



**Assessments of the primary factors affecting driving speed and the violation of
the speed limit by drivers in Addis Ababa**

Tareqwa Tsegaye

ADVISOR: Getu Segni (Dr.)

**A Thesis Submitted to School of Civil and Environmental Engineering in
Partial Fulfillment of the Requirements for the Degree of Master of Science in
Civil Engineering**

(Road and Transport Engineering Stream)

ADDIS-ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF CIVIL AND ENVIROMENTAL ENGINEERING

ASSESSMENTS OF THE PRIMARY FACTORS AFFECTING DRIVING SPEED
AND THE VIOLATION OF THE SPEED LIMIT BY DRIVERS IN ADDIS
ABABA

BY: TAREQWA TSEGAYA

APPROVED BY BOARD OF EXAMINERS

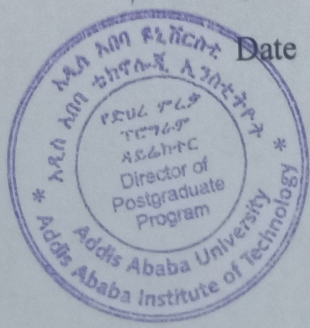
Dr. Getu Segni [Signature] 23/06/2023
Advisor Signature Date

Internal Examiner Signature Date

Posean Solomon (PhD) [Signature] 15/June/2023
Examiner Signature Date

Rared Ali [Signature] 24/06/2023
Chairman Signature Date

Abraham Gebre (Dr.)
Dean, School of Civil &
Environmental Engineering



DECLARATION

I hereby declare that this thesis is my original work except for citations and quotations; which have been duly acknowledged. I also declare that it has not been presented for the award of a degree in any other University.

Tareqwa Tsegaye

Author's Name



Signature

15 June / 2023

Date

Acknowledgment

I sincerely thank the Almighty God for His mercies, power, and, most importantly, for His support and love throughout my academic career up to this level. His kindness has enabled me to succeed and flourish in all of my academic and life endeavors.

I am unable to fully express my gratitude to Dr. Getu Segni, who has been my nimble, flexible, and always supportive advisor. Thank you for your constant support and encouragement. Thank you for believing in me even if I quit on myself, especially during the seemingly challenging times. I am most grateful to you.

I must not fail to sincerely appreciate and acknowledge the financial support from the female scholarship of Addis Ababa University and my husband for providing me with his time during the data collection for this thesis.

Last but not least, I would like to express my deep gratitude to my loving parents, W/ro Shinbera Yimer and Ato Tsegaye Bedaso, for their unwavering support and the roles they played on my behalf. My greatest appreciation also goes to my beloved husband, Birehanu Tessema, and my baby, Yemariyam Birhanu, for understanding me when i am not around.

Table of Contents

Acknowledgment.....	i
Table of Contents	ii
List of Tables	v
List of Figures.....	vii
ABSTRACT.....	ix
1. Introduction	1
1.1. Background	1
1.2. Statement of the Problem.....	2
1.3. Research Questions.....	3
1.4. Objective of the study	4
1.4.1. General Objective.....	4
1.4.2. Specific Objective	4
1.5. Significance of the study	4
1.6. Scope and limitation of the Study.....	5
1.7. Organization of the thesis.....	6
2. Literature Review	7
2.1. Introduction.....	7
2.2. Speeding and traffic safety	7
2.3. Posted speed limit violation and traffic accidents.....	9
2.4. The relationship between road type and speed	10
2.5. Speed and Vehicle type.....	11
2.6. Driver Behavior and Speeding.....	11
2.7. The effect of pedestrian density in speeding.....	13
2.8. Crash Data Analysis and speeding	14
2.9. Spot Speed.....	15
2.10. Type of modeling used for speed study	18
2.11. Summary of literature review	20
3. Methodology and Data collection.....	21
3.1. Introduction.....	21

3.2. Identification of Site Conditions	21
3.2.1. Road Type.....	22
3.2.2. Traffic condition.....	23
3.2.3. Traffic facilities.....	23
3.2.4. Environmental conditions.	23
3.3. Selection of study location	23
3.4. Identification and selection of variables for data collection	28
3.4.1. Identification and selection of dependent (criterion) variables	28
3.4.2. Identification and selection of independent (predictor/explanatory) variables	30
3.4.3. Dependent and independent variables for driver survey compliance to posted speed limit	31
3.5. Data Collection Method	31
3.5.1. Equipment for the study	31
3.5.2. Data Collection Times	33
3.5.3. Data collection plan.....	34
3.5.4. Sample Size requirement for speed (Spot speed per section).....	34
3.5.5. Sample Size requirement for posted speed limit compliance (driver’s behavior survey) 34	
3.6. Data Analysis Techniques	41
3.6.1. Procedures for factors affecting speed	41
3.6.2. Procedures for posted speed limit compliance (drivers behavior survey).....	42
3.7. Data Collection	43
3.7.1. Data Collection for speed violation prediction, road geometry	43
3.7.2. Data collection for Drivers compliance to the posted speed limit survey	44
4. Data analysis and Discussion	46
4.1. Descriptive statistics.....	47
4.1.1. Descriptive statistics for spot speed analysis.....	47
4.1.2. Descriptive statistics for Drivers survey.....	51
4.2. Multiple linear regression model	52
4.2.1. Multiple linear regressions assumptions checked	53
4.2.2. Developing multiple linear regressions model.....	62

4.3. Violation of posted speed limit by drivers on different types of road and PSL	67
4.3.1. Vehicle composition and sample size for 30 km/hr. posted speed limit.	67
4.3.2. Vehicle composition and sample size for 40 km/hr. posted speed limit.	72
4.3.3. Vehicle composition and sample size for 50 km/hr. posted speed limit.	76
4.4. Drivers attitudinal survey analysis.....	79
4.4.1. Mean Comparison of the Likert question.....	80
4.4.2. Mean comparison Causes of speeding as per driver perspective.....	81
4.4.3. Mean comparison Compliance of drivers with the speed limit.....	83
4.4.4. Mean comparison Intention of drivers.....	85
4.4.5. Mean comparison for commercial drivers.....	86
4.5. Ordinal Logistic regression model for self-reported violation of the speed limit	87
4.6. Discussion.....	95
5. Conclusion and Recommendation.....	97
5.1. Conclusion	97
5.2. Recommendation.....	99
REFERENCES.....	100
Appendix.....	103
Appendix 1: speed frequency Distribution graph for each road section.....	103
Appendix 2: Drivers survey Questionaries'	115

List of Tables

Table 3.1: Road type and speed limit standard of Addis Ababa City.....	24
Table 3.2: Selected road sections and characteristics for the study	26
Table 3.4: Independent Variables and their characteristics.....	30
Table 3.5: Sample observation data sheet.....	32
Table 3.6: Geometric parameters of the road sections.....	36
Table 4.1: Descriptive statistics for spot speed analysis	47
Table 4.2: Descriptive statistics for Drivers survey	51
Table 4.3; Description of categorical variables statistics for multiple linear regression models.....	52
Table 4.4; Description of continuous variables statistics for multiple linear regression models.....	53
Table 4.5: Correlation of independent variable.....	57
Table 4.6: Model Summery for MLR	59
Figure 4.8: Normal distribution graph	60
Table 4.6: Dummy variable for type of road.....	62
Table 4.7: Dummy variable for Land Use	62
Table 4.8: Dummy variable for Road pavement Conditions	63
Table 4.9: Dummy variable for Posted speed limit.....	63
Table 4.10: Model Summery for MLR	63
Table 4.11: Model Summery for MLR	63
Table 4.12: ANOVA Test	64
Table 4.13: Coefficients of the MLR model.....	65
Table 4.14: Cross tabulation of variables with speed compliance and violation at 30Km/hr. PSL	68
Table 4.17 Mean value for 5 scale likert answers	80
Table 4.18 Mean value for 4 scale likert answers	80
Table 4.19 Descriptive statics for causes of speeding as per driver perspective	81
Table 4.20: Descriptive statics for Compliance of drivers with the speed limit.....	83
Table 4.21: Descriptive statics for Intention of drivers.....	85

Table 4.21: Descriptive statics for commercial drivers	86
Table 4.22: Independent variable description for Ordinal Logistic regression model.....	87
Table 4.23: Model fitting information.....	88
Table 4.24: Dummy variables for type of road	88
Table 4.25: Dummy variables for gender of drivers.....	88
Table 4.26: Dummy variables for driving experience	89
Table 4.27: Dummy variables for driver’s marital status.....	89
Table 4.28: Dummy variables for driver’s educational level.....	89
Table 4.29: Dummy variables for driver’s Vehicle ownership.....	89
Table 4.30: Linear regression for collinearity.....	89
Table 4.31: Parameter estimates for Ordinal Logistic regression model	91
Table 4.32: Goodness-of-Fit for Ordinal Logistic regression model.....	92
Table 4.33: Pseudo R-Square for Ordinal Logistic regression model.....	92
Table 4.34: Parameter estimates for gender and marital status of drivers.....	93

List of Figures

Figure 2.1: Different type of Radar.....	16
Figure 2.2: Example Radar Meter Spot Speed Study Layout	16
Figure 2.3: Pneumatic Road Tubes	17
Figure 2.4: Road Tubes and Recorder	17
Figure 3.1: Road Hierarchy	22
Figure 3.2: Road network of Addis Ababa City.....	25
Figure 3.3: Selected roads of Addis Ababa for this Study	28
Figure 3.4: Hand Held Pocket Radar.....	32
Figure 3.6: Positioning of Observer	33
Figure 3.7: Sample summary format of data collection detail for spot speed	44
Figure 4.1: Pedestrian Volume vs. 50 th percentile speed.....	54
Figure 4.2: No. of lane vs. 50 th percentile speed	54
Figure 4.3 : 85 th percentile speed vs. 50 th percentile speed.....	55
Figure 4.4: Pedestrian walk way width vs. 50 th percentile speed	55
Figure 4.5: Percent of violation vs. 50 th percentile speed	56
Figure 4.6: PSL vs. 50 th percentile speed	56
Figure 4.7: homoscedasticity test.....	59
Figure 4.9: Normal P-P Plot.....	61
Figure 4.9: Box Plot for 50 th percentile speed	62
Figure 4.10: Cluster Bar percent of Land use by Violators at 30Km/hr. PSL.....	69
Figure 4.11: Cluster Bar percent of Types of road by Violators at 30Km/hr. PSL.....	69
Figure 4.12: Cluster Bar percent of Plate Code by Violators at 30Km/hr. PSL.....	70
Figure 4.13: Cluster Bar percent of Type of Vehicle by Violators at 30Km/hr. PSL.....	70
Figure 4.14: Cluster Bar percent of Age of Drivers by Violators at 30Km/hr. PSL	71
Figure 4.15: Cluster Bar percent of Gender of Drivers by Violators at 30Km/hr. PSL	71
Table 4.15: Cross tabulation of variables with speed compliance and violation at 40Km/hr. PSL	72
Figure 4.16: Cluster Bar percent of Land use by Violators at 40Km/hr. PSL.....	73
Figure 4.17: Cluster Bar percent of Types of road by Violators at 40Km/hr. PSL.....	73

Figure 4.18: Cluster Bar percent of Plate Code by Violators at 40Km/hr. PSL.....	74
Figure 4.19: Cluster Bar percent of Type of Vehicle by Violators at 40Km/hr. PSL.....	74
Figure 4.20: Cluster Bar percent of Age of Drivers by Violators at 40Km/hr. PSL	75
Figure 4.21: Cluster Bar percent of Gender of Drivers by Violators at 40Km/hr. PSL	75
Table 4.16: Cross tabulation of variables with speed compliance and violation at 50Km/hr. PSL	76
Figure 4.22: Cluster Bar percent of Land use by Violators at 50Km/hr. PSL.....	77
Figure 4.23: Cluster Bar percent of Types of road by Violators at 50Km/hr. PSL.....	77
Figure 4.24: Cluster Bar percent of Plate Code by Violators at 50Km/hr. PSL.....	78
Figure 4.25: Cluster Bar percent of Type of Vehicle by Violators at 50Km/hr. PSL.....	78
Figure 4.26: Cluster Bar percent of Age of Drivers by Violators at 50Km/hr. PSL	79
Figure 4.27: Cluster Bar percent of Gender of Drivers by Violators at 50Km/hr. PSL	79
Figure 4.28: Bar chart for causes of speeding as per driver perspective.....	83
Figure 4.29: Bar Chart for the likelihood of becoming involved in a collision is decreased by obeying the speed limit	84
Figure 4.30: Bar chart for intention of drivers to comply with the speed limit	85
Figure 4.31: Bar chart for commercial driver’s effect of income and compliance to speed limit.....	86

ABSTRACT

Infrastructure projects, such as road construction, are one of the most important projects in Ethiopia. Growth in this sector is critical for growth in national income as it is among the largest sectors that generate employment within the country and is a key driver for the economic development of Ethiopia. Addis Ababa Roads Authority has administered road projects at the city level, and traffic is controlled by Addis Ababa City Administration Traffic Management. Traffic control includes posted speed limits, traffic warning signs, and traffic lights. However, the posted speed limits are not well known by the drivers, and most of the time drivers violate the rule by over speeding. There are several factors that contribute to these posted speed limit violations. In order to reduce speed limit breaches, future work should focus on identifying the main causes of violations of the posted speed limit as well as the main factors influencing drivers' speed when operating a vehicle on Addis Ababa City roadways. A detailed analysis of the literature and desk research was conducted, and the results allowed for the identification of both global and local causes of speeding violations and factors influencing driver speed.

This paper focuses mainly on two data sources, which are collected directly from the road (spot speed of vehicles) and closed-ended questionnaires. Spot speed data on different road types and 450 questionnaires were distributed to randomly selected drivers by convenience sampling. Multiple linear regression models for the average speed of vehicles on a section (50th percentile speed). Furthermore, the driver's compliance with the posted speed limit is analyzed by using ordinal logistic regression through self-reported violations. The likert scales have been analyzed by using cross tabulation and bar charts for causes of speeding as per driver perspective and compliance with the posted speed limit.

As a result of the study, the independent variable inputs are statistically significant with a P-value of less than 0.05 with a 95% confidence interval, and they have a significant effect on the 50th percentile speed. For ordinal logistic regression through self-reported violations, gender of drivers, marital status of drivers, age of drivers, and driving experience of drivers have a significant effect on the violation of speed with a P-value of less than 0.05 with a 95% confidence interval.

On the other hand, drivers have the intention of complying with the speed limit and also understand the effect of speeding. However, they still do not comply with the speed limit. Commercial drivers agree that income affects violating the speed limit, and most commercial drivers understand that complying with the PSL affects their per-day income.

Key words: Posted speed limit, 50th percentile speed, 85th percentile speed, Compliance of drivers, multiple linear regression model, ordinal logistic regression

1. Introduction

1.1. Background

Road traffic accidents claim the lives of more than 1.35 million people annually or one every 24 seconds. The primary cause of road traffic injuries is excessive speed, which is also responsible for one in three road fatalities in high-income countries. According to estimates, 40–50% of drivers exceed the speed limit, and every 1 km/h increase in speed is associated with a 4-5% increase in fatal collisions. When speeds are decreased, the danger of death and injury is significantly lower (WHO, 2022). Ethiopia has not achieved the goal of the United Nations Decade of Action for Road Safety (2011–2020): to reduce road fatalities and injuries by 50 percent by 2020 (WHO, 2015).

All countries report that speeding is a contributing factor in 15% to 35% of fatal road crashes. Similarly, driving under the influence of alcohol is a factor in 10% to 30% of fatal crashes in all countries (ITF Report, 2020). An increase in average speed is directly related both to the likelihood of a crash occurring and to the severity of the consequences of the crash. For example, every 1% increase in mean speed produces a 4% increase in the fatal crash risk and a 3% increase in the serious crash risk. Speeding and drink-driving remain two key factors in fatal crashes (WHO).

The risk of a crash happening as well as the seriousness of the effects of the incident is strongly correlated with an increase in average speed. For instance, a 1 km/hr. increase in mean vehicle speed causes a 4-5% increase in fatal collisions. And when a collision does happen, speed also influences how severe the impact will be. The chance of mortality for car occupants in an accident with an impact speed of 80 km/h is 20 times higher than it would be with an impact speed of 30 km/h. (WHO, 2018). High speed also compounds the consequences of other drivers' mistakes, such as distractions or failing to maintain the proper safety distance, increasing the likelihood of being involved in an accident. (Svenson, Eriksson, Slovic, Mertz, and Fuglestad (2012))

With a total area of 540 km², Addis Abeba is divided into 116 woredas and 10 subcities. The city serves as both the political and economic hub of the nation and is home to the headquarters of both the African Union and the UN Economic Commission for Africa. More than 100 embassies, as well as other international aid and development organizations, are housed there. Three million people are thought to live in the metropolis. At the present rate of

2.1% growth, the city's population is expected to reach 5 million in ten years. Addis Abeba is a rapidly expanding metropolis that is showing signs of significant social, economic, and structural change. Addis Abeba is home to more than 70% of all registered vehicles in the nation. (Transport Policy of Addis Ababa, 2011).

Speed compliance was positively correlated with the drivers' age. Speed compliance for male drivers was shown to be lower than for female drivers. (A. Yadav, Ankit Kumar, 2021) and driver perception (estimate) of speed versus their actual speed and concluded that drivers' speed perception was lower than their actual driving speed (Haglund and Aberg, 2000).

To overcome this concern, the concerned authorities of Addis Ababa have located speed limit signs on the selected road. The raw data comes from the Addis Ababa Police Commission and speed data collected from the site. The main focus of this paper is on the assessment of the relation between the main factors influencing speeding, their significance level by speeding violation type prediction, and acceptance of the posted speed limit on Addis Ababa City roads. And also other measures to use other than posting speed limits to reduce traffic crashes.

1.2.Statement of the Problem

When evaluating road accident fatalities, road user behavior is the primary consideration. The study demonstrates that, after accounting for other variables, the "fatal four"—driving under the influence of alcohol or drugs, speeding, flouting traffic laws, or using a cell phone—are the main risk factors for fatalities in road accidents. 98% of crashes were caused by human error, and 16% of crash victims were fatal (UNDP, 2021). Road traffic injuries, according to WHO (2004), are a significant yet underappreciated public health issue that calls for coordinated measures for effective and long-term prevention. Road traffic systems are the most intricate and hazardous of all the systems that humans engage with on a daily basis. In order to bring road users to a safe speed using an integrated set of measures, speed management must place safety at its core, according to WHO (2015). Victims, their families, and nations as a whole suffer significant economic losses as a result of road traffic injuries. The expense of treatment (including rehabilitation and event investigation) as well as reduced/lost productivity (e.g., wages) for individuals killed or crippled by their injuries, as well as family members who must take time off work (or school) to care for the injured, contribute to these losses.

By considering the posted speed limit on roads in Addis Ababa, Ethiopia, in the selected area. However, the effectiveness of this posted speed limit has not been assessed yet. This study focuses on assessing and predicting speeding violation types and also evaluating which variable is more significant when it comes to speeding above the posted speed limit on freeways in Addis Ababa City with respect to the reduction of traffic crashes and also the acceptance of the posted speed limit by the drivers. In addition to driver demographics, vehicle characteristics are reported to influence the speed selection behavior of drivers. For instance, large vehicles (e.g., vans and commercial vehicles) and vehicles pulling a trailer are reported to be slower than regular cars (Fildes et al., 1991).

In general, poor driving habits, excessive traffic, and unforeseen changes in the geometry of the roadway, and terrible weather conditions all play a role in speeding and traffic accidents. Driver behavior is crucial in assessing whether or not the posted speed limit is being followed, but it is frequently complicated and unpredictable. The importance of non-behavioral factors in speeding and traffic accidents must nevertheless be determined in order to offer cost-effective actions to reduce the risk of accidents and estimate current or future safety performance. In order to reduce traffic accidents, it was necessary to know more about driver behavior and which factor is more important when it comes to exceeding the posted speed limit on different types of urban highways in Addis Ababa City. By analyzing the average speed (50th percentile speed) and 85th percentile speed of vehicles on different types of roads and the speeding violation type of the posted speed limit, transportation engineers can incorporate various elements into the roadway design in an effort to enhance traffic safety.

1.3. Research Questions

In order to find a solution to the problems due to speeding above the posted speed limit in relation to driver characteristics, vehicle characteristics and roadway characteristics in Addis Ababa, questions are formulated as follows:

- What are the main factors that affect the driving speed?
- What is the main reason that drivers violate the rule by speeding over the posted speed limit?
- What can be done to reduce the violation of the posted speed limit?

1.4. Objective of the study

Drivers' speed selection behavior has been influenced by three perspectives: (i) driver characteristics, (ii) vehicle characteristics, and (iii) roadway characteristics. This research tried to assess the main factors that affect the speed and driver characteristics toward the speed limits violation in different road classes (arterials, sub-arterials, collectors, and local roads) of Addis Ababa City.

1.4.1. General Objective

The general objective of the thesis to assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa.

1.4.2. Specific Objective

- To evaluate the Posted Speed limit violation by the road users (Drivers)
- To assess significant factors which affect the speed of a road sections.
- To assess the main reason that why drivers violate the rule by speeding over the posted speed limit.
- To find and recommend a solution to reduce the violation of the posted speed limit.

1.5. Significance of the study

This study improves the following points:

- To assist concerned government institutions and policymakers in visualizing and associating the impacts of speeding, as well as identifying relation between variables related to speeding and their significance.
- To identify and assess the relation between driver's behavior and speeding above the posted speed limit in different Road types of Addis Ababa City and also whether the posted speed limit fully fills the intended purpose or not then indicates for the responsible body
- This makes it easier to find solutions for safer road conditions. These kinds of studies can be used to develop preventive interventions aimed at reducing the occurrence of road traffic crashes.

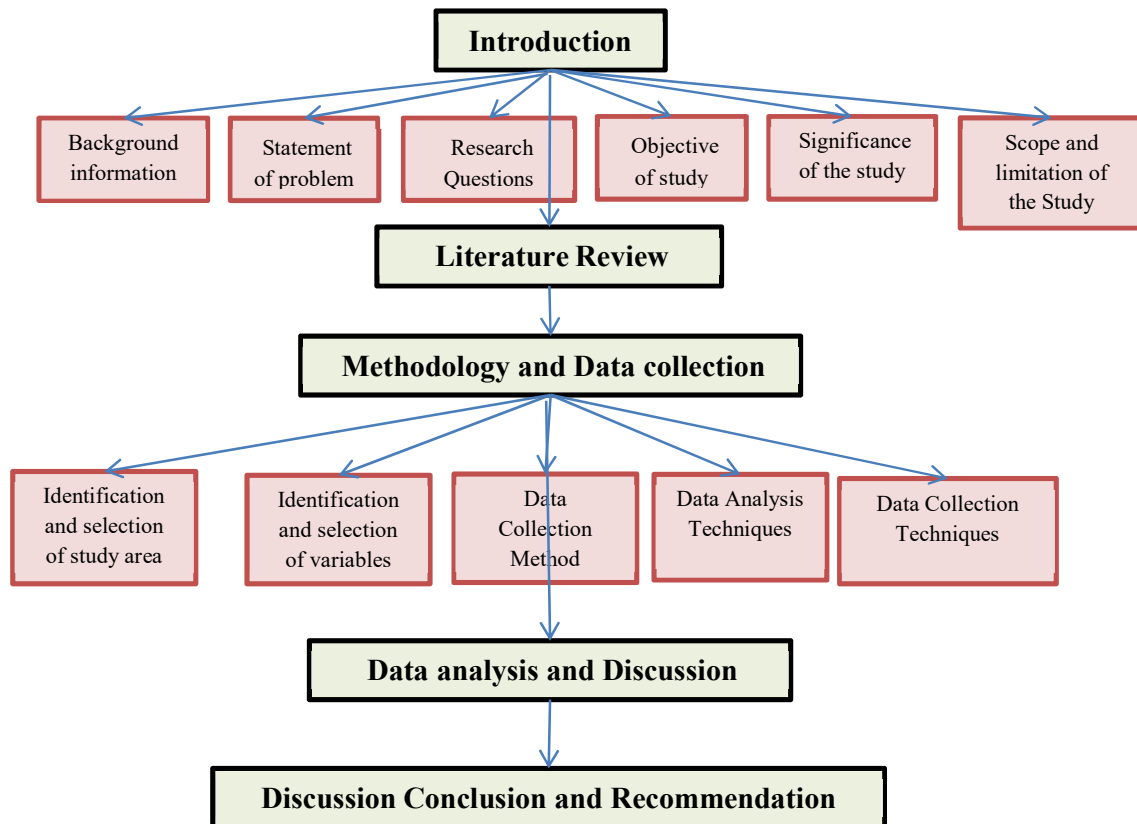
1.6. Scope and limitation of the Study

This paper was subjected to selected straight tangent roads of Addis Ababa City with different road types which has posted speed limit and also without posted speed limits.

The study has limitations for the reason that it did not include all road sections and drivers in the city, which is due to time and budget constraints. It has been done by taking representative samples from each type of road and drivers in the city and also intersections and ring roads are not studied for this researcher.

1.7. Organization of the thesis

There were five chapters in this study. The broad context of the study, the issue statement, the general and specific study objectives, the research question, and the scope of the investigation are briefly summarized in chapter one. A survey of pertinent literature is covered in chapter two. A description of the study area, data collection, extraction, and analysis methods, sample size calculation, and study design are all covered in chapter three's discussion of research techniques. In chapter four, extensive data analysis and a discussion of findings are offered. The last chapter comes to a conclusion and offers some suggestions.



2. Literature Review

2.1. Introduction

Speeding violations are now a major cause for concern in Ethiopia because they raise both the likelihood and severity of traffic accidents. The legal maximum (or minimum) speed for a particular stretch of highway is known as the speed limit. The speed limit posted is that which is permitted by law and is indicated on the speed limit sign. In this chapter, several literature reviews have been discussed about traffic safety, accidents, vehicle type, driver behavior, spot speed vs. speeding, But there is little study on the effect of speeding on different types of roads on the operating speed of the driver and also on the effect of the per day income of drivers on speeding compliance and violation.

2.2. Speeding and traffic safety

The chance of a road crash and the severity of the injuries that arise from crashes are both influenced by speed, which has been identified as a major risk factor in road traffic injuries. Exceeding the speed limit is referred to as excessive speed. Driving at a speed that is inappropriate for the current road and traffic conditions is referred to as driving at an inappropriate speed. A significant majority of the fatalities and injuries that occur in traffic accidents are caused by excessive and inappropriate speed. Speed is believed to be the primary factor in about half of all traffic accidents in some low-income and middle-income nations, compared to about 30% of traffic fatalities in high-income countries. (WHO, 2004). According to (National Highway Traffic Safety Administration, , 2002) one third of all fatal crashes were related to speeding, that is, exceeding the speed limit or traveling too fast for the existing condition. Traffic collisions occur due to the vehicle's speed, and their outcome is directly related to kinetic energy. High kinetic energy produced by a moving object at a high speed causes a high incidence of traffic injuries. Road safety is tied to a variety of factors, but in the case of operating speed, a high-speed change is particularly susceptible to a traffic accident and is linked to a serious issue with road safety (Elvik 2004).

According to (Dan Zhaol, 2019) The article aims to explicitly the impact of traffic enforcement measures on the speeding behavior on low speed limit roads and determines that other vehicles' average speed is the most important reference to choose speed instead of traffic penalties, and the results of the model evaluation show that speeding violation grows

severe if traffic enforcements are lax. Speed, which has been recognized as a significant risk factor in road traffic injuries, has an impact on both the likelihood of a road crash and the severity of the injuries that result from crashes. Excessive speed is defined as going over the posted speed limit. Driving at an unsuitable speed means going faster than is necessary given the traffic and road conditions at the time. Excessive and inappropriate speed is the primary factor in a large percentage of traffic accident fatalities and injuries. In some low- and middle-income countries, speed is thought to be the main contributing factor in about half of all traffic accidents, as opposed to 30% of traffic fatalities in high-income ones. Speed, which has been recognized as a significant risk factor in road traffic injuries, has an impact on both the likelihood of a road crash and the severity of the injuries that result from crashes. Excessive speed is defined as going over the posted speed limit. Driving at an unsuitable speed means going faster than is necessary given the traffic and road conditions at the time. Excessive and inappropriate speed is the primary factor in a large percentage of traffic accident fatalities and injuries. In some low- and middle-income countries, speed is thought to be the main contributing factor in about half of all traffic accidents, as opposed to 30% of traffic fatalities in high-income ones (Zeyang Cheng, 2019).

(Vikash V. Gayah,2018) quantify the operational and safety impacts of setting speed limits below engineering recommendations Operating speed and reported crash data were collected from various sites in Montana, United States, which currently implements these lower than engineering recommended speed limits and analyzed using a variety of regression models to assess speed limit compliance and the effects of speed enforcement in speed zones with posted speed limits set lower than engineering recommendations. The research provides highway engineers with guidance regarding how to implement speed limits lower than engineering recommended values. This research describes the methods used to quantify the impacts of lower than engineering recommended speed limits on observed operating speeds and safety performance. Models of operating speeds (mean and 85th percentile values) and speed limit compliance were created using linear, quintile and logistic regression, while safety performance was quantified using the Empirical-Bayes before-after approach. The practice of setting speed limits lower than engineering recommended levels was also evaluated using the operating speed and safety performance models.

Aarts and Van Schagen (2006) mentioned traffic flow as one of the most common factors which confound the relationship between speed and safety. Unfortunately, traffic volume

(Average Annual Daily Traffic) data were not readily available for locations considered in this study since the City of Edmonton does not collect the data for all urban roads. Hence, traffic flow was manually estimated by collecting vehicle counts at the speed survey locations continuously for several days during the data collection period. The data were then used to compute the average flow per hour at the locations of interest. The variable representing traffic flow was log transformed to ensure that the model does not produce any estimates when traffic volume is zero.

Most of the researchers used electronic data and should seek to identify if statistically significant changes to the crash type distribution are observed and also detail interactions between the variables is not discussed.

2.3. Posted speed limit violation and traffic accidents

The speeding violation has become a key concern in the traffic safety management, as it increases the risk of traffic crashes, as well as the severity of these crashes.

According to the study of (Zeyang Cheng& Jian Lu, 2019) predict the speeding violation type according to the influence factors, and from which the speeding violation situations can be determined. The predicted target (i.e., the speeding violation type) is a binary variable (i.e., the speeding level between 10% and 20% is type 1, and the speeding level between 20% and 50% is type 2), and it is set as follows: for the presence of speeding violation type resulting from the influence factors, 0="type 1" and 1="type 2".By the influence factor analysis about the speeding violation type, some unrelated factors such as vehicle type, speeding limits, week, and time of day are removed. Operating speed models may provide a clue as to how lower posted speed limits are associated with driver speed choice. A large body of work has attempted to model the relationship between operating speeds and roadway features such as radius or degree of curvature, super elevation, tangent lengths, access density and traffic volumes, among others. However, relatively few studies incorporate posted speed limits into these models due to the belief that significant correlation exists between the posted speed limit and other roadway characteristics (e.g., radius of curvature), although more recent work finds that omission of posted speed limits from an operating speed model might actually bias model estimates (Himes et al., 2013)

Posted speed limits are often set based on the results of an engineering study, which involves collecting a sample of free-flow vehicle operating speeds in favorable conditions (e.g., daylight with no adverse weather) and selecting an appropriate speed (usually the 85th percentile value) given the speed distribution. However, for a variety of reasons, including the presence of school zones, citizen requests, political pressure, and perceived safety issues, posted speed limits are sometimes lowered to values below engineering recommendations. In fact, a recent survey of state highway transportation agencies found that this practice is fairly common throughout the United States (Donnell et al., 2016). Speed limit compliance worsened as the difference between the engineering recommended and posted speed limits increased. The presence of verified heavy police enforcement reduced both mean and 85th-percentile operating speeds by approximately 4 mph and increased speed limit compliance (Vikash V. Gayah, 2018).

2.4. The relationship between road type and speed

According to (Boyu Y. Chena S.B., 2019) Speeding is one of the major contributors to traffic crashes. To solve this problem, speeding prediction is recognized as a critical step in a pre-warning system. Furthermore, there is a large discrepancy between actual and perceived road environmental information given that a driver's visual perception plays a crucial role as the dominant source of information in determining driver's behavior. The road network plays a key role in the connectivity and development of modern society as a way to ensure their coherent functioning, both from the social and economic perspectives (Taylor, Bonsall, and Young 2000). At the top of the hierarchy are highways and motorways with free traffic flow. These are followed by arterial urban roads with controlled multimodal traffic flow; these aim to handle the overall traffic flow fast and efficiently with a speed limit of 50–70 km/h. Finally, at the bottom of the hierarchy are local distributors and local roads within the urban areas that are characterized by high accessibility and low-speed limits. They are the major suppliers of the traffic flow to arterial roads, whereas the primary function of the arterial roads is to ensure smooth connectivity between various destinations (Elvik et al., 2009). Local distributor roads combine acceptable possibility with acceptable accessibility; their speed limit in Denmark is normally 50 km/h, while local roads have high accessibility but low possibility, with a speed limit of 30–50 km/h (Vejdirektoratet, 2012). It is notable that local roadways' functionality depends on both their physical location and anticipated traffic flow.

2.5. Speed and Vehicle type

Traffic conditions are the results of many, varied and complex interactions among the four primary elements of the traffic system: drivers, vehicles, roadways and controls. However, traffic engineers pay scant attention to the effects of their constructions on road users and vehicle performance. A dichotomous variable with two categories violation and compliance was used to describe speed limit violations. The risk of speeding was also examined using binary logistic regression in relation to variables and interaction terms. The analysis's findings showed that the location, rush-hour status, traffic light condition, vehicle type, and driver gender were the main contributing factors for approaching speed (Bor-Shong Liu, 2007). Highway Capacity Manual (HCM) (2000) discussed briefly on the factors influencing the traveling speed and indicated that the speed of vehicle operating on the urban street is highly influenced by road environment, interactions between vehicles, percentage of trucks and bus, traffic control, adjustment land use and traffic density on the road segment. The other study by (Zamanov 2012) on the influence of road geometry on the speed of vehicle under 200 vehicles per hour traffic flow on urban streets shows that the number of lane width, median width, Investigation of Hot Spot Location and Excessive Speeding.

With regard to vehicle related factors, many vehicle designs play an important role in safety, such as airbags, electronic stability control, anti-lock braking systems and low center of gravity design so as to avoid rollover. Other factors such as lighting and weather conditions can affect road safety through both the road user and roadway system (Golob and Recker, 2003).

2.6. Driver Behavior and Speeding

The speed selection behavior of drivers has been reported to vary across driver demographics, psychological attributes, and vehicle-specific factors. In addition, the relative degree of speeding has received little attention and thus remains relatively unexplored.

According to the study of (Amir, Afghari, and Md. Haque, 2018) investigate the effects of roadway geometrics, traffic characteristics, and site-specific factors on speeding behavior of drivers. A panel mixed logit fractional split model is estimated to analyze the proportion of speed limit violations across highway segments. To account for possible unobserved heterogeneity, the suitability of latent class model specification is also tested. Anderson A.

