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School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

Enhancing safe routes to school through the setting up of a school safety zone using school zone and speed limit signs: A case study of Kigamboni ward in Dar es Salaam, Tanzania

Gladness Rwejumura

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences, specialization Traffic Safety

SUPERVISOR :

Prof. dr. Davy JANSSENS

MENTOR :

Mevrouw Helene DIRIX

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PREFACE

The research topic behind this study was activities to promote safe and sustainable transport to school. The motivation for the choice of topic came from years of witnessing the hardships faced by schoolchildren, mostly from low-income households on Dar-es-Salaam's roads as they make their school journeys. This group of children mostly rely on walking and public transport to go to school as government-owned primary schools do not own school buses. As a result, they find themselves at high risk of suffering road traffic injuries or fatalities as they walk on roads, some of which lack the infrastructure to separate them from fast-moving traffic. Furthermore, the drivers do not constantly adapt their driving style according to pedestrians' presence, making it very dangerous. My promoter challenged me to think of an intervention that would act as a solution to this problem. And that is how the study scope, aim and objectives were developed. As a Master student specialising in Road Safety and coming from Africa, I ought to contribute to Africa's research database with a study based on a solution rather than the already known problems similar in some regions of the continent. The study will be the first of its kind to focus on creating a school safety zone using school zone and speed limit signs only to make the routes to schools safer whilst improving the schoolchildren's road safety.

ACKNOWLEDGEMENTS

I want to extend my sincere and heartfelt gratitude to every person who helped me make headway in this endeavour through their assistance, guidance, cooperation, and encouragement that made this study's preparation and finalization possible. Above all else, I thank my GOD for everything. Furthermore, I am incredibly thankful to VLIR-UOS for funding my Master's program and UHasselt for granting me the opportunity. Finally, I extend my gratitude to my UHasselt supervisory team, Prof. dr. Davy Janssens and Mevrouw Hélène Dirix. I acknowledge their contribution as a promoter who guided me through the plan of approach and as a mentor who provided detailed feedback throughout the thesis preparation.

My sincere thanks also go to TARURA Dar es Salaam and the Kigamboni Municipal Council, who permitted me to research the chosen study area. The Head and deputy head teachers of Ufukoni, Kigamboni and Kivukoni Primary Schools for their cooperation.

My most profound appreciation to Jeffrey Witte, the Executive Director of Amend, Simon Kalolo and George Maleka of Amend, Augustus Fungo, Irene Msellem and Amos William of Road Safety Ambassadors (RSA) Tanzania and Superintendent Deus. W. Sokoni of the Tanzania Traffic Police. I am ineffably thankful to Simon Kalolo, who made a tremendous contribution in the data collection process and Augustus Fungo, who assisted in selecting the study area.

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SUMMARY

The current research aimed to implement and evaluate the effectiveness of creating a School Safety Zone (SSZ) using school zone and speed limit signs as a road safety intervention to make safer the routes to the school. The scope of the case study area was the three government primary schools located in Kigamboni Ward in Dar-es-Salaam, Tanzania. 1.36 million people have been estimated to die on roads worldwide while 50 million people are injured (World Health Organization (WHO), 2018), which is one death every 24 seconds (*People Are Signing up to Streets for Life!,* 2021). At the same time, speed has been attributed to 50% of global road crashes (WHO, 2021). Three thousand children and young people are estimated to be killed or seriously injured on the world's roads every day (*People Are Signing up to Streets for Life!,* 2021).

Several studies mention children to be the most vulnerable road users (DaCoTa, 2012; Draisin et al., 2016; Kobusingye, 2014) and most at risk on the streets where they live, play and travel to school (*People Are Signing up to Streets for Life!,* 2021). Globally, many children are seriously injured or are killed daily in road traffic crashes that sometimes occur a few yards from the school gates (Child Health Initiative, 2019; *We All Want the Best for Our Kids*, 2017). Children from Low and Middle-Income Countries are the most affected (*Road Traffic One of the Biggest Killers of African Youths*, 2018). In Africa, the highest burden of road death is on vulnerable road users, with pedestrians having the highest number (WHO, 2018), which is the case in Tanzania. Many schoolchildren in the country are pedestrians; they walk to school. Road safety challenges such as the traffic mix of vulnerable road users with vehicles, lack of formal sidewalks, etc. (Child Health Initiative, 2020; Lagarde, 2007) make these schoolchildren's journeys unsafe. These discoveries show a need for more road infrastructural interventions to ensure safe and sustainable transport to school for schoolchildren in the region.

The research design and methodology comprised: selecting an area in Dar es Salaam with a need for the intervention, seeking permission from responsible authorities to carry out the research, data collection and analysis, and establishment of the intervention. Data was collected through semi-structured interviews, focus group discussions, speed observations and questionnaire surveys in the selected case study area. The Theory of Planned Behaviour (TPB) was employed in the questionnaires to examine the extent to which the TPB constructs would predict the behaviour to comply with the intervention (installed school zone and speed limit signs). The speed observations and questionnaires surveys were designed as a pre and post-intervention study. In both pre and post-intervention survey, 124 people participated, whilst 309 vehicles were observed pre-intervention and 289 post-intervention. The observations were done during the school opening and closing hours for 90 minutes in each period. Ufukoni Primary School (P.S) was chosen as the treatment site that received the intervention. Kigamboni and Kivukoni Primary Schools were selected as the comparison sites that did not receive the intervention. Data analysis was done using Microsoft excel for the speed data and SPSS for the questionnaire data.

