ASSESSMENT OF ROAD TRAFFIC ACCIDENTS IN SHEGER CITY OF OROMIA REGION, ETHIOPIA

Girma Tola Dida

A Thesis Submitted to the Department of Mechanical Engineering

College of Mechanical, Chemical and Materials Engineering

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Automotive Engineering

Office of graduate studies

Adama Science and Technology University

December 2024

Adama, Ethiopia

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Advisor: Ramesh Babu Nallamothu (Ph.D.)

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DECLARATION

I hereby declare that this Master Thesis entitled “Assessment of Road Traffic Accidents in Sheger City of Oromia Region, Ethiopia” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through

_____ _____ _____

Name of student Signature Date

RECOMMENDATION

I/we, the advisor(s) of this thesis, hereby certify that I/we have read the revised version of the thesis entitled "Assessment of Road Traffic Accidents in Sheger City of Oromia Region, Ethiopia" prepared under my guidance by Girma Tola Dida) submitted in partial fulfillment of the requirements for the degree of Mater's of Science in Automotive Engineering. Therefore, I/we recommend the submission of revised version of the thesis to the department following the applicable procedures.

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APPROVAL

I/we, the advisors of the thesis entitled “Assessment of Road Traffic Accident in Sheger City of Oromia Region, Ethiopia” developed by Girma Tola, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Major Advisor/Supervisor	Signature	Date
Co-advisor/Co-supervisor	Signature	Date

APPROVAL PAGE

I, the advisor of the thesis entitled "Assessment of Road Traffic Accident in Sheger City of Oromia Region, Ethiopia" and developed by Girma Tola Dida; hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Dr. Ramesh Babu Nallamothu _____ _____

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We, the undersigned, members of the Board of Examiners of the thesis by Girma Tola have read and evaluated the thesis entitled "Assessment of Road Traffic Accident in Sheger City of Oromia Region, Ethiopia" and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of Master of Science in Automotive Engineering.

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LIST OF ABBREVIATIONS AND ACRONMYS

AU	African Union
BAC	Blood alcohol content
CSA	Central Statistical Agency
ECE	Economic Commission for Europe
ERA	Ethiopian Road Authority
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
IRTAD	International Road Traffic Accident Database
PDO	property damage
RTA	Road Traffic Accident
SARSE	South Africa road safety system approach
UNECA	United Nations Economic Commission For Africa
UNICEF	United State of Children's fund
WB	World Bank
WHO	World Health Organization

ABSTRACT

Road traffic accidents (RTAs) pose significant health, economic, and developmental challenges to African nations, with sub-Saharan countries being particularly affected. In Ethiopia, one of the world's least developed nations, traffic accidents result in an annual loss of at least 400 million birr. The research aimed to examine the trends, scope, and primary risk factors of traffic accidents in Sheger City of Oromia Region, Ethiopia. Most studies on Ethiopian traffic accidents have relied solely on quantitative survey methods, which often underestimated the role of pedestrians and emphasized driving behaviors as the primary cause. To address these gaps, this study adopted a mixed-methods approach, incorporating both qualitative and quantitative analyses to better capture human behavioral factors. A cross-sectional descriptive design was employed, involving interviews with drivers, pedestrians, traffic officers, and medical personnel. The study's sample included 50 interview participants and two focus group discussions comprising 10 participants each. Aggregated road traffic accident data spanning five years were also collected. Sampling strategies such as purposive, availability, snowball, and quota sampling were utilized. Quantitative data were analyzed using percentages and means, while qualitative data from interviews, focus groups, observations, and case studies underwent narrative analysis and statistical evaluation using SPSS. The study identified significant trends, patterns, and risk factors associated with RTAs in Sheger City. Over the five-year period from 2018 to 2022, road traffic accidents increased substantially. There was a marked rise in fatalities, severe injuries, minor injuries, and material damages, with material damages showing the most pronounced growth. The economic impact peaked in 2022, reaching 25,541,693 Birr. Sululta Sub City recorded the highest number of accidents, followed by Sebeta, Burayu, Gelan, and Tafo Sub Cities. The research highlighted human factors, particularly driver behaviors, as major contributors to RTAs. Key behavioral risks included failing to maintain vehicle distance, speeding, and neglecting pedestrian priority. Environmental and road-related factors, such as black spot locations and road quality, also played a significant role. Vehicle-related issues, including problems with tires, steering, and brakes, were identified as additional contributing factors. Based on the findings of the study, it was recommended that continuous road safety education be given in schools, workplaces, and mass media to enhance health extension services and prevent accidents. And also, pedestrian protection measures should be implemented to ensure safe pedestrian movement. Finally, Traffic Management and Control using SUMO ((Simulation of Urban MObility) software should be utilized and implemented.

Keywords: human factor, mixed method, pedestrian safety, risk factors, traffic accident, vehicle

1. INTRODUCTION

1.1. Background of the Study

Road traffic injuries continue to pose a substantial and frequently undervalued public health issue on a global scale, necessitating coordinated and sustainable preventive strategies (Peder *et al*., 2004). The earliest documented road traffic accident took place in 1896 in Great Britain, leading to two deaths. Since that time, the incidence and severity of road accidents have increased significantly (Norman and WHO, 1962). According to the World Health Organization (2020), approximately 1.2 million people die annually in road crashes, with an additional 20–50 million suffering non-fatal injuries. Recent research highlights that road traffic accidents have risen from the ninth to the third leading cause of global disease burden. A road traffic accident (RTA) is defined as any occurrence involving one or more moving vehicles on a publicly accessible roadway (WHO, 2009). According to projections by Peder *et al.* (2004), RTAs are anticipated to rank as the third largest contributor to the global disease burden by 2020. Damian (2006) observed that RTAs result in fatalities, injuries, disabilities, economic losses, and social disruptions, all of which exacerbate poverty. Worldwide, road accidents have resulted in direct economic losses estimated at US$ 518 billion, with low-income countries disproportionately affected, incurring losses of US$ 65 billion—surpassing their total annual development aid (Peder *et al.*, 2004).

In developing nations, pedestrians and bus or minibus passengers account for the majority of road accident casualties (IRTAD, 2007). Kwdso (2011) emphasizes the daily toll of road accidents, where countless lives are lost, leaving broken families and disrupted communities. In Africa, road traffic accidents are a critical health and economic issue, with sub-Saharan countries particularly affected. Nigeria and South Africa alone account for nearly 40% of all road fatalities in the region, while Ethiopia, Kenya, Tanzania, Uganda, and the Democratic Republic of the Congo contribute to 64% of fatalities (Chen, 2009; WHO, 2013).

In Ethiopia, the situation has deteriorated as the number of vehicles has risen, leading to increased traffic congestion and conflicts between vehicles and pedestrians. Despite government initiatives aimed at road development, road accidents continue to be a significant issue within the country's transport sector (UNICEF, 2013). Each year, numerous lives are lost, and substantial property damage occurs due to road traffic incidents. Over the past 11 years, the country has witnessed an average of 8,115 road accidents annually (CSA, 2000/01-

2010/11). Ethiopia, among the world's poorest nations, loses at least 400 million birr annually to RTAs and reported 95 fatalities per 10,000 motor vehicles in 2007/08 (UNECA, 2009). This figure was an average of 12 million Ethiopian Birr per year 15 years ago, making it the third leading cause of fatalities. Currently, the estimated financial damage to property (excluding human casualties) exceeds 15 million Ethiopian Birr each year on average (CSA, 2000/01-2010/11).

According to African UNICEF (2013), the traffic accident death rate in 2007/08 was 95 per 10,000 motor vehicles, placing the country among those with extremely high road safety challenges. Additionally, in that same year, police reports documented 15,086 accidents, resulting in 2,161 fatalities and over 82 million Ethiopian Birr in losses, equivalent to approximately US$7.3 million in property damage (US$1 = 11.34 Ethiopian Birr). Up until 2005/06, traffic accidents and fatalities were increasing at rates of 17% and 10% per year, respectively, although there has been a recent decline in these figures. In that same year, there were 2.84 road accident fatalities per 100,000 people (UNICEF, 2013).

According to a report by the World Health Organization, traffic accidents in Ethiopia contribute to an age-adjusted death rate of 20 per 100,000 people. This represents 2.50% of all deaths in the country, placing Ethiopia 68th in the world for crash fatalities. Road traffic accidents rank as the 12th leading cause of death among the top twenty causes in the nation. The report further indicates that the economic costs associated with road crashes and injuries amount to 1% of the Gross Domestic Product (GDP) in low-income countries like Ethiopia (WHO, 2016). The increased use of motorized transport to support socio-economic and physical integration is a consequence of the recent modernization and urbanization of the city. Numerous new roads have been built, and existing roads have been improved to stimulate economic growth and address the rising motorization rate (Samson, 2006).

Ethiopia's Road Authority reported 15,082 accidents during 2015–2016, resulting in 2,161 fatalities and 7,140 injuries that did not result in death (ERA, 2015). Despite existing studies, no research has specifically focused on traffic accidents in the current research area. Studies in the Amhara National Regional State and Addis Ababa suggest that the frequency of traffic accidents is increasing across Ethiopia’s urban and semi-urban areas (Mekonen, 2007). Vulnerable groups, particularly pedestrians, comprise 55% of traffic-related deaths in Ethiopia, followed by passengers (37%), drivers (6%), and motorcyclists (2%) (WHO, 2009). Research by Persson (2008) found that male drivers accounted for 91.1% of accidents, with

driver age and vehicle service history contributing to 55% and 42.2% of accidents, respectively. Similarly, Sileshi (2014) attributed 83.8% of accidents to driver error, identifying it as the leading cause. Lakew (2014) identified correlations between accident frequency and behaviors such as yielding to pedestrians, crossing techniques, and seatbelt usage. Gebremeskel (2014) and Seid *et al*. (2015) highlighted the disproportionate impact of male drivers on pedestrians and passengers compared to female drivers.

The Oromia Regional State, geographically central and Ethiopia's largest region, bears a significant burden of RTAs, contributing 14.5% of national accidents and 24% of fatalities (Teferi *et al*., 2014). Factors affecting post-accident outcomes include delays in accident detection, challenges in victim rescue, inadequate transportation to medical facilities, and insufficient pre-hospital care (Seid *et al*., 2015). A study conducted by Hordofa *et al.* (2018) in Burayu Town revealed that road traffic accidents (RTAs) represent the most significant public health concern in Sheger City. The research highlights the alarming prevalence of fatalities associated with RTAs, indicating a critical need for targeted interventions and policy measures to enhance road safety and reduce the incidence of such tragic events. The findings underscore the multifaceted nature of traffic-related issues, including factors such as vehicle density, infrastructure quality, and driver behavior, which collectively contribute to the high rates of mortality in urban settings.

1.2 Statement of the Problem

Road traffic accidents (RTAs) are a critical public safety concern in Sheger City and its surrounding areas, leading to significant loss of life, injuries, and economic burdens. Despite various interventions, the frequency and severity of RTAs continue to rise, posing challenges to urban mobility and road safety management. The primary challenges contributing to RTAs in Sheger City include poor driving behavior, inadequate road infrastructure, vehicle defects, and gaps in traffic law enforcement. Reckless driving, speeding, failure to yield to pedestrians, and impaired driving are among the leading behavioral factors causing accidents. Additionally, deficiencies in road design, lack of pedestrian walkways, unclear traffic signs, and poor maintenance of road surfaces exacerbate the risk of collisions. Vehicle-related factors, such as brake failures and worn-out tires, further compound the problem. The enforcement of traffic laws remains inconsistent, allowing unqualified drivers and non-compliant road users to contribute to road hazards.

The impacts of RTAs in Sheger City are far-reaching. They result in avoidable fatalities, long-term disabilities, and financial strain on victims and their families. Moreover, RTAs contribute to traffic congestion, reducing the efficiency of transportation systems and hampering economic activities. Addressing these issues requires a data-driven approach to identify high-risk areas, assess key accident causes, and implement targeted interventions. This study seeks to fill the existing research gap by systematically analyzing the trends, causes, and consequences of road traffic accidents in Sheger City. By integrating both qualitative and quantitative data, the research aims to provide evidence-based recommendations for improving road safety and reducing accident-related fatalities and injuries.

1.3. Objectives

1.3.1. General Objective

This thesis aims to assess the road traffic accidents that occurred in Sheger City, Oromia Region, Ethiopia, during the study period.

1.3.2. Specific Objectives

The specific objectives of this study are to:

- Evaluate the trends and scale of road traffic accidents.
- Identify the primary factors that contribute to road traffic accidents.
- Examine how inadequate road traffic management affects public safety in Sheger City of Oromia Region, Ethiopia.

1.4. Scope

This study focuses on assessing road traffic accidents (RTAs) in Sheger City of Oromia, Ethiopia. It aims to analyze the trends, risk factors, and impacts of RTAs over a five-year period (2018–2022). The study is geographically limited to five sub-cities within Sheger City: Burayu, Sululta, Sebeta, Tafo, and Gelan, which were purposively selected due to their high incidence of traffic accidents.

The study employs a mixed-methods approach, integrating both qualitative and quantitative data. Quantitative data is obtained from police accident reports, government transportation offices, and other relevant institutions, while qualitative data is collected through structured

interviews, focus group discussions, and direct observations involving key stakeholders such as traffic police, drivers, pedestrians, accident victims, and city transport officials. This study does not include other sub-cities within Sheger City, such as Koye Face, Gefersa Guje, Furi, Gelan Guda, Kura Jida, Mana Abichu, and Melka Nono, due to resource constraints. Additionally, while the research incorporates socio-economic impacts, it does not extend to broader policy-level evaluations at the national level. By addressing these aspects, this study aims to provide valuable insights that will inform policymakers, law enforcement agencies, and urban planners in developing effective road safety interventions for Sheger City.

1.5. Significance of the Study

Road traffic accidents have emerged as a major concern for the government, road safety organizations, and the general public. As a result, this study enhances the understanding of the trends, patterns, and risk factors associated with traffic accidents. The findings are anticipated to motivate further research by the local bureau, encouraging additional actions. This report serves as a valuable resource for individuals interested in conducting similar studies and can be utilized for academic purposes. Furthermore, the discussions aim to raise awareness about road safety issues in the area and offer recommendations to inform policy and strategic decisions in the ongoing transformation of the transportation sector.

1.6. Operational Definitions

- **Risk Factors**: These are the various elements that increase the likelihood or probability of a road traffic accident occurring and intensify the consequences of a collision.
- **Serious Injury (as defined in police reports)**: A serious injury is one that results in: death within 30 days of the accident, hospitalization for over 24 hours, or a life-altering injury such as a severe fracture, amputation, or brain injury.
- **Slight Injury**: A minor injury, such as a sprain (including whiplash to the neck), a minor cut or bruise, or a slight shock that can be treated at the scene of the accident.

1.7. Limitations of the Study

This study has several limitations that may affect its results. The main issue is the use of secondary data from traffic police records, which could be inaccurate or incomplete due to underreporting of road traffic accidents. Furthermore, the study focuses only on five sub-cities in Sheger City, which may overlook differences in traffic conditions in other areas.

While using both qualitative and quantitative methods adds depth to the research, it also made it challenging to connect themes with statistical data. Additionally, the researcher encountered several challenges during the survey and data collection process, including time constraints, lack of funding, outdated information, and limited collaboration from government offices. To ensure the study's success, these issues were addressed. The researcher provided a brief explanation of the study's purpose to the respondents, who were solely academic participants, and assured them that their information would be treated confidentially. Because of these limitations, the findings should be viewed carefully, highlighting the need for further research that covers a wider area and collects more detailed data.

1.8. Organization of the Study

This study is divided into five chapters to provide a clear and thorough analysis. Chapter One introduces the research, including the background, problem statement, objectives, scope, significance of the study, operational definition and limitation of the study. Chapter Two offers a literature review, covering relevant theories, previous studies, and policy discussions related to road traffic accidents. Chapter Three explains the methodology, detailing the mixed-methods approach, study design, data sources, and analysis techniques. Chapter Four presents a detailed examination of the results, combining descriptive statistics and thematic insights to identify trends, patterns, and risk factors associated with road traffic accidents. Finally, Chapter Five wraps up the study by summarizing the main findings, suggesting intervention strategies, and recommending areas for future research. This organized structure helps ensure clarity and coherence, making it easier to understand the complex issues surrounding road traffic accidents in Sheger City.

2. LITERATURE REVIEW

2.1. Explanation of Road Traffic Crashes

A road traffic crash refers to any collision involving vehicles on public roads, encompassing incidents with a single vehicle, as well as collisions involving other road users, animals, pedestrians, or stationary objects (Safe & Tesema et al., 2004). "The Economic Commission for Europe (ECE) defines road traffic accidents (RTAs) as injuries occurring on paths or roads open to the public, resulting in one or more fatalities or injuries, with at least one moving vehicle involved." RTAs are also described as collisions between vehicles, vehicles and people, vehicles and animals, or vehicles and stationary objects (ECE, 2005). The World Health Organization (WHO) defines a road traffic crash as "any crash involving a device designed primarily for, or being used at the time primarily for, conveying persons or goods from one place to another." It can also be categorized based on various factors, such as the severity of injuries requiring hospitalization or a fatality occurring within 30 days of the crash. For example, "the crash occurred on any road, street, or any place open to the public, and involved one or more road vehicles which were in motion at the time of the accident" (WHO, 2004). A traffic collision is often described as "an event that is unexpected, associated with chance, probability, or unfortunate outcomes." It can also be defined as "the occurrence that typically produces injury, death (fatal), or property damage (PDO)." Therefore, studying the factors contributing to accidents is crucial for reducing traffic crashes by combining safety-focused road network design and planning.

2.2. Theoretical and Empirical Review

A theory, according to Creswell (2009), is a connected collection of variables or constructs assembled into claims or theories. The theoretical framework supports sociological research; theories organize and synthesize vast amounts of data, are often broad in scope, connect disparate facts, and provide context, attempting to explain facts (Parson, 2007). For this study, two social and behavioral science theories—system theory and risk theory—are applied, along with an empirical literature review. This approach is chosen because theories play a crucial role in guiding empirical research procedures and offering insights into research issues (Gilbert, 2015).

2.3. System Theory

System theory serves as the foundational theoretical framework for this study. It is also known as the systems approach (Rayan, 2008). According to Salmon et al. (2010), it is the most advanced framework used in road safety research in recent decades. The core principle of system theory is that accidents result from the failure of interactions between system components in the traffic domain. The theory primarily focuses on the maladjustment between people and their environment (Muhlrad and Lassarre, 2005). Consequently, traffic accidents arise from a combination of physical, socio-environmental, human, and vehicle factors. The primary elements of the theory include the road environment, vehicles used for transportation, and human behavior (WHO, 2015). The environmental aspect encompasses both natural and constructed environments, in addition to social and transportation networks. The human factor encompasses individuals' perceptions of risk, general street behavior, pedestrian behavior, and demographic characteristics of road users, such as age, sex, education, socioeconomic level, and life cycle stage (WHO, 2004).

