ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCE
SCHOOL OF PUBLIC HEALTH

# *Seat belt utilization among public transport drivers in Addis Ababa, Ethiopia: an in-side vehicle observational study*

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**A thesis report submitted to the school of graduate studies, Addis Ababa University in partial fulfillment of the requirements for the degree of Master in public health**

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# ADDIS ABABA UNIVERSITY
# SCHOOL OF GRADUATE STUDIES

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ADDIS ABABA UNIVERSITY
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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **AM** | **"*Ante Meridian*", which means "before noon" in Latin** |
| **AOR** | **Adjusted Odds Ratio** |
| **CI** | **Confidence Interval** |
| **COR** | **Crude Odds Ratio** |
| **CS** | **Collector Streets** |
| **DA-LYS** | **Disability Adjusted Life Years** |
| **DRC** | **Democratic Republic of Congo** |
| **E.C.** | **Ethiopian Calendar** |
| **ETB** | **Ethiopian Birr** |
| **F.D.R.E** | **Federal Democratic Republic of Ethiopia** |
| **GDP** | **Gross Domestic Product** |
| **MVC** | **Motor Vehicle Crashes** |
| **MVOSS** | **Motor Vehicle Occupant Safety Survey** |
| **N.B.** | **Nota Bene, which means 'note well'** |
| **NGO** | **Non-Governmental Organization** |
| **NHTSA** | **National Highway Traffic Safety Administration** |
| **NHTSA'S FARS** | **NHTSA'S Fatality Analysis Reporting System** |
| **No.** | **Number** |
| **NOPUS** | **National Occupant Protection Use Survey** |
| **Ob.No.** | **Observation Number** |
| **Observ.** | **Observation** |
| **PAS** | **Principal Arterial Street** |
| **PI** | **Principal Investigator** |
| **PM** | **"*Post Meridiam*", which means "after noon" in Latin** |
| **SAS** | **Sub-Arterial Street** |
| **SD** | **Standard Deviation** |
| **SN** | **Serial Number** |
| **SPSS** | **Statistical Package for Social Sciences** |
| **SUR** | **Semi-Urban Roads** |
| **SUVs** | **Sports Utility Vehicles** |
| **UN** | **United Nations** |
| **UR** | **Urban Roads** |
| **U.S.A** | **United States of America** |
| US$ | **United States Dollar** |
| **WHO** | **World Health Organization** |

## ABSTRACT

**Background:** Proper seat belt wearing can significantly save lives and reduce the risk of serious injury during road traffic crashes. In Ethiopia, an increasing vehicle crash fatalities and injuries is one of health challenges for the 21$^{th}$ century though it has road traffic laws including seat belt use since 2011. Commercial public transport vehicles, especially taxi/mini buses and public transport buses usually prone to traffic crashes. The country seat belt use laws obligate drivers to utilize seat belt while driving and the well known drivers' seat belt use estimate and enforcement seem to be high although it has a proper seat belt utilization estimate and enforcement gap. The reliable estimate and enforcement of proper seat belt usage is confirmed by an in-side vehicle observation aimed at reducing the burden of severe injuries and fatalities from traffic crashes.

**Objective**: This study examined proper safety seat belt utilization and factors associated with utilization of seat belt among drivers of public transport vehicles in Addis Ababa, Ethiopia.

**Methods:** A cross-sectional study was conducted to assess safety seat belt wearing status and factors associated with safety seat belt utilization among drivers of public transport vehicles using an in-side vehicle observational approach in Addis Ababa city, Ethiopia, in February, 2017. We observed 600 vehicles at 20 observation sites after we prepared observational cheklists and protocols and the collected data was analyzed using SPSS version 21.0. Multivariate logistic regression model was used to identify variables for driver utilization of proper seat belt and to test which variables had statistically significant association with it at p-value < 0.05.

**Results:** The prevalence of driver proper safety seat belt utilization among public transport drivers observed in-side vehicles in February, 2017 in Addis Ababa was 47.5% with 95% CI=43.3, 51.3. The multivariate analysis revealed that khat chewing drivers with AOR=2.41(1.04, 5.60, p<0.05), drivers engaged in driving distraction activities with AOR=2.93 (2.08, 4.13, p<0.001) and vehicle type (city public transport bus drivers) with AOR=1.66(1.09, 2.52, p<0.05) were more likely associated with driver none proper safety seat belt utilization.

**Conclusion:** Proper seat belt use among public transport vehicle drivers was very low (47.5%) and less than the well known high seat belt use reports. Khat chewer, distraction engaged and public transport bus drivers were more likely to not use proper seat belt. Thus, educating drivers and high visibility enforcement are important to promote proper seat belt utilization and ultimately to save lives and to reduce severe traffic accidents during crashes.

# 1. INTRODUCTION

## 1.1. Background

Road traffic injuries are a major public health problem; they are responsible of a great number of years of potential life lost being the ninth cause of mortality around the world. Road traffic injuries claim more than 1.2 million lives and cause up to 50 million people incurs nonfatal injuries each year in the world (1). In 2012, among the causes of injury related deaths in the world, 24% were contributed by road traffic injuries (2). It is the second most known cause of death among economically active population group 15-44 year-old and often the bread winners in a family (3).

The future looks far worse than the present, as predicted by WHO, the year 2030 traffic fatalities will be the seventh leading cause of death. This rise is driven by the escalating death toll on roads in low- and middle-income countries including Ethiopia– particularly in emerging economies where urbanization and motorization accompany rapid economic growth. According the latest WHO Global status report on road safety published in 2015, road traffic death rates in low- and middle income countries are more than double those in high-income countries. 90% of road traffic deaths occur in low- and middle-income countries although they account for 82% of the world's population with only 54% of the world's registered vehicles (4).

As a low-income country, Ethiopia has low number of vehicles with high road traffic accidents compared to others. According to Ethiopian Transport Authority, road traffic injuries caused the loss of 2765, 3331, 3847 and 4352 Ethiopian lives in the year 2005, 2006, 2007 and 2008 E.C, respectively with major body injuries of 4157, 6039, 5634 and 6886 and minor body injuries of 5047, 5888, 5839 and 7071 in the respective years. This is indicating an increasing trend of road traffic accidents year by year though road traffic safety laws do exist and there are low number of vehicles in the country (5). The recent total number of vehicles registered in Ethiopia until June 30, 2016 is 708,416. Among these vehicles, 447,669 (63%) were registered in Addis Ababa city administration (6).

A population of Addis Ababa is 3,194, 999 with annual growth rate 2.5 (CSA, 2014). This huge population causes a tremendous pressure of the demand for municipal services including road traffic services and motorization for the city. Addis Ababa motorized public transport demand is offered by the public owned Ambessa City Bus enterprise, privately owned mini buses, long distance buses, and the paratransit vehicles (taxies of various forms) including, recently, three-wheeled vehicles (Bajaj) (7).

Enforcement of the existing road safety laws is paramount of importance to shape road user behaviour particularly on the key risk factors including proper seat belt utilization (4). Ethiopia has road traffic safety regulations including driver and passenger seat belt utilization to control road traffic accidents. According to road traffic safety regulations of the Addis Ababa City Government Regulation No.27/2000, one who drive without fastening or causing others do not fasten the seat belt of the vehicle considered as one of grave traffic offence type and its penalty for this offence is Birr 160 (8). According to Ethiopian Road Transportation Traffic Control Council Ministers Regulation No. 208/2011, Sub-article (3) of Article (5) of this regulation states safety belt use as follows: (A) *Any driver may not drive any vehicle other than motorcycle without fastening safety belt.* (B) *When any driver drives a motor vehicle other than motorcycle carrying a passenger shall ascertain that the said passenger has fastened safety belt* (9).

## 1.2. Statement of the problem

Although road traffic injuries have been a leading cause of morbidity and mortality for many years, most traffic crashes are both predictable and preventable based on reliable evidence. Low-income countries like Ethiopia where road traffic injuries and fatalities are of serious and emerging public health concern needs road traffic accident prevention strategies based on evidence. In countries like Ethiopia, there must be considerable evidence on interventions that are effective at making roads safer to successfully implement these interventions which are corresponding to reductions in road traffic deaths (4). Several of the traffic injuries could be prevented by modifying certain drivers' behaviours. Among others, proper seat belt wearing can significantly save lives and reduce the risk of serious injury during the occurrence of road traffic crashes (10). Properly wearing a seat-belt reduces the risk of a fatality among drivers and front-seat occupants by 45–50% and the risk of minor and serious injuries by 20% and 45%

respectively. Among rear seat occupants, seat-belts reduce fatal and serious injuries by 25% and minor injuries by up to 75 % (4).

The perceived enforcement of seat belt law in Ethiopia was rated eight out of 10 (with zero being the lowest and 10 the highest) but the rate of seat belt wearing among all occupants in vehicles is < 1 % in the most recent Global Status Report on Road Safety (4). According to the sample count in Addis Ababa city in 2010, 96% of drivers used seat belt whilst driving (11). A recent unpublished repeated road side observational study in Addis Ababa conducted by the School of Public Health of Addis Ababa University and Johns Hopkins International Injury Research Unit found a seat belt use among drivers 97% and 99%; and passengers 6% and 14% in round 1 and round 2 observation, respectively (12). Nevertheless, the country current seat belt use reporting doesn't show the proper use of the seat belt and hence overestimates seat belt use rate particularly in public transport vehicles. Though the recent seat belt use enforcement and drivers' seat belt use rate seems to be high, there is no an in-side vehicle observational study to confirm that these studies are reliable to estimate the correct utilization and to identify factors for no and/or improper utilization of seat belt among public transport drivers.

Among the prevention methods for the problem of road traffic injuries, promoting proper seat belt use among passengers is an important one for road traffic injuries reduction by evidence based finding ways (4). Self reported data and observational study are the two methods to calculate the prevalence of seat belt use, but the self reported method overestimates prevalence than the observational study method. Recently, observational studies, especially in-side vehicle observational studies have been utilized to measure such behaviors. A direct in-side vehicle seat belt use observational study is a methodology of naturalistic study of drivers of vehicles. It can lead to more validate and accurate estimates of proper seat belt use. Since there is a lack of adequate in-side vehicle observational studies for proper seat belt usage while driving in Ethiopia to obtain reliable estimates, this in-side vehicle observational study aimed to assess proper seat belt utilization among public transport drivers in Addis Ababa city. Additionally, this study investigated observable factors for none seat belt utilization among drivers by direct in-side vehicles observation. Thus, this study provided a reliable estimate of the level of seat belt utilization status and observable associated factors for none proper safety seat belt utilization among public transport drivers in Addis Ababa, Ethiopia level.

### 1.3. Rationale and significance of the study

The reason why this study is needed is to understand the reliable rate of the proper seat belt use and identify factors affecting proper seat belt use among drivers while driving because it has implications for road safety. There is a lack of reliable estimate of proper seat belt use in Ethiopia, particularly an in-side vehicle observational study. Thus, the correct or proper use of seat belt is confirmed by in-side vehicle observation. This reliable estimation of the proper seat belt use rate is crucial for public health efforts aimed at reducing the burden of severe injuries and fatalities from road traffic crashes (13).

As a means of one of the interventions to road safety accidents by promote appropriate seat-belt fastening while driving among drivers and seat belt use among passengers, Ethiopia need to collect regular and reliable data on proper seat-belt wearing rates among drivers and passengers and, based on the reliable findings, need to know its status, and implement proper seat belt use by vehicle monitoring as well as driver and passenger awareness and education about the benefits of proper seat belt use and enforcement of the law of correct buckling up of proper seat belt while driving, which is one of the international road safety laws ratified by the country, to reduce road traffic safety challenges.

The contribution of this study is to provide data on seat-belt wearing rates as an intermediate indicator of the broader goal of reducing injuries and fatalities, and can help sustain political and public support for these efforts. Only 84 countries have any data on seat-belt wearing rates, with this number disproportionately higher in high-income countries (77%) than in low- and middle-income countries (7% and 43% respectively). As a low income country, Ethiopia is still assumed to have low rate of seat-belt wearing among all vehicle occupants (<1%) (4)**;** and no reliable data for the rate of proper seat belt wearing and factors determining proper seat belt use while driving due to lack of adequate reliable research findings from an in-side vehicle observational study. Thus, this study contributes to estimate proper seat belt use rate reliably and identify factors for none proper seat belt utilization while driving. This identified gap study is important for road safety policy makers and the concerned stakeholders by incorporating the finding recommendation as one of the intervention method for road safety accident severe and fatality.

## 2. LITERATURE REVIEW

### 2.1. Magnitude of road traffic accident

Road traffic injuries are currently one of the major public health challenges in the globe. According to Johns Hopkins International Injury Research Unit and World Health Organization collaborating center for injuries, violence and accident prevention for global road safety, about 1.3 million people lost their lives each year because of road traffic crashes. If any action is not taken, road traffic injuries are predicted to become the fifth leading cause of death globally by 2030 (14). The recent road safety report of WHO showed that they are a leading cause of death among young people and are the number one cause of death among those aged 15–29 years though they are a leading cause of preventable death in the world. Globally, 1.25 million road traffic deaths occur every year, with millions more sustaining serious injuries and living with long-term adverse health consequences, with three out of four deaths are among men. Road traffic injuries are currently estimated to be the ninth leading cause of death across all age groups globally, and are predicted to become the seventh leading cause of death by 2030. This rise is driven by the escalating death toll on roads in low- and middle-income countries – particularly in emerging economies where urbanization and motorization accompany rapid economic growth. Although low- and middle –income countries have only half of the world's vehicles; they have 90 % of the world's road traffic deaths. Road traffic fatality per 100,000 people is 17.4 in the world. But road traffic fatalities per 100,000 population in low- income countries, middle-income countries and high- income countries are 24.1, 18.4 and 9.2 respectively. The chance of dying in a road traffic crash depends on where we live. The chance of dying in a road traffic crash is 9.3% in Europe, 15% in U.S.A, 17.0% in South East Asia, 17.3% in Western pacific and 26.6% in Africa (4).