Natasha, M., (2020) study and examination of a sample of fleet drivers' self-reported and objective behavior of adhering to posted speed restrictions. According to the authors, drivers' attitudes are the most important predictor and strongest correlation of intentions to obey the speed limit in both work and personal vehicles. Additionally, they look into the relationship between TPB variables and observed speeding behavior, and their findings suggest that participants who had higher intentions to obey the speed limit or higher levels of perceived behavioral control (PBC) did so less frequently than those who had lower intentions or lower PBC. According to Adams-Guppy and Guppy (1995), work-related drivers are more often faced with time-pressures than other drivers, which reflect a potentially important utility in their driving-based decision-making, with a likely consequence for behaviors such as speeding. However, Newnam, Watson, and Murray (2004), using Ajzen and Fishbein's (1980) Theory of Planned Behaviors (TPB), carried out one of the only other similar studies examining the factors influencing driver's speeding behavior in work and private settings. Results showed, drivers in their study had a higher intention to speed in their private vehicles than when using a work vehicle.

Do Duy Din, Hisashi Kubota, (2012) In order to address this issue, a questionnaire study was conducted with a sample of 367 Japanese drivers. The results of the study revealed that while most of the drivers believed that exceeding the 30 km/h speed limit would shorten their travel time, they did tend to have positive beliefs about doing so. Despite the seriousness of the level of speeding, several drivers preferred enforcing a 30 km/h speed limit on residential streets and favored defending the rights of vulnerable street users. In this study, the authors created logistic regression models and discovered an association between the drivers who disobeyed the 30 km/h speed limit and those who had committed. In this study, the authors created logistic regression models and found that the drivers who disapproved of the 30 km/h speed limit were linked to those who had broken traffic laws, who believed it was acceptable for them to drive at a high speed, who did not take into account the opinions of residents, who had negative beliefs about obeying the speed limit, and who found it difficult to refrain from doing so. Additionally, this study provided evidence in favor of using social advertising and public awareness programs as speeding solutions.

Credibility also influenced judgments whereby drivers selected appropriate speeds consistent with the speed limits for the 10% lower condition, but not for speed limits that deviated highly from the appropriate (Yee M. L., Siang Y. C., 2020) Speeding collisions occur due to

drivers' tendency to take risks, including driving over the posted speed limit or at speeds that are unsafe given the prevailing conditions (i.e., road, weather, or light conditions). Adding to the complexity of the problem is the fact that even drivers who do not consider themselves aggressive drivers are likely to speed on occasion (NHTSA, 2004; EKOS Research Associates, 2005). Although changing driving attitudes and behaviors could avoid the majority of collisions, doing so is proving challenging, in part because too many drivers prioritize convenience over the risks that speeding poses to themselves, their passengers, and other road users.

Based on the above literature review, information regarding only drivers' opinions, attitudes, and behaviors with respect to speeding and driving on urban roads This indicates the negligence of the driver's daily income with compliance with the posted speed limit and safety regulations, as well as the driver's understanding of the function and classification of the road or bad behavior of the driver, especially the driver of a passenger car. However, all of the above studies have some limitations because they were conducted regardless of the method of speed enforcement, roadway geometry, roadside features, or land use development. Based on different studies conducted in different countries, the degree of compliance with the posted speed limit varies with driver behaviors, vehicle type (work or private), and method of enforcement of the speed limit.

2.7. The effect of pedestrian density in speeding

The NTSB Special Investigative Report on Pedestrian Safety states that the “overwhelming safety factor for a vehicle striking a pedestrian remains the physics of differential mass (the weight and size of a pedestrian compared with that of a vehicle), plus the lack of protection afforded by pedestrians. Consequently, of primary importance is mitigating speed or avoiding impact.” (NTSB, 2018)

Due to the large number of injuries and deaths in pedestrian vehicle crashes, the safety of pedestrians remains a key issue when improving traffic safety. For this reason, a significant amount of pedestrian safety research has been undertaken. Research has investigated the characteristics of pedestrians in motor-vehicle crashes, for example: the influence of alcohol, head injuries, demographic and economic characteristics, roadway characteristics, environmental factors, collision types, party at fault, and locations (Ulfarsson et al.,)

Kim et al. (2008) present a pedestrian-injury severity analysis using a heteroskedastic logit model. They found that heteroskedasticity was present, violating the Multinomial logit assumption, and found that the heteroskedasticity was captured with pedestrian age. This is reasonable, because there is likely a greater variance in health conditions among older pedestrians than younger pedestrians. For example, some older people maintain good health, whereas others are frail.

Among these crashes, vehicle-pedestrian crashes are a major concern as such crashes have a unique inevitability and high severity level. Walking as a pedestrian has become increasingly dangerous since there have been a large number of vehicle-pedestrian crashes that cause pedestrian fatalities and serious injuries (Zhang et al., 2014)

2.8. Crash Data Analysis and speeding

There have been studies that aim to explore the relationship between speed and number of accidents, most of which suggest that increased speed is associated with more accidents or higher accident rates (van Schagen, 2006 ;). The effect of change in speed on road safety has been extensively investigated by Nilsson (2004), who employed before-after studies in Sweden using the Power Model. It was found that changes in the number of accidents (or accident rate) can be associated with the changes in speed according to a power function. Positive associations between changes in speed and accidents were found, though the magnitude depends on types of accidents (e.g. fatal and injury). Similarly, Elvik et al. (2004) undertook an extensive evaluation on the effect of speed on accidents again using the Power Model. They concluded that there is a causal relationship between changes in speed and changes in road accidents, i.e., the number of accidents go down if speed goes down and vice versa. Taylor et al. (2002) employed a cross-sectional analysis on 174 road segments from rural roads in England, and found a positive relationship between accident frequency and average speed. This appeared to confirm the findings of Elvik et al. (2004);

Taylor et al. (2002) classified the sample into four different road groups based on a set of characteristics such as accident rate, mean speed, Annual Average Daily Traffic (AADT), junction density, bend density, access density and hilliness. Four dummy variables were created and included in the models to represent the road groups, and the variables used to classify road groups were also included in the model. This means that data such as average speed and AADT were used twice in the models. In addition, the Poisson regression model

may be misspecified and a more sophisticated model such as a negative binomial (NB) model or a spatial econometric model may be more appropriate in order to model the accident frequency data. Another recent empirical study by Wang et al. (2009a) who looked at area wide level speed and road casualties also found that increased average speed within a ward is positively associated with total fatalities and serious injuries.

2.9. Spot Speed

Speed can be thought of as the rate at which an object covers distance. A fast-moving object has a high speed and covers a relatively large distance in a given amount of time, while a slow-moving object covers a relatively small amount of distance in the same amount of time. According to ERA (Ethiopian Road Authority) manual design speed is the selected speed used to determine the different component of geometric design elements of roadways (stopping sight distance, minimum curve radius, and length of vertical curve of the alignment) depending on the purpose of the road, traffic volume and topography of the ground the road alignment passing through (ERA 2013).

Operating speed is the speed at which drivers are observed operating their vehicles during free-flow conditions. The 85th percentile of the distribution of observed speeds is the most frequently used measure of the operating speed associated with a particular location or geometric feature. Design speed is a selected speed used to determine the various geometric design features of the roadway. The assumed design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use, and the functional classification of highway. Except for local streets where speed controls are frequently included intentionally, every effort should be made to use as high a design speed as practical to attain a desired degree of safety, mobility, and efficiency within the constraints of environmental quality, economics, aesthetics, and social or political impacts. (AASHTO. 2001)

Spot speed studies are used to figure out how fast a traffic stream moves at a specific location. Spot speed study data is used to calculate vehicle speed percentiles, which are useful in a variety of speed-related decisions (Robertson 1994). Because traffic counts on a Monday morning or on a Friday peak period may show unusually high volumes, they are not usually used in the analysis; instead, counts are usually done on Tuesday, Wednesday, and Thursday. One of three methods is used to collect spot speed data:

a) A stopwatch

A small sample size taken over a short period of time can be used to successfully complete a spot speed study using the stopwatch method. The stopwatch method is a simple and low-cost way to collect speed data.

b) A radar meter

In spot speed studies, a radar meter is a commonly used device for directly measuring speeds(as (shown in fig). This device can be used hand-held, in a vehicle, or on a tripod. Radar meters have an effective measuring distance of 200 feet to 2 miles (Parma 2001). To accurately measure speed, a radar meter requires line-of-sight and is easily operated by one person.



Figure 2.1: Different type of Radar

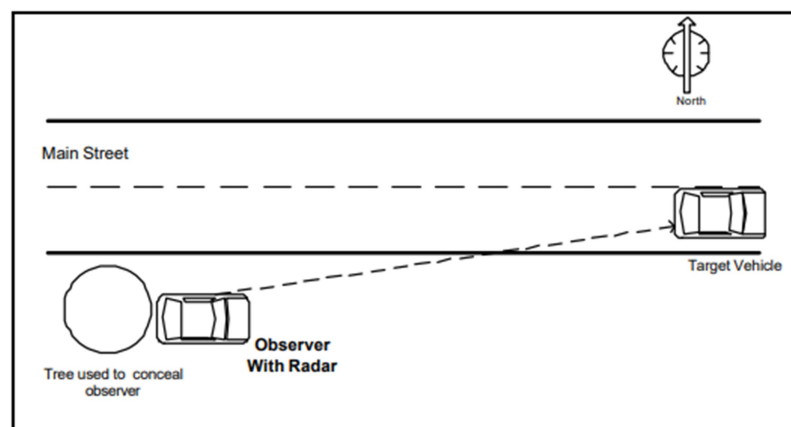


Figure 2.2: Example Radar Meter Spot Speed Study Layout

c) A pneumatic road tube

The pneumatic road tube method is typically used for longer data collection times than the stopwatch or radar meter methods. Pneumatic tubes are placed in the travel lanes (see Figure) and connected to recorders on the side of the road (see Figure) using this method.



Figure 2.3: Pneumatic Road Tubes



Figure 2.4: Road Tubes and Recorder

2.10. Type of modeling used for speed study

Zeyang Cheng, 2019 predict speeding violation type (including type 1 and type 2) prediction method using electronic law enforcement data obtained from the public security administration of Wujiang. he uses a decision tree method to predict the speeding violation type according to the influence factors, and from which the speeding violation situations can be determined. The result demonstrate that under the hypothetical conditions, the high speeding violation level (i.e., type 2) tends to occur under high rainfall environment, and the foreign license plate and autumn present a larger probability of high speeding violation level than the local license plate and other seasons (i.e., spring, summer, and winter), respectively.

Do Duy Din, Hisashi Kubota, (2012) developed logistic regression models and identified that the drivers who did not support the 30 km/h speed limit were associated with those who had committed traffic-law violations, who had negative beliefs about complying with the speed limit, who did not consider residents' opinions, who believed it is acceptable for them to drive at a high speed, and who felt it difficult to refrain from speeding.

A probabilistic model is estimated by Fred Mannering, 2007 using data gathered from 988 drivers in Indiana. Estimation findings show that drivers' perception of the speed above the speed limit at which they will receive a speeding ticket is a critical determinant of what they believe is a safe speed – suggesting that enforcement plays an important role in safety perceptions.

Dan Zhaol and Fengchun Han1 2019 explore the impact of traffic enforcement measures on the speeding behavior on low speed limit roads. Virtual traffic enforcement was designed by considering three factors related to traffic enforcement, and a stated preference survey questionnaire including six scenarios was designed and implemented; finally, a series of generalized regret random minimization models were established to study the relationship of speeding behavior and traffic enforcement as well as drivers' personal characteristics. The researchers figures out that other vehicles' average speed is the most important reference to choose speed rather than traffic penalties, and the model estimation results show that speeding violation grows severe if traffic enforcements are lenient.

Afgari 2018 used a panel mixed logit fractional split model to analyses the proportion of speed limit violations across highway segments. To account for possible unobserved

heterogeneity, the suitability of latent class model specification is also tested. The results of the panel mixed logit fractional split model suggest a tendency among drivers to commit minor speed limit violations irrespective of causal factors. Among potential road geometric and traffic factors, radius of horizontal curves, percentage of heavy vehicle traffic on segments with divided median, posted speed limit and road functional classification are factors that influence speeding behavior.

George, John, and Kimonas, use Log linear analysis and developed four models: for motorways, main roads, country roads and built-up area roads. The researchers revealed that the dependent variable (self-reported exceeding the speed limit) is strongly dependent on the belief that other drivers exceed speed limits for all four road types. Other variables found to have an impact on the attitude towards exceeding speed limits concern driver characteristics (gender, age group, annual kilometer age).

Zhen Chen and Wei (David) ,2018 develops a multinomial logit (MNL) model to investigate and identify significant contributing factors that determine the pedestrian-vehicle crash severity in North Carolina, United States. The results show that the factors that significantly increase the probability of fatalities and disabling injuries include: driver's physical condition (bad condition), vehicle type (motorcycle and heavy truck), pedestrian age (26-65 and over 65), weekend, light condition (dawn, dusk and dark), roadway characteristics (curve), roadway surface (water), roadway class (NC route) and speed limit (35-50 mph and above 50 mph). This model and analysis results provide insights on developing effective countermeasures to reduce vehicle-pedestrian crash severities and improve traffic system safety performance.

(Vikash V. Gayah,2018) Models of operating speeds (mean and 85th percentile values) and speed limit compliance were created using linear, quintile and logistic regression, while safety performance was quantified using the Empirical-Bayes before-after approach. The practice of setting speed limits lower than engineering recommended levels was also evaluated using the operating speed and safety performance models

Using data from the city of Montreal, Eluru et al. (2013) developed an ordered fractional split model that assessed the proportion of vehicles traveling in each speed interval for a segment of roadway. The authors also developed a panel mixed version of the ordered fractional split model to account for repeated vehicle speed proportion observations.

2.11. Summary of literature review

Various researchers investigated the relationship between road geometry, posted speed limits, and operating speeds, including crash severity and driver behavior, in various urban and suburban areas. According to the findings of the literature review, there is no consensus on the impact of posted speed limits on the operating speed of drivers on different types of roads. This suggests that driving culture and driver knowledge of traffic safety and rules, particularly posted speed limit conditions, have an impact. However, all transportation agencies set posted speed limits based on the 85th percentile speed, which is influenced by road density, roadside development (land use), and accident experience, as these factors have a significant impact on drivers' speed choices.

Speeding puts everyone on the road in danger. Speeding claimed the lives of 9,478 people in 2019. We're all familiar with the stresses of modern life and juggling a hectic schedule, but speed limits are in place to protect all road users (WHO, 2018). From 2015 to 2019, 17,357 people were killed in traffic accidents in Ethiopia, with 12.9 percent of those killed in Addis Ababa (Addis-Ababa Police Commission, 2020). The number of vehicles has more than doubled in the past five years. Road crashes in the city are a major public health concern; more than 450 people die every year on the roads, with pedestrians being the most vulnerable group. (BLOOMBERG PHILANTHROPIES, 2019)

The study's gap was that most speed models did not account for the operating speeds of drivers on different classes of urban roads. Because different classes of urban roads have different design and evaluation standards and because all speed prediction models are based on local driver driving behavior, despite the fact that driving conditions are influenced by incorrect driver behavior, heavy traffic, unplanned roadway geometry changes, and unfavorable weather conditions, As a result, the speed prediction model developed in one city should not be applied to other cities. The study's goal was to model operating speed on an Addis-Ababa urban road, which is used to estimate posted speed limits, as well as evaluate the existing urban road by taking into account different classes of urban roads, pedestrian volume, road geometry, and traffic crash data, which are useful for traffic management policy and strategy.

3. Methodology and Data collection

3.1. Introduction

It is still terrible how many individuals have been killed or seriously hurt in traffic accidents. As a result, the purpose of this thesis is to assess the main factors that affect speed and if, among driver characteristics, speed limits are violated in different road classes (arterials, sub-arterials, collectors, and local roads) of Addis Ababa City.

The procedure for gathering data and the approach taken to analyze it were the main topics of this chapter. With respect to gender, vehicle type, road type, understanding of speeding, and other factors as discussed in the data collection section, the goal of this study is to assess the main factors that affect speed, their significance level by speeding violation, and drivers' recognition of the posted speed limit violations in different road classes (arterials, sub-arterials, collectors, and local roads) of Addis Ababa City. In relation to these, the main factors that affect the speed of a vehicle are modeled using a multiple linear regression model, and the driver's compliance with the posted speed limit is analyzed using ordinal logistic regression through self-reported violations. From Never exceed the speed limit up to the PSL above 30 km/hr. and to increase the accuracy level of the data analysis, this study used software (SPSS and Excel worksheets). Overall, this paper focuses mainly on two data sources, which are collected directly from the road (spot speed of vehicles) and questionnaires acquired from drivers, in order to achieve its objective and help decision-makers take appropriate measures in order to prevent and reduce road accidents and increase road safety.

3.2. Identification of Site Conditions

Ethiopia was the site of this study. The nations have many nation and nationalities and also have almost equal south-north and west - east sizes. Ethiopia's capital is Addis Ababa with territory that has grown to approximately 550 square kilometers (km²), and it is divided into 116 Woredas and 11 administrative Sub cities. Among the 11 sub- cities and one currently established sub city "LemiKura".

3.2.1. Road Type

According to *AACRA (2004) geometric design manual*, classified highway functions in to the following categories:

- Principal Arterial streets
- Sub Arterial Streets
- Collector Streets
- Access Streets/ Local Road

Arterials are probable to deliver a higher mobility for the extended journey length. So, they ought to convey a very high operational speed and level of service (Los). Since access to abutting property is not their core purpose, some access control mechanism is required to improve mobility. The collectors accommodate the shorter travel while also supplying the arterials with traffic, they also have to serve adjacent properties and offer some mobility. Therefore, a design speed and service level that is in the middle is reasonable. Local roads are mostly used for property access, therefore mobility and top operating speeds aren't really necessary.

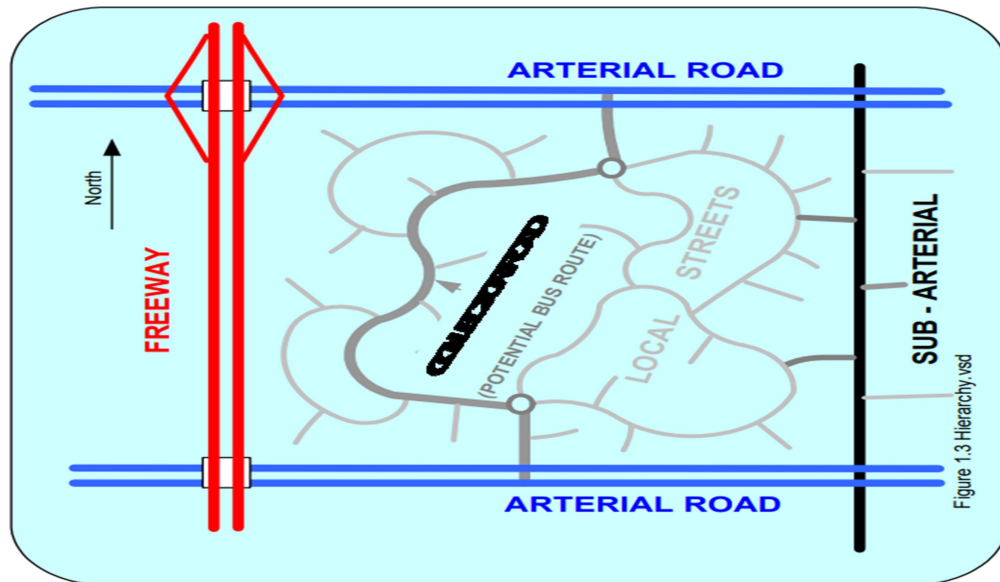


Figure 3.1: Road Hierarchy

3.2.2. Traffic condition

The most important factors in determining traffic conditions were vehicle composition and directional distribution. For the Vehicle composition in this thesis Passenger's cars (light vehicles, pickups, micro vans, utility vehicles), mini - buses, buses (Sheger Bus, Higer Bus, Public Bus etc.) and heavy trucks and for the directional distribution, traffic flow in the examined portion is recorded separately for both path of traffic.

3.2.3. Traffic facilities

Major four-lane two-way, two-lane two-way motorways and arterials meet in the city center, where the majority of traffic ends and begins. The city's road network is made up of collector and local streets that link to these roads. In general, road linkages, roundabouts, un-signalized intersections, and signalized intersections were identified as the four basic types of traffic infrastructure found in Addis Ababa. The focus of this study was solely on four types of road (Principal Arterial, Sub Arterial, Collector and Local Streets). The majority of Addis Ababa road segments include the following characteristics:

1. Kerbs: common on downtown arterials and sub arterials but rare on local streets
2. Shoulders: mostly potholed and occupied by various activities
3. Sidewalks: exist on many major arterials
4. Medians: exist on all multilane facilities
5. Lane markings: common with major arterials

3.2.4. Environmental conditions

These were described as all conditions other than geometry and traffic circumstances that could affect driver visibility and behavior. Weather conditions such as rain and also time of day is considered.

3.3. Selection of study location

An inventory of traffic facilities and conditions was identified in the preceding section. Based on the findings, certain roads and areas were chosen for this section. Time and financial constraints hampered the selecting process. This choice was significant because the results based on them were intended to represent the entire Addis Ababa research area. This study was conducted on urban highways in the city that include arterial, sub arterial, collector, and local and have clearly marked posted speed limits. Road section for the study is selected based on

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

- They have complex modality (private and commercial vehicles)
- They have a significant traffic volume over the course of a day
- Have the required measures to reduce speeding
- Budget and time consumption of this study
- To avoid issues affecting the vehicle's speed, the road section must be straight.
- There are no obstructions in the way of the observation instrument (Pocket Radar).
- The current section of road is not undergoing any form of maintenance or construction work, as this could impede the driver's movement and reduce the vehicle's free-flowing speed.
- The road surface is well maintained and free of problems that could slow down arriving road vehicles, such as potholes or deformations.
- Because the goal of this study is to assess the primary factors affecting driving speed and the violation of the speed limit, the roads chosen must have various posted speed limits.
- Within the chosen road stretch, there are no major intersections.
- The posted speed restriction signs should be visible to drivers.

According to *AACRA (2004) GDM* minimum Design speed for vehicles and speed limits by road type is discussed on the following table;

Table 3.1: Road type and speed limit standard of Addis Ababa City

Road Type	Proposed Speed Limit or Speed Environment	Minimum Design Speed for Cars
Suburban Freeway Through Carriageway	100	110
Suburban Freeway to Freeway Ramp	80	80
Suburban Freeway to Arterial Road Ramp	60/70*	60/70
Suburban Freeway Collector-Distributor Road	80	90
Inner Urban Freeway Through Carriageway	80	90
Inner Urban Freeway to Freeway Ramp	60	60
Inner Urban Freeway to Arterial Road Ramp	60/70*	60/70
Inner Urban Freeway Collector-Distributor Road	70	80
Freeway Loop Ramp	Truck Advisory Sign 35	40
Continuous Frontage Road	70	80
Arterial Road Controlled Access	70	80
Discontinuous Frontage Road	60**	60**
Arterial and sub-arterial road with frontage access	60	70
Collector roads and industrial/commercial access roads	60	60
Low Volume Residential Collector roads (<3000 vpd)	50	50
Local Residential Street	30	30
Access place	15	15
Temporary roads (e.g. construction sidetracks)	40-60	40-60

* Ramp speed limit to be the same as arterial road speed limit.

** Lower design speed may be acceptable if the frontage road is connecting minor streets only

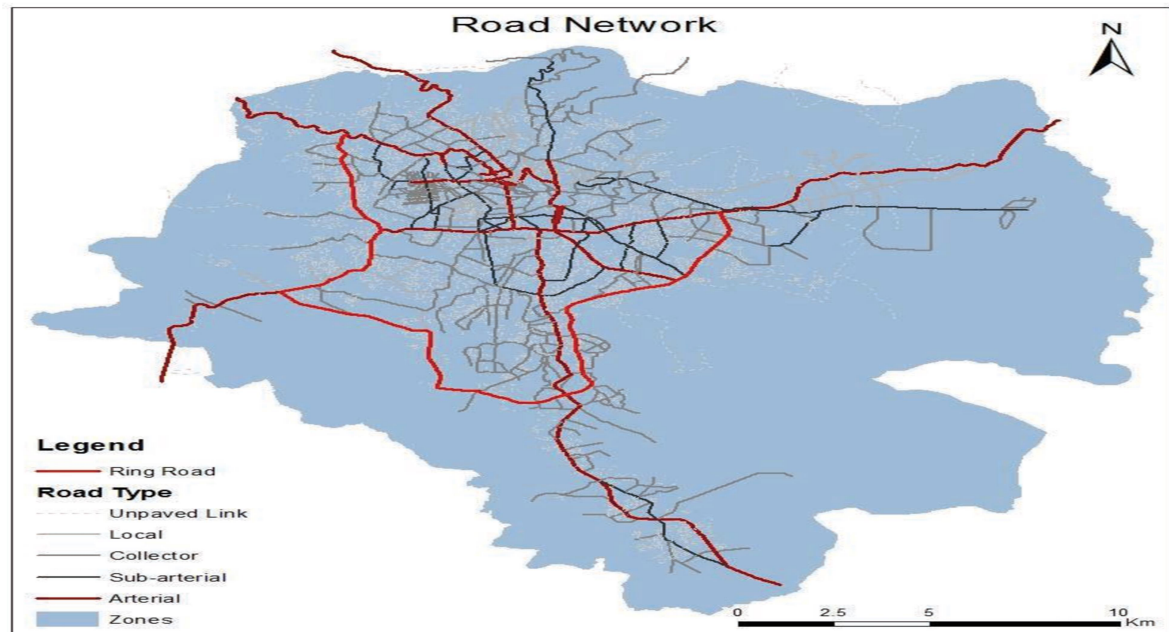


Figure 3.2: Road network of Addis Ababa City

Based on the above selection criteria and type of road classification of *AACRA (2004) GDM* road sections were selected after primary field visit and using Google Map of Addis Ababa City. The sampling technique used for this study is stratified random sampling method and convenience method for road selection because the study was conducted on different road classification and also different PSL. Initially; the study population was classified in to 4 types of road classification (Arterial, Sub Arterial, Collector and Local Roads) and also PSL of 30Km/hr. 40Km/hr., 50Km/hr., and No PSL. All posted speed limit category and Road Classification Type have almost equal chance of selection (25% for each). Then after, a total of road section;

- ❖ 11 Arterial Road (4 having 30Km/hr. 3 having 40Km/hr., and 4 having 50Km/hr.)
- ❖ 15 Sub Arterial Road (7 having 30Km/hr. 3 having 40Km/hr., 4 having 50Km/hr. and 1 No PSL)
- ❖ 5 Collector (3 having 30Km/hr. and 2 No PSL)
- ❖ 2 Local Road (2 No PSL)

There for over all of thirty five road sections were selected as shown in the Table below;

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Table 3.2: Selected road sections and characteristics for the study

No .	Road segment location	Type of road	Length of the road section (KM)	Land Use	School Zone area	PSL(K m/hr)	Type of Pavement
1	Jakross Light -Goro meskelegna	Sub Arterial	2.23	Mixed		30	AC
2	Jakross Light -Goro meskelegna	Sub Arterial	2.23	Commercial		40	AC
3	Kara Sq - Tafo Sq	Sub Arterial	2.7	Residential	school Zone	30	AC
4	Gedera sq - Yeka Tafo Condominium	Arterial	1	Residential		30	AC
5	Yeka Tafo Condominum- Ayat Sq	Arterial	2	Commercial		30	AC
6	Semit Sq -Goro meskelegna 1	Sub Arterial	2.65	Mixed		50	AC
7	Semit Sq -Goro meskelegna 2	Sub Arterial	2.65	Residential		40	AC
8	Goro sq- ICT park 1	Sub Arterial	2.51	Residential		40	AC
9	Goro sq- ICT park 2	Sub Arterial	2.51	Farm land		50	AC
10	ICT - Hachalu sq sec 1	Sub Arterial	3.5	Farm land		50	AC
11	ICT - Hachalu sq sec 2	Sub Arterial	2.5	Farm land		50	AC
12	Koye Sq - Tulu dimtu sq 1	Sub Arterial	3.2	Farm land		50	AC
13	Koye Sq - Tulu dimtu sq 2	Sub Arterial	4.2	Residential		30	AC
14	UNISA Sq - Akaki Menhariaya	Arterial	6	Mixed		50	AC
15	Yeka Kidanemeheret church - British Embassy	Collector	3.4	Mixed		30	AC
16	Shola markt -English Embassy	Sub Arterial	1.3	Mixed		50	AC
17	Kenya embassy - Kebena sq	Sub Arterial	0.8	Residential	School Zone	30	AC

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

No .	Road segment location	Type of road	Length of the road section (KM)	Land Use	School Zone area	PSL(K m/hr)	Type of Pavement
18	Minilik Hospital - Kagnew Peace Keeping sq	Collector	1	Residential		No PSL	AC
19	Ferensay -Abo Mazoria	Sub Arterial	2.5	Mixed	School Zone	No PSL	AC
20	Abo Mazoria - Frensay Embassy	Sub Arterial	2	Mixed		30	AC
21	Kagnew Peace Keeping sq - 6 Killo sq	Sub Arterial	0.85	Commercial	School Zone	30	AC
22	6 Killo sq - Afencho ber sq	Sub Arterial	0.65	Mixed	School Zone	30	AC
23	Adwa sq - Semen Mazegaja	Arterial	0.75	Commercial		40	AC
24	Semen Mazegaja - Kechene Medhanialem Church	Collector	1.1	Mixed		No PSL	AC
25	Addisu Gebeya sq - Winget sq	Arterial	4.2	Mixed		50	AC
26	Asko - Winget sq 1	Arterial	3.7	Commercial	school Zone	30	AC
27	Asko - Winget sq 2	Arterial	3.7	Commercial		40	AC
28	Winget sq - 18 Bridge Kolfe	Arterial	2.8	Commercial		50	AC
29	18 Bridge Kolfe - Winget sq	Arterial	2.8	Commercial		50	AC
30	Winget sq - Paulos Hospital 1	Arterial	2.2	Commercial	School Zone	30	AC
31	Winget sq - Paulos Hospital 2	Arterial	2.2	Commercial		40	AC
32	Kotebe collage - Wesen	Local	0.5	Residential		No PSL	cobble Stone
33	kotebe 02 - 02 kotebe mewech	Collector	0.85	Mixed		30	AC
34	Wondirad Scool - St Michael Church	Collector	0.75	Mixed	School Zone	30	AC
35	Minilik Hospital - Kebena School	Local	0.35	Residential		No PSL	cobble Stone

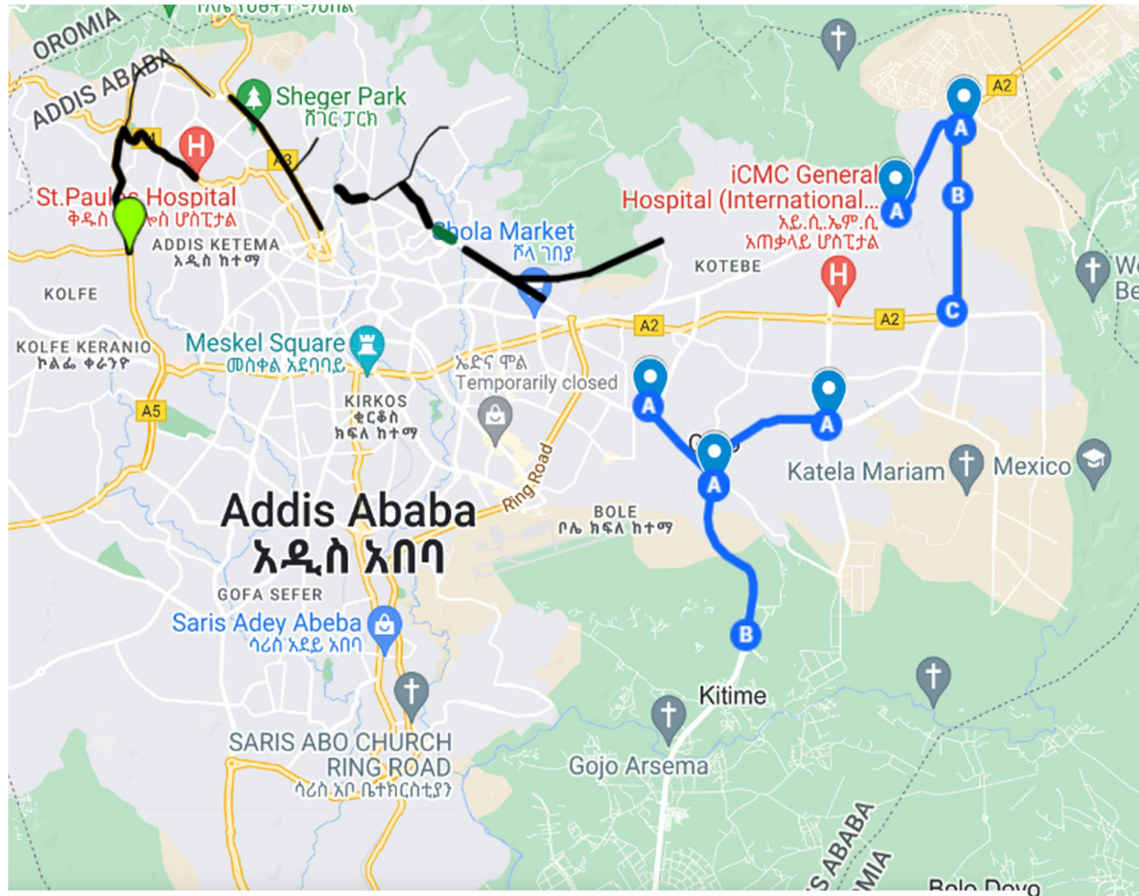


Figure 3.3: Selected roads of Addis Ababa for this Study

3.4. Identification and selection of variables for data collection

The selection of a road section was supported in part by the understanding of variables for data collection. It was useless to choose sites that would not supply the necessary data for the investigation. Simultaneously, the study's goal and manner of approach dictated the types of variables to consider. The manner of approach in this situation was based on aggregated data collection of traffic characteristics. Of course, in advance to data collection, it was essential to identify the criteria (dependent) and predictor (independent) variables that were most important in this study. The process of identification and choice of such variables is explained below.

3.4.1. Identification and selection of dependent (criterion) variables

In most traffic studies, the following dependent variables (or measures of effectiveness: MOE) are taken into account:

- Speed, including free-flow speed (a crucial variable in many models);
- Capacity (the greatest steady flow that a road can accommodate);
- Flow/capacity ratio (As noted in HCM 2000, it is frequently used as an indicator of whether additional capacity is required, as well as an input for determining level-of-service for certain road types.)
- Level of service (a term used to describe the level of 'comfort' and maneuverability of a driver.);
- Delay (The time discrepancy between a vehicle's free-flow (or desired) travel time and its actual travel time)
- Number of stops
- Bunching (the percentage of vehicles that do not ride in platoons as leading vehicles).

