International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Investigation on the Impact of Ancillary Roadworks on Road Safety in Uganda: A Case of Kampala-Jinja Road

Ssebuliba Isaac

Department of Civil and Environmental Engineering, Kyambogo University (June, 07th 2024)

Abstract

Increased accidents on Ugandan roads compelled the construction of road ancillaries, with a major aim of improving road safety, to attain sustainable economic development and further achieve SDG target 3.6 and SDG target 9.1. This study investigated the impact of ancillary roadworks on road safety in Uganda, a case of the Kampala – Jinja road. The study used a correlation research design with a quantitative approach. Primary data were collected from 30 field traffic officers, 19 drivers, 03 OC traffic police stations, 36 road engineers, 01 IOV, 01 RTO, and 12 market leaders whereas secondary data were extracted from accident data from Uganda Police. Questionnaire data were analysed with SPSS version 24.0. Results indicated that 39% of installed informatory signs, 47% of installed regulatory signs, and 60% of installed warning signs had been vandalised, exposing road users to the risk of accidents. Guardrails were still existing but some had rusted and others covered with grown grass, making them not seen by road users. The majority of road accidents were serious, accounting for 149 (46.3%) cases, followed by 130 fatal accidents (40.4%) and 43 (13.3%) minor accidents for the period from 2017 to 2022. Correlation results indicated that all ancillary road works were significant except road signs. Yet, regression results indicated that road marking (βeta = 0.307), guardrails (βeta = 0.286), and humps and rumble strips (βeta = 0.360) have a positive significant effect on road safety unlike road lights, road signs, walkways, and service lanes which were insignificant. Police traffic law enforcement and regular improvement on road infrastructure are required. It is concluded that road marking, guardrails, humps, and rumble strips significantly affect road safety. The study recommended that the construction of humps and rumble strips of moderate size, road marking with higher retro reflectivity (>200 mcd/lx/m2), and strong guardrails, can help in ensuring road safety with the support of enforcement of traffic laws of Uganda.

1. Introduction

More than 1.2 million people die on the world's roads each year, according to the World Health Organization (WHO) worldwide status report on road safety for 2023 (WHO, 2023), and it's predicted that road collisions will be the 5th leading cause of death if nothing is done by 2030. Furthermore, the new global Sustainable Development Goals (SDGs) and Agenda 2030 which were adopted by the United Nations (UN) in 2015, have three of these SDGs relating to road safety (UNDP, 2022). These include; SDG target 3.6: which calls for all governments to half the number of global deaths and injuries from road accidents; and SDG target 9.1: calling for investment in sustainable and accessible infrastructure, to enable growth and employment creation. This SDG further aims at developing a reliable, quality, sustainable infrastructure inclusive of all regional and trans-border infrastructure, aimed at supporting economic

development and human wellbeing.; SDG target 11.2: which calls for a safe, accessible, affordable, and sustainable transport system for all by 2030; improving road safety, by expanding public transport, not forgetting the needs of vulnerable road users such as women, older people, children, persons with disabilities, among others.

Low and Middle-Income Countries (LMICs) have higher road traffic fatality rates of about 21.5 and 19.5 per 100,000 populations respectively, compared to that of high-income countries, which is about 10.3 per 100,000 (Haghani et al., 2022). According to the World Health Organisation, the impact of road crashes on economic development is predicted to cost about 5% of the country's Gross Domestic Product (GDP) in LMICs (WHO, 2021). In the African continent, 26.6 deaths per 100,000 of the population occur due to road fatalities, compared to the world's average of 17.5 road deaths per 100,000 people and 9.3 per 100,000 in the European region annually (WHO, 2021). Uganda, in the last decade alone, being a Low Income Country, recorded an increase in road crash fatalities from 2,597 to 3,503 in 2016 representing a growth of 25.9%. The accident severity index is 24 people killed per 100 road crashes. On average, Uganda loses 10 people per day in road traffic crashes, which is the highest level in East Africa (UNECE, 2018)".

The Uganda Police annual crime report of 2022 indicates a general increase of 17% in the number of road crashes reported as compared to the year 2021. That is to say, from 17,443 in 2021 to 20,394 in 2022. The report further details the categories of road crashes in Uganda, for the years 2021 and 2022 as follows; fatal crashes increased by 16.9%, from 3,757 in 2021 to 3,901 in 2022; serious crashes increased by 18.8%, from 9,070 in 2021 to 10,776 in 2022; minor crashes increased by 23.9%, from 4,616 in 2021 to 5,717 in 2022 (Uganda Police Force, 2023). Additionally, Uganda launched a legislative plan to address current gaps in the Traffic and Road Safety Act, as well as best practices in road design and evaluation of road traffic accidents in line with the United Nations Decade of Action for Road Safety (WHO Regional Office for Africa, 2018).

Studies by Stanley et al. (2022) and Walekhwa et al. (2022) established the causes of accidents on Ugandan roads to include; driving vehicles or riding motorcycles in a dangerous mechanical condition, reckless driving, lack of formal training for commercial motorcycle riders, limited use of seat belts, state of some of the ancillary roadworks and their terrain, poor attitudes and human errors among others. Whereas such studies have been made, the impact of ancillary roadworks on road safety has not yet been thoroughly explored, necessitating research about it. Several road ancillaries, ranging from road signs, road markings, guardrails, humps, and rumble strips, among others, have been fixed/installed on different roads within Uganda, per the General Specification for Roads and Bridge Works issued by the Ministry of Works and Transport (MoWT), with the main aim of achieving a uniform approach to road safety. However, over time, these have faded, been vandalised, or knocked down but later on not reinstated. A deteriorated road ancillary system, which is later not refurbished, poses a danger to the safety of the different road users since the hazard for which they were initially installed still exists throughout the road's design life and beyond. Statistics from the annual Uganda police crime report over a six (6) year period, that is to say, 2015 – 2021 indicated that, among others, fatalities due to overspeeding increased from 115 in 2015 to 125 in 2021, obstacles on the carriageway increased from 0 in 2015 to 05 in 2021 and reckless driving fatalities increased from 1480 in 2015 to 2644 in 2021. These can further be attributed to a lack of proper speed control signs, and faded road markings; among others. The effectiveness of the road ancillary system on Ugandan roads, if not checked, may give rise to the number of road fatalities and all its adverse effects on the country's GDP due to anticipated increased expenditure on accident victims, among others. As such, a study was necessary to investigate the impact of these road ancillaries on road safety in Uganda, given

the increasing rate of road fatalities, and the maintenance patterns of existing roads in the country. The purpose was to establish the impact of ancillary roadworks on road safety in Uganda, a case of the Kampala – Jinja road. The research questions were; What is the current status of ancillary road features on the Kampala - Jinja road? Is there a relationship between the rate of accidents and the status of road ancillaries? What external factors to ancillary roadworks impact road safety in Uganda? What tool can be used to mitigate the impact of road ancillaries on road safety on the Kampala – Jinja road?

The study was justifiable, given the reaffirmation of the SDGs in February 2020 and road safety decade of action (2020 – 2030) by the UN member states, whose global aim is to reduce road fatalities by 50% by 2030. The installation of road ancillaries is one of the measures aimed at reducing fatalities on world roads.

The installation of road ancillaries on road projects is all aimed at guiding how these roads should be effectively used by the stakeholders and how traffic regulations are to be enforced by the concerned authorities. The findings of this study gave an informed view of the effectiveness of these ancillary works in ensuring road safety in Uganda. The recommendations in this report will help in improving road safety systems within the country's roads, an action that will minimise the government expenditure on accident victims who are admitted to different health facilities, a venture that will increase Uganda's GDP.

The study was conducted in Eastern Uganda, on the Kampala - Jinja road, in areas covering Lugazi to Kitigoma. The study area is located in the Sezibwa region district according to the Uganda Police boundary demarcations. It was limited to ancillary road works along the Kampala – Jinja road, specifically covering black spots, as detailed by data from the Uganda Police, in areas from Lugazi to Kitigoma village and the fatalities that occurred for a period between 2018 to 2022). The study will provide information about the road infrastructure required to control traffic and achieve road safety in Low- and Middle-Income Countries (LMIC).

2. Literature

2.1 Traffic Control

Traffic control devices date back to ancient civilizations when roads were marked in primitive ways, such as with trees or stones. The purpose of this practice was primarily navigational, and these can be considered the first directional road signs (Babić et al., 2022). This study is defined by the Geneva Protocol of 1949, where the UNECE laid the standards for the widely acceptable road signs, road markings, and traffic signals, among others. This protocol was further revised and later named the Vienna Convention and is regularly reviewed (UNECE, 2010). The UNECE objective was to mainly achieve a uniform approach to road signs, markings, and symbols. This was created to ensure that people traveling to different countries understand these signs for their own and other road users' safety (UNECE, 2010). Uganda, like all other UN member states adopted this unified system of road marking, and road signs, among others and these are fully installed on the country's roads, according to series: 5000 of the General Specification for Roads and Bridge works issued by the MoWT, a pre-requite by all road contractors before handing over the projects. Uganda's commitment to the restoration of vandalised or knocked road ancillaries is still wanting, posing a safety danger to the different road users.