Africa faces a rapidly increasing road crash tragedy disproportionate to the level of motorization and road network density. It causes unbearable human and economic losses to the region. Every year, road crashes are estimated to claim over 300,000 lives in Africa. The correct number is unknown due to the very poor accident data recording and management system in the region. It is estimated to be the fourth leading cause of death of persons aged 5 through 44 years. Over 75% of the casualties are of productive age between 16-65 years who contribute to the household income which evidently underscores the significant impact of road crashes on the livelihoods of poor households. Of these, males account for about 73% of deaths and 70% of all the disability-adjusted life years (DA-LYs) lost because of road traffic injury most of whom are bread winners for their family. These indicate how road crash is directly linked to poverty and underline the need for development and poverty reduction strategies to incorporate mechanisms to sustainably address road crash issues (15).

The African Region has the highest road fatality rates of all the world's regions. The African Region remains the least motorized of the six world regions, but suffers the highest rates of road traffic fatalities (see Annex I, page no.48), with 37 of 44 surveyed countries having death rates well above the global average of 18.0 deaths per 100,000 population. While the regional average is 24.1 deaths per 100,000 population, for the 19 countries in the middle-income category, covering 44% of the Region's population, the rate is 27.8 deaths per 100,000 population. By comparison, the global average for middle-income countries is 20.1 deaths per 100,000 population.

While the African Region possesses only 2% of the world's vehicles it contributes 16% to the global deaths. Nigeria and South Africa have the highest fatality rates (33.7 and 31.9 deaths per 100,000 population per year, respectively) in the region. More than one in four deaths in the African Region occur on Nigeria's roads, and with six other countries; Democratic Republic of Congo (DRC), Ethiopia, Kenya, South Africa, Tanzania, and Uganda, are responsible for 64% of all road deaths in the region. While Ethiopia, Kenya, and Tanzania have relatively low (for the region) road fatality rates, Nigeria, South Africa, and Uganda combine big populations with very high fatality rates, resulting in large numbers of deaths. These seven countries must reduce their road deaths considerably if the region is to realize a significant reduction in deaths (16).

According to the systematic review of Bulletin of the World Health Organization, from all registry-based studies, Nigeria recorded the highest and lowest total crash rate at 716.57 per 100,000 population and 2.9 per 100,000 population, in 1990 and 2011, respectively. Ethiopia recorded the highest death rate at 81.6 per 100,000 population in 2011, while the lowest death rate was recorded in Nigeria at 1.64 per 100,000 population in 2007. From the available population-based studies for review, Nigeria reported the highest number of road traffic injury and death rates at 4,120 per 100,000 population and 160 per 100,000 population, respectively.

The road traffic injury rate is the highest recorded in any single study in Africa. Algeria and Ghana also reported high road traffic injury rates at 700 and 938 per 100,000 population, respectively. When the estimated pooled rates for the African continent is considered for total crashes, the pooled rate was 52.8 per 100,000 population, with the median at 39.7 per 100,000 population. The pooled fatal crash rate was estimated at 9.6 per 100,000 population with a median at 4.8 per 100,000 population. Pooled crash injury and death rates were estimated at 65.2 injuries and 16.6 deaths with medians of 38.9 injuries and 7.9 deaths per 100,000 population, respectively. From 1990 to 2015, road traffic injury rates increased from 40.7 to 92.9 per 100,000 population. In contrast, death rates decreased from 19.9 to 9.27 per 100,000 population (17). Applying these figures and using the United Nations (UN) population estimates for the region(18), the pooled estimate came to 106,000 road traffic deaths and 1.1 million injuries in 2015, compared with 126,000 deaths and 260,000 injuries in 1990 (17).

According to the peer review stream to characterize the Police-reported Road Traffic Crashes in Ethiopia over a Six Year Period from the year 2005 to 2011, fatal and injury crashes totaled 66,115 over a six year period. The composition of fatalities and injuries were 22% and 78% respectively. The highest number of crashes (fatal, injury, and property damage) involved drivers in the 18–30 year age group (45%) and in the 31-50 year age group (35%). The drivers in the age group 18-30 were involved in more crashes, followed by the age group 31-50. Crashes were analyzed in terms of vehicle type, and findings indicated that commercial vehicles were involved in 38.4% of fatalities and 37.8% of injuries in the six-year period. Minibus taxis and buses were also involved in 34.5% of fatalities. Vehicle roadworthiness may be a problem, since 36% of imported vehicles and 65% of the vehicle population have been found to have an age of over 15 years. Given these figures, it is not surprising that vehicles aged over 5 years were involved in the majority of crashes in Addis Ababa (19). According to Ethiopian Federal Police Commission, defined as died within 30 days of crash, the reported road traffic fatalities in 2012/2013 was 3, 362 (79% M, 21% F). In Ethiopia, WHO estimated road traffic fatalities was 23,837 (95%CI: 18,528–29,146) and road traffic fatality rate per 100,000 population was 25.3, more than twice the global rate (17.4 road traffic deaths per 100,000 people). Estimated GDP lost for Ethiopia due to road traffic crashes was 0.8–0.9% (4).

## 2.2. Seat belt utilization

### 2.2.1. Benefit of seat belt utilization

Seat-belts limit the movement of vehicle occupants in the event of a crash, dispersing the force of the restraint to reduce the likelihood of serious or fatal injury. They work as part of the wider occupant restraint system that includes airbags, seats, head rests and the vehicle structure itself. Wearing a seat-belt reduces the risk of a fatality among drivers and front-seat occupants by 45–50%, and the risk of minor and serious injuries by 20% and 45%, respectively. Among rear- seat occupants, seat-belts reduce fatal and serious injuries by 25% and minor injuries by up to 75%. Wearing a seat-belt also significantly decreases the risk of being thrown from the vehicle in the event of a crash (4).

According to NHTSA, ejection from the vehicle is one of the most injurious events that can happen to a person in a crash. In fatal crashes in 2014, about 80 percent of passenger vehicle occupants who were totally ejected from the vehicle were killed. Seat belts are very effective in preventing total ejections; in 2014, only 1 percent of the occupants reported to have been using restraints were totally ejected, compared to 30 percent of the unrestrained occupants. Among passenger vehicle occupants 5 and older, seat belts saved an estimated 12,802 lives in 2014. If all passenger vehicle occupants 5 and older had worn seat belts, 15,616 lives (that is, an additional 2,814) could have been saved in 2014. From 1975, when NHTSA's FARS database began, to 2014 seat belts have saved a total of 330,507 lives. If all passengers had worn seat belts during these years, a total of 709,489 (that is, an additional 378,983 lives) could have been saved (20).

The study of preventive effect of seat belt on clinical outcome for road safety injuries in Korea revealed among 23,698 eligible patients, 15,304 (64.6%) wore seat belts. In terms of clinical outcome, no seat belt group had higher proportions of case-fatality and intracranial injury compared to seat belt group (both $P < 0.001$). Compared to seat belt group, AORs (95% CIs) of no seat belt group were 10.43 (7.75- 14.04) for case-fatality and 2.68 (2.25-3.19) for intracranial injury respectively. In the interaction model, AORs (95% CIs) of no seat belt use for case-fatality were 11.71 (8.45- 16.22) in drivers and 5.52 (2.83-14.76) in non-driving passengers, respectively. Furthermore, the demographic characteristics by driving status showed from 23,698 eligible patients, 14,465 (61.0%) were drivers. Among drivers, 76.7% (n=11,091) were wearing seat belts, whereas 45.6% (n=4,213) among non-driving passengers used seat belts ($P<0.001$). In terms of clinical outcome, drivers group had a higher proportion of case-fatality and clinically important injury (both $P<0.001$). In terms of intracranial injury, AORs (95% CIs) comparing the seat belt group and no seat belt group were 3.05 (2.47-3.75) in drivers and 2.06 (1.54-2.76) in non-driving passengers. In terms of clinically important injury, AORs (95% CIs) of seat belt group compared with no seat belt group were 2.64 (2.41-2.90) in drivers and 1.61 (1.43-1.81) in non-driving passengers (21). The study in from March 2010 to March 2011 on seatbelt use and related factors among drivers involved in a motor vehicle crash (MVC) in Iran, Sistan and Baluchistan province revealed unbelted drivers were 7 and 17.4 times more likely than belted drivers to experience injury and death, respectively (22).

In terms of seat belt use practice, in a number of high-income countries, seat-belt wearing rates are high among both front and rear-seat occupants. For example, France has a seat-belt wearing rate of 99% among front-seat occupants and 87% among rear-seat passengers (4). Annual national survey 2009 on the rates of seatbelt wearing among drivers and passengers carried out in Irish roads found that 89% of adults (drivers, front and rear passengers) were recorded wearing a seatbelt – the highest rate recorded to date. 90% of drivers observed on Irish roads observed were wearing a seatbelt, no improvement on 2008 wearing rates (23). The seat belt use survey in Florida in 2014 revealed overall seat belt use rate for drivers and passengers combined measured 88.8% in June 2014 (Standard Error = 0.706%; 95% CI 87.4% - 90.4%) (24). North Dakota's seat belt use survey study revealed the seat belt use rate among drivers in North Dakota was 77.4%, 78.0% and 81.0% for the year 2012, 2013 and 2014 respectively with baseline year (2012) to 2014 difference +2.7 (25). Seat belt use study of Scotland in 2014 also revealed the proportion of drivers observed correctly using a seatbelt was 96.4%, as were 96.7% of front seat passengers and 99.0% of rear seat passengers (26). In 2014, seatbelt use study in vehicles in Barcelona (Spain) showed that the prevalence of people not wearing safety belt in all study vehicles was 10.5% among drivers, 4.6% among front seat passengers, and 32.2% among some of the rear passengers. The prevalence of non-use of safety belt was higher among some of the rear passengers, regardless the type of the vehicle (10).

### 2.2.2. Factors affecting seat belt utilization

#### *2.2.2.1. Driver related factors*

**I. Socio-demographic factors**

The conference presentation in Australia in 2009 on review of the psychosocial and behavioural correlates of adult seat belt use showed that there was strongest association across data sources for age; gender; occupant type; ethnicity; travel location, other driving and health behaviours (27). In 2013, the study in United States showed estimates of the associations between non-seatbelt use as a passenger and key socio-demographic factors. With respect age, non-seatbelt using passengers were significantly less likely to be 50 years or older (AOR = 0.51, 95% CI = 0.38-0.68). Like passengers, drivers who did not to use seatbelts were less likely to be over the age of 50 (AOR = 0.6, 95% CI = 0.44-0.81). In terms of gender, non-seatbelt using passengers were significantly more likely to be male than female (AOR = 1.90, 95% CI = 1.52-2.38). Similar to non-seatbelt using passengers, drivers who did not to use seatbelts were less likely to be over the age of 50 (AOR = 0.60, 95% CI = 0.44-0.81) and were more likely to be male (AOR = 1.87, 95% CI = 1.47-2.38). In terms of family income, non-seatbelt using drivers were significantly less likely to reside in households earning more than $75,000 per year (AOR = 0.55, 95% CI = 0.37-0.83). In terms of education, non-seatbelt using drivers were significantly less likely to have graduated from high school (AOR = 0.74, 95% CI = 0.55-1.00), attended some college (AOR = 0.51, 95% CI = 0.37-0.71), to be a college graduate (AOR = 0.17, 95% CI = 0.11- 0.27) compared to seat belt using drivers (28). One study in Spain also showed that the association of age, sex and seat belt use with the risk of early death after a traffic crash differed depending on which of the two components of risk was considered: the risk dependent on intrinsic severity of the crash decreased as age increased, was lower in women and was slightly higher in drivers who did not wear seat belts (29).

The self-administered report survey among drivers conducted in Trinidad and Tobago indicated that there was a significant difference in the use of seatbelts by the drivers with respect to all the socio-demographic variables i.e. age ($x^2$ = 27.480, $p < 0.005$), sex ($x^2$= 99.223, $p < 0.005$), marital status ($x^2$ = 11.229, $p < 0.05$), education (x2 = 169.350, $p < 0.005$) and years of driving ($x^2$ = 26.913, $p < 0.005$) in 2011 (30). Risk factors for road traffic injuries and road traffic injury prevention training manual of WHO stated that adults age 18-34 are almost 10% less likely to wear a seat belt than adults 35 years or older. Men are 10% less likely to wear seat belts than women. Adults who live in rural areas are 10% less likely to wear seat belts (78% use) than adults who live in urban and suburban areas (87% use) (31). In 2012, non-seatbelt use and associated factors among Thai drivers during Songkran festival also showed correctly used seat-belts reduce the risk of fatality in a crash by approximately 60%, but young male drivers use their seat-belts less often than other groups and are more likely to be involved in crashes (32).