In this study, the above variables were screened as follows:

- i. The level of service (LOS) was not used since it is intended to make the results more understandable than if the numerical values of the dependent variables and service measures were given directly. In essence, levels of service (LOS) evaluations are more beneficial to decision makers who are not analytically inclined and prefer to indicate a situation with a single number or letter.
- ii. The concept of a free-flow travel time, or free-flow 'slowness' (sec/km), is implied by delay. It's more suited to extended lengths of road than the ones featured in this research. Control delay is the primary service metric for measuring LOS at crossings; hence it's an essential performance measure on interrupted-flow facilities. In this situation, it was thought to be impossible.
- iii. The quality of traffic performance is measured by the number of stops: It's especially effective in corridor studies where a high percentage of stops is predicted due to the abundance of junctions. As a result, it was deemed irrelevant in our study, which did not cover intersections.
- iv. Bunching was found to be potentially appealing on two-lane, two-way rural roads, but less so on urban highways in an experiment like this one.

As a result, speed was chosen as the primary dependent variables (or measures of effectiveness: MOE) for describing drivers compliance to posted speed limit and prediction of speed limit violation. This includes free flow speed and operational speed (at a certain level of flow).

3.4.2. Identification and selection of independent (predictor/explanatory) variables

The following parameters were used as input data for this study as independent variables.

Table 3.4: Independent Variables and their characteristics

Item No.	Independent variable	Characteristics
1	Driver characteristics	
1.1	Drivers Age (observational Guess)	Youth (15-24 years)
		Adults (25-64 years)
		Seniors (65 years and over)
1.2	Gender	Male
		Female
2	Vehicle characteristics	
2.1	Vehicle Type by Plate Code	Commercial (license Plate Code 1 and 3)
		Private (license Plate Code 2)
		Governmental (license Plate Code 4)
2.2	Vehicle Type function	Passenger's car (light vehicles, pickups, micro vans, utility vehicles)
		Mini bus
		Bus (Sheger Bus, Higer Bus, Public Bus etc.)
		Truck
3	The traffic characteristics	
3.1	Pedestrian crossing the road section	High volume
		Low Volume
		Small Volume
3.2	Percentage of heavy vehicles	None
		10- 30%
		>30%
4	Road environment	
4.1	Posted speed limit	30 KM/hr.
		40 KM/hr.
		50 KM/hr.
		No Psl
4.2	Type of road	Principal Arterial
		Sub Arterial
		Collector
		Local street
4.3	Time of the day	6:00 AM- 9:59

Item No.	Independent variable	Characteristics
		10:00 AM- 2:59PM
4.4	Land Use	Residential Area
		Commercial area
		Institutional area
4.5	Road Type	One way
		Two way Divided
		Two Way Undivided
4.6	Road pavement Conditions	Dry
		Wet

3.4.3. Dependent and independent variables for driver survey compliance to posted speed limit

Driver and vehicle demographic parameters were acquired qualitatively using questionnaires in order to determine the impact on driver compliance and speeding engagement. This qualitative data was utilized to assess drivers' speeding violations and acceptance of posted speed limits in Addis Ababa, with the goal of identifying the major variables that contributed to the initial speeding reason. Driver demographic features (gender, marital status, age, education, and experience) were the dependent variables. Drivers self-reported driving beyond the PSL on a certain road type by km/hr were the independent variables for drivers exceeding the PSL on a certain type of road.

In this section, it is also needed to assess if the drivers are well aware of the speed limit on each type of road in the city without the existence of the posted speed limit and if the drivers per day income affects their ability to drive within the speed limit.

3.5. Data Collection Method

3.5.1. Equipment for the study

Stopwatches, radar meters, and pneumatic road tubes are some of the methods for gathering spot speed data on the spot. The radar meter approach was used in this study since it is a typical tool for directly measuring speeds in spot speed investigations. As a result, three types of equipment were employed in the data collecting procedure, including a Hand Held Pocket speed Radar, a mobile camera, and an observation data sheet, as illustrated in the figure below;

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



Figure 3.4: Hand Held Pocket Radar

Table 3.5: Sample observation data sheet

Date :				Start Time:					
Name :				End Time:					
Location:				Weather:					
Speed Limit:30 Km/hr.				No of lanes/dir.					
Median Width									
Speed	Passenger Car			Bus			Truks		
	Record	plate no	total No	Record	plate no	total No	Record	plate no	total No
30		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
31		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
32		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
33	////	1 2 3 4 5	4		1 2 3 4 5			1 2 3 4 5	
34		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
35		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
36	///	1 2 3 4 5	3		1 2 3 4 5			1 2 3 4 5	
37		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
38		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
39		1 2 3 4 5			1 2 3 4 5			1 2 3 4 5	
40		1 2 3 4 5		///	1 2 3 4 5	3		1 2 3 4 5	
41		1 2 3 4 5			1 2 3 4 5		//	1 2 3 4 5	2
42		1 2 3 4 5			1 2 3 4 5		//	1 2 3 4 5	2

Figure 3.6 shows the arrangement of the radar meter spot speed study. This investigation was carried out by two observers, with one capturing the spot speed and the other writing down the observed spot speed on a data sheet. The specific steps for carrying out a radar meter spot speed study are listed below;

1. Choose the best location for the radar meter.
2. Determine the best selection technique based on the observed spot speed.
3. Make notes on the observation data sheet that has been prepared.

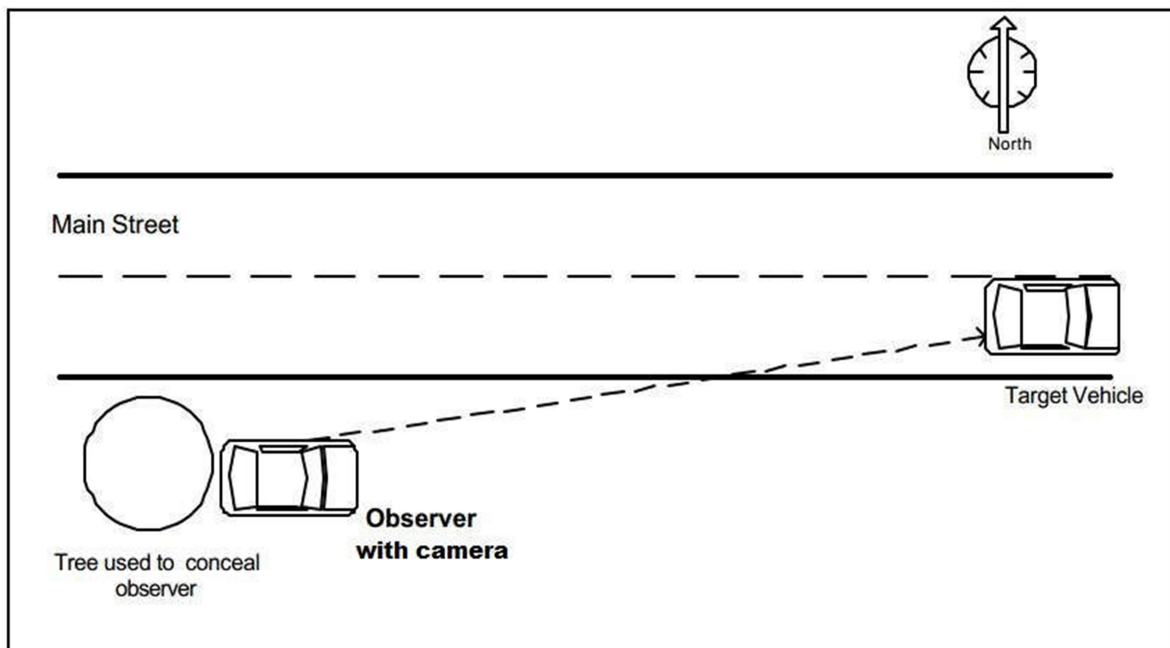


Figure 3.6: Positioning of Observer

3.5.2. Data Collection Times

It is well known that the time to conduct the study is determined by the study's goal. Data was collected for this study during weekday (Tuesday, Wednesday, and Thursday) morning sessions for around three weeks to guarantee that the minimal sample size was met. It should be emphasized that the spot speed research's actual data collection for the second week took place after the first week's preliminary study. Specifically, observations were made between the hours of 9.00 a.m. and 11.00 a.m. to acquire spot speed data in a free-flowing environment. However, some criteria, such as severe weather and unexpected traffic conditions, are avoided during the data collection procedure. This is because these

circumstances influenced the driver's choice of vehicle. However, some criteria, such as severe weather and unexpected traffic conditions, are avoided during the data collection procedure.

3.5.3. Data collection plan

The free-flow speeds (spot speeds) of automobiles utilized in this study were chosen from pocket radar that was positioned on a chosen stretch of road section until the required number of vehicles was reached. From the captured radar speed data, all types of free-flow automobiles were chosen. If all of the vehicles remain free flow for the duration of the data collection, they have an equal chance of being selected. After the routes were chosen using a stratified random sampling method, the road sections were chosen using a systematic-random method. After the pilot survey, the driver posted speed limit compliance survey questionnaire was given to drivers in Addis-Ababa city by using a simple convenience sampling procedure.

3.5.4. Sample Size requirement for speed (Spot speed per section)

A suitable sample size to satisfy statistical considerations was calculated based on the procedure described in Li et al., 2002). A minimum of 110 spot speed observations were calculated (at the 5% level of significance) using an 8 km/hr standard deviation and a 1.5 km/hr permitted error. Typically, a sample of at least 50 vehicles and ideally 100 vehicles should be gathered for spot speed assessment at a specified site (Ewing, 1999).

3.5.5. Sample Size requirement for posted speed limit compliance (driver's behavior survey)

To find responders among local drivers, convenience sampling was employed. Convenience sampling (also recognized as availability sampling) is a non-probability sampling strategy that collects data from individuals in the community who are easily accessible to take part in the study. This information was gathered using closed-ended, well-structured questionnaires. Because observational and field measurement data have poorer reliability and accuracy, the sample size needed for a question should always be larger than direct field data. As a result, Cochran's formula for determining sample size for unknown populations was utilized. (Cochran, 1963) created the following formula to determine a representative sample

$$N = \frac{Z^2 * p * q}{e^2}$$

The constraints used in the above formula have the following explanations

- e is the margin of error
- P is the proportion of the success
- q is defined as 1-P in other words it can be stated as proportion of failure
- Z² is the abscissa of the normal curve that cuts off an area α at the ends (1- α equals the desired confidence level example 95%)
- To obtain the largest sample size, the greatest variability was assumed to be equal to 50% (p = 0.5) while the 95% confidence level and 5% precision were used.

$$N = \frac{1.96^2 * 0.5 * 0.5}{0.05^2} = 385 \text{ drivers should at least answer the questionnaires'}$$

However in order to find a good response 450 questionnaires are distributed throughout the city. This method of sampling provides for the recruitment of a typical sample of the driving population in the Addis Ababa City. However this sample contains all kinds of driver based on gender, age, type of vehicle and also driving experience.

Road sections were selected after primary field visit and using Google Map of Addis Ababa City. The sampling technique used for this study is stratified random sampling method and convenience method because the study was conducted on different road classification and also different PSL. Initially; the study population was classified in to 4 types of road classification (Arterial, Sub Arterial, Collector and Local Roads) and also PSL of 30Km/hr. 40Km/hr., 50Km/hr., and No PSL. All posted speed limit category and Road Classification Type have almost equal chance of selection (25% for each). Then after, a total of road section;

- ❖ 11 Arterial Road (4 having 30Km/hr. 3 having 40Km/hr., and 4 having 50Km/hr.)
- ❖ 15 Sub Arterial Road (7 having 30Km/hr. 3 having 40Km/hr., 4 having 50Km/hr. and 1 No PSL)
- ❖ 5 Collector (3 having 30Km/hr. and 2 No PSL)
- ❖ 2 Local Road (2 No PSL)

There for over geometric parameters of the road sections were shown in the Table below;

Table 3.6: Geometric parameters of the road sections

I.No.	Road segment location	Road Section ID	Type of road	Length of the road section (km)	Land Use	School Zone area	PSL (Km/hr)	Gradient of the road	NO. of lane/dir.	Median divided	median width (m)	pedestrian walk way width(m)	Type of Pavement
1	Jakross Light Goro meskelegna	JG 1	Sub – Arterial	2.23	Mixed		30	Down grade	3	YES	1	3	AC
2	Jakross Light Goro meskelegna	JG 2	Sub – Arterial	2.23	Commercial		40	Up grade	3	YES	1	3	AC
3	Kara Sq - Tafo Sq	KT	Sub – Arterial	2.7	Residential	school Zone	30	Down grade	3	YES	0.5	3	
4	Gedera sq - Yeka Tafo Condominium	GY	Arterial	1	Residential		30	Up grade	3	YES	30	3	AC
5	Yeka Tafo Condominum- Ayat Sq	YTC	Arterial	2	Commercial		30	Up grade	3	YES	30	3	AC
6	Semit Sq - Goro meskelegna 1	SG 1	Sub – Arterial	2.65	Mixed		50	Down grade	2	YES	30	5	AC

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

I.No.	Road segment location	Road Section ID	Type of road	Length of the road section (km)	Land Use	School Zone area	PSL (Km/hr)	Gradient of the road	NO. of lane/dir.	Median divided	median width (m)	pedestrian walkway width	Type of Pavement
7	Semit Sq - Goro meskelegna 2	SG 2	Sub – Arterial	2.65	Residential		40	Down grade	2	YES	30	5	AC
8	Goro sq- ICT park 1	GI 1	Sub – Arterial	2.51	Residential		40	Down grade	3	YES	30	5	AC
9	Goro sq- ICT park 2	Gi 2	Sub – Arterial	2.51	Farm land		50	Up grade	3	YES	30	5	AC
10	ICT - Hachalu sq sec 1	IH 1	Sub – Arterial	5	Farm land		50	Up grade	3	YES	30	5	AC
11	ICT - Hachalu sq sec 2	IH 2	Sub – Arterial	5	Farm land		50	Down grade	3	YES	30	5	AC
12	Koye Sq - Tulu dimtu sq 1	KT 1	Sub – Arterial	3.2	Residential		50	Up grade	3	YES	30	5	AC
13	Koye Sq - Tulu dimtu sq 2	KT 2	Sub – Arterial	3.2	Residential	school Zone	30	Up grade	3	YES	30	5	AC
14	UNISA Sq - Akaki Menhariaya	UA	Arterial	6	Mixed		50	Down grade	3	YES	1	5	AC
15	Yeka Kidanemeh	YKB	Collector	3.4	Mixed		30	Down grade	2	YES	0.5	3	AC

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

I.No.	Road segment location	Road Section ID	Type of road	Length of the road section (km)	Land Use	School Zone area	PSL (Km/hr)	Gradient of the road	NO. of lane/dir.	Median divided	median width (m)	pedestrian walkway width	Type of Pavement
	eret church - British Embassy												
16	Shola markt - English Embassy	SE	Sub - Arterial	1.3	Mixed		50	Up grade	3	YES	2.5	3	AC
17	Kenya embassy - Kebena sq	KK	Sub - Arterial	0.8	Residential	School Zone	30	Down grade	3	YES	2.5	3	AC
18	Minilik Hospital - Kagnew Peace Keeping sq	MHK P	Collector	1	Residential		No PSL	Up grade	1	No	0	0	AC
19	Ferensay - Abo Matoria	FAM	Sub - Arterial	2.5	Mixed	School Zone	No PSL	Down grade	3	YES	1	3	AC
20	Abo Matoria - Frensay Embassy	AMF	Sub - Arterial	2	Mixed		30	Up grade	3	YES	1	3	AC
21	Kagnew Peace Keeping sq - 6 Killo sq	K6K	Sub - Arterial	0.85	Commercial	School Zone	30	Up grade	3	YES	1	3	AC
22	6 Killo sq - Afencho	6KA	Sub - Arteri	0.65	Mixed	School Zone	30	Down grade	3	YES	1	3	AC

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

I.No.	Road segment location	Road Section ID	Type of road	Length of the road section (km)	Land Use	School Zone area	PSL (Km/hr)	Gradient of the road	NO. of lane/dir.	Median divided	median width (m)	pedestrian walk way width	Type of Pavement
	ber sq		al										
23	Adwa sq - Semen Mazegaja	AS	Arterial	0.75	Commercial		40	Up grade	3	YES	1	3	AC
24	Semen Mazegaja - Kechene Medhanialm Church	SMK	Collector	1.1	Mixed		No PSL	Down grade	1	No	0	0	AC
25	Addisu Gebeya sq - Winget sq	AGW	Arterial	4.2	Mixed		50	Down grade	3	YES	0.5	15	AC
26	Asko - Winget sq 1	AW 1	Arterial	3.7	Commercial	School Zone	30	Down grade	3	YES	1	4	AC
27	Asko - Winget sq 2	AW 2	Arterial	3.7	Commercial		40	Down grade	3	YES	1	4	AC
28	Winget sq - 18 Bridge Kolfe	W18	Arterial	2.8	Commercial	school Zone	30	Up grade	2	YES	1	3	AC
29	18 Bridge Kolfe - Winget sq	18W	Arterial	2.8	Commercial		50	Down grade	3	YES	1	3	AC
30	Winget sq - Paulos Hospital 1	WP 1	Arterial	2.2	Commercial	School Zone	30	Down grade	3	YES	2	3	AC

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

I.No.	Road segment location	Road Section ID	Type of road	Length of the road section (km)	Land Use	School Zone area	PSL (Km/hr)	Gradient of the road	NO. of lane/dir.	Median divided	median width (m)	pedestrian walkway width	Type of Pavement
31	Winget sq - Paulos Hospital 2	WP 2	Arterial	2.2	Commercial		40	Down grade	4	YES	2	3	AC
32	Kotebe collage - Wesen	KCW	Local	0.5	Residential		No PSL	Down grade	1	No	0	0	cobble Stone
33	kotebe 02 - 02 kotebe meweche	K02M	Collector	0.85	Mixed		30	Down grade	2	YES	0.5	3	AC
34	Wondirad Scool - St Michael Church	WSM	Collector	0.75	Mixed	School Zone	30	Down grade	2	YES	0.5	3	AC
35	Minilik Hospital - Kebena School	MHK	Local	0.35	Residential		No PSL	Down grade	1	No	0	0	cobble Stone

3.6. Data Analysis Techniques

3.6.1. Procedures for factors affecting speed

The general flow or steps of the analysis include;

- ✓ Data were Collected i.e. traffic data(Spot Speed) and road feature data on different types of road
- ✓ Descriptive statistics of the speeding violation on samples of the collected data were carried out for each road section.
- ✓ 50th and 85th percentile were calculated
- ✓ The Link between the associated characteristics and speeding violations is investigated using multiple linear regression analysis.
- ✓ The Multiple linear regression analysis performed using SPSS.
- ✓ The study predicts significant factors affecting speed based on the influence factors stated on item 3.4.2 (Identification and selection of independent (predictor/explanatory) variables. Then, based on the types of speeding violations and the factors that influence them, regulations and procedures can be developed.

Descriptive statistics were conducted by importing the collected spot speed data into SPSS software, and the output results were discussed below regarding PSL and type of road classification.

Multiple linear regressions

When the dependent variable has more than two categories and is a nominal type, multinomial regression is utilized. The independent variables are not arranged naturally. The formula for a multiple linear regression is:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots \dots + \beta_NX_N$$

Where:

Y is the dependent variable in our case speed

X is the independent / explanatory variable

β_0 is the constant coefficient

$\beta_1, \beta_2, \dots, \beta_n$ is the slope of the independent variables

By using either the maximum likelihood technique or the ordinary least square method, multiple linear regression coefficients are computed (Simon P, et al., 2003).

The following five multiple linear regressions assumptions will be verified before regression analysis was conducted.

1. The outcome variable and the independent factors must be related linearly. If there is a linear or curved link, scatterplots can demonstrate it.
2. Multiple regressions make the assumption that the independent variables do not have a strong correlation. Values for the Variance Inflation Factor (VIF) are used to test this presumption.
3. Multiple regressions make the assumption that the variance of residuals should be constant along the projected value (homoscedasticity). By placing the expected and residual value on a scatter plot, it may be verified.
4. Multiple regressions make the assumption that continuous normally distributed variables should be present in the dependent variable. Plotting a histogram and a normal residual P-P plot will show the independent variable's normal distribution.
5. Data that deviates from the value predicted by the regression model should be eliminated from the analysis.

3.6.2. Procedures for posted speed limit compliance (drivers behavior survey)

The general flow or steps of the analysis include;

- ✓ A questionnaire was utilized to collect responses from drivers on their perceptions of speed restriction believability and speed choice.
- ✓ Data were Collected i.e. Questionaries' (interviews) collected from Drivers of Addis Ababa City based on their different demographic characteristics.
- ✓ Descriptive statistics of on samples of the collected data were carried out.

- ✓ Then for the compliance of drivers and causes of speeding mean comparison is used to interpret the likert scale questions.
- ✓ The ordinal logistic regression analysis used for driver's self-reported speeding violation performed using SPSS.
- ✓ The study will assess' compliance of the speed limit influence factors stated on item 3.4.3 (Dependent and independent variables for driver survey compliance to posted speed limit).

Ordinal logistic regression analysis

The link between an ordinal response variable and one or more explanatory factors can be modeled using the statistical analysis technique known as ordinal logistic regression. An ordinal variable is a categorical variable for which the category levels are clearly arranged.

The following three ordinal regressions assumptions are verified before regression analysis was conducted.

1. Measurement of your dependent variable ought to be done at the ordinal level.
2. Multicollinearity does not exist. When there is a strong correlation between two or more independent variables, this is known as multicollinearity. Due to these challenges, it becomes difficult to identify the variable that helps to explain the dependent variable and technical difficulties arise when computing an ordinal regression.
3. Odds ratio should be satisfied

3.7. Data Collection

3.7.1. Data Collection for speed violation prediction, road geometry

Primary sources of data were employed for all types of dependent and independent parameters in order to achieve the study's goal. Primary information was gathered from the field through observation, field linear measurements, and spot speed records using pocket radar. So as to collect all necessary field data for Multiple linear regression model, first 35 urban road straight tangent section with different road type, posted speed limit and roadway feature would be randomly selected using primarily field survey which meet the criteria stated on item 3.3 of this

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

study and at each selected urban road tangent section, the following road geometry; number of lanes, lane width, median type, pedestrian volume, pedestrian walk way width, pavement type and posted speed limit were obtained ;and the land use data include commercial , residential and farmland and also School zone areas were also obtained using observational survey by considering the function of the building or available land next to the road.

The data collection was conducted by two people, while one person held the pocket radar in position and the other person recorded the spot speed measurement form, as indicated by the sample below:

I.NO	Speed	Plate No					Vehicle Type			Age			Gender	
1	34	1	2	3	4	5	P	B	T	Y	M	O	M	F
2	43	1	2	3	4	5	P	B	T	Y	M	O	M	F
3	42	1	2	3	4	5	P	B	T	Y	M	O	M	F
4	43	1	2	3	4	5	P	B	T	Y	M	O	M	F
5	39	1	2	3	4	5	P	B	T	Y	M	O	M	F
6	53	1	2	3	4	5	P	B	T	Y	M	O	M	F
7	60	1	2	3	4	5	P	B	T	Y	M	O	M	F
8	32	1	2	3	4	5	P	B	T	Y	M	O	M	F
9	67	1	2	3	4	5	P	B	T	Y	M	O	M	F
10	68	1	2	3	4	5	P	B	T	Y	M	O	M	F
11	31	1	2	3	4	5	P	B	T	Y	M	O	M	F
12	58	1	2	3	4	5	P	B	T	Y	M	O	M	F
13	66	1	2	3	4	5	P	B	T	Y	M	O	M	F
14	21	1	2	3	4	5	P	B	T	Y	M	O	M	F
15	66	1	2	3	4	5	P	B	T	Y	M	O	M	F
16	61	1	2	3	4	5	P	B	T	Y	M	O	M	F
17	37	1	2	3	4	5	P	B	T	Y	M	O	M	F
18	43	1	2	3	4	5	P	B	T	Y	M	O	M	F
19	42	1	2	3	4	5	P	B	T	Y	M	O	M	F
20	55	1	2	3	4	5	P	B	T	Y	M	O	M	F
21	40	1	2	3	4	5	P	B	T	Y	M	O	M	F
22	45	1	2	3	4	5	P	B	T	Y	M	O	M	F
23	39	1	2	3	4	5	P	B	T	Y	M	O	M	F
24	48	1	2	3	4	5	P	B	T	Y	M	O	M	F

Figure 3.7: Sample summary format of data collection detail for spot speed

3.7.2. Data collection for Drivers compliance to the posted speed limit survey

A survey of Addis Ababa city drivers has been conducted by well-structured questionnaires. Based on information provided by the drivers themselves through a questionnaire with six components, the drivers' compliance with the posted speed limit and self-reported speeding violations were assessed. The parts are; general information about drivers demographic characteristics; knowledge of drivers' speed and posted speed limits in the city, compliance of drivers with posted speed limits, including self-reported speeding violations by drivers, cause for

overspeeding; intention of drivers to comply with the PSL; and a specific question for commercial drivers about the effect of daily income on complying with the PSL. The compliance of drivers with the speed limit, the intention of drivers to comply with the PSL, and the effect of daily income for commercial drivers were answered by using a Likert scale (from "strongly agree to "strongly disagree," which rate from 1 to 4). On the other hand, the cause of overspeeding has been answered by Likert scales from "always the cause" to "never the cause." The self-reported speed violation of PSL is answered by a scale from "Never exceed PSL" to "> 30 km/hr."

A total of 450 closed-end questionnaires were distributed to randomly selected drivers at a commercial center, government offices, and also institutions by convenience method of sampling in order to meet the minimum requirement of sample size of 385. A total of 401 respondents responded. The questioners were originally written in English, but for ease of communication with the drivers, they were translated into Amharic.

4. Data analysis and Discussion

Data analysis involves viewing, transforming, and modeling data to produce actionable information. This modeling procedure makes it possible to pinpoint statistically significant factors for vehicle over speeding contributors. Regression analysis is a statistical method for determining how closely two variables are related. For various types of data, there are several types of regression analysis. Spot speed data were modeled using multiple linear regressions (MLR), and the drivers' compliance and self-reported speeding violations were analyzed using ordinal logistic regression.

4.1. Descriptive statistics

4.1.1. Descriptive statistics for spot speed analysis

Table 4.1: Descriptive statistics for spot speed analysis

Types of road	Sec. ID	Actual psl (Km/hr.)	Max. Spot Speed (Km/hr.)	Min. Spot Speed (Km/hr.)	50 th percentile speed (Km/hr.)	85 th percentile speed (Km/hr.)	Pedestrian Volume (Vol./hr.)	parking density	Gradient of the road	NO.of lane/dr.	median width(m)	pedestrian walk width(m)	Pavement surface type
Arterial	GY	30	56	25	40	47.85	589	5	Up grade	3	30	3	dry
	YTC		65	27	34	40	430	20	Up grade	3	30	3	dry
	AW 1		79	37	53	60	569	12	Down grade	3	1	4	dry
	W18		60	26	39	45	356	10	Up grade	2	1	3	wet
	WP 1		68	26	42	52	294	15	Down grade	3	2	3	dry
	AS	40	71	29	49.5	57	588	15	Up grade	3	1	3	dry
	AW 2		75	31	47	56	500	10	Down grade	3	1	4	dry
	WP 2		79	29	49	64.85	256	12	Down grade	4	2	3	wet
	UA	50	95	42	58	77.85	346	0	Down grade	3	1	5	wet

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Types of road	Sec. ID	Actual psl (Km/hr.)	Max. Spot Speed (Km/hr.)	Min. Spot Speed (Km/hr.)	50 th percentile speed (Km/hr.)	85 th percentile speed (Km/hr.)	Pedestrian Volume (Vol./hr.)	parking density	Gradient of the road	NO.of lane/dr.	median width(m)	pedestrian walk width(m)	Pavement surface type
	AGW		92	32	58.5	69	324	0	Down grade	3	0.5	15	dry
	18W		90	34	58	71	560	0	Down grade	3	1	3	wet
Sub – Arterial	JG 1	30	72	29	51	60	345	12	Down grade	3	1	3	wet
	KT		65	26	43	55	445	0	Down grade	3	0.5	3	dry
	KT 2		79	35	51	68	129	0	Up grade	3	30	5	wet
	KK		68	26	42	52	256	5	Down grade	3	2.5	3	dry
	AMF		61	26	37	45	189	10	Up grade	3	1	3	wet
	K6K		51	26	38	45	294	20	Up grade	3	1	3	dry
	6KA		48	21	36	40	354	5	Down grade	3	1	3	dry
	JG 2	40	68	28	45	50	326	10	Up grade	3	1	3	dry
	SG 2		64	29	43	50	265	5	Down grade	2	30	5	dry
GI 1	71		29	47	57.6	185	0	Down grade	3	30	5	wet	

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Types of road	Sec. ID	Actual psl (Km/hr.)	Max. Spot Speed (Km/hr.)	Min. Spot Speed (Km/hr.)	50 th percentile speed (Km/hr.)	85 th percentile speed (Km/hr.)	Pedestrian Volume (Vol./hr.)	parking density	Gradient of the road	NO.of lane/dr.	median width(m)	pedestrian walk width(m)	Pavement surface type
	SG 1	50	66	29	43	53	235	2	Down grade	2	30	5	dry
	Gi 2		90	34	49	68	89	0	Up grade	3	30	5	dry
	IH 1		76	39	58	68	52	0	Up grade	3	30	5	dry
	IH 2		161	40	60	77	34	0	Down grade	3	30	5	wet
	KT 1		90	34	56	71	136	0	Up grade	3	30	5	wet
	SE		87	32	55	68	680	15	Up grade	3	2.5	3	dry
	FAM		No PSL	62	28	39	45	326	10	Down grade	3	1	3	dry
Collector	YKB	30	66	24	39	47	295	15	Down grade	2	0.5	3	dry
	K02M		72	29	50.5	60	850	25	Down grade	2	0.5	3	dry
	WSM		69	31	53	60.85	382	15	Down grade	2	0.5	3	dry
	MHK P	No PSL	66	24	40	49.55	402	0	Up grade	1	0	0	dry
	SMK		62	28	39	47	375	0	Down grade	1	0	0	wet

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Types of road	Sec. ID	Actual psl (Km/hr.)	Max. Spot Speed (Km/hr.)	Min. Spot Speed (Km/hr.)	50 th percentile speed (Km/hr.)	85 th percentile speed (Km/hr.)	Pedestrian Volume (Vol./hr.)	parking density	Gradient of the road	NO.of lane/dr.	median width(m)	pedestrian walk width(m)	Pavement surface type
Local	KCW	No PSL	58	25	41	48	229	4	Down grade	1	0	0	wet
	MHK	No PSL	55	24	39	45	195	9	Down grade	1	0	0	dry

4.1.2. Descriptive statistics for Drivers survey

Table 4.2: Descriptive statistics for Drivers survey

Variable	Variable distribution	SPSS Coding	Frequency	Percent
1. General Information about Drivers				
Driver age	(18-24) Years	1	80	20
	(25-35) Years	2	163	40.6
	(35-50) Years	3	124	30.9
	>50 Years	4	34	5.5
Gender	Male	1	347	86.5
	Female	2	54	13.5
Driving ex	<5 Years	1	115	28.7
	(5-10) Years	2	170	42.4
	(10-15) Years	3	96	23.9
	>15 Years	4	20	5
Marital Status	Single	1	177	44.1
	Married	2	224	59.9
Educational Level	<High school	1	3	0.7
	High school	2	207	51.6
	Diploma	3	163	40.6
	Degree	4	28	7
	Masters and above	5	0	0
Vehicle ownership	Self-Owned	1	71	17.7
	Private Company	2	68	17
	GOV	3	85	21.2
	Private person Owned	4	177	44.1
2. General Questions about the knowledge of speed and speed limit				
How many times a week would you go on the Addis-Ababa urban road	1 days a week	1	0	0
	2 days a week	2	0	0
	3 days a week	3	0	0
	4 days a week	4	26	6.5
	all week	5	375	93.5
Do you know all the types of the rode in the Addis-Ababa as per AACRA GDM	Yes	1	90	22.4
	No	2	311	77.6

Variable	Variable distribution	SPSS Coding	Frequency	Percent
Do you know the posted speed limit on different road types in Addis-Ababa city even if it is not placed with a sign?	Yes	1	63	15.7
	No	2	338	84.3

4.2. Multiple linear regression model

While conducting the regression model, the five assumptions for MLR have been checked, and the descriptive statistics of the categorical and continuous data following variables have been checked as follows:

Table 4.3; Description of categorical variables statistics for multiple linear regression models

Variable	SPSS coding	Variable Description
Type of Road	1	Arterial
	2	Sub –Arterial
	3	Collector
	4	Local
Posted Speed Limit	1	30 KPH
	2	40 KPH
	3	50 KPH
	4	No PSL
Land Use	1	institutional
	2	mixed
	3	Residential
	4	commercial
	5	Farmland
Pavement Surface	1	Dry
	2	Wet
Longitudinal Gradient	1	Up grade
	2	Down grade

Table 4.4; Description of continuous variables statistics for multiple linear regression models

	Descriptive Statistics								
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
percent of violation	35	0	100	69.71	33.250	-1.325	.398	.474	.778
50th percentile speed (Km/hr.)	35	34.0	60.0	46.357	7.5776	.301	.398	-1.174	.778
85th percentile speed (Km/hr.)	35	40.00	77.85	56.2557	10.60938	.402	.398	-.912	.778
Pedstrian Volume (Vol./hr.)	35	165	465	315.23	91.319	.117	.398	-1.418	.778
parking density	26	5	19	12.38	3.623	-.042	.456	-.473	.887
NO.of lane/dir.	35	1	4	2.63	.731	-1.194	.398	.779	.778
median width(m)	35	.0	30.0	9.243	13.3325	.985	.398	-1.085	.778
pedestrian walk width(m)	35	0	15	3.57	2.465	2.777	.398	13.591	.778
Valid N (listwise)	26								

4.2.1. Multiple linear regressions assumptions checked

The following five multiple linear regressions assumptions checked for regression analysis.

1. The outcome variable and the independent factors must be related linearly. If there is a linear or curved link, scatterplots can demonstrate it, as shown below. Pedestrian volume, 85th percentile speed, parking density, pedestrian walk width, median width, percent of violations, and number of lanes have an almost linear relationship with the 50th percentile speed, which represents the average traffic.