Findings showed both mean and 85th percentile speeds reduced post-intervention at both the treatment and comparison sites. It was a 4.12 km/h (16%) and 5.2 km/h (17%) reduction in mean and 85th percentile speeds at the treatment site, respectively. At the comparison sites, the speed reductions were; 5.18km/h (26%) for mean speed and 7 km/h (26%) for 85th percentile speed at the Kigamboni P.S site and 4.78km/h (19%) for mean speed and 5km/h (16%) for 85th percentile speed at the Kivukoni P.S site. The highest speed reductions were observed in motorcycles at the treatment and Kigamboni P.S site, whereas at the Kivukoni P.S site, it was highest among cars, followed by

motorcycles. During pre-intervention, twenty-one vehicles travelled between the speed of 30 and 50km/h at the treatment site, five at Kigamboni P.S and seventeen at Kivukoni P.S sites. Post-intervention, this number reduced to eight at both Ufukoni and Kivukoni P.S and zero at Kigamboni P.S. Two vehicles were observed to go at speed above 50km/hr, at Ufukoni and Kivukoni P.S each. Post-intervention, no vehicles travelling above 50km/h were observed in all three sites, as the number of vehicles travelling within 30km/h increased.

The survey findings showed that people agreed that the school zone and speed limit signs were a good intervention in making the routes to school safer and improving schoolchildren's road safety in the area. The means of normative beliefs, perceived behavioural control, behavioural intentions and behaviour regarding the intervention increased while attitude reduced post-intervention.

The ordinal regression analysis results showed that normative beliefs and perceived behavioural control significantly predicted behavioural intentions. In turn, intentions predicted behaviour to comply with the school zone and speed limit signs. Respondents who believed that people important to them would find the intervention a good measure, and those who perceived that they had control of reducing their speeds were more likely to intend to comply with the posted signs. Those with higher intentions were more likely to abide by the installed signs.

The results showed that creating an SSZ using school zone and speed limit signs as an intervention succeeds in making routes to school safer whilst improving schoolchildren road safety. The study participants suggested that the intervention be implemented in the other schools in the ward and different school zones in the country. Although infrastructural road improvements catering to non-motorised and motorised transport users alike should be provided together with the signs, this has been proven to be most effective. The results also implied that road safety awareness for the Kigamboni ward community was a necessity. Hence it was recommended for the Kigamboni Municipality and other respective road safety actors to consider strategies or activities to provide for more road safety awareness in the area. In compliance with speed limit and school zone signs, road safety awareness or educational campaigns may focus on the people's normative beliefs, perceived behavioural control, and intentions to comply with the traffic signs inside the SSZ. The other recommendations were the political will to make road safety a priority and continued collaboration among and between government authorities and road safety practitioners.

Keywords: School Safety Zone, Safe Routes to School, Intervention, School zone and speed limit signs, Speed, Theory of Planned Behaviour

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LIST OF ABBREVIATIONS

BIGRS – Bloomberg Initiative for Global Road Safety

FGD – Focus Group Discussions

FIA – Fédération Internationale de l'Automobile

GoT – Government of Tanzania

iRAP – International Road Assessment Programme

LATRA – Land Transport Regulatory Authority

NGO – Non-Government Organization

NMT – Non-Motorised Transport

OECD – Organisation for Economic Co-operation and Development

P.O. – Proportional Odds

P.S – Primary School

PBC – Perceived Behavioural Control

PLUM – Polytomous Universal Logit Model

RSA – Road Safety Ambassadors

RTI – Road Traffic Injuries

SACP – Senior Assistant Commissioner of Police

SARSAI – School Area Road Safety Assessment and Improvements

SPSS – Statistical Package for the Social Sciences /Statistical Product and Service Solutions

SSA – Sub Saharan Africa

SSZ – School Safety Zone

SUMATRA – Surface and Marine Transport Regulatory Authority

TANROADS – Tanzania National Roads Agency

TARURA – Tanzania Rural and Urban Roads Agency

TPB – Theory of Planned Behaviour

U.N. – United Nations

UNRSC – United Nations Road Safety Collaboration

VRU – Vulnerable Road Users

WHO – World Health Organization

1. INTRODUCTION

According to the WHO Global Status report on road safety, 2018, Road Traffic Injuries (RTI) are the 8th leading cause of death among all age groups but the leading cause of death of children between 5-14 years and young adults between 15-29 years (WHO, 2018). The risk of injury or death in a road crash is faced by everyone using the roads. However, it is more among some people than others, and this group is referred to as Vulnerable Road Users (VRU). European Union's Intelligent Transport Systems Directive refers to VRU as non-motorised road users, such as pedestrians, cyclists, motorcyclists and persons with disabilities or reduced mobility and orientation (*Safety of Vulnerable Road Users*, n.d.).

More than half, 54% of all traffic deaths globally are among VRU. Pedestrians and cyclists represent 23% and 3% respectively, whereas motorised 2-3 wheelers represent 28%. As drivers or passengers of four-wheeled vehicles account for 29% and 17% is unspecified. In Africa, 40% of traffic deaths are among pedestrians, 9% among motorised 2-3 wheelers and 4% among cyclists. Driver/passengers of four-wheeled vehicles account for 40%, and the remaining 7% is for unspecified road users (WHO, 2018). These statistics depict that the burden is highest for pedestrians in the African VRU group.

Children have been cited as the most vulnerable of the VRU (DaCoTa, 2012; Daily News, 2020; Draisin et al., 2016; Kobusingye, 2014; *Road Traffic One of the Biggest Killers of African Youths*, 2018). According to DaCoTa (2012), children in road traffic are defined as persons aged 0 to 14. And being aware of the risk that will enable individuals to perceive dangerous traffic situations is mainly dependent on age. Children are at higher risk because they are easily distracted (DaCoTa, 2012; Fell et al., 2017; *Safety of Vulnerable Road Users*, n.d.). Mc Mahon (2008) mentioned that it is essential for drivers to understand children's traffic behaviour limitations. Kobusingye (2014) outlines some of these limitations as children being physically less resilient multi-taskers, make more flawed judgements, and decisions on roads, such as poor judgment of speed and distance. And also, due to their short stature, they may not be able to see over cars whilst the drivers may not see them in traffic.