Specific to gender, the survey of seat belt use done in North Dakota showed that males were less likely than females to wear seatbelts (73.9% vs. 89.0%). Male rates were observed to be anywhere from 8% to 27% lower than female use rates for counties surveyed. This trend of higher female seat belt use rates holds for each vehicle type as well – female use ranged from 85.7% to 92.6% over the four vehicle types, while male use ranged from 67.2% to 82.5%. Although drivers outnumbered passengers by a ratio of 4:1, passengers buckled up at a rate of 83.8% compared to drivers at 78.3%. This may be mainly due to the fact that drivers are more likely to be men than women (69.8% vs. 30.2%), and their seat belt use rates are much lower than women – 74.4% compared to 87.4% respectively. Females, regardless of occupant position, consistently demonstrated greater rates of use than males. In 2014, female passengers led seat belt use rates (92.1%) followed by female driver use of 87.4%. Male belt use was considerably less – 70.6% for passengers and 74.4% for drivers (25). The other study done on non-seat belt use in Thailand indicated that the non-use rates were 29.9 % and 23.3 % of male and female drivers respectively (32). The survey results in Florida also indicated that belt usage measured lower among male occupants compared to female occupants by a 5.8%. Furthermore, male passengers were 3.6 points less likely belted compared to male drivers (83% vs. 86.6% respectively). Alternatively, female passengers yielded a slightly higher rate (92.6%) than female drivers (91.9%). More specifically, driver's seat belt use by gender comparison, female drivers were 5.3 points more likely belted compared to male drivers (91.9% vs. 86.6% respectively) (24). In addition, in Scotland, driver seatbelt use proportion by gender had a difference with female had more likely seat belt use (97% in 2009 and 98.2% in 2014 survey) than male use (93% in 2009 and 97.7% in 2014 survey) (26). The Irish study indicated that no significant change was found in male front seatbelt usage rates in 2009 compared with 2008 (87% vs. 87%). However, female drivers were two times more likely to wear their seatbelt compared to male drivers. Male overall front seat wearing rates show no change in 2009; however, the wearing seatbelts for females in the front of the car has increased by a percentage point to 94% in 2009 from 93%. Female drivers were two times more likely to be wearing their seatbelt compared to male drivers (23).

In terms of age, one study in Iran revealed compared to young drivers (under 20 years old), seat-belts were used 3.8 and 6 times more frequently in those aged 21 - 25 and 26 - 30 years, respectively (22). The Scotland study revealed seat belt use across all age categories had a difference with the age group 30-59 years seat belt use 97%, less likely than the age group 17-29 and +60 years use (98.2% and 98.0% respectively) (26). The other study in Australia showed that there was lower seat belt use among younger to middle age (up to 40/44 years) adult occupants compared with older age occupants. This held true across drivers and passengers; males and females (27). The other study of Ohio showed that percentage of seat belt use by the 26-64 age groups was the lowest as compared with other age groups. The passengers under fifteen years old had the highest seat belt use rates. The probability of seat belt use, by age groups at $\alpha = 0.05$ with a chi-square = 2.678, and p = 0.444, means that these differences are not statistically significant (33). The study of safety belt and mobile phone usage in vehicles in Barcelona (Spain) indicated that there was a statistically significant difference in the prevalence of drivers who were not wearing safety belt according to age in all vehicles (p = 0.001), particularly in private cars (p = 0.007). In the bivariate analysis, only the variables age (_65 years old) was significantly related to non-use of safety belt in private vehicles (10). Other study in Korea indicated that driver, middle aged (30-44 yr), male, daytime injured patients were more likely to use seat belts (all $P < 0.001$) (21).

### II. Substance use behaviour

Using data from the 2011 Youth Risk Behavior Surveys from 38 states in United States, the most pronounced differences existed according to students' substance use behaviors. They found that teens who engaged in substance use behavior were among the least likely to buckle up, and as the number of substance use behaviors increased, the likelihood of always wearing a seat belt steadily declined.  For measured risk taking behaviors, students who engaged in the behavior reported seat belt use of about 20 percentage points lower compared with their counterparts who did not engage in the behavior (34).

In term of smoking, one study in seat belt use in the context of health-related behaviors and driver behaviors in a sample of Turkish confirmed that front seat belt use was negatively correlated with smoking frequency (the correlation coefficient between front seat belt use and smoking is -0.12 at $p < 0.01$) (35).

The other study in U.S indicated that in terms of substance misuse, non-seatbelt using passengers were significantly more likely to meet criteria for nicotine dependence (AOR = 1.61, 95% CI = 1.28-2.04), as well as alcohol (AO R = 1.55, 95% CI = 1.16-2.07) and marijuana abuse (AOR = 2.09, 95% CI = 1.38-3.16). In consistent to passengers, non-seat belt using drivers were significantly more likely to be nicotine dependent (AO R = 1.77, 95% CI = 1.38-2.27) and to abuse marijuana (AO R = 2.52, 95% CI = 1.48-4.29), as well as alcohol use (AO R = 1.29, 95% CI = 0.98-1.70) (28). The study of National Highway Traffic Safety Administration (NHTSA) indicated that belt nonuse often is associated with a risky lifestyle, aggressive behavior, and irresponsible attitude. Indeed, on the basis of self-reports, individuals who did not use seat belts or who used them inconsistently reported that they engaged in more behaviors that increase the risk for a crash, including consuming more alcohol and drugs and accumulating more traffic violations, than regular belt users (36).

Drivers who operate motor vehicles after using substance and drinking are less likely than other drivers to wear seat belts. One study conducted in U.S. revealed belted status varied by drug/drug categories. Approximately half of drivers were belted (51.9 %), but this varied from 67.1 % (unimpaired) to 33.0 % (drugs plus alcohol). Compared to the unimpaired (no drugs or alcohol detected), the odds of a driver being unbelted varied: alcohol and cannabis (OR 3.70, 95 % CI 3.44–3.97), alcohol only (3.50, 3.36–3.65), stimulants (2.13, 1.91–2.38), depressants (2.09, 1.89–2.31), narcotics (1.84, 1.67–2.02) and cannabis only (1.55, 1.43–1.67). Unbelted drivers were over 4 times more likely to die in the crash compared to belted drivers (age- and gender-adjusted odds of death, 4.42, 95 % CI: 4.25, 4.60). These are notable for drivers with both alcohol and cannabis who were 3.7 times more likely to be unbelted and drivers on alcohol were 3.5 times more likely to be unbelted. Drivers on depressants or stimulants were twice as likely to be unbelted (37). Khat chewing may not different other substance misuse to affect seat belt use while driving although there is no study confirming that chewing khat is the underlying cause of none seat belt use.

### III. Driver distraction

Driver distraction is an important risk factor for road traffic injuries. There are different types of driver distraction, usually divided into those where the source of distraction is internal to the vehicle – such as tuning a radio, or using a mobile phone, and those external to the vehicle – such as looking at billboards or watching people on the side of the road (38).

Although there are no sufficient studies, some studies revealed driving distraction is a cause for non-seat belt use of drivers. For example, one study in the city of Doha, Qatar mobile phone use was significantly lower among drivers who were wearing a seat belt as compared to drivers who were not (3.5 % versus 17.9 %, $p < .001$) (13). The other study in Saudi Arabia revealed after controlling for grade those who were willing to engage in activities even when they were dangerous, those who assumed there was no harm in not wearing seat belt (AOR = 2.77, 95% CI = 1.24, 6.21, p < =.05), and those who used a mobile phone while driving (AOR = 2.96, 95% CI = 1.41, 6.23, p <= .01) were at nearly three times higher risk for practicing Tafheet (dangerious driving activity) (39).

### *2.2.2.2. Vehicle related factors*

Distracted driving and seat belt use study in New York City in 2014 reavealed there is a noticeable difference in driver's use of a seat belt by type of vehicle. Among the study vehicle types taxi and city bus drivers were the leading and the second leading vehicle drivers who were not wearing a seat belt respectively. Almost half of the taxi drivers (45.6%) and city bus drivers (30.2%) were observed not wearing a seat belt respectively. In general, commercial vehicle operators displayed a greater tendency not to wear a seat belt than non-commercial drivers (40).

In U.S.A the literature review study of seat belt use and characteristics of nonusers showed that unbelted drivers are more likely to be driving older rather than newer vehicles. Belt use is highest among drivers of vans/minivans, sport utility vehicles, and passenger cars, with belt use in pickup trucks significantly lower than other vehicle types. Drivers of light commercial vehicles use seat belts less frequently than drivers of passenger vehicles, even when age, sex, and vehicle type are accounted for (36). The roadside observational study in Qatar revealed vehicle type was significantly associated with seat belt use ($p < .001$) and with mobile phone use ($p < .001$). In particular, drivers of sport utility vehicles (SUVs) demonstrated lower seat belt use (60.2 %) and higher mobile phone use (13.6 %) compared to drivers of other vehicle types (13). The study in Ohio revealed SUV occupants had the highest seat belt usage rate at 81.1 percent. On the other hand, pickup truck occupants were the lowest seat belt users with seat belt use rates of 64.9 percent. The likelihood of occupants of pickup trucks and vans not using seat belts were significantly higher than that of passenger cars and SUV occupants at $\alpha = 0.05$ with a chi-square = 9.814, and $p = 0.020$. The descriptive analysis exhibits that there were 47 van occupants who used seat belts, which is equivalent to 71.2 percent of all van occupants; while there were 63 (64.9 percent) belted pickup truck occupants (33).

#### *2.2.2.3. Driving environment related factors*

**A. Time**

The roadside observational study in Qatar revealed seat belt use was significantly higher in the early morning (7.00 am to7.59 am) and early afternoon (3.00 pm to 3.59 pm) than in late morning and late afternoon ($p < .001$) (13). The other interesting observation in Ohio indicated that seat belts were being more used in the evening trips than for both afternoon and morning trips. The seat belt usage rates were lowest for the afternoon trips. It was observed that 77.6 percent of vehicle occupants used seat belts in the evening trips, and 76 percent for the morning trips and 69.9 percent for the afternoon trips. The difference in the likelihood of seat belt use by the time period of observation was not statistically significant at $\alpha = 0.05$ with a chi-square = 3.144, and $p = 0.208$ (33). Although seat belt use was not considered, a peer review stream study in Ethiopia illustrated that the majority of crashes occurred during daylight hours. Crashes increased rapidly from 6:00am to 7:00am. Numbers were more or less steady until 8:00 pm after which they declined in most cases, though not as steeply as the morning increase (19).

In terms of day of a week, in Scotland, the study of seatbelt and mobile phone usage survey in 2014 revealed at all study sites similar levels of seatbelt use were found on weekdays and at weekends for car drivers and front seat passengers; however there was a notable decrease in the wearing rate amongst rear seat passengers from 100% to 95.2% (26). This may not be the case in all countries including Ethiopia. But, the study in Ohio, in terms of day of the week of observation, the average seat belts use for weekdays was slightly lower than that of weekends. It was observed that 76.9 percent of vehicle occupants used seat belts in the weekends while for weekdays the use rate was 74.9 percent. The probability difference of seat belts use by day of observation was not significant at $\alpha = 0.05$ with a chi-square = 0.082 and p = 0.774 (33).

**B. Route/Roadway of driving**

According to the literature review of potential mechanisms underlying the decision to use a seat belt conducted in U.S.A, some differences in seat belt use have been found in studies that make observations on "rural" and "urban" roads. Use rates are lower in rural areas than more urban ones, but it is unclear exactly what causes this. Similarly, drivers on highways use belts more than drivers on city streets. This finding may overlap with the urban/rural difference reported above, but the comparison here is road or traffic type, and not "urbanicity" per se. Whether the lower of belts while traveling use on city streets is a function of drivers who are also city dwellers, or something about the act of driving in a city compared to on a highway (e.g., perhaps perceived reduced risk due the slower speed) would have to be investigated through more complex multivariate models. Higher speeds correlate with higher belt use (41).

Other study in Florida indicated that seat belt use differed by road way type. Seat belt use results conducted in Florida shows that belt use measured was highest on Minor Arterials (92%) followed by Principal Arterials (90.6%), all of which typically yield higher traffic densities with higher rates of speed. Observers measured the lowest belt usage on local roads (83.8%), which are less frequently travelled roadways, and usually found within neighborhoods in city limits (24). In Scotland, seatbelt and mobile phone usage survey result showed seatbelt use was above 96% for drivers for all categories of road and area, with a slightly lower wearing rate found on minor roads (94% in 2009 and 98.3% in 2014 survey) than major roads (91% in 2009 and 98.5% in 2014 survey) in urban areas (26). In North Dakota in 2014 seat belt use survey, frequency of seat belt use was highest on primary roads/limited-access highways (87.0%) followed by local roads/paved non-arterial streets (77.7%) and secondary roads/main arteries (73.1%) (25). The observed seat belt use rate for drivers on rural highways in North Dakota rural roads in 2015 survey was 67.2%. This use rate is significantly different than the use rate in rural towns at 43.0%. Both use rates fall well below the NOPUS estimate of about 81%. Rural highway seat belt driver use rates had increased in the previous six years before dipping in 2015. Use in towns has ranged from 35.6% to 46.0%. Comparing 2015 to the previous three-year average to the average, highway use increased from 61.3% to 69.3% and use in town from 41.2% to 42.4%. The percentage point increase of 8.0 for highway use is a 13% increase and the 1.2 percentage point increase translates to a 3% rise in town use, respectively. With regard to the year-to-year movement, the decrease in driver use on rural highways from 2014 to 2015 is significant at the 99$^{th}$ percentile ($X^2$=8.9258, ρ=0.003, n=6,801). The increase from 2014 to 2015 for seat belt use in towns is statistically significant at the 95$^{th}$ percentile ($X^2$=4.9210, ρ<0.03, n=4,753) (42).

### C. Proper seat belt use law enforcement

It is well documented that countries or states with primary seat belt laws enforcement have much higher usage patterns. In Yerevan, Republic of Armenia revealed the estimated seat belt usage increased 10-15% points after enactment of primary seat belt laws in the period from April 2009 to May 2010 follow-up survey (43). Reviews of evidence regarding strategies to increase the use of safety belts of American Journal of Preventive Medicine indicated seat belt laws increase seat belt use and reduce traffic fatalities in the general population (44**)**. As of June 2015, 34 states and the District of Columbia had primary enforcement seat belt laws (primary laws), which allow law enforcement to stop drivers and issue tickets solely because someone is not belted, and 15 states had secondary enforcement seat belt laws (secondary laws), which allow tickets to be issued only after a driver has been pulled over for another reason. Some states with secondary laws have a primary enforcement provision within the law for children and youth, typically up to age 17 or 18 years. New Hampshire, the only state without a seat belt law for adults, has a primary enforcement provision for drivers and passengers < 18 years as part of their child passenger safety law (45).