2.4. Major Factors Contributing to Vehicle Crashes

Road traffic crashes arise from a complex interplay of various factors and cannot be linked to a single cause. The Ethiopia Steps Survey (2015) on the Road Traffic Accident Facts Report identifies the contributing factors as follows: Vehicle Factors (8%), Human Factors (80%), Road Environment Factors (3%), and Other Factors (9%). In comparison, a more recent study on motorbike traffic injuries conducted in Iran and worldwide found that human factors contribute to 58.82% of these injuries, vehicle factors account for 22.05%, and environmental factors comprise 17.64%. The study also revealed that the human element is the most significant factor when it comes to the likelihood of traffic accidents involving motorcycles or other motor vehicles (Mazaheri *et al*., 2018).

2.4.1. Human Behavior Factors

The behaviors, experience, and driving skills of individuals play a significant role in determining the appropriate inspection and regulatory measures for road safety, as highlighted by studies on road traffic accidents (Gueguen *et al*., 2015; Han, 2015). Human factors play a significant role in the occurrence of road traffic crashes, accounting for the largest share. In developing countries, it is estimated that these factors are responsible for 70

to 80% of all traffic crashes (WHO, 2013). A study by Odoro (1995) in Kenya found that human factors contributed to 85% of all accidents. In Ethiopia, research by Persson (2008) indicated that human factors were responsible for 91.1% of traffic accidents in Addis Ababa. These factors include age, alcohol and drug use, driving experience, rider training, speed, and helmet usage.

Studies involving drivers in traffic accidents suggest that while alcohol is the most prevalent cause of driver impairment, other drugs or addictions can worsen the situation (Politis et al., 2013). Research has demonstrated that driving under the influence of alcohol or drugs impairs judgment and vehicle control (Guohula *et al*., 2013; Elvik, 2013; Sebego *et al.,* 2014; Papadimitriou *et al.,* 2014; Rudistill, 2014)."Additionally, Evelyn (2008) found that middle-aged people's use of drugs and binge drinking among young people were significant risk factors for both mortality and injury. In Ethiopia, the Federal Police Commission has set national regulations for drunk driving for both general and young drivers. According to the 2012–2013 statistics, the permissible blood alcohol content (BAC) level is less than or equal to 0.08g/dl for both groups, but 4% of all traffic fatalities are linked to alcohol-related crashes.

Moreover, speeding is identified as a primary risk factor for collisions involving all road users, with motorbike riders experiencing the highest rate of speeding-related crashes (77%). Chepngetich's (2016) study showed that for every 1% increase in speed, the risk of traffic accidents increases by 20.4%. This highlights the significant risk of collisions when riders exceed the speed limit. More recent research indicates that increasing speed from 80 to 89 miles per hour (mph) raises the risk of death by 13%, and increasing speed from 80 to 90 mph increases the likelihood of dying by 27%. This explains why speeding is a major contributor to traffic accidents.

2.4.2. Vehicles factors

Using a safe vehicle is a key strategy to reduce the risk of traffic injuries within a safe system approach. The World Health Organization emphasizes that regular servicing of a car within its service year is essential for safe driving, addressing critical issues such as brake failure, tyre deterioration, light problems, and other mechanical flaws. This highlights the ease with which one can become involved in traffic accidents if any of these issues are present (WHO, 2013). The observation made by Nicholas *et al*. (2001) states that mechanical problems, such

as worn tires, faulty brakes, and other car malfunctions, are another crucial factor that leads to street visitor accidents.

As a result, in developing countries like Ethiopia, the majority of vehicles are often old and frequently contribute to injuries. According to statistically significant studies regarding vehicle components, quick tire removal increases the frequency of traffic accidents (Elvic, 2015).

The study by Roddis (2014) on the risk factor of RTA through vehicle factor indicated that high strength steels in vehicles, the stiffness of the front-end structure of vehicles had a strong impact on protecting passengers from accident levels, and that travelling backseats had a strong correlation with the reduction of road traffic accident levels. In addition, according to previous studies, junction angle and lighting both statistically significantly affect the probability of crashes across all collision categories (Dong *et al.*, 2014). Other research on RTA crush also revealed that, the length of bus-only center lanes, overcrowding, and the kind of vehicles had the most effects on an increase in traffic accidents (Kyoung-Ah *et al.*, 2016). Additional research in Germany indicates that approximately 2,300 accidents involving heavy goods vehicles occur annually due to improper loading, with estimates suggesting that inadequate load securing contributes to up to 25% of truck-related accidents (Sebego *et al*., 2014).

2.4.3. Road and Environment Factors

Environmental factors such as broken and narrow roads, heavy traffic, poor light, and the quickly increasing number of cars are all contributing factors to road traffic crashes. Ensuring road safety for all users is one of the government's duties. The bulk of collisions resulting from loss of control breakdowns (77%) happened on straight road portions instead of on bends (23%). (Senserick *et al*., 2017). According to the physical environment, various climatic risks and geo hazards, such as heat, fog, strong winds, snow, rain, ice, flooding, hurricanes and avalanches, have an impact on roads and therefore on traffic accidents (Jian andWong,2014).

Similar to this, environmental variables such as road design, location, time of day, season, we ather, visibility, and traffic laws all have a big influence on traffic accidents (Stevens *et al*., 2 007; Kebede, 2013). Similar research findings were reported by Vorko *et al*. (2006), who showed that poor visibility at night and during the day, as well as urban linkages, were major

risk factors for fatal traffic accidents. Research on the connection between passenger carrying, nighttime driving, and crush outcomes reminds us of a major influence on traffic accidents (Lawrence, 2004). In a similar vein, there is a correlation between the time of day, the weather, and the seasonality of traffic accidents (Bentri, 2011). According to Stevens *et al.* (2007), the majority of accidents typically happen at night, on weekends, and between October and December. Concerning the road factor, certain research studies have reported that roadside activities, such as street selling and petty trading, enhance the probability of traffic accidents (Sebego *et al.*, 2014). Besides, encroachments impeded 77% of the sidewalk width on average, forcing pedestrians to step onto the road and causing vehicles to swerve (Kyoung-Ah *et al.,* 2016). Illegally parking vehicles restricted 33% of the street width on average (Faraz *et al.,* 1999).

2.4.4. System of Traffic Laws, Control and Regulations

Research on drivers' penalties shows that almost all violations have been reduced (Rudistill, 2014). According to research on traffic inspections, the percentage of drivers who said speed cameras had an impact on their driving had also reduced over time. Furthermore, the majority of drivers (61%) believed that speed cameras were going to improve safety. (Edna, 2016). To enhance road traffic safety, it is essential to implement effective traffic management strategies (WHO, 2015). Research on traffic law enforcement revealed that roadside suspensions led to a 65.2% decrease in repeat incidents of drunk driving in Ontario (Tracey *et al*., 2015). Another study on the effects of traffic penalties revealed similar results, demonstrating a significant drop in the proportion of drivers who reoffended and the length of time it took to do so (Siskind, 2015). The overall preventive effect of penalties is supported by the above information.

2.5. Risk Theory

Hinders (2011) defines risk as an individual's subjective assessment of the likelihood of a particular negative event occurring and their concern for its consequences. Thus, an individual's ability to assess risk is influenced by both the estimated probability and the severity of the potential consequences. According to Damian (2006), four components work together to determine risk in transportation. The first factor is exposure, which pertains to the level of movement or travel among various users or the density of the population within the system. The second factor is the fundamental likelihood of a crash occurring given a

particular level of exposure. The third is the likelihood of injury if an accident occurs, and the fourth is the result or consequence of the injury. Building on these findings, Rocío *et al.* (2016) showed that the degree of disability is linked to social, economic, and health factors, all of which significantly affect recovery in Spain. While road traffic accidents (RTAs) primarily cause mild disability, in 2,000 cases, they also lead to moderate, severe, or complete disability.

2.6. Policy Review

Road safety laws and regulations are crucial for reducing accidents as they govern road users by balancing their rights and responsibilities (WHO, 2015). State policies guide these traffic rules. For this study, the researcher has reviewed road safety policies from various global regions, including European, African, sub-Saharan, South African, and Ethiopian policies. Schopper (2009) notes that injury prevention is not a new concept, as all nations have laws and regulations addressing issues related to violence and injury, and many have already taken steps to address the consequences of injury and violence. To tackle traffic accidents, each country must develop its own road policy (WHO, 2001).

Some European countries, including Germany, Bulgaria, Hungary, Norway, and Finland, have well-organized national road safety policies, complemented by continental policies. In Africa, the African Charter (AU, 2011) includes 34 articles on regulating road safety and outlining the responsibilities of governments and drivers. For Sub-Saharan Africa, the Economic Commission for Africa (ECFA, 2009) has established road safety policies focusing on seat belt use, speed limits, and drunk driving. A few African countries, such as South Africa, have a comprehensive road safety policy, exemplified by the Road Safety System Approach (SARSE) for 2011-2020 (Alene, 2015). In Ethiopia, although there is no well-organized national road safety policy, there are some established proclamations, such as Proclamation number 468/2005 and Regulation number 205/2011. To enhance road safety management, it would be beneficial for Ethiopia to adopt policies similar to those in European countries, through an integrated and participatory approach to traffic accident management.

2.7. Studies done on Road Traffic Accidents

Researchers in traffic safety have been deeply concerned about the casualties resulting from road traffic accidents. Various models have been employed to analyze the injuries and

fatalities associated with these incidents. For example, Bunn *et al*. (2003) aimed to evaluate if traffic calming measures implemented across entire areas could lead to a decrease in deaths and injuries related to crashes. They utilized data from the Transport Research Information Service, International Road Research Documentation, and additional sources concerning fatalities, injuries, and traffic incidents. The findings indicated that implementing area-wide traffic calming strategies in urban areas could significantly lower traffic-related injuries.

Abbassi (2005) conducted a study on road accidents in Kuwait, employing an Autoregressive Integrated Moving Averages (Box-Jenkins) model and comparing its effectiveness to that of Artificial Neural Networks (ANN) for predicting fatalities from road traffic incidents. His findings indicated that ANN outperformed the Box-Jenkins model, particularly for long-term data sets that lacked seasonal trends or autocorrelation. In another study, Ismaila *et al*. (2009) focused on modeling deaths and injuries from road traffic accidents in Nigeria, analyzing data collected between 1960 and 2006. They discovered that of the eleven models available in the SPSS 16.0 statistical software including linear, logarithmic, inverse, quadratic, cubic compound, power, S, growth, exponential, and logistic the cubic model provided the most accurate predictions for both injuries and fatalities.

Van *et al*. (2006) estimated the number of non-fatal road traffic injuries (RTI) in Thai Nguyen, Vietnam, using the capture-recapture method. In order to estimate the total, the capture-recapture approach matches two independent samples. The technique was used to more precisely estimate non-fatal RTIs using the combined records of Thai Nguyen City's hospitals and police sources. They discovered that, in underdeveloped nations with limited resources for setting up and maintaining regular reporting systems, the capture-recapture method can be a cost-effective substitute for assessing traffic injuries.

Fatim *et al*. (2007) used data from the National Health Survey of Pakistan (NHSP 1990–1994) to estimate the annual incidence patterns and severity of unintentional injuries among people over five in Pakistan. In order to assess the overall annual incidence, trends, and severity of unintentional injuries for males and females in urban and rural locations, 18,315 people over the age of five were questioned using a two-stage stratified approach. They discovered that Pakistan had a high rate of unintentional injuries among people older than five. The findings were deemed helpful in organising additional research and setting priorities for injury prevention initiatives both domestically and in other developing nations facing comparable circumstances.

Nasr (2010) used a regression model to examine road accident deaths in Pakistan, both in rural and urban areas. The model attributed accidents to a variety of factors, including weather, driving abilities, vehicle condition, road length, population density in each region, and compliance with auto insurance. He discovered that whereas the overall number of accidents increased by 10% between 1998 and 2008, the growth rate of fatal accidents increased by 16%, which was considerably worse. In order to generate prediction distributions based on numbers rather than rates per a million vehicle kilometres driven, Raeside (2004) proposed using models based on Broughton's (1991) methodology.

Traffic volumes are not included in the models. The methodology employed autoregressive and linear trend terms to model the annual data series of Great Britain's total, serious, and minor casualties. This study aims to adapt Raeside's methodology to the unique circumstances of Nigeria. It is thought that using the model in a developing nation will close a significant research gap.

2.8. Road Traffic Accident in Ethiopia

Being a low-income and developing nation, Ethiopia also experiences a high frequency of serious traffic accidents. And there are numerous reasons why the aforementioned issue exists, including the sharp rise in the demand for transportation, the increase in population density, urbanization, the rise in car ownership despite the availability of more transportation options, the availability of subpar safety handling systems, and so forth. Ethiopia is therefore listed as one of the nations with the highest global traffic accident death rates. For example, the WHO study from 2013 states that the road crash fatality rate in Ethiopia was 4984.3 deaths per 100,000 vehicles annually, compared to 574 deaths per 100,000 vehicles annually across sub-Saharan Africa. According to numerous studies, Ethiopia has one of the highest automobile mortality rates in the world, with over 100 fatalities for every 10,000 vehicles.

Comparing this to Kenya and the UK, where the numbers are roughly 19 and 2, respectively, is important. In terms of severity, Ethiopian crashes result in almost 30 times as many fatalities or injuries as those in the United States. Generally speaking, the problem's scope and intensity are growing periodically and negatively impacting both the nation's economy and people's quality of life.

2.9. Road Accident Recording Systems in Ethiopia

All traffic accidents within their jurisdiction must be recorded by the Traffic Police's regional departments. The collection and processing of national accident data falls under the purview of the Federal Police Commission. Accident data are manually submitted at the Woreda Police Station in each region. Accident classification, date, time, day of the week, year, driver's age, sex, education, ownership, vehicle service year, vehicle defects, accident location, road traffic condition, road surface condition, road junction type, weather and illumination condition, collision type, property damage, and parties injured (age, sex, physical fitness, and the like) are all included in the traffic police accident data form. The relevant Region Police Commissions receive monthly reports. To create national accident statistics, the Region Police Commission will then submit a quarterly report to the Federal Police Commission.

A large portion of the data is required for the traffic police's own operations in Ethiopia, mainly for the purpose of enforcing the law and conducting prosecutions. Although the police have no direct interest in or use of some of the accident data, other organizations depend on it for their operations. Ethiopia's data recording system was often quite antiquated and subpar, particularly at the woreda and zonal levels. For example, Eskindir (2019) identified significant gaps in traffic accident data collection within the Gurage Zone, Yem Special Woreda of the Southern Nations, Nationalities, and Peoples' Region (SPNNR), as well as the Jimma Zone Police Commission Office. It was observed that specific regions lacked data for a duration of four years, while other areas exhibited inaccuracies in the recording of accident causes and locations.

2.10. Countermeasures to reduce Vehicle crashes

According to a recent report by the World Health Organization (2017), motorcycles and three-wheelers contribute to 23% of all road traffic fatalities, resulting in over 286,000 deaths globally each year. This number is on the rise unless urgent measures are implemented by governments. While there are no universal strategies for mitigating the severity and injury rates of motorcycle accidents, approaches vary significantly by location. Additionally, the Ministry of Interior's traffic accident report for Abu Dhabi in 2013 highlighted that road traffic crashes occur for numerous reasons, making it difficult to pinpoint the primary causes due to the diversity of incidents.

Nevertheless, recognizing the various measurement kinds is essential for road user safety. Therefore, it is crucial and desperately needed that developed nations like Ethiopia spread their successful motorbike injury interventions to poor nations like Ethiopia.

2.10.1. Enforcement

One important strategy for preventing traffic accidents is strict enforcement, which calls on law enforcement to make sure that drivers follow traffic laws. However, as police officers are the main source of information about traffic accidents, they play a crucial role in reducing the issue of motorbike crashes. Nonetheless, the majority of researchers discovered that traffic campaigns and police enforcement are highly successful in stopping reckless riding, such as using cell phones while riding a motorcycle, and speeding. Additionally, police enforcement is essential in tackling the issue of motorbike traffic accidents. In the UK, police officers lower the number of fatalities and serious injuries by 33 percent, and in Europe, they might cut the number of road traffic deaths and serious injuries by 50 percent, according to the WHO (2009) research. Therefore, all risk factors for safe road users are addressed by efficient enforcement.

2.10.1.1. Enforcement of speed limit

Furthermore, reducing the severity of vehicle crashes effectively depends on the enforcement of speed restrictions. However, careful thought should be given before setting a speed limit; it must depend on the function of the road and the traffic composition. For example, the World Health Organization (WHO) reported in 2013 that the speed limit in developed nations like Sweden and Australia is not to exceed 50 km/h. In Ethiopia, however, the Federal Police Commission's 2012/2013 data shows that the speed limit in urban areas is 60 km/h, while in rural areas it is 70 km/h. This concept differs from the previous one, though, because a large number of vulnerable road users reside in metropolitan areas. For road users to be safe, the speed limit must be modified in some way. Furthermore, speed cameras have shown great success in lowering the number of motorcyclists that are speeding. To improve vehicle safety, the government must take into account the above described factors.

2.10.1.2. Enforcement of alcohol in vehicle crashes

Enforcing drunk driving laws strictly can cut road deaths by 20%, according to World Health Organization analysis (2015). Additionally, the data suggests that driving after consuming alcohol raises the likelihood of a traffic accident. Therefore, in order to reduce drunk driving and improve road safety, tough enforcement is a must.

2.10.2. Providing valuable education on road safety issues

Education, which includes everything from awareness campaigns to driver training, may significantly increase everyone's understanding of road safety hazards (WHO, 2013). The government should thus offer traffic safety education programs in crucial training facilities, such as the rider training center, in order to promote road safety for individuals who require instruction. Additionally, drivers must be aware of what constitutes appropriate riding behavior. By doing so, education can assist lower traffic hazards, particularly for those who violate traffic regulations.

Therefore, traffic safety issues including speeding, drunk driving, cell phone use, not wearing a safety helmet for motor bike, and other distractions like side-chatting with friends while driving should be the main emphasis of education programs. Because of its inherent importance, road safety requires special attention in order to preserve lives. In actuality, these elements are not given more attention in our nation when it comes to road safety. Besides, there is a pressing need for increased attention from the government and other stakeholders to enhance road safety.

2.7. Research Gap

A review of the literature on road traffic accidents (RTAs) highlights several key gaps that need further exploration. Many studies primarily focus on improving traffic crash reporting methods, but they do not adequately address the effectiveness of documentation practices or the need for training programs aimed at better understanding and preventing accidents. Additionally, previous research has established significant correlations between accident frequency and factors such as driver priority, pedestrian crossing behavior, and seatbelt use. However, most Ethiopian studies rely heavily on quantitative methods, with a strong emphasis on driver behavior as the leading cause of RTAs. This narrow focus overlooks the complex interplay between human, environmental, and infrastructural factors.

Another critical gap is the lack of research on the socioeconomic consequences of road traffic accidents. Existing studies rarely examine the financial burden on accident victims, healthcare systems, and urban productivity. Moreover, the theoretical frameworks used in previous studies are often limited, failing to incorporate multidisciplinary perspectives that could provide deeper insights into the root causes and long-term impacts of RTAs.