Globally, 700 children daily die in road traffic crashes, and thousands more are seriously injured. More than two million children annually are prevented from obtaining an education due to RTI or death (Child Health Initiative, 2019). According to the International Road Assessment Program (iRAP), road traffic crashes sometimes occur just yards away from the school entrance (*We All Want the Best for Our Kids*, 2017). iRAP is a charity dedicated to saving lives worldwide by eliminating high-risk roads ("iRAP", 2021). More than 95% of children affected by RTI and deaths globally are from Low and Middle-Income Countries. However, there are regional variations; for example, a child from Sub-Saharan Africa (SSA) is twice as likely to be killed than a counterpart in South-East Asia, the next most dangerous region. The one constant in these countries is that the most killed are children travelling as pedestrians followed by those travelling on bicycles, then motorcycle passengers, or those using unsafe forms of public transport (*Road Traffic One of the Biggest Killers of African Youths*, 2018). "Although road accidents and traffic injuries rates are high in the entire Sub-Saharan region in Africa, there is no accurate data on its prevalence and its nature at this level." (Adhikari, 2015, para. 3).

Surveys demonstrate that between 70-90% of children in African cities walk to school (*Road Traffic One of the Biggest Killers of African Youths*, 2018). One survey of 2,953 primary-school-aged children done by Amend, a road safety Non-Government Organization (NGO) in Dar es Salaam, found that over 87% of them walk to school (Draisin et al., 2016). Fell et al. (2017) postulated that many

schoolchildren, even relatively young ones, in Tanzania walk unaccompanied by adults on their way to and from school. The streets lack footways and safe crossing points, bringing these children into conflict with moving vehicles on every journey. At the same time, the children's lack of skill in coping with traffic risks is compounded by their frequent exposure to traffic, mainly for those living in towns or urban areas. This puts them at high risk of getting involved in road crashes.

Fell et al. (2017) mentioned that the official Tanzania 2013 road crash statistics showed that 106 children under 13 years died while 226 were injured. The authors believed that these children were probably pedestrians and the figures were perhaps low because children's ages tend not to be accurately reported. In February 2020, five primary school pupils were killed by a vehicle that ran them over as they walked from school to home. Later on the same year, a group of students who were trotting back to their school were hit by a vehicle that veered off the road killing two students and leaving seven others injured (Daily News, 2020).

From the above, we can tell that some or most of these school journeys are being made in unsafe traffic conditions or roads. A survey by iRAP in almost 250,000 kilometres of road in 60 countries around the world showed that; more than 80% of roads on which pedestrians were present, and traffic flowed at more than 40 km/h had no formal sidewalk, with this proportion reaching more than 90% in SSA. At the same time, for cyclists, 88% of roads lacked separate bicycle facilities (Child Health Initiative, 2020). Lagarde (2007) outlined some of the road safety challenges faced in SSA as a traffic mix of incompatible road users (pedestrians, cyclists, motorbikes, cars, and trucks), communities living within the road vicinity, poor vehicle conditions, under-developed infrastructure (e.g. the lack of paved urban streets), lack of risk awareness, and ineffective enforcement jeopardised by corruption or bribery. According to WHO (2018), many countries have road infrastructure and vehicle designs favouring motorised transport and speeding. The high burden of deaths among VRU is reflective of the infrastructure that gives more priority to motorised transport.

1.1 Problem Statement

In their research, Museru et al. (2002) concluded that road traffic injuries are a significant problem among school-aged children in Dar es Salaam. The proximity of some schools to highways was also noted as another concern (Moshiro et al., 2005; Museru et al., 2002; Zimmerman, 2012). And this is because the schoolchildren are put at a higher risk of suffering RTI or fatalities. Even though these studies were carried out a decade ago, the situation has not changed much. Many schools, especially in urban areas in Tanzania, are situated along or near urban and trunk roads.

A population-based study on RTI incidences and crash characteristics in Dar es Salaam established that 43.9% of all injuries occurred on the route to work or school. The majority of pedestrian RTI occurred on highways (Zimmerman et al., 2012). A study to evaluate a road safety intervention program in Dar es Salaam found that approximately 92% of all injured pupils at selected schools were pedestrians before any interventions. And an estimated 63% of RTI occurred on a journey to or from school. Approximately 48% of all injury cases involved a child hit by a motorcycle (Draisin et al., 2016).

In their conclusions, Zimmerman (2012) recommended an intervention focusing on child pedestrians to be carried out in the country, whilst Draisin et al. (2016) suggested an intervention specific to unpaved roads to be further explored.

1.2 Justification of the Study

Children require safe and secure routes to school as pedestrians and cyclists (Mc Mahon, 2008). In the 2030 Manifesto for "These are our streets," the plan is to provide safe, child and climate-friendly neighbourhoods focusing on safe and healthy journeys for children and youth. The vision is a world designed to ensure that no one gets hurt walking to school or hanging out with friends (Child Health Initiative, 2020).

Low-cost infrastructural interventions in school zone areas, including signage, sidewalks, speed humps and traffic-calmed crossings, have been proven to have the potential to reduce RTI rates and severity around school areas in Dar es Salaam (Draisin et al., 2016). Thus, this study focused on implementing a school safety zone using school zone and speed limit signs as a low-cost infrastructural intervention and evaluating the effect of the intervention in improving the safety of the routes to school in an area with schools alongside unpaved urban roads. Additionally, the study investigated the TPB constructs (attitude, normative beliefs, perceived behavioural control, intentions and behaviour) of the adults (parents and motorists) in predicting the behaviour to comply with the intervention.

Before implementing the intervention in the study area, there were no traffic signs to alert road users, especially motorists, that they were entering a school zone. Moreover, there is no signage of the schools alongside the roads, only markings of the school names on the school gates of Kigamboni and Kivukoni Primary Schools. After the intervention, the road section 100m before and after the school gate of Ufukoni P.S was designated a school safety zone, with school zone and speed limit signs.

1.3 Aim of the Study

The study seeks to implement and evaluate the effectiveness of creating a school safety zone using school zone and speed limit signs as an intervention to make safer routes to school for schoolchildren in Kigamboni Ward and improve their safety on the road.

1.3.1 Objectives

i. To explore the road safety interventions used to improve schoolchildren road safety in Tanzania.

ii. To identify the road safety intervention from (i) to be applied in the case study area.

iii. Establish a school safety zone using school zone and speed limit signs as an intervention to make safer routes to school in the case study area.

iv. Evaluate the effect of the implemented interventions above in enhancing safer routes to school and schoolchildren road safety in the case study area.