One study in London indicated that 15.3% of drivers were not wearing a seat belt and 2.5 % of drivers were using a hand held mobile phone while he or she passed the observer. Both of these proportions were slightly higher in the penalty phase of observation than during the grace period (noncompliance with seat belt 15.8% *v* 14.8%; use of mobile phone 2.6% *v* 2.3%). The model for not using seat belts and for hand held mobile phone use showed that breaking one law was significantly associated with increased likelihood of breaking the other. For example, 3.6% of drivers not wearing seat belts also used a hand held mobile phone (compared with 2.3% of those wearing a seat belt), and 22.0% of drivers using a telephone were not wearing a seatbelt (compared with 15.1% of those not using a mobile phone). Overall, phase (grace or penalty) had only a small effect on both behaviours, and drivers were more likely to wear a seat belt and not to use a mobile phone when the traffic was heavier (46).

***Conceptual framework for determinants of drivers proper seat belt utilization***

The following figure (figure 1) shows the factors affecting seat belt utilization and how they affect to use it. Individual factors (such as sex, age, smoking, khat chewing and driver distraction), vehicle related factors (such as vehicle type, vehicle seat and seat belt status) and driving environment related factors (such as time, day and route of driving and presence of seat belt use enforcement) affect seat belt utilization independently among drivers while driving. These factors (individual, vehicle and driving related factors) also have relationship between each other to affect seat belt utilization in combination. For example, driving environment related factors may be intermediate factors that are caused/ modified by individual factors to affect seat belt use among drivers while driving.

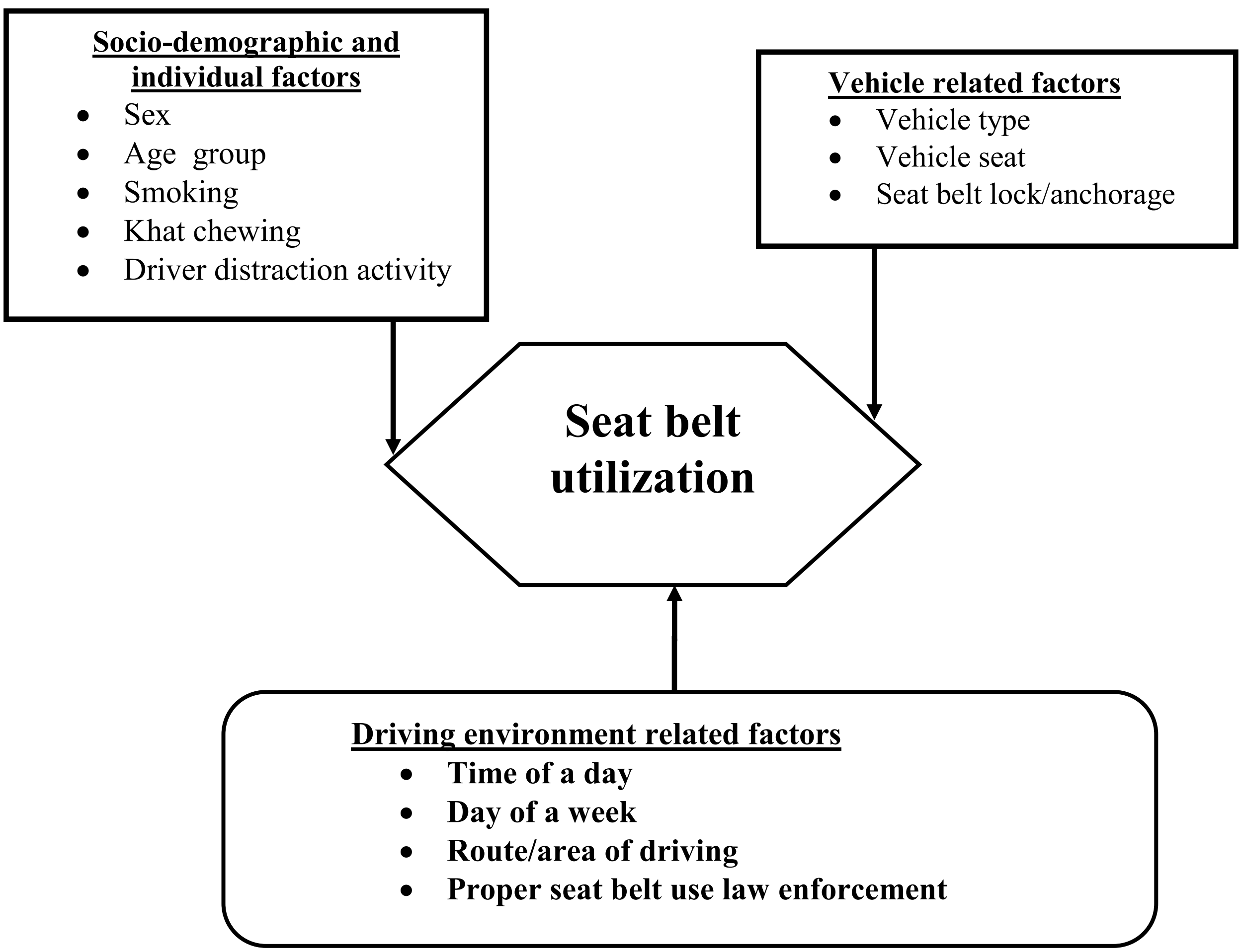


**Figure 1:** *Conceptual framework: Analytical framework for the in-side vehicle observational study of seatbelt use and its associated factors among public transport drivers in the city of Addis Ababa, Ethiopia, 2016/17. Source: Adopted by reviewing different literatures.*

## 3. OBJECTIVE

### 3.1. General objective

- To assess proper safety seat belt utilization and observable factors associated with none utilization among public transport drivers in Addis Ababa city, Ethiopia.

### 3.2. Specific objectives

1. To measure the prevalence of proper safety seat belt usage
2. To identify observable factors associated with none use of proper safety seat belt

# 4. METHODS AND MATERIALS

## 4.1. Study setting

The study was conducted from January to February 2017, at 20 randomly selected urban and semi-urban roads from the total of 558 main city roads (about 159 PAS, 137 SAS and 262 CS streets) found within Addis Ababa city, the capital city of Ethiopia. Urban/main roads are major/principal arterial streets (PAS) of the sub-city which provide the traffic flow in the continuous base and/or connect one sub-city to other sub city (ies) and semi-urban roads are sub-arterial or collector streets (SAS and CS) of the sub-city which provide an access to arterial roads or move from local areas to principal arterial streets and have lower level of travel mobility than principal arterial streets. Semi-urban streets of sub-city move or pass through/feed urban/main roads (principal arterial streets) from residential or local roads found within the sub-city.

In the year 2013, the city had a total of 1,807 km asphalt road, 1,777 km gravel and 277 km cobble stone each with seven meter width. The road network coverage rose from 9.8% in 2001 to 13.7 % in 2004 E.C. Road transport service helps for swift movement of people and goods from one location to another. Taxis, mid and public buses dominate public transport in Addis Ababa. The total number of buses, total number of buses in service and total number of peoples used the city buses are 756, 708 and 153,821,429 respectively with 450,000 travelers per day (47).

At present Ambessa bus enterprise provides city bus services on 119 routes and with more than 1,240 kms of bus lines within the city and the neighboring towns. An annual passenger transported by Ambessa bus was 102 million passengers in 2009 with the daily volume of passengers served by the enterprise was 280,378 and 295,578 passengers in 2009 and 2010 respectively. The daily volume of passenger operational bus was 1,268 in 2009 and currently, the distance covered per operational bus was 145 kms. The importance of mini bus taxis as motorized mode of public transport is evident in their increasing modal share and currently, their number is about 10,000 operate in the city and carry 1.4 million passengers trips daily. Privately operated higer buses numbering 470, which were introduced in 2008, carry about 1.7 million passengers daily. In addition, long distance buses and intermediate buses also provide city public transport services (about one million passengers) in order to alleviate shortage of public transportation during the peak hours (7).

### 4.2. Study design

A cross-sectional in-side vehicle direct naturalistic observational study design was conducted in Addis Ababa, Ethiopia in 2016/17 on the utilization of seat belt among public transport drivers.

### 4.3. Source population

Source populations were all public transport vehicle drivers (Taxi and city public transport buses- Ambessa or Mid/Midi buses) that move and work to transport passengers at Addis Ababa city public roads.

### 4.4. Study population

The study populations were drivers of public transport vehicles (Taxi, Ambessa buses and Mid/Midi buses) who were driving these vehicles at selected public road locations of Addis Ababa to give public transport business services for passengers.

**Inclusion Criteria:** The study included all public transport vehicles (Taxis, Ambessa and Mid/Midi public transport buses) that moved and worked to load and unload passengers at the selected public roads of the city to give public transport business services for passengers.

**Exclusion Criteria:** The study excluded public transport vehicles that did not give public transport business services for the general population of the city and regional and long distance buses that did not load and unload passengers for short distance at the selected public roads except at their terminals.

### 4.5. Sample size determination

The theoretical sample size of vehicles for in-side vehicle observation was determined as follows by assuming the expected proper seat belt use prevalence among drivers was 50% since there was no previous prevalence study of proper seat belt use observed in-side vehicles. The 95% confidence interval (CI), a degree of precision/standard error/margin of error (d) of 4 % and a design effect (deff) of 1.5 were also considered for sample size determination. There was no need of correction formula to minimize sample size so that the study or source population size (number of public transport vehicles) in Addis Ababa city is greater than 10,000.

$$\mathbf{n} = \frac{(Z\alpha/2)^2 \, P\,(1-P)*deff}{(d)^2} = \frac{(1.96)^2 0.5(1-0.5)*1.5}{(0.04)^2} = \mathbf{600}$$

### 4.6. Sampling procedure

A multistage sampling method was used for in-side vehicle observational study participants/drivers since they are homogeneous on public roads and public roads are scattered in all sub-cities. First stratify Addis Ababa city into sub-cities, then cluster/group roads into urban/main roads and semi-urban/minor roads for each sub-city. Urban/main roads are major/principal arterial streets of the sub-city and/or connect one sub-city to other sub city (ies) and semi-urban roads are minor residential streets/arterial roads (sub-arterial or collector streets) pass through/feed urban/main roads found within the sub-city. One main/urban and one semi-urban road per sub-city were selected randomly as the observation locations/roads for each sub-city. Thus, for all 10 sub-cities, there were 20 randomly selected public roads (10 urban and 10 semi-urban roads) for observation locations in the city.

The calculated total sample size, 600 vehicles for observation was equally distributed to all or 20 randomly selected roads in Addis Ababa. One data collector per sub-city was recruited to collect sample vehicles for observation through the two randomly selected observation locations/roads (1 urban road and 1 semi-urban road) of each sub-city. For the two selected public roads of each sub-city, the data collector took six days to collect 60 vehicle observations. Three days (two weekdays and one weekend) per randomly chosen observation location per sub-city were required to collect 30 sample vehicles for observation. From this information we can understand that the six days of a week was used for observation for data collector per sub city after excluding one weekday (excluded one day from Monday to Friday) randomly and then we distributed 2 weekdays and 1 weekend randomly for selected observation location/road per sub-city. Though the data collection was finished in one week by ten data collectors assigning one per sub city, the time was extended to two weeks for the purpose of supervision and observation form/checklist collection from the data collectors: we divided the ten sub-cities equally and then five sub-cities' observation locations with five data collectors by assigning one data collector per sub-city in one week and the other remaining five sub-cities' in next week.

The observation period per day was from 7:00 AM – 7:00 PM which was divided into three time category: from 7:00 AM - 11:00 AM, 11:00 AM – 3:00 PM and 3:00 PM – 7:00 PM. The data collector took 15-30 minutes per one in-side vehicle observation and had 30 minutes break time to search and select randomly the next eligible vehicle. In the morning, four vehicles was observed: the first observation from 7:00 AM -8:00 AM with a break time of 30 minutes, the second observation from 8:00 AM-9:00 AM with a break time of 30 minutes, the third observation from 9:00 AM-10:00 AM with a break time of 30 minutes and the fourth observation from 10:00 AM- 11:00 AM with a break time of 30. But in the noon, three vehicles were observed: from 11:00 AM-3:00 PM and in the evening time, three vehicles also were observed: from 3:00 PM- 7:00 PM. One hour within the noon time (11:00 AM-3:00 PM) and one hour within the evening time (from 3:00 PM- 7:00 PM) was allowed as a free time for the data collector to have lunch and tea break respectively. According to this time interval principle, the data collector collected10 sample vehicles for observation per day.

Before starting the trip in the vehicle, the data collector needed to be on the appropriate front seat or near to the driver to observe him/her clearly to fill the observation form. He/she was sure that driver observation was clear to fill the observation form/checklist. Finally, he/she was sure that the observation location had to be within the sub-city to enter into the vehicle for observation and to search/wait and then return to the other end of selected road by another eligible vehicle through the selected observation location/road, not going further from the boundary of his/her assigned and selected sub-city's observation location/road to observe the sampled vehicle. The following figure (figure 2) depicts a sampling frame for this sampling procedure.