This study aims to address these research gaps by:

1. **Integrating a mixed-methods approach** – combining quantitative accident data with qualitative insights from key stakeholders, including drivers, pedestrians, traffic police, and urban planners.
2. **Examining the broader socioeconomic effects of RTAs** – assessing their impact on victims, families, and city infrastructure.
3. **Evaluating the effectiveness of traffic law enforcement and public awareness campaigns** – identifying potential weaknesses in existing road safety measures.
4. **Providing data-driven recommendations** – offering actionable solutions to reduce accident rates and improve road safety management in Sheger City.

By filling these gaps, this research will contribute to a more comprehensive understanding of RTAs, supporting the development of more effective policies and interventions. Table 2.1 below shows the general overview and summary of comparative analysis of all topics of the literature review:

Table 2.1. Summary of the comparative analysis of literature review

Title of Literature Review	Authors and Year	Research Approach and Method	Research Parameter	Key Findings
Explanation of Road Traffic Crashes	WHO, 2004	Systematic and comprehensive analysis	Definition	A road traffic crash involves at least one moving vehicle and results in injury, fatality, or property damage.
Theoretical and Empirical Review	Creswell, 2009	Theoretical Framework Analysis	Role of theory in research	Theories help structure research by explaining relationships between variables.
System Theory	Salmon et al., 2010	System Approach	Interactions between system	Traffic accidents result from failures in the

		Analysis	components	interactions between drivers, vehicles, and the road environment.
Major Factors Contributing to Vehicle Crashes	Ethiopia Steps Survey, 2015	Numerical Investigation	Human, vehicle, and environmental factors	Human factors contribute 80% of crashes, followed by vehicle factors (8%) and road environment (3%).
Human Behavior Factors	Gueguen et al., 2015	Behavioral Study	Speeding, alcohol use, experience	Speeding and alcohol consumption are major risk factors; younger drivers are more likely to crash.
Vehicle Factors	WHO, 2013	Vehicle Safety Analysis	Mechanical faults in vehicles	Poorly maintained vehicles, including worn tires and brake failures, significantly contribute to crashes.
Road and Environmental Factors	Kebede, 2013	Numerical Investigation	Road design, visibility, weather	Poor road conditions, lack of lighting, and extreme weather increase accident risks.
System of Traffic Laws, Control, and Regulations	Siskind et al., 2015	Survey and Numerical Investigation	Impact of penalties on traffic violations	Strict penalties reduce repeat offenses and improve road safety.
Risk Theory	Damian, 2006	Risk Analysis Framework	Exposure, probability, consequences	Higher exposure increases crash risk; economic and social factors influence accident severity.
Policy Review	WHO, 2001	Policy Analysis	Road safety laws and national policies	Countries must develop unique road policies; comprehensive enforcement improves outcomes.
Research Gap	Various sources	Comparative Analysis	Limitations in existing studies	Many studies focus only on driver behavior and ignore the role of infrastructure, socioeconomic impact, and enforcement effectiveness.

3. MATERIALS AND METHODS

3.1. Research Method

A combined technique (qualitative and quantitative) were employed in this investigation. Both qualitative and quantitative methods have advantages and disadvantages. A mixed approach was an appropriate method for statistical analysis, combining detailed narrative descriptions, identification of overall themes, multiple perspectives, statistical data, and holistic analysis. It integrates words, images, and numerical variables, and allows for the study of behavior across various contexts or conditions, addressing the gaps in both qualitative and quantitative methods (Paul *et al.,* 2007). The concurrent transformational technique, one of the mixed-method approaches, was used in this investigation. Creswell (2009) states that a particular theoretical perspective served as the study's compass while using the concurrent transformative technique. During the data collection process, the method may or may not be sequential, and either of the designs (qualitative or quantitative) were given precedence. This approach has been selected for all of its concepts because it allows the researcher to employ theoretical frameworks on which the researcher may rely and offers the researcher the opportunity to select the issue of priority.

3.2. Study Design

The study's research strategy adopted a mixed methods approach, incorporating both quantitative (descriptive) and qualitative data. This included techniques such as observation, interviews, and focus group discussions (FGD). The philosophical foundation of the study was pragmatism. The pragmatic approach was selected because it makes use of numerous data sources, multiple methods that may be used simultaneously or sequentially, and multiple viewpoints for result interpretation. Analysing quantitative data involved using percentages and means, whereas analysing qualitative data from observation, focus group discussions, interviews, and victim cases used theme and narrative analyses. Analysing the patterns, trends, and risk factors of traffic accidents is, ultimately, a suitable design.

3.3. Study Area and Data Sources

3.3.1. Study Area

Sheger City is located in the central region of the Oromia Regional State, encircling the capital city, Finfine. The total estimated area of Sheger City is 1,600 km². It consists of

twelve districts (Burayu, Koye Face, Gelan, Tafo, Furi, Gelan Guda, Gefersa Guje, Kura Jida, Mana Abichu, Melka Nono, Sebeta and Sululta), 40 Rural kebeles and 36 districts (figure 3.1) (Sheger City Administration Office, 2023). Among its Sub Cities Burayu, Sebeta, Sululta, Tafo, and Gelan were purposively selected.

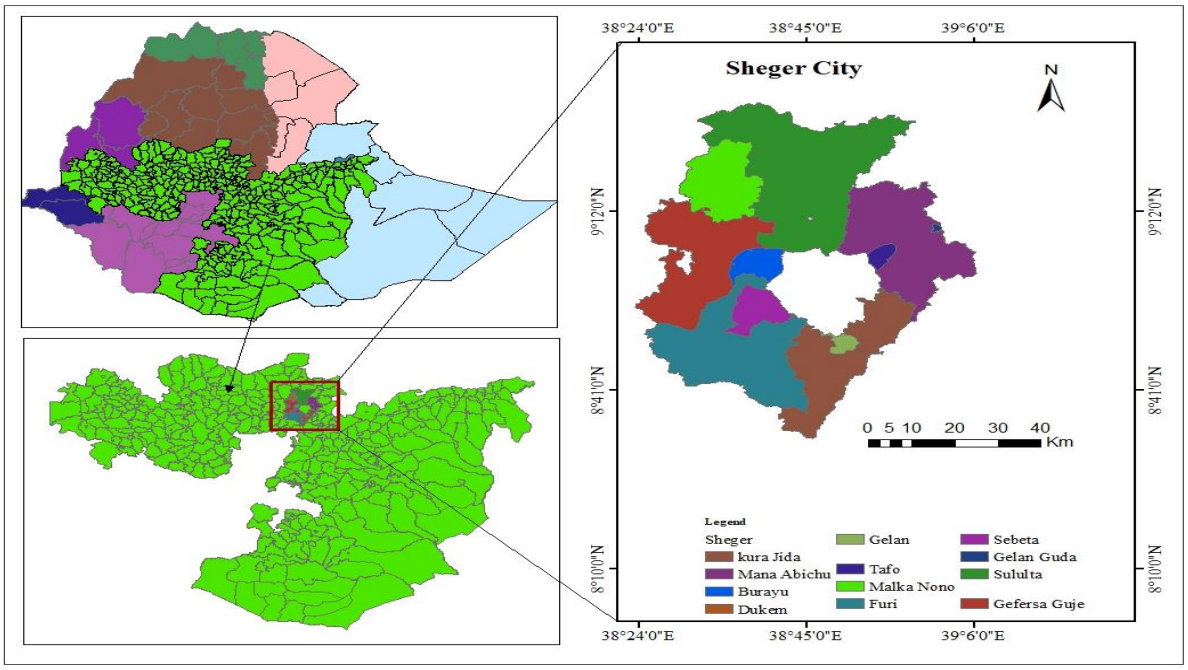

Figure 3.1. Location Map of Study Area

3.3.2. Data Source

To meet the goals of this research, both primary and secondary data were collected. Primary data was collected from participants through focus group discussions (FGD), semi-structured interviews, in-depth interviews, key informant interviews, case studies, and non-participant observation. Furthermore, pertinent books, journals, articles, and reports from international organizations like WHO, the World Bank, and IRTAD were reviewed to enhance the study. Secondary data was sourced from Road Traffic Accident (RTA) records spanning from 2018 to 2022.

3.4. Methods of Data Collection

This study used both qualitative (case study methodology, interviews, focus group discussions (FGD), and observation) and quantitative (sorting and analyzing secondary data) approaches to collect data.

3.4.1. Qualitative Method

The proposed research methodology employs a qualitative approach to explore the meanings and interpretations individuals ascribe to their experiences related to road traffic accidents. This aligns with the perspective outlined by Scott and Deirdre (2009), who emphasize the importance of understanding how people define, describe, and make sense of their lived experiences. Primary data was collected through semi-structured interviews with key informants, including traffic police, transportation specialists, and health professionals. Additionally, personal observations and focus group discussions with relevant government officials were carried out. By means of personal observation, the researcher examined pedestrian crossing behaviors at three different intersections in Burayu sub city**.** The observations were conducted continuously over a period of one month to capture a comprehensive understanding of pedestrian and driver interactions. Data collection took place during two specific time periods: lunchtime ensuring that the study accounted for variations in pedestrian behavior and traffic flow at different times of the day.

The purpose is to obtain comprehensive, confidential insights from knowledgeable stakeholders and elicit the perspectives and actions of government organizations regarding road traffic accident prevention and management in the study area. This qualitative approach aims to provide in-depth, contextual understanding to inform evidence-based policies and interventions. Semi-structured interviews were conducted with pedestrians and drivers to gather basic information about the socio-economic implications and risk variables associated with RTAs.

3.4.2. Quantitative Method

Statistical findings and comparisons are produced using quantitative methods. Kotheri (2004) notes that quantitative research methods may provide quick solutions that lack meaningful connections to individuals or the field, and statistical associations can be based on arbitrary factors when viewed within the context of naturally occurring interactions. In this study, quantitative data was gathered from the traffic police's statistical reports on road traffic accidents in the Burayu, Tafo, Sululta, Sebeta, and Gelan districts from 2018 to 2022. The aim of gathering this data was to describe the trends and patterns of road traffic accidents in the study area.

3.5. Sampling Size and Method

3.5.1. Sample Size

The qualitative data was collected by evenly distributing participants across sub-cities, the study captures variations in traffic conditions, enforcement practices, and public awareness, providing a comprehensive and representative assessment of road traffic accidents in Sheger City. The sample size was calculated using a formula for single population Proportion as follows.

$$n = \frac{(Z\alpha/2)2p(1-p)}{(\mathrm{d})2}$$

Where, N=maximum sample size to represent large population; Z=with 95% confidence level (Z=1.96); D= margin of sample error; Where Zα/2 (critical value) =1.96 for 95%; d= 0.05; (p) = 24% from previous study, fatality rate of road traffic accidents prevalence in Oromia (United Nation, 2011).

$n = \frac{(1.96)2*0.24(1-0.24)}{(0.05)2}$= 284 after adding 10% of incomplete and undetermined recorded of fatal accidents, then the final Sample size was 308.

Besides, for this study, the researcher determined the sample size for the qualitative part of the research based on the data saturation point. A purposive sampling method was utilized, resulting in a total of 208 participants: traffic police officers, health experts in risk prevention, experts from the Road and Transport Authority, pedestrians, and drivers. The remaining 100 participants were engaged in focus group discussions conducted across five subcities, with each group consisting 20 members. To address statistical considerations, such as the fatality rate per 10,000 vehicles, it is essential to analyze a minimum of five years' worth of road traffic accident fatalities to ensure an adequate selection of candidate variables for the analysis. Consequently, these statistical factors were emphasized as criteria for determining the sample size for this study (Yosef, 2008).

3.5.2. Sampling Method

The current study included several sample methods, including purposive, availability, snowball, and purposeful (quota) sampling. For primary data collection, quota sampling was employed in this study, with the population divided into five groups: traffic police officers,

health experts, road and transport authority experts, drivers, and pedestrians. This stratification helps enhance the validity of the research by ensuring that all relevant groups are represented. Participants from the six groups were selected using various sampling techniques. Traffic police officers, health experts, and Road and Transport Authority experts were chosen through purposive sampling, ensuring the inclusion of individuals with pertinent expertise. Pedestrians were selected using availability sampling, allowing for the inclusion of participants who were readily accessible. Drivers, on the other hand, were selected through snowball sampling, where initial participants helped identify additional participants. For the recorded traffic accident data, all aggregated data from the five sub-cities over the past five years were collected to ensure comprehensive coverage of the trends and patterns involved in the study.

3.6. Data Analysis Techniques

Both qualitative and quantitative techniques were used to analyze the data that was collected from various sources. Thematic analysis was used to identify and characterize the risk factors for traffic accidents based on information obtained from focus group discussions, interviews, and observation. Descriptive statistical analysis was conducted on the accident record data obtained from the traffic police department. The information on the collected data was entered into Epi-Data Version 3.2 following several phases of accuracy and completeness validation. Once inputted, the data was transferred to SPSS Program Version 22 for analysis, with all statistical tests conducted at a significance level of 5%. A one-way analysis of variance (ANOVA) was then used to assess the statistical significance of p-values, aiming to identify the primary contributing factors to vehicle collisions. The trends and patterns of traffic accidents in the study area were summarized using percentages and means.

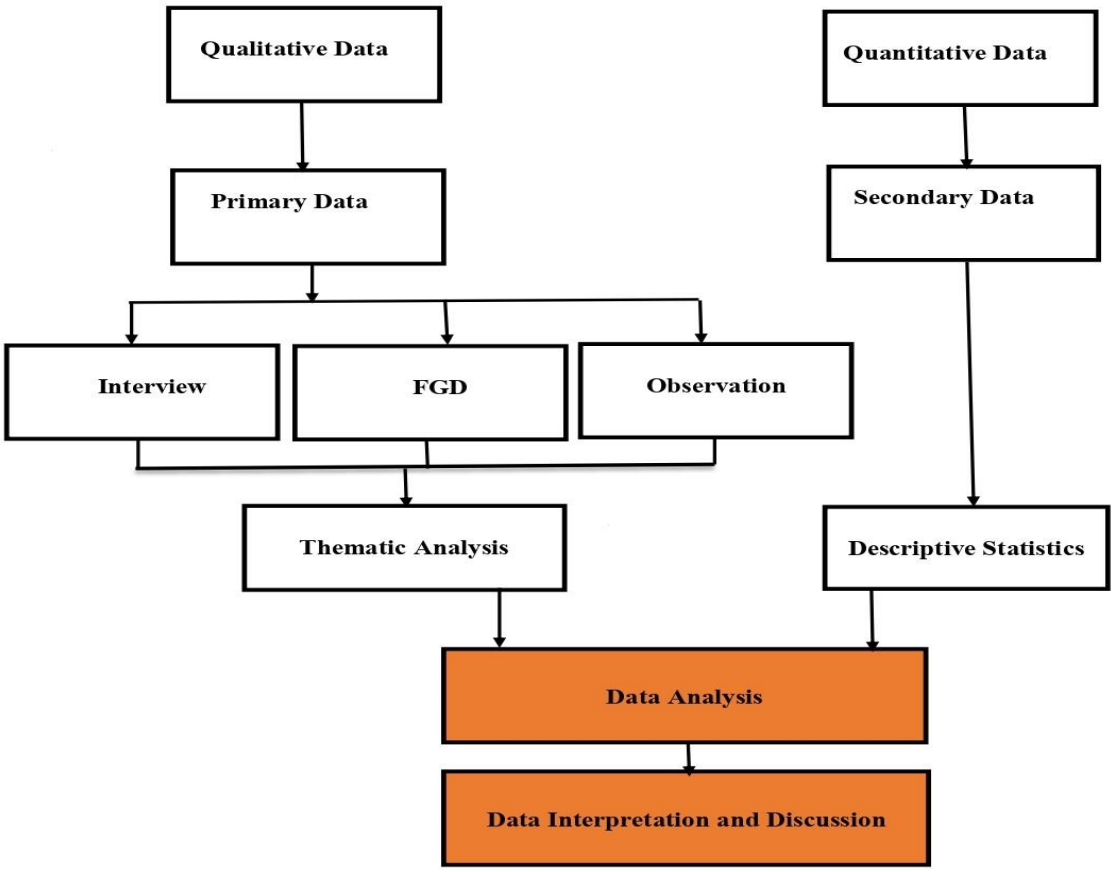

Figure 3.2. Study Flowchart

4. RESULTS AND DISCUSSIONS

4.1. Analysis and Discussion Based on Descriptive statistics

All crashes (deaths, injuries, or property damage) occurring within the defined research scope are included in this analysis. Tables, graphs, and percentages are used to illustrate how crashes are distributed across the different degrees of injury severity. These statistics provide a trend that may be used to compare and find trends in collision, death, injury, and property damage across several factors.

4.1.1. Trends of Road Traffic Accident by Years (2018-2022)

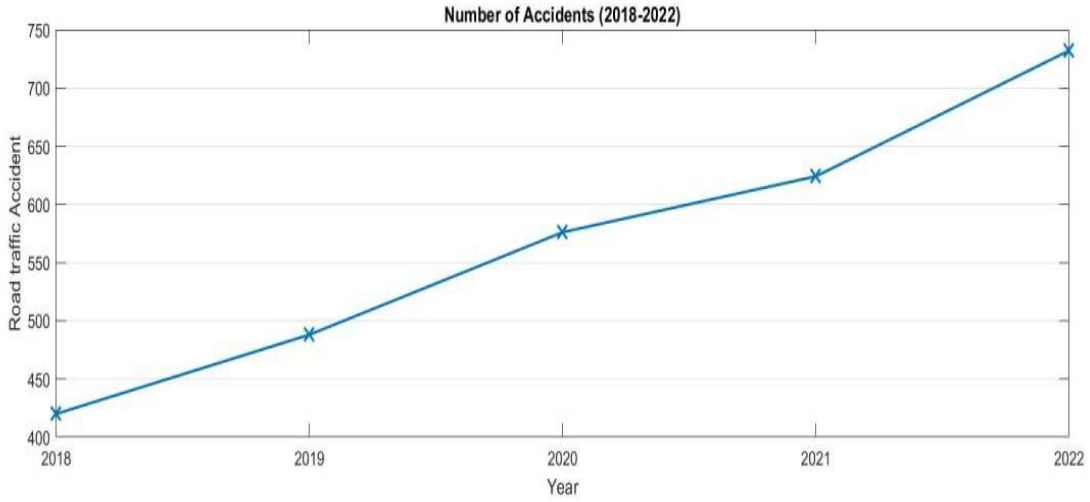

Figure 4.1. Trends of RTA by Total Accidents

Figure 4.1 illustrates the trend of road traffic accidents from 2018 to 2022, indicating a steady rise in the number of incidents over the five-year period. The data points reveal a clear upward trajectory, with 420 accidents reported in 2018, increasing to 488 in 2019, 576 in 2020, and 624 in 2021 and peaking at 732 in 2022. The percentage of increment shows that the number of accident increased from 2018 to 2022 by 74.29%. This indicated that over the research period of time, the RTA problem had been growing at an alarming rate. Many of the respondents suggested that the increments of this issue attributed to driver negligence, poor road traffic control, the efficacy of current policies, increased vehicle density, urban population growth, and infrastructure deficiencies in the study area. Likewise, Shiferaw (2020) noted that the trend of road traffic accidents (RTAs) during the study period rose by 101% in the Oromia Special Zone surrounding Finfine, highlighting a concerning increase in RTAs.