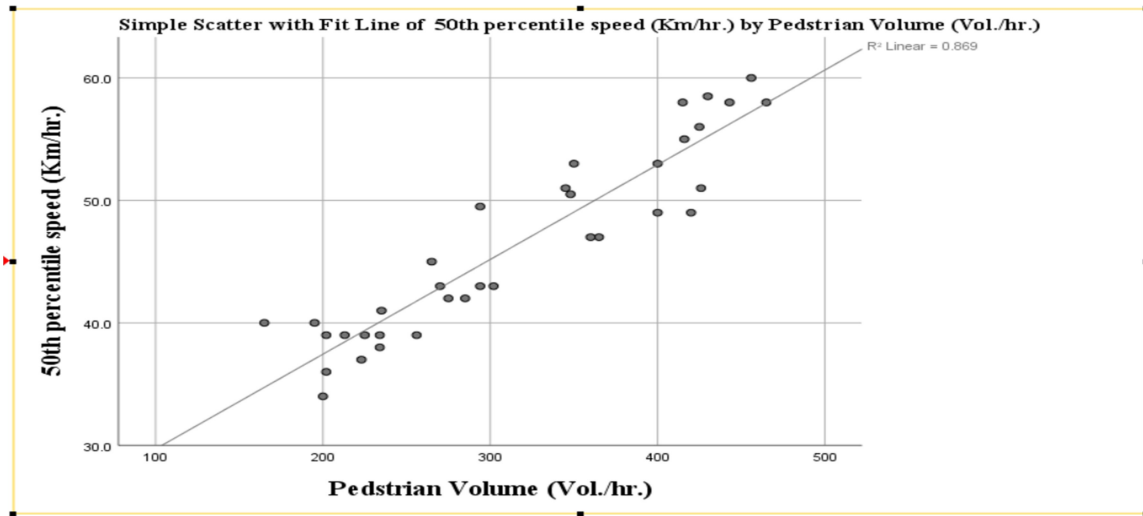


Figure 4.1: Pedestrian Volume vs. 50th percentile speed

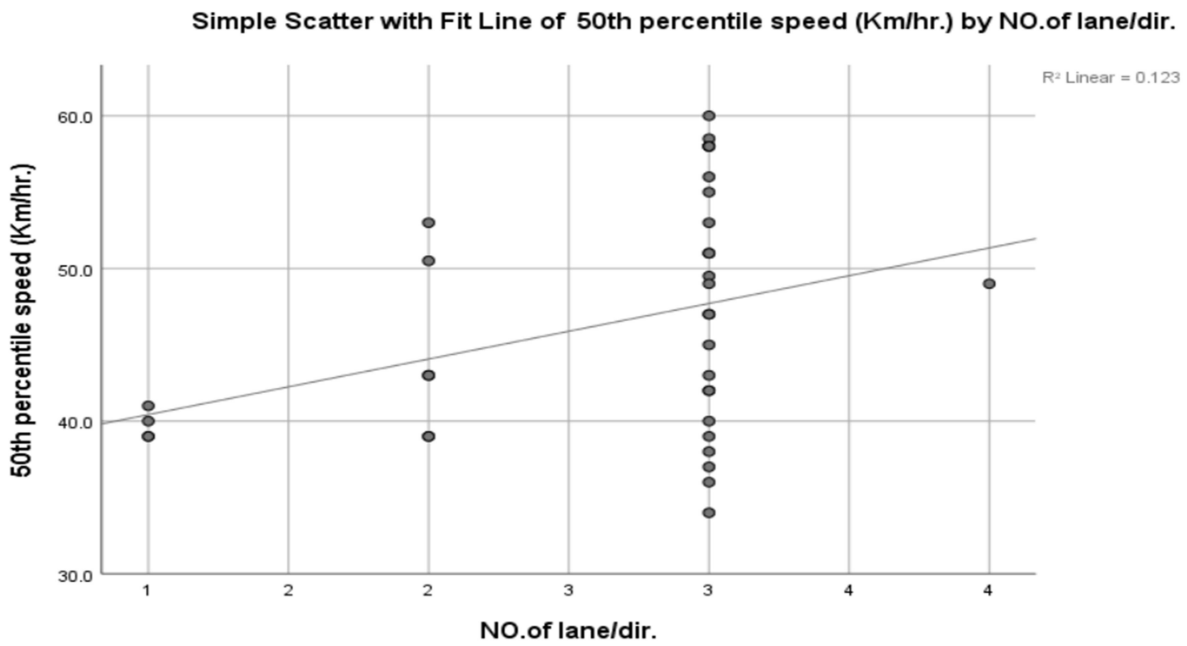


Figure 4.2: No. of lane vs. 50th percentile speed

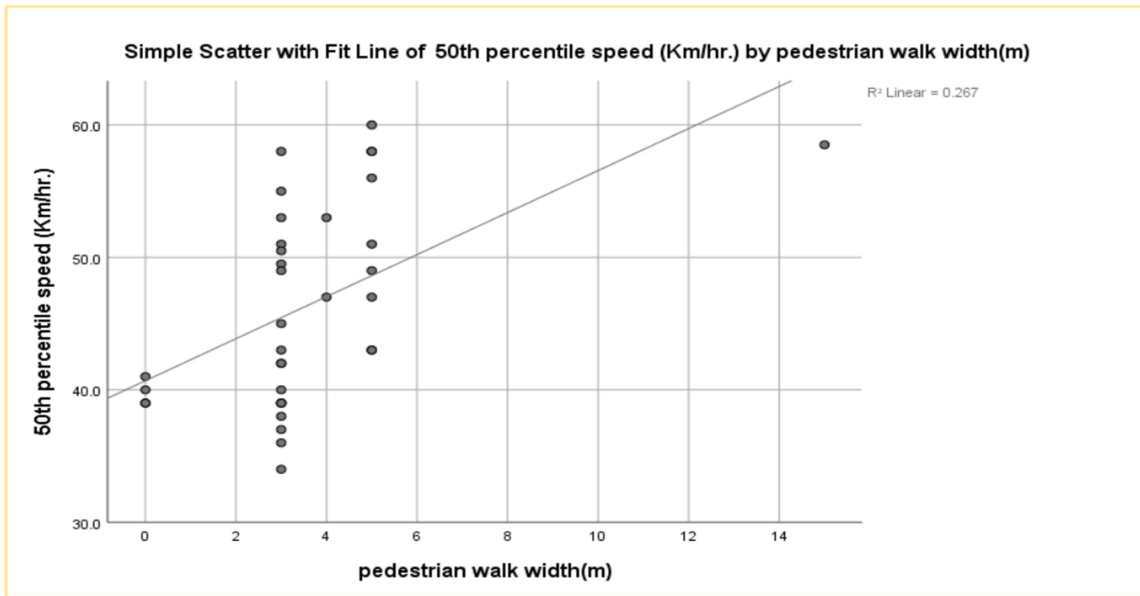


Figure 4.3 : 85th percentile speed vs. 50th percentile speed

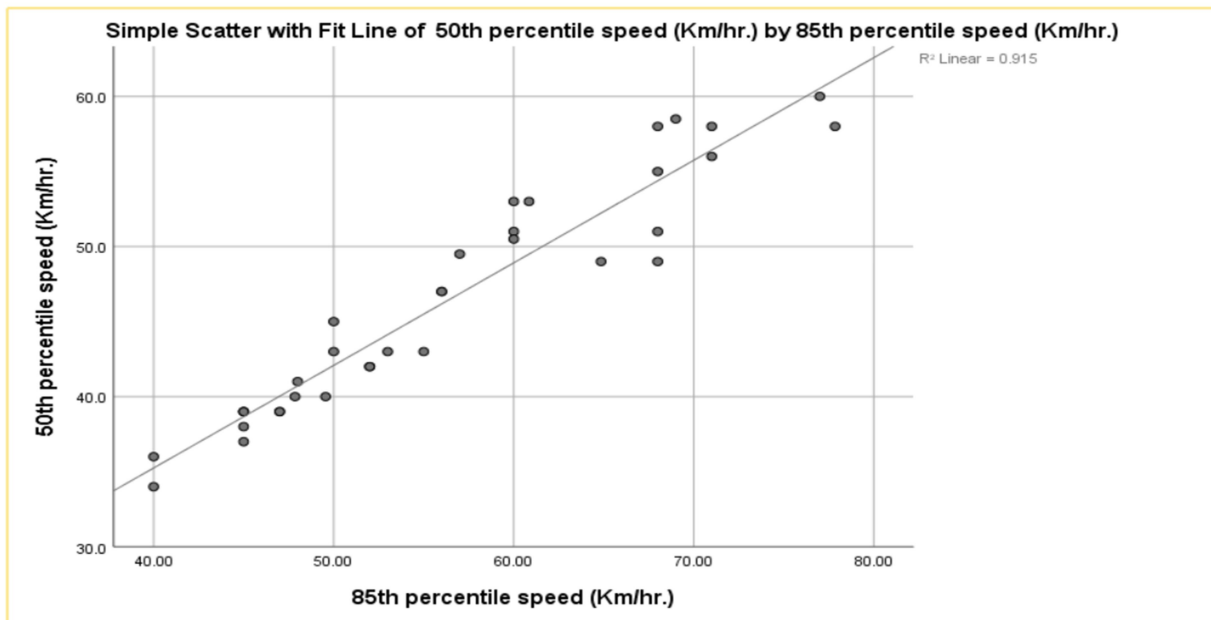


Figure 4.4: Pedestrian walk way width vs. 50th percentile speed

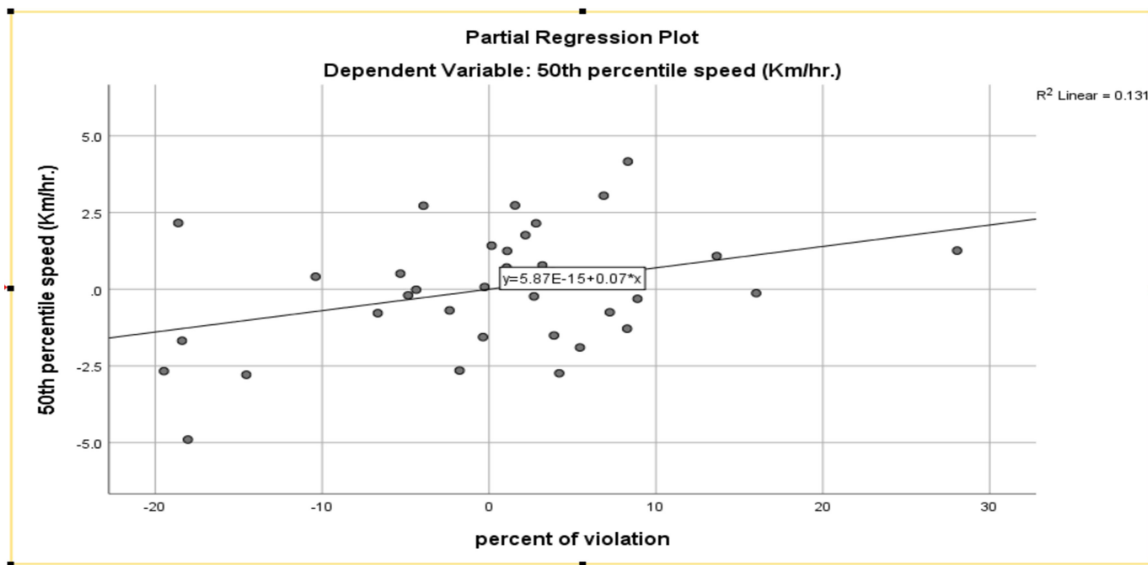


Figure 4.5: Percent of violation vs. 50th percentile speed

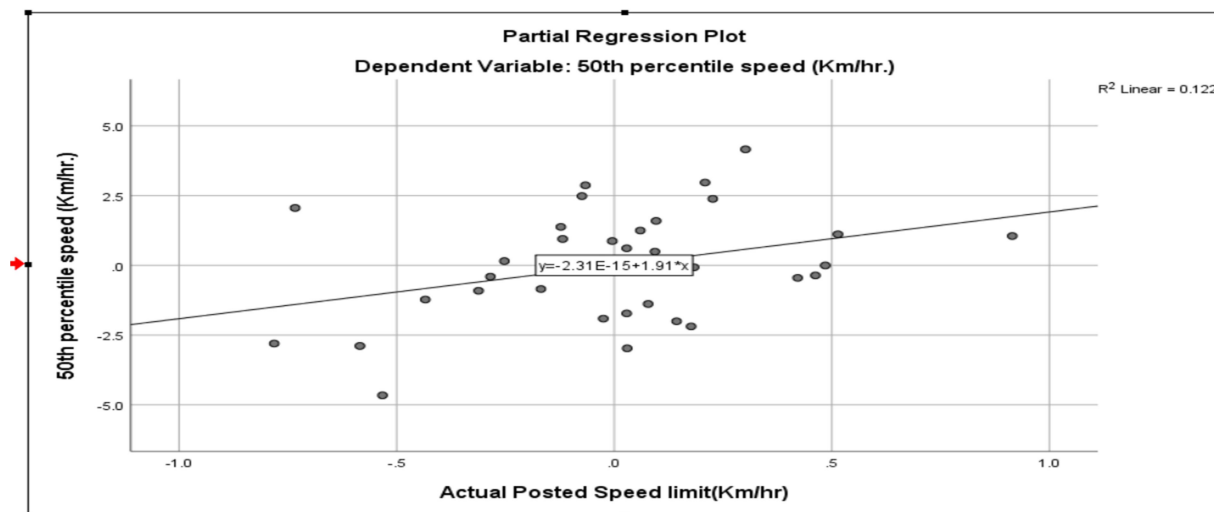


Figure 4.6: PSL vs. 50th percentile speed

1. Multiple regressions make the assumption that the independent variables do not have a strong correlation. Values for the Variance Inflation Factor (VIF) or Pearson correlation are used to test this presumption. By using Pearson correlation with the value from ± 1 (-1 up to -0.7 have perfect negative correlation, -0.7 up to +0.7 have no linear correlation and from +0.7 up to +1 have perfect direct correlation). From the correlation table below that is 85th percentile speed, Pedestrian Volume and parking density are highly correlated.

Table 4.5: Correlation of independent variable

Correlations													
Pearson Correlation	V50th (Km/hr.)	Types of road	PSL (Km/hr)	percent of violation	V85th (Km/hr.)	Pedestrian Volume (Vol./hr.)	parking density	Gradient of the road	NO.of lane/dir.	median width(m)	Ped. an walk width(m)	Land use	Pavement surface type
V50th (Km/hr.)	1.000	-.054	-.026	.227	.946	.898	.849	.114	.178	-.091	.293	.095	.096
Types of road	-.054	1.000	.429	-.470	-.093	-.103	.220	.346	-.756	-.217	-.535	-.038	.027
PSL (Km/hr)	-.026	.429	1.000	-.960	-.056	-.102	.124	.204	-.414	-.043	-.385	.034	-.010
percent of violation	.227	-.470	-.960	1.000	.255	.294	.040	-.246	.484	.014	.423	.034	.032
V85th (Km/hr.)	.946	-.093	-.056	.255	1.000	.939	.895	.088	.271	-.001	.337	.086	.197
Pedestrian Volume (Vol./hr.)	.898	-.103	-.102	.294	.939	1.000	.825	.151	.263	-.021	.422	.024	.247
parking density	.849	.220	.124	.040	.895	.825	1.000	.170	.007	-.080	.060	-.063	.276
Gradient of the road	.114	.346	.204	-.246	.088	.151	.170	1.000	-.253	-.185	-.043	-.183	-.105
NO. of lane/dir.	.178	-.756	-.414	.484	.271	.263	.007	-.253	1.000	.042	.458	.126	.054

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

median width(m)	-.091	-.217	-.043	.014	-.001	-.021	-.080	-.185	.042	1.000	.570	-.358	.077
pedestrian an walk width(m)	.293	-.535	-.385	.423	.337	.422	.060	-.043	.458	.570	1.000	-.087	-.006
Land use	.095	-.038	.034	.034	.086	.024	-.063	-.183	.126	-.358	-.087	1.000	.052
Pavement surface type	.096	.027	-.010	.032	.197	.247	.276	-.105	.054	.077	-.006	.052	1.000

2. Multiple regressions make the assumption that the variance of residuals should be constant along the projected value (homoscedasticity) is the presumption that the residuals' (or the degree of error in the model's) variability varies similarly at each point throughout the model. In other words, at any point when the predictor variables are present, the dispersion of the residuals should be relatively consistent (or the linear model throughout). By placing the expected and residual value on a scatter plot or using Durbin Watson it may be verified. As shown in the figure below the plot is concentrated around the line zero which shows there is no issue of homoscedasticity.

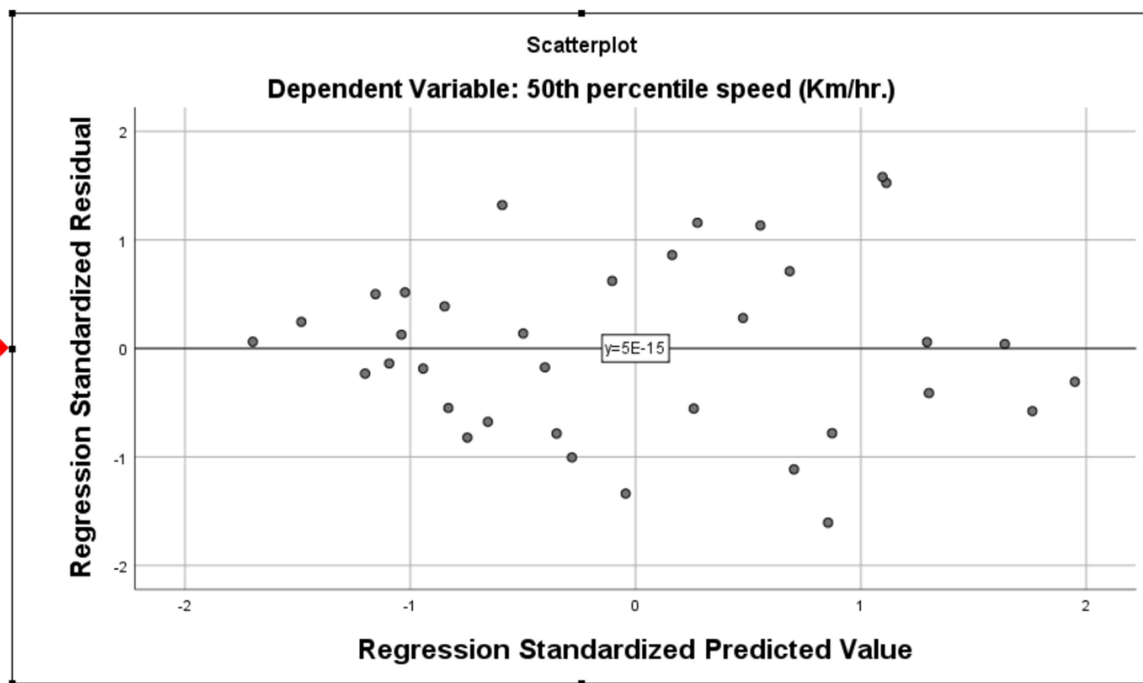


Figure 4.7: homoscedasticity test

Table 4.6: Model Summary for MLR

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.799 ^a	.638	.414	5.7992	2.259

- ▶ a. Predictors: (Constant), Pavement surface type, psl50kph, residential, psl40kph, pedestrian walk width(m), downroad, collectors, institutional, Subarterial, parking density, NO.of lane/dir., psl30kph, arterial
- b. Dependent Variable: 50th percentile speed (Km/hr.)

The Durbin-Watson statistic showed that this assumption had been met, as the obtained value was between 1.5 – 2.5 (Durbin-Watson = 2.259) which indicates that there is no relationship between the residual variables and the independent variable and assumption 3 is satisfied.

3. Multiple regressions make the assumption that continuous normally distributed variables should be present in the dependent variable. Plotting a histogram and a normal residual P-P plot showed the independent variable's normal distribution. It was nearly normally distributed, with nearly identical mean and median values, as indicated in the bell-shaped normal distribution graph below.



Figure 4.8: Normal distribution graph

The P-P plot for the model can be used to verify or refute this assumption. The residuals are distributed more normally the closer the dots are to the diagonal line.

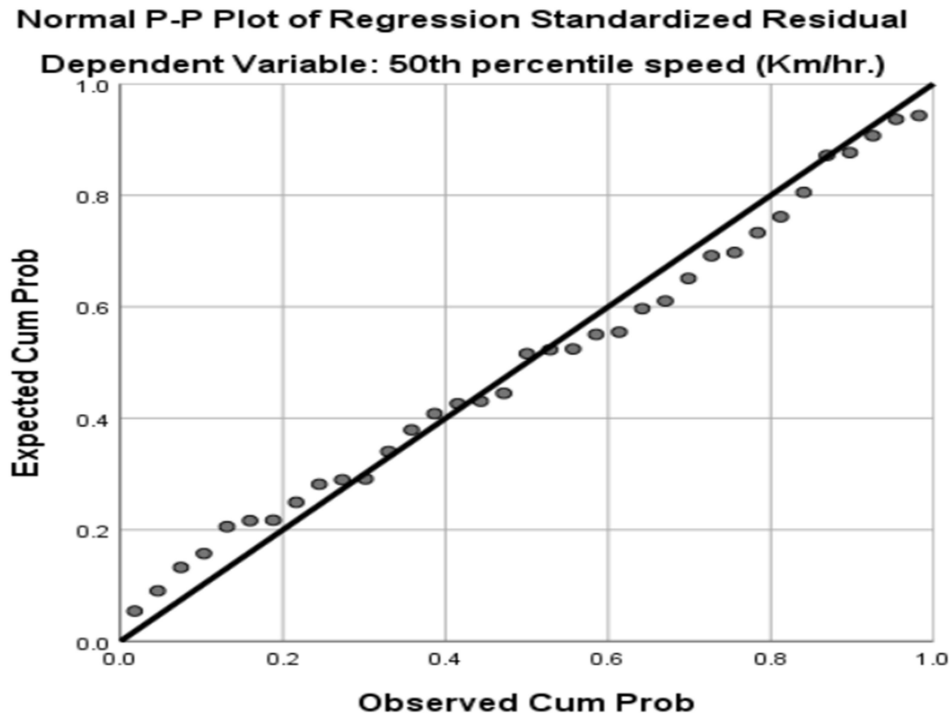


Figure 4.9: Normal P-P Plot

The Kolmogorov-Smirnov and Shapiro-Wilk normality tests were also used to look at the normal distribution of 50th percentile speed.

Ho; 50th percentile speed is normally distributed

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
50th percentile speed (Km/hr.)	.123	35	.200*	.942	35	.066

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The null hypothesis was not rejected because it is not significant ($0.200 > 0.05$) at 95 % confidence level. Therefore 50th percentile speed of these data was normally distributed continuous variable.

4. Data that deviates from the value predicted by the regression model should be eliminated from the analysis. Box plot was used to check the outlier data as shown below

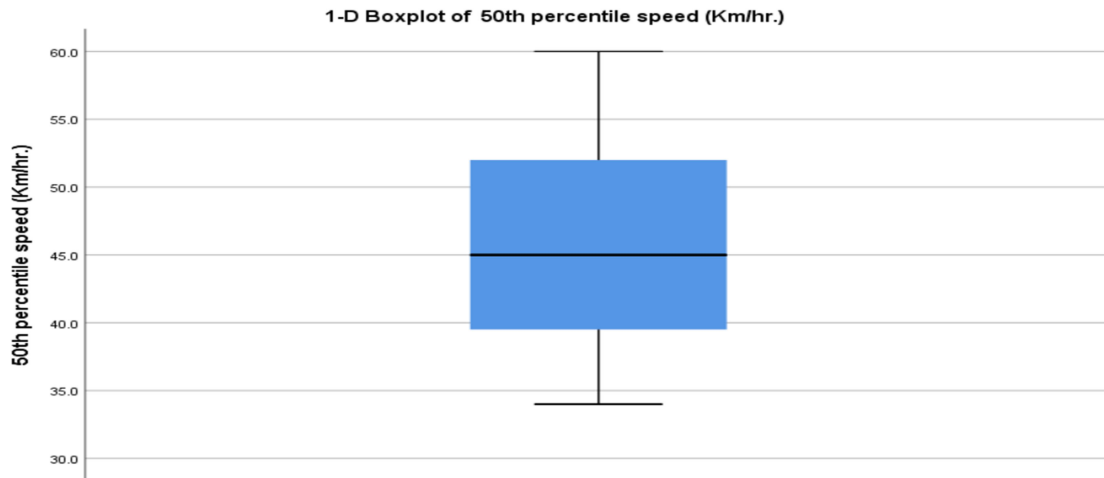


Figure 4.9: Box Plot for 50th percentile speed

4.2.2. Developing multiple linear regressions model

Following the fulfillment of all linear regression assumptions, a linear regression model was created by progressively selecting the most significant variables to determine how each independent variable affected the 50th percentile speed of drivers. Since there are both continuous and categorical variables for these data dummy variables for the SPSS input has been created as follows;

Table 4.6: Dummy variable for type of road

Type of road	D1	D2	D3	D4
Arterial	1	0	0	0
Sub Arterial	0	1		0
Collector	0	0	1	0
Local street (reference)	0	0	0	0

Table 4.7: Dummy variable for Land Use

Land Use	D1	D2	D3
Residential Area	1	0	0
Institutional area	0	1	
Commercial area (reference)	0	0	0

Table 4.8: Dummy variable for Road pavement Conditions

Road pavement Conditions	D1	D2
Dry	1	0
Wet(reference)	0	1

Table 4.9: Dummy variable for Posted speed limit

Posted speed limit	D1	D2	D3	D4
30 KM/hr.	1	0	0	0
40 KM/hr.	0	1	0	0
50 KM/hr.	0	0	1	0
No Psl(reference)	0	0	0	0

Table 4.10: Model Summary for MLR

Model Summary^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.971 ^a	.942	.910	2.2670
<p>a. Predictors: (Constant), Pavement surface type, percent of violation, median width(m), Landuse, Gradient of the road, parking density, 85th percentile speed (Km/hr.), Types of road, pedestrian walkwidth(m), NO.of lane/dir., Actual Posted Speed limit(Km/hr), Pedstrian Volume (Vol./hr.)</p> <p>b. Dependent Variable: 50th percentile speed (Km/hr.)</p>				

As shown above, the R-square (coefficient of determination) in the model summary table can be interpreted as the proportion of variation in the dependent variable accounted for by the set of predictors [by multiplying the value, we can see the percentage of variation accounted for]. As a result, we can see that the set of predictors accounted for approximately 94.2 % of the variation in test score. However, the 85th percentile, percent of violations and pedestrian volume are not included in the model due to correlation diagnostics. The retraction analysis model summary will be as follows:

Table 4.11: Model Summary for MLR

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.799 ^a	.638	.414	5.7992

a. Predictors: (Constant), Pavement surface type, psi50kph, residential, psi40kph, pedestrian walk width(m), downread, collectors, institutional, Subarterial, parking density, NO.of lane/dir., psi30kph, arterial

b. Dependent Variable: 50th percentile speed (Km/hr.)

Cohen (1988) suggested the following standards for judging the size of the effect of the set of predictors and the dependent variables using R-square; $R^2 = 0.02$ (Small effect); $R^2 = 0.13$ (medium effect); $R^2 = 0.26$ (large effect). Therefore using these standards, the size of the effect of the predictors 63.8 % on the dependent variable may describe as large.

The table below presents a detailed regression model with analysis of variance (ANOVA).

Table 4.12: ANOVA Test

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1246.035	13	95.849	2.850	.016 ^b
	Residual	706.250	21	33.631		
	Total	1952.286	34			

a. Dependent Variable: 50th percentile speed (Km/hr.)

b. Predictors: (Constant), Pavement surface type, psi50kph, residential, psi40kph, pedestrian walk width(m), downread, collectors, institutional, Subarterial, parking density, NO.of lane/dir.,psi30kph, arterial

The result given in the ANOVA table are used to test whether the R-square computed from ones data differs significantly from a population R- square of 0[A population R- square of 0 is the null hypothesis for this test].this test relies on the F distribution for degree of freedom (df_{reg} and df_{res}) and assuming a given significant level ($\alpha=0.05$).Based on the result provided above, we infer that the population R-square is greater than Zero[R-square=0.638 ,F(13,21)=2.850, p<0.05]

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Table 4.13: Coefficients of the MLR model

Model	Coefficients ^a								
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1 (Constant)	32.820	7.614		4.311	.000	16.939	48.702		
parking density	-.098	.258	-.081	-.379	.009	-.636	.440	.379	2.635
NO. of lane/dir.	4.475	3.085	.432	1.450	.062	-1.961	10.910	.197	5.064
pedestrian walk width(m)	1.228	.559	.400	2.198	.040	.063	2.394	.529	1.889
psl50kph	14.616	5.682	.738	2.572	.018	2.763	26.468	.213	4.699
Pavement surface type	5.084	2.202	.323	2.308	.032	.490	9.677	.893	1.120

a. Dependent Variable: 50th percentile speed (Km/hr.)

Based on the above developed model, parking density, number of lanes per direction, pedestrian walkway width (m), and pavement surface condition are significant at 95% confidence level with a better degree of determination. Having an equation of

$$\begin{aligned}
 Y(\text{50th percentile speed}) &= 32.820 + 1.228 \text{ Pedestrian walk width(m)} \\
 &- 0.098 \text{ parking density} \\
 &+ 4.475 \text{ NO. of lane} \\
 &/\text{dir.} + 5.084 \text{ pavement conditions(1 for Dry and 0 for wet)}
 \end{aligned}$$

From the above model equation we can interpret the partial slopes that

- ✓ For every one meter increase in pedestrian walkway width, the 50th percentile speed is expected to increase by 1.228 units, holding the remaining predictors constant. This indicates that the wider the pedestrian walkway, the more the driver feels the need to increase the speed. On the other hand, the mean value of causes of speeding according to driver perspective on the drivers' attitudinal survey (there is no pedestrian on the road) was 2.54, which is most of the time a cause. The width of

pedestrian walkways increases along city freeways with a low volume of pedestrians, while the volume of pedestrians is higher but the width is narrow, which should be the opposite. In similar studies about the effect of shoulders, even if there is no research on the pedestrian walkway, except at one location, speeds on roads with shoulders wider than or equal to 6 ft (1.8 m) were greater than 50 mph (80 km/h). Speeds on roads with shoulders between 0 and 4 ft (1.2 m) also reached 50 mph (80 km/h); however, most of them were slower than those seen on roads with wider shoulders (Fitzpatrick, K., 2002).

- ✓ For every one unit increase in parking density, the 50th percentile speed is expected to decrease by 0.098 units, holding the remaining predictors constant. In the presence of parked cars, which effectively reduced the width of the road and led to lowering the average speed of vehicles in a section by making it impossible for drivers to maneuver another vehicle freely, which is similar to the findings of (Edquist, J. (2012), and Fitzpatrick, K. (2002), speeds were slower when parking was allowed on the street.
- ✓ Holding the remaining predictors constant, the 50th percentile speed is expected to increase by 4.475 units for every unit increase in the number of lanes/dir. In line with expectations, adding lanes allows for more agility and flexibility in the driver's choice of speed, and, also related to the compliance issue, drivers are more likely to The speed limit on freeways or the number of lanes is greater than 3 per direction, and also in relation to these results, studies by Kockelman, K.M., and Ma, J. (2007) find that higher speeds are produced by adding lanes above those recommended by the Highway Capacity Manual.
- ✓ Dry Pavement Condition (coded as 1) is expected to have a score of 5.084 out of 50.thpercentile greater than Wet pavement condition (coded as 0) holding the remaining predictor's constant. When using dichotomous variables, as we are here, partial slops can be considered the difference in mean between the two groups, holding the remaining predictors constant. Along wet pavement, slower speeds are typically seen since drivers are more concerned about their safety. Mostly, drivers are afraid of skidding due to wet pavement, which results in accidents. The tendency of wet pavement to slow down traffic is high (Kockelman, K.M., and Ma, J., 2007).

For those variables which are not significant for the 50th percentile speed ($p>0.5$)

- ✓ The type of road is not a significant variable for the 50th percentile speed, which indicates that drivers are not influenced by the different types of roads in the city. There is a big gap between differentiating the road types based on speed limits and functions. In relation to this, as shown in the descriptive statistics for the drivers survey, only 22.4 % of drivers know all the types of roads in Addis Ababa as per AACRA GDM, and only 15.7 % of drivers know the posted speed limit on different road types in Addis Ababa city, even if it is not placed with a sign. This clearly indicates that there is a large gap in knowledge of the road types in the city of Addis Ababa and that the types of roads cannot affect the speed of vehicles.
- ✓ The posted speed limit is not also a significant variable for the 50th percentile speed, which shows that there is a lack of consideration for the posted speed limit while driving on different urban roads in the city. These also imply that drivers in the city have irresponsible and uncontrolled behavior; the 85th percentile of all sections in this study is above the posted speed limit.
- ✓ Land use is not a significant variable for the 50th percentile speed, which indicates that as a reference variable for commercial areas, drivers do not differentiate whether the area has different kinds of land use while driving.

4.3. Violation of posted speed limit by drivers on different types of road and PSL

In this section, factors affecting vehicle speed are assessed by driver degree of compliance and violation of the posted speed limit as per road type, vehicle class, driver age, and driver gender; land use and the posted speed limit are described in graph and tabular form. Drivers whose spot speed is greater than the speed limit are considered violators unless they comply. All of the data required for the study was collected using pocket radar and then transferred to SPSS to determine the spot speed distribution of each vehicle for various road types and PSL. Land use and road types are primarily collected through field observation, while plate code No, type of vehicle, age of drivers (by guess), and gender of drivers are collected through observation at spot speed collection. A total of 3,000 vehicle spot speeds have been gathered.

4.3.1. Vehicle composition and sample size for 30 km/hr. posted speed limit.

From the SPSS data sheet using cross-tabulation and cluster bar charts, a total of 1500 vehicles' spot speeds were gathered at 30Km/hr. PSL. The table below provides a summary of variables and a spot speed violation.

- ✓ Drivers who comply with the PSL are non-violators (having spot speed of < 30Km/hr.)
- ✓ Drivers who exceed the PSL are violators (having spot speed of >30 Km/hr.)