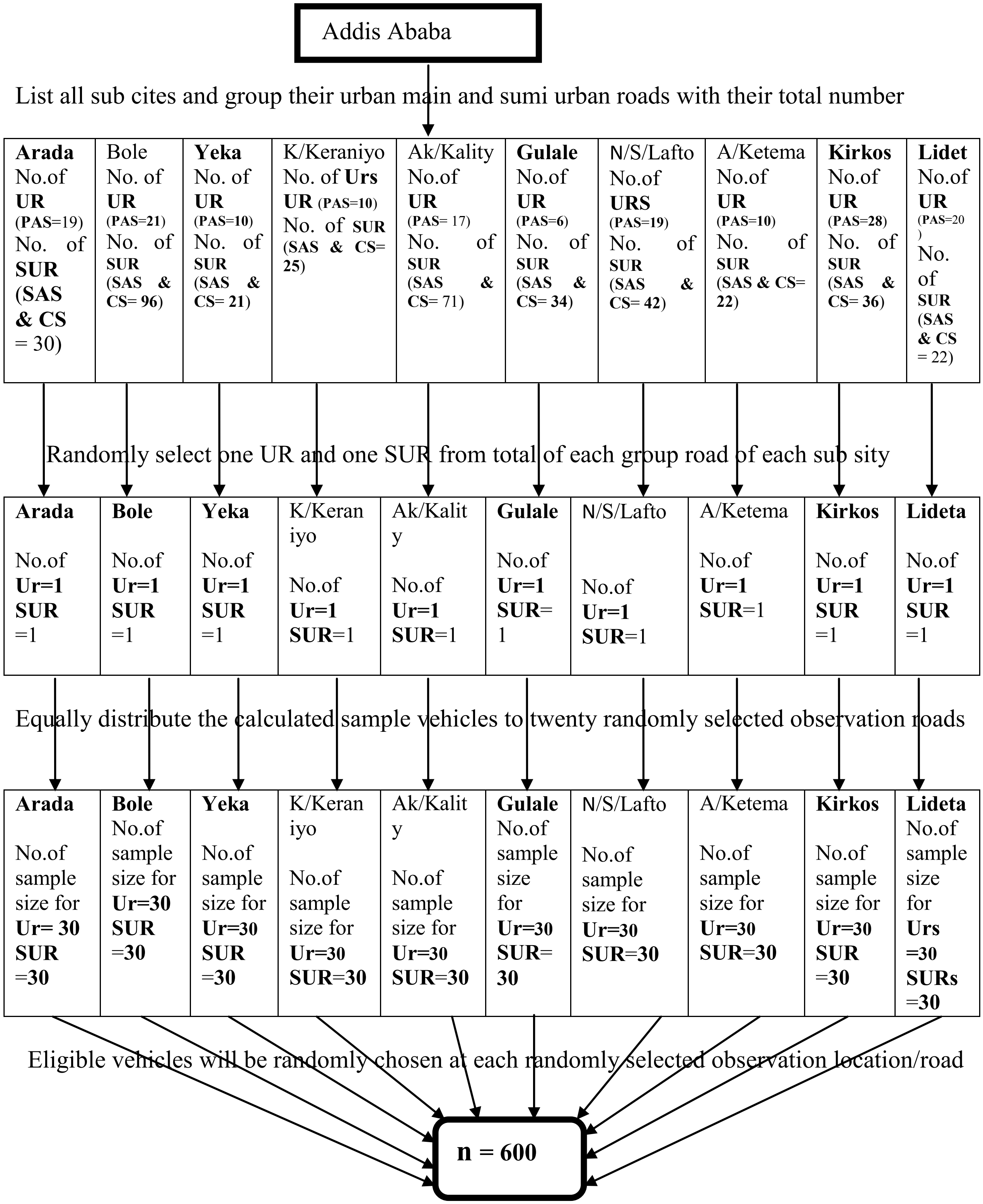


**Figure 2:** *Sampling frame: Schematic presentation of the sampling procedure for in-side observational seat belt use study among drivers used in the study area, Addis Ababa city, Ethiopia, 2016/2017.*

### 4.7. Data collection tools and procedure

The data collection tool was a road in-side vehicle observational data collection form/checklist for the study population and the data was collected after entering in the eligible vehicle for the measurement of use of safety belt in vehicles and factors affecting its use. (See Annex II, page no. 49).

A loading or unloading point of passenger(s) along the selected observation road segments was used as point of data collector entrance and exit for eligible in-side vehicle observation. The data collectors conducted direct in-side vehicle observation of the eligible/included vehicle by random selection through those selected observation sites/segments of each sub-city to fill the observation form. The observations was made when the eligible vehicle start the journey at point of data collector entrance to the next return/exit point of the selected observation site where he/she exited the vehicle at the next return point/fermata or when vehicle stopped to pick or exit the passenger(s) through the selected observation site, then returned to the starting point/site by other eligible vehicle for other observation through that selected observation site. For each sub-city for each data collector, each entrance into and exit from each eligible vehicle and journey of observation had to be within the selected observation location, not beyond the selected observation location of the sub-city. This procedure was the same and was used by all data collectors for all selected observation sites of each sub-city. The study was randomly selected the eligible vehicles through the chosen roads in order to select and enter into the eligible vehicles for observation.

Observations were occurred from within eligible vehicle and data collector needed to be close the driver within the vehicle to record necessary data. For each eligible vehicle, data collector recorded its type (Ambessa bus or mid/midi bus and taxi) and seat/seatbelt status (distorted/non distorted); driving-related variables: time of observation (morning, afternoon, and evening), day of a week (weekend days/week days), route and proper seatbelt use enforcement; and the driver's variables: whether the driver was wearing a proper seat belt (yes/no), driver distraction(yes/no), approximate age (18-34/35-64/ $\geq$ 65 years old), sex (male/female), smoker and khat chewer. He/she also noted if a driver's status couldn't be discerned/recognized, usually because of vision obstacles. He/she was not recorded registration numbers or other details of vehicles or drivers.

### 4.8. Data quality management

Preparation of data collection protocol (see Annex III, page no. 51), checklist, training of data collectors and controlled data entry was used for as a data quality management system. The data collection protocol was prepared to guide data collectors how to observe in-side vehicle and fill observation data collection form. Test sites were selected to represent the types of sites and situations we could expect to encounter in the vehicle observation. No actual sites in the sample of roadway segments were used as test sites.

After test, data collection was made by in-side vehicle observation for eligible vehicles which were driven through randomly selected observation sites between 7:00 A.M. and 7:00 P.M. for selected times (i.e., morning, noon, and evening), including weekdays and weekends. We observed ten vehicles per day per observation site per sub-city. Four vehicles in morning, three vehicles in noon and three vehicles in evening time category were observed respectively. We took 15-30 minutes to observe one eligible vehicle and to fill the observation form after that we had a break time of 30 minutes between two consecutive observations to search and to select randomly another next eligible vehicle.

Before starting the trip in the vehicle, we needed to be on the appropriate front seat or near to the driver to observe him/her clearly to fill the observation form. We were sure that driver observation was clear to fill the observation form. Finally, we were sure that the observation location must be within the sub-city to enter into the vehicle for observation and to search/wait and then return to the other end of selected road segment by another eligible vehicle through the selected observation location, not going further from the boundary of the assigned and selected sub-city's observation location to observe the sampled vehicle. Though the data collection was finished in one week by ten data collectors assigning one per sub city, the time was extended to two weeks for the purpose of supervision and observation form/checklist collection from the data collectors.

Steps were taken to ensure quality control with respect to data entry. Database records were verified to match the number of observations. An accuracy check was done on a systematic sample of records and was measured at greater than 99.9% for every field. Errors were discovered during quality assurance checks and were corrected prior to completion of all analyses.

Additionally, to ensure the quality of the data, first information were given to transport authority on the objectives, relevance of the study, methods, and confidentiality of information for drivers and registered vehicles, and then permission received from the traffic department to conduct the observational study when requested. The data collection tool was prepared in English form and no need of translation in to Amharic, and then back to English because the study was done by the data collectors (at least they have diploma degree) who understand English observation form and conduct the study by themselves, neither they administered the questionnaire to drivers nor interviewing them as a participant interview.

## 4.9. Data processing and analysis

After the data collection was completed; the quantitative data was checked for completeness and consistencies, then entered and cleaned using EPI Info version 3.5.3 statistical software and exported to SPSS 21 for analysis. Data was presented using frequency tables. All vehicles were summarized using frequency distributions. The prevalence of proper safety seat belt use among drivers was computed along with their 95 % confidence intervals. The association between none utilization of proper safety seat belt with the estimated age of the driver, driver smoking, driver khat chewing, driver distraction, the type of vehicle, observation day and the time of day were assessed by bivariate and multivariate analysis. All analyses were done using SPSS (version 21). A p-value of 0.05 or less was considered for statistically significant association. The variables that had p-value $< 0.2$ in bivariate analysis were selected for multivariate analysis in binary logistic regression.

## 4.10. Measurement variables

- ❖ **Outcome variable:**
  - **Driver proper seat belt utilization**
- ❖ **Independent variables:**

- **Driver related variables:**
  - Sex
  - Age group
  - Smoking
  - Khat chewing
  - Driver distraction
- **Vehicle related characteristics:**
  - Vehicle type(ambessa/lion bus,mid/midi bus or taxi/mini bus taxi)
  - Vehicle seat/seat belt status
- **Driving environment related characteristics:**
  - Time (morning time, noon time and evening time)
  - Day of a week (weekday/weekend)
  - Routes of driving
  - Seat belt use law enforcement

### 4.11. Operational definitions

**Proper seat belt utilization:** This variable is a driver seat belt use as a binary variable (yes/no). Proper utilization of seat belt is wearing correctly locked proper seat belt not damaged/distorted and it is tightly fastened in such way that it passes through the shoulder and chest/across the front of the body. Otherwise he/she will be considered as non-proper seat belt user (either improper seat belt user or unbelted).

**None seat belt utilization**: This is the opposite of seat belt utilization which either unbelted (never utilize seat belt) driver or incorrectly/improperly belted condition of driver (either seatbelt is not locked or utilized loosely) while driving.

**Public transport vehicle type:** This variable indicates the type of vehicle giving business public transport services in Addis Ababa and was recorded as: city public transport bus (large city or mid/midi public transport bus) or taxi (mini bus taxi) during sample vehicle observation.

**Seat belt distortion status:** Seat belt is considered as distorted/deformed or changed to use it securely if original mounting location of seat belt or its anchorage changed/distorted or seat belt anchorage modification by oldness or by different things different from its original form to a motor vehicle. Vehicle driver seat distortion stutus also reports the status of distortion/deformation of the vehicle seat that affect seat belt performance to use it securely as binary variable (yes/no).

**Observation road type:** This is the street type considered as semi-urban road (including sub-arterial street (SAS) and collector street (CS) away from main/urban roads but near and connected into the principal streets) and major/urban road including the main traffic density flow/busier area within the city and it is considered as principal arterial street (PAS).

**Observation day:** This variable is the day when the data will be collected. It will be coded in a binary form either as weekday or weekend depending on the day when the data will actually be collected, that is, Monday through Friday as weekday and for Saturday and Sunday as weekend.

**Time of observation**: The time of observation variable will be divided into three time periods, that is, morning time (from 7.00 am to 11.00 am), noon time (11.00 am to 3.00 pm) and evening time (3.00 pm to 7.00 pm). These time frames will be coded as AM, Noon, and PM, respectively.

**Seat belt use law enforcement:** when the driver is unbelted and will fasten due to fear of safety belt use laws enforcement of traffic police. This variable will be divided as primary or secondary safety belt laws enforcement observed. Primary safety belt use enforcement allows police to stop drivers solely for being unbelted. Secondary safety belt enforcement permits police to ticket/give warn unbelted drivers only if they are stopped for other reasons such as speeding.

**Distraction:** This variable is a driving distraction as binary variable (yes/no). Driving distraction is considered as driver distraction while the driver is tuning a radio, or using a mobile phone, or talking with the passenger, or looking at billboards or watching people on the side of the road through the side window of the vehicle.

**Smoking:** The driver is considered as a smoker if he/she smoking cigarette while driving or any piece of cigarette is seen in the vehicle at which near to the driver/front seat or he/she is just seen smoking cigarette before entering the vehicle and then driving the vehicle. Otherwise the driver is not smoking while driving.

**Khat chewing:** The driver is considered as a khat chewer if he/she is chewing khat while driving or any khat leaf/leaves is/are seen in the vehicle at which near to the driver/front seat or he/she is just seen chewing khat before entering the vehicle and then driving the vehicle. Otherwise the driver is not chewing khat while driving.

### 4.12. Ethical consideration

This study was considered free/exempt from requiring informed consent because 1) no study records included private information about drivers (name, sex, age, etc.), and 2) it was not feasible to obtain consent of drivers while they were operating vehicles. The data was not analyzed by or shared with vehicle owners/companies. Thus, the study result did not negatively affect study participants rather they will be indirectly benefited from the implementation of ultimate goal of the study.

Ethical approval for the research was obtained from Addis Ababa University, College of Health Sciences, and School of Public Health Research Ethics Committee. Official letters written by the university were in our hand to give the F.D.R.E. Ministry of transport and communication, Ethiopian Federal Police Commission, Ethiopian Road Authority, Addis Ababa City Road Authority Bureau and Addis Ababa City Administration when requested during data collection. So that permission could be secured at all levels.

Although there was no direct benefit for public transport drivers from the study but benefit traffic safety bodies and other stakeholders, first information was ready to be given to transport authority on the objectives, relevance of the study, methods, confidentiality of information for drivers and registered vehicles, and to get permission from the traffic department and the concerned authorities for the precaution (safety) of data collectors to conduct the observational study. Because there was no need of participant interview, informed consent and questionnaire distribution as it was a naturalistic observational study and the information about driver and vehicle registration was not recorded, the study was ethically acceptable.

### 4.13. Dissemination of results

Final result of this paper will be given to School of Public Health, Addis Ababa Health Bureau and the F.D.R.E. Ministry of transport and communication, Ethiopian Federal Police Commission, Ethiopian Road Authority, Addis Ababa City Road Authority Bureau and Addis Ababa City Administration and also given for the sponsor and other governmental and non-governmental organizations (NGO) responsible in road traffic safety development. Publication in a reputable journal and presenting it in conferences will be considered.

# 5. RESULTS

## Driving environment and vehicle conditions

600 public transport vehicles were observed at 20 public road segments through direct in-side vehicle observation in Addis Ababa in February 2017. The time range to observe one vehicle was 15-30 minutes through the selected road. Half (50%) of vehicles were observed at principal arterial (PAS) public road segments and all observed vehicle drivers were not encountered any seat belt use enforcement for being unbelted or to check improper or proper safety seat belt use during our in-side vehicle observation at all observation public road segments. 240(40%) and 400(66.7%) of public transport vehicles were observed in the morning time (from 7:00AM-11:00AM) and weekdays respectively (***Figure 3 & 4***). Out of all observed public transport vehicles, 459(76.5%) of public transport vehicles observed were taxi; 168(28.00%) and 248(41.3%) of all vehicles observed had distorted driver seats and safety seat belts, respectively.

