should be made to provide vocational training for survivors who are interested in participating. Such training can aid in reducing stress and trauma and can also enable survivors to become economic contributors to their families rather than dependent

members. In case of major family earner returning to the job will help to maintain the household living condition.

- h. Peer support groups have proven to be effective in providing psychological support to individuals following injury. In Nepal, there is a need to establish a survivor network (road crash victim society) to provide support to needy survivors.

9.5 Recommendation for Future Studies


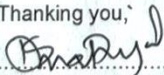
This research has revealed several gaps in the literature related to RTIs in Nepal.

Therefore, some recommendations for future research made:

1. The absence of a national-level study on road crashes and evidence-based policies makes it difficult to address the road safety issue effectively. Some studies conducted in Nepal relied on police reports, which may not accurately reflect the true extent of the problem where data is largely underreporting. Therefore, conducting community-based research to obtain a better understanding of the actual road safety situation in Nepal is crucial for developing effective policies and programs.
2. The study highlights the significant impact of road crashes on the quality of life of both the victims and their families. However, this small-scale research limits its ability to fully capture the situation of all road crash victims in Nepal. Therefore, it is urgent to conduct large-scale research focusing on the experiences of road crash victims and their families, in order to address the challenges they face.

Appendix

Appendix A: Ethical Approval

 Tribhuvan University Institute of Science and Technology Kirtipur, Kathmandu, Nepal	
Institutional Review Committee	
<p>IRC/loST Chairperson</p> <p>Assoc. Prof. Dr. Surendra Gautam Asst. Dean-Academics, loST</p> <p>IRC/loST Members</p> <p>Prof. Dr Anjana Singh Prof. Dr Krishna D Manandhar Prof. Dr Sangeeta Rajbhandary Prof. Dr Shankar P Khanal Prof. Dr Kumar Sapkota Prof. Dr Prakash Ghimire Prof. Dr Chhatra M Sharma Assoc. Prof. Dr Megha R Banjara</p> <p>Member Secretary</p> <p>Assoc. Prof. Dr Komal R Rijal</p> <p>Head, Central Department of Microbiology</p> <p>IRC/IOST Secretariat</p> <p>Central Department of Microbiology Phone: 4331869</p>	<p>Ref. No.: 969/6781079 Date: 12 April, 2022</p> <p>PI: Prof. Dr. Yogendra Bahadur Gurung PhD student: Bhagabati Sedain Central Department of Population Studies, Tribhuvan University (TU), Kirtipur, Kathmandu</p> <p>Ref.: IRC Ethical Approval of research proposal entitled "Road traffic crashes and its impact on victims and their families in Nepal"</p> <p>Dear Prof. Dr. Gurung,</p> <p>It is our pleasure to inform you that the above mentioned proposal submitted on 14 March, 2022 (Regd. No IRCIOST-22-0025), following independent expert review and discussion in the IRC/loST meeting held on 11 April, 2022 has been approved for implementation [start date 12 April, 2022 and end date 11 October, 2022], maintaining ethical principles, set by the Nepal Health Research Council.</p> <p>The investigators have to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure including deviation of the protocol, data management and budget need to be submitted in detail with justification for seeking prior approval to implement the proposed change including extension of the date, in the protocol.</p> <p>Further, the researchers are also directed to follow the national ethical guidelines published by Nepal Health Research Council during the implementation of research. You are required to submit the final report to the IRC within a month of completion of the research, as planned in the approved proposal.</p> <p>If you have any questions, please contact the Institutional Review Committee of Institute of Science and Technology, Tribhuvan University.</p> <p>Thanking you,  Assoc. Prof. Dr. Komal Raj Rijal Member Secretary Institutional Review Committee Institute of Science and Technology Tribhuvan University</p>

Appendix B: Informed Consent

a. Letter from Dhulikhel

DHULIKHEL HOSPITAL
KATHMANDU UNIVERSITY HOSPITAL



27/04/2022

To whom it may concern

On behalf of the Emergency Department at Dhulikhel Hospital, Kathmandu University, I write that my department has no objection to the conducting of the research study.

This study will explore the social and economic impact of road traffic deaths and injuries to the victims and their family members. The researcher will collect the details of the road traffic victims registered in our emergency record from 2075 Baisakh to 2076 Chaitra. The researcher will personally contact the identified respondents for qualitative survey. This research will aid us in improving the Emergency Services and care delivered to trauma patients. We will be able to recommend changes and addition of services for maximum benefit of patients using our services.

No humans will be harmed and there is no direct intervention will be taken place.

I wish all the success for the study and we are happy to support this research in any possible way.