4.1.2. Distribution of Road Traffic Accidents by Types

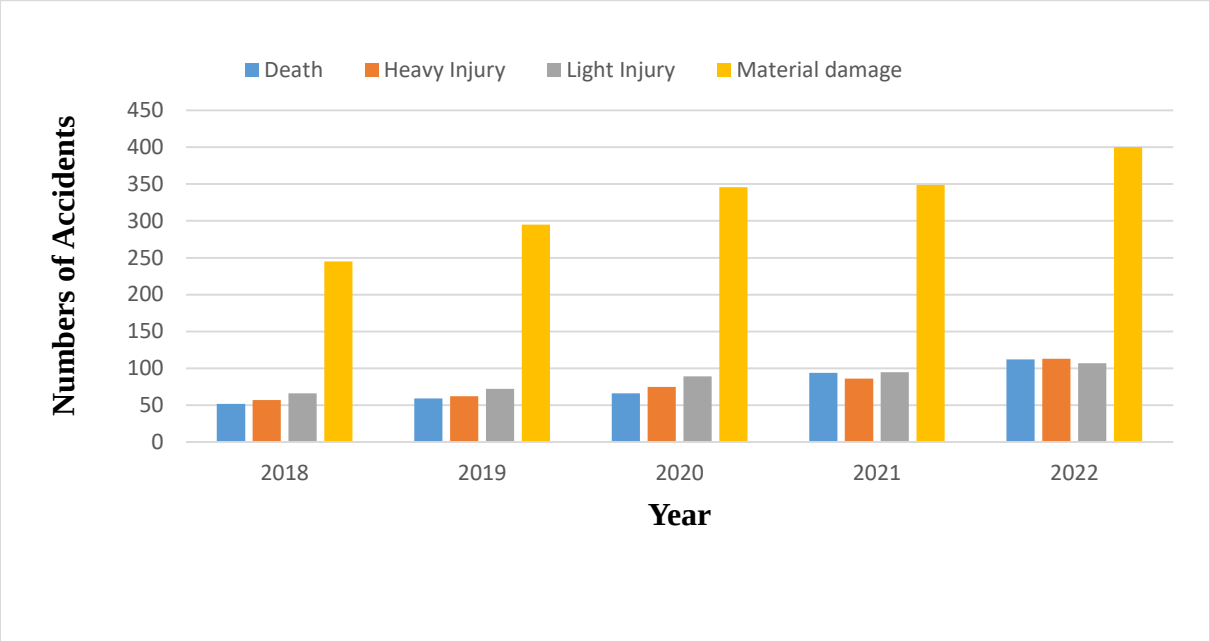

Figure 4.2. Distribution of RTA by Types

In 2018, the number of deaths was 52, heavy injuries were 57, light injuries were 66, and material damages were 245. By 2022, these numbers had risen significantly, with deaths reaching 112, heavy injuries at 113, light injuries at 107, and material damages peaking at 400. The most notable increase is observed in material damages, which surged from 245 in 2018 to 400 in 2022 (figure 4.2). Similarly, the number of deaths more than doubled over the same period. Heavy injuries and light injuries also showed a steady rise. This figure indicates that the number of fatalities, serious injuries, and minor injuries remained relatively stable across all years; however, the incidence of road traffic accidents (RTAs) resulting in material damage was significantly higher. The significant increase in material damages and fatalities indicates the urgent need for improved road safety measures and interventions to reduce the impact of accidents on individuals throughout the city. These findings suggest a concerning trend of increasing road traffic accidents and their severity in Sheger City.

4.1.3. Trends of Road Traffic Accidents by Material Damage

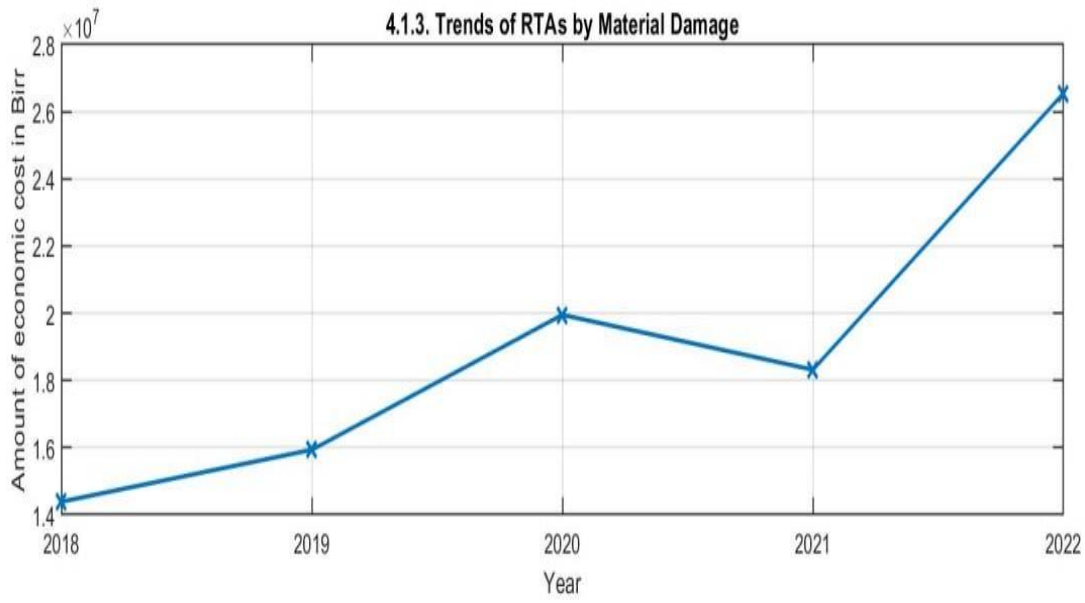

Figure 4.3. Material damages (Estimated Cost in Birr)

The graph shows how the material damages (costs) varied through five years of time, with various amounts recorded each year. The economic cost was 14,388,643 Birr in 2018, rising to 15,935,419 Birr in 2019. There was a notable increase in 2020, reaching 19,951,421 Birr, which was followed by a decline to 18,317,693 Birr in 2021. The economic cost reached its highest value in 2022, 25,541,693 Birr, which is the highest value in the dataset (figure 4.3). These fluctuations show how the economic landscape in Sheger City is changing, with notable variations in costs over time. The sharp increase in economic cost in 2022 highlights a significant financial impact on the city. Overall, the economic cost of road traffic accidents (RTA) showed a significant increase, especially by the end of the study period. This can be attributed to the fact that even in cases where pedestrians are hit by vehicles, the risk of material damage remains substantial in every collision, regardless of whether the road user dies. Besides, the rate of increase in material damage (the economic costs) in Sheger city over the five years rose by 84.46%. This increment in material damage in Sheger city is predominantly due to the increase in road traffic accidents. Addressing this issue requires a comprehensive approach, including improved traffic management, infrastructure investment, and enhanced public safety measures to mitigate future economic impacts.

4.1.4. Trends of Road Traffic Accidents by Sub City

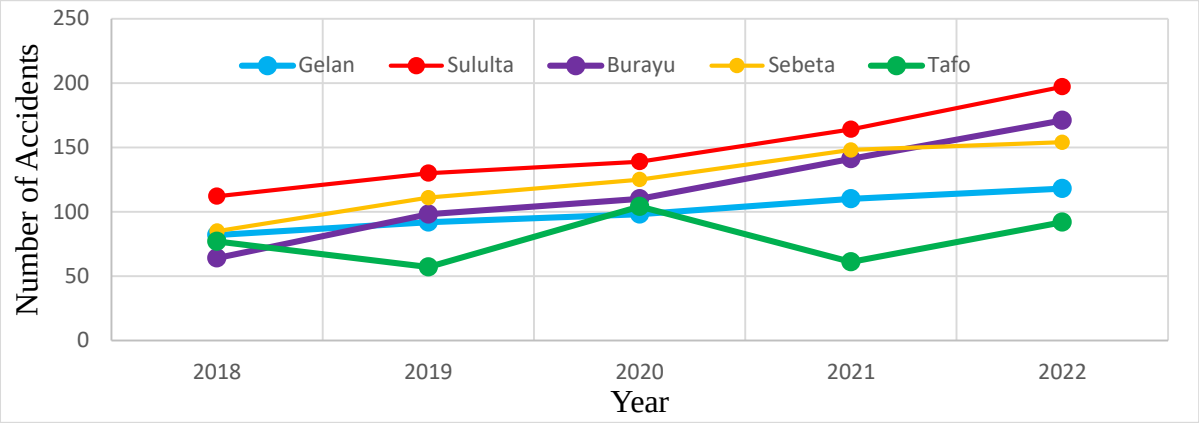

Figure 4.4. Trends of RTA by sub city

Figure 4.4 reveals that among the 2,840 accidents recorded in the study area, Sululta sub-city accounted for the highest number with 742 accidents during the study period, followed by Sebeta sub-city with 623 accidents. The lowest number of recorded accidents was in Tafo sub-city, which had 391 incidents. Notably, the rate of increase in road traffic accidents (RTAs) in Burayu sub-city over the five years rose by 167.2%, followed by Sebeta at 81.2%, Sululta at 75.9%, Gelan at 43.9% and Tafo at 19.5%. This shows that compared to Sebeta, Sululta, and Gelan sub cities, the rate of RTA has significantly increased in Burayu and Tafo sub cities. In other words, these statistics shows that Burayu and Tafo sub cities are highly exposed to road traffic accidents than others. In contrary, Tafo took the lowest rate of RTA.

4.2. Demographic Characteristics of the Driver

The demographic information on the drivers involved in the accidents describes the human element of the collision, with a particular emphasis on the driver's involvement. Human factors suggest that a driver's operational error frequently initiates a sequence of events that may culminate in a collision. A significant percentage of these errors can be attributed to the interplay between road conditions and the driver's individual characteristics, including age, gender, driving experience, and educational background.

4.2.1. Road Traffic Accident Distribution by Driver's Age

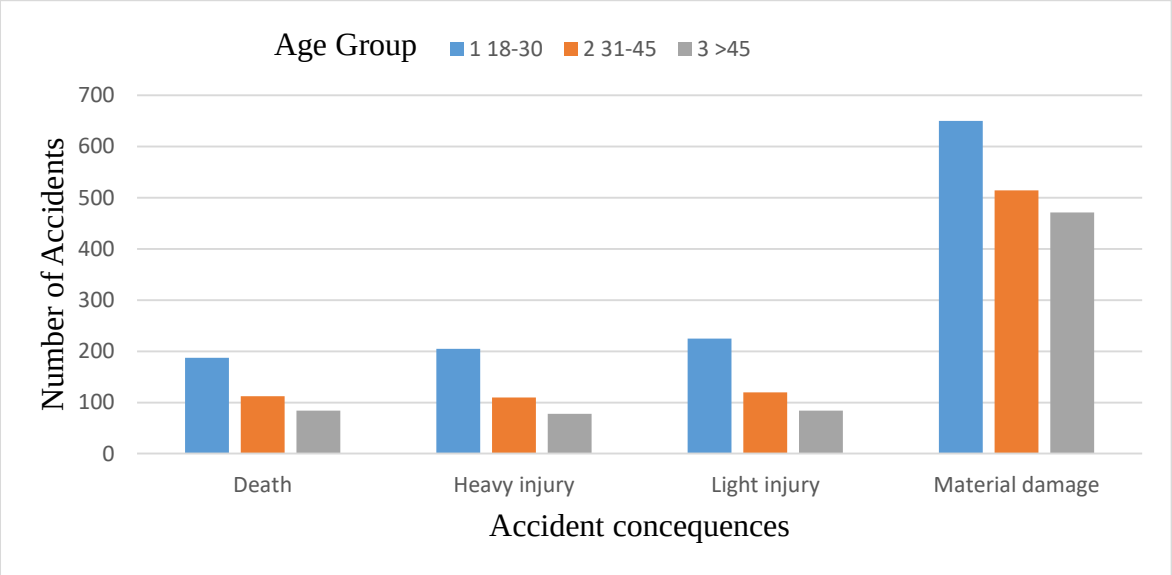

Figure 4.5. Distribution of RTAs by Ages of the drivers

These results indicate that the ages of the drivers probably influence each other, highlighting the importance of looking deeper into this factor to Road traffic accident. Furthermore, on the above figure 4.5 the data indicated that the largest number of accidents was recorded in the 18-30 age group, totaling 1,267 incidents (44.61%). This group also had the highest number of deaths (187), heavy injuries (205), light injuries (225), and cases of material damage (650). This is because these young drivers are naturally irresponsible; rather than driving for the safety of themselves and their passengers, they drive fast and recklessly in an effort to increase their income.

The age group of 31-45 have 856 cases which accounts for 30.14% of road traffic accidents in the city of Sheger. These group of individuals suffered 112 fatal, 110 serious, 120 moderate and 514 material damage cases. Within the age bracket of 45 years and above (>45), individuals made up to 717 cases (24.25%) of road traffic accidents in Sheger city. It comprised of 84 deceased, 78 severely injured, 84 lightly injured, and 471 cases of destroyed property. These results highlight the importance of age group in determining the severity and consequences of road traffic accidents. According to Tegegn (2019), the age group of 18 to 30 years was the most affected by motorcycle collisions, followed closely by the 31 to 50 age group. In the South Omo Zone of Ethiopia, these age groups represented 257 incidents (66.2%) and 85 incidents (21.9%) of all motorcycle crashes, respectively.

Mahlet (2016) found that drivers between the ages of 18 and 50 have a higher frequency of crashes in Kolfe Keranyo Sub city, Addis Abeba. However, drivers in the 18–30 age bracket account for 68% of all fatal collisions, which is the greatest rate of fatalities. As the age of the driver grows, the severity of collisions generally reduces. The senior drivers (>50) have a larger association with collisions resulting in serious injuries, with a relative risk ratio of 3.14, even though the teenagers (18–30) group is significant. These "old" drivers those over the age of fifty also have a history of minor injuries. This indicate that the results for the driver's age match those from the descriptive crash distribution, which suggests that collisions involving adolescents tend to be more severe. This result is consistent with the research of Islam and Mannering (2007), which indicates that drivers between the ages of 16 and 24 and middle-aged (25–64) had a higher risk of death and serious injury.

This trend also holds for every traffic accident fatality and injury. The age distribution of individuals in this developing country shows that around half of the population is under the age of 18, however people of working age are more likely to be involved in crashes. People in the workforce probably travel more during the day on average, especially when they are walking, or using different forms of transportation. They are accordingly more likely to be involved in collisions as they interact with vehicle traffic more frequently under a range of road conditions. Consequently, these age groups experience a higher rate of road traffic crash-related injuries and fatalities than other age groups.

4.2.2. Distribution of Road Traffic Accidents by Gender of the Driver

Table 4.1. Distribution of Road Traffic Accidents by Driver's Gender

No	Sex	Accident implication (consequence)						
		Death	Heavy injury	Light injury	Material damage	Total RTA	Total driver	Rate %
1	Male	348	365	387	1568	2668	4210	63.4
2	Female	35	28	42	67	172	512	33.6
	Total	383	393	429	1635	2840	4722	
	Chi square	62.59						
	P Value	0.00000025						

Source: Traffic police records for the study area from 2018 to 2022.

In Sheger City, a total of 2,840 road traffic accidents were reported, with males being more involved as compared to females. This data indicates that approximately 63.3% rates of road traffic accidents (RTAs) were caused by male drivers, while around 33.6% rates were

attributed to female drivers. In the accidents, not only did some individuals die, suffer a heavy injury, light injury, but they also had their property damaged. To be more precise, table 4.1 indicate the deaths among the male population were 348 (13.03%), heavy injuries were 365 (13.65%), and there were 387 cases of light injuries (14.50%), with material damage being the highest category at 1,568 (58.82%). On the other hand, in the case of females, 35 of people were died, 28 were heavily injured and 67 materials were damaged. This can be explained by the fact that there are more men who drive and that they tend to drive more aggressively and riskily. Based on the data, a higher percentage of RTAs are stereotypically attributed to men, involving different sad outcomes such as death, heavy injury, light injury, and material damage.

In line with the current research, Mahlet (2016) noted that male drivers are predominantly involved in most accidents and are significant contributors to fatal, serious, and minor injury incidents related to property damage in Kolfe Keranyo Sub City, Addis Ababa. The risk ratio for fatal crashes involving male drivers is 16.37 times higher. In comparison, the exponential values for female drivers experiencing minor and serious injuries are 5.64 and 4.66, respectively, indicating that male drivers tend to sustain more severe injuries. This finding aligns with the results from the descriptive analysis conducted. Similarly, a study in Turkey by Ali and Ötüken (2014) supports this observation by showing that male drivers are more frequently involved in serious accidents. Additionally, Kim et al. (2010) suggested that male drivers exhibit more aggressive behavior and a propensity for risk-taking, which heightens the chances of pedestrians suffering fatal injuries.

4.2.3. Distribution of Road Traffic Accident by Driver's Level of Education

Table 4.2 indicates that 30.35% of road traffic accidents (RTAs) were caused by drivers who had completed the second cycle of primary education, while 26.3% were attributed to those who had not finished their secondary education. Furthermore, drivers in their first cycle of primary education were responsible for 22.96% of RTAs. The lowest percentage of RTAs, roughly 19.86%, were caused by drivers with more education than a high school diploma (figure 4.6). The distribution of traffic accidents varies according to level of education, mostly because of exposure levels and levels of safety awareness.

Table 4.2. Road Traffic Accident Distribution by Driver's Educational Background

No	Educational Background	Accident implication (consequence)					
		Death	Heavy injury	Light injury	Material damage	Total	%
1	First cycle primary education level (1-4)	95	88	114	450	652	22.96
2	Second cycle primary education level (5-8)	102	115	120	525	862	30.35
3	Secondary school level (8-12)	110	110	106	340	747	26.30
4	Above secondary school level	76	80	89	320	565	19.89
	Total	383	393	429	1635	2840	100
	Chi square	12					
	P_Value	0.02133					

Source: Traffic police records for the study area from 2018 to 2022.

A chi-square value of 12 suggests a moderate difference between the observed and expected frequencies. The p-value of 0.02133 is less than the commonly used significance level of 0.05 (5%). Since the p-value (0.02133) is less than the chosen significance level of 0.05, the observed differences between the expected and observed frequencies are statistically significant (Kwak, 2023).