2.2 Impact of traffic control devices on traffic safety

Babić et al., (2020) establish that road markings form the traffic surface and provide visual guidance for road users which has a positive significant relationship with road safety, and that road markings with higher retro reflectivity (>200 mcd/lx/m2) have positively associated with the lower number of road

accidents at 95% confidence level. Furthermore, drivers tend to drive closer to the centreline on roads without edge line markings.

Some countries use color-coded road markings to indicate the speed limit, whereby roads with different speed limits have different colored center and edge lines (Charlton, Starkey & Malhotra, 2018). In this system, center, and edge lines are painted red in low-speed zones (35 km/h), yellow in moderate-speed zones (50 km/h), and blue or green for higher-speed zones (90 km/h and 130 km/h respectively) which significantly support road safety (Charlton, et al. 2018). For roads in Uganda, chevron markings are used at points towards the islands in case of emergency parking, and also the use of zig-zag centreline markings at sections where humps and rumble strips exist. Zhang et al., (2023); in their study concluded that using multicolor perceptual marking as a form of road marking was key to mitigating crash risk factors. The different marking patterns yielded great speed reduction, and increased distance headway, and were effective in the correction of the lane deviation vehicles, among others.

The guardrails protect drivers, motorcyclists, and bicycles who turn off the road from hitting obstacles such as steep embankments, hillsides, utility poles, retaining, and bridge pillars, among others, and they have a positive significant effect on road safety (Bambach, Mitchell & Grzebieta, 2013). The guardrails are a key dimension used to protect road users from accidents. Lioi et al., (2022), in their study, suggested that drivers take guardrails as a protection system, a sight obstruction, and as a hard obstacle. They further suggest that the use of barriers that are higher and superior to the minimum required standards should be evaluated, and its impact on driver behavior checked to reduce the effects.

Obeng et al., (2022) stated that humps and rumble strips have a positive significant relationship on road safety to lining high-speed roadways which deter shoulder driving or the low-speed control version. As a result, humps and rumble strips have been mostly adopted and used along urban sections of trunk roads and highways to ensure road safety.

Galanis, Botzoris, and Eliou, (2017) asserted that walkways and service lanes promote pedestrian mobility and have a positive significant relationship with road safety. Walkways and service lanes are safety measures that split vulnerable road users from vehicular traffic and also increase the sustainability index of an urban area as well as improve the citizens' quality of life.

Road signs must be visible and draw the attention of drivers. Drivers' awareness of road signs varies according to factors such as sign type, driver experience, familiarity with the sign, and time of day, among others (Oviedo-Trespalacios et al., 2019).

2.3 External factors and road safety

A study by Su et al., (2023) discovered that speed was a major stimulator to aggressive driving, where aggressive drivers tend to drive much faster than natural drivers, hence causing more errors. The study further suggests that there is a positive relationship between speed and the risk of crash; making aggressive driving a road safety risk factor. Drivers would choose to drive at higher speeds due to frustrating events like slow leading vehicles, and traffic congestion, hence using aggressive behavior in response.

A study conducted on maladaptive mobile phone use while on the road found that 90.9% of road users with high maladaptive phone use were more likely to use their phones while on the road (Rahmillah et al., 2023). Mobile phone use while on the road is currently considered one of the biggest road safety issues for different road users, right from drivers to pedestrians. The study further associates this as a determinant of distraction while on the road for both motorists and vulnerable road users. It links it to road safety risk events like falling, slipping, collision, moving violations, road traffic injuries, and motor vehicle crashes, among others.

The elements that affect motor vehicle crashes include those that result from collisions with other vehicles, people, and the environment on the road. Technically, any vehicle is characterised by both electro-mechanical components and accessories. As a result, failure of any vehicle component, such as the braking system and tyres can result in an accident at any time (Haq, Ampadu & Ksaibati, 2023).

Road infrastructural factors include the road layout, roadside environment, communication from the road signs, road markings, and the road's lighting status, among others. Cvahte Ojsteršek and Topolšek, (2019), in their study, noted that thinking of personal problems, chores, and roadside advertisements, and looking at them, as well as the natural environment presents a negative impact on drivers.

2.4 Mitigation methods of road ancillaries on road safety

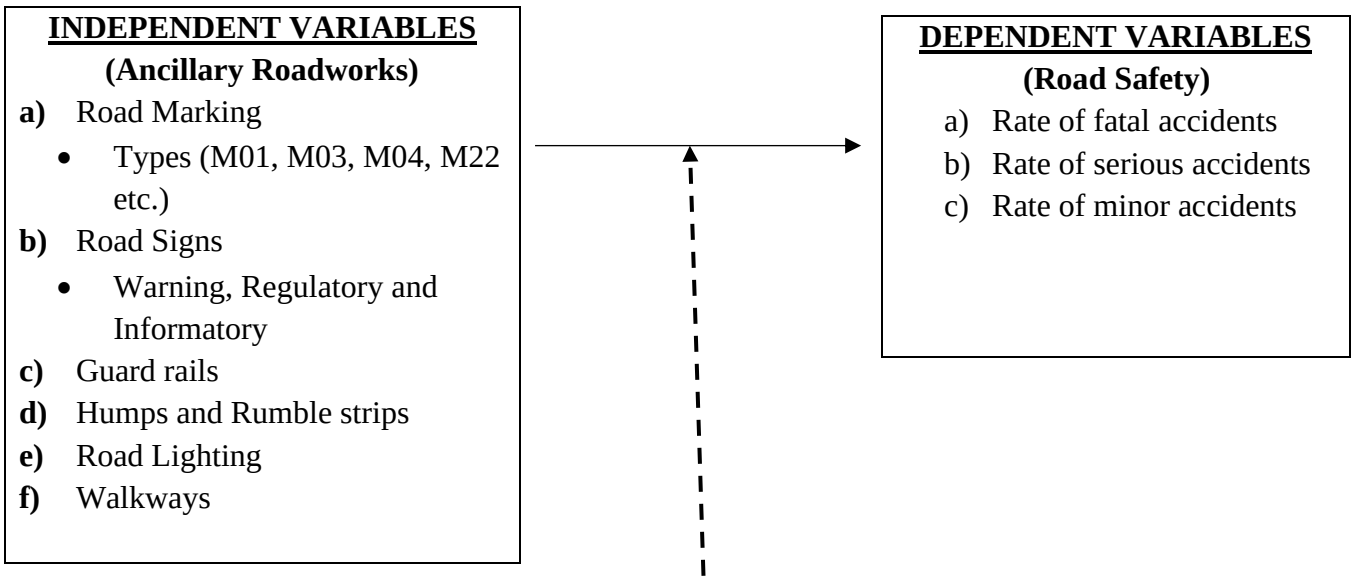
The effective and well-planned open-median traffic control on a one-side-widened freeway with entrance and exit signs of the same zone ensures road safety (Haq, Ampadu & Ksaibati, 2023). The location and length of median openings must be assessed in the road design stage to provide safe and comfortable transportation for travelers. Road users need guidance on open-median management for traffic safety on highways.

Road expansions and upgrades are conventional measures that increase highway capacity by widening roadways and improving geometric design and safety facilities (Zhao et al., 2014). This reduces traffic flow in case of two-side road widening on the highway to ensure road safety.

The WHO and the World Bank jointly released a global report on road traffic injury prevention, which described the global burden of road traffic injuries. The primary goal was to persuade governments and other stakeholders to address the issues of road traffic accidents and the consequences of those accidents. Among the mitigation measures, included setting Laws requiring seat belts or child restraints for all motor vehicle occupants; laws requiring bicycle and motorized two-wheeler riders to wear helmets; blood alcohol limits for drivers, with random breath testing at checkpoints (WHO, 2013).

2.5 Conceptual Framework

The conceptual framework reflected the way variables were adopted to explain the study problem. Ancillary road works considered in the study as independent variables included road making, road signs, guard rails, humps and rumble strips, road lighting, and walkways, while road safety was measured in the form of a reduction in the rate of fatal, serious and minor accidents was the dependent variable as shown in Figure 1.



MODERATING VARIABLES

External Factors

- Traffic enforcement, vehicle condition, road infrastructure condition, driver's age, experience, etc.
- Level of awareness of traffic rules, aggressive driving, etc.
- High speed of road users

Figure 1. Conceptual Framework

3.1 Research methodology

The study adopted a correlation research design, that sought to relate both the dependent and independent variables (Lau, 2017). This method helps to find out how variables are interconnected, making the investigations of the extent to which a variation in the characteristics of the other. The correlation research design therefore helped in investigating the impact of ancillary roadworks on road safety for the area under study. During the study, a quantitative approach was adopted to collect data with questionnaires. A series of questions, both open-ended and closed-ended, were structured as regards the crucial areas of the research. For the quantitative approach, the data was analysed numerically by finding the extent to which the variables relate and their characteristics. This was done using both inferential and descriptive statistics, for example, frequency distributions, Pearson correlation, and multiple linear regressions (Apuke, 2017). Cross-sectional Data was organised and entered in the Statistical Package for Social Sciences software (SPSS 24) to generate Pearson correlation and direct entry method was used for regression. The questionnaires yielded the required data in an economical and faster way for the study.