Sincerely,

Dr. Sanu Krishna Shrestha

Associate Professor

HOD, Department of General Practice and Emergency Medicine

Dhulikhel Hospital, Kathmandu University Hospital



b. Letter from Highway Community Hospital

PAN NO.:302506934

राजमार्ग सामुदायिक अस्पताल
HIGHWAY COMMUNITY HOSPITAL

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मिति : २०७८।११।१५

श्री भगवती सेडाई ज्यू
त्रिभुवन विश्व विद्यालय
जनसंख्या अध्ययन विभाग किर्तिपुर

सडक सुरक्षा सम्बन्धि अध्ययनका लागि सडक दुर्घटनामा परि यस राजमार्ग सामुदायिक अस्पताल मलेखु मा उपचारका लागि आएका घाईटेहरुको विवरण उपलब्ध गराउनुका साथै आवश्यक सहयोग गराईने ब्यहोरा जानकारी गराउँदछौ ।

केशव कुमार मकाजु
निर्देशक
Director

Appendix C: Data Collection Tools (Qualitative Survey Checklist)

My name is I am from the Tribhuvan University Central Department of Population Studies.

This study aims to calculate the economic costs of road traffic deaths and injuries.

Similarly, this study will explore the social impacts of road traffic injuries to the victims and their families. The information from this study survey will help the government of Nepal to formulate policies to address the economic and social problems of the road traffic victims by formulating relevant policies and implementing them for all road traffic victims. Although his survey is for academic purposes, the information you provide is very helpful for road safety policy planning and has the potential to provide ideas to address the road traffic victims by improving the current provisions for road traffic injuries and deaths in Nepal. In this regard, I would like to ask you some questions about your experiences.

There is no possible risk if you agree to participate in this interview. I might be asking some sensitive and personal questions and it is very important that you give us your answer honestly and without shyness. Whatever information you provide will be kept strictly confidential and will not be shown to other persons. I will not be asking your name and you should not worry that anyone will know the information that you have provided us with.

This survey has been approved by the ethical review committee at the Nepal Health Research Council. This research is funded is not funded by any agency.

This interview may take approximately 30 to 45 minutes to complete. Your participation is voluntary and there is no penalty for refusing to take part. You are free to ask any questions. You may refuse to be in this interview process, refuse to answer any question in the interview; and stop the interview at any point. However, I hope that you will participate in this survey since your views are very important.

Do you like to participate in this survey Yes.....1 No.....2

Researcher

Bhagabati Sedain

Central Department of Population Studies

Information about victim's health status

- a) For what purpose were you/the deceased traveling, and where, in which vehicle, did the road crash occur?"

- b) Did you/the deceased receive emergency services after the crash?
- c) Were you/the deceased taken to the hospital? If yes, how were you taken there?
- d) Were you/the deceased admitted to the hospital? If yes, how long did you stay in the hospital?
- e) After returning home from the hospital, did you visit for further health services? If yes, what kind of services did you take/are you taking?
 - Physiotherapy:
 - Psychosocial counselling:
 - Others:
- f) Have you had to use any aids or equipment for mobility or other purposes due to the crash?
- g) What is your current health condition?
- h) What efforts have you made to avoid the problems caused by this crash?
- i) Have you or any other family members developed any new health problems due to this crash?
 - Injured
 - Spouse
 - Father/Mother
 - Son/Daughter
- j) Has the crash caused any issues in the healthcare of other family members?
- k) Have any family members experienced problems like difficulty sleeping, nightmares, lack of interest, unwillingness to communicate, or feelings of depression due to this crash?
- l) Do you wish to add anything about the health impacts faced by the person involved in the road crash?

Direct expenses caused by the road crash:

- a) How did you manage the expenses for the treatment and other needs of yourself/the deceased?
- b) How much was spent on the treatment and other needs of yourself/the deceased?
- c) Under what categories were these expenses incurred?
- d) What was the largest expense incurred for?
- e) How much was spent on medical treatments?
- f) How much was spent on transportation, such as ambulances or other vehicles, for travel due to the road crash?
- g) How much do you estimate was spent on food, phone calls, and other items (additional expenses incurred while being in the hospital or at home due to the crash)?
- h) If you had to make changes to your home or living space due to this crash, how much did that cost?
- i) If you are using monthly medications, how much do you spend on them?
- j) Would you like to add anything about other financial impacts caused by the road crash?

Indirect expenses caused by the road crash (reduction in family income)

- a) How many people are there in your family, and how many have a regular income?
 - **Number:**

- **Income:**
 - Adults:
 - Children:
 - Earning adults:
 - Earning children:
- b) What is the primary source of income for your household?
- c) What is the approximate monthly income of your household?
- d) What were you doing before the crash?
 - Sole income earner in the household.....
 - Main income contributor in the household:
 - Regular earner:
 - Part-time worker and student:
 - Student only:
 - Homemaker:
 - Unemployed:
 - Other:
- e) What was your/the deceased's role as an income earner in the family? How has the crash impacted the family's financial situation?
- f) What was your/the deceased's monthly income at the time of the crash?
- g) What kind of support or lack of support have you received from your workplace due to this crash?
- h) If you were engaged in agriculture, how has the crash impacted your agricultural work and income?
- i) If you were running a business, what kind of impact has the crash had on your business?
- j) How has the crash affected your family's income?
- k) How long did you or your family member have to take leave or were unable to work due to this crash? What kind of impact did it have on your job and income?
- l) Are you currently working? If yes, what kind of work are you doing?
- m) If you are not working, what are your opportunities for finding work (a job) that you can do?