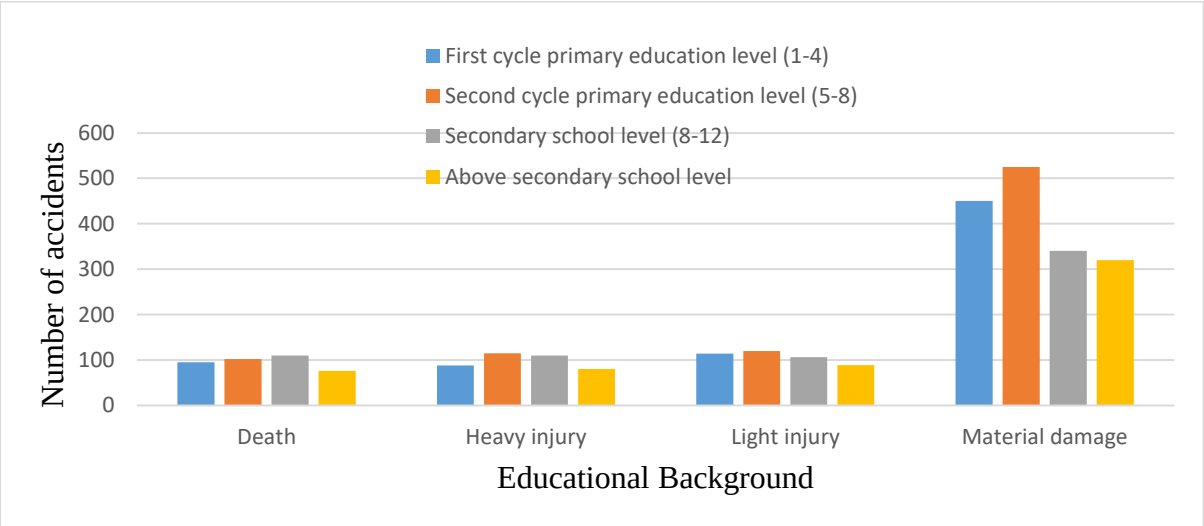

Figure 4.6. RTA distribution by driver's educational background

This research aligns with findings from a study by Mahlet (2016) conducted in the Kolfe Keranyo Sub city of Addis Ababa, which indicated that individuals with education beyond

high school face a lower risk of severe traffic accidents (fatalities). Additionally, the study by Misganaw and Gebre-Yohannes (2011) suggests that drivers with less education are linked to an increased risk of traffic-related fatalities and injuries. Furthermore, they said that an elementary school education level will result in a 1.48 rise in the relative log possibilities of being involved in fatal crashes compared to property damage. Compared to drivers with a high school education, these drivers had a 4.4 higher relative risk ratio of fatal collisions. In terms of driver's education, Ali and Ötüken (2014) also found results that align closely with the current data. Additionally, Gonfa (2015) estimates that drivers with a high school education level are involved in a significant number of road accidents, contributing to 42.9% of all casualties along the Addis Ababa to Jimma Highway. According to a research conducted in Burayu Town by Hordofa *et al*. (2018), drivers with just a primary education (4–8 grade) caused a high number of deaths (65–56%), whereas drivers with a higher education level (27–23%) caused fewer deaths. This indicates having greater level of education increases better judgment of drivers and responsible behaviour. When compared to drivers with only a high school education, drivers with higher education levels are insignificant. It also implies that drivers with less education than a secondary school have a greater risk of dying in collisions.

4.2.4. Distribution of RTAs Based on the Driver's Experience Level

The data figure 4.7 revealed that drivers with less than one year of experience had the highest percentage of accidents resulting in death (25.92%) and heavy injury (36.25%), which was followed by drivers with 1-2 years of experience. However, drivers with 3-5 years of experience had the highest percentage of accidents resulting in light injuries (20.49%). This indicates that the study considered the driving experience that helped in reducing the number of severe road traffic accidents, with inexperienced drivers being at the highest risk of causing these accidents.

Table 4.3. Distribution of Road Traffic Accidents Based on the Driver's Experience Level

No	Driving Experience	Accident Implication (Consequence)					
		Death	Heavy injury	Light Injury	Material damage	Total	%
1	Below one year	96	88	102	450	736	25.92
2	From 1-2 years	85	110	100	380	675	23.77
3	From 3-5 years	82	75	85	340	582	20.49

4	From 5-10 years	75	80	73	246	474	16.69
5	Above 10 years	45	40	69	219	373	13.13
	Total	383	393	429	1635	2840	100
	Chi-square	22.52					
	P_value	0.032					

Source: Traffic Police records of the study area from 2018-2022.

From the above table (table 4.3), a chi-square score of 22.52 indicates a moderate to substantial difference between the observed and expected frequencies. This suggests that the variables are likely not independent. And also the p-value of 0.032 is lower than the significance level of 0.05. This indicates that the observed variations between the expected and observed frequencies are statistically significant. Given these results, the chi-square test statistic of 22.52 and the p-value of 0.032 suggest that the variables being tested are likely dependent (Kwak, 2023).

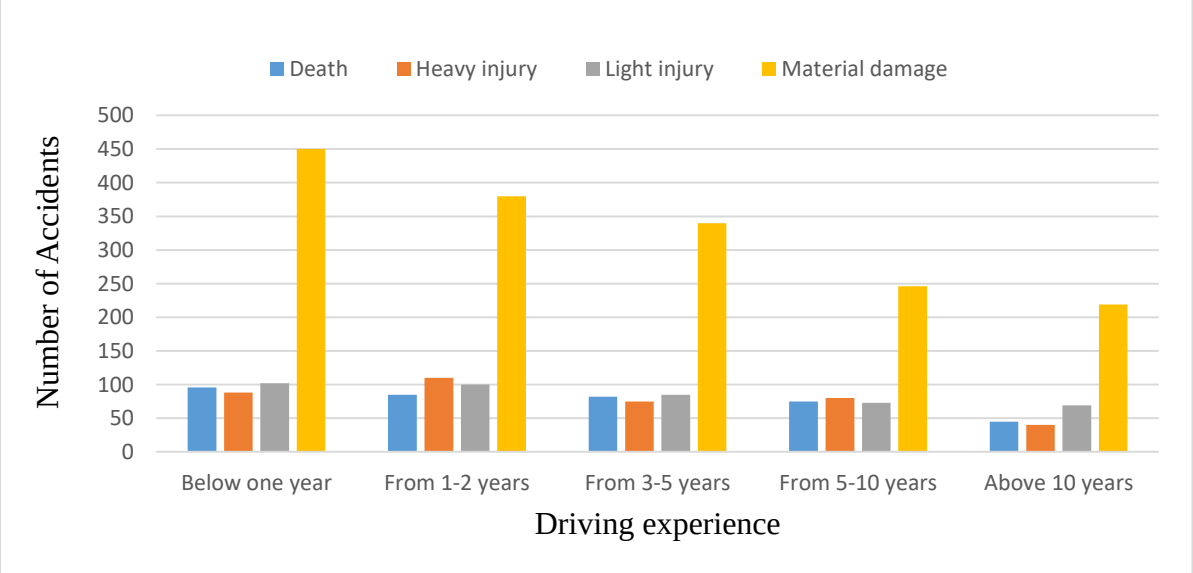

Figure 4.73. Distribution of RTA based on the driver's experience level

The degree of collisions and drivers' driving experience are inversely correlated. This is consistent with research by Simons-Morton and Hartos (2013), which indicates that young drivers have a higher crash risk and that their crash rate is particularly high during the first year of licensing. Experience reduces the severity of injuries, and newly licensed drivers are more exposed to danger. According to Hordofa *et al.* (2018), accidents in Burayu town were frequently caused by drivers with only three to five years of experience. Similarly, according to a study conducted in Qatar that stated "drivers with around five years of driving experience were more likely to be engaged in collisions (Chalya *et al*., 2010).

4.2.5. Distribution of RTAs by Major Risk Factors

The data in the table 4.4 shows that the major causes of accidents are behavioral factors, which account for 85.88% of all accidents. These behavioral factors are made up of different types of reckless driving, such as speeding, driving under the influence of drugs or alcohol, not giving priority to vehicles, etc. Such actions not only risk drivers and passengers` lives but also those of other road users and pedestrians. On the other hand, a lower percentage of accidents, 5.60%, are related to vehicle factors. These could include mechanical failures, no maintenance or poor vehicle conditions, which, in turn, create accidents. Beyond that, road and environmental elements are identified as the cause of 7.11% of accidents, indicating the necessity of considering poor road conditions, unclear signage, and environmental hazards while improving road safety. Moreover, breaking traffic laws and regulations accounts for only 1.41% of the accident percentage, which ascertains the significance of following traffic rules to prevent accidents.

Table 4.4. Distribution of Road Traffic Accidents by Major Risk Factors

No	Causes	Accident implication (consequence)					
		Death	Heavy injury	Light injury	Material damage	Total	%
	I. Behavioral factors						
1	Drink driving	20	22	16	60	118	4.15
2	Addiction driving	6	4	11	47	68	2.39
3	Driving opposite of right side	8	10	2	55	75	2.64
4	Not prioritizing vehicles	4	45	41	105	195	6.87
5	Not prioritizing pedestrians	113	96	120	156	485	17.08
6	Not keeping the distance b/n vehicles	8	10	75	312	405	14.26
7	Passing on curve side driving	12	14	4	47	77	2.71
8	Chang the direction after by passing	15	16	2	59	92	3.24
9	Driving over normal speed	96	88	75	254	513	18.06
10	Reckless driving	4	3	4	34	45	1.58
11	Improper changing the direction	6	5	4	31	46	1.62
12	Start driving wrongly	10	12	7	46	75	2.64
13	Improper stopping	9	9	6	26	50	1.76
14	Fatigue driving	4	3	8	22	37	1.30
15	Driving on stress	4	2	4	34	44	1.55
16	Pedestrian problem	6	8	5	35	54	1.90

17	Improper loading	7	4	9	40	60	2.11
	II. Vehicle factors						
18	Break problem	0	2	3	33	38	1.34
19	Old Tyres problem	2	6	4	28	40	1.41
20	Tyres blast	6	4	4	26	40	1.41
21	Steering problem	4	2	3	32	41	1.44
	III. Road and environment factor						
22	Road and environment problem	32	28	22	120	202	7.11
	IV. Traffic law and regulation factors						
23	By disregarding the traffic police's directive	7	0	0	29	36	1.27
24	By passing Priority giving sign	0	0	0	4	4	0.14
	Total	383	393	429	1635	2840	100

Source: Police records of the study area from 2018-2022.

4.3. Risk Factors Linked to Traffic Accidents

The data collected by traffic police regarding accidents serves as a foundation for establishing objectives and priorities for remedial measures. To formulate these measures effectively, it is essential to identify the primary processes that lead to accidents, as well as the interconnections among various factors related to driver and pedestrian behaviors, vehicle interactions, and the road environment. However, authorities have reported that numerous incidents occurring in Sheger City were not sufficiently documented. Consequently, alongside the analysis of multiple incidents within the city, field observations were conducted to gather more comprehensive insights.

The gathered and analyzed qualitative data of risk factors are presented in the following section.

4.3.1. Behavioral Factors for RTAs

4.3.1.1. Driver Traffic Behavior

Data from police traffic accident reports in Sheger City indicates that a significant number of traffic incidents are attributed to driver errors. Various factors contribute to the elevated accident rates linked to drivers, including lack of experience, age-related issues, and insufficient understanding of the significance and enforcement of traffic laws.

The chief inspector of the city, who was one of the major informants, stated that;

"Speeding was the primary cause of most incidents. because the drivers are unable to control their cars. An accident might result from even the simplest path of obstacles. Drivers are therefore limited to two options in these kinds of situations: either they immediately turn off their vehicles or they collide".

A similar response was provided by the primary informant of the traffic police officer.

"Who said that the majority of accidents were reported in areas where drivers were required to slow down their speed of driving, especially at zebra crossings? While crossing the road, drivers do not give pedestrians priority. Many accidents were due to the over speeding of drivers at public crossing areas".

The head of the transport authority stated further that:

"Failure to keep an appropriate distance between vehicles is typically the cause of a collision of vehicles. This suggests that drivers are not able to predict the other cars' distance and speed. Additionally, some drivers let their friends use their cars to gain experience driving on busy roads after they've dropped off passengers, which can be very dangerous and lead to accidents.

The accident depicted in Figure 4.8 shows a collision that occurred in Sebeta Sub City in 2022, attributed to insufficient spacing between vehicles. This tragic event resulted in the death of five individuals and caused an estimated financial loss of approximately 3.4 million Ethiopian Birr (ETB).

Figure 4.8. Road traffic accident at Sebeta Subcity

Source: *Sebeta Traffic Police 2022*

One of the primary risk factors identified is excessive speed while driving, which significantly contributes to road traffic accidents (RTAs). This observation aligns with the findings of Kebede (2013), who determined that high-speed driving is a major factor leading to vehicular collisions. In line with this result Tegegn (2019) reported that the variation of often riding above the limited speed has too much significant effect on the occurrence of motorcycle crashes in South Omo Zone, Ethiopia. Besides, Gubing (2015) also stated that the driving-risk levels in near-crash events were most affected by the braking velocity, triggering variables, possible object type, and potential crash type. The lack of radar material in the Sheger city has prevented the application of speed limitations rules. During traffic assessments, the speed control radar reduces RTA levels by 61% (Edna, 2016). In alignment with these findings, Shiferaw (2020) identified that the lack of priority given to pedestrians is a primary risk factor for road traffic accidents (RTAs), contributing to a daily toll of fatalities. Similarly, other research indicates that the failure to prioritize pedestrians significantly impacts both the incidence of road traffic accidents and the severity of injuries (Kirolos, 2015).

To accomplish the objectives of the research, an additional questionnaire survey was conducted. The questionnaires, comprising various direct and indirect inquiries regarding traffic laws and their importance, were formulated to allow the researcher to assess the drivers' level of compliance with and comprehension of these regulations. The survey involved the collection of data on a number of different variables, including sex, age, education level, level of driving experience, type of vehicle driven, driving in Sheger City, service of the vehicle, normal driving speed, and parking habits. As shown in Table 4.9, a significant majority of the drivers are male, comprising 83.2% of the respondents, whereas female participants accounted for only 16.8% of all observations in the study area. The respondents were distributed into three main age categories: 43.8% were below 30 years old, 39.4% were between 31-45 years old, and 16.8% were above 45 years old. Moreover, a majority of the respondents were shown to possess a Public I license (56.2%, n =50), followed by Public II (23.6%, n = 21), Public III (12.4%, n = 11) and Truck I (7.8%, n = 7) licenses. Half of the respondents (50.6%, n = 27) had a secondary school level of education, while one-third (30.3%, n = 27) were at a second cycle primary education level, and 13.5% (n = 12) went further and were above the secondary school level. Additionally, 36% usually drove two-four-axle single-unit vehicles, while 28.1% drove passenger cars and 20.2% drove buses (table 4.5).

Table 4.5. Respondents for questionnaires on the Behavior of Drivers

S. No	Questionnaires	Total	%
Sex			
1	Male	74	83.2
2	Female	15	16.8
Age			
1	Under 18	0	0
2	18-30	39	43.8
3	31-45	35	39.4
4	Above 45	15	16.8
Level of License			
1	None	0	0
2	Automobile	0	0
3	Public I	50	56.2
4	Public II	21	23.6
5	Public III	11	12.4
6	Truck I	7	7.8
Educational level			
1	Illiterate	0	0
2	First cycle primary education level (Grade1-4)	5	5.6
3	Second cycle primary education level(Grade5-8)	27	30.3
4	Secondary school level (Grade 8-12)	45	50.6
5	Post-secondary school level	12	13.5
What category of vehicle do you typically operate?			
1	Passenger vehicles	25	28.1
2	Buses	18	20.2
3	Single-unit vehicles with two to four axles	32	36
4	Single trailers with four to six axles	14	15.7
5	Multi-trailer configurations with more than five axles	0	0
Duration of Driving Experience in Sheger City?			
1	Under 1 Year	5	5.6
2	1 - 2 Years	14	15.7
3	2 - 5 Years	36	40.5
4	5 - 10 Years	28	31.5
5	More than 10 Years	6	6.7
What is the duration of service that the vehicle you operate has provided in this city?			
1	Less than 2 years	11	12.4
2	2 - 5 years	28	31.4
3	5 - 10 years	30	33.7
4	More than 10 years	20	22.5
When operating a vehicle, what is your typical speed (approximately) within urban areas? School/animal cross, villages along the highway?			
1	Less than 30 km/ hr.	0	0
2	30 - 40 km/hr	10	11.2
3	40 - 50 km/hr	21	23.6
4	50 - 60 km/hr	27	30.3

5	Greater than 60 km/h	31	34.9
Where do you often park your vehicle?			
1	on the road	50	56.2
2	Parking area	21	23.6
3	Around commercial center/office area	18	20.2

The distribution of the respondents based on their driving experience in Sheger City was as follows: 40.5% had been driving for only 2–5 years (n = 36), while 31.5% had 5–10 years of driving experience (n = 28), with others having varied durations of driving experience. The survey participants claimed their vehicles had been in the city for 2–5 years (n = 28) and for more than 10 years (n = 20) as well. The majority of questionnaire respondents reported driving at speeds between 50-60 km/h (30.3%, n = 27) and above 60 km/h (34.9%, n = 31) in town, at school or animal crossings, and in villages along the highway. The majority of respondents endorsed parking on the street as their preferred parking location (n = 50, 56.2%), followed by parks (n = 21, 23.6%) and around commercial center/office area (n = 18, 20.2%).

Drinking alcohol while driving was the other risk factor identified for RTA in the study area. In a similar vein, many research findings indicate that operating a vehicle when impaired by alcohol or other drugs is known to affect the driver's judgement and control (Guohula Li *et al*., 2013; ElviK, 2013). The government adopted laws under Proclamation No. 468/2005 of the road and transport authority's currently in effect law to handle the alcohol-driving risk component of RTA problems. Nevertheless, the study area (Sheger city) has no alcohol testers for traffic police inspection. Also other study stated that using alcohol tester license suspension was associated with 65.2% reduction in drinking driving recidivism (Sebego *et al*. 2014).

Another determinant factor identified in this study was the failure to prioritize other vehicles. In alignment with these findings, Hordofa *et al*. (2018) reported that drivers who did not yield to other vehicles while driving faced a threefold increased risk of causing fatalities in traffic accidents compared to those who did. This finding closely resembles a study conducted in central Ethiopia along the road between Akiki and Adama, which indicated that drivers who failed to give priority to other vehicles were 5.2 times more likely to cause a fatality than those who did prioritize (Fekede *et al*., 2014).

Furthermore, Figure 4.9 illustrates the road traffic accident (RTA) resulting from driver speeding. This incident occurred in 2022, resulting in twelve fatalities and approximately eight million ETB in material damages.

Figure 4.9. A road traffic accident occurred in Burayu Subcity.

Source: Burayu Traffic Police 2022

4.3.1.2. Traffic Behaviors of Pedestrians

The most susceptible group of road users in traffic is pedestrians, according to police accident data from various zones and districts. The main reason why pedestrians are more likely to be involved in accidents is that cyclists and vehicles don't prioritize pedestrian safety. As previously said, the majority of pedestrian accidents are caused by vehicles that neglect to give way to pedestrians at crosswalks. However, some pedestrians' ignorance and lack of attention can be considered accountable for a lot of accidents. In contrast to drivers, a significant portion of pedestrians in the town lacks formal education on basic road safety rules, acquiring knowledge primarily through observation.

The participants in the FGD stated that “the drivers are not solely responsible for over speeding, but they also noted that passengers are part of the problem. Especially when people are too busy to be on time to the destination, this behavior prevails and causes a shared disregard for the road safety law among the drivers and passengers.”

The results of a research on pedestrian traffic behavior conducted in five Sheger sub-cities are therefore discussed in the following subsections. It is believed that exposure to traffic and age both affect one's level of traffic experience. The majority of the pedestrians polled in this study (72%) are between the ages of 24 and 50. It is possible to examine the pedestrians' exposure to traffic in terms of the journeys they took.