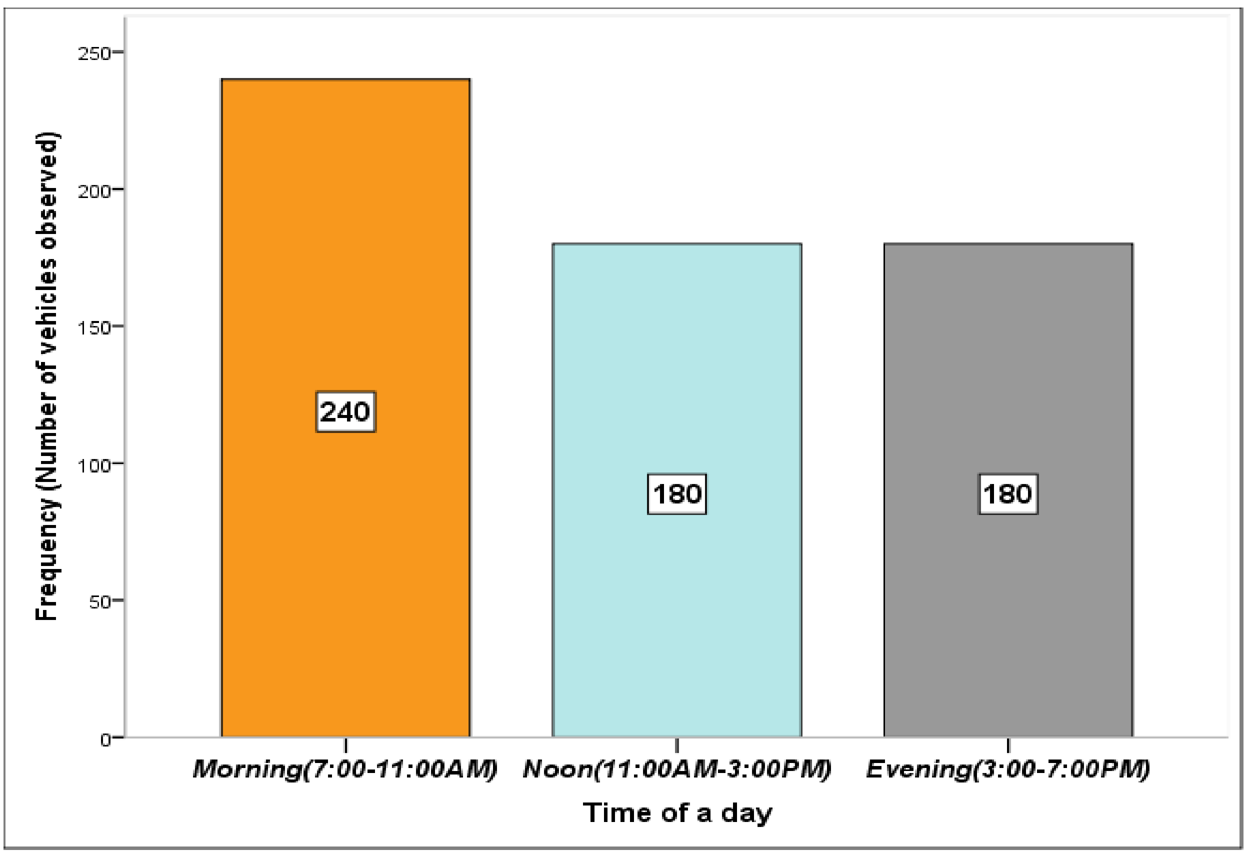


**Figure 3:** ***Number of public transport vehicles observed inside vehicle by time categories in Addis Ababa, Ethiopia, February 2017***

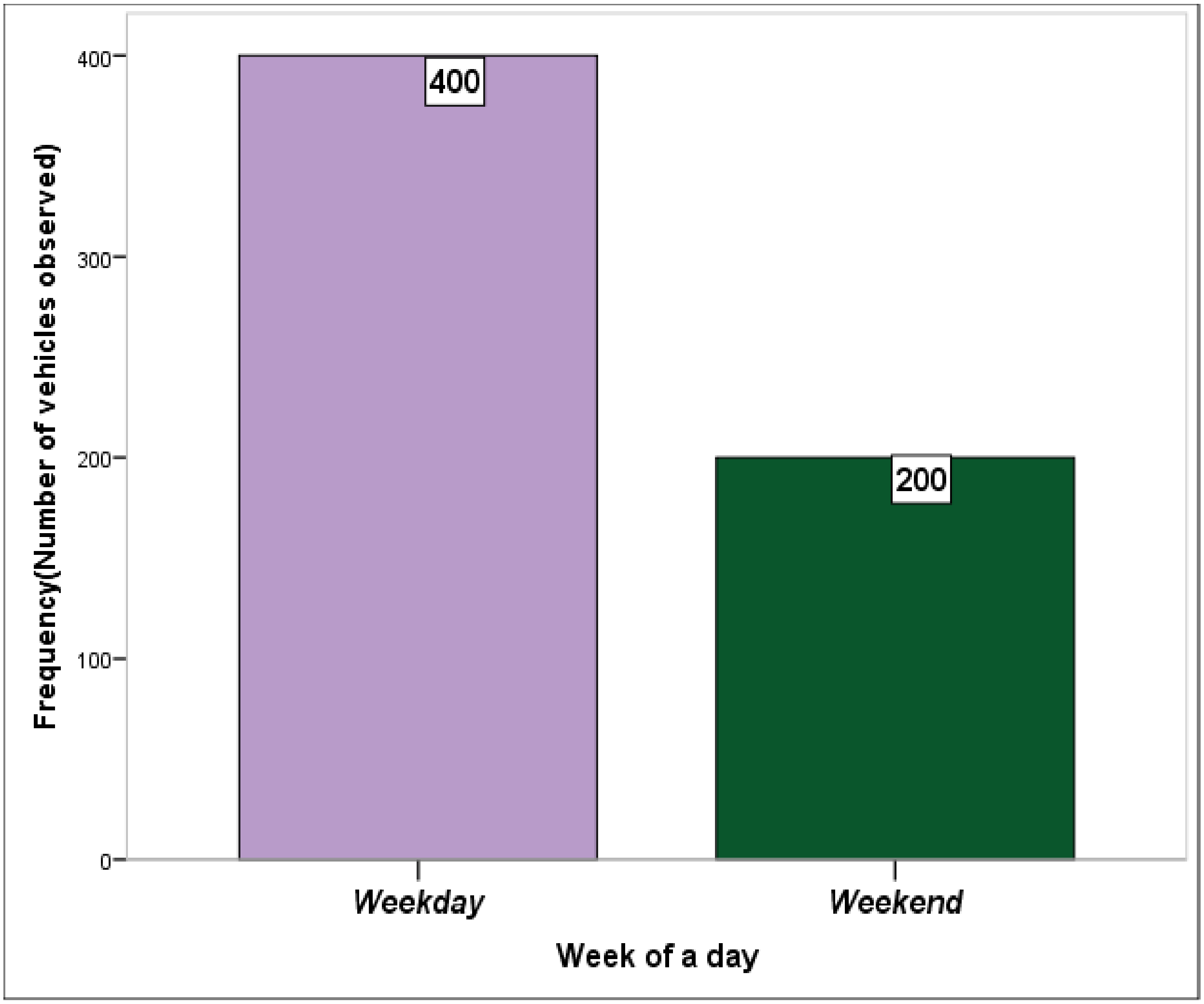


**Figure 4:** ***Number of public transport vehicles observed inside vehicle by week of a day in Addis Ababa, Ethiopia, February 2017***

## Driver related characteristics

Out of the total 600 public transport drivers observed in-side vehicles, almost all of them (99.7%) were males and about 341(56.8%) of drivers were in the age group of 35-64 years. Among the observed drivers, about 3(0.5%) were smoking cigarette,34(5.7%) were chewing khat and 273(45.5%) were doing one or more of driver distractions (tuning radio/music, mobile phone use, talking with passengers or looking at billboards or watching people on the side of the road through the side window of the vehicle) while driving (***Table 1***).

**Table 1:** ***Observed individual related charactersitics of public transport drivers in vehicles in Addis Ababa, Ethiopia, February 2017***

| Variables | Observed counts (n=600) | Percent (%) |
|---|---|---|
| **Sex** | | |
| Male | 598 | 99.7 |
| Female | 2 | 0.3 |
| **Age group** | | |
| 18-34 | 202 | 33.7 |
| 35-64 | 341 | 56.8 |
| >=64 | 57 | 9.5 |
| **Smoking cigarette** | | |
| No | 597 | 99.5 |
| Yes | 3 | 0.5 |
| **Khat chewing** | | |
| No | 566 | 94.3 |
| Yes | 34 | 5.7 |
| **Doing driver distraction** | | |
| No | 327 | 54.5 |
| Yes | 273 | 45.5 |

## *Drivers' safety seat belt utilization status*

The overall prevalence of proper safety seat belt utilization among public transport drivers observed in-side vehicles in Addis Ababa was 47.5 % with 95% CI=43.3, 51.3. The rest 52.5 % were none effective safety seat belt utilizers with 95% CI=48.7, 56.7. The prevalence of non-proper safety seat belt utilization was the sum of the improper seat belt utilization (unlocked utilization of seat belt and/or very loosely utilization of seat belt), 35.7 % and unbelted (never utilized safety seat belt), 16.8 % during observation (***Figure 5***).

The prevalence of proper seat belt utilization observed by the $65^{+}$ age group was the highest (59.6%) as compared with the age 35-64 group (44.3%) and 18-35 group (49.5%). Khat chewer, distraction engaged and city public transport bus drivers were relatively lower proper seat belt users (***Table 2***).

All female drivers and all cigarette smoker drivers observed were proper seat belt utilizers and none proper seat belt utilizers, respectively. Driver proper seat belt utilization observed was the lowest (45.0%) around the evening- 3:00-7:00 PM as compared with the morning-7:00-11:00 AM (49.2%) and the noon time-11:00 Am-3:00 PM (47.8%). Drivers in weekends were lower proper seat belt utilizers than drivers in weekdays (45.5% vrs.48.5%).

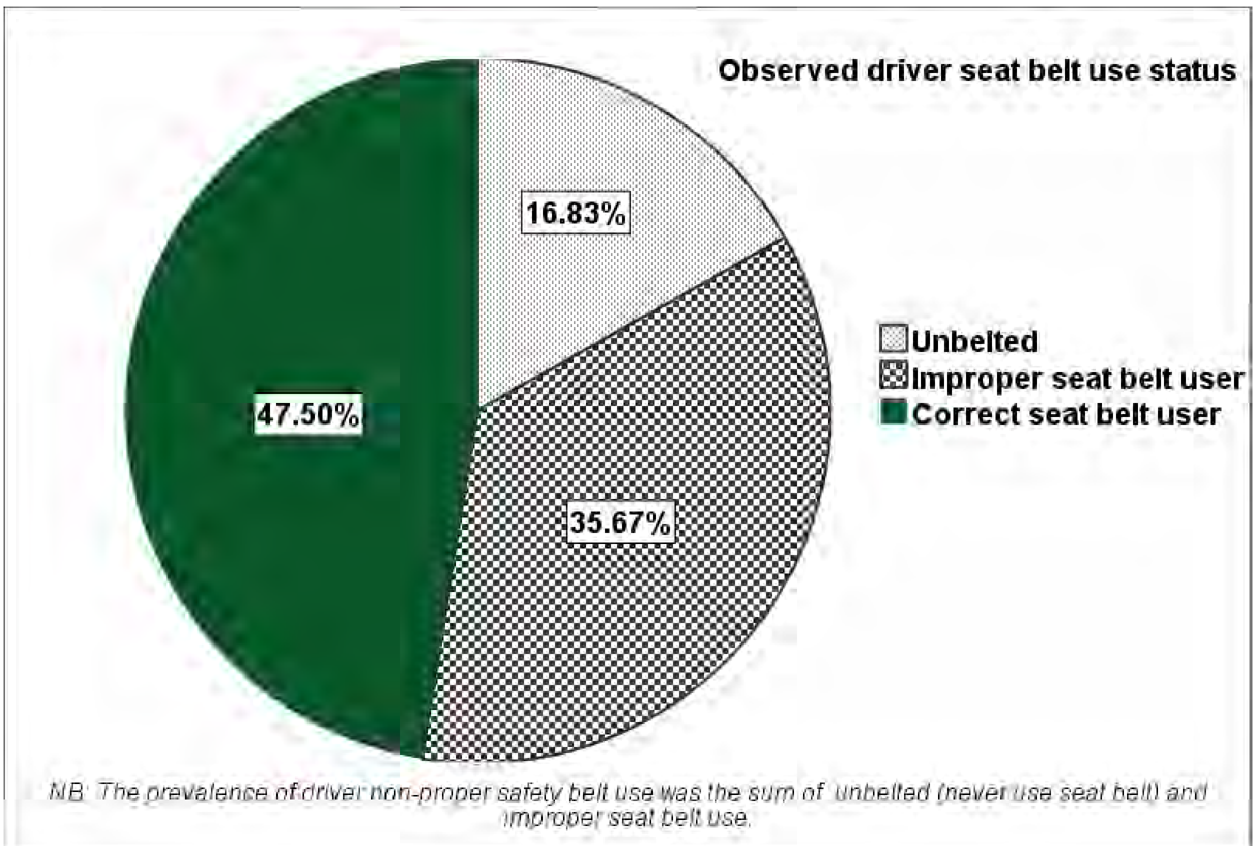


***Figure 5: The type of drivers' safety seat belt utilization status of public transport vehicles observed inside vehicle in Addis Ababa, Ethiopia, February 2017***

### *Factors associated with drivers' none utilization of proper safety seat belt*

## Bi-variate analysis

Age, khat chewing and engaged in driver distraction activity while driving has showed significant statistical association with none proper safety seat belt utilization in the bi-variate analysis. But, vehicle type and observation site/location were insignificant in bi-variate analysis at $p<0.05$.