The study population comprised 32 field traffic officers (with 14 traffic officers from Lugazi police station, 09 traffic officers from Mabira police station, and 09 traffic officers from Njeru police station), 03 Officers-in-Charge (OCs) of traffic police (from Lugazi, Mabira and Njeru), 01 Regional Traffic Officer (RTO), 01 Regional Inspector of Vehicles (IOV)), 40 road engineers with information about the study area, 12 top management committee members representing the markets along the section under study (04 committee members from each of the markets of Mabira/Najjembe, Lugalambo, and Njeru markets), 06 local leaders form Lugazi and Njeru Town councils and 20 drivers which were randomly selected. Out of 115, a sample size of 108 respondents was selected using the Krejcie and Morgan formula (Bukhari, 2021) to participate in this study.

The informants were identified using systematic random sampling and purposive sampling from road engineers, OC traffic, and IO. The researcher administered a questionnaire on a 5-point scale of 1 = Strongly Disagree[SD], 2 = Disagree[D], 3 = Undecided[U], 4 = Agree[A], 5 = Strongly Agree [SA] to traffic officers and some engineers, followed by a review of police reports, accident data for black spots – crash prediction method and newspaper articles where 106 participants were achieved. 83.8% of the respondents were male and 16.2% were female, the majority (52.40%) were of the age group between 31 to 40 years and had attained education above secondary. Penal data from police traffic report was used to establish the status of ancillaries' road works from 2017 to 2022. Observation of the status of ancillary roadworks on Jinja road from checklist extracted on black spot sections which include; Kasaku, Tembo,

Kitega, Lugazi town, Lugazi mosque, Kawolo hospital mortuary, Bulyantete, Sagazi, Najjembe, Kinoni, Lwankima, Lugalambo, Kikaula Picnic, among others. Lastly, OC traffic officers for the police stations, the RTO, and IOV were engaged in this study. The validity and reliability coefficient exceeded the threshold of 0.75 as recommended by Creswell, 2014.

Qualitative data was analysed using the content analysis to generate non-numeral data in words about ancillary roadworks and road safety for sustainable economic development. The standard ethical considerations were adopted induced by an introduction letter from Kyambogo University, Graduate School, which was presented to the Senior staff officer under the Directorate of Traffic and Road Safety from Uganda Police Force, who issued a letter which was presented to the traffic in-charges of the different police station from where data was collected.

4.0 Data analysis, discussion, and findings

4.1 The status of road ancillaries on the Kampala - Jinja Road

The introduction of road signs on Uganda roads is by the provision of the United Nations Convention on Road Signs and Signals (the 1968 Vienna Convention). Traffic Signs Manual for Uganda consists of advice on the design and use of traffic signs given the existing road traffic situation in Uganda but in line with the Vienna Convention. Traffic signs are categorised into; warning Signs, which warn drivers of the dangers or difficulties on the road ahead; Regulatory Signs, which tell drivers what they must or must not do; and Guidance Signs, which help drivers find the way to their destination; Informatory Signs, which help drivers to find services and places of interest and supplementary plates, which give supplementary information to the main sign.

Table 1 Summary Status of Road Signs in the Study Area

Details	Instructed Signs (2017)	Existing Signs (2022)	Missing Signs	Rate of Vandalism (%)
Warning Signs (W)	25	15	10	40.0
Regulatory Signs (R)	34	18	16	47.0
Guidance Signs (G)	12	02	10	83.3
Informatory Signs (I)	41	25	16	39.0
Total	112	60	52	

Table 1 reveals that 40% of the earlier installed warning signs were missing, while 60% were still existing but faded which indicates partial damage; 53% of the installed regulatory signs were still existing with paint deterioration which indicates partial damage, and 47% were vandalised with mental poles remind bent which is complete damage.

Furthermore, 61% of the informatory signs were still existing although faded making them not visible indicating partial damage while 39% were missing. It evidenced that only 16.3% of the earlier installed guidance signs were still existing but slightly faded, with 83.3% vandalised which indicated complete damage making the road not safe for users as drivers can easily cause accidents. Studies have linked vandalism to being caused by humans, with high rates of vandalism happening in densely populated areas, and that it can lead to unsafe driving behaviors (Khalilikhah, Heaslip & Hancock, 2016). Concerning the status of road marking, the study area from Lugazi – Kitigoma spans about 28.43Km and a total of

19.565Km was marked with a continuous centreline, the balance being marked with a broken centreline which indicated partial damage. It was also found that most of the sections had faded edge line markings, paint deterioration, and the climbing lanes which were not visibly seen except for noticing a change in road widths indicating partial damage. Based on the status of guardrails, the study found out that most of the guardrails earlier installed still exist, although most of them had folded sheets and were covered with overgrown vegetation which indicates partial damage. However, some guardrails that were earlier knocked remained with bent metal and treated timber posts which had not been replaced indicating complete damage. Responses on strong agreed and agreed are reported as agreed while strong disagreed and disagreed are reported as disagreed.

Table 2: Frequency, Percentages and Mean on Critical Factors for Road Safety

Road Safety	F/ %	SD		D	U	A	SA	Mean	SD	Rank
The number of road signs and other ancillaries on the road is insufficient. (RF8)	**F**	0		6	3	81	15	**4.35**	**3.92**	**1**
	%	0.00		5.7	2.9	77.1	14.3			
The rate of accidents at black spots is high. (RF6)	**F**	1		2	6	96	**0**	**4.25**	**3.78**	**2**
	%	0.9		1.9	5.7	91.4	0.0			
The rate of motor vehicle accidents is high. (RF1)	**F**	3		7	5	80	10	**4.12**	**3.70**	**3**
	%	2.9		6.6	4.8	76.2	9.5			
There is a high rate of accidents due to overspeeding. (RF3)	**F**	3		10	5	80	7	**4.12**	**3.73**	**4**
	%	2.9		9.5	4.8	76.2	6.6			
Road accidents are a public problem. (RF2)	**F**	4		11	2	79	9	**4.03**	**3.63**	**5**
	%	3.8		10.5	1.9	75.2	8.6			
Vehicles fall off the road embankment in the absence of guardrails. (RF4)	**F**	8		10	11	70	6	**3.78**	**3.41**	**6**
	%	7.6		9.5	10.5	66.6	5.7			
There are high cases of overspeeding in urban sections of the road. (RF7)	**F**	5		16	8	69	7	**3.70**	**3.32**	**7**
	%	4.8		15.2	7.6	65.7	6.6			
Accidents involving pedestrians are high at marketplaces and other urban sections of the road. (RF5)	**F**	7		12	10	71	5	**3.63**	**3.26**	**8**
	%	6.6		14.4	9.5	67.6	4.8			

Table 2 indicated that 91.4% of the respondents agreed that the road signs and other ancillaries were insufficient, 2.9% were undecided and 5.7% responded disagreed that road signs and other ancillaries are sufficient within the study area. A mean of 4.35 ranked in the first position (1st) reaffirms that the road signs and other road ancillaries were insufficient within the study area in relation to the five-point Likert scale. Furthermore, 91.4% of the respondents agreed that the rate of accidents at black spots is high, 2.9% disagreed and 5.7 were undecided. The mean of 4.25 ranked in the second position (2nd) indicating that the respondents strongly agreed on the five-point Likert scale used. As regards whether the rate of motor

vehicle accidents was high, a bigger percentage of the respondents (85.7%) agreed, while the remaining 9.5% disagreed and 4.8% were undecided. A mean of 4.12 ranked in the third position (3rd), indicates that the respondents agreed on the five-point Likert scale used. The results therefore suggest that the rate of motor vehicle accidents in the study area is high. Finding whether there was a high rate of accidents due to overspeeding, 82.8% of the respondents agreed, 12.4% disagreed and 4.8% were undecided. The mean of 4.12 ranked in the fourth position (4th) indicated that the respondents agreed. In regards to whether road accidents are a public problem, a majority of 83.8% of the respondents agreed, 14.3% disagreed and 1.9% were undecided. With a mean of 4.03 ranked in fifth position (5th), suggests that the respondents agreed that road accidents were a public problem. Of the total respondents, 72.3% agreed that vehicles fall off the road embankment in the absence of guardrails, 17.2% disagreed and 10.5% were undecided. A 3.78 mean ranked in sixth position (6th), close to 4 therefore suggests that the respondents agree with the narrative mentioned. Regarding whether there were high cases of overspeeding in urban sections of the road under study, 7.6% of the respondents were undecided, 20% disagreed and 72.4% agreed. A mean of 3.70 ranked in the seventh position (7th), close enough to four, indicates that the respondents agreed accordingly. Lastly, as to whether accidents involving pedestrians are high at marketplaces and other urban sections of the road section under the study, 72.4% of respondents were in agreement, 18.1% disagreed, whereas 9.5% were undecided. The data from the respondents gave a mean of 3.63 ranked in eighth position (8th), just enough to conclude that they agree to the statement raised. The above results, therefore, suggest that road safety is a concern of all stakeholders that use the Kampala – Jinja road. It further suggests that the insufficiency or absence of road ancillaries on any road jeopardises the safety of the different road users and other stakeholders.