Table 4.6. Trip Purpose and Respondents' Perceptions

S. No	Questionnaires	Total	%
What category of trip purpose accounts for the majority of your time?			
1	To farm field	14	15.7
2	Shopping	21	23.6
3	Educational Trip	18	20.2
4	Recreational	11	12.4
5	To office	25	28.1
How do you assess the severity of road traffic accident issues in the city?			
1	Significant Issue	48	53.9
2	Moderate Issue	32	35.9
3	Non-Issue	9	10.1
Have you experienced traffic accidents during your travels?			
1	Yes	39	43.8
2	No	50	56.2
If your answer to the previous question is "yes," how many times have you encountered traffic accidents?			
1	1 time	14	15.7
2	2 times	9	10.1
3	3 times	9	10.1
4	> 4 times	7	7.9

Table 4.6 shows that the majority of respondents stated that their primary reason for travelling to their office (28.1%), followed by shopping (23.6%), educational trip (20.2%), visits to their farms (15.7%), and recreation (12.4%). In addition, the participants have already answered whether they think the city road accident problems are very sharp, considerably sharp, slightly sharp or not at all sharp. The rate of pollution was reported by 53.9% of responders as a big problem, 35.9% of them noted it as a medium-size problem, and the other 10.1% did not find it as a problem. In addition, responders were inquired whether they had been unable to avoid traffic accidents during their trips or not and here 43.8% of the responders replied ‘yes’ and rest 56.2% of them responded ‘no’. Some had accidents once, twice, three times, or even more than four times during their travels, at different intervals.

Table 4.72. Respondents for questionnaires on the prevalent types of collisions, sidewalks and walking behavior

S. No	Questionnaires	Total	%
What types of collisions or road accidents are most prevalent in this city?			
1	Vehicle-to-Vehicle Collision	7	7.8
2	Vehicle-to-Bicycle Collision	0	0
3	Vehicle-to-Pedestrian Collision	9	10.1
4	Vehicle-to-Stationary Object Collision	27	30.3
5	Bicycle-to-Bicycle Collision	0	0
6	Bicycle-to-Pedestrian Collision	0	0
7	Bicycle-to-Horse-Drawn Cart Collision	7	7.8
8	Horse-Drawn Cart-to-Pedestrian Collision	4	4.5
9	Vehicle-to-Horse-Drawn Cart Collision	16	17.9
10	Others	20	22.5
How often do you utilize sidewalks and walk alongside roads?			
1	Always	21	23.6
2	Some times	41	46.1
3	Rarely	27	30.3
4	Never	0	0
When walking along roads, do you walk with your:			
1	Facing Oncoming Vehicles	61	68.5
2	With Back to Oncoming Vehicles	28	31.5

The information in the table 4.7 shows that the majority of accidents at 30.3% involved motor vehicles colliding with static objects, while 17.9 and 10.1 percent were accidents with motor vehicles and horse-drawn carts and motor vehicles and pedestrians, respectively. Use of the sidewalk was not the same, with 23.6% always using them, 46.1% sometimes, and 30.3% rarely. On the road, 68.5% of the respondents were put in the oncoming vehicles' way, while 31.5% walked with their backs towards the traffic flow.

Table 4.83. Respondents for questionnaires on crossing habits, traffic sign understanding, police enforcement, knowledge sources, and road safety education

S. No	Questionnaires	Total	%
Where do you typically cross the main roads?			
1	At Signalized Intersections	4	4.5
2	At Crossroads	21	23.6
3	At Mid-Block Crosswalks Away from Intersections	27	30.3
4	At Any Spot	30	33.7
5	Behind Stopped Vehicles	7	7.9
Do you comprehend traffic signs, signals, and road markings while traveling on the highway?			
1	Yes	64	71.9
2	No	25	28.9
Are drivers who violate traffic rules and regulations penalized for their offenses in the presence of traffic police?			
1	Always	27	30.3
2	Occasionally	39	43.8
3	Never	23	25.8
How would you evaluate the traffic police's commitment to their responsibilities?			
1	Excellent	7	7.9
2	Satisfactory	32	35.9
3	Unsatisfactory	50	56.2
Have you ever received education on road safety rules from relevant authorities?			
1	Yes	32	35.9
2	No	57	64.1
What is your source of knowledge and experience regarding road safety rules?			
1	Literature	11	12.4
2	Guardians	14	15.7
3	Educational Institutions	25	28.1
4	Traffic Authorities	5	5.6
5	Mass Media	30	33.7
6	Clerical Leaders	4	4.5

The above table 4.8. revealed that the most common places where participants stated crossing main streets was at any point (33.7%), followed by places away from junctions and mid-block pedestrian crossings (30.3%), junctions (23.6%), vehicles standing or spaces behind them (7.9%), and traffic lights (4.5%). Similarly, around 71.9% of the participants affirmed that they understood traffic signs, signals and road signs while driving in the town, while the rest (28.9%) said that they only understood such signs partially. In addition, the results indicate that some offences committed by motorists in the presence of a traffic law enforcer may be repudiated (43.8%), with 30% always penalized and 25.8% never penalized. To add

to that, respondents had disparate opinions about the effectiveness of traffic policing, with 56.2% rating it as unsatisfactory, 35.9% rating it as satisfactory and 7.9% rating it as excellent. On the other hand, the most striking aspect of the survey was when 64.1% indicated that such education was not provided to them by the concerned officials, while 35.9% mentioned that they had received such education. In the last place, media platforms (34%) are the most popular channels of obtaining knowledge about road safety laws among respondents, followed by educational Institutions (28.1%), guardians (15.9%), literature (12.4%), traffic authorities (5.6%), and clerical leaders (4.5%).

Additionally, the one-month observation of pedestrian crossing behavior at three intersections in Burayu sub-city revealed frequent jaywalking, with many pedestrians crossing outside designated crosswalks and ignoring traffic signals, especially during peak hours like lunchtime. Drivers often failed to yield at crosswalks, and speeding near pedestrian zones was common, increasing accident risks. Poorly marked crosswalks and limited police presence further contributed to unsafe behaviors, as both pedestrians and drivers frequently disregarded traffic rules without consequences. To improve safety, authorities should enhance crosswalk visibility, deploy more traffic police for enforcement, implement speed-calming measures, and launch targeted public awareness campaigns on pedestrian rights and safe crossing habits.

4.3.2. Vehicle Factor for Road Traffic Accident

An interview with a driver who is 30 years old said that “now days, brake problems are among the serious problems in most vehicles. Some vehicles may have inadequate brake performance, especially after driving long distances. It is crucial to take a break and allow the vehicle's brakes to cool down to ensure their proper functionality. Failure to do so may result in the brakes becoming ineffective and compromising the safety of the vehicle and its occupants. Similarly, the driver's age of 28 said that “tyre problems, especially the front leg tyre blast or tyre removal, have been a more serious risk factor for RTAs. This study aligns with the findings of Chand *et al*. (2021), who noted that the mechanical attributes of vehicles involved in road accidents play a significant role in this issue. Factors include inadequate vehicle maintenance and the absence of modern safety features such as lane assistance, brake assistance, electronic stability control, and anti-lock braking systems.” Contrary to these findings, Tegegn (2019) conducted research in South Omo Zone, Ethiopia, and concluded that regarding the mechanical problems of motorcycle riders, about 94.3% have no

mechanical problem, whereas only 5.7% have the problem only at the time of crashes, which includes brake (0.5%), lighting (0.8%), and tyre problems (1.8%).

4.3.3. Road and Environmental Factors for RTAs

4.3.3.1. Condition of road

Information gathered from the FGD, key informants of traffic police, and semi-structured interview participants reveals that, despite having a large budget for road construction, the project has significant flaws shortly after it is finished, and the road has not maintained properly throughout time. Furthermore, the FGD data revealed that there is an issue with pedestrian road crossings, or "zebra" regions, since they are painted during road construction but are not maintained. As a result, it produces a line that is invisible to pedestrians and drivers.

The existing roads conditions in the Sheger City are in poor conditions. The main problem is that roads are not designed to provide a certain job by following an appropriate standard approach. The main things that affects traffic accident on the road was road classifications and road conditions, such as curves on the road, pinpointing of notifications, and bad weather, which can cause a road accident. Besides these, shabby road conditions, bad maintenance, and the vehicle losing control can lead to serious accidents (figure 4.10). Furthermore, the absence of pedestrian walkways and safe crossing points can heighten the vulnerability of pedestrians and lead to accidents. Road problems need to be combated by way of the implementation of infrastructural development, maintenance, and traffic legislation.

Figure 4.10. The poor road conditions and bad maintenance at Sebeta Subcity

The key informant for Traffic police officer said that:

> *In my capacity as a traffic police officer, I note that the major road elements contributing to the cause of road traffic accidents are poor road geometry, inadequate signage, a lack of walkways for pedestrians, and insufficient road maintenance. These elements mostly produce unforeseen situations that cause a high risk of colliding, uncontrollable driving, and more dangers for pedestrians, hence requiring more road infrastructure and rehabilitation.*

4.3.3.2. Traffic Segregation

Traffic categories should be separated according to function, as well as by location and time, as a fundamental traffic engineering principle. Roads are places where vehicles are usually parked and also where pedestrians and animals walk. On the other hand, there are no distinction movement differences throughout all of the transportation options in the study area due to an extremely mixed traffic flow. "In parallel with these findings, Gonfa (2015) indicated that heavy trucks operate on nearly all routes without restrictions or regulations, resulting in traffic conflicts between fast-moving through traffic, slower local traffic, and vulnerable pedestrians."

For instance, the following photo depicts a busy street scene with horse-drawn carts on the left, a group of people, and a big vehicle on the right; all are on the same high way (figure 4.11). This indicate that there is no Safeway for pedestrians and carts that aggravate the risk RTA for the Sheger City.

Figure 4.11. Traffic segregation in Sululta Subcity

Source: Direct observation

4.3.3.3. Facility on the road

Most of the roadway in Sheger City has a significant volume of mixed traffic; however, the road networks lack safe pedestrian and vehicular facilities. On the road, there are insufficient or nonexistent engineering features to separate cars and pedestrians or to improve safety on shared surfaces, such as constructed walkways, pedestrian crossings, barriers, speed-calming facilities, traffic signs and adequate street lighting. Besides, the other focus group discussion (FGD) indicated that new buildings are under construction in the town, which causes the dumping of construction materials such as sand, stones, gravel, wood and reinforcement metals along the roadsides. Besides the pedestrian walkway, these materials also encroach on the roadway, leaving pedestrians with insufficient space on the walkway (figure 4.12). Therefore, they are forced to cross the roadway, thus increasing the possibility of pedestrian's road traffic accidents.

This result is in agreement with the finding Wang *et al*. (2018) who investigated that the traffic conditions and road geometry had significant elements that could give rise to high-risk traffic conditions. And also the authors analyzed traffic, road geometry, weather, and driver behavioral attitudes, as the basic attributes of the area surrounding the accident. In addition, Gonfa (2015), also stated that the road environment lacks important road safety facilities that provide proper guidance to road users. Road traffic accidents seem to be increasing as a result of the aforementioned, and safe highway services depend on being able to look ahead and identify possibly conflicting traffic.

Figure 4.12. Dumping of construction materials on the road at Burayu Subcity

Source: Direct observation

4.3.3.4. Weather and Lightening

As far as environmental aspects are concerned, weather and lighting have a considerable impact on the accidents of hit-and-run. Undesirable weather circumstances involving rain, fog, and snow, reducing visibility, and other traction characteristics will lead to RTAs that are more likely to occur. Finally, after the sun sets, the increasingly dark roads become another danger factor that increases road users' risks to both drivers and pedestrians.

” The informant transport authority expert added that;

Environmental conditions, including bad weather, gloomy visibility, and the presence of natural hurdles, also significantly influence the outcome of road traffic accidents. Poor weather conditions, by obscuring visibility and decreasing traction, are some of the variables that contribute negatively to road safety.

Mahlet (2016) found that, across all severity levels, there are more crashes during the daytime than at night in Kolfe Keraniyo, Addis Ababa, likely due to the high volume of vehicular traffic during the day. However, 2.97% (57 out of 1919) of crashes occurring in darkness result in fatalities, which is higher than the 2.2% (111 out of 5053) of fatal crashes that occur during daylight hours. Harold *et al*. (2013) also stated that varying levels of darkness, both with and without streetlights, are associated with the severity of crash injuries. Similarly, Bergel-Hayat *et al*. (2013) noted that visibility, temperature, wind speed, precipitation, and moisture content are key external factors affecting the frequency and severity of crashes. Due to a lack of education and expertise in traffic engineering, traffic police generally overestimated the role that road surroundings play in traffic accidents.

4.3.4. Factors Related to Traffic Law Control and Regulation Systems

The fourth major risk factor for RTAs is the system of traffic laws, control, and regulations, which accounts for around 1.41% of the studied area. The following section contains the qualitative data that was gathered, examined, and evaluated for the traffic law control and regulation system.

The key informant of the traffic police chief inspector said that:

> *we have the best laws, rules, and regulations that prohibit speeding and drinking. While it has not been implemented because of a lack of available resources, such as speed control styles and breath alcohol analyzers, as a result, we have no evidence that either the drivers are driving above normal speed or are intoxicated.*

The informant transport authority expert added that;

> *Some of our traffic laws are not adequately enforced, due to several reasons it can lead to more drivers engaging in dangerous behaviors, such as speeding, drunk driving, or disregarding traffic signals. This increases the likelihood of RTAs. And also when penalties for traffic violations are not severe enough or are inconsistently applied, it can fail to deter drivers from committing offences, leading to more accidents.*

A 40-year old driver, in a semi-structured interview, said, "Some drivers are using forged driving licenses, which points to serious traffic accidents." Based on the driver's statement, I asked the traffic police officer a question: "Is there a problem with a forged driving license in your area?"

> *In reply, he said, "Yes, we have occasionally seen it." However, some regional states presently provide driver's licenses. The registration numbers for these licenses vary depending on the different regions of the country. Furthermore, the falsified license appears to be a legitimate one, but we use forensic machine analysis to verify it.*

A 35-year-old pedestrian who participated in a semi-structured interview stated, "Occasionally, drivers get into arguments with traffic police." After that, they drove aggressively and made RTA into other vehicles or objects.

4.4. Results of One-Way ANOVA for Questionnaire Data

When the factor (independent variable) has two or more groups, a one-way analysis of variance is performed to determine whether there is a statistically significant difference

between the means of the groups. Analyze, compare means, one-way ANOVA, and examine the relationship between the factors that influence vehicle collisions (dependent variable) and the frequency of crashes (factor variable) to do a one-way analysis of variance. The maximum death, heavy injury, light injury as well as material damage were observed due to behavioral factors followed by vehicle factors, however the lowest death, heavy injury, light injury and material damage were recorded from Traffic law and regulation factors. The result indicated that human behavior factor has pronounced effect on accident rates and severity than other factors (table 4.9). This might be due it's less predictability and more direct influence on risky driving situations.

Table 4.94. Analyzed data of all factors with One-way Analysis of Variance (ANOVA)

Factors	**Dependent Variables**			
	Death	Heavy injury	Light injury	Material Damage
Behavioral factors	325^{a}	347^{a}	384^{a}	1323^{a}
Vehicle factors	39^{b}	28^{b}	22^{b}	153^{b}
Road and Environmental factors	12^{c}	15^{c}	14^{c}	119^{c}
Traffic law and regulation factors	7^{c}	0^{d}	0^{d}	33^{d}
LSD	**9.01**	**6.4482**	**7.1106**	**22.86**
CV	**4.71**	**3.31**	**3.39**	**2.81**

Means with the same letter are not significantly different b/n the factors and vice versa at P<0.05

Where LSD=least of significance difference, CV= Coefficient of variation

Table 4.10. Mean square values of dependent variables Death, Heavy injury and Light injury

Dependent variable	Mean Square	F Value	Pr > F
Death	70666.75***	3475.41	<.0001
Heavy Injury	83393***	8005.73	<.0001
Light Injury	104036***	8213.37	<.0001
Material Damage	1126392***	8603.89	<.0001

*** - indicate there's highly significant differences b/n those dependent variables

Furthermore, from the above ANOVA table (table 4.10), the mean square value for deaths, heavy injury and light injury indicates a substantial amount of variation attributable to the

factors under consideration. The highest F value and low p-value (<.0001) further confirms that the results are statistically significant, indicating strong evidence against the null hypothesis.

Table 4.11. Summary of the initial data of all factors with One-way Analysis of Variance (ANOVA)

Behavioral factors	Accident implication (consequence)			
	Death	Heavy injury	Light injury	Material damage
Not prioritizing to pedestrians	113[a]	96[a]	120[a]	156[c]
Driving over speed	96[b]	88[b]	75[b]	254[b]
Drink driving	20[c]	22[d]	16[d]	60[e]
Change direction after by passing	15[d]	16[e]	2[h]	59[ef]
Passing on curve side driving	12[de]	14[ef]	4[gh]	47[g]
Start driving wrongly	10[ef]	12[fg]	7[fg]	46[g]
Improper stopping	9[efg]	9[gh]	6[fg]	26[i]
Not keeping the distance b/n vehicles	8[fg]	10gh	75b	312a
Driving opposite of right side	8[fg]	10gh	2h	55f
Improper changing the direction	6[gh]	5ij	4gh	31h
Addiction driving	6[gh]	4j	11e	47g
Pedestrian problem	6[gh]	8hi	5fgh	35h
Not giving priority to vehicles	4[h]	45c	41c	105d
Reckless driving	4[h]	3j	4gh	34h
Fatigue driving	4[h]	2j	4gh	34h
Driving on stress	4[h]	3j	8ef	22i
CV	10.93	9.2	7.68	3.42
LSD	3.7	3.33	3.07	4.71

Means with the same letter are not significantly different b/n the factors and vice versa at P<0.05

The data indicated that critical behavioral factors contributing to road accidents include the failure to give priority to pedestrians, which accounted for 113 fatalities, 96 severe injuries, 120 minor injuries, and 156 instances of material damage (table 4.11). Additionally, driving at excessive speeds was identified as the most significant factor, with corresponding figures of 96, 88, 75, and 254 for fatalities, severe injuries, and material damages, respectively. Addressing these behaviors through targeted education and enforcement measures could significantly reduce fatalities and injuries on the road.

4.5. Generalization and Interpretation

As we discuss in the above sections, Distribution of RTAs by Major Risk Factors" provides a comprehensive analysis of the distribution of road traffic accidents (RTAs) in the five subcities of Sheger City such as Burayu, Sululta, Sebeta, Tafo and Gelan Subcities. The findings categorize the risk factors into four main groups: Factors related to human behavior, characteristics of vehicles, conditions of the roadway and surrounding environment, as well as traffic laws and regulations, are significant contributors to road traffic collisions. The findings from this study highlight critical elements that are associated with the rising incidence of road traffic accidents in Sheger City.