Middle age (35-64 year) drivers were more likely than old age ($65^{+}$ year) drivers for none proper safety seat belt utilization with COR=1.86 (1.05, 3.29, $p<0.05$). Khat chewing drivers were more likely than not khat chewing drivers for none utilization of proper safety seat belt while driving with COR=3.12 (1.39, 7.00, $p<0.05$) and driving distraction activity engaged drivers were more likely than not driving distraction activity engaged drivers for none utilization of proper safety seat belt while driving with COR=3.00 (2.15, 4.20, $p<0.001$) (***Table 3)***.

### Multi-variate analysis

Only drivers who chewing khat, engaged in driving distraction activities and driving city public transport buses were statistically significant in multivariate analysis at $p<0.05$.

Khat chewing, engaged in driving distraction activities and being city public transport bus drivers were associated with none utilization of proper safety seat belt significantly. Khat chewing drivers were more likely than not khat chewing drivers for none utilization of proper safety seat belt while driving with AOR =2.41(1.04, 5.60, $p<0.05$) and drivers engaged in driving distraction activities were more likely than drivers not engaged in driving distraction activities for none utilization of proper safety seat belt while driving with AOR=2.93 (2.08, 4.13, $p<0.001$). Similarly, the multivariate analysis revealed that city public transport bus drivers were more likely than taxi drivers for none utilization of proper safety seat belt while driving with AOR=1.66 (1.09, 2.52, $p<0.05$) (***Table 3***).

**Table 2:** ***Proportion of proper seat belt utilization while driving by drivers in public transport vehicles by driver age, khat chewing, and engaged in driving distraction activity, vehicle type and observation site observed in side vehicles in Addis Ababa, Ethiopia, February 2017***

| **Variables** | **Proper safety seat belt utilization count Yes** | **No** | **Proper safety seat belt utilization % (95%CI)** | ***p-value** |
|---|---|---|---|---|
| **All (n=600)** | **285** | **315** | **47.5 (43.3, 51.3)** | **-** |
| **Age group** | | | | 0.077 |
| 18-34 | 100 | 102 | 49.5 (42.7, 56.3) | |
| 35-64 | 151 | 190 | 44.3 (39.1, 49.6) | |
| >=64 | 34 | 23 | 59.6 (46.7, 71.4) | |
| **Khat chewing** | | | | 0.007 |
| Yes | 8 | 26 | 23.5 (12.4, 40.0) | |
| No | 277 | 289 | 48.9 (44.8, 53.1) | |
| **Driver distraction activity** | | | | 0.000 |
| Yes | 90 | 183 | 33.0 (27.7, 38.8) | |
| No | 195 | 132 | 59.6 (54.2, 64.8) | |
| **Vehicle type observed** | | | | 0.212 |
| City public transport bus | 60 | 81 | 42.6 (34.7, 50.8) | |
| Taxi | 225 | 234 | 49.0 (44.5, 53.6) | |
| **Observation location/area** | | | | 0.102 |
| Urban road/PAS | 153 | 147 | 51.0 (45.4, 56.6) | |
| Semi-urban road | 132 | 168 | 44.0 (38.5, 49.7) | |

* Chi-square and Fisher's exact test from cross tabulation

**Table 3:** ***Crude and adjusted odds ratios for none utilization of proper safety seat belt while driving by drivers in public transport vehicles by driver age, khat chewing, and engaged in driving distraction activity, vehicle type and observation site observed in side vehicles in Addis Ababa, Ethiopia, February 2017***

| **Variables** | **Proper seat belt utilization count** | | **COR (95% CI)** | **P-value** | **AOR (95% CI)** | **P-value** |
|---|---|---|---|---|---|---|
| | **No** | **Yes** | | | | |
| **All (n=600)** | **315** | **285** | - | - | - | - |
| **Age group** | | | | | | |
| 18-34 | 102 | 100 | 1.50 (0.80, 2.74) | 0.177 | 1.52 (0.80, 2.90) | 0.201 |
| 35-64 | 190 | 151 | **1.86 (1.05, 3.29)** | **0.033** | 1.66 (0.91, 3.04) | 0.101 |
| >=64 | 23 | 34 | 1.00 | | 1.00 | |
| **Khat chewing** | | | | | | |
| Yes | 26 | 8 | **3.12 (1.39, 7.00)** | **0.006** | **2.41 (1.04, 5.60)** | **0.041** |
| No | 289 | 277 | 1.00 | | 1.00 | |
| **Driver distraction activity** | | | | | | |
| Yes | 183 | 90 | **3.00 (2.15, 4.20)** | **0.000** | **2.93 (2.08, 4.13)** | **0.000** |
| No | 132 | 195 | 1.00 | | 1.00 | |
| **Vehicle type observed** | | | | | | |
| City public transport bus | 81 | 60 | 1.30 (0.89, 1.90) | 0.179 | **1.66 (1.09, 2.52)** | **0.019** |
| Taxi | 234 | 225 | 1.00 | | 1.00 | |
| **Observation location/area** | | | | | | |
| Urban road/PAS | 147 | 153 | 0.75 (0.55, 1.04) | 0.086 | 0.75 (0.54, 1.06) | 0.104 |
| Semi-urban road | 168 | 132 | 1.00 | | 1.00 | |

COR: crude odds ratio

AOR: adjusted odds ratio derived from a logistic regression model adjusted for all variables in the table.

CI: confidence interval

## 6. DISCUSSION

Proper safety seatbelt utilization protected drivers from severe injury and fatality. The objective of this study was to investigate the prevalence of driver proper safety seat belt utilization and the determinants for none utilization among public transport drivers through an in-side vehicle observational study approach. The study explored some determinants of drivers' none utilization of proper safety seat belt in public transport vehicles that could be done through direct in-side vehicle observation during the movement of the trip in Addis Ababa at 20 observation sites in February 2017.

This study revealed that the prevalence of proper safety belt utilization among public transport vehicles observed through direct in-side vehicle was very low (47.5 %) with 95% CI=43.3, 51.3. The prevalence of seat belt utilization in this study was lower than that of the self-reported study among taxi drivers in Addis Ababa that reported 86.7 % of the taxi drivers wore their seatbelt when they were driving (48). This might due to the over reporting of drivers including improper wearing of seat belt (reporting unlocked/non-functional seat belt utilization and very loose seat belt utilization).

The prevalence of drivers proper safety seat belt utilization observed in our study (47.5 % with 95% CI=43.3, 51.3) was lower than those reported in the sample count in Addis Ababa city in 2010, 96% of drivers used seat belt whilst driving (11) and unpublished repeated road side observational study in Addis Ababa conducted by the School of Public Health of Addis Ababa University and Johns Hopkins International Injury Research Unit Fund, 97% and 99% of drivers used seat belt whilst driving in round 1 and round 2 observation, respectively (12). These differences might due to the fact that these studies were a road side observational studies which they might not assess correct seat belt utilization through an in-side vehicle observation for the proper utilization of the safety belt, or they might include all vehicles as a source population and hence overestimates seat belt utilization rate particularly in public transport vehicles. This large difference shows that seatbelt utilization is much less in high-risk taking public transport drivers than the general population (drivers).

The result of proper safety seat belt utilization of this study was lower than that of the study done in Spain (10), city of Doha,Qatar (13), Korea (21), Irish road (23), North Dakota (25) and Scotland (26). This could be due to the discomfort of distorted seats and seat belts or they might be due to old enough to utilize proper seat belt effectively by drivers in Ethiopia and/or drivers of these countries were driving new vehicles without deformed/distorted safety driver seats and seat belts. These differences also might due to responsible drivers' behaviors for safety belt utilization concern while driving and the presence of restrict seat belt use enforcement in these countries. Additionally, this difference also might be due to these studies in these countries were road side, not in-side vehicle observational study approach.

Driver characteristics have always played an important role in seatbelt utilization. The non-proper utilization rate of seat belt among the observed male drivers was higher than female drivers in this study. This is similar to other study results conducted in Florida (24), in North Dakota (25), in Scotland (26) and in Thailand (32) in which none seat belt utilization rate in male drivers is greater than that of female drivers. There was a difference in age categories with the age group >= 65 years none seat belt utilization (40.4%), less likely than the age group 18-34 and 35-64 years none utilization (50.5% and 55.7% respectively). This is similar to the study in Scotland (26).

When the binary logistic regression model was employed for some observable factors, the only factors remained significantly associated with none utilization of proper seat belt were khat chewing (AOR=2.41, 95%CI=1.04,5.60, $p<0.05$), engaged in driving distraction activities (AOR=2.93, 95%CI=2.08, 4.13, $p<0.001$) which is similar to the study in Barcelona (Spain) (10), in the city of Doha, Qatar (13) and in Saudi Arabia (39) and driving city public transport bus (AOR=1.66, 95%CI=1.09, 2.52, $p<0.05$). This might be due to the pay close attention of traffic police to proper safety belt use enforcement to city public transport bus, khat chewer, and/or driving distraction activity engaged drivers while driving is low. This also might be due to annual inspection of vehicles is low to check and maintain safety seat belt for proper utilization.

Gender, smoking, observation road type, time and day of week of observation were not significantly associated with none proper seat belt utilization both in bi- and multi- variate analysis in Addis Ababa, Ethiopia. This might be due to small number of female drivers (the heavy reliance on professional vehicle drivers in the country specially in public transport vehicles, who are almost exclusively male), not smoking while driving rather they dare doing before and after driving, small distance of semi urban/sub arterial to urban/principal arterial streets or afraid of the law or afraid of traffic police fine (equal presence of traffic police) in both road types in all time ranges and days of a week in the city.

## 7. STRENGTH AND LIMITATION

This in-side vehicle direct observational study design makes the results of this study better than responant (driver) self reports since it reduces subjective bias of drivers to estimate proper safety seat belt utilization. It is also better than road side direct observational study design results for the estimation of proper safety seat belt utilization because the study is high visibility of vehicles and drivers and hence this study identifies improper safety seat belt utilization; it improves the reliability and validity of the data and allows high precision of the observed estimates. The study design also suggests possibility of naturalistic observational investigation of risky road user behaviors not done adequately or though of before in Ethiopia for evidence based road traffic accident intervantion.

The study is not without limitations. The present study results may not be generalized to reflect the overall population (drivers) of Addis Ababa since our study was limited to public transport drivers. It was also limited to urban public roads, and daytime hours as the visibility is too low during nighttime to observe vehicle drivers. We therefore cannot comment on any differences in behavior that could have been observed on rural public road or at night vehicle drivers.

We might not sure to assess the effect of age on the proper safety seat belt utilization since it is difficult to reliably measure age when using an observational study design. Likewise, smoking could be an underestimate to show its relationship with outecome variable since this factor usually observed before and after driving. Therefore, comparison of our study with other published studies documenting self-reported data with respect to these factors is inappropriate.

Aditionally, our observation limited to only observable driver related factors. Thus, the study was not assess driver's body size, chronic health problems, educational level and year of driving since it is unethical to conduct interview and measurement while driving to assess their association with none proper seat belt utilization.

## 8. CONCLUSION

Based this study, the true proper safety seat belt usage among public transport drivers in Addis Ababa was very low (less than 50%). The study result disproved the perceived and well known high seat belt use estimates founded from driver self-reports (greater than 85%) and road side observations (greater than 95%). This big difference indicated that the seat belt use enforcement laws do not intervene the compliance of proper safety seat belt utilization.

Among observable independent variables studied, khat chewing, driver distraction and city public transport bus had significant association with none proper safety seat belt usage in Addis Ababa, Ethiopia.

## 9. RECOMMENDATIONS

Since it is largely considered that seat belt utilization increase the probability of survival when involved in severe crashes, the great significance of having every vehicle driver belted properly all the time cannot be overemphasized enough.

Therefore, the current study recommends for enforcement officials to pay close attention to khat chewing, driver distraction activity engaged and city public transport bus drivers since these types of drivers and vehicles significantly show lower proper seat belt utilization.

Traffic safety officials also have to contribute their high visibility proper seat belt use enforcement efforts such as in-side vehicle monitoring and checking the proper locking and utilizing of proper safety seat belt. Besides this, they should also increase the awareness and education of drivers about risk and risk-taking behaviours especially drivers engaged in khat chewing and driver distraction activities while driving since they are significantly liable for lower proper seat belt utilization. In addition, they have to conduct vehiclele inspections for the safety of vehicle seat belts for proper utilization.

We also recommend the launch of multi-agency educational and awareness campaigns such as media/advocacy efforts, individual agency campaigns and local programs addressed to surveillance the compliance of the proper safety belt utilization.

Furthermore, we recommend public health and traffic safety policies to improve interventions focusing on increasing the proper safety seat belt utilization to reduce the severity of road traffic injuries.

Finally, we recommend further studies have to be conducted among long distance and regional public transport drivers. In addition, we recommend further mixed study design methods focusing on in-side vehicle observation with focus group discussion, interview and measurement to address driver body sizes, chronic health problems and other driver exposure variables which potentially affect the proper safety seat belt utilization.