Road safety is still a concern that needs to draw the attention of all the stakeholders, including UNRA, MoWT, and Uganda Police, among others. For instance, the rate of accidents as a result of the current status of road ancillaries in the study area, one of the respondents stated. Most black spots are common for accident occurrences, and we have increased the number of the previously known black spots based on the accident records. Adherence to the few existing road safety features by drivers, like road signs, and no overtaking zones is still a challenge. In addition, Other accidents are a result of brake failures, and tyre bursts, among others. These vehicle systems should be thoroughly checked, but drivers find this not necessary. Hence some accidents that we get on our roads. Much as ancillaries are still a problem, vehicle conditions also matter when it comes to road safety.

Road accident data was collected from Lugazi, Mabira, and Njeru police stations, and this was done as part of achieving the second objective of the study, which seeks to determine the relationship between the rate of accidents and the current status of the road ancillaries. The accident data collected covers a period running from 2017 (a period when the study area was handed over to the client) up to 2022. The collected road traffic accident data was collected covering black spot area within the study area and was categorised the road accident data into; fatal; serious and minor accidents. A total of 130 Fatal road accidents were recorded for a period covering 2017 to 2022, 149 serious accidents and 43 minor accidents for the same period. The highest fatalities were recorded in 2019 with the lowest in 2020. The most serious accidents were recorded in 2022 with the lowest in 2020, while most minor accidents were received in 2022 with the lowest minor accidents recorded in 2020. The records indicating the lowest fatalities, and serious and minor accidents in the year 2020 can be attributed to the Covid-19 lockdown that saw fewer vehicles (goods vehicles) only allowed to move on the roads for most of the year. This Covid-19 lockdown period

made fewer risk exposures for vehicles to accidents since the road had very few vehicles. More so, even the various traffic police checkpoints and roadblocks that have been mounted within the study area, particularly Lugazi, Mabira, and Njeru have helped in the reduction of accidents, though to a smaller extent.

Table 3: Percentages, Frequencies and Means for Road Marking

Road Marking (RM)	**F/ %**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
A marked road is easier to drive on at any time of the day. (RM 1)	**F**	0	2	0	93	10	**4.62**	**4.14**	**1**
	%	0.0	1.9	0.0	88.6	9.5			
Road markings easily guide as to when to overtake or not to while driving. (RM 2)	**F**	0	2	1	83	19	**4.53**	**4.06**	**2**
	%	0.0	1.9	1.0	79.0	18.1			
Marked pedestrian crossings are key to ensuring road safety at any busy section of the road. (RM 4)	**F**	2	4	1	90	8	**4.43**	**3.99**	**3**
	%	1.9	3.8	1.0	85.7	7.6			
Enforcing traffic regulations on overtaking is hard for a road with faded road markings. (RM 5)	**F**	2	10	2	83	8	**4.14**	**3.75**	**4**
	%	1.9	9.5	1.9	79.0	7.6			
The road marking in the study area is not adequate. (RM6)	**F**	3	7	12	74	9	**4.08**	**3.69**	**5**
	%	2.9	6.6	11.4	70.5	8.6			
Some traffic accidents are a result of driving on wrong lanes, due to faded centerline markings. (RM3)	F	7	9	4	80	5	3.96	3.59	6
	%	6.6	15.2	3.8	76.2	4.8			

Table 3 indicated that the majority of the respondents agreed to the fact that a marked road is easier to drive on at any time of the day (98.1%), while only 1.9% were in disagreement. Furthermore, a mean of 4.62 ranked in the first position (1st), close to five shows that they strongly agreed based on a five-point Likert scale. As to whether road markings easily guide when to overtake or not while driving, 97.1% of the respondents agreed, 1.0% were undecided and 1.9% were in disagreement. A mean of 4.53 ranked in the second position (2nd) showed that they strongly agreed. As regards whether marked pedestrian crossings were key to ensuring road safety at any busy sections, 93.3% of the respondents agreed, 5.7% disagreed and 1.0% were undecided. The results therefore suggested that the respondents were in strong agreement, with a mean of 4.43 ranked in third position (3rd). Concerning whether enforcing traffic regulations on overtaking is hard for a road with faded road markings, 86.7% of the respondents agreed, 11.4% disagreed and 1.9% were undecided. A 4.14 mean ranked in the fourth position (4th) indicates that the respondents agreed that it's hard to enforce traffic regulations on overtaking a road with faded road markings. 79.1% of the respondents agreed that the road marking in the study area was inadequate, 9.5%

disagreed, whereas 11.4% were undecided. A mean of 4.08 ranked in the fifth position (5th) indicated that the respondents agreed on the five-point Likert scale that the road marking in the study area is not adequate. Over 81% of the respondents agreed that some traffic accidents are a result of driving on a wrong, faded, or unmarked lane, 15.2% disagreed and 3.8% were undecided. A mean therefore of 3.96 ranked in sixth position (6th), close to four, indicating that the respondents agreed to the statement on road marking. These road marking patterns mean a lot in road safety, we have had accidents that are due to careless overtaking. These drivers need to understand these marking patterns and what they mean, even when they are fully in place. Some drivers do not understand them." In addition, road markings and what they mean when it comes to regulating driver behaviors on the road. But even in some sections, like the Njeru market area, you cannot mark it as an overtaking (broken lines at the centreline) section yet it's a market area.

Table 4: Percentages, Frequencies, and Means for Road Signs

Road Signs (RS)	F/ %	SD	D	U	A	SA	Mean	SD	Rank
Warning signs can minimize accidents in blackspots and other sections of the road. (RS4)	F	0	3	5	90	7	**4.36**	**3.89**	**1**
	%	0.0	2.9	4.8	85.7	6.6			
Road signs regulate road user behaviors while using the road. (RS2)	F	0	5	8	90	2	**4.30**	**3.85**	**2**
	%	0.0	4.8	7.6	85.7	1.9			
The absence of road signs on any given road is a safety hazard to all road users and roadside vendors. (RS5)	F	3	6	2	89	5	**4.30**	**3.89**	**3**
	%	2.9	5.7	1.9	84.8	4.8			
Regulatory signs (like speed limit signs) greatly help in minimising accidents caused due to over speeding. (RS3)	F	3	6	1	85	10	**4.27**	**3.85**	**4**
	%	2.9	5.7	1.0	81.0	9.5			
The rate of vandalism of road signs is high. (RS6)	F	1	3	20	74	**7**	**4.11**	**3.68**	**5**
	%	0.9	2.9	19.0	70.5	6.6			
I clearly understand the meaning of all road signs on the road. (RS1)	F	5	7	4	80	9	**3.99**	**3.59**	**6**
	%	4.8	11.4	3.8	76.2	8.6			

Table 4 indicates that 92.3% agreed that warning signs at black spot sections of the road would help in minimising accidents, 2.9% disagreed and 4.8% were undecided. Based on the mean of 4.36 ranked in the first position (1st), this indicates that the respondents strongly agreed. Regarding whether road signs regulate road user behaviors while using the road, 87.6% of the respondents agreed, 4.8% disagreed and 7.6% were undecided. With a mean of 4.3 ranked in second position, the respondents were in strong agreement. The respondents were asked whether the absence of road signs at any given road was a safety

hazard to all road users and other stakeholders. 89.5% of them agreed, 8.6% disagreed and 1.9% were undecided. The mean of 4.30 ranked in the third position suggests that road signs are of great importance if safety is to be realised on the roads. Regarding whether speed limit signs are of great help in minimising accidents due to overspeeding, the majority of the respondents (90.4%) agreed, 8.6% disagreed and 1.0% were undecided. A mean of 4.27 ranked in fourth position was an indication that the respondents agree that speed limit signs can minimise accidents that occur due to overspeeding. When asked whether the rate of vandalism of road signs was high, 77.2% of them agreed, 19.0% were undecided and 3.8% were in disagreement. With a mean of 4.11 ranked in fifth position, the respondents agree that the rate of vandalism of road signs was high in the study area. 84.8% of the respondents clearly understood the meaning of all road signs on the road, 11.4% were in disagreement and 3.8% were undecided. The mean = 3.99 ranked in the sixth position, close to four, suggesting that the respondents agreed that they clearly understood all road signs on the road. In addition, even without speed limit signs, no driver should exceed 50 km/hr in town sections. Road users do not need a sign to regulate this and can charge any driver for over speeding in case this speed limit is exceeded in such town sections.