Behavioral Factors: The results revealed that there is a strong relationship between behavioral factors and the number of RTAs in terms of their occurrence and severity. The main behavioral risk factors are driving over the speed limit (18) and not giving priority to pedestrians (17%). The three categories mentioned above represent 10%–15% of the total accidents. 18% were due to skipping the marking while changing lanes, and 14.26% resulted from not keeping the distance between vehicles. The observations are indicative of the necessity of focusing on driver behavior, which includes speed management, pedestrian exposure hazard awareness, and safe following distance techniques to lessen RTA occurrences. Vehicle Factors: The survey results indicated that vehicular factors like faulty brakes, old tires and tyre blasts and defective steering account for a relatively smaller proportion of the overall accidents ranging from 1.34% to 1.44%. This suggests that while vehicle maintenance and safety are important considerations, the primary focus should be on addressing behavioral factors.

Road and Environment Factors: The research shows that "road and environment issues" are responsible for 7% of the accidents. In 11% of total accidents, infrastructure and weather conditions play a role as factors affecting the safety of roads. This is a call to the responsible authorities to put more funds into road construction and other transport infrastructure and to address what could increase the occurrence of accidents. Traffic Law and Regulation Factors: The data indicates that the contravention of traffic laws and regulations, such as the bypass of traffic police orders (In the list of primary causes, the distracted driver (27%) and priority giving signs (0,14%) play together a small role in the total number of accidents. This suggests that while enforcement of traffic laws is essential, the primary focus should be on addressing the more prevalent behavioral and environmental risk factors. The statistical analysis, as

indicated by the Chi-square test and the corresponding p-values, suggests that the differences in the distribution of accidents across the different accident implications (death, heavy injury, light injury, and material damage) are statistically significant for any of the risk factors (p-values < 0.05).

The results of this research enhance the comprehensive understanding of road safety within the Sheger City area and can guide the formulation of specific interventions and policies aimed at improving road safety while decreasing both the frequency and severity of road traffic incidents. The knowledge acquired from this study can be utilized by policymakers, transportation agencies, and advocates for road safety to identify priorities and execute effective strategies that address critical risk factors, thereby improving the overall safety of the transportation infrastructure in Sheger City.

4.6. Countermeasures

The next step is to provide an appropriate countermeasure for the particular site conditions once the accident data has been analyzed and the primary risk factor for traffic accidents has been determined.

4.6.1. Raise Awareness and Promote Safe Driving Behaviors in Sheger City

As we can see from the following figure 4.13, the researcher and his staff initiated a training session for the selected drivers, bicycle riders, households, and cyclists to highlight the key factors that contribute to road traffic accidents, such as speeding, distracted driving, and impaired driving, and encourage safe driving practices. And also provide guidance on the proper use of safety equipment, like seatbelts and child car seats, and the benefits of their usage. Finally, the trainer was aware of the development of engaging content, such as articles, blog posts, or social media campaigns, to raise awareness about the importance of road safety.

Figure 4.134. Awareness creation in Burayu Subcity for students and drivers

4.6.2. Closing of Risky Median Openings

Risky median openings are those that have a history of collisions, near-misses, or are situated in a way that increases the chances of accidents occurring. Therefore, the researcher and his staff are involved in closing these risky median openings in Burayu and Tafo Subcities by physically blocking (removing the gap in the median) that prevents vehicles from crossing over to the opposite lanes. This action helps to reduce the potential for head-on collisions, sideswipes, and other types of accidents that can occur when vehicles attempt to cross the median.

4.6.3. Installation of Barriers in Risk-Crossing Areas

Risk crossing areas are locations where pedestrians, cyclists, or vehicles are more likely to encounter safety hazards when attempting to cross the road. The identified areas were near intersections, bus stops, school zones, or other places where the risk of collisions was elevated. Therefore, the researcher and his staff are involved in installing barriers in the Burayu and Sululta subcities, which aim to physically separate and guide the flow of traffic as well as provide a safe and designated crossing point for pedestrians and other vulnerable road users (figure 4.14). The barriers can take various forms, such as concrete dividers, guardrails, or bollards, and are designed to channelize the movement of vehicles and create a safer environment for all road users.

Figure 4.14. Installed road barriers at Burayu Subcities

4.6.5. Installation of Different Road Safety Signs

The researcher and his colleagues in Burayu subcity also identified driver uncertainty and hesitation as key contributors to the high rates of road traffic accidents (RTAs) in the area, prompting them to propose a strategic countermeasure: the installation of clear road safety signs. Through data-driven assessments to determine optimal sign placements, the research team worked with local authorities to secure funding and approvals, ultimately installing the signs across Burayu Subcity in collaboration with transport authority offices (figure 4.15). The results were highly positive, as the guidance provided by the signs reduced driver hesitation, leading to smoother traffic flow and a significant decrease in RTA frequency and severity. Drivers reported feeling more confident navigating the subcity roads, curbing the sudden, erratic behaviors that had previously contributed to the high accident rates. The success of this countermeasure demonstrates the transformative impact that strategically placed direction and other signs can have on improving overall road safety and efficiency, serving as a model for other urban centers facing similar challenges.

Figure 4.15. The installation of different road safety signs in Burayu Subcity

5. CONCLUSIONS AND RECOMENDATIONS

5.1. Conclusions

Any collision or incident involving one or more moving vehicles on a publicly accessible private road is referred to as a road traffic accident (RTA). Thus, this study was conducted in Sheger City of Oromia Region, Ethiopia for the last five years. The result revealed that the number of road traffic accidents in Sheger City has consistently increased over the past five years, with 420 accidents reported in 2018, 488 in 2019, 576 in 2020, 624 in 2021, and a peak of 732 in 2022. The number of deaths, heavy injuries, light injuries, and material damages has risen significantly, with the most notable increase in material damages. The economic cost of these accidents has also fluctuated, with the highest value in 2022 at 25,541,693 Birr. The study found that Sululta sub city had the most accidents, with 742, followed by Sebeta with 623. The rate of RTA increment in Burayu sub city has increased by 167.2% over the five-year period, followed by Tafo, Sebeta, Sululta, and Gelan.

The study focuses on the human factors involved in road traffic accidents, focusing on the driver's role. The young (18–30) age drivers were responsible for the majority of accidents (44.61%), the 31–45 age group accounted for 30.14% and the 45-year-old age group had 24.25% of road traffic accidents in Sheger City. Male drivers committed 93.93% of road traffic accidents, while female drivers committed 6.06%. Male drivers had the highest number of deaths, heavy injuries, and light injuries, while female drivers had the lowest. Second cycle primary education level drivers committed 30.35% of road traffic accidents, followed by 26.3% of secondary school-level drivers and 22.96% of first-cycle primary education drivers. Drivers with less than one year of experience had the highest percentage of accidents resulting in death and heavy injury, followed by those with 1-2 years of experience.

The data reveals that behavioral factors account for 85.88% of accidents, including reckless driving and speeding. Vehicle factors account for 5.60%, while road and environmental elements account for 7.11%. Breaking traffic laws accounts for 1.41% of accidents, emphasizing the importance of addressing poor road conditions, unclear signage, and environmental hazards in improving road safety. In general, according to police traffic accident data in Sheger City, a large number of traffic accidents are caused by the faults of drivers. There are several reasons for the higher accident rates associated with drivers, such as inexperience, aging, and a lack of knowledge about the importance and application of traffic laws. Last but not least, there is no legislation that forbids low-quality tires. Other

legal gaps include the non-enforcement of speed limits and the non-enforcement of drunk driving rules.

5.2. Recommendations

Given this level of knowledge on the components of injury severity in traffic accidents, proper action must be made to address this issue. In order to strengthen the foundation of the country's infrastructure, the government intends to expand the road network. Here are some recommendations for actions that should assist in addressing this problem.

- By scaling up the simulation using SUMO to a broader transportation system, the study was able to evaluate the performance of various traffic management strategies, identify potential bottlenecks, and optimize signal timing.
- To improve the activity of health extension services, the government's continuous programme of road safety education delivered by health extension workers should be given in schools, workplaces, and even through mass media in the towns.
- Pedestrian protection measures, including clear markings, fencing, sidewalks, and self-explanatory road design, are crucial for preventing accidents and ensuring safe pedestrian movement.
- Strengthen road safety laws, address risk factors, and prioritize seat belt usage and curbing cell phone conversations while driving.
- Improve police officers' perception of penalties to influence public compliance and behavior.
- Advanced driving education and regular behavioral change programs are crucial for reducing crashes among young and inexperienced drivers, as well as pedestrian safety education for children.
- To mitigate RTAs caused by increased vehicle speeds, it is recommended:
    - ✓ To implement various speed-calming measures, like ramble strips and road humps.
    - ✓ Setting up the speed monitor radar at a specific accident-prone site
    - ✓ A warning sign on a curve or steep gradient to lower vehicle speed and signs and signals to slow down.
- The following measures should be taken to reduce the impact of poor parking facilities on the frequency of RTAs:
    - ✓ Limit parking services at road segments with multiple access road facilities

- ✓ Take into account preventing parking to enhance driveway movements and pedestrian sight lines
- ✓ Develop parking areas; and provide off-street parking.

5.3. Future Scope of Research

The study of the distribution of road traffic accidents (RTAs) by major risk factors in the five sub-cities of Sheger City (Burayu, Sululta, Sebeta, Tafo and Gelan) is a step towards the future study of Sheger City, Of Oromia Region, Ethiopia, on a larger scale. Building upon the insights gained from this study, the following future research directions can be explored to enhance the understanding and mitigation of road safety challenges in the region:

- ❖ Expanding the Geographical Scope:
  - ➢ Extend the assessment of the RTAs not only to other Subcities but to other regions within Of Oromia Region in order to get a more complete picture of the RTA landscapes in the wider geographical area.
  - ➢ And also conduct comparative analyses to detect the possible regional differences in the distribution and determinants of RTAs, that will help in designing the targeted interventions.
- ❖ Longitudinal Analysis:
  - ➢ Compile and analyze the RTA data over a longer time period to see the trends, patterns, and changes in the distribution of risk factors and their effect on accidents occurrence and severity.
  - ➢ Study the outcome of implemented interventions and strategies by evaluating their influence on the rate and severity of injuries and fatalities over time.
- ❖ Multidisciplinary Collaboration:
  - ➢ Enhance multidisciplinary participations between researcher community, policymakers, road traffic engineers, public health workers, and other relevant bodies.
  - ➢ Leverage the expertise of different disciplines like traffic engineering, behavioral science, urban planning, and public policy to create and implement the broad strategies to deal with the varied road traffic accidents in Oromia.
- ❖ Community-based Interventions:

- Engage with local communities, particularly high-risk groups (e.g., pedestrians, vulnerable road users), to understand their perceptions, concerns, and experiences related to road safety.
- Design and implement community-based interventions, such as awareness campaigns, educational programmes, and grassroots initiatives, to empower and involve local stakeholders in the process of improving road safety.

The assessment of RTAs in Sheger City of Of Oromia Region, Ethiopia, can be further enhanced and improved by following these future research directions. This will result in an increased understanding of the underlying problems and the development of more effective, data-driven strategies to improve road safety and reduce the frequency of traffic accidents in the region.

REFERNCES

Africa, U.N.E.C.F (United Nations Children's fund). (2009). Report on road safety.

Alene, N. B. (2015). Politicizing waste collection and discipling waste collectors: A critical analysis of waste management practice in Addis Ababa, Ethiopia (2003–2012). University of Toronto (Canada).

Ali, K. and Ötüken, S. (2014) 'Multinomial logit analysis of risk factors influencing road traffic injury severities in the Erzurum and Kars', *Accident Analysis and Prevention*.

AU (2011) African Road Safety Charter. Togo: AU.

Bentri Orit. T (2011) "The parental factor in adolescent reckless driving: The road ahead." *Journal of Accident Analysis and Prevention,* 1-4.

Beth M, H. (2014) "Fatigue on the Deck: The Consequence of Sleep Loss & the Benefit of Snapping." *Journal of Accident Analysis and Prevention,* 62 (309-318).

Chalya, P.L., Mabula, J.B., Ngayomela, I.H., Kanumba, E.S., Chandika, A.B., Giiti, G., et al., (2010) Motorcycle injuries as an emerging public health problem in Mwanza City, north-western Tanzania. Tanzan. J Health Res. 12, 214–221 (Pub Med).

Chand, A., Jayesh, S., and Bhasi, A. B. (2021). Road traffic accidents: An overview of data sources, analysis techniques and contributing factors. *Materials Today: Proceedings*, *47*, 5135-5141.

Chen, G. (2009) "Road Traffic Safety in Africa Countries Status, Trends, Contributing Factors, Counter Measures and Challenges." The City University of Newyork: Un Published Final Report.

Creswell Jone (2009) Research Design: Qualitative, Quantitative and Mixed method approach. Lossangeless. London. New Dalahi and Singapore: SAGE.

CSA (Central Statistical Agency). (2011). Road traffic accidents and it implication survey Ethiopia: CSA publication, 2005.

Deus, D. (2006). Risk factor and road traffic accident in Tanzania: A case study of Caba district (Master's thesis). Norwegian University of Science and Technology (NTNU).

Dong, C., Clarke, D., Richards, S., & Huang, B. (2014). Differences in passenger car and large truck involved crash frequencies at urban signalized intersections: An

exploratory analysis. *Accident Analysis and Prevention*, 62, 87-94. https://doi.org/10.1016/j.aap.2013.09.015

ElviK Rune (2013) "Risk of road traffic accident associated with the use of drugs: A systematic review & meta- analysis of evidence from epidemiological study". *Journal of Accident Analysis and Prevention,* 60: 254-267.

ERA (2015) "*Road safety report of the year."* Addis Ababa: Ethiopia.

Eskindir Zekios. (2019). Investigation of the Effect of Roadway Elements on Traffic safety in Addis Ababa: A Case of Nifas Silk Lafto Sub City". Msc Degree Thesis, Addis Ababa University

Evelyn Vingilis and Piotr Wilk (2008) "The effect of health status, distress, alcohol and medical drug use on subsequent motor vehicles injury." *Journal of Accident Analysis and Prevention,* 40(2029-2036)

Faraz, M. Khan, Munima Jawaid, Habib Chotani, Stephen Luby (1999) "Pedestrian environment and behavior in Karachi, Pakistan" *Journal of Accident Analysis and Prevention,* 31: 335–339

Fekede, A. Demeke, A. Gezahegn, T. (2014) Magnitude of, trends in, and associated factors of road traffic collision in central Ethiopia.

Gebremikael Atsebeha (2014) "possible engineering solutions: case study of Akaki Kaliti sub city road." MA thesis, 15. Addis Ababa University.

Gilbert Nigel (N.Y) (2015) "*Research Theory and Method*. WATERMARKED.

Guéguen N., Meineri S. and Eyssartier C. (2015) A pedestrian's stare and drivers' stopping behavior: A field experiment at the pedestrian crossing. *Safety science*, *75*, 87-89.

Guibing Li, Jikuang Yang and Ciaran Simms. 2015. "The influence of giant stance on pedestrian limb injury risk." *Journal of Accident Analysis and Prevention*, 85(83-92).

Guohula Li, J. E. 2013. "Drug use and fatal motor vehicle crush: A case-control study." *Journal of Accident Analysis and Prevention,* 60: 205-210.

Han, D. L. (2015) "Behavioral effect on pedestrian's stimulation using cellular automata." *Journal of Safety Science*, 80-85 :45-55.

Harold, B., Weissa, K., and Carlo, P., (2013), 'Analysis of factors associated with injury severity in crashes involving young New Zealand drivers', Accident Analysis and Prevention

Hinders, Martin lof. (2011) Risk theory. department of Mathematics Stockhom university.

Hordofa, G. G., Assegid, S., Girma, A., and Weldemarium, T. D. (2018). Prevalence of fatality and associated factors of road traffic accidents among victims reported to Burayu town police stations, between 2010 and 2015, Ethiopia. *Journal of Transport & Health, 10*, 186-193.

IRTAD, I. T. (2007) "understanding of road traffic causality. Netherland: *Ministry of public work and water management."*

Islam, S. and Mannering, F., (2007), 'Driver aging and its effect on male and female single-vehicle accident injuries: Some additional evidence', Purdue University, Alabama

Jian Sheng and Wong Y. (2014) "The effect of road tunnel environment on car following behavior". *Accident Analysis and Prevention,* 100–109.

Kebede Anteneh (2013/14) "Road Traffic Accident related Fatalities in Addis Ababa City. *An Analysis of Police Report*." Addis Ababa: MA thesis. University of Addis Ababa.

Kim, J., Shankar, V. Ulfarsson, G., and Mannering F., (2010), 'A Note on Modeling PedestrianInjury Severity in Motor-Vehicle Crashes with the Mixed Logit Model', *Accident Analysis & Prevention.*

Kirolos Haleem, Albert Gan and Priyanka Alluri. (2015) "Analyzing pedestrians crush injury severity at signalized and signalized location." *Journal of Accident Analysis and Prevention*. 86(29- 36).

Knighta B. (2013) "The perceptions of young rural drivers in NSW, Australia of speeding and associated risk: A mixed methods study." *Journal of Accident Analysis and Prevention*, 55: 172–177.

Kotheri C. (2004) Research Methodology, Method and Technics. *Place of publication*: new age publisher.

Kwak, S. (2023). Are Only p-values less than 0.05 significant? A p-value greater than 0.05 is also significant. *Journal of Lipid and Atherosclerosis, 12*(2), 89.

Kyoung-Ah, Young-ihn, Joon-Ki and Gudmundur F. (2016) "Special regression analysis of traffic crushes in seol." *Journal of Accident Analysis and Prevention,* 91(190-199).

L. Wang, C. Luo, G. Zhang Yu, Y. and Zhang, L., (2018) An analysis of the characteristics of road traffic injuries and a prediction of fatalities in China from 1996 to 2015, Traffic Injury. Prevention. 19 749–754. 10.1080/15389588.2018.1487061.

Lakew H. (2014) "Analysis of factors that affect road traffic accidents in Bahirdar City, north west Ethiopia." *Applied Mathematics and Statistics,* 91-96.

Lawrence Lam (2004) "Environmental factors associated with crash-related mortality and injury among taxi drivers in New South Wales, Australia," *Journal Accident Analysis and Prevention,* 36: 905–908

Mahlet Geremew (2016) Assessment of Reported Road Traffic Crash in Kolfe Keranyo Sub city, Addis Ababa (MSc Thesis, Addis Ababa University).

Mazaheri M., Keshavarz M., Soori H., Ramezankhani A., Sohrabi V., Sohrabi V.F., and Moradi A. (2018) Influencing factors on the occurrence of road accidents with a special emphasis on motorcyclists in national and global research; a review of the studies conducted in Iran and the world. *World Family Medicine,* 16(3), 198-220.

Mekonen Tewolede (2007) "Empirical Analysis on Traffic accidents involving human injuries: the case of Addis Ababa." Addis Ababa, Ethiopia, MA thesis of Addis Ababa university.

Misganaw, B., and Gebre-Yohannes, E., (2011), 'Determinants of Traffic Fatalities and Injuries in Addis Ababa', Journal of the Ethiopian Statistical Association.

Muhlrad N. and Lassarre S. (2005) Systems approach to injury control. *En: Tiwari, G., Mohan, D. and Muhlrad, N., The way forward: Transportation planning and road safety. Nueva Delhi, McMillan India Ltd,* 52-73.

Norman L. and World Health Organization. (1962) *Road traffic accidents: epidemiology, control, and prevention.*

Odoro W. (1995) "Road traffic accident in kenya: An epidemiological appraisal." *East African Medical Journal,* 295-305.