1.3.2 Research Questions

i. What are the road safety interventions used to improve schoolchildren road safety in Tanzania?

ii. What road safety interventions identified in (i) can be applied to make safer the routes to school in the case study area?

iii. What is the effect of the implemented intervention in making safer the routes to school and improving the schoolchildren' road safety in the case study area?

1.4 Scope of the Study Area

The Kigamboni ward has four sub wards, 16 streets and 16 hamlets. According to the previous Population and Housing Census of 2012, the Kigamboni ward had 30,496 inhabitants (15,262 males and 15,234 females). The population was expected to reach 36,364 in the year 2019. Overall, the population structure of the Kigamboni Municipal, according to the 2012 census data, showed that 63.1% of the population fell between 15 and 64 years, 34.7% were children below 15, and 2.2% were above 65 years (National Bureau of Statistics & Kigamboni Municipal Council, 2019).

The Municipality's dominant mode of transport is road transport, which predominates almost 100% of traffic movements. The road network by 2018 consisted of 45.8 km of tarmac road and 246.9 km of unpaved roads. Most of the roads in the Kigamboni district are in poor condition. The urban roads, especially the collector roads, are unpaved with no road signs, drainage channels, road lights, diagonal parking, bus bays and pedestrian sidewalks. Thus, the municipal set an objective to improve the roads by at least 90% and make them passable throughout the year (National Bureau of Statistics & Kigamboni Municipal Council, 2019). The situation during this study showed that this target has not yet been achieved in the case study area.

Kigamboni ward has four government primary schools with a total of 4,877 pupils, according to 2019 statistics (National Bureau of Statistics & Kigamboni Municipal Council, 2019). This research focused on the three government primary schools in the Kigamboni ward: Ufukoni, Kigamboni and Kivukoni Primary Schools, located close to each other. The other school is not located within the same sub wards and is further away from the site; hence it was excluded. The three schools lie along unpaved urban roads, as shown in the images below.

FIGURE 1 The unpaved urban road alongside Ufukoni and Kigamboni Primary Schools.

FIGURE 2 The unpaved urban road alongside Kigamboni Primary school on the left.

FIGURE 3 The unpaved urban road alongside Kivukoni Primary School on the left.

The area faces high traffic from cars, motorcycles, motor tricycles and pedestrians due to the available essential facilities. Trucks and buses were observed to not be regular on this road. These facilities are Kigamboni police station, Primary and District court, Health Centre (Hospital) and Catholic Church. Qualitas polyclinic, EAGT church and the surrounding residential settlements. FIGURE 4 shows the case study area with the green area marking the school zones. FIGURE 5 is an enlarged portion of the case study area. It also shows the schools indicated using coloured X marks. Ufukoni P.S is marked with a red X, and it is where the intervention was implemented, thus acted as the test (treatment) site. The other two schools, Kigamboni P.S, marked with a black X, and Kivukoni P.S marked in a blue X, did not receive the intervention and served as the control (comparison) sites.

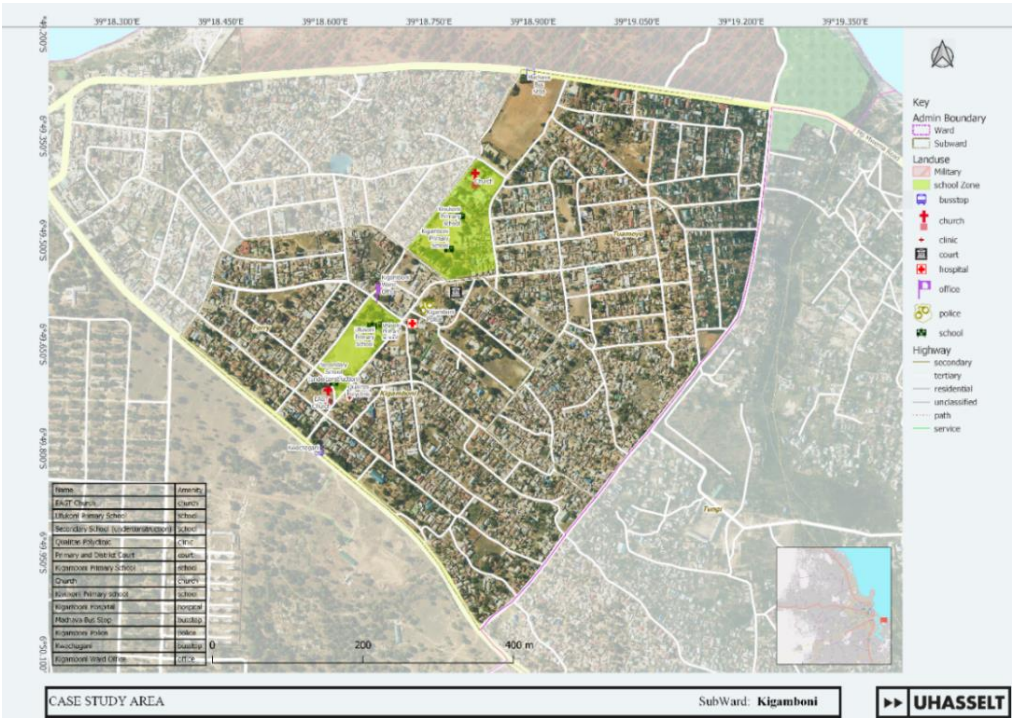


FIGURE 4 Map of the case study area.