Table 4.14: Cross tabulation of variables with speed compliance and violation at 30Km/hr. PSL

Variables		None violators VS violators				Total	
		<30 km/hr.		> 30km/hr.			
		Count	%	Count	%	Count	%
Land use	Institutional	34	44.2	366	25.7	400	26.7
	Residential	8	10.4	292	20.5	300	20
	Commercial	35	45.5	765	53.8	800	53.3
Total		77	100	1423	100	1500	100
Types of Road	Arterial	24	31.2	476	33.5	500	33.3
	Sub Arterial	46	59.7	654	46	700	46.7
	Collector	7	9.1	293	20.6	300	20
Total		77	100	1423	100	1500	100
Plate Code No	Code 1	2	2.6	85	6	87	5.8
	Code 2	31	40.3	391	27.5	422	28.1
	Code 3	31	40.3	782	55	813	54.2
	Code 4	13	16.9	130	9.1	143	9.5
	Code 5	0	0	35	2.5	35	2.3
Total		77	100	1423	100	1500	100
Type of Vehicle	Passenger	61	79.2	918	64.5	979	65.3
	Mini - Bus	2	2.6	275	19.3	277	18.5
	Bus	7	9.1	81	5.7	88	5.9
	Truck	7	9.1	149	10.5	156	10.4
Total		77	100	1423	100	1500	100
Age of Drivers	Young (18-35)	19	24.7	772	54.3	791	52.7
	Mid young(36-49)	28	36.4	486	34.2	514	34.3
	Old (>50)	30	39	165	11.6	195	13
Total		77	100	1423	100	1500	100
Gender of	Male	34	44.2	1301	91.4	1335	89

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Variables		None violators VS violators				Total	
		<30 km/hr.		> 30km/hr.			
		Count	%	Count	%	Count	%
Drivers	Female	43	55.8	122	8.6	165	11
Total		77	100	1423	100	1500	100

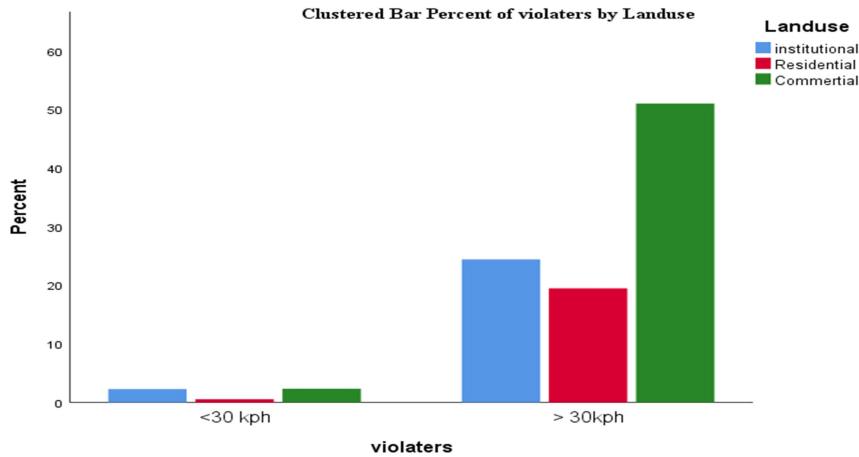


Figure 4.10: Cluster Bar percent of Land use by Violators at 30Km/hr. PSL

As shown in the graph regarding the land use the versus speeding at 30 km/hr PSL there is high violation of speed on commercial areas than the others and also on residential areas also highly affected by speed violation.

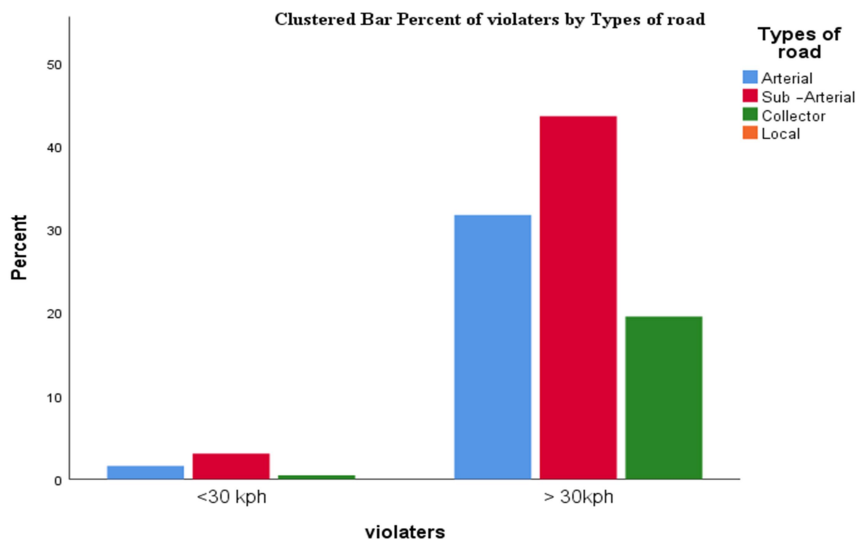


Figure 4.11: Cluster Bar percent of Types of road by Violators at 30Km/hr. PSL

As shown in the graph regarding the Types of road versus speeding at 30 km/hr PSL there is high violation of speed on Sub arterial roads than the others and also on Arterial and Collector roads are also highly affected by speed violation.

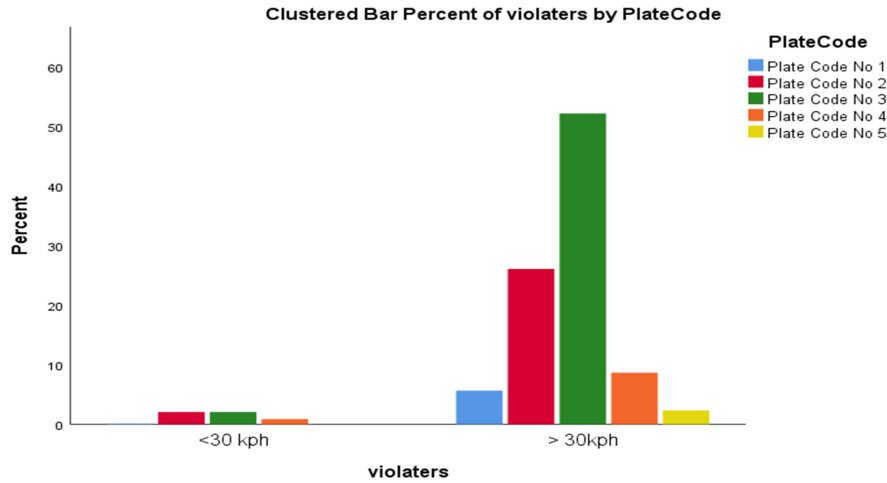


Figure 4.12: Cluster Bar percent of Plate Code by Violators at 30Km/hr. PSL

As shown in the graph regarding the Plate code versus speeding at 30 km/hr PSL there is high violation of speed by drivers of Plate code no.3 which are commercial drivers this shows that the commercial area need emphasis regarding speed violation than the others.

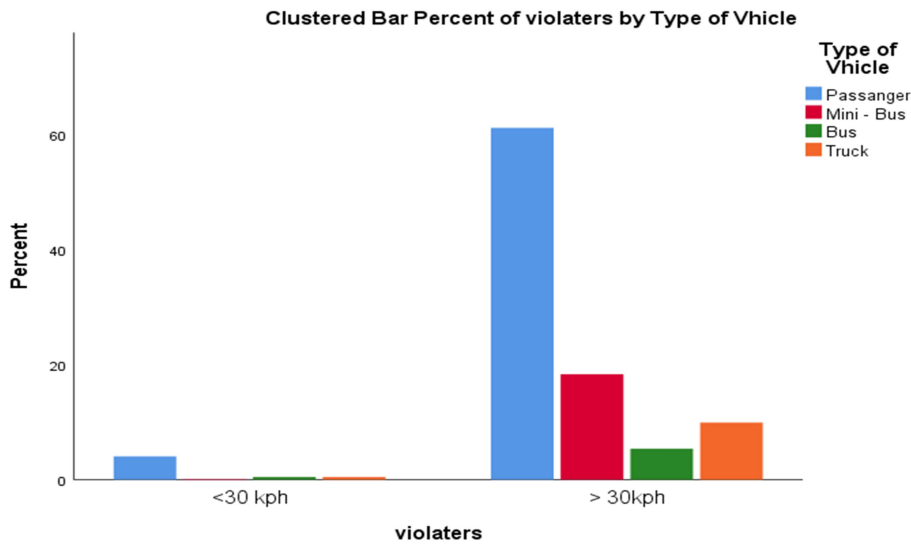


Figure 4.13: Cluster Bar percent of Type of Vehicle by Violators at 30Km/hr. PSL

As shown in the graph regarding the types of vehicle versus speeding at 30 km/hr PSL there is high violation of speed by drivers of passenger car than the others.

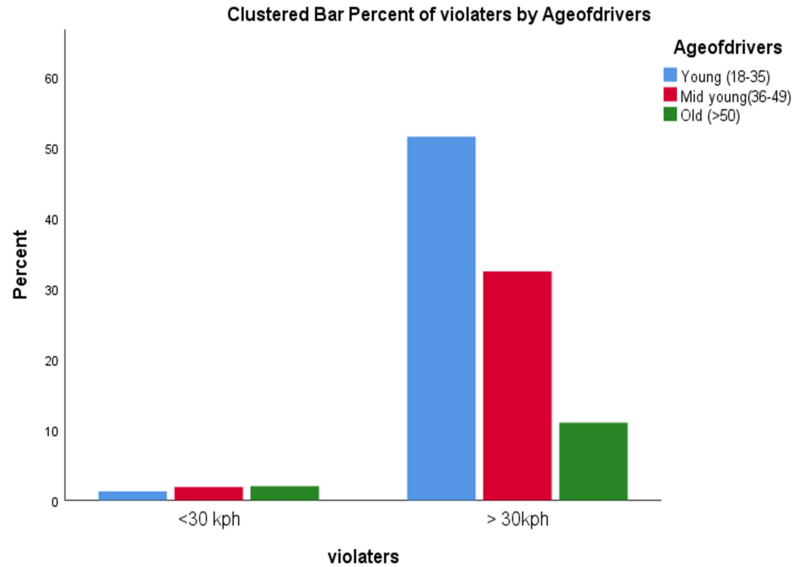


Figure 4.14: Cluster Bar percent of Age of Drivers by Violaters at 30Km/hr. PSL

As shown in the graph regarding age of drivers versus speeding at 30 km/hr PSL there is high violation of speed by young drivers and mid young drivers than the others.

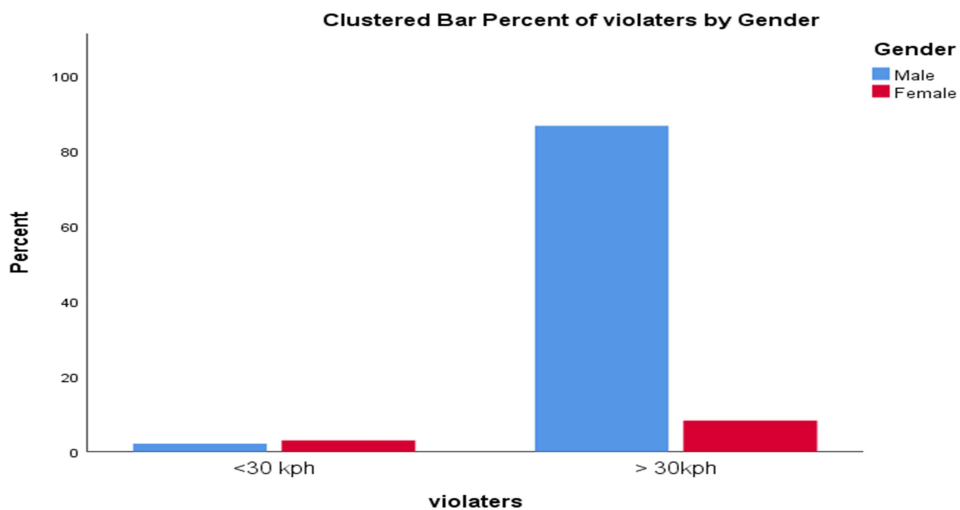


Figure 4.15: Cluster Bar percent of Gender of Drivers by Violaters at 30Km/hr. PSL

As shown in the graph regarding Gender of drivers versus speeding at 30 km/hr PSL there is high violation of speed by Male drivers than Female.

4.3.2. Vehicle composition and sample size for 40 km/hr. posted speed limit.

From SPSS data sheet using cross tabulation and cluster bar chart, a total of 600 vehicles' spot speeds were gathered at 40Km/hr. PSL. The table below provides a summary of variables and spot speed violation.

- ✓ Drivers who comply with the PSL are non-violators (having spot speed of < 40Km/hr.)
- ✓ Drivers who exceed the PSL are violators (having spot speed of >40Km/hr.)

Table 4.15: Cross tabulation of variables with speed compliance and violation at 40Km/hr. PSL

Variables		None violators VS violators				Total	
		<40 km/hr.		> 40km/hr.			
		Count	%	Count	%	Count	%
Land use	institutional	25	15	75	17.3	100	16.7
	Residential	32	19.2	68	15.7	100	16.7
	Commercial	11	65.9	290	67	400	66.7
Total		167	100	433	100	600	100
Types of Road	Arterial	77	46.1	223	51.5	300	50
	Sub Arterial	90	53.9	210	48.5	300	50
Total		167	100	433	100	600	100
Plate Code No	Code 1	0	0	10	2.3	10	1.7
	Code 2	64	38.3	127	29.3	191	31.8
	Code 3	98	58.7	252	58.2	350	58.3
	Code 4	5	3	337	8.5	42	7
	Code 5	0	0	7	1.6	7	1.2
Total		167	100	433	100	600	100
Type of Vehicle	Passenger	131	78.4	248	57.3	379	63.2
	Mini - Bus	4	2.4	103	23.8	107	17.8
	Bus	10	6	38	8.8	48	8
	Truck	22	13.2	44	10.2	66	11
Total		167	100	433	100	600	100
Age of Drivers	Young (18-35)	50	29.9	253	58.4	303	50.5
	Mid young(36-49)	81	48.5	150	34.6	231	38.5
	Old (>50)	36	21.6	30	6.9	66	11
Total		167	100	433	100	600	100
Gender of Drivers	Male	110	65.9	407	94	517	86.2
	Female	57	34.1	26	6	83	13.8
Total		167	100	433	100	600	100

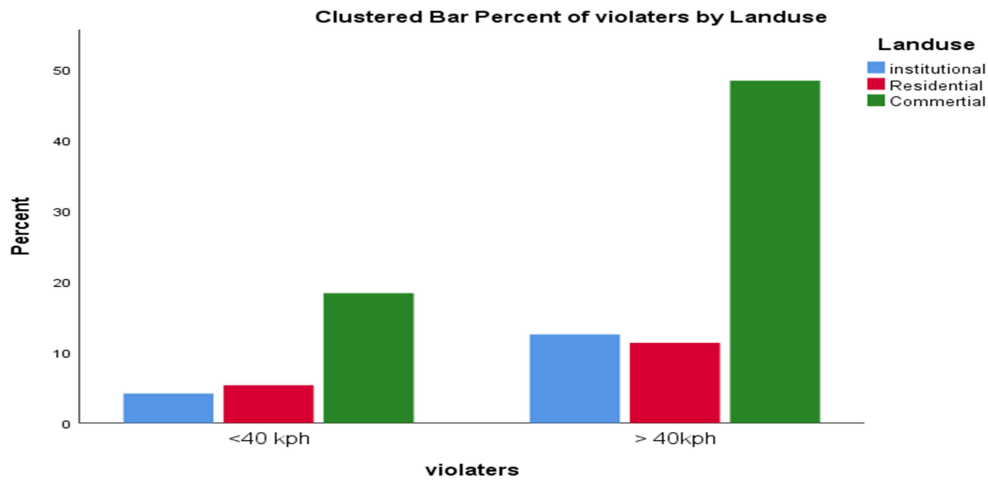


Figure 4.16: Cluster Bar percent of Land use by Violaters at 40Km/hr. PSL

As shown in the graph regarding the land use the versus speeding at 40 km/hr PSL there is high violation of speed on commercial areas than the others and also on residential areas also highly affected by speed violation.

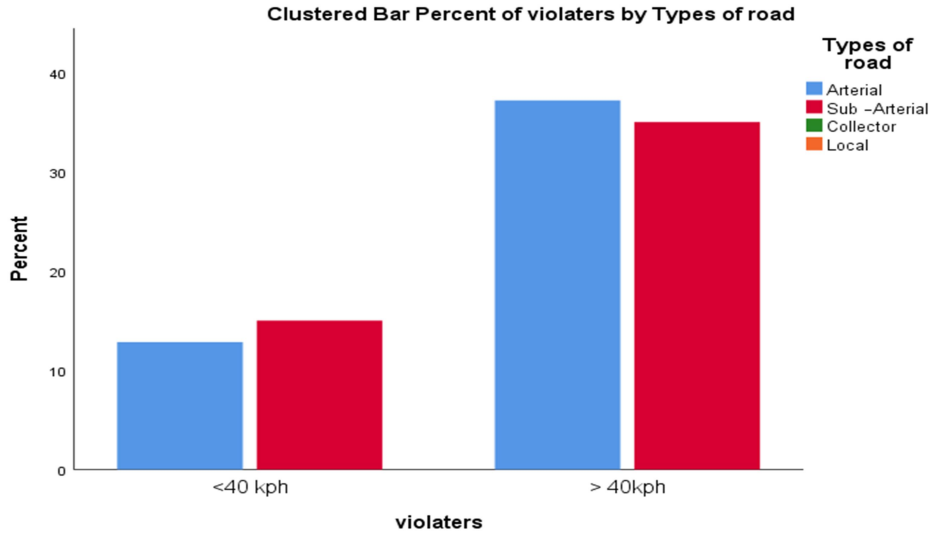


Figure 4.17: Cluster Bar percent of Types of road by Violaters at 40Km/hr. PSL

As shown in the graph regarding the Types of road versus speeding at 40 km/hr PSL there is high violation of speed on both Sub arterial roads and Arterial than the others.

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

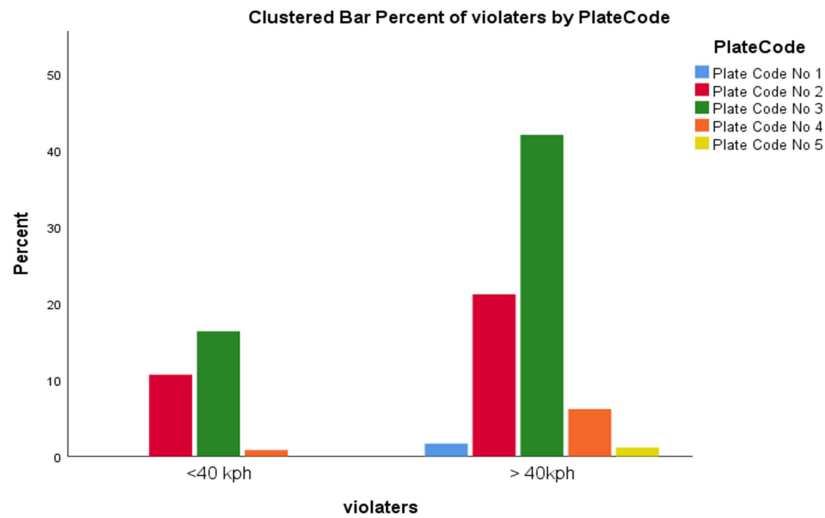


Figure 4.18: Cluster Bar percent of Plate Code by Violators at 40Km/hr. PSL

As shown in the graph regarding the Plate code versus speeding at 40 km/hr PSL there is high violation of speed by drivers of Plate code no.3 which are commercial drivers this shows that the commercial area need emphasis regarding speed violation than the others.

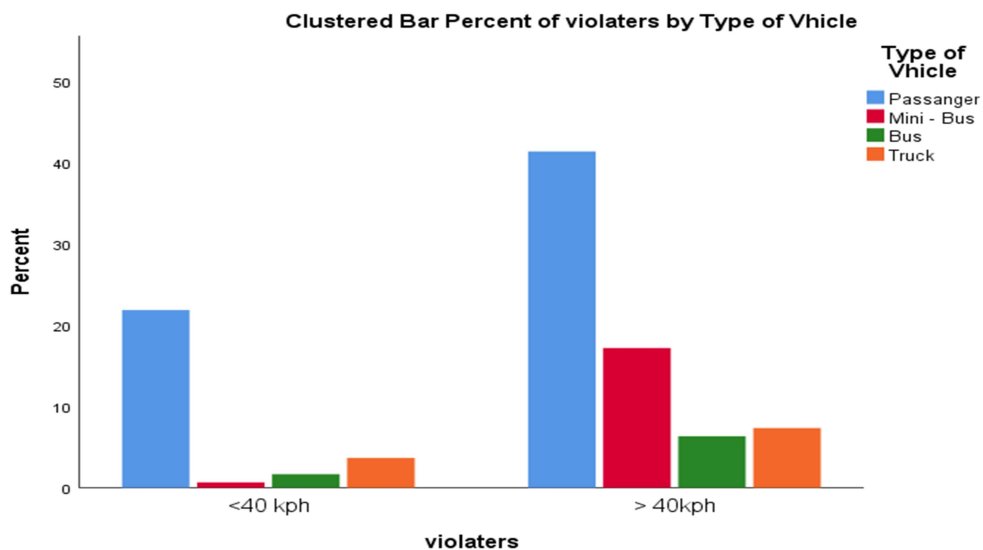


Figure 4.19: Cluster Bar percent of Type of Vehicle by Violators at 40Km/hr. PSL

As shown in the graph regarding the types of vehicle versus speeding at 40 km/hr PSL there is high violation of speed by drivers of passenger car than the others.

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

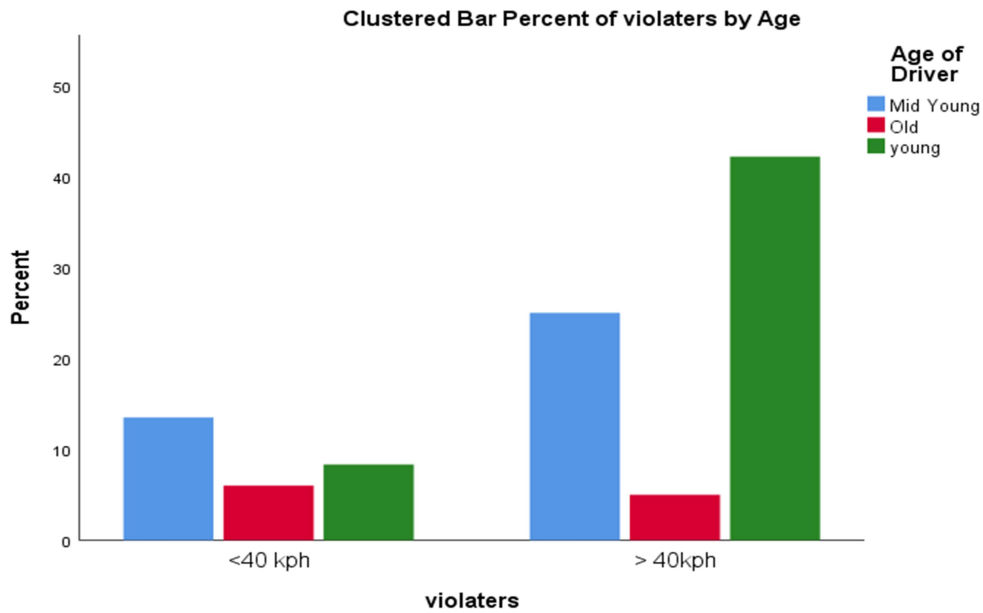


Figure 4.20: Cluster Bar percent of Age of Drivers by Violators at 40Km/hr. PSL

As shown in the graph regarding age of drivers versus speeding at 40 km/hr PSL there is high violation of speed by young drivers and mid young drivers than the others.

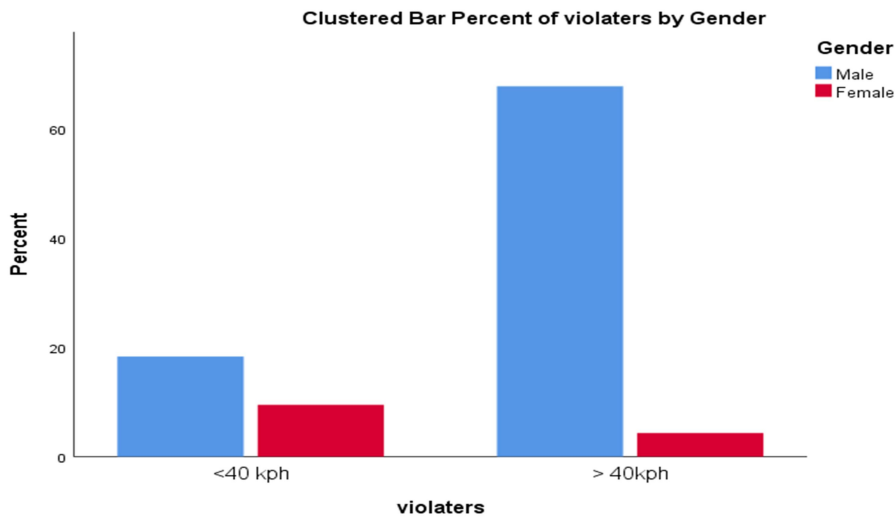


Figure 4.21: Cluster Bar percent of Gender of Drivers by Violators at 40Km/hr. PSL

As shown in the graph regarding Gender of drivers versus speeding at 40 km/hr PSL there is high violation of speed by Male drivers than Female.

4.3.3. Vehicle composition and sample size for 50 km/hr. posted speed limit.

From SPSS data sheet using cross tabulation and cluster bar chart, a total of 900 vehicles' spot speeds were gathered at 50Km/hr. PSL. The table below provides a summary of variables and spot speed violation.

- ✓ Drivers who comply with the PSL are non-violators (having spot speed of < 50Km/hr.)
- ✓ Drivers who exceed the PSL are violators (having spot speed of >50Km/hr.)

Table 4.16: Cross tabulation of variables with speed compliance and violation at 50Km/hr. PSL

Variables		None violators VS violators				Total	
		<50 km/hr.		> 50km/hr.			
		Count	%	Count	%	Count	%
Land use	institutional	135	42.9	265	45.3	400	44.4
	Residential	109	34.6	91	15.6	200	22.2
	Commercial	71	22.5	229	39.1	300	33.3
Total		315	100	585	100	900	100
Types of Road	Arterial	67	21.3	233	39.8	300	33.3
	Sub Arterial	248	78.7	352	60.2	600	66.7
Total		315	100	585	100	900	100
Plate Code No	Code 1	11	3.5	21	3.6	32	3.6
	Code 2	139	44.1	130	22.2	269	29.9
	Code 3	136	43.2	376	64.3	512	56.9
	Code 4	20	6.3	51	8.7	71	7.9
	Code 5	9	2.9	7	1.2	16	1.8
Total		315	100	585	100	900	100
Type of Vehicle	Passenger	229	72.7	347	59.3	576	64
	Mini - Bus	22	7	113	19.3	135	15
	Bus	10	3.2	28	4.8	38	4.2
	Truck	54	17.1	97	16.6	151	16.8
Total		315	100	585	100	900	100
Age of Drivers	Young (18-35)	81	25.9	345	59.2	426	47.5
	Mid young(36-49)	124	39.6	189	32.4	313	34.9
	Old (>50)	108	34.5	49	8.4	157	17.5
Total		315	100	585	100	900	100
Gender of Drivers	Male	227	73.2	556	95.5	783	87.8
	Female	83	26.8	26	4.5	109	12.2
Total		315	100	585	100	900	100

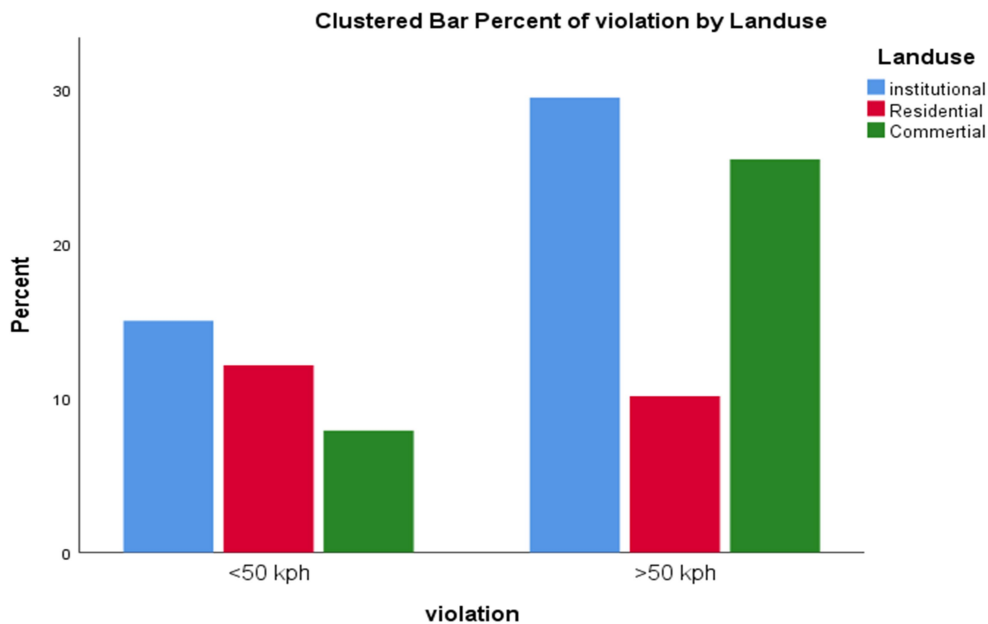


Figure 4.22: Cluster Bar percent of Land use by Violators at 50Km/hr. PSL

As shown in the graph regarding the land use the versus speeding at 50 km/hr PSL there is high violation of speed on institutional areas than the others and also on residential areas also highly affected by speed violation.

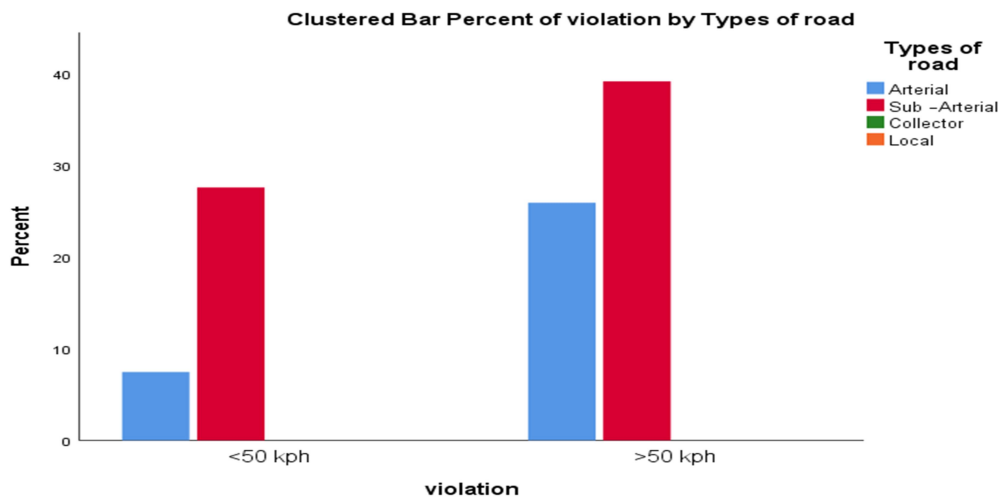


Figure 4.23: Cluster Bar percent of Types of road by Violators at 50Km/hr. PSL

As shown in the graph regarding the Types of road versus speeding at 50 km/hr PSL there is high violation of speed on both Sub arterial roads and Arterial than the others.

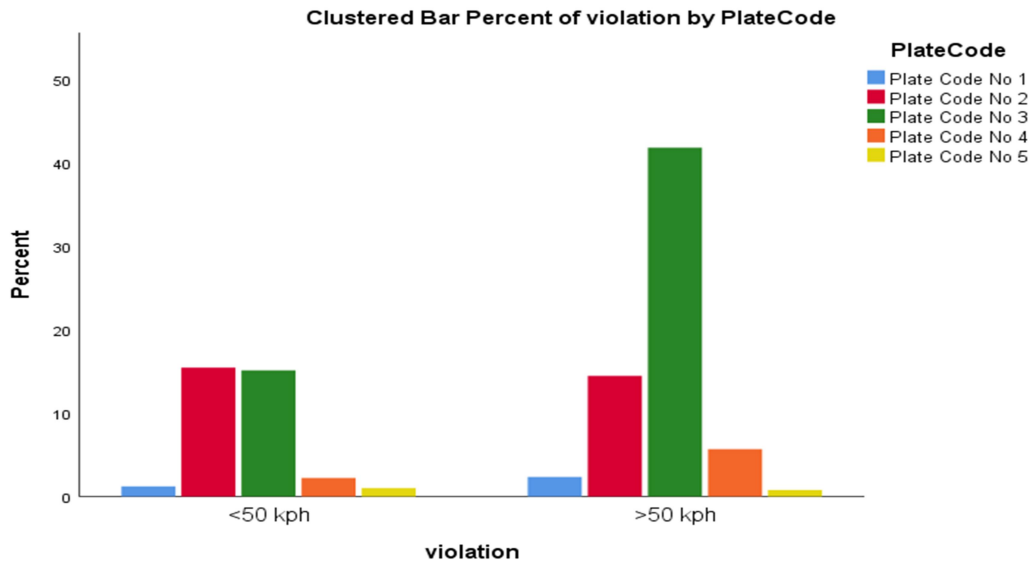


Figure 4.24: Cluster Bar percent of Plate Code by Violators at 50Km/hr. PSL

As shown in the graph regarding the Plate code versus speeding at 50 km/hr PSL there is high violation of speed by drivers of Plate code no.3 which are commercial drivers this shows that the commercial area need emphasis regarding speed violation than the others.

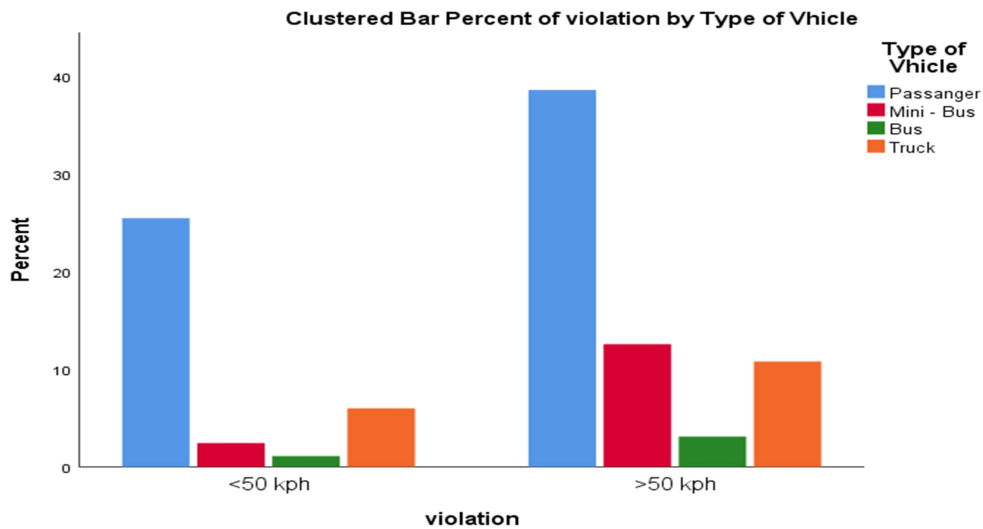


Figure 4.25: Cluster Bar percent of Type of Vehicle by Violators at 50Km/hr. PSL

As shown in the graph regarding the types of vehicle versus speeding at 50 km/hr PSL there is high violation of speed by drivers of passenger car than the others.