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## 11. ANNEXES

### 11.1. Annex I: A comparison of regional populations, road deaths, and registered vehicles

| S.No. | Region | Populations (%) | Road Deaths (%) | Registered Vehicles (%) |
|---|---|---|---|---|
| 1 | African Region | **12** % | **16** % | **2** % |
| 2 | American Region | 14 % | 12 % | 27 % |
| 3 | Eastern Mediterranean Region | 9 % | 10 % | 4 % |
| 4 | European Region | 13 % | 8 % | 26 % |
| 5 | South East Asian Region | 26 % | 27 % | 15 % |
| 6 | Western Pacific Region | 26 % | 27 % | 26 % |

**11.2. Annex II: In-side vehicle observational study form-Survey instrument of some observable factors associated with drivers proper seat belt utilization**

## Seat Belt Use In-side vehicle Observational Survey Form

**Page number ______of_______**

Date:_____________ Start Time:_________AM/PM End Time:______AM/PM
DayTime Description (Morning, Noon,After noon or Evening):_________________
Observation Day Description(Weekday or Weekend):________________________
Sub-city:____________ Observer Name:________________________________
Route/Site location Description(Urban/Semi-urban):_____________________________________
Site ID Number:__________(if application)
Road Traffic Type Observed: ☐ Presence of Traffic density observed
☐ No Presence of Traffic density observed

The driver wear seat belt when traffic police is just seen/observed due to fear of police to stop him/her for being unbelted: Yes ☐ No ☐

Traffic police ticket/give warn for unbelted drivers to wear seat belt only if they are stopped for other reasons: Yes ☐ No ☐

| Ob. No. | Vehicle Type | | | Driver | | | | | | | | | | | | | | | | | Deformed/ Distorted | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | City public transport bus | | Taxi | Sex | | Estimated Age Group (Years) | | | Proper Seat Belt Utilization | | | Smoking | | Khat chewing | | Distraction | | | | | Seat | | Seat belt | |
| | Amb essa bus | Mid bus | | M | F | 18-34 | 35-64 | ≥65 | Y | N | | Y | N | Y | N | Y | | | | N | Y | N | Y | N |
| | | | | | | | | | | UB | IB | | | | | TR | MPU | TP | LW | | | | | |
| **001** | | | | | | | | | | | | | | | | | | | | | | | | |

**F = Female**
**M= Male**
**Y = Yes**
**N = No**
**UB= Unbelted**
**IB=Improper belted**
**Ob. No. = Observation number**

**TR = Tuning a radio/music**
**MPU = Mobile phone use**
**TP = Talking with the passenger**
**LW = Looking at billboards or watching people through side window**

<u>**NB**</u>**: Please tick/mark by using ‘‘√’’ in the appropriate place for each variable during in-side vehicle observation!**

## Seat Belt Use In-side vehicle Observational Survey Form

**Page number ______of_______**

Date:____________ Start Time:________AM/PM End Time:______AM/PM
DayTime Description (Morning, Noon,After noon or Evening):_________________
Observation Day Description(Weekday or Weekend):_______________________
Sub-city:___________ Observer Name:_______________________________
Route/Site location Description(Urban/Semi-urban):____________________________________
Site ID Number:__________(if application)
Road Traffic Type Observed: ☐ Presence of Traffic density observed
☐ No Presence of Traffic density observed

The driver wear seat belt when traffic police is just seen/observed due to fear of police to stop him/her for being unbelted: Yes ☐ No ☐

Traffic police ticket/give warn for unbelted drivers to wear seat belt only if they are stopped for other reasons: Yes ☐ No ☐

| **Ob. No.** | **Vehicle Type** | | | **Driver** | | | | | | | | | | | | | | | | | **Deformed/ Distorted** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **City public transport bus** | | **Taxi** | **Sex** | | **Estimated Age Group (Years)** | | | **Proper Seat Belt Utilization** | | | **Smoking** | | **Khat chewing** | | **Distraction** | | | | | **Seat** | | **Seat belt** | |
| | **Amb essa bus** | **Mid bus** | | **M** | **F** | **18-34** | **35-64** | **≥65** | **Y** | **N** | | **Y** | **N** | **Y** | **N** | **Y** | | | | **N** | **Y** | **N** | **Y** | **N** |
| | | | | | | | | | | **UB** | **IB** | | | | | **TR** | **MPU** | **TP** | **LW** | | | | | |
| **002** | | | | | | | | | | | | | | | | | | | | | | | | |
| 003 | | | | | | | | | | | | | | | | | | | | | | | | |
| **004** | | | | | | | | | | | | | | | | | | | | | | | | |
| **---** | | | | | | | | | | | | | | | | | | | | | | | | |
| **600** | | | | | | | | | | | | | | | | | | | | | | | | |

**F = Female**
**M= Male**
**Y = Yes**
**N = No**
**UB= Unbelted**
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**TR = Tuning a radio/music**
**MPU = Mobile phone use**
**TP = Talking with the passenger**
**LW = Looking at billboards or watching people through side window**

**<u>NB</u>: Please tick/mark by using ''√'' in the appropriate place for each variable during in-side vehicle observation!**

## 11.3. Annex III: An in-side vehicle observational study protocol for drivers' proper seatbelt utilization

### Seatbelt Observations

(NB: This protocol is adopted from Johns Hopkins International Injury Research Unit Study Protocol Seatbelt Observations)

**Goal:** To determine seatbelt usage rates in the chosen sites through random in-side vehicle observations

**Step 1:- List all possible observation locations/public roads in Addis Ababa city, divided into the following categories and sub-categories. Also dived time interval per day for observation as categorized below.**

- **Categories – select one from each of two options below as appropriate**

1. Urban roads/locations per sub-city
    1. Principal arterial streets (PAS) of the sub- city
2. Semi-urban roads per sub-city
    1. Sub-arterial streets (SAS) of the sub- city
    2. Collector streets (CS) of the sub- city
3. Time category (observation time interval per a day for each location category)
    1. Morning (from 7:00 AM-11:00 AM)
    2. Noon( from 11:AM-3:00 PM)
    3. Evening (from 3:00PM-7:00 PM

*__Recommendation:__ The three time category must be considered on each observation day and in each specified time interval only three or four vehicles must be observed with 15-30 minutes for in-side vehicle observation per vehicle. There is 30 minutes free time between two consecutive vehicle observations for another eligible vehicle search and random selection.

- **All locations and vehicles must meet the following criteria:**
    a. Location must be safe for observer.
    b. Public transport vehicles rather than other cars must be randomly selected for observation.
    c. Location where observer may be located at a loading and unloading site where observer must be to enter into the eligible vehicle easily.
    d. Location where local population rather than tourists are likely to be observed.
    e. Sitting location where observer may be sited in the vehicle that is near or side to driver.
    f. The observer simply observes naturalistically, does not disturb driver privacy and safety.

***Recommendation:** It will be difficult to accurately observe seatbelt use for vehicles at the back seat of vehicle. Therefore it is recommended that at the front seat, or near to the driver where drivers will be closely observed at the front seat/near to the driver be selected for this study to ease observations and ensure accuracy of the observation.

**Step 2:- Choose locations for observation**

a. From the list of locations meeting the above criteria, randomly select 20 locations (one urban street and one semi-urban street per sub city for one data collector in each sub-city). Ensure that each category is represented. If necessary, randomly select within the sub-category listing.

b. For every site and vehicle chosen, make a record of site description and factors affectinfg drivers seat belt use including:
    1. Category/Sub-category
    2. Road type (urban road/street or semi-urban road/street)
    3. Other road markings or signage (presence of traffic police or not at that street)
    4. Factors for unbelted or improper seat belt use (time and day, sex and age group of driver, smoking and khat chewing status of driver, deriver distraction, vehicle type and seat belt status)

**Step 3:- Set up schedule for observations**

**a.** The days/time intervals are outlined Table 4 below.

**b.** The table assumes two research assistants would be assigned to one site per day.

**c.** Every site should be observed for two weekdays (Mon-Fri) and one weekend-day (Sat-Sun), such that every site is observed for 3 full days.

**d.** If there are sufficient resources, an additional weekday can be added for each site, such that every site is observed for 4 full days (3 weekdays and 1 weekend-day).

**e.** The schedule assignment per site will and should be done randomly.

f. After four vehicles will be observed in the first time category (from 7:00 Am- 11:00 Am), the number of vehicles will be observed in the second time schedule from 11:00 Am-3:00 Pm) is three and in the third time schedule (from 3:00 Pm-7:00 Pm) is also three to consider lunch time and tea break time respectively.

**Table 4:** *Seatbelt Observation Schedule (sample)*

| **Time category of a day** | **Day** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Weekday** | | | | | **Weekend-day** | |
| | Mon | Tues | Wed | Thurs | Fri | Sat | Sun |
| | Number of vehicles will be seen | Number of vehicles will be seen | Number of vehicles will be seen | Number of vehicles will be seen | Number of vehicles will be seen | Number of vehicles will be seen | Number of vehicles will be seen |
| 7:00 Am-11:00 Am | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 11:00 Am-3:00 Pm | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 3:00 Pm-7:00 Pm | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Total time schedule of a day is from **7:00 Am to 7:00 Pm** | Total = 10 | Total = 10 | Total = 10 | Total = 10 | Total = 10 | Total = 10 | Total = 10 |

**Rules for observation**

1. Base your observational period on time and the number of vehicles that you observe on that day/time. Even if you only observe a small number of vehicles at one location, you should observe the location for three days.
2. This protocol requires that you only observe in-side vehicle travelling on selected road at the observation location. This is true even if you are observing at a vehicle "end to end" travelling location. This will help you to full driver observation during the observation period. It will also make it easier for you to reliably collect/document the data at a location with specified--time period.
3. When conducting observations, **drivers who are properly wearing shoulder straps** is 'wearing a seat belt' or not and factors for not using/fastening proper seat belt. Therefore, if you observe that the driver is wearing the shoulder strap behind his/her back or the seat belt is not locked or worn very loosely while driving (an improper utilization of the seat belt), consider he/she as 'not wearing seat belt'. Individual/drivers', vehicle and driving environment characteristics must be observed strictly specified in the observation form and mark in the appropriate space on the observation form.
4. Use the Seatbelt Observation Form to record seatbelt use among drivers and factors affecting non-use sitting next/behind to the driver.
5. Things to Keep in Mind:
    - Be in conscious and
    - Safe!

## 11.4. Annex IV: Randomly selected road locations (one main and one minor road per sub-city) in Addis Ababa city for in-side vehicle observation for drivers' proper seat belt utilization and factors affecting proper use

| S.No. | Sub-city | Randomly selected roads/locations for Drivers proper seat belt utilization study by in-side vehicle observation | Number of vehicles observed in this location |
|---|---|---|---|
| 1 | **Akaki Kality** | 1. **PAS 3**: From Akaki Road (Tirunesh Bejing hospital) to Kality Technology University | 30 public transport vehicles |
| | | 2. **SAS 2**: From Kality Gabriel to Habitat real state | 30 public transport vehicles |
| 2 | Nefas Silk-Lafto | 1. **PAS 3**: From Gotera inter-change to Kality RA | 30 public transport vehicles |
| | | 2. **SAS 1**: From Adey Abeba to Saris adisu Sefer | 30 public transport vehicles |
| 3 | Kolfe Keraniyo | 1. **PAS 4**: From Winget to Asko bridge | 30 public transport vehicles |
| | | 2. **CS 2:** From Kolfe Pilipos through Lomi sefer to Asko Addis sefer | 30 public transport vehicles |
| 4 | Gullele | 1. **PAS 3**: From 4 killo to Shiromeda RR | 30 public transport vehicles |
| | | 2. **SAS 1**: From Medahnialem high school to Rufael | 30 public transport vehicles |
| 5 | **Lideta** | 1. **PAS 4**: From Areke fabrica to T/Himanot Sq | 30 public transport vehicles |
| | | 2. **SAS 2**: From T/Himanot Sq to Somale tera Sq (Shewa supermarket) | 30 public transport vehicles |
| 6 | **Kirkos** | 1. **PAS 4**: From Kazanchiz Total to S/t Urael church | 30 public transport vehicles |
| | | 2. **SAS 1**: From Mexico to Bulgaria mazoria | 30 public transport vehicles |
| 7 | Arada | 1. **PAS 4**: From Arat Kilo to Kebena bridge | 30 public transport vehicles |
| | | 2. **SAS 2**: From Lipzing Sq (German School) Mismar Factory /From Abware Adebabay to Germen deledeye Balederase | 30 public transport vehicles |
| 8 | Addis Ketema | 1. **PAS 4**: From Autobes Tera to Paster | 30 public transport vehicles |
| | | 2. **SAS 2**: From Chid Tera to Mirab hotel | 30 public transport vehicles |
| 9 | Yeka | 1. **PAS 4**: From Ararat junction to Kotebe Karalo | 30 public transport vehicles |
| | | 2. **SAS 2**: From Civil Service to Hill Side School | 30 public transport vehicles |
| 10 | **Bole** | 1. **PAS 4**: From Gured Shola through Sumite to Yeka Bole | 30 public transport vehicles |
| | | 2. **SAS 1:** From Abo Sq to Bole Bulbula Medhanialem church | 30 public transport vehicles |

NB:

| Road type | Road type of PAS | Width | Road Type | Road type of SAS | Width | Road type | Road type of CS | Width |
|---|---|---|---|---|---|---|---|---|
| **PAS** =Principal Arterial Street | PAS-0 | >60m | **SAS** = Sub-Arterial Street | SAS-1 | 25m | **CS** = Collector Streets | CS1 | 15m |
| | PAS-1 | 60m | | SAS-2 | 20m | | CS2 | 20m |
| | PAS-2 | 50m | | | | | CS3 | 25m |
| | PAS-3 | 40m | | | | | CS4 | 30 |
| | PAS-4 | 30m | | | | | | |

**Declaration**

I, the undersigned, declared this is my original work and has not been presented in this or any other university and all sources of materials used for this thesis have been duly acknowledged.

**Name of the student:** Semegnew Takele

Sign: _____________

Date: _____________

Place: Addis Ababa University

This thesis has been submitted for examination with my approval as university advisor.

**Approval of the primary Advisor**:

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School Of Public Health

Addis Ababa University

Signature _______________

Date ___________________

Place Addis Ababa University