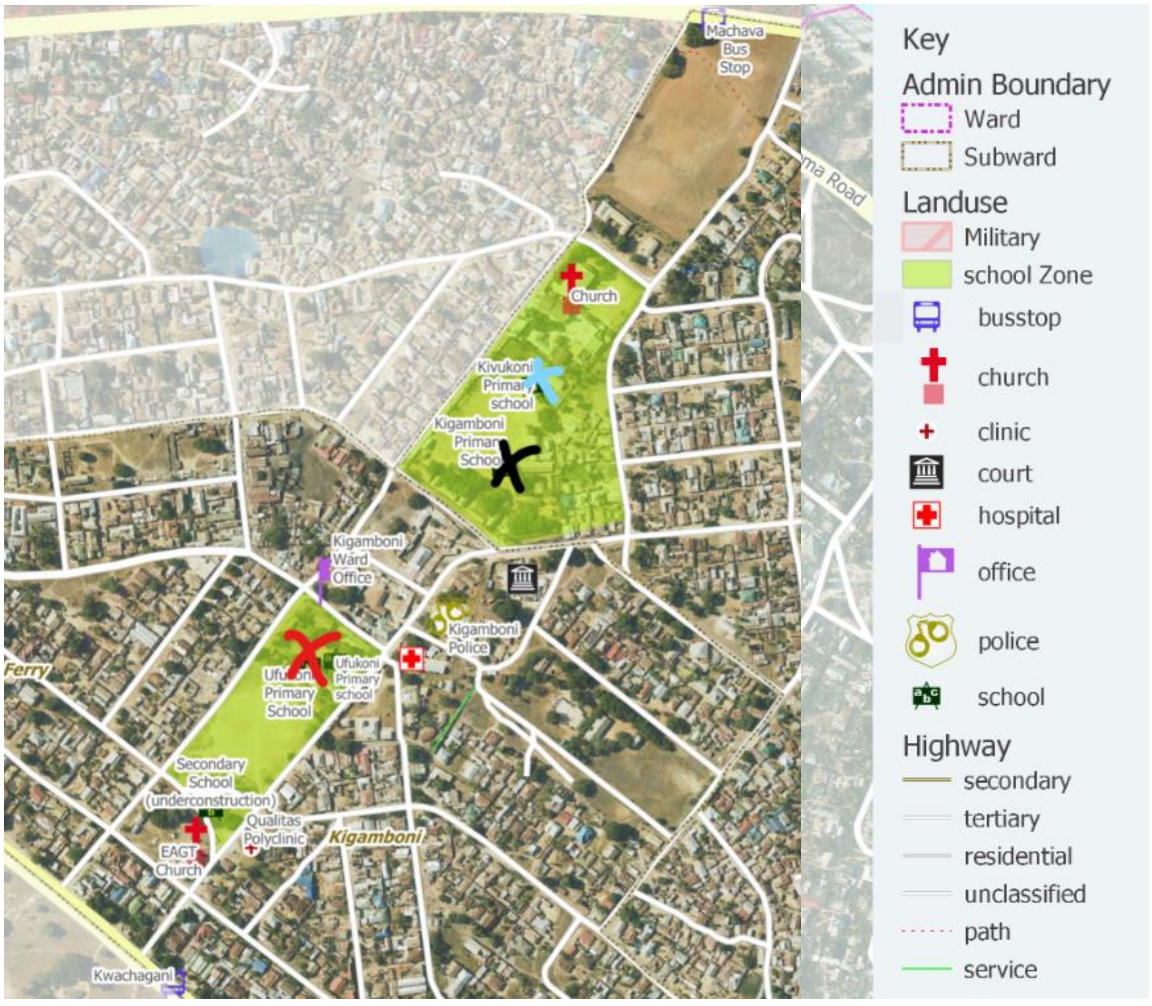


FIGURE 5 An enlarged portion of the map showing the schools and the other facilities in the area.

2. LITERATURE REVIEW

This chapter overviews secondary (past studies) literature and primary data sources (interviews or personal communications) on road safety status and road safety interventions focused on motorists in brief and schoolchildren in more detail in Tanzania. In so doing, answering research questions one and two.

2.1 Road Safety Status in Tanzania

2.1.1 Road Traffic Burden

Road traffic crashes have been identified as the most common injury mechanism and a leading cause of the burden of trauma in Tanzania (Mwandri et al., 2020; Sawe et al., 2017; Sawe et al., 2020). It was expected for Tanzania to experience an increased trauma due to the road traffic crashes as a result of rapid urbanisation, poor road infrastructure, increase in motor vehicles, many of which are old not road worthy and the rise of the use of commercial motorcycles (Chalya et al., 2010; Sawe et al., 2017). According to the then-current prices, the estimated GDP loss due to road crashes without property damage costs was 3.4% in 2013, 3.1% in 2014 and 2.8% in 2015. These estimated costs did not consider the probability of the actual number of road crashes being significantly higher than the police records (Fell et al., 2017). Hence, these estimated costs could have been higher if the latter was taken into consideration. VRU carry the highest burden of road traffic injuries in the country (WHO, 2018), with pedestrians being the most affected group (Mutafungwa, 2021).

In his speech to journalists who had completed their training in Road Safety reporting, the Commander of the Road Safety Force, Senior Assistant Commissioner of Police (SACP) Wilbroad Mutafungwa, gave the current road traffic statistics as presented in TABLE 1. The last five years, 2016-2020, after the implementation of the Bloomberg Initiative for Global Road Safety (BIGRS) project, showed a decline in both road traffic deaths and injuries in the country, as seen in TABLE 2.

TABLE 1 Road crashes, deaths and injury trend from 2011-2020 in Tanzania (Mutafungwa, 2021)

YEAR	CRASHES	DEATHS	INJURIES
2011	23,986	3,981	20,802
2012	23,578	3,969	20,111
2013	23,842	4,002	20,689
2014	14,360	3,760	14,530
2015	8,337	3,468	9,383
2016	9,856	3,256	8,958
2017	5,578	2,581	5,489
2018	3,732	1,788	3,746
2019	2,704	1,439	2,834
2020	1,714	1,270	2,126

TABLE 2 Five-year comparison and percentage change in road traffic crashes, deaths and injuries (Mutafungwa, 2021)

	2010-2015	2016-2020	CHANGE	PERCENTAGE CHANGE
Crashes	94,103	23,584	-70519	-75
Deaths	19,180	10,334	-8846	-46
Injuries	85,515	23,153	-62362	-73

The decline was noted to be due to the joint efforts of the Tanzanian Traffic Police and other stakeholders. The implementation of the BIGRS project in collaboration with WHO and the Tanzanian government was also mentioned as another contributing factor. Despite this reduction, more needs to be done to reduce the current number towards zero deaths and injuries (Mutafungwa, 2021).