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

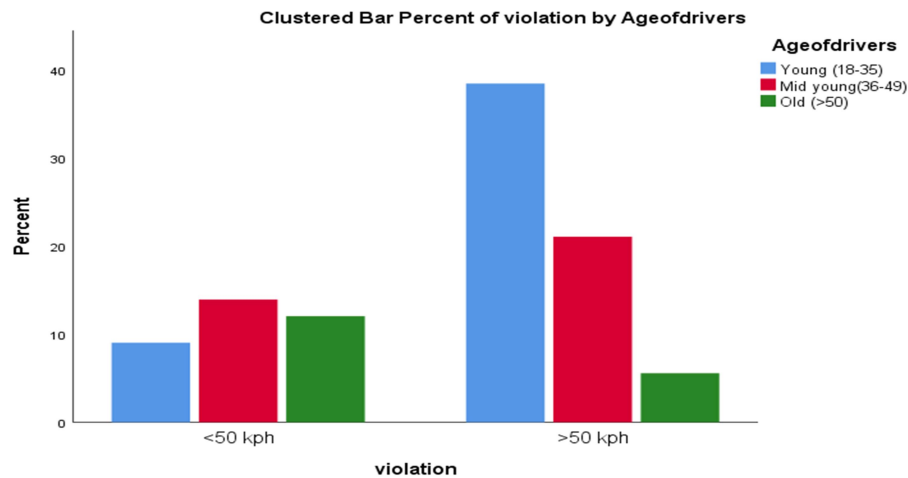


Figure 4.26: Cluster Bar percent of Age of Drivers by Violators at 50Km/hr. PSL

As shown in the graph regarding age of drivers versus speeding at 40 km/hr PSL there is high violation of speed by young drivers and mid young drivers than the others.

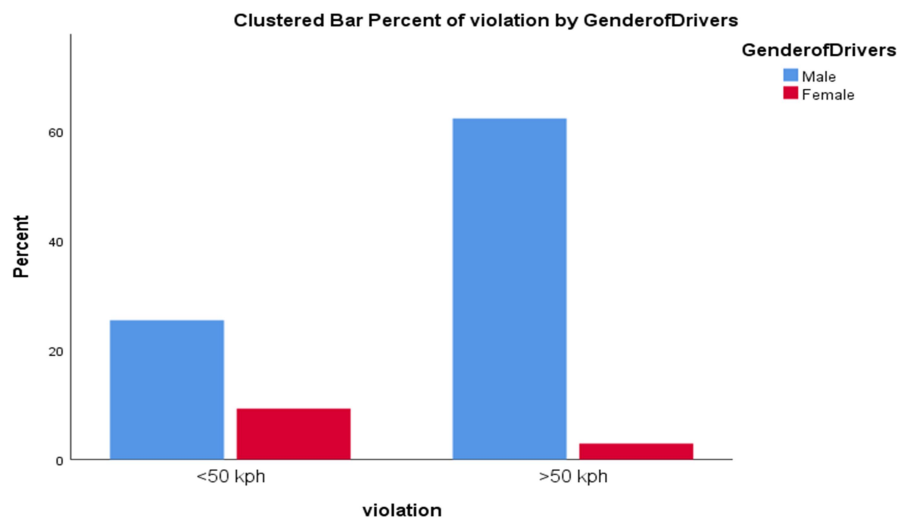


Figure 4.27: Cluster Bar percent of Gender of Drivers by Violators at 50Km/hr. PSL

As shown in the graph regarding Gender of drivers versus speeding at 40 km/hr PSL there is high violation of speed by Male drivers than Female.

As a result of the preceding narrative, the degree of compliance in residential areas decreases as the PSL decreases, whereas violations of the PSL in commercial areas increase as the PSL increases. Regarding the driver's compliance on different types of roads, there is a higher violation of the PSL on arterial roads than on sub-arterial roads in all types of PSL. And also, drivers' compliance on collector roads is low compared to other types of roads. Plate No. 1 and 3 are commercial drivers, which violate the PSL more than others. On the other hand,

plate No. 4, which is government, also does not comply with the PSL at 40 km/hr. and 50 km/hr. Passenger cars and buses comply with the PSL, and trucks also violate the PSL by a minimum. However, minibuses have a high percentage of violations on every PSL. This data has been gathered by guessing the age of drivers by setting out the intervals of young (18–35), mid-young (36-49), and old (>50). In this regard, on every PSL, young drivers violate the PSL while older drivers have complied with the speed limit. Female drivers comply with the posted speed limit more than male drivers.

4.4. Drivers attitudinal survey analysis

Comparison of mean for Likert data and also ordinary logistic regression has been conducted in this section.

4.4.1. Mean Comparison of the Likert question.

In this section, a mean comparison was conducted for causes of speeding as per the driver's perspective, compliance of drivers with the speed limit, intention of drivers, and also commercial drivers. The mean comparison has been done using the following interval for 5-scale and 4-scale Likert data, as shown below:.

Table 4.17 Mean value for 5 scale likert answers

5 scale likert		Mean value
Always the Cause	Strongly Agree	1-1.8
Most of the time the Cause	Agree	1.9-2.6
Sometimes the Cause	I have no idea	2.7-3.4
Rarely the Cause	Disagree	3.5-4.2
Not all is the Cause	Strongly Disagree	4.3-5

Table 4.18 Mean value for 4 scale likert answers

4 scale likert	Mean value
Strongly Agree	1-1.75
Agree	1.85-2.5
Disagree	2.6-3.25
Strongly Disagree	3.35-4.0

4.4.2. Mean comparison Causes of speeding as per driver perspective

Table 4.19 Descriptive statics for causes of speeding as per driver perspective

	Variable	Variable description	SPSS Coding	Frequency	Percent	Mean	Standard dev.
causes of speeding as per driver perspective							
1.	Don't realize how fast you are going	Always the Cause	1	37	9.2	2.93	1.039
		Most of the time the Cause	2	89	22.2		
		Sometimes the Cause	3	171	42.6		
		Rarely the Cause	4	73	18.2		
		Not all is the Cause	5	31	7.7		
2.	Have an emergency	Always the Cause	1	41	10.2	2.92	1.067
		Most of the time the Cause	2	90	22.4		
		Sometimes the Cause	3	162	40.4		
		Rarely the Cause	4	76	19		
		Not all is the Cause	5	32	8		
3.	Have a broken speedometer	Always the Cause	1	21	5.2	4.63	1.027
		Most of the time the Cause	2	5	1.2		
		Sometimes the Cause	3	23	5.7		
		Rarely the Cause	4	4	1		
		Not all is the Cause	5	348	86.8		
4.	Speed out of habit	Always the Cause	1	25	6.2	3.47	1.116
		Most of the time the Cause	2	34	8.5		
		Sometimes the Cause	3	158	39.4		
		Rarely the Cause	4	94	23.4		
		Not all is the Cause	5	90	22.4		
5.	Time is money	Always the Cause	1	53	13.2	2.97	1.164
		Most of the time the Cause	2	69	17.2		
		Sometimes the Cause	3	169	41.9		
		Rarely the Cause	4	61	15.2		
		Not all is the	5	50	12.5		

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

	Variable	Variable description	SPSS Coding	Frequency	Percent	Mean	Standard dev.
		Cause					
6.	You are drunk or high on drugs	Always the Cause	1	10	2.5	3.8	1.069
		Most of the time the Cause	2	33	8.2		
		Sometimes the Cause	3	119	29.7		
		Rarely the Cause	4	106	26.4		
		Not all is the Cause	5	133	33.2		
7	If the traffic around you is going faster than the speed limit	Always the Cause	1	9	2.2	3.59	1.083
		Most of the time the Cause	2	49	12.2		
		Sometimes the Cause	3	149	37.2		
		Rarely the Cause	4	84	20.9		
		Not all is the Cause	5	110	27.4		
8.	When there is no Radar on the area	Always the Cause	1	10	2.5	3.24	1.042
		Most of the time the Cause	2	86	21.4		
		Sometimes the Cause	3	169	42.1		
		Rarely the Cause	4	71	17.7		
		Not all is the Cause	5	65	16.2		
9.	When there is no traffic police around	Always the Cause	1	86	21.4	2.59	1.178
		Most of the time the Cause	2	108	26.9		
		Sometimes the Cause	3	118	29.4		
		Rarely the Cause	4	62	15.5		
		Not all is the Cause	5	27	6.7		
10.	There is no pedestrian on the road	Always the Cause	1	66	16.5	2.54	1.131
		Most of the time the Cause	2	164	40.9		
		Sometimes the Cause	3	85	21.2		
		Rarely the Cause	4	59	14.7		
		Not all is the Cause	5	27	6.7		

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

As indicated above the lower the mean the cause for speeding is most of the time the reason from the above value of mean reason no 9 and 10 are most of the time causes and reason 1, 2, 5 and 8 are sometimes cause for speeding which is also indicated by bar chart below

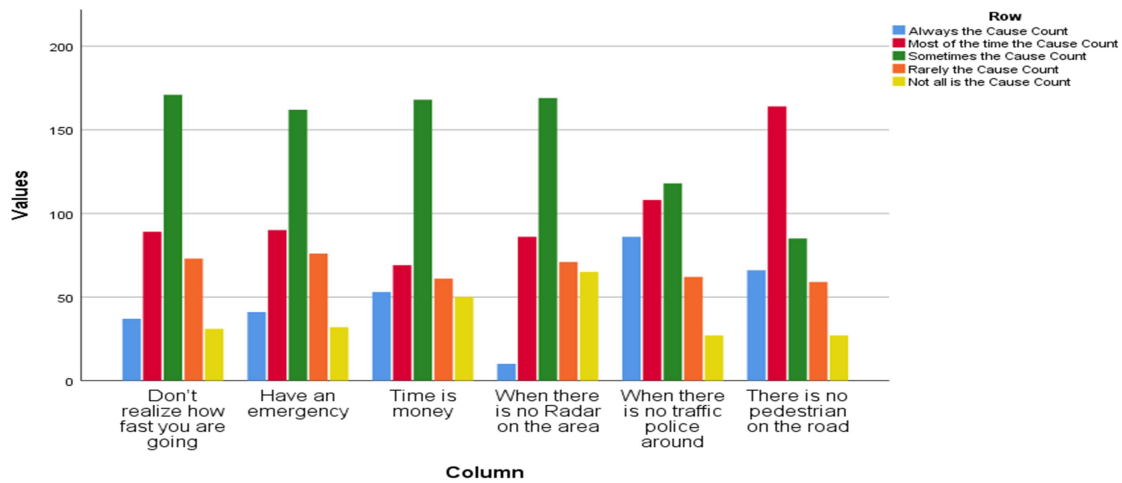


Figure 4.28: Bar chart for causes of speeding as per driver perspective

4.4.3. Mean comparison Compliance of drivers with the speed limit

Table 4.20: Descriptive statics for Compliance of drivers with the speed limit

	Variable	Variable description	SPSS Coding	Freque ncy	Percent	Mean	Stand ard dev.
Compliance of drivers with the speed limit							
C1	The likelihood of becoming involved in a collision is decreased by obeying the speed limit?	Strongly Agree	1	192	47.9	1.6	0.711
		Agree	2	193	48.1		
		I have no idea	5	7	1.7		
		Disagree	3	8	2		
		Strongly Disagree	4	1	0.2		
C2	Valuing the maximum speed limit makes you drive in a more comfortable way?	Strongly Agree	1	106	26.4	2.06	0.887
		Agree	2	192	47.9		
		I have no idea	5	13	3.2		
		Disagree	3	89	22.2		
		Strongly Disagree	4	1	0.2		
C3	As long as you drive carefully, going over the speed limit is acceptable?	Strongly Agree	1	22	5.5	2.26	0.697
		Agree	2	291	72.6		
		I have no idea	5	0	0		
		Disagree	3	51	12.7		
		Strongly Disagree	4	37	9.2		
C4	I could get to my destination	Strongly Agree	1	9	2.2	2.25	0.648
		Agree	2	318	79.3		

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

	Variable	Variable description	SPSS Coding	Frequency	Percent	Mean	Standard dev.
	faster if I went over the speed limit?	I have no idea	5	0	0		
		Disagree	3	37	9.2		
		Strongly Disagree	4	37	9.2		
C5	I always check the speed limit of the road while driving?	Strongly Agree	1	150	37.4	2.74	0.646
		Agree	2	210	52.4		
		I have no idea	5	0	0		
		Disagree	3	35	8.7		
		Strongly Disagree	4	6	1.5		
C6	Do you think the posted speed limit is too low on freeways?	Strongly Agree	1	105	26.2	2.08	0.951
		Agree	2	207	51.6		
		I have no idea	5	13	3.2		
		Disagree	3	54	13.5		
		Strongly Disagree	4	22	5.5		
C7	How much do you think you exceed the posted speed limit in Km/hr. while driving?	Never exceed PSL	1	29	7.2	2.08	0.906
		10Km/hr	2	178	44.4		
		20 Km/hr	3	99	24.7		
		30Km/hr.	4	95	23.7		
		>30Km/hr.	5	0	0		

As indicated above, the lower the mean, the stronger the agreement of drivers for compliance. From the above value of the mean, reason no. 1 strongly agrees that the likelihood of becoming involved in a collision is decreased by obeying the speed limit. As shown in the chart below

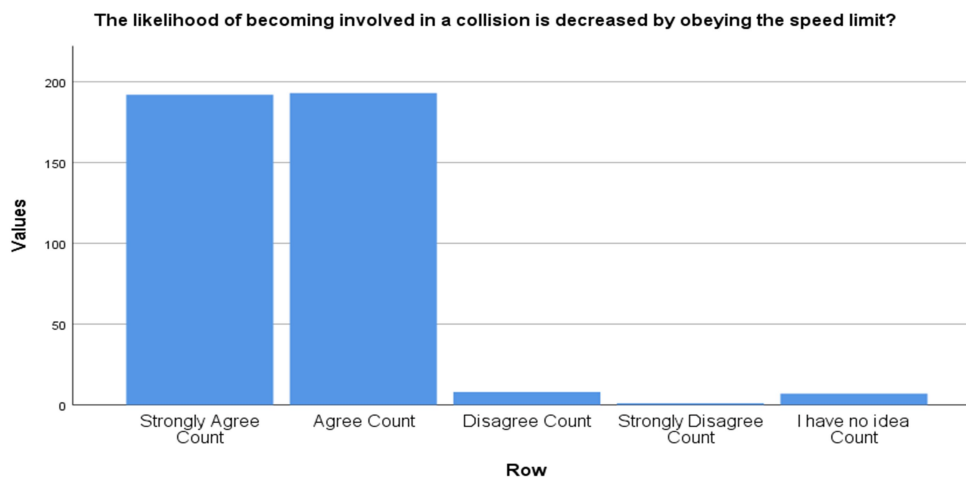


Figure 4.29: Bar Chart for the likelihood of becoming involved in a collision is decreased by obeying the speed limit

4.4.4. Mean comparison Intention of drivers

Table 4.21: Descriptive statics for Intention of drivers

	Variable	Variable description	SPSS Coding	Freque ncy	Percent	Mean	Stand ard dev.
Intention of drivers							
I1	I intend to drive within the speed limit on Addis Ababa roads?	Strongly Agree	1	48	12	2.52	0.696
		Agree	2	137	34.2		
		Disagree	3	216	53.9		
		Strongly Disagree	4	0	0		
I2	I intend to drive within the speed limit on freeway of Addis Ababa roads?	Strongly Agree	1	27	6.7	3.06	0.94
		Agree	2	84	20.9		
		Disagree	3	127	31.7		
		Strongly Disagree	4	163	40.6		

As shown above, most drivers disagree with driving within the speed limit on Addis Ababa roads; however, on the freeways of Addis Ababa, the mean value shows that they refuse the posted speed limit on the freeways of the city.

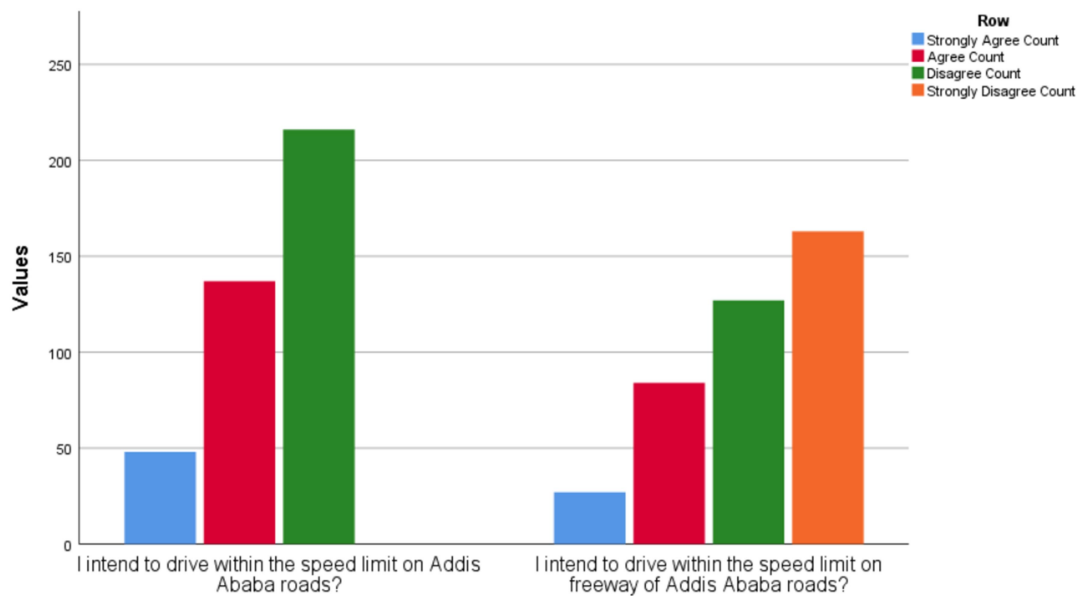


Figure 4.30: Bar chart for intention of drivers to comply with the speed limit

4.4.5. Mean comparison for commercial drivers

This question was collected from drivers who are employed by the owners of the vehicle, not the company, with a daily basis income of above ETB 500 birr and who have no monthly salary, no employment agreement, and no annual leave.

Table 4.21: Descriptive statics for commercial drivers

	Variable	Variable description	SPSS Coding	Frequency	Percent	Mean	Stand ard dev.
For commercial drivers							
1	Do you think you're per day income affect violating the speed limit?	Strongly Agree	1	74	38.3	1.71	0.644
		Agree	2	103	53.4		
		Disagree	3	14	7.3		
		Strongly Disagree	4	2	1		
2	Do you think complying with the speed limit affect your daily income?	Strongly Agree	1	60	31.1	1.77	0.565
		Agree	2	118	61.1		
		Disagree	3	14	7.3		
		Strongly Disagree	4	1	0.5		

As shown above per day income affects violating the speed limit and most of the commercial drivers understand that complying with the PSL affect their per day income.

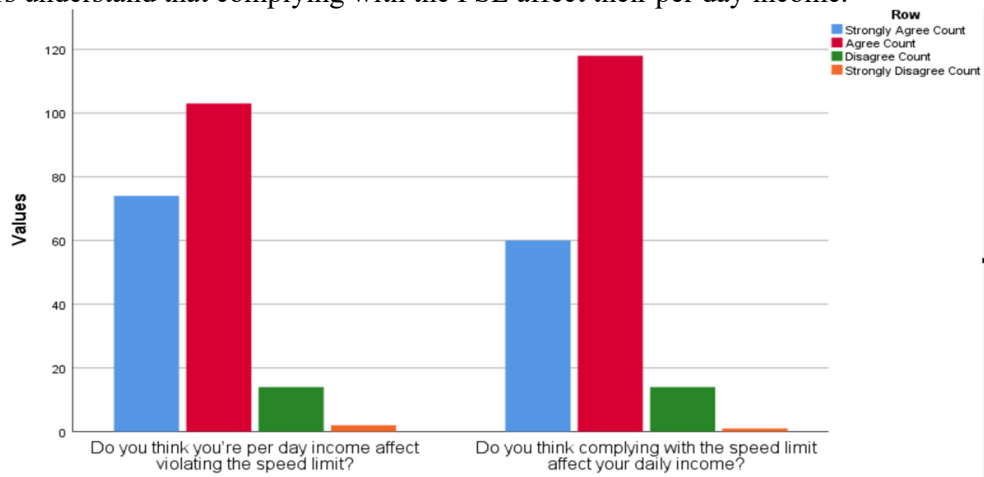


Figure 4.31: Bar chart for commercial driver's effect of income and compliance to speed limit

4.5. Ordinal Logistic regression model for self-reported violation of the speed limit

For self-reported violations of the speed limit, ordinary logistic regression has been conducted with a categorical dependent variable that is ordered from very high violations (> 30 km/h) , high violations (20–30 km/h) and low violations (never exceeding the speed limit). Before going to the analysis, the following assumptions should be fulfilled: Measurement of your dependent variable ought to be done at the ordinal level.

1. The first assumption is fulfilled because our dependent variable self-reported violation of the posted speed limit is ordered from very high violation(>30Km/hr.) , high violation(20-30 Km/hr.) ,Mediums Violation (10-20 Km/hr.) a Low Violation (Never exceed the speed limit)
2. Odds ratio should be satisfied that the effect of the predictors on the odds of falling in to higher or lower verses category on the dependent variable is the same across categories

To check this assumption using SPSS, we run the ordinal regression by using self-reported violations of the posted speed limit as the dependent variable and independent categorical variables as follows:

Table 4.22: Independent variable description for Ordinal Logistic regression model

Variable	Variable description	SPSS Coding
Driver age	Very young (18-24) Years	1
	Young (25-35) Years	2
	Mid young(35-50) Years	3
	Old >50 Years	4
Gender	Male	1
	Female	2
Driving experience	<5 Years	1
	(5-10) Years	2
	(10-15) Years	3
	>15 Years	4
Marital Status	Single	1
	Married	2
Educational Level	<High school	1
	High school	2
	Diploma	3
	Degree and above	4

Variable	Variable description	SPSS Coding
Vehicle ownership	Self-Owned	1
	Private Company	2
	GOV	3
	Private person Owned	4

Table 4.23: Model fitting information

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	900.364			
Final	423.723	476.641	14	.000

As shown in the above table, the model fit is significant, and we need a non-significant test result from the test of parallel lines to prove that the assumption of proportional odds is met, meaning the effect of the independent variable on the cumulative probability of falling into a higher category does not vary across categories on the dependent variable. in this output, $P = 0.125$.

3. Multicollinearity does not exist. When there is a strong correlation between two or more independent variables, this is known as multicollinearity. Due to these challenges, it becomes difficult to identify the variable that helps to explain the dependent variable and technical difficulties arise when computing an ordinal regression.

To check this assumption first we have to change the independent variables to dummy variables so that the SPSS can check for collinearity.

Table 4.24: Dummy variables for type of road

Type of road	D1	D2	D3	D4
(18-24) Years	1	0	0	0
(25-35) Years	0	1		0
(35-50) Years	0	0	1	0
>50 Years	0	0	0	0

Table 4.25: Dummy variables for gender of drivers

Gender	D1	D2
Male	1	0
Female	0	1

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Table 4.26: Dummy variables for driving experience

Driving experience	D1	D2	D3	D4
<5 Years	1	0	0	0
(5-10) Years	0	1		0
(10-15) Years	0	0	1	0
>15 Years	0	0	0	0

Table 4.27: Dummy variables for driver’s marital status

Marital Status	D1	D2
Single		1
Married		0

Table 4.28: Dummy variables for driver’s educational level

Educational Level	D1	D2	D3	D4
<High school	1	0	0	0
High school	0	1		0
Diploma	0	0	1	0
Degree	0	0	0	0

Table 4.29: Dummy variables for driver’s Vehicle ownership

Vehicle ownership	D1	D2	D3	D4
Self-Owned	1	0	0	0
Private Company	0	1		0
GOV	0	0	1	0
Private person Owned	0	0	0	0

After this we run linear regression to find the collinearity between independent variables as shown on the table below

Table 4.30: Linear regression for collinearity

		Collinearity Statistics	
		Tolerance	VIF
Model	18-24	.199	5.014
	35-50	.269	3.712
	>50	.243	4.123
	Female	.752	1.329
	Dex1	.270	3.704
	Dex3	.236	4.231
	Dex4	.286	3.494
	Single	.435	2.297

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Coefficients

Model	Collinearity Statistics	
	Tolerance	VIF
Less than high school	.951	1.051
Diploma	.704	1.420
Degree	.795	1.257
Self-owned	.420	2.381
Private	.611	1.637
Private self-owned	.447	2.235

a. Dependent Variable: self-reported violation

There is no multicollinearity problem in the data because the tolerance value is less than 10% and the value of VIF is also less than 10. After the assumption of ordinal logistic regression is met, generalized linear regression is done for ordinal logistic regression, and the output is as follows:

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

Table 4.31: Parameter estimates for Ordinal Logistic regression model

		Parameter Estimates									
Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	[self reported violation =1]	-.353	.8214	-1.963	1.257	.185	1	.667	.702	.140	3.513
	[self reported violation =2]	5.106	.9058	3.331	6.881	31.780	1	.000	165.031	27.962	973.996
	[self reported violation =3]	8.003	.9620	6.118	9.889	69.216	1	.000	2990.700	453.879	19706.315
	[Age of Drivers=1]	-.991	1.0595	-3.067	1.086	.874	1	.050	.371	.047	2.962
	[Age of Drivers=2]	-2.167	.9255	-3.981	-.353	5.482	1	.019	.115	.019	.703
	[Age of Drivers=4]	0 ^a	.	.	.	.	.	.	1	.	.
	[Gender of Drivers=1]	4.505	.5280	3.471	5.540	72.823	1	.000	90.513	32.159	254.751
	[Gender of Drivers=2]	0 ^a	.	.	.	.	.	.	1	.	.
	[Drivers driving Expriance=1]	3.662	1.1241	1.459	5.866	10.615	1	.001	38.955	4.302	352.716
	[Drivers driving Expriance=2]	3.262	1.0607	1.183	5.341	9.457	1	.002	26.100	3.264	208.698
	[Drivers driving Expriance=3]	2.297	.9207	.492	4.101	6.224	1	.013	9.944	1.636	60.426
	[Drivers driving Expriance=4]	0 ^a	.	.	.	.	.	.	1	.	.
	[Marital status of driver=1]	2.767	.3812	2.020	3.514	52.677	1	.000	15.908	7.536	33.583
	[Marital status of driver=2]	0 ^a	.	.	.	.	.	.	1	.	.
	[Vehicle ownership=1]	-5.050	.5066	-6.043	-4.057	99.370	1	.000	.006	.002	.017
	[Vehicle ownership=2]	-3.007	.3903	-3.772	-2.243	59.375	1	.000	.049	.023	.106
	[Vehicle ownership=3]	-2.999	.3946	-3.772	-2.225	57.759	1	.000	.050	.023	.108

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa

[Vehicle ownership=4]	0 ^a	.	.	.	.	.	.	1	.
(Scale)	1 ^b	.	.	.	.	.	.	.	.

Dependent Variable: self-reported violation

Model: (Threshold), Age of Drivers, Gender of Drivers, Drivers driving Experience, Marital status of driver, Educational level of drivers, Vehicle ownership

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.

Table 4.32: Goodness-of-Fit for Ordinal Logistic regression model

Z

Goodness-of-Fit			
	Chi-Square	Df	Sig.
Pearson	1301.889	181	.000
Deviance	392.116	181	.000

Link function: Logit.

Table 4.33: Pseudo R-Square for Ordinal Logistic regression model

Pseudo R-Square	
Cox and Snell	.695
Nagelkerke	.759
McFadden	.480

Link function: Logit.

As shown above the model is good fit and also as per the value of Nagelkerke R square =0.759 that explain that the independent variables explain the dependent variable about 75.9%. Most of the variables have significant value except educational levels. Any ordinal regression represents a succession of binomial logistic regression. If the dependent variable has k categories, it is cumulatively split into K-1 binomial variables.

1. Very high violation (>30Km/hr.) ,
2. High violation (20-30 Km/hr.) ,
3. Mediums Violation (10-20 Km/hr.) and
4. Low Violation (Never exceed the speed limit)

The first dichotomous variable (very high violation (>30Km/hr.)) separates the case in the first category of the dependent variable (1) from the other (2, 3, & 4). The second binomial variable (high violation (20-30 Km/hr.)) separate the cases in the first two categories of the dependent variables (1 & 2) from the others (3&4) finally, the last binomial variable (k-1) separates the cases in the first k-1 categories of the dependent variable (1,2,3.....K-1) from the last one. B value and odds ratio value Exp(B) determine the model as follows

- ✓ For instance the gender and marital status of drivers category

Table 4.34: Parameter estimates for gender and marital status of drivers

Category	B	Exp(B)
Male	4.505	90.153
Female	-4.505(0-4.505)	0.011 ($e^{-4.505}$)
Single	2.767	15.908
Married	-2.767	0.063

This explains that the odds that male drivers violate the speed limit are 90.153 times higher than the same odds for female drivers. The probability of male drivers violating the speed limit is 98 % ($90.153 / (1+90.153)$) and the probability of female drivers not violating the speed limit is 2% lower than female drivers. On the other hand, the odds that a female driver violates the speed limit are 90.153 times lower than the same odds for male drivers. The probability of male drivers to violate the speed limit 1.08 % and the probability not violating the speed limit is 98.92 % than male drivers. The result of this analysis demonstrates that

females perceive speed risk as being larger and are more willing to drive slowly than speed because they have more responsibility for taking care of the family and also have economic influence in the city of Addis Ababa. Similar research in other countries also confirms that (Dan Zhaol, (2019; Do Duy Din, Hisashi Kubota,(2012)) female drivers tended to speed less frequently than male drivers.

Regarding the marital states of drivers, the results indicate that the odds that single drivers violate the speed limit are 15.9 times higher than the same odds for married drivers. The probability of single drivers violating the speed limit is 94 % and the probability of married drivers not violating the speed limit is 6%. On the other hand, the odds that a married driver violates the speed limit are 15.9 times lower than the same odds for male drivers. Male drivers have a 5.93% chance of exceeding the speed limit, while female drivers have a 94.07% chance of not exceeding the speed limit. This indicates that married drivers owed their lives to another person and that most of the families in the city relied on the income generated by the man of the household. Therefore, those responsibilities are the main reasons why married drivers' violations are lower than those of single drivers.

The odds of violating the speed limit for very young, young, and mid young drivers are 0.371, 0.1155, and 0.582 greater than those of the old drivers, and the probability that very young, young, and mid-young drivers violate the speed limit is 27%, 10%, and 37%, respectively. This result also aligns with the outcome of every PSL; young drivers violate the PSL while older drivers have complied with the speed limit. Young drivers lack experience and responsibility, so they tend to violate the speed limit more than older ones. In another similar study, it was discussed that younger drivers were found to surpass speed limits faster than other drivers (Deery AH, 1999).

For the categorical variable driving experience, drivers who have < 5 years' experience, (5–10) years of driving experience, and (5–10) years of driving experience have the odds of violating the speed limit of 38.955, 26.1, and 9.944, respectively, higher than those who have >15 years of driving experience, and the probability of violating the speed limit is also 97%, 96%, and 91%. This indicates that the longer a driver has experience, the less likely he is to violate the speed limit. However, this finding argues with the finding of Dan Zhaol, (2019) that the longer the driving skill, the greater the probability of violation of speed. However, the study was done in other countries, and in Addis Ababa, the longer the experience the driver

has, the older the driver becomes, and also the more responsible he becomes. Therefore, it is clear that the more experienced the driver, the less likely he is to be a speed violator.

For this model, educational qualifications and ownership of a vehicle are not significant. This indicates that educational level has no effect on violations of the speed limit, which is concerning when the level of education is getting higher and the understanding of the effect of speed on road safety should be higher. On the other hand, it is a good implication that whether a driver owns the vehicle or not, it has less effect on the type of violation of the speed limit. Therefore, drivers do not keep in mind that they don't own or control the vehicle while speeding.

4.6. Discussion

According to the findings of this thesis, the main factors influencing a road section's average speed are pedestrian walkway width, parking density, number of lanes, and pavement surface conditions. The width of pedestrian walkways increases along city freeways with a low volume of pedestrians, while the volume of pedestrians is higher but the width is narrow, which should be the opposite. In the presence of parked cars, which effectively reduced the width of the road and led to lowering the average speed of vehicles in a section by making it impossible for drivers to maneuver another vehicle freely, which is similar findings when compared to Edquist, J., 2012 and Fitzpatrick, K., 2002. Speeds were slower when parking was allowed on the street. In line with expectations, adding lanes allows for more flexibility in the driver's choice of speed and the tendency of wet pavement to slow down traffic is high due to skid resistance and a lack of confidence that drivers have control of the vehicles, which is similar to the finding of (Kockelman, K.M. and Ma, J., 2007).

It has been found that young and inexperienced drivers violate the posted speed limit. As a result, it is clear that the experienced driver's speed violations decrease, which contradicts Dan Zhaol's (2019) finding that the longer the driving skill, the greater the probability of speed violations. Married drivers owed their lives to another person's existence, and most of the families in the city relied on the income generated by the man of the household. Therefore, those responsibilities are the main reasons why married drivers' violations are lower than those of single drivers. Hisashi Kubota (2012) finds that female drivers tend to speed less frequently than male drivers because they have more responsibility for taking care of the family and also have economic influence in the city of Addis Ababa.

Regarding the results of the mean comparison to this Drivers, on the other hand, have intentions to obey the speed limit and understand the consequences of exceeding the speed limit; however, they do not obey the speed limit due to a lack of traffic police in the area; it is difficult to place traffic police in every section; however, increasing the penalty for violation may solve the problem, which has a similar understanding. According to (Dan Zhaol, 2019) The severity of speeding violations increases if traffic enforcement is lax. Commercial drivers with plate numbers 1 and 3 violate the PSL more than others. On the other hand, plate No. 4, which is for government vehicles, also does not comply with the PSL at 40 km/hr. and 50 km/hr. Commercial drivers agree that income affects violating the speed limit, and most commercial drivers understand that complying with the PSL affects their per day income. They will give fixed daily payments to the owner of the vehicle regardless of any reason, and the income generated above the fixed price will be given to the driver. So, in order to get both incomes, commercial drivers tend to speed in order to save time and fulfill their per day income. The pressure on drivers is high in the city.

During data collection on local roads and also sub-aerial roads, there was no posted speed limit sign placed in the areas. And also, it has been noted that there is no warning signs placed in residential areas that show the land use of the area around the road.

5. Conclusion and Recommendation

The study will come to a close in this chapter, which will summarize the major findings with regard to the objectives and research questions, as well as their importance and contribution. Additionally, it will discuss the study's limitations and suggest areas for additional investigation.

5.1. Conclusion

This study achieved the objective of the study, which was to evaluate whether the posted speed limit is acceptable to drivers or not and also factors affecting the speed of drivers while driving on Addis Ababa City roads. Therefore, to find those factors influencing speeding, this research conducted spot speed data on different types of road sections as per the AACRA manual and also a driver's attitudinal survey was distributed to different drivers in the city. The effect of different variables that influence the 50th percentile speed of a road section has been analyzed using multiple linear regressions, and drivers' compliance and self-reported speeding violations were analyzed using ordinal logistic regression. Based on the findings of the analysis,

- ✓ Pedestrian walkway width, number of lanes/dir., and pavement condition increase the average speed, which is the 50th percentile speed, while parking density decreases the average speed. On the other hand, the mean value of causes of speeding according to driver perspective on drivers' attitudinal survey (There is no pedestrian on the road) was 2.54, which is most of the time cause. The width of pedestrian walkways increases along city freeways with a low volume of pedestrians, while the volume of pedestrians is higher but the width is narrow. As per the compliance questioners, drivers strongly agree that the posted speed limit is low for freeways in the city. The number of lanes has a significant effect on the 50th percentile speed when it increases the confidence and also the ability to maneuver in a free flow of traffic. Then again, parking density decreases the 50th percentile speed, which leads to complying with the speed limit. The type of road and land use, the posted speed limit is not also a significant variable for the 50th percentile speed, which shows that there is a lack of consideration for the posted speed limit while driving on different urban roads of the city. These also imply that drivers in the city have irresponsible and uncontrolled

behavior. The 85th percentile of all sections in this study is above the posted speed limit.