Table 5: Percentages, Frequencies, and Means for Guardrails

Guardrails (GR)	**F/%**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
Guardrails should always be replaced once knocked, to avoid further road fatalities. (GR2)	**F**	0	2	0	90	13	**4.46**	**3.98**	**1**
	%	0.0	1.9	0.0	85.7	12.4			
Guardrail end sections should be crashworthy to avoid damage to vehicles and the death of occupants as a result of accidents. (GR3)	**F**	2	4	3	85	11	**4.26**	**3.81**	**2**
	%	1.9	3.8	2.9	81.0	10.5			
Guardrails are a major safety feature in preventing vehicles from falling off the roadway. (GR1)	**F**	1	5	5	87	7	**4.24**	**3.79**	**3**
	%	0.9	4.8	4.8	82.9	6.6			
The adequacy of guardrails is low within the study area. (GR4)	**F**	3	10	8	75	9	**4.02**	**3.64**	**4**
	%	2.9	9.5	7.6	71.4	8.6			

Table 5 indicated the impact of guardrails on road safety1, 1.9% of the respondents disagreed while 98.1% were in agreement. With a mean = 4.46 ranked in first position (1st) close to five, the results indicate that the respondents strongly agreed that these guardrails should be replaced once they get knocked. Guardrail end sections should be crashworthy to avoid vehicle damage and death of occupants due to accidents, 91.4% of the respondents agreed, 5.7% disagreed, and 2.9% were undecided. The 4.26 mean ranked second position (2nd) indicated that 89.5% of the respondents agreed that guardrails are a major safety feature that prevents vehicles from falling off the roadway, 4.8% were undecided and 5.7% disagreed. The mean = 4.24 ranked in third position (3rd) was an indicator that they agreed based on the five-point Likert scale. Regarding whether guardrails should be replaced once they get knocked, 80% of the respondents

agreed that the guardrails are inadequate within the study area, 12.4% disagreed and 7.6% were undecided. With a mean of 4.02 ranked in fourth position (4th) close to four, the respondents agreed that the guardrails were inadequate in the study area.

Table 6: Percentages, Frequencies, and Means for Humps and Rumble Strips

Humps and Rumble strips (HR)	F/%	SD	D	U	A	SA	Mean	SD	Rank
These should be marked for easy visibility of drivers and other road users. (HR4)	F	0	2	2	84	17	**4.62**	**4.14**	**1**
	%	0.0	1.9	1.9	80.0	16.2			
Humps and rumble strips should be installed on urban sections and marketplaces. (HR1)	F	1	3	0	89	12	**4.48**	**4.00**	**2**
	%	0.9	2.9	0.0	84.8	11.4			
Humps and rumble strips should be of moderate sizes to avoid further accidents. (HR5)	F	1	3	3	87	11	**4.44**	**3.98**	**3**
	%	0.9	2.9	2.9	82.9	10.5			
In some places, humps and rumble strips have become worn out. (HR2)	F	2	4	4	75	20	**4.26**	**3.80**	**4**
	%	1.9	3.8	3.8	71.4	19.1			
Road users in urban sections of the road are vulnerable in the absence of humps and rumble strips. (HR3)	F	3	4	7	76	15	**4.21**	**3.79**	**5**
	%	2.9	3.8	6.7	72.4	14.3			

Table 6 indicated that humps and rumble strips should be marked for easy visibility of both drivers and other road users, 96.2% of the respondents agreed, 1.9% disagreed and the rest (1.9%) were undecided. With a mean of 4.62 ranked first position (1st) close to five, the respondents strongly agreed that the humps and rumble strips should be marked for easy visibility of both drivers and other road users. The majority of the respondents (96.2%) agreed that humps and rumble strips should be put in urban and market sections of the road while 3.8% of them disagreed. The mean values obtained (4.48) ranked second position, close to five, indicating that the respondents strongly agreed that these humps and rumble strips should be put in the above-mentioned sections of the road. As regards whether humps and rumble strips in some road sections had become worn out, 90.5% of the respondents agreed, 5.7% disagreed and 3.8% were undecided. The mean of 4.26 ranked in fourth position, indicated that the respondents agreed with the question administered. As regards whether humps and rumble strips in some road sections had become worn out, 90.5% of the respondents agreed, 5.7% disagreed and 3.8% were undecided. The mean of 4.26 ranked in fourth position, indicated that the respondents agreed with the question administered. The majority of the respondents (86.6%) agreed that road users in urban sections of the road were vulnerable in the absence of humps and rumble strips, 6.7% of them disagreed while 6.7% were undecided. The results further suggested that the respondents agreed, given a mean value of 4.21ranked in fifth position.

Table 7: Percentages, Frequencies, and Means of Road Lighting

Road Lighting (RL)	F/%	SD	D	U	A	SA	Mean	SD	Rank
Road lighting has a great impact on road safety for both pedestrians and drivers. (RL2)	F	0	1	0	9	95	**4.60**	**4.11**	**1**
	%	0.0	1.0	0.0	8.6	90.4			
Streetlights should be installed on all urban sections of the road to minimize accidents due to poor night visibility. (RL3)	F	0	1	2	922	10	**4.55**	**4.07**	**2**
	%	0.0	1.0	1.9	87.6	9.5			
Some sections of the road are dark at night, making visibility poor. (RL1)	F	2	4	2	82	15	**4.43**	**4.00**	**3**
	%	1.9	3.8	1.9	78.1	14.3			
The street lights within the study area are insufficient. (RL5)	F	0	2	5	89	9	**4.39**	**3.92**	**4**
	%	0.0	1.9	4.8	84.8	8.5			
Lighting black spots can help mitigate accidents in these sections, especially during night-time. (RL4)	F	3	5	1	85	11	**4.28**	**3.85**	**5**
	%	2.8	4.7	1.0	81.0	10.5			

Table 7 on road lighting indicated that 4.60 mean ranked in first position, close to five, indicating that the majority of the respondents (99.0%) strongly agreed that road lighting has of great impact on road safety for both pedestrian and drivers, while the rest (1.0%) disagreed. As to whether street lights should be installed on all urban sections of the road to minimise accidents due to poor night visibility, 97.1% of the respondents agreed, 1.9% were undecided, and 1.0% disagreed. A mean of 4.55 ranked in the second position indicated that the respondents strongly agreed to light the urban sections of the road to minimise accidents due to poor visibility. Further, 92.4% of the respondents agreed that some sections of the road were dark at night, making visibility poor, 5.7% disagreed while the rest (1.9%) were undecided. With a mean of 4.43 ranked in third position, the results indicated that some sections of the road get dark at night, making visibility hard for road users. Whether street lights within the study area were insufficient, a majority 93.3% of the respondents agreed, 4.8% were undecided and 1.9% disagreed. A mean of 4.39 ranked in the fourth position is an indicator that the respondents strongly agreed that the street lights in the study areas were insufficient. Regarding whether lighting black spots sections of the road would help in mitigating accidents in these sections, especially at night, a mean of 4.28 ranked in the fifth position indicating that 91.4% of the respondents agreed, while 7.6% disagreed and 1.0% were undecided.

Table 8: Percentages, Frequencies, and Means for Walkways and Service Lanes

Walkways and Service Lanes (WS)	F/ %	SD	D	U	A	SA	Mean	SD	Rank
Service lanes are important for the isolation of vehicles around marketplaces and urban sections of the road. (WS2)	F	0	0	4	91	10	**4.50**	**4.01**	**1**
	%	0.0	0.0	3.8	86.7	9.5			
	F	0	3	3	90	9	**4.49**	**4.01**	**2**

The walkway should be laid on all urban sections of the road. (WS1)	**%**	0.00	2.9	2.9	85.7	8.5			
Walkways and service lanes separate fast-moving vehicles from pedestrians and slow-moving vehicles. (WS3)	**F**	3	6	5	84	7	**4.23**	**3.81**	**3**
	%	2.9	5.7	4.8	80.0	6.6			
There are no walkways on sections where they are required. (WS4)	**F**	2	7	13	68	15	**3.99**	**3.57**	**4**
	%	1.9	6.6	12.4	64.8	14.3			

Table 8 indicated that the way service lanes were important in the isolation of vehicles and pedestrians at urban and market places of the road, 96.2% of the respondents agreed and 3.8% were undecided. A mean of 4.5 ranked in the first position, which is close to five on the Likert scale indicating that the respondents strongly agreed with the construction of service lanes at marketplaces and urban sections of the road. In addition, the majority (94.2%) of the respondents agreed that walkways should be laid on all urban sections of the road, with a mean of 4.49, while 2.9% were undecided and 2.9% disagreed. Therefore, a mean (4.49) ranked in a second position close to five indicating that the respondents strongly agreed to laying walkways in urban sections of the road. In addition, 86.6% of the respondents further agreed that walkways and service lanes separate fast-moving vehicles from pedestrians and slow-moving vehicles. 8.6% disagreed and 4.8% were undecided. A mean of 4.23 ranked in third position indicated that the respondents agreed. Furthermore, 79% of the respondents agreed, 8.6% disagreed and the rest (12.4%) were undecided with a mean of 3.99 ranked in fourth position, that no walkways at sections where they are required. Some drivers do not understand
these signs and other features. There is a need for timely training, possibly during permit renewals because some of them are lacking in this area. The accidents are due to mechanical failures in the vehicles. These are notably brakes, and tyre bursts, among others. Other accidents are a result of aggressive driving mostly on weekends and public holidays. Some of the drivers are first-time drivers in this area and they don't take extra care while driving. This can even give a better maintenance planning policy for our roads. Some accidents couldn't even have happened if some of these ancillaries had been replaced on time.