Insurance/compensation/loans due to the road crash:

- a) What was the main source for covering medical expenses caused by the crash?
- b) From where did you gather funds to cover medical expenses for the crash?
- c) What kinds of financial problems have you faced after the crash?
- d) Has any family member had to take on extra work due to this crash?
- e) Has any family member's income decreased due to this crash? If yes, who and how much?
- f) Have you or your family received any compensation or discounts due to this crash?
- g) Did you receive any amount from insurance because of this crash?
- h) Did you take a loan to cover the expenses caused by this crash? If yes, from where?
- i) Did you have to sell any movable or immovable property to cover the expenses caused by this crash?
- j) Have you received any disability allowance or other support after becoming disabled due to this crash?

- k) Would you like to add anything about the insurance, compensation, or loans related to the road crash?

Other impacts caused by the road crash:

You can share any experiences or observations related to this.

- a) What changes have occurred in your family due to the road crash?
- b) How has the crash affected household and professional work?
- c) What difficulties have you faced in mobility and participation in social activities due to the crash?
- d) Have there been any essential tasks that you couldn't complete due to the crash?
- e) How has the crash affected your or your family members' education?
- f) How has the crash impacted your family's standard of living (food, shelter, clothing, medical treatment)?
- g) How has the crash affected recreational activities in your family?
- h) What problems have your children faced due to the crash?
- i) Has your way of thinking or perspective changed before and after the crash? If yes, how? Has the crash affected the social lives (presence and activities) of you and your family members?
- j) Have there been any changes in family relationships?
 - Relationship with spouse:
 - Relationship with parents:
 - Relationship with children:
- k) How has the crash impacted your relationships with society, friends, and others?
- l) How do you feel during festivals or celebrations?
- m) How did you perceive life before the crash, and how do you perceive it now?
- n) If you are the spouse of the person involved in the crash, how has the crash impacted your relationship?
- o) Would you like to add anything about the social impacts of road crashes on the affected individuals and their families?
- p) Has there been any change in the behaviour of society towards you or your family members (positive or negative)

Thank You!

Appendix: D**Table: Distribution of road traffic deaths by district 2018/19, Nepal**

Name of the district by crash	Type of road injury		Total
	Injury	Death	
Achham	9	6	15
Argakhanchi	146	9	155
Baglung	110	17	127
Baitadi	60	5	65
Bajhang	41	11	52
Bajura	5	4	9
Banke	370	52	422
Bara	531	62	593
Bardiya	518	40	558
Bhaktapur	658	41	699
Bhojpur	62	5	67
Chitawan	788	105	893
Dadeldhura	113	30	143
Dailekh	56	11	67
Dang	818	71	889
Darchula	20	5	25
Dhading	570	56	626
Dhankuta	110	13	123
Dhanusa	401	69	470
Dolakha	114	13	127
Dolpa	8	12	20
Doti	53	15	68
Eastern Rukum	22	13	35
Gorkha	36	8	44
Gulmi	75	11	86
Humla	0	1	1
Ilam	48	7	55
Jajarkot	31	10	41
Jhapa	142	69	211
Jumla	14	6	20
Kailali	102	48	150
Kalikot	4	5	9
Kanchanpur	113	37	150
Kapilvastu	722	37	759
Kaski	192	19	211
Kathmandu	3397	132	3529
Kavrepalanchowk	435	31	466
Khotang	30	9	39
Lalitpur	772	37	809
Lamjung	67	7	74
Mahottari	276	40	316
Makawanpur	487	42	529
Manang	1	2	3
Morang	1792	85	1877
Mugu	19	2	21
Mustang	22	20	42
Myagdi	38	5	43
Nawalpur	823	84	907

Nuwakot	154	40	194
Okhaldhunga	56	11	67
Palpa	219	29	248
Panchthar	48	6	54
Parasi	221	27	248
Parsa	173	27	200
Parbat	102	8	110
Pyuthan	145	17	162
Ramechhap	171	14	185
Rasuwa	19	8	27
Rautahat	490	39	529
Rolpa	96	18	114
Rupandehi	1332	75	1407
Salyan	63	10	73
Sankhuwasabha	82	4	86
Saptari	1012	72	1084
Sarlahi	632	45	677
Sindhuli	455	40	495
Sindhupalchowk	189	12	201
Siraha	392	76	468
Solukhumbu	21	9	30
Sunsari	480	71	551
Surkhet	372	22	394
Syangja	238	9	247
Tanahu	532	37	569
Taplejung	26	6	32
Terhathum	12	1	13
Udyapur	293	30	323
Western Rukum	73	10	83
Total	23319	2192	25511

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