- ✓ Violation of the PSL at residential area increase when the PSL increase in the other hand violation of PSL at commercial area increase as the PSL increase. Regarding the driver's compliance on different types of roads, there is a higher violation of the PSL on arterial roads than sub arterial roads in all types of PSL. And also, drivers' compliance on collector roads is also low compared to the other types of roads. Commercial drivers with plate numbers 1 and 3 violate the PSL more than others. On the other hand, plate No. 4, which is government vehicles, also does not comply with the PSL at 40 km/hr. and 50 km/hr. Commercial drivers agree that income affects violating the speed limit and most commercial drivers understand that complying with the PSL affects their per day income.
- ✓ Passenger cars and buses comply with the PSL, and trucks also violate the PSL by minimum. However, minibuses have a high percentage of violations on every PSL. On every PSL, young drivers violate the PSL while older drivers have complied with the speed limit. Female drivers comply with the posted speed limit more than males.
- ✓ One of the significant reasons for the cause of speeding is that there is no traffic police in the area rather than when there is no radar control in the area.
- ✓ In addition to this, ordinal logistic regression for self-reported violations of the speed limit explains that male drivers, single drivers more often violate the PSL than female and married drivers. Drivers who have driving experience of less than 5 years have higher violations than experienced ones.

During the research, some limitations have been noted that would have improved the output of this study, which are that the road section geometric design document and also crash data have not been included due to time and budget constraints and also due to a lack of centralized data of accidents that happened due to over speeding.

5.2.Recommendation

This study has analyzed the significant factors affecting the speed of vehicles and also drivers' acceptance of the posted speed limit on different types of roads in Addis Ababa City. Based on the study, the following recommendations are provided for the transport authority and also the traffic management of the city or other concerned bodies of the city:

- ✓ The prevailing operating speed of vehicles at all study sites exceeds the posted speed limit and the design speed. The high percentages of driver noncompliance with speed limits require that speed limit enforcement be actively increased.
- ✓ There are sections with no posted limit and also drivers drive at maximum speed in the city. This should be given priority and resolve the issue.
- ✓ There is a violation of the posted speed limit in a residential area. Signs that show the area is residential should be placed. Only school zone marks have been placed.
- ✓ It has been found that young and inexperienced drivers violate the posted speed limit. Therefore, awareness should be created by emphasizing the reachability of this awareness to the young ones. As we know, social media has a great effect on the younger generations.
- ✓ It is recommended that advanced technology on the PSL, such as variable speed limits, be used on the city's freeways. And the posted speed limit is also below the capacity of the road.

For future studies, the road sections geometric design and also crash data of the road sections is recommended to be researched since this have an impact on finding the exact damage that driving above the Posted speed limit has contributed. Furthermore, drivers' compliance with speed limits by previous accident history should be studied so that having an accident can definitely have an impact on compliance with the speed limit.

REFERENCES

- Dan Zhao¹ , Fengchun Han¹, Meng Meng², Jun Ma¹ and Quantao Yang¹, 2019. Exploring, the influence of traffic enforcement on speeding behavior on low-speed limit roads. School of Traffic Management, People's Public Security University of China, Beijing, China
- Zeyang Cheng ^{1,2,3} Jian Lu ^{1,2,3} Zhenshan Zu⁴ and Yunxuan Li^{1,2,3}, 2019. Speeding Violation Type Prediction Based on Decision Tree Method: A Case Study in Wujiang, China, Journal of Advanced Transportation Volume 2019, Article ID 8650845, 10 page
- Vikash V. Gayah* , Eric T. Donnell, Zhengyao Yu, Lingyu L, 2018 Safety and operational impacts of setting speed limits below engineering recommendations, Accident Analysis & Prevention Volume 93, August 2016, Pages 32-40
- Aarts, L., Van Schagen, I., 2006. Driving speed and the risk of road crashes: a review. *Accid. Anal. Prev.* 38 (2), 215–224.
- Donnell, E.T., Gayah, V.V., Yu, Z., Li, L., DePrator, A., 2016. Speed Limits Set Lower Than Engineering Recommendations. FHWA Rep. No. FHWA/MT-16-008/8225-01.
- Taylor, M. A. P., P. W. Bonsall, and W. Young. 2000. *Understanding Traffic Systems: Data Analysis and Presentation*. 2nd ed. UK: Ashgate publishing .
- BoYu YurenChena ShanBaob, 2019 Quantifying visual road environment to establish a speeding prediction model: An examination using naturalistic driving data, Accident Analysis & Prevention Volume 129, August 2019, Pages 289-298
- Bor-Shong Liu *,2007. Association of intersection approach speed with driver characteristics, vehicle type and traffic conditions comparing urban and suburban areas ,Accident Analysis and Prevention 39 (2007) 216–223.
- Anderson A. Natasha, M., 2020. Do drivers differ in their attitudes on speed limit compliance between work and private settings? Results from a group of Nigerian drivers. Elsevier Ltd
- Do Duy Din, Hisashi Kubota, 2012 Drivers' perceptions regarding speeding and driving on urban residential streets with a 30 km/h speed limit. International Association of Traffic and Safety Sciences.

George Kanellaidis, John Golias, and Kimonas Zarifopoulos, 1995, A Survey of Drivers' Attitudes Toward Speed Limit Violations. *Journal of Safety Research*, Vol. 26. No. 1. pp. 31-40,

Yee Mun Lee , Siang Yew Chong , Karen Goonting , Elizabeth Sheppard , 2020. The effect of speed limit credibility on drivers' speed choice. Y.M. Lee et al. / *Transportation Research Part F* 45 (2017) 43–53.

Boone, H.N. and Boone, D.A. (2012) Analyzing Likert Data. *The Journal of Extension*, 50, 1-5.

Fred Mannering , 2007. An empirical analysis of driver perceptions of the relationship, *Transportation Research Part F* 12 (2009) 99–10

Gary A. Davis, 2018. Relating Severity of Pedestrian Injury to Impact Speed in Vehicle-Pedestrian Crashes, *Transportation Research Record* 1773 Paper No. 01- 0495

Eluru, N., Chakour, V., Chamberlain, M., Miranda-Moreno, L.F., 2013. Modeling vehicle operating speed on urban roads in Montreal: a panel mixed ordered probit fractional split model. *Accident Analysis and Prevention* 59, 125–134

Ewing, R. 1999. Traffic Calming Impacts. In *Traffic Calming: State and Practice*. Washington, D.C.: Institute of Transportation Engineers, pp. 99–126.

World Health Organization, (2018). *Global Status Report on Road Safety: Summary*, Report No. WHO/NMH/NVI/18.20, Geneva, Switzerland.

World Health Organization - News Alert. (2021). Geneva [online]. Available from: <https://www.unroadsafetyweek.org/en/news/news-item/t/world-health-organization-newsalert/> [accessed 11 July 11, 2022].

Robertson, H. D. 1994. Spot Speed Studies. In *Manual of Transportation Engineering Studies*, ed. H. D. Robertson, J. E. Hummer, D. C. Nelson. Englewood Cliffs, N.J.: Prentice Hall, Inc., pp. 33–51.

A. Yadav, Ankit Kumar, 2021. Investigating the effects of driving environment and driver characteristics on drivers' compliance with speed limit, *Traffic Injury Prevention*

A. Yadav, Ankit Kumar, 2021. Investigating the effects of driving environment and driver characteristics on drivers' compliance with speed limits. *Traffic Injury Prevention*

Fitzpatrick, K., Carlson, P. J., Brewer, M.A., Wooldridge, M. D., and Miaou, S. P. "Design Speed, Operating Speed, and Posted Speed Practices." National Cooperative Highway Research Program Project 15-18 draft final report, July 2002

Afghari, Amir Pooyan, Haque, Md. Mazharul (Shimul), & Washington, Simon(2018) ,Applying fractional split model to examine the effects of roadway geometric and traffic characteristics on speeding behavior, *Traffic Injury Prevention*, 19(8), pp. 860-866.

Mannering F. An empirical analysis of driver perceptions of the relationship between speed limits and safety. *Transportation Research Part F: Traffic Psychology and Behaviour*. 2009;12(2): 99-106

Cull, A., Porter, M., Nakagawa, S., Smith, G., Rapoport, M., Marshall, S., . . . Mazer, B. (2020). Speeding and Speed Modification of Older Drivers: Does Vehicle Type Make a Difference? *Canadian Journal on Aging / La Revue Canadienne Du Vieillissement*, 39(3), 385-392.

Molnar, L. J., Eby, D. W., Bogard, S. E., LeBlanc, D. J., & Zakrajsek, J. S. (2018) Using naturalistic driving data to better understand the driving exposure and patterns of older drivers. *Traffic Injury Prevention*, 19, S83–88. doi: 10.1080/15389588.2017.1379601

Joon-Ki Kim, Gudmundur F. Ulfarsson, Venkataraman N. Shankar, Sungyop Kim, Age and pedestrian injury severity in motor-vehicle crashes: A heteroskedastic logit analysis, *Accident Analysis & Prevention*, Volume 40, Issue 5, 2008, Pages 1695-1702

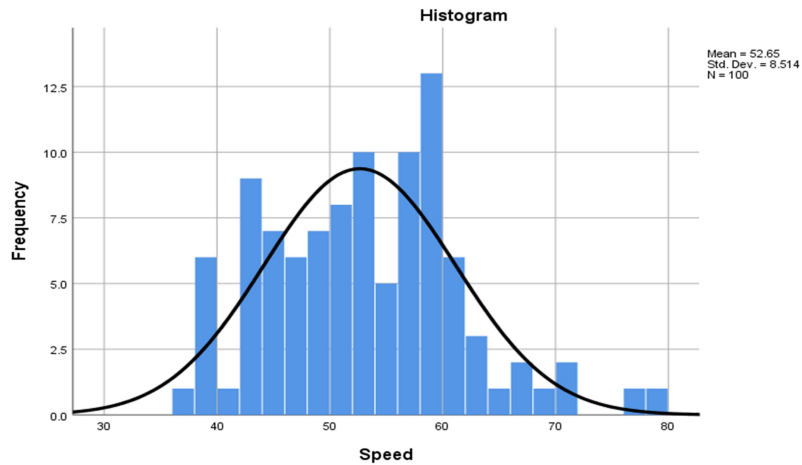
Deery AH (1999) Hazard and risk perception among young novice drivers. *J Saf Res* 30(4):225–236

Yannis, G., Louca, G., Vardaki, S. and Kanellaidis, G., 2013. Why do drivers exceed speed limits. *European Transport Research Review*, 5(3), pp.165-177.

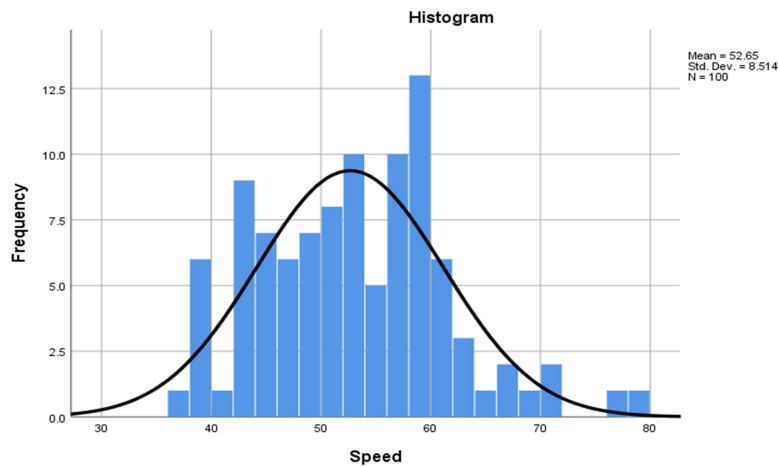
Elvik, R., 2009. An exploratory analysis of models for estimating the combined effects of road safety measures. *Accident Analysis & Prevention*, 41(4), pp.876-880.

Appendix

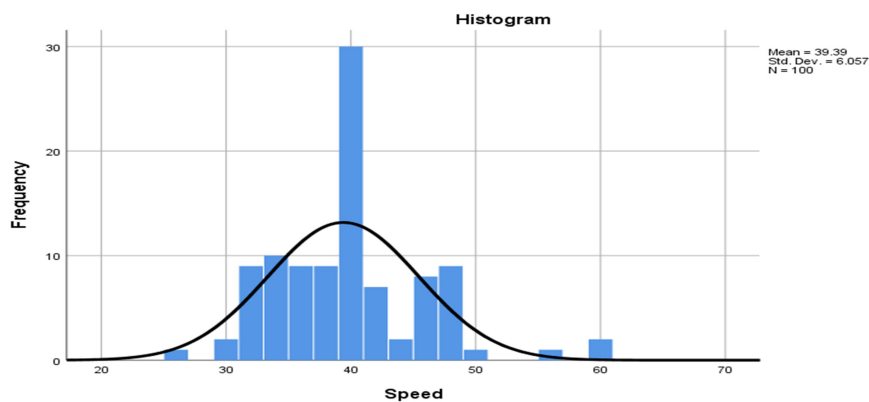
Appendix 1: speed frequency distribution graph for each road section



AW1 speed frequency graph

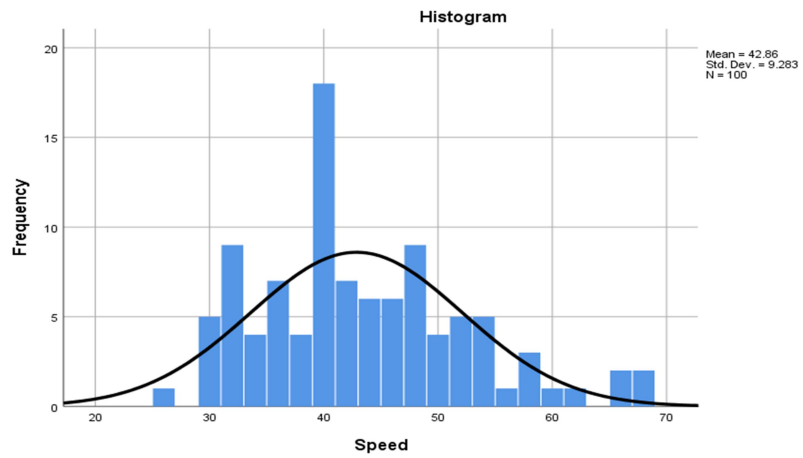


GY speed frequency graph

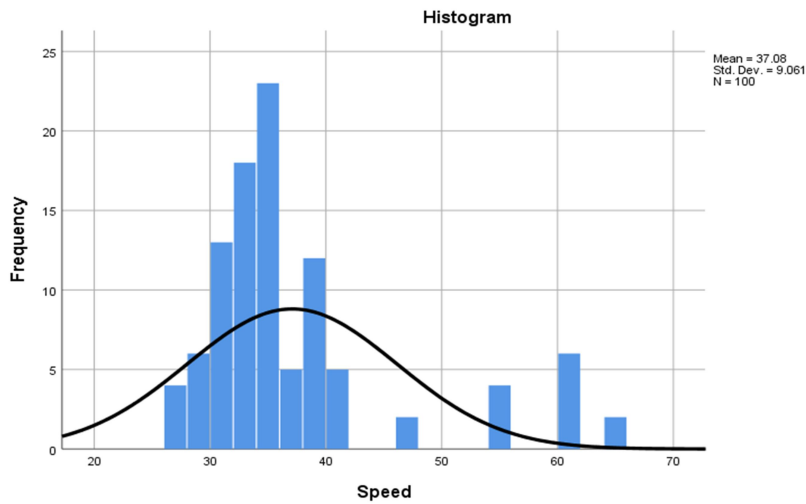


W18 speed frequency graph

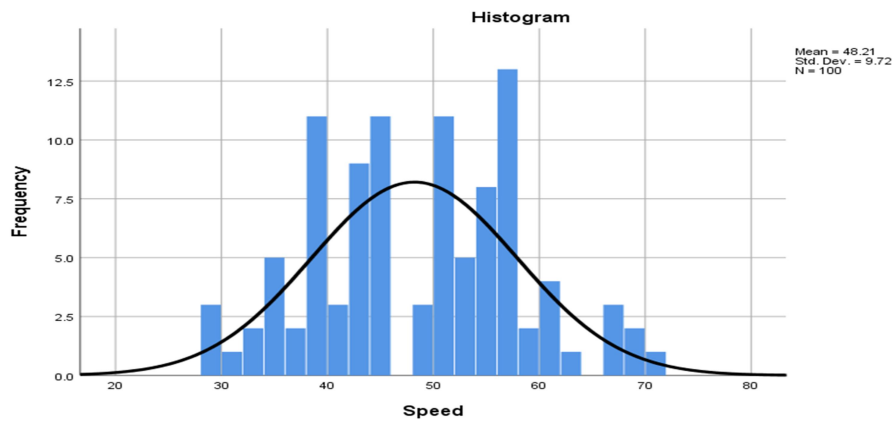
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



WP1 speed frequency graph

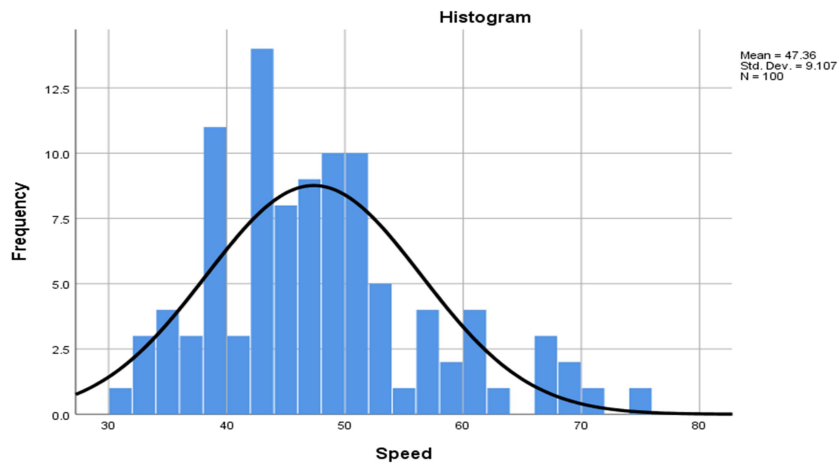


YTC speed frequency graph

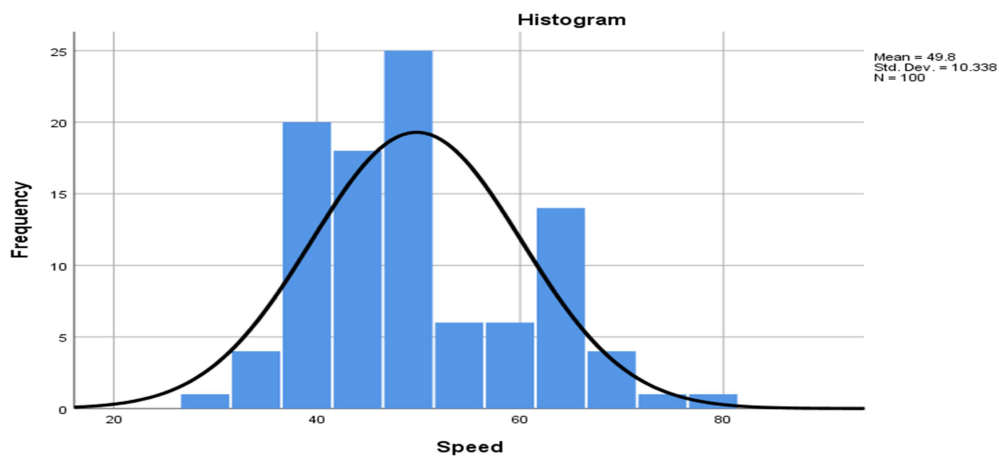


AS speed frequency graph

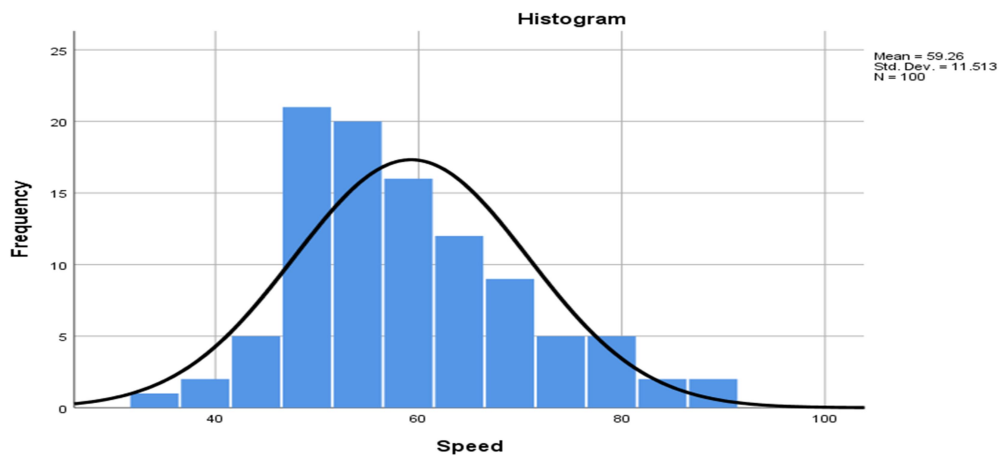
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



AW2 speed frequency graph

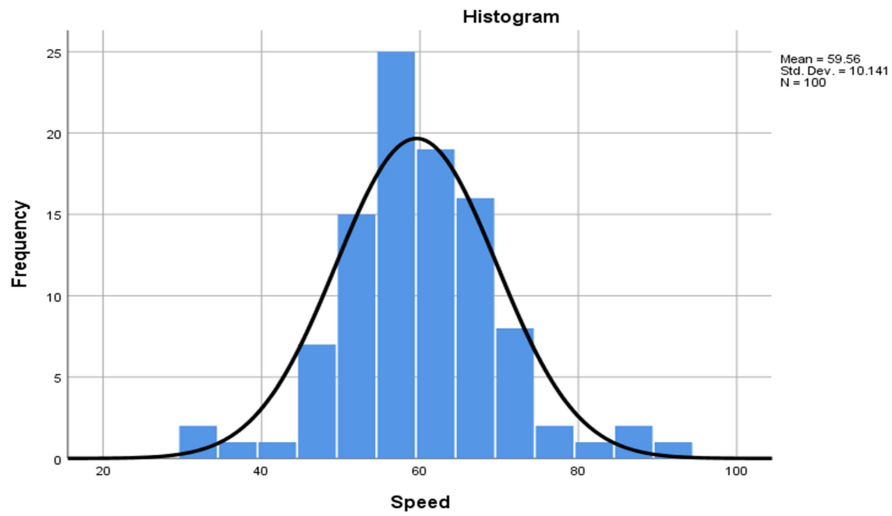


Wp2 speed frequency graph

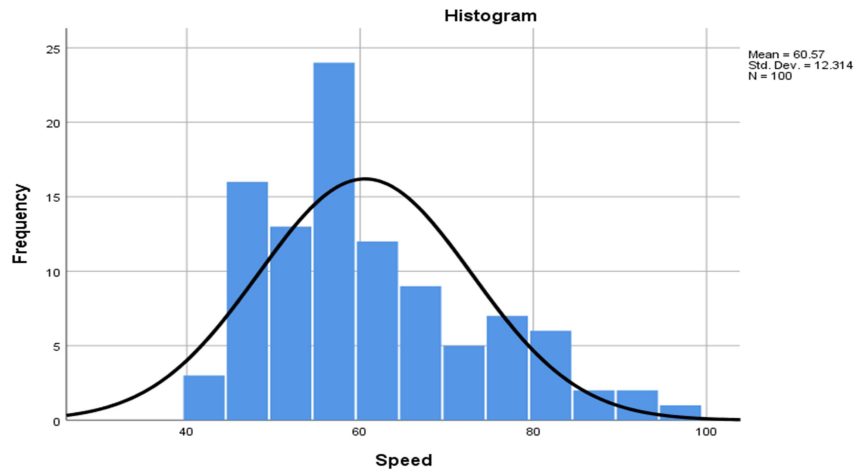


18w speed frequency graph

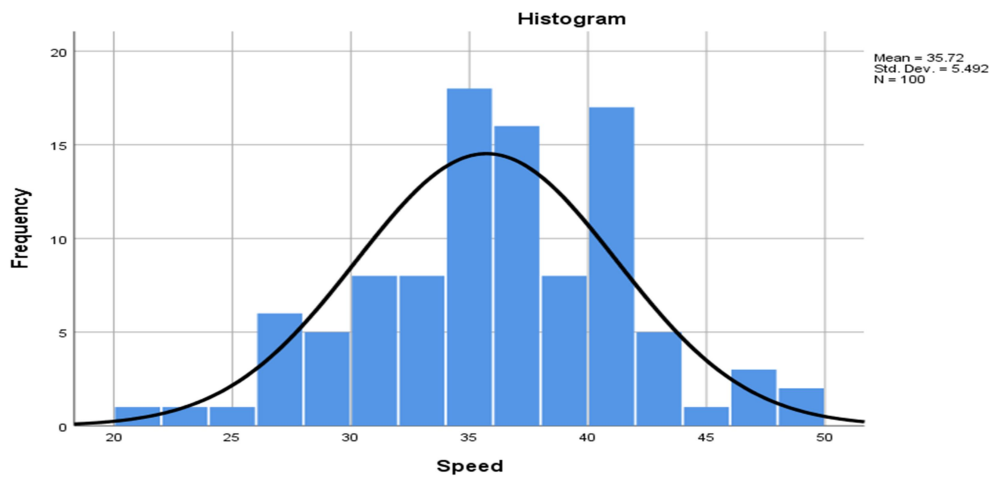
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



AGW speed frequency graph

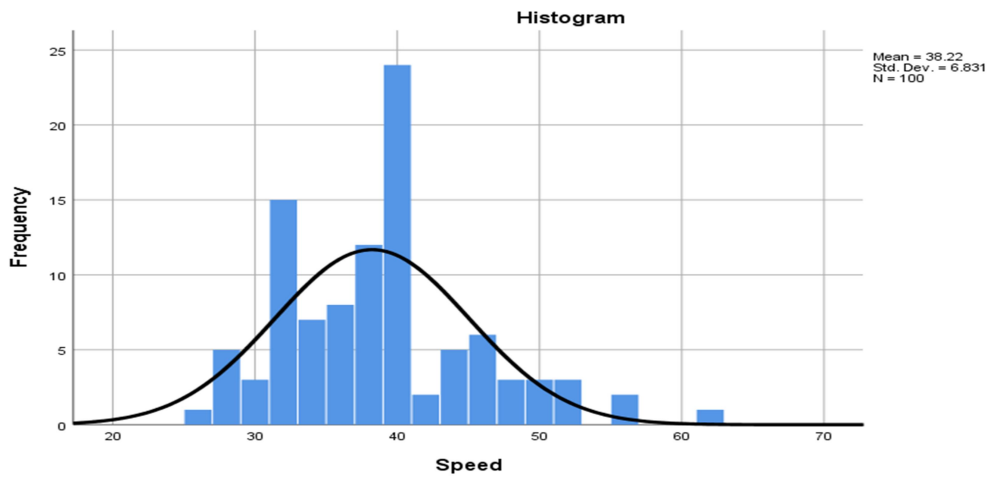


UA speed frequency graph

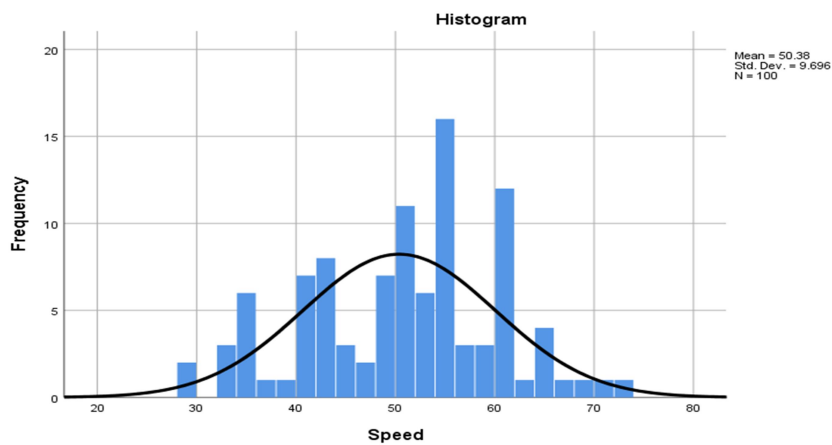


6KA speed frequency graph

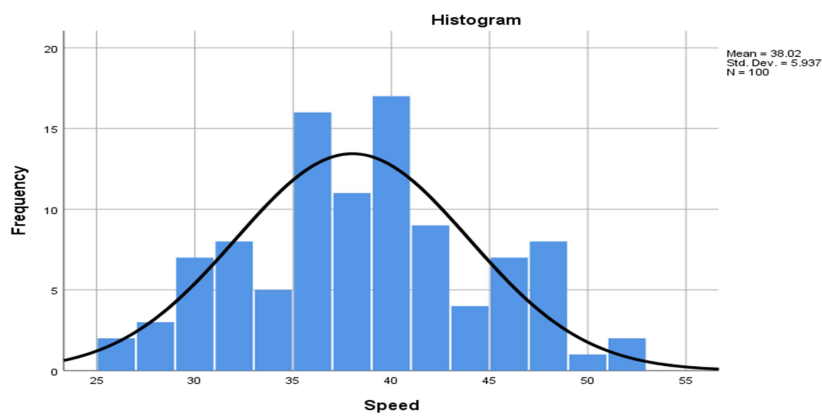
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



AMF speed frequency graph

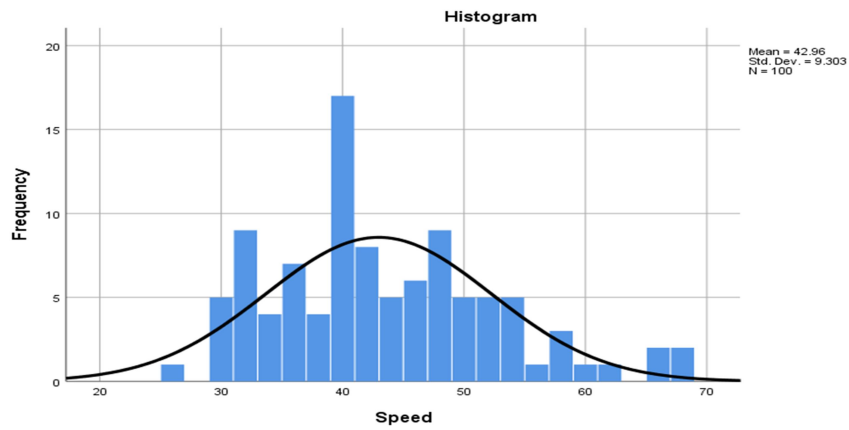


JG1 speed frequency graph

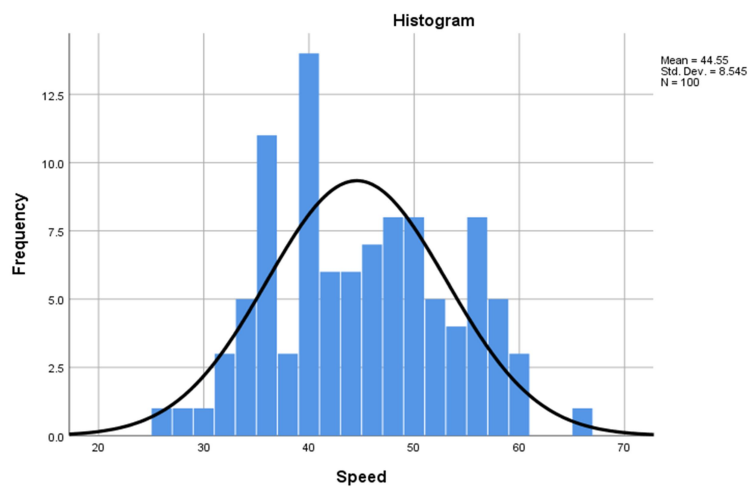


K6K speed frequency graph

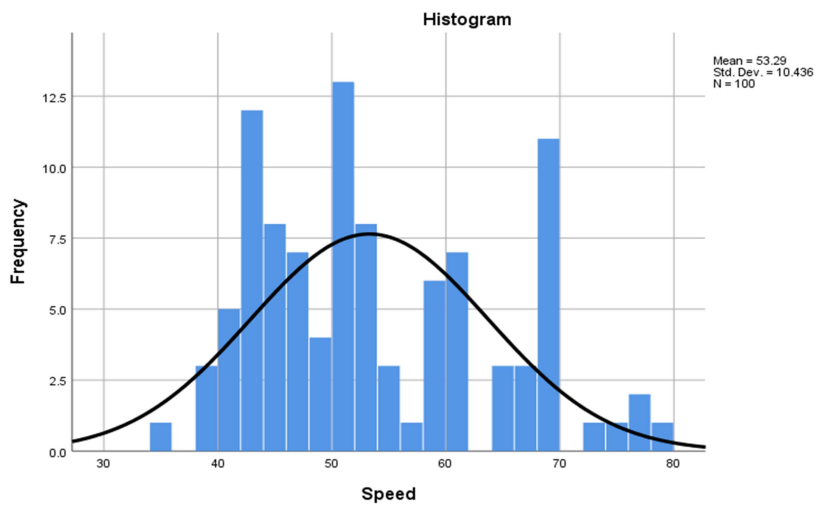
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