2.1.2 Road Traffic Offences

Violation of traffic rules and regulations are a common occurrence in Tanzania (Msuya, 2018). Road traffic offences in Tanzania were highest in the Dar es Salaam region (Tanzania Police Force & National Bureau of Statistics, 2016). However, in a speech during the World Day of Remembrance for Road Traffic Victims, SACP Fortunatus Muslim stated that these offences had reduced by 18%. From 2,694,237 in 2018 to 2,208,928 in 2019 (Muslim, 2020).

The 2015 Tanzanian crimes and road incidents statistics report divided the causes into three groups; human factors (84.4%), environmental factors (8.8%) and defective motor vehicles (7.3%). Human factors were those caused due to human behaviour such as careless driving and road users. Environmental factors were those caused due to road conditions (road barriers, poor road infrastructure and railway crossing) and fire. And defective motor vehicles referred to vehicles with substandard features, i.e. motor vehicle defects and poor motor vehicle lighting (Tanzania Police Force & National Bureau of Statistics, 2016). These causes concurred in a study done by Eliakunda et al. (2018), where they cited the causes as human factors, road state and vehicle factors. Furthermore, they mentioned the probability of road accidents to be more significant when there was a problem based on one of the three factors or a combination of two. And the failure to have short and long-term plans to address these three factors together was assumed to be the reason as to why the problem still exists.

In the human factors, the leading causes of road crashes were careless motorcyclists (24.1%) and drivers (21.9%). Other human factors listed were dangerous driving, speeding, intoxication, unattended cattle and careless cyclists, passengers, pedestrians, pushcart operators and overtaking. The environmental factors were fire, road barriers, railway crossing and poor road infrastructure, which contributed to 3.6% of the crashes (Tanzania Police Force & National Bureau of Statistics, 2016).

Human factors have continued to be a leading cause of accidents in the country. Many motorists have been seen to be habitual violators of traffic rules. They go above-posted speed limits, overtake recklessly and some disrespect traffic signals. In urban areas, many bus drivers stop their buses anywhere, even in the middle of the road, to hastily pick up or drop off passengers (Msuya, 2018). Currently, speeding by motorists was mentioned as the leading cause of road crashes and deaths (Mutafungwa, 2021).

2.1.3 Road Safety Challenges

The road safety challenges in Tanzania are broad and cannot all be discussed in this section. Below are just a few to help the reader get a glimpse of the situation and relate it to the study and its findings.

Pillar, one of the Global Plan for the Decade of Action for Road Safety 2011-2020, encouraged member countries to do the following. Establish strong lead agencies, develop national strategies coordinated by the lead agency, set realistic and long-term targets for national activities, fund the strategy, establish and support data systems for ongoing monitoring and evaluation (UNRSC, 2015). In Tanzania, the National Road Safety Council is identified as the lead agency through legal empowerment (Fell et al., 2013; WHO, 2018). However, the council is not efficient because the government has never funded it, whilst the funding set aside by the government to support an effective road safety programme is entirely inadequate. Meanwhile, there is limited coordination between stakeholders to deliver road safety interventions, and no one is held accountable for their performance. The set targets were seen to be over-ambitious with no priorities. In addition, a systematic system for road crash data collection and analysis by each road authority is not in place, and there is a high dependency of this data to come from the Traffic Police (Fell et al., 2013). Kimaro et al. (2016) defined the situation as existing fragmented systems managed by the different stakeholders who exhibit a strong sense of ownership. The researchers saw a need for the formation of an integrated road safety framework. Subsequently, there is little formal monitoring and evaluation of road safety (Fell et al., 2017).

There is limited road safety research carried out in the country, with academia seeming to undertake little or no research on the subject. Moreover, it is not specified in the National Road Safety Policy which measures and actions will improve this (Fell et al., 2017).

According to WHO (2018), critical components of an integrated strategy to prevent traffic deaths and injuries are the enaction and enforcement of legislation on five key risk factors: speed, drink-driving, motorcycles helmet use, use of seat-belts and child restraints. The review of Tanzania's legislation on these factors showed that drink-driving, motorcycle helmet wearing, and seat-belt laws do not meet best practice except for speed law. There are no national child restraint and mobile phone use while driving laws (WHO, 2018). Several proposals have been made to update the current Road Traffic Act, which by current standards is old, and it neither accounts for the significant changes in road transport initiatives nor meets international best practices (Msuya, 2018).

The traffic police are chronically underequipped and underfunded. There is the impression that traffic law enforcement is done in a somewhat ad hoc, unplanned way; officers are stationed at the same places every day, so there is no element of surprise. This possibly reflects the chronic lack of vehicles available to the traffic police. (Fell et al., 2017, p.102)

Fell et al. (2017) summarised the following problematic road user behaviour in mainland Tanzania. The tendency to speed among bus and truck drivers and motorcyclists. Motorcyclists are reputable for taking many risks and breaking traffic laws, e.g., speeding, risky overtaking, and running the red light. Private car drivers are usually involved in single-vehicle and front-impact crashes that indicated the possibility of speeding, loss of vehicle control, collisions with pedestrians or risky overtaking. Pedestrian and bicyclist were associated with careless road user behaviour. However, the authors agreed that this might be true in some instances but insisted that the safe facilities for VRU lacked on many roads. Besides, in places where they existed, these spaces were often encroached by vendors or parked vehicles, forcing pedestrians to walk on roads.

Compared to international standards, the driver training period in actual traffic conditions in Tanzania is short, and the driving test is deemed simple. The licensing system has failed to consider age, driving experience, attitudes, and skills. There is a lack of a structured practical driving training program that includes elements of awareness of potential or actual danger and how to avoid it. A simulator training that will increase drivers' awareness of the effects of road crashes and provide training that will cater for both drivers and other road users was noted to be needed (Eliakunda et al., 2018; Fell et al., 2017). Tanzania neither has a national drivers' training curriculum nor a unified monitoring mechanism for the motor vehicle drivers training in Tanzania (Eliakunda et al., 2018).