Correlation of Ancillary Roadworks and Road Safety

Correlation strength is measured from -+ 0.01 to -+1.0, often expressed as r. The coefficient range; is -+0.01 to -+0.40 weak; -+0.41 to -+0.69 moderate and -+0.70 to -+0.99 strong relationship. The identified log codes; are Log_RM Road marking, Log_RS Road signs, Log_GR Guardrails, Log_HR Humps and Rumble strips, Log_RL Road lighting, Log_WS Walkways and Service Lanes, and Log_RF Road Safety. Pearson's correlation analysis was used to establish the relationship between the variables.

Table 9 Correlation of Ancillary Roadworks and Road Safety

	Log_RM	**Log_RS**	**Log_GR**	**Log_HR**	**Log_RL**	**Log_WS**	**Log_RF**
Log_RM	1						
Log_RS	.214*	1					
Log_GR	.354**	.241*	1				

Log_HR	.315**	.494**	.412**	1			
Log_RL	.224*	.332**	.273**	.515**	1		
Log_WS	.296**	.475**	.439**	.569**	.564**	1	
Log_RF	.367**	.162	.388**	.427**	.325**	.341**	1
*. Correlation is significant at the 0.05 level (2-tailed).							
**. Correlation is significant at the 0.01 level (2-tailed).							

Table 9 revealed that road marking with a correlation coefficient of 0.367 has a positive weak significant relationship with road safety. This implies that improvement on the road marking ancillary works takes the same direction as road safety. The increase in road marking enables users of the roads specifically drivers, pedestrians, cyclists, and motorcyclists move in the safe zone to ensure road safety. Road marking minimizes accidents since the users can easily see and interpret them to decide the next course of action. The findings of this study are in agreement with Dario, et al, (2020) who establish that road markings form the traffic surface and provide visual guidance for road users which has a positive significant relationship with road safety. In an earlier study by Li (2017), it was also established that road markings with higher retroreflflectivity (>200 mcd/lx/m2) have a positive association with the lower number of road accidents at a 95% confidence level. Road signs with a correlation coefficient of 0.167 have an insignificant positive weak relationship with road safety (P value is greater than 0.05). This implies that road signs are quite many and unique to road users specifically drivers, pedestrians, cyclists, and motorcyclists who encounter difficulty knowing and interpreting all the road signs which hinders road safety. Guardrails with a correlation coefficient has 0.388** have a weak positive significant relationship with road safety. This implies that improvement on guardrails takes the same direction as road safety. The finding concurs with Selva, Ranjith, Roop, and Vignesh (2018) who stated that the guardrail infrastructure feature has a positive significant relationship with road safety. Humps and rumble strips with a correlation coefficient of 0.427 have a moderate positive significant relationship with the road safety. This implies that improvement on humps and rumble strips takes the same direction as road safety. The finding is in agreement with Atuah, Yaw, Michael, and Clifford (2022) who stated that humble and rumble strips have a positive significant relationship with road safety to lining high-speed roadways which deters shoulder driving or the low-speed control version. The rumble strips make drivers a little more alert that the roadway is changing to force them to slow down to go over a speed bump on autopilot, the vibration and sound of rumble strips immediately alert the driver that there could be a danger to themselves or pedestrians to ensure road safety. Road lighting with a correlation coefficient of 0.325 has a moderate positive significant relationship with road safety. The increase in the numbers and quality of road lights improves safety by increasing the visibility of roadside hazards and by reducing the effects of glare from other light sources in the visual environment, such as vehicle headlamps. The finding concurs with Bullough (2016) who established that road lights have a positive significant relationship with road safety.

Walkways and service lanes with a correlation coefficient of 0.341 have a weak positive significant relationship with road safety. This implies that improvement on walkways and service lanes takes the same direction as road safety. The finding agreed with those of Athanasios, George, and Nikolaos (2016) who assert that walkways and service lanes promote pedestrian mobility has a positive significant relationship with road safety. The ancillary roadworks require continued maintenance and improvement with the support of police enforcement of road traffic laws to ensure road safety.

Table 10 Regression on the effect of ancillary road works and road safety

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.125	.084		1.485	.141
Log_RM	.319	.099	.307	3.614	.029
Log_RS	-.118	.108	-.111	-1.088	.279
Log_GR	.291	.102	.286	3.865	.045
Log_HR	.392	.131	.360	4.231	.028
Log_RL	.114	.115	.107	.996	.322
Log_WS	.044	.125	.042	.353	.725
R	.798				
R Square	.637				
Adjusted R Square	.615				
F-Change	9.683				
Sig. F Change	.000				

Table 10 revealed that ancillary roadworks through road marking, road signs, guardrails, humps and rumble strips, road lighting, walkways, and service lanes explain 63.7% variation in road safety at a 95% level of significance (Adjusted R Square = 0.637), other factors such as enforcement of law on road users, installation of speed limit governor, fasten seat among other external factors excluded from the study contributed 36.3% on the road safety. F-Change of 9.683 indicates that the predictors have a significant influence on road safety. Road safety with 0.125 is not attained when study predictors are zero.

Multi Linear Regression analysis establishes that road marking with standardized coefficient beta .307 has a positive significant contribution to road safety. This implies that a unit change in road marking improvement contributes to a 0.307-unit change in road safety. The findings agreed with Darko; Dario; Mario; and Marija (2020) who stated that road marking has a significant impact on road safety because it helps to regulate traffic by guiding road users and predicting the traveling trajectory and road boundaries. Road signs with standardized coefficient beta -0.111 have a negative insignificant contribution to road safety. Road signs are good although quite many to be mastered by the drivers and pedestrians which makes them insignificant to road safety. Guardrails with a standardized coefficient beta of 0.286 have a positive significant contribution to road safety. This implies that a unit improvement and change in guardrails contribute to 0.286 unit change in road safety. Guardrails on the sides of the road protect drivers and pedestrians from falling and hitting obstacles to ensure road safety. In addition, humps and rumble strips with a standardized coefficient beta of 0.360 have a positive significant contribution to road safety. This implies that a unit improvement and change in humps and rumble strips contribute to a 0.360 unit change in road safety. Humps and rumble strips forcefully control the speed of motorists and other users which reduces and eliminates on-the-road accidents. Road lights with standardized coefficient beta 0.107 have a positive insignificant contribution to road safety. This implies road lights are good and desired for visibility purposes for road users although insignificantly affect road safety. Similarly, walkways and service lanes with standardized coefficient beta 0.042 have a positive insignificant contribution to road

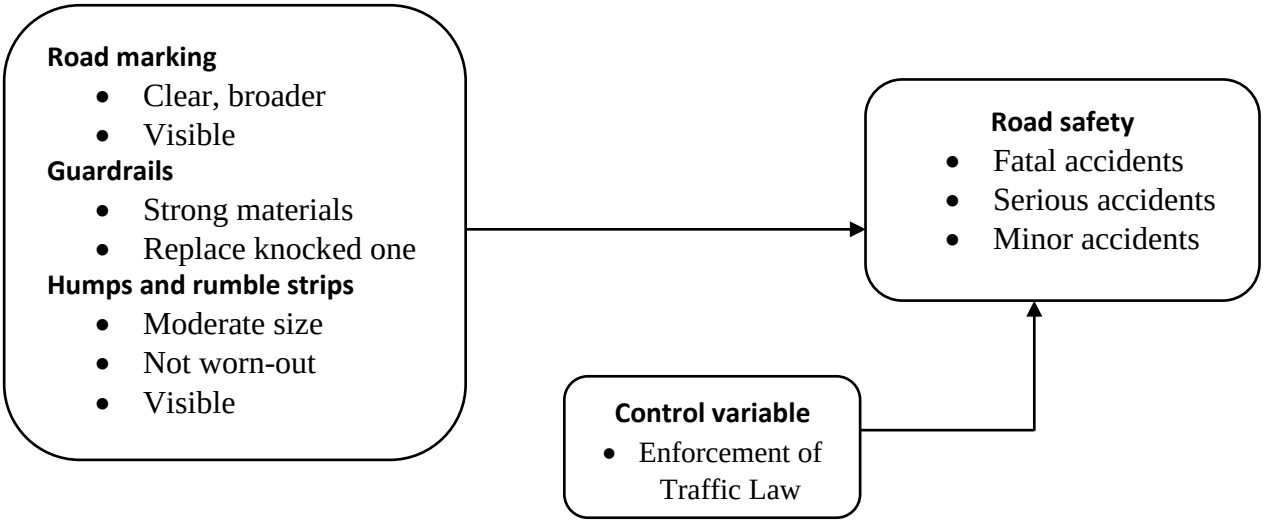
safety. The walkways and service lanes help to separate motorists from the people which is desirable and good although does not significantly contribute to road safety.