KK speed frequency graph

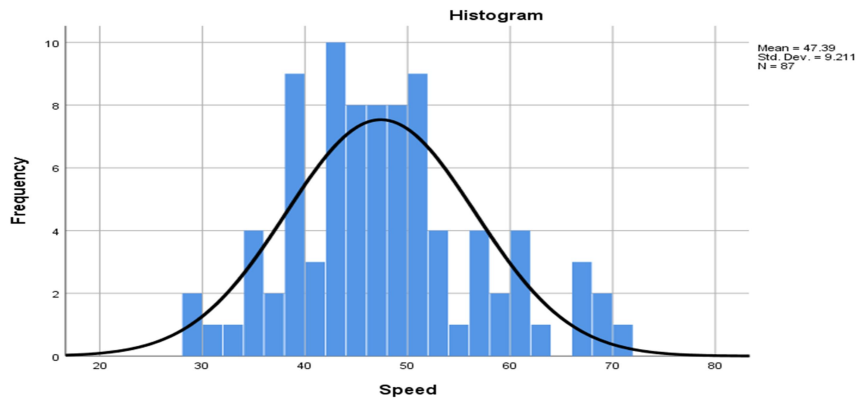


KT speed frequency graph

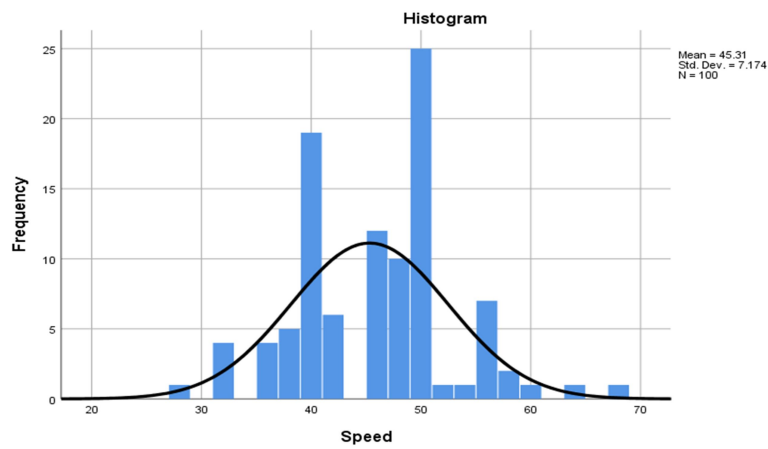


KT 2 speed frequency graph

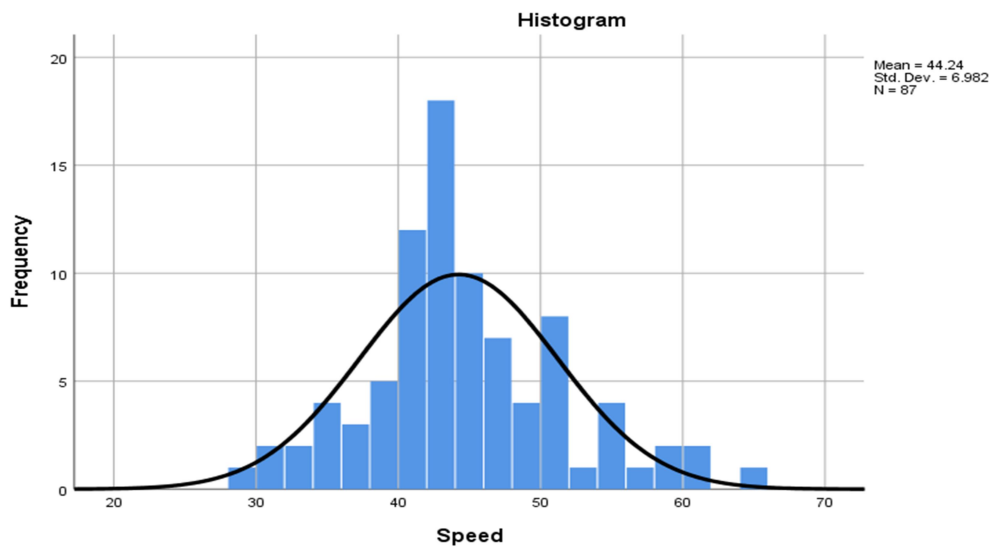
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



GI 1 speed frequency graph

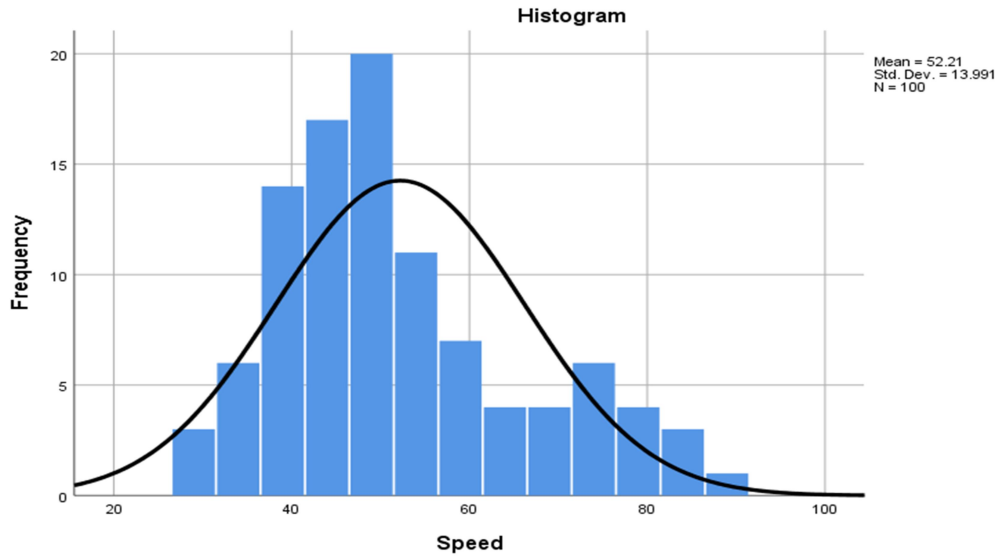


JG2 speed frequency graph

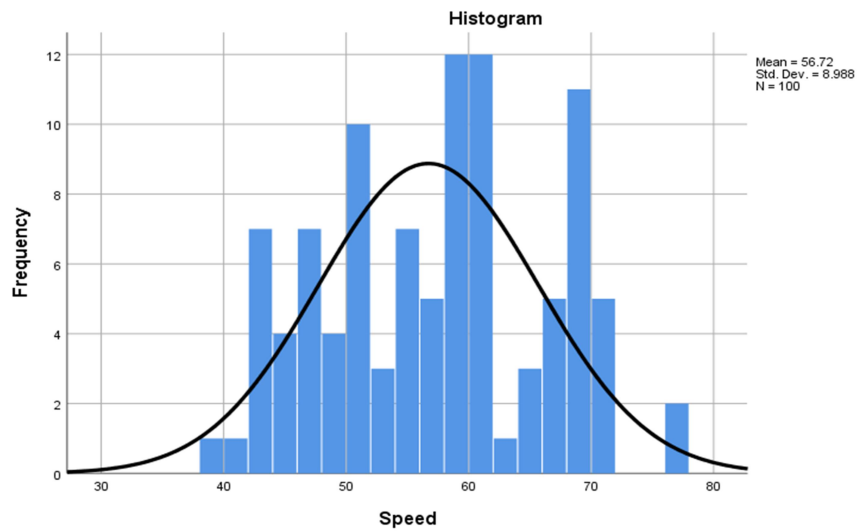


SG2 speed frequency graph

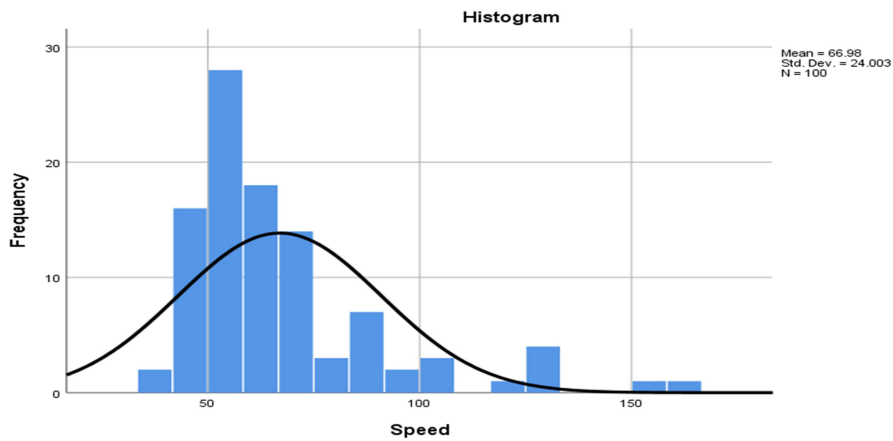
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



GI 2 speed frequency graph

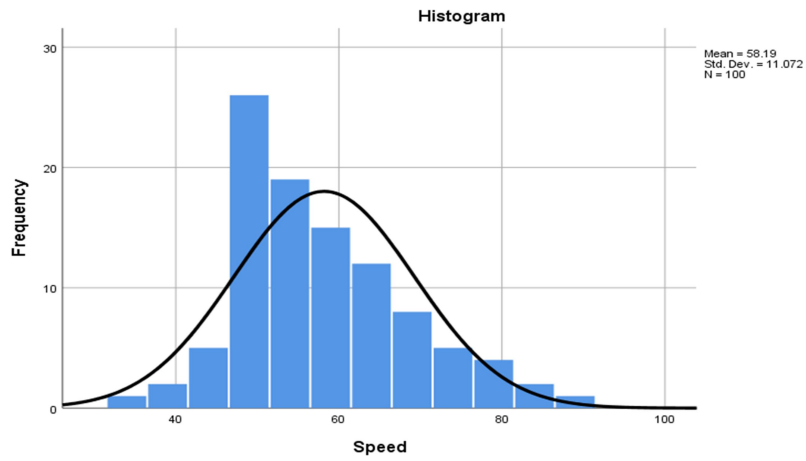


IH1 speed frequency graph

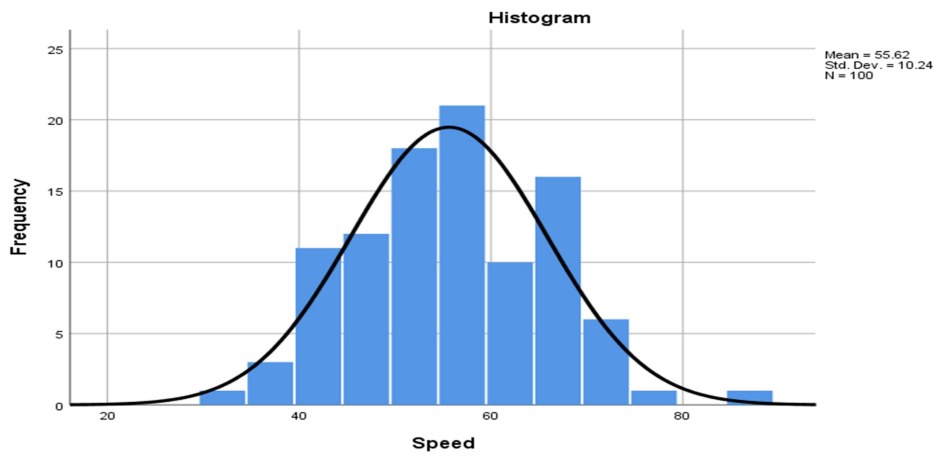


IH2 speed frequency graph

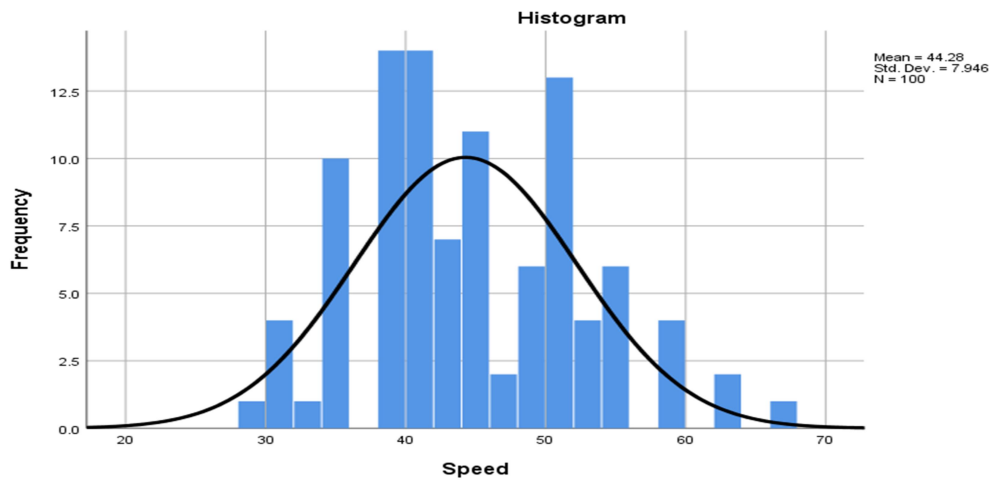
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



KT1 speed frequency graph

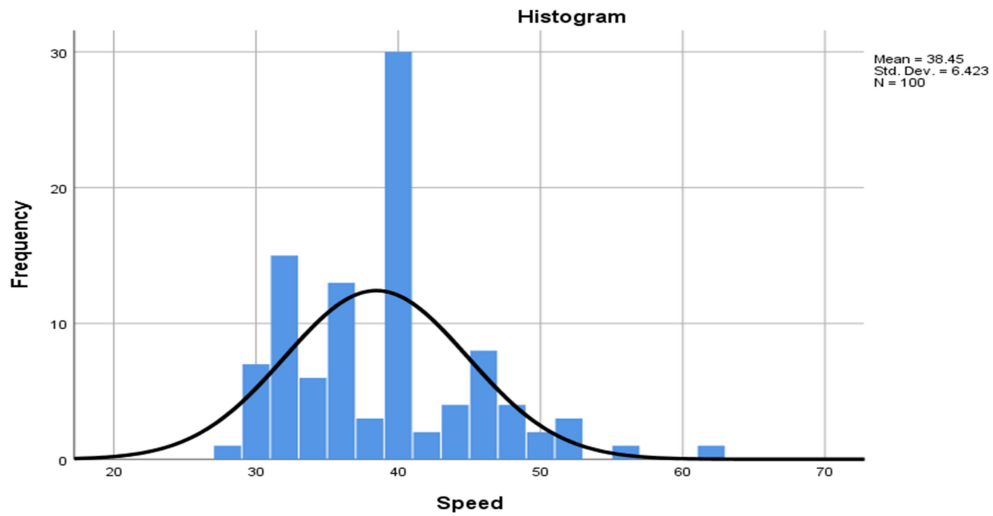


SE speed frequency graph

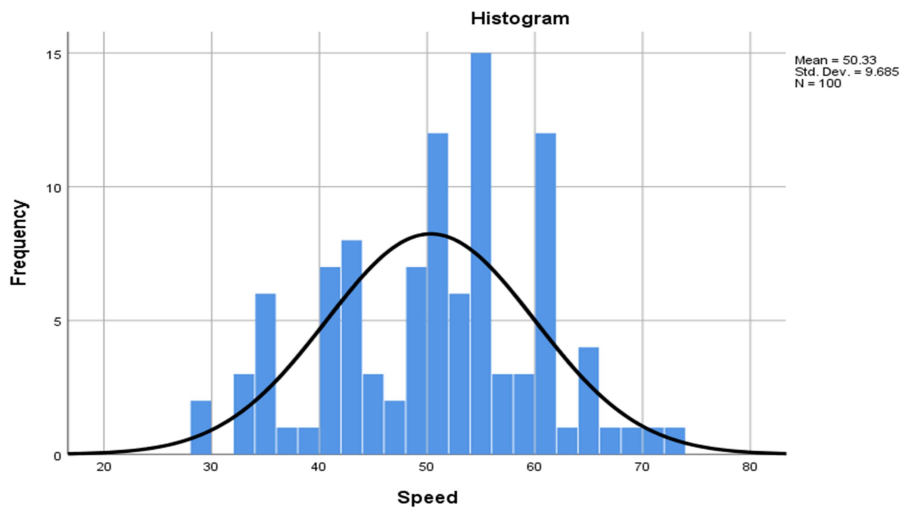


SG speed frequency graph

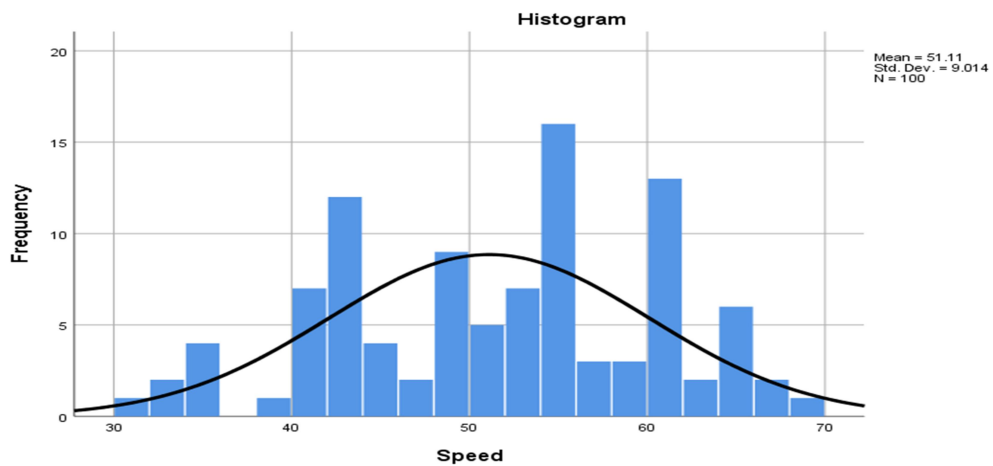
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



FAM speed frequency graph

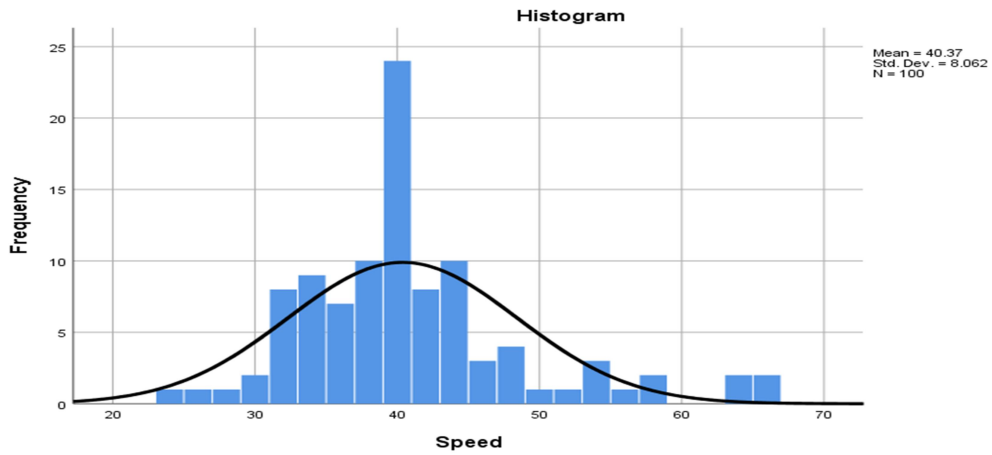


KO2M speed frequency graph

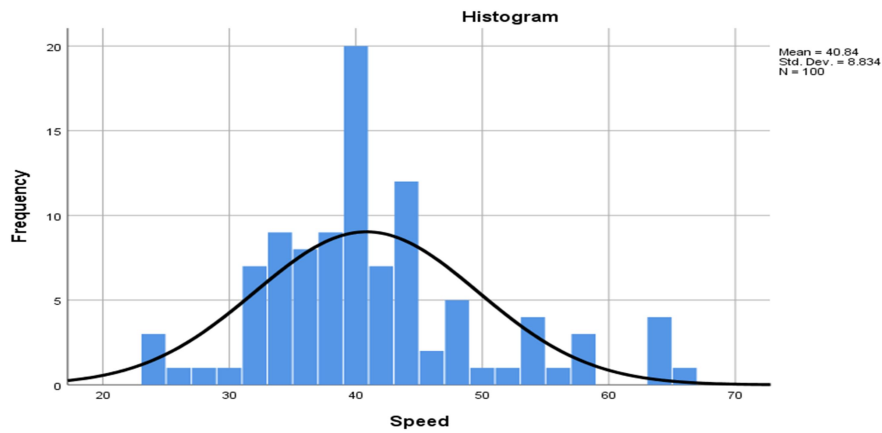


WSM speed frequency graph

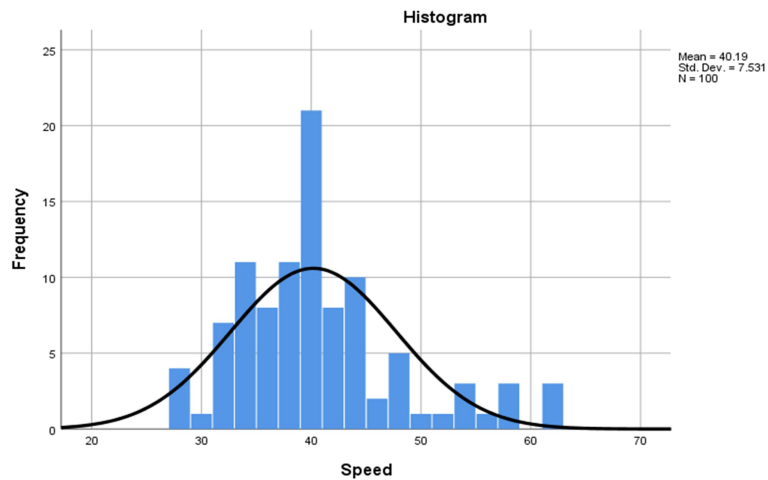
Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



YKB speed frequency graph

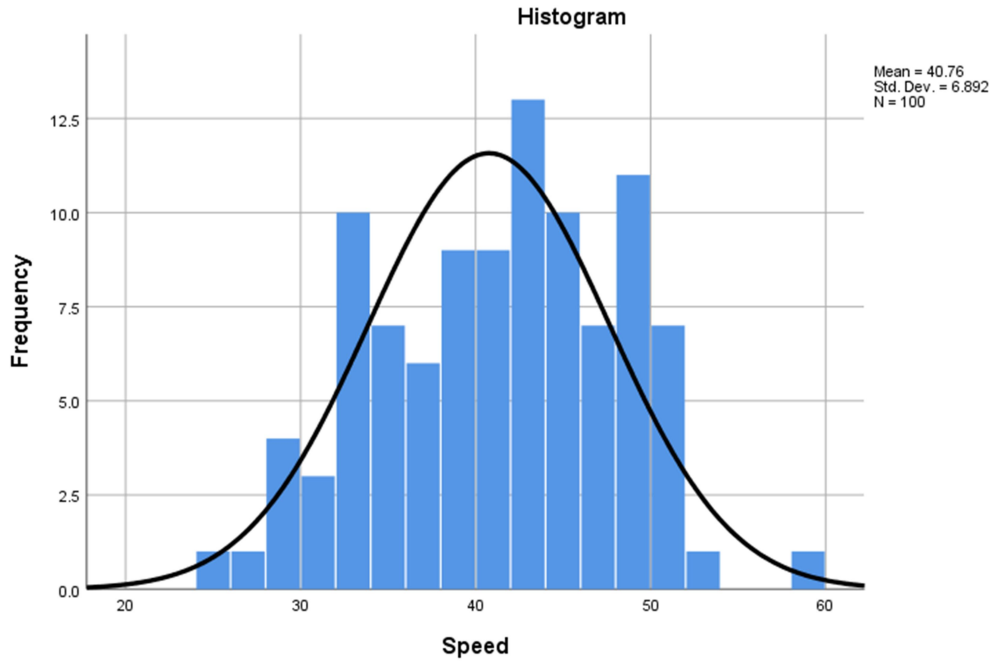


MHKP speed frequency graph

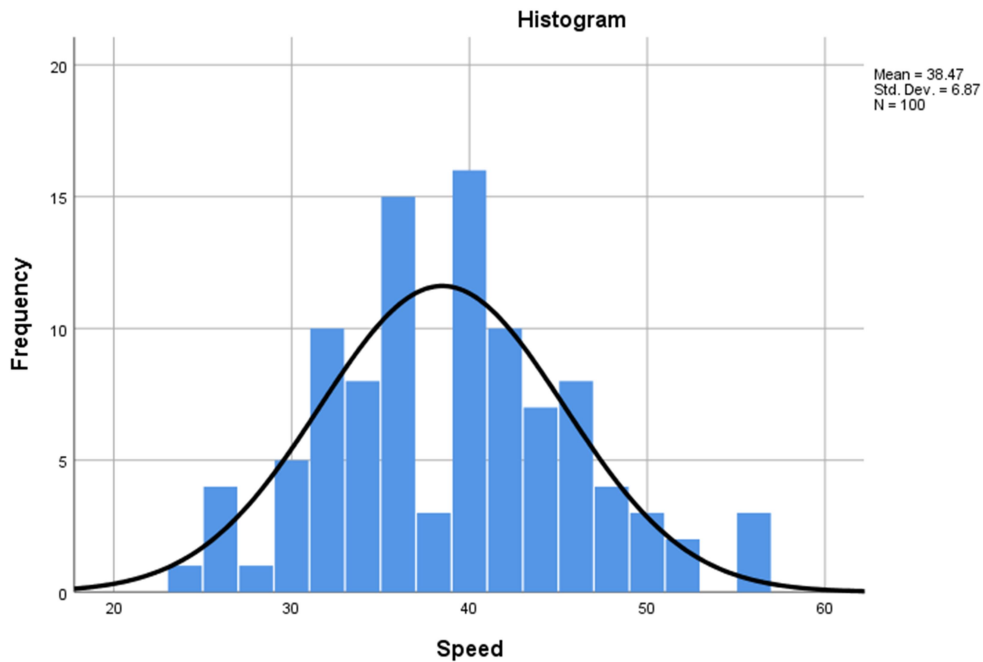


SMK speed frequency graph

Assessments of the primary factors affecting driving speed and the violation of the speed limit by drivers in Addis Ababa



KCW speed frequency graph



MKH speed frequency graph

Appendix 2: Drivers survey Questionaries'

Dear Respondent,

Re: Research Questionnaire

I am a Masters Student on Road and Transport in civil engineering department at Addis Ababa Institute of Technology, Addis Ababa University doing research entitled "Assessment on the relation between main factors influencing speeding, their significance level by speeding violation type prediction and acceptance of the posted speed limit in Addis Ababa City roads". This research forms part of the requirements for my Masters qualification.

I would appreciate it if you would just take a few moments to fill out the enclosed questionnaire in this regard. Your comments will be held in the strictest secrecy, and any information you submit will be used only for academic purposes. We greatly value and appreciate your collaboration.

Finally, I'd like to take this chance to express my appreciation for returning the completed questionnaire so quickly.

Yours Faithfully,

Tareqwa Tsegaye,

MSc. Student @ AAiT, AAU.

Instruction for completing the Questionnaire

Please mark as “X” on the space provided to indicate your response where appropriate. Where responses different from the one indicated are required, please write your response in the space provided. You may mark more than one response when necessary and appropriate.

1. General Information about Drivers

1.1 How old are you?

(18-24) Years (25-35) Years (35-50) Years >50 Years

1.2 Gender?

Male Female

1.3 How long is your driving experience?

<5 Years (5-10) Years (10-15) Years >15 Years

1.4 Marital Status?

Single Married

1.5 Educational Level?

<High school High school Diploma Degree Masters and above

1.6 Vehicle ownership?

self owend private company Government private person owned

2. General Questions about the knowledge of speed and speed limit

2.1 How many times a week would you go on the Addis-Ababa urban road?

1 days a week 2 days a week 3 days a week 4 days a week all week

2.2 Do you know all the types of the rode in the Addis-Ababa as per AACRA GDM?

YES NO

2.3 Do you know the posted speed limit on different road types in Addis-Ababa city even if it is not placed with a sign?

YES NO

3. causes of speeding as per driver perspective

3.1 What are the causes of speeding? Please choose from the below-listed causes of speeding?

Please rate the following cause of speeding from 1 to 5

1. Always the Cause
2. Most of the time the Cause
3. Sometimes the Cause
4. Rarely the Cause
5. Not all is the Cause

<input type="checkbox"/>	Don't realize how fast you are going
<input type="checkbox"/>	Have an emergency
<input type="checkbox"/>	Have a broken speedometer
<input type="checkbox"/>	Speed out of habit
<input type="checkbox"/>	Time is money
<input type="checkbox"/>	You are drunk or high on drugs
<input type="checkbox"/>	If the traffic around you is going faster than the speed limit
<input type="checkbox"/>	When there is no Radar on the area
<input type="checkbox"/>	When there is no traffic police around
<input type="checkbox"/>	Enforcement level of the country is low

4. Compliance of drivers with the speed limit

4.1 The likelihood of becoming involved in a collision is decreased by obeying the speed limit?

Strongly Agree Agree Disagree Strongly Disagree

4.2 Valuing the maximum speed limit makes you drive in a more comfortable way?

Strongly Agree Agree Disagree Strongly Disagree

4.3 As long as you drive carefully, going over the speed limit is acceptable?

Strongly Agree Agree Disagree Strongly Disagree

4.4 I could get to my destination faster if I went over the speed limit?

Strongly Agree Agree Disagree Strongly Disagree

4.5 I always check the speed limit of the road while driving?

Strongly Agree Agree Disagree Strongly Disagree

4.6 Do you think the posted speed limit is too low on freeways?

Strongly Agree Agree Disagree Strongly Disagree

4.7 How much do you think you exceed the posted speed limit in Km/hr. while driving?

Never 10Km/hr. 20 Km/hr. 30Km/hr. >30Km/hr.
exceed PSL

5. Intention of drivers

5.1 I intend to drive within the speed limit on Addis Ababa roads?

Strongly Agree Agree Disagree Strongly Disagree

5.2 I intend to drive within the speed limit on freeway of Addis Ababa roads?

Strongly Agree Agree Disagree Strongly Disagree

6. For commercial drivers

6.1 Do you think you're per day income affect violating the speed limit?

Strongly Agree Agree Disagree Strongly Disagree

6.2 Do you think complying with the speed limit affect your daily income?

Strongly Agree Agree Disagree Strongly Disagree

Thank you for your time!!

የመግቢያ ደብዳቤ

ውድ ተጠሪ

ድጋ፡ የጥናት መጠይቅ

እኔ በአዲስ አበባ ቴክኖሎጂ ኢንስቲትዩት በሲቪል ኢንጅነሪንግ ትምህርት ክፍል የማስተርስ ትምህርት ለማግኘት በተመለከተ ግምገማ፣ በአዲስ አበባ ዩኒቨርሲቲ የፍጥነት ፍጥነትን በሚነኩ ዋና ዋና ጉዳዮች መካከል ያለውን ግንኙነት በተመለከተ ግምገማ፣ የፍጥነት መጠንን በፍጥነት መጠን እና የተለጠፈውን ተቀባይነት መቀበል። በአዲስ አበባ ከተማ መንገዶች የፍጥነት ገደብ" ይህ ጥናት ለማስተርስ ትምህርት የሚያስፈልጉትን መስፈርቶች በከፊል ይመሰርታል። በዚህ ጉዳይ ላይ የተዘጋውን መጠይቅ ለመሙላት ጥቂት ጊዜ ወስደህ ብታቀርብ ደስ ይለኛል። አስተያየቶቻችን በጥብቅ በሚስጥር ይያዛሉ፣ እና ማንኛውም ያስገቡት መረጃ ለአካዳሚክ ዓላማ ብቻ ጥቅም ላይ ይውላል። ትብብርዎን በጣም እናደንቃለን። በመጨረሻም፣ የተጠናቀቀውን መጠይቅ በፍጥነት ስለመለስኩ ያለኝን አድናቆት በዚህ አጋጣሚ ለመግለጽ እወዳለሁ።

መጠይቁን ለመሙላት መመሪያ

እባክዎን ምላሽዎን በተገቢው ጊዜ ለማመልከት በተዘጋጀው ቦታ ላይ "X" የሚል ምልክት ያድርጉበት። ከተጠቆሙት የተለዩ ምላሾች በሚያስፈልጉበት ቦታ፣እባክዎ ምላሽዎን በተጠቀሰው ቦታ ይፃፉ። አስፈላጊ እና አስፈላጊ ሆኖ ሲገኝ ከአንድ በላይ ምላሽ ላይ ምልክት ማድረግ ይችላሉ።

1. ስለ አሽከርካሪዎች አጠቃላይ መረጃ

1.1 እድሜዎ ስንት ነው?

(18-24) ዓመታት (25-35) ዓመታት (35-50) ዓመታት > 50

ዓመታት

1.2 ጾታ?

ወንድ ሴት

1.3. መንጃ ፍቃድ ያገኙት በስንት አመት ነው?

(18-24) ዓመታት (25-35) ዓመታት (35-50) ዓመታት > 50 ዓመታት

1.4. የመንዳት ልምድዎ ለምን ያህል ጊዜ ነው?

<5 ዓመታት (5-10) 10-15 ዓመታት > 15 ዓመታት

1.5. የጋብቻ ሁኔታ?

ያላገባ ገባ

1.7 የትምህርት ደረጃ?

<ከፍተኛ ትምህርት ቤት ከፍተኛ ትምህርት ዲፕሎማ ማስተርስ ዲግሪ

እና በላይ

1.9 የተሽከርካሪ ባለቤትነት?

የ ራስ ራስ የግል ኩባንያ የ መንግስት መንግሥታዊ በግል ባለቤትነት
 ራስ ያልሆነ ድርጅት የተያዘ ሰው

2. ስለ ፍጥነት እና የፍጥነት ገደብ እውቀት አጠቃላይ ጥያቄዎች

2.2 በAACRA GDM መሠረት ሁሉንም የመንገድ ዓይነቶች በአዲስ-አበባ ያውቃሉ?

አዎ አይ

2.4 በአዲስ አበባ ከተማ በተለያዩ የመንገድ ዓይነቶች ላይ የተለጠፈውን የፍጥነት ገደብ በምልክት ባይቀመጥም ያውቃሉ?

አዎ አይ

እንደ አሽከርካሪው እይታ የፍጥነት መንስኤዎች ምንድን ናቸው?

እባክዎ ከታች ከተዘረዘሩት የፍጥነት መንስኤዎች ውስጥ ይምረጡ

እባክዎ የሚከተለውን የፍጥነት መንስኤ ከ1 ወደ 5 ደረጃ ይስጡ

1. የሁልጊዜ ምክንያት
2. አብዛኛውን ምክንያት
3. አንዳንድ ጊዜ ምክንያት
4. አልፎ አልፎ ምክንያት
5. ሁሌም ምክንያት አይደለም

<input type="checkbox"/>	ምን ያህል በፍጥነት እንደሚሄዱ አይገነዘቡም ድንገተኛ ሁኔታ ይኑርዎት
<input type="checkbox"/>	የተሰበረ የፍጥነት መለኪያ ይኑርዎት
<input type="checkbox"/>	ፍጥነት በልምምድ ውጪ
<input type="checkbox"/>	ጊዜ ገንዘብ ነው
<input type="checkbox"/>	ለማሳየት እና ትኩረት ለመሰጠት ይፈልጋሉ
<input type="checkbox"/>	ደክሞኛል እና በፍጥነት ወደ ቤት መሄድ ይፈልጋሉ
<input type="checkbox"/>	ሰክረሃል ወይም በአደንዛዥ እፅ ከፍተኛ ነው።
<input type="checkbox"/>	ዝቅተኛ የእግረኛ እንቅስቃሴ አለ።
<input type="checkbox"/>	በዙሪያዎ ያለው ትራፊክ ከፍጥነት ገደቡ በበለጠ ፍጥነት የሚሄድ ከሆነ
<input type="checkbox"/>	የመንገድ አውታር ጥሩ በሚሆንበት ጊዜ
<input type="checkbox"/>	በአካባቢው ራዳር በማይኖርበት ጊዜ

6 የንግድ አሽከርካሪዎች

6.1 የቀን ገቢዎ የፍጥነት ገደቡን በመጣስ ላይ ተጽዕኖ ያሳድራል ብለው ያስባሉ?

- በጣም ተስማማ ተስማማ አልስማማም በጣም አልስማማ

6.2 የፍጥነት ገደቡን ማክበር የቀን ገቢዎን የሚጎዳ ይመስልዎታል?

- በጣም ተስማማ ተስማማ አልስማማም በጣም አልስማማ

ለጊዜዎት አመሰግናለሁ!!