Additionally, there are no standard training tracks. Training schools that are mostly privately owned have inadequate training facilities and inadequacy of qualified driving instructors. The country's current driver training and licensing system are motivated by profit interest, surpassing the need for qualified trainees in terms of age, knowledge, driving experience, skills, and appropriate attitudes (Eliakunda et al., 2018).

It is not clear who is responsible for road safety education in schools, and also, only a small proportion of children in Tanzania are receiving road safety training. And this proportion may not be inclusive of children not at school since many of these programmes were seen to focus on primary school children. Generally, the effectiveness of road safety training is not known because there has been almost no evaluation (Fell et al., 2017).

Gaps were identified in national road safety campaigns. The National Road Safety Week, which could be considered a national campaign, does little to raise awareness or change behaviour (Fell et al., 2017).

They gave this overview of the urban road conditions. The existence of conflicts between traffic streams and between motor vehicles and non-motorised transport (NMT) was caused by poor urban or traffic planning and decades of underfunding of urban traffic and transport systems. The biggest safety problem was the failure to provide for NMT, where main streets lacked adequate footways and not much help offered to crossing pedestrians due to motorists' lack of respect for NMT. Urban road authorities were remarked on the possibility of doing much more to control traffic speeds, channelise traffic, and provide pedestrian islands. Improvements to urban roads in recent years were noted, although old roads and many more urban roads were identified to face still the challenge of lack of sidewalks (Fell et al., 2017).

The road authorities' identification and treatment of crash sites on existing roads were not being made very scientifically and systematically. Besides, there was a lack of financial and human resources and inadequate acquisition of excellent and reliable road crash information (Fell et al., 2017).

The majority of the private sector vehicle fleet comprised old vehicles (10 years) which lacked many basic car safety features (Fell et al., 2017). The lack of adequate standards for imported cars gives way to sub-standard vehicles, with the yearly legally required vehicle inspection process being entirely ineffectual (Eliakunda et al., 2018; Fell et al., 2017).

The existing situation concerning post-crash care in Tanzania is poor. There is no national organised trauma system, an emergency care access number for ambulance services. Currently, each hospital has its emergency number and incompatible communication equipment with each other (Fell et al., 2017). As a result, post-crash help is usually dependent on people standing by or witnesses and

crash survivors who use private transport for rushing casualties to hospitals (Boniface et al., 2016; Fell et al., 2017). Furthermore, Boniface et al. (2016) conveyed that prehospital care in Tanzania is almost nonexistent, and health care service deliveries are poor.

2.2 Road Safety Interventions

2.1.1 Motorist Focused Interventions

The Government of Tanzania (GoT), through its road transport governing authorities and ministries, has put efforts to combat road crashes. These efforts have aimed at implementing several interventions and activities in collaboration with multiple stakeholders, e.g. international donors, developmental banks, NGOs, etc. Below are some examples of interventions focusing on motorists.

Fines as stipulated in the Tanzania Road Traffic Act of 1973 and its various amendments, and the Land Transport Regulatory Authority, LATRA (Private Hire Services) Regulations, 2020 are imposed on motorists who break the law or regulations. According to Haji (2017), these fines have a high impact on reducing road accidents.

An existing good practice speed law according to the WHO's criteria for a best practice speed law. It includes a national speed limit law with urban speed limits not exceeding 50km/h (WHO, 2018). The maximum speed limit has been set to 80km/h (Fell et al., 2017; Tunda, 2018).

The use of speed radars on highways in Tanzania has proved to be very successful in curbing road crashes, and alcohol testing among drivers also paid off (Mbago, 2016).

There is a mandatory installation of Vehicle Tracking Systems on buses that make long trips (Regional buses) by SUMATRA, now known as LATRA. LATRA uses VTS to monitor the speeds of these buses, and the devices notify the drivers through an alarm when a rate of 85km/h is exceeded. According to the authority, this system helps in reducing road traffic crashes (Tunda, 2018).

A road safety application called Akili for motorcyclists has been developed and is currently being finalised for introduction in the market. The application will be used as a tool to assist in law enforcement for this road user group (D. W. Sokoni, personal communication, November 11, 2020).

2.2.2 Road Safety Education and Awareness to all Road Users

The Traffic Police department delivers road safety education to all road users through various activities in the country. Road safety education for children is discussed in more detail in the next section. In addition, specialised road safety training programs are being delivered to motorcyclists. Likewise, road safety awareness is given to civilians through radio and television stations (46 such programmes), newspapers and community campaign events (D. W. Sokoni, personal communication, November 11, 2020).

Developmental banks like the African Development Bank (AfDB) and World Bank require the government to employ consultants who will provide road safety awareness campaigns to the people living along the roads under construction (Fell et al., 2017; Sinohydro Corporation LTD & UWP Consulting, 2018b). For example, FIGURE 6 shows a road safety campaign delivered to motorcyclists during a road construction project in Arusha, Tanzania.

FIGURE 6 A road safety awareness campaign for motorcyclists (Sinohydro Corporation LTD & UWP Consulting, 2018b).

2.3 The Five Es and Pupil's Road Safety Interventions in Tanzania

In Tanzania, several initiatives or interventions are used by the government and private road safety practitioners, particularly road safety NGOs, to improve schoolchildren road safety. These efforts fall under the different key components of the Safe Routes to School framework of the 5 Es.

The five Es: Education, Encouragement, Engineering, Enforcement, and Evaluation to improve traffic safety for school children were developed from the Safe Routes to School (SRTS) approach (Safe Routes to School, 2021). The technique improves the conditions for students who walk or cycle to school through non-infrastructure (e.g., awareness campaigns and education) and infrastructure projects and programs (Safe Routes to School, 2021; Zimmerman & Lieberman, 2020).

2.3.1 Education

According to the European Union ROSE 25 (2005) report, road safety education is a crucial pillar of traffic safety work. It summarises the totality of measures that aim at positively influencing traffic behaviour patterns with emphasis on:

- promoting knowledge and understanding of traffic rules and situations,
- improving skills through training and experience,
- strengthening or changing attitudes towards risk awareness and
- personal safety and the safety of other road users.