Papadimitriou, E., Theofilatos, A., Yannis, G., Cestac, J., and Kraïem, S. (2014) Motorcycle riding under the influence of alcohol: Results from the SARTRE-4 survey. *Accident Analysis and Prevention*, *70*, 121-130.

Paul S., John B., Williamson D. and John R. (2007) The Research imagination. Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo: Cambridge University Press, New York.

Peder M., Scurfield R., Sleet D., Mohan D., Hyder A. and Jarawan E. (2004) *World report on road traffic injury prevention*. Geneva, Switzerland: WHO

Persson A. (2008) Road traffic accidents in Ethiopia: magnitude, causes and possible interventions. *Advances in transportation studies*, *15*, 5-16.

Politis I., Socrates B. and Panagitis P. (2013) "Exploring the effect of attitudinal & perception characteristics on drinking non-compliant behavior." *Journal of Traffic Accident Analysis and Prevention*, 316-323.

R. Bergel-Hayat, M. Debbarh, C. Antoniou, G. Yannis (2013) Explaining the road accident risk: weather effects, *Accident Analysis Prevention*. 60, 456–465, https:// doi.org/10.1016/j.aap.2013.03.006

Rayan A. (2008) "What is A system approach". http://arxiv.org/pdf/0809.1698.pdf.

Redi, K. (2015). *Assessment of Road Traffic Crash Data Collection and Management System of Ethiopia* (Doctoral dissertation, Addis Ababa University).

Rocío P., Teresa L., Sarah B., (2016) "Pedestrians related and drivers related factors associated with the risk factor of causing collision involving pedestrians in Spain." *Journal of Accident Analysis and Prevention*, 91 (36-42).

Roddis E. (2014) "High strength steels, stiffness of vehicle front-end structure, and risk." *Journal of Accident Analysis and Prevention*, 43-54.

Rudistill Tonily s. z. (2014) "Trends in drug use among drivers killed in USA traffic crush." *Accident Analysis and Prevention,* 70,178-187.

Rune, E. (2015). Can electronic stability control replace studded tyres? *Journal of Accident Analysis and Prevention,* 85, 170-186. https://doi.org/10.1016/j.aap.2015.09.020

Safe car guide and Tesema (2004) *Data mining using adaptive progress trees*

Salmon P., Lenne G., Stanton N, Jenkins P and Walker H. (2010) "Managing error to the open road: the contribution of human error and methods." *Journal Safety Science*, 48,1225-1235.

Samson, F. (2006). Analysis of Traffic Accident in Addis Ababa: Traffic Simulation. Msc Degree Thesis, Addis Ababa University

SARSE. (2011-2020) "National road safety strategy." *Johannesburg:* SARSE.

Schechtman, E., Bar-Gera, H., & Musicant, O. (2016). Drivers' views on speed and enforcement. *Journal of Accident Analysis and Prevention*, 89, 99-121. https://doi.org/10.1016/j.aap.2016.01.012

Schopper J. (2009) "Developing policies to prevent injury and violence: *guidelines for policy maker and planner*. Genève: WHO."

Scott-Parker B., Watson B., King M. and Hyde, M. K. (2014) "I drove after drinking alcohol" and other risky driving behaviors reported by young novice drivers. *Accident Analysis and Prevention, 70*, 65-73.

Sebego M., Naumann R., Rudd R., Voetsch K., Dellinger A. and Ndlovu C. (2014) The impact of alcohol and road traffic policies on crash rates in Botswana, 2004–2011: a time-series analysis. *Accident Analysis and Prevention, 70*, 33-39.

Seid M., Azazh A., Enquselassie F. and Yisma E. (2015) Injury characteristics and outcome of road traffic accident among victims at adult emergency Department of Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia: a prospective hospital based study. *BMC emergency medicine*, *15*, 1-9.

Senserrick T., McRae D., Wallace P., Rome L, Rees P. and Williamson, A. (2017) Enhancing Higher-Order Skills Education and Assessment in a Graduated Motorcycle Licensing System. *Transport and road safety research*, 3,14.

Shiferaw, Y., Gemechu, D., and Jibat, N. (2020) Risk factors and implications of road traffic accidents in Oromia Special Zone Surrounding Finfinnee, Ethiopia. *The Ethiopian Journal of Social Sciences and Language Studies (EJSSLS)*, *7*(1), 49-65.

Sileshi F. (2014) "Road trafic accident the neglected health problem in Amara regional state, Ethiopia." *Journal of Health Science and Development*, 28(1).

Simons-Morton, G., and Hartos, L., (2003), 'How well do parents manage young driver crash risks?', Journal of Safety Research.

Siskind V., Fleiter J., Watson A. and Soole D. (2015) Assessing specific deterrence effects of increased speeding penalties using four measures of recidivism. *Accident Analysis and Prevention, 84,* 27-37.

Stevens J., Thomas K. and Sogolow, E. D. (2007) Seasonal patterns of fatal and nonfatal falls among older adults in the US. *Accident Analysis and Prevention, 39*(6), 1239-1244.

Teferi A, Yemane B, Alemayehu W, and Abebe A. (2014) Effectiveness of an improved road safety policy in Ethiopia: an interrupted time-series study. Bio Med Central, 14(539).

Tegegn Mota (2016). Assessment of Motorcycle Crashes in South Omo Zone, Ethiopia (MSc Thesis, Addis Ababa University).

Tracey Ma, Patrick A. Byrne, Maryam Haya, Yoassry Elzohairy (2015) "Working in tandem: the contribution of remedial program and road side license suspension to drinking and driving deterrence in Ontario." *Journal of Accident Analysis and Prevention*. 85(248-258).

UNECA (2009) "Case study: *Road safety in Ethiopia*." ECA/NRID/019.

United Nation, (2011). Economic Commission for Africa, Case Study: Road Safety in Ethiopia, Volume 19.

Vorko Jovic and Kern Biloglave (2006) "Investigation of risk factors on road traffic accidents. "*Journal of Safety Research,* 93-98.

WHO (2001) "A five year WHO strategy for road traffic injury prevention." Genève, Switzerland: WHO.

WHO (2004) "world report on road traffic injury prevention." Genève: world health organization

WHO. (2009).The world health statistics report.20 Avenue Appia, 1211 Geneva 27, Switzerland: WHO.

World Health Organization, (2013). Global Status Report on Road Safety: Supporting a Decade of Action.

World Health Organization. (2015). *Global status report on road safety 2015*. World Health Organization.

World Health Organization, 'Global Status Report on Road Safety': Retrieved from http://www.who.int/violence_injury_prevention/road_safety_status/2016/en/

World Health Organization (2017). Powered two and three-wheelers Safety: A road safety manual for decision-makers and practitioners.

Yosef, E., (2008). (Oromia Transport Authority), Pedestrian road use Safety, Finfinne.

APPENDICES

Appendix I

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Interview Guide for Road and Transport Authority Expert (Key Informant Interview)

A. Personal Information

- **Date: _____Age: ____Gender: _____Position/Rank: _____**

B. Questions Related to Risk Factors

B. Questions About Risk Factors

1. How critical do you consider road traffic accidents in Sheger City?

.....

2. How does the rate of traffic accidents in Sheger City compare to other regions?

.....

3. What trends in traffic accidents have you observed over time?

.....

4. How do you gather information following a road traffic accident?

.....

5. Are there challenges in getting timely information after an accident? If yes, what are they?

.....

6. How are injured individuals usually transported to medical facilities?

   - Police vehicle…….
   - Ambulance……
   - Assistance from other motorists…….
   - Self-arranged transportation by victims……
   - Other: ……..

7. What measures exist to enforce speed limits? Are there laws regulating speed?

.....

8. Do you face challenges in maintaining accident records?

.....

9. Are there barriers to implementing traffic safety programs in your area?

.....

10. Do you believe current traffic laws effectively reduce accidents?

.....

11. What factors contribute to road traffic accidents in Sheger City?

- Vehicle-related issues:……
- Infrastructure problems:……..
- Driver behavior:……..
- Legislative shortcomings:……..

12. What measures do you take to reduce traffic accidents in your jurisdiction?

.....

C. Questions About Impacts

13. Are you aware of the policies related to transportation, law enforcement, and health services?

    .....
    .....

14. Do you consider traffic accident consequences a major concern in Sheger City?

.....

15. What are the impacts of losing a family's primary income earner in accidents?

.....

16. How do traffic accidents affect the nation socio-economically?

- Fatalities……
- Physical injuries……..
- Material damages……..
- Psychological, economic, and social impacts on families……

- Broader societal consequences……

D. Questions About Traffic Laws

17. How do you evaluate the traffic regulations in your area?

.....

18. Are there any safety laws that regulatory bodies have failed to enforce? If yes, why?

.....

19. Do any current traffic laws require amendments or new ones for better traffic management?

.....

E. Final Remarks

20. Is there any additional input you'd like to share? Any suggestions or corrections to help reduce road accidents?

.....

APPENDIX II

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Interview Guide for Traffic Police (Key Informant Interview)

A. Personal Information

- **Date: _____Age: ____Gender: _____Rank/Position: _____**

B. Questions Related to Risk Factors

1. How critical do you consider road traffic accidents in Sheger City?

.....

2. How does the rate of traffic accidents in Sheger City compare to other regions?

.....

3. What trends in traffic accidents have you observed over time?

.....

4. How do you gather information following a road traffic accident?

.....

5. Are there challenges in getting timely information after an accident? If yes, what are they?

.....

6. How are injured individuals usually transported to medical facilities?

- Police vehicle…….
- Ambulance……
- Assistance from other motorists…….
- Self-arranged transportation by victims……
- Other: ……..

7. What measures exist to enforce speed limits? Are there laws regulating speed?

.....

8. Do you face challenges in maintaining accident records?

.....

9. Are there barriers to implementing traffic safety programs in your area?

.....

10. Do you believe current traffic laws effectively reduce accidents?

.....

11. What factors contribute to road traffic accidents in Sheger City?

- Vehicle-related issues:……
- Infrastructure problems:……..
- Driver behavior:……..
- Legislative shortcomings:……..

12. What measures do you take to reduce traffic accidents in your jurisdiction?

.....

C. Questions About Impacts

13. Are you aware of the policies related to transportation, law enforcement, and health services?

.....

14. Do you consider traffic accident consequences a major concern in Sheger City?

.....

15. What are the impacts of losing a family's primary income earner in accidents?

.....

16. How do traffic accidents affect the nation socio-economically?

- Fatalities……
- Physical injuries……..
- Material damages……..

- Psychological, economic, and social impacts on families……
- Broader societal consequences……

D. Questions About Traffic Laws

17. How do you evaluate the traffic regulations in your area?

.....

18. Are there any safety laws that regulatory bodies have failed to enforce? If yes, why?

.....

19. Do any current traffic laws require amendments or new ones for better traffic management?

.....

E. Final Remarks

20. Is there any additional input you'd like to share? Any suggestions or corrections to help reduce road accidents?

.....

thanks!

Appendix III

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Interview Questions for Drivers (Semi-Structured)

Interviewee Information

Dear Participant,

This study investigates the risk factors and impacts of road traffic accidents (RTAs) in Sheger City. Ethiopia sees a significant human contribution to RTAs, making traffic safety a priority. This research aims to collect data supporting institutions involved in traffic safety campaigns. You are free to skip any uncomfortable question or withdraw from the study at any time. Your personal identity is not required; only your position and age range will be recorded. All provided information will remain confidential and used solely for academic purposes. Thank you!

A. Personal Details

Date: _____Age Range: _____Gender: _____Occupation: _____

B. Questions About Risk Factors

1. How long have you been driving?.....
2. Can you describe your daily driving routine? How did you prepare to get your driver's license?

   ……
   ….
3. Do you think vehicle types contribute to traffic accidents?

…….

4. Have you ever been involved in a traffic accident?

…….

5. How does your job influence your driving habits?

…….

6. What concerns do you have about driver attitudes and behaviors?

…….

7. How do you view pedestrian behaviors related to traffic?

…….

8. Are there unethical drivers in your area? What behaviors do they display?

…….

9. What motivates behaviors like speeding, overloading, or double parking?

…….

10. What driving behaviors do you think cause accidents?

…….

11. Are there penalties for speeding, and are drivers aware of them?

…….

12. What unsafe driving practices do you occasionally engage in?

…….

13. From your perspective, what are the primary risk factors for RTAs?

…….

14. As a pedestrian, do you feel at risk of being involved in an accident?

…….

15. What factors contribute to traffic accidents in your area?

- Vehicle issues:……..
- Road environment:……..
- Human behavior:…….
- Legal or regulatory gaps:…….

C. Questions About Impacts

16. Are the consequences of traffic accidents a serious concern in the study area?

…….

17. What impacts have you seen in your community, and how have they affected victims?

…….

18. How do road traffic accidents affect the country socio-economically?

- Fatalities ……
- Physical injuries …….
- Material damages …….
- Social, psychological, and economic impacts on families ……..

D. Questions About Traffic Laws

19. Are you familiar with policies on transport and law enforcement?

…….

20. Are there road safety laws that haven't been implemented? Why?

…….

21. Do traffic laws need revision or new legislation for better management? Please explain.

…….

E. Final Remarks

22. Is there anything else you'd like to share? Do you have suggestions for improving traffic safety?

…….

Appendix IV

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Interview Questions for Health Experts (Key Informant Interview)

A. Personal Information

Date: _____Age: _____Gender: _____Rank/Position: _____

B. Questions About Risk Factors

1. Do you think road traffic accidents are a major issue in Sheger City?

…….

2. How does the frequency of traffic accidents in Sheger City compare to other zones in the country?

…….

3. Based on your experience, how have traffic accidents evolved over time regarding injuries and fatalities?

…….

4. What challenges do you face in receiving accident victims?

…….

5. Are there sufficient facilities to treat all injured individuals? If not, what alternatives do you suggest?

…….

6. Is the system for transporting victims from accident sites to healthcare facilities adequate for providing timely care?

…….

7. Do residents in Sheger City express fear about traffic accidents?

…….

8. What are the obstacles to implementing traffic safety measures in Sheger City?

…….

9. What factors contribute to road traffic accidents in Sheger City?

- Vehicle-related issues:……..
- Road environment:…….
- Behavioral factors:…….
- Legislation and regulations:……..

10. What improvements do you recommend for medical services for accident victims?

…….

C. Questions About Impacts

11. Do you believe the consequences of traffic accidents are a significant issue in the area?

…….

12. What are the implications of losing a family's primary income earner?

…….

13. How do traffic accidents affect the country's socio-economic conditions?

- Fatalities ……
- Physical injuries……
- Material damages…….
- Social, psychological, and economic effects on victims' families…….
- Broader societal impacts……

D. Questions About Traffic Laws

14. Are you familiar with existing policies on transportation law enforcement and healthcare services?

…….

15. How do you evaluate the traffic laws in your area?

…….

16. Are there road safety regulations that haven't been enforced? If so, why?

…….

17. Do current traffic laws need amendments or new legislation to improve road safety? Please explain.

…….

E. Final Remarks

18. Do you have any additional input or suggestions to help reduce road traffic accidents?

…….

Appendix V

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Interview Questions for Pedestrians (Semi-Structured)

Information for Participants

Dear Participant,

This study examines risk factors and impacts of road traffic accidents (RTAs) in Sheger City. Given the significant human role in RTAs in Ethiopia, traffic safety is a key priority. The research seeks to gather data to aid organizations in traffic safety campaigns. You may skip

any question or withdraw from the study at any time. We only ask for your position and age range; personal identity is not required. All data will remain confidential and used for academic purposes only. Thank you!

A. Personal Information

Date: _____Age Range: _____Gender: _____Occupation: _____

B. Questions About Risk Factors

1. How often do you walk or cross streets? Can you describe your experiences?

…….

2. What challenges do you face while walking or crossing roads?

…….

3. Do pedestrian attitudes and behaviors pose safety risks? If so, how?

…….

4. How do road conditions in this area affect pedestrian movement?

…….

5. Do pedestrian actions impact drivers' behavior?

…….

6. How do pedestrians in this area get exposed to RTAs?

…….

7. Why do you think pedestrians behave in certain ways?

…….

8. Are you aware of any penalties for pedestrian violations?

…….

9. What are the primary risks pedestrians face on the roads?

…….

10. Do you feel unsafe as a pedestrian?

…….

11. What factors contribute to RTAs in this area?

- Vehicle-related issues: ……
- Road conditions:……..
- Behavioral factors:……
- Legal and regulatory gaps:……..

C. Questions About Impacts

12. Do you consider the impacts of RTAs a serious issue in this area?

…….

13. What impacts have you observed in your community, and how have they affected victims?

…….

14. How do RTAs affect the socio-economic conditions of the country?

- Fatalities ……..
- Physical injuries…….
- Material damages……..
- Social, psychological, and economic impacts on families……

D. Questions About Traffic Laws

15. Are you familiar with the current transportation and traffic law enforcement policies?

…….

16. Are there road safety regulations that haven't been enforced? If so, why?

…….

17. Do traffic laws need amendments or new ones for better management? Please explain.

…….

E. Final Remarks

18. Is there anything else you'd like to share? Do you have suggestions to improve road traffic safety?

……
……

Appendix VI

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Focus Group Discussion Interview Guide

A. Questions About Risk Factors and Impacts

1. Do you consider road traffic accidents to be a major problem in Sheger City?
2. What are the main risk factors contributing to RTAs in Sheger City?
3. Who are the primary victims of road traffic accidents in this city?
4. What safety measures have been introduced by local authorities to prevent RTAs?
5. Do you think these safety measures effectively reduce road accidents?
6. Do the current traffic laws and regulations contribute to decreasing accidents?
7. Who do you believe is primarily responsible for road traffic accidents in Sheger City?
8. What steps has the central government taken to address RTAs in this area?
9. Does the community in Sheger City associate RTAs with traditional beliefs or superstitions?
10. What challenges do local authorities face when implementing road safety measures?
11. What are the implications of losing a family's primary income earner due to an accident?

B. Questions About Traffic Laws and Regulations

12. How do you evaluate the traffic regulations in your town?
13. Are there any road safety laws that have not been enforced? If so, why?
14. Do you believe there are flaws in current traffic laws that require amendments or new legislation? Please explain.

C. Closing Remarks

15. Is there any additional information you'd like to share that hasn't been covered?

…….

…….

16. Do you have suggestions or corrections to help reduce road traffic accidents?

…….

…….

Appendix VII

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

College of Mechanical, Chemical and Materials Engineering

Department of Mechanical Engineering

MSc in Automotive Engineering

Observation Checklist

1. The researcher observed the behavior of both vehicles and pedestrians, focusing on adherence to speed limits, use of signals, and pedestrian practices while crossing roads. Observations will particularly focus on busy areas and involve collaboration with traffic police.
2. Observations were conducted during peak hours:
   - ✓ **Morning:** 7:30 AM to 8:30 AM
   - ✓ **Evening:** 1:30 PM to 2:00 PM

3. Data collections were focused on traffic congestion, road system efficiency, and the use of zebra crossings.
4. Additional roadside observations were carried out to gather supplementary information on traffic patterns and conditions.

Note: All questionaries have been translated into Afan Oromo and Amharic. However, these translations are not included in the main thesis report due to size limitations.