5.0 External factors impact on road safety in Uganda

External factors are behavior elements undertaken to supplement the impact of the ancillary roadworks on road safety. Traffic enforcement through issuing express penalties, and warnings; inspection of observable elements to determine the vehicle condition, regular improvement on road infrastructure condition, and upgrade of driving permits among others support road ancillaries in achieving road safety. According to the Police Road Safety Report (2021), 80% of road users comply with the ancillary roadworks due to the issuing of express penalties that support road safety. It was further indicated in the road safety survey report for Uganda Police that improvement in road infrastructure conditions through tarmac reduces road accidents by 70% to ensure road safety.

This agreed with the findings of Henry, Esau, Justinah, Mary, Mutisya & Kaaya (2022) about Factors Influencing Highway Road Accidents in Uganda: A Case Study of Kampala-Masaka Highway and results indicated that human error (100%), unqualified drivers/riders (90.9%), nature of the road (81.8%), weather and vehicle conditions (63.6%) as the main causes of HRA whereas death (100%), damage of vehicles (90.9%), injuries (72.7%) and unemployment (63.6%) were its outcomes.

The tool to be adopted is illustrated below:



Road safety requires clear broader and visible road marking, durable standard guardrails and visible moderate size humps and rumble strips with control of enforcement of traffic laws in the Low and Middle Income Economies (LMIEs). Uganda as LMIEs has capacity to construct and maintain road marks with speed limit signs, guardrails, humps and rumble strips to reduce over-speeding in the prevention of road accidents.

6.0 Conclusions

The road signs are few compared to the requirements especially warning signs which are critical but below average thus increasing the road accidents in the study area and Uganda at large. Road markings are lacking since only about 9.95 km out of 19.565Km representing 50.8% are marked which indicates that 49.2% were faded marks. Therefore, ancillaries' road works are lacking and require quick fixing with

regular maintenance to avoid road accidents from over speeding, following too close, careless driving, careless driving, careless pedestrians, and mechanical failure of vehicles and motorcycles in Uganda.

The road ancillaries including road markings, guardrails, humps and rumble strips, road lighting, walkways, and service lanes have a positive significant relationship with road safety, unlike road signs. However, multiple simple regressions indicated that road making, guardrails, humps, and rumble strips have a positive significant effect on road safety at a 95 percent confidence level. Safe roads have road marks, guardrails, humps, and rumbles to regulate and control the users especially drivers and pedestrians to minimize and prevent road accidents for Sustainable Development Goal 3.6 which calls for all governments to half the number of global deaths and injuries from road accidents. The use of express penalties, warnings; inspection of observable elements to determine the vehicle condition, regular improvement on road infrastructure condition, evaluation of driver's age and experience as well as renewal and upgrade of driving permit support the effective use of roads to minimise on the accidents were the external behavior factors for road safety in Uganda. The external factors are desired to supplement the ancillaries' road works to achieve road safety.

Clear road marking with warning signs and regulatory signs (like speed limits), maintained guardrails to prevent vehicles and pedestrians from falling off, and humps and rumble strips with moderate size and standards to control vehicles and pedestrians contribute to road safety. However, enforcement of road law by policy supplements compliance with the ancillary road works for road safety.

7.0 Recommendations

The humble and rumble strips should be moderate in size to ease the usability of the roads by the vehicles for road safety. The moderate size should be standard to accommodate all motorists with a high rate of stability to foster sustainable road transport and travel safety in Uganda. The government should widen the roads and mark them clearly with standards-approved colors to reduce vehicle crashes to ensure road safety. Road markings with higher retroreflectivity (>200 mcd/lx/m2) are associated with a lower number of road accidents. Regular maintenance and informal education should be conducted to sensitize people on the interpretation of road marks to avoid misinterpretation to secure road safety. The MoTW should ensure the minimum level of retroreflection required by drivers' ranges between 100 and 150 mcd/lx/m2 in dry conditions and about 150 mcd/lx/m2 in wet conditions to ensure road safety. The study suggests that empirical studies are needed to establish the way road lights and their impact on Driver behavior and Road Safety. Effectiveness of humps and rumble strip installation in speed reduction on highways in Uganda.

REFERENCES

1. APUKE, O. (2017) Quantitative Research Methods: A Synopsis Approach. Arabian Journal of Business and Management Review (Kuwait Chapter)., 6(11), pp. 40–47.
2. BABIĆ, D., FIOLIC, M., BABIĆ, D. and GATES, T. (2020). Road Markings and Their Impact on Driver Behaviour and Road Safety: A Systematic Review of Current Findings. Journal of Advanced Transportation, 2020(1), pp. 1–19.
3. BABI´C, D., BABI´C, D., CAJNER, H., SRUK, A. and FIOLI´C, M. (2020) Effect of Road Markings and Traffic Signs Presence on Young Driver Stress Level, Eye Movement and Behaviour in Night-Time Conditions: A Driving Simulator Study. Safety, 6(2), p. 24.

4. BABIĆ, D., BABIĆ, D., FIOLIC, M., and FERKO, M. (2022) Road Markings and Signs in Road Safety. Encyclopedia, 2(4), pp. 1738–1752.
5. BAMBACH, M., MITCHELL, R. and GRZEBIETA, R. (2013) The Protective Effect of Roadside Barriers for Motorcyclists. Traffic injury prevention, 14(7), pp. 756–765.
6. BUKHARI, S.A. (2021) Sample Size Determination Using Krejcie and Morgan Table.
7. BULLOUGH, J.D. (2016) Road Lighting. In: LUO, M.R. (ed.) Encyclopedia of Color Science and Technology. New York, NY: Springer, pp. 1127–1132.
8. CHARLTON, S.G., STARKEY, N.J. and MALHOTRA, N. (2018) Using road markings as a continuous cue for speed choice. Accident Analysis & Prevention, 117(8), pp. 288–297.
9. CRAWFORD, M. (2014) Strengths and Limitations of Correlational Design.
10. CVAHTE OJSTERŠEK, T., and TOPOLŠEK, D. (2019) Influence of drivers' visual and cognitive attention on their perception of changes in the traffic environment. European Transport Research Review, 11(1), p. 45.
11. DIAMANDOUROS, K. and GATSCHA, M. (2016) Rainvision: The Impact of Road Markings on Driver Behaviour – Wet Night Visibility. Transportation Research Procedia, 14(6), pp. 44–53.
12. FINCHAM, J. (2008) Response Rates and Responsiveness for Surveys, Standards, and the Journal. American Journal of Pharmaceutical Education, 72, p. 43.
13. GALANIS, A., BOTZORIS, G. and ELIOU, N. (2017) Pedestrian road safety in relation to urban road type and traffic flow. Transportation Research Procedia, 24(C), pp. 220–227.
14. GARACH, L., CALVO, F. and DE OÑA, J. (2022) The effect of widening longitudinal road markings on driving speed perception. Transportation Research Part F: Traffic Psychology and Behaviour, 88(9), pp. 141–154.
15. HAGHANI, M., BEHNOOD, A., DIXIT, V. and OVIEDO-TRESPALACIOS, O (2022) Road safety research in the context of low- and middle-income countries: Macro-scale literature analyses, trends, knowledge gaps, and challenges. Safety Science, 146(1), pp. 105–113.
16. HAQ, M.T., AMPADU, V.-M.K. and KSAIBATI, K. (2023) An investigation of brake failure related crashes and injury severity on mountainous roadways in Wyoming. Journal of Safety Research, 84, pp. 7–17.
17. 17) HENRY, M., ESAU, M. JUSTINAH, M. MARY, S.M. & KAAYA, S. (2022) about Factors Influencing Highway Road Accidents in Uganda: A Case Study of Kampala-Masaka Highway. ISSN 2520-7504 (Online) Vol.6, Iss.1, 2022 (pp. 108 - 118).
18. ISHTIAQ, M. (2019) Book Review Creswell, J. W. (2014). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (4th ed.). Thousand Oaks, CA: Sage. English Language Teaching, 12(5), p. 40.
19. KHALILIKHAH, M., HEASLIP, K. and HANCOCK, K. (2016) Traffic Sign Vandalism and Demographics of Local Population: A Case Study in Utah. Journal of Traffic and Transportation Engineering (English Edition), 3(3), pp. 192–202.
20. Lioi, A., Hazoor, A., Castro, M., and Bassani, M. (2022) Impact on driver behavior of guardrails of different height in horizontal-vertical coordinated road scenarios with a limited available sight distance. Transportation Research Part F: Traffic Psychology and Behaviour, 84(6), pp. 287–300.
21. MOSTAFA, S. and AHMAD, I. (2017) Recent Developments in Systematic Sampling: A Review. Journal of Statistical Theory and Practice, 12(3), pp. 290–310.

22. OBENG, D. A. TUFFOUR, A. Y., POKU-BOANSI, M., and AMOAKO, C. (2022) The effectiveness of rumble strips installations in speed reduction along major highways in Ghana – The case of N1 highway. Scientific African, 16(1), pp. 12–15.
23. OVIEDO-TRESPALACIOSA, O., VERITY, T., WATSONA, B., and HINTONB, J.A. (2019) The impact of road advertising signs on driver behaviour and implications for road safety: A critical systematic review. Transportation Research Part A: Policy and Practice, 122(21), pp. 85–98.
24. RAHMILLAH, I. F., AMINA TARIQ, A., KING, M., and OVIEDO-TRESPALACIOS, O. (2023) Is distraction on the road associated with maladaptive mobile phone use? A systematic review. Accident Analysis & Prevention, 181(4), pp. 106–109.
25. MBOWA, S., ESAU, M., JUSTINAH, M., MARY, M., and KAAYA, S. (2022) Factors influencing highway road accidents in Uganda: A case of Kampala -Masaka highway. 6(1), pp. 108–118.
26. SU, Z., ROGER, W., JOSEPH, V. S. and MARK, E. (2023) The relationship between aggressive driving and driver performance: A systematic review with meta-analysis. Accident; Analysis and Prevention, 183(2), pp. 69–72.
27. THE GLOBAL ROAD SAFETY FACILITY (2022) Annual Global Road Safety Report. Available from: https://www.roadsafetyfacility.org/country/uganda [Accessed 06/09/23].
28. UGANDA POLICE FORCE (2023) The 2022 Annual Crime Report. [Online] Uganda Police Force. Available from: https://www.upf.go.ug/download/the-2022-annual-crime-report/ [Accessed 01/03/23].
29. UNDP (2022) Sustainable Development Goals | United Nations Development Programme. [Online] UNDP. Available from: https://www.undp.org/sustainable-development-goals [Accessed 30/08/23].
30. UNECE (2010) Consolidated Resolution on Road Signs and Signals. [Online] Available from: https://digitallibrary.un.org/record/699670 [Accessed 17/01/2023].
31. UNECE (2018) Uganda urgently needs to move from Policy to Action to improve Road Safety – UN report | UNECE. Available from: https://unece.org/uganda-urgently-needs-move-policy-action-improve-road-safety-un-report [Accessed 30/08/23].
32. VENKATARAMAN, V. (2019) Monitoring on Guardrails to Afford Road Safety Using IOT. Journal of Autonomous Intelligence, 1(2), p. 13.
33. WALEKHWA, A.W., MULOLO, F., ACHIRO, C., NANTONGO, M., NAKAZIBWE, B., and MASANZA, M. M. (2022) A Rapid Assessment of Road Crashes in Uganda: Notes from the Field. Dr. Sulaiman Al Habib Medical Journal, 4(4), pp. 174–181.
34. WHO (2023) Global Status Report on Road Safety - Time for Action. [Online] WHO | Regional Office for Africa. Available from: https://www.afro.who.int/publications/global-status-report-road-safety-time-action [Accessed 30/08/23].
35. WHO (2021) Global Status Report on Road Safety - Time for Action. [Online] WHO |Regional Office for Africa. Available from: https://www.afro.who.int/publications/global-status-report-road-safety-time-action [Accessed 24/01/23].
36. WHO (2013) Strengthening road safety legislation: a practice and resource manual for countries. Geneva: World Health Organization.
37. WHO REGIONAL OFFICE FOR AFRICA (2018) Uganda launches Legislative Action Plan on Road Safety. [Online] WHO | Regional Office for Africa. Available from: https://www.afro.who.int/news/uganda-launches-legislative-action-plan-road-safety

38. ZHANG, H., HOU, N., DING, N. and JIAO, N. (2023) Using multicolor perceptual markings as a rear-end crash risk mitigator: A field investigation. Accident Analysis & Prevention, 179(1), pp. 106–881.

QUESTIONNAIRE FOR RESPONDENTS

Dear Respondent,

My name is **ISAAC SSEBULIBA**, and I am conducting an academic study on the **''Impact of Ancillary Roadworks on Road Safety in Uganda: A Case Study of the Kampala-Jinja Road''**. This is in Partial Fulfillment for the award of a **Master of Science in Construction Technology and Management of Kyambogo University (KYU).** I am honored to request your participation in this study by responding truthfully and honestly to the questions on this questionnaire. Your response to this questionnaire is highly valued and you are among the people with profound knowledge in this study area. The provided information is solely for academic purposes and will be kept strictly confidential.

Thank you very much.

Yours Faithfully

……..

Ssebuliba Isaac
0703-670026/0706-906010
Email: isaacssebuliba@gmail.com

SECTION A: BACKGROUND INFORMATION

Please tick the appropriate box

1. **Sex**

Male	Female

2. **Age group**

Below 30 years	31-40 years	41-50 years	Above 51 years

3. **Level of Education**

A-Level & below	Certificate	Diploma	Degree	Masters	PhD

4. Years you have resided within the Area of Study

5 years and below	6-10 years	11-15 years	Above 15 years

5. Position within the Area of Study

Traffic Officer	Market Leader	Driver	Road Engineer	Local Leader

Others (Specify) ……

SECTION B: RESPONSE ON RESEARCH VARIABLES

Please indicate your level of agreement or disagreement with the statement on a scale of 1 **(Strongly Disagree)** 2 **(Disagree)** 3 **(Undecided)** 4 **(Agree)** 5**(Strongly Agree).**

No	**Independent Variables**	**SD**	**D**	**U**	**A**	**SA**
		1	**2**	**3**	**4**	**5**
a)	**Road Marking (RM)**					
RM1	A marked road is easier to drive on at any time of the day.					
RM2	Road markings easily guide as to when to overtake or not to while driving.					
RM3	Some traffic accidents are a result of driving on wrong lanes, due to faded centerline markings.					
RM4	Marked Pedestrian crossings are key to ensuring road safety at any busy section of the road.					
RM5	Enforcing traffic regulations on overtaking is hard for a road with faded road markings.					
RM6	The road marking in the study area is not adequate.					
		SD	**D**	**U**	**A**	**SA**
b)	**Road Signs (RS)**	**1**	**2**	**3**	**4**	**5**
RS1	I clearly understand the meaning of all road signs on the road.					
RS2	Road signs regulate road user behaviors while using the road.					
RS3	Regulatory signs (like speed limit signs) greatly help in minimising accidents caused due to over speeding.					
RS4	Warning signs can minimize accidents in blackspots and other sections of the road.					
RS5	The absence of road signs on any given road is a safety hazard to all road users and roadside vendors.					
RS6	The rate of vandalism of road signs is high.					
		SD	**D**	**U**	**A**	**SA**
c)	**Guardrails (GR)**	**1**	**2**	**3**	**4**	**5**

GR1	Guardrails are a major safety feature in preventing vehicles from falling off the roadway.					
GR2	Guardrails should always be replaced once knocked, to avoid further road fatalities.					
GR3	Guardrail end sections should be crashworthy to avoid damage to vehicles and the death of occupants as a result of accidents.					
GR4	The adequacy of guardrails is low within the study area.					
		SD	**D**	**U**	**A**	**SA**
d)	**Humps and Rumble strips (HR)**	**1**	**2**	**3**	**4**	**5**
HR1	Humps and rumble strips should be installed on urban sections and marketplaces.					
HR2	In some places, humps and rumble strips have become worn out.					
HR3	Road users in urban sections of the road are vulnerable in the absence of humps and rumble strips.					
HR4	These should be marked for easy visibility of drivers and other road users.					
HR5	Humps and rumble strips should be of moderate sizes to avoid further accidents.					
		SD	**D**	**U**	**A**	**SA**
e)	**Road Lighting (RL)**	**1**	**2**	**3**	**4**	**5**
RL1	Some sections of the road are dark at night, making visibility poor.					
RL2	Road lighting has a great impact on road safety for both pedestrians and drivers.					
RL3	Streetlights should be installed on all urban sections of the road to minimize accidents due to poor night visibility.					
RL4	Lighting black spots can help in mitigating accidents in these sections, especially during nighttime.					
RL5	The street lights within the study area are insufficient.					
		SD	**D**	**U**	**A**	**SA**
f)	**Walkways and Service Lanes (WS)**	**1**	**2**	**3**	**4**	**5**
WS1	The walkway should be laid on all urban sections of the road.					
WS2	Service lanes are important for the isolation of vehicles around marketplaces and urban sections of the road.					
WS3	Walkways and service lanes separate fast-moving vehicles from pedestrians and slow-moving vehicles.					
WS4	There are no walkways on sections where they are required.					
	DEPENDENT VARIABLES	**SD**	**D**	**U**	**A**	**SA**

A)	Road Safety (RF)	1	2	3	4	5
RF1	The rate of motor vehicle accidents is high.					
RF2	Road accidents are a public problem.					
RF3	There is a high rate of accidents due to overspeeding.					
RF4	Vehicles fall off the road embankment in the absence of guardrails.					
RF5	Accidents involving pedestrians are high at marketplaces and other urban sections of the road.					
RF6	The rate of accidents at black spots is high					
RF7	There are high cases of over speeding in urban sections of the road.					
RF8	The number of road signs and other ancillaries on the road is insufficient.					