Road safety education should be tailored according to the learners' age group and experience (Riaz et al., 2019). When provided to children, it helps increase the levels of knowledge, skills and awareness of the participants who will act as ambassadors or agents of change at home and in the community. This will raise a generation of traffic rules conscious road users who will reduce the burden of ensuring traffic safety is the responsibility of only road safety managers in Tanzania.

In Tanzania, road safety education and awareness to schoolchildren are provided by the teachers through the Civics subject locally known as "Somo la Uraia" (D. W. Sokoni, personal communication, November 11, 2020), the Traffic Police, road safety NGOs and in most cases a collaboration of both.

Amend's school-based road safety education

Amend is a global non-profit organisation that deals with road safety. It has offices in Tanzania, Ghana, and Mozambique to carry out its activities that focus mainly on Sub Saharan Africa. The organisation's road safety programs focus on preventing road traffic injuries in Africa's highest-risk populations through infrastructure, engineering, education, training, advocacy in combination with scientific studies into the area, i.e. the causes, nature, and impact of RTIs ("Our Work – Amend," 2020).

Amend has been providing tailored road safety education in African countries since 2006. Although their main focus is on road safety lessons in primary schools (FIGURE 7), their road safety education program has extended to secondary schools (FIGURE 8), communities, and street children who do not attend school. Close contacts between the NGO and high-risk schools are maintained to ensure that the lessons are regularly reinforced. The program's knowledge retention surveys in primary schools have also been done ("Our Work – Amend," 2021).

FIGURE 7 Road safety education given by an Amend worker at Usagara Primary School (Amend, 2021a).

Amend, and the Total Foundation initiated a 10-month project in September 2020 called VIA, a comprehensive road safety education program for secondary school students developed by the Total Foundation and its partners. Through Amend, the program has been adapted to the African context and is implemented in Tanzania, Togo and Guinea. The programme was delivered for forty minutes daily after school in one month through the school road safety clubs that the NGO established at the schools. In Tanzania, two secondary schools in Tanga and Dar es Salaam were involved, and twenty students per school graduated from the program to become road safety "ambassadors" to their schools and communities ("Our Work – Amend," 2021).

FIGURE 8 Old Tanga Secondary School students during Via (Amend, 2021b).

The Traffic Police

The Police Force's Road Safety Department introduced road safety curriculums and specialised training to parents and teachers (Daily News, 2020). The traffic police education unit has provided primary school teachers training in a project that aims to train the trainers or teachers. One thousand teachers have received this education in Dar es Salaam, 200 in Mwanza, 100 in Kilimanjaro and 100 in Geita regions (D. W. Sokoni, personal communication, November 11, 2020).

The Traffic Police use a special van (FIGURE 9) when carrying out their road safety campaigns in schools and communities. The van has a screen and speakers used to relay the messages to the children in the audience. Video messages and songs are used to capture and keep their interest during the Traffic Police' awareness or training programme.

FIGURE 9 Traffic Police van used in children road safety campaigns (D. W. Sokoni, personal communication, November 6, 2020).

Road Safety Ambassadors (RSA) Tanzania

The Training of Trainers termed as ToT by Road Safety Ambassadors (RSA) Tanzania is a programme that, together with the refresher courses, is offered by the NGO to support sustainable road safety in Tanzania (Lanka, 2020).

RSA is an NGO and a civil society organisation dedicated to improving road safety in Tanzania in three areas: public awareness of road safety issues, road safety advocacy, support road safety enforcement by reporting road defects and unsafe road behaviour to the authorities. It was founded in 2013 as a Facebook Group among concerned friends. Currently, it has a membership of more than 68,000 members throughout the country. People from different backgrounds with different professionalism are part of this society, and they all work voluntarily for the NGOs course. Communication, coordination and direction are via Facebook and WhatsApp groups (A. Fungo, personal communication, September 26, 2020).

In collaboration with the Kilimanjaro Regional Traffic Unit and support from the Foundation for Civil Society (FCS), RSA has trained teachers from various primary schools in Moshi Municipality about traffic signs, road safety rules and regulations. This training aims to provide road safety knowledge and skills that can be passed on from the teachers to their pupils to improve road safety for this road user group. The above was done as part of the NGO's project called '*Nenda Salama Barabarani*', which translates to travel safely on the road (Lanka, 2020). The Nenda Salama Barabarani project also includes an awareness campaign among pupils (FIGURE 10). In this campaign, road safety education is taught to school children. So far, the campaign has reached 36 schools in the Kilimanjaro and Pwani regions in Tanzania, and 36 teachers have been trained. A total of 192 road safety lessons have been taught to 19,292 students in the 36 schools (I. Msellem, personal communication, February 28, 2021).

FIGURE 10 Pupils during road safety lessons (I. Msellem, personal communication, February 28, 2021).

Private Companies

Private companies that have also been donors to road safety projects with NGOs have also been active in organising their road safety campaigns to educate children. An example is TOTAL, which in September 2012 launched a campaign as shown in FIGURE 11 in Dar es Salaam that highlighted the importance of road safety across 240 schools and reaching 60,000 children. An educational kit called "Safety Cube" was used for the sessions (*Tanzania - Educating Children about Road Safety Issues*, 2013).

FIGURE 11 A road safety campaign (*Tanzania - Educating Children about Road Safety Issues*, 2013).

Road safety awareness campaigns that have targeted schools started to be initiated during road infrastructure construction near schools in road projects receiving funding from the World Bank. These campaigns ensure the schoolchildren are reminded or taught basic road safety knowledge to safeguard their safety as they walk to and from school during the construction and road operation. FIGURE 12 shows road safety campaigns in two schools in Arusha during urban roads' construction or rehabilitation in the city.

FIGURE 12 School road safety campaigns (Sinohydro Corporation LTD & UWP Consulting, 2018a).

The World Bank developed a people-centred community engagement model with technical assistance from Amend in the improvement of Tanzanian rural roads. The model assisted in the provision of advocacy and awareness (FIGURE 13) of road safety risks facing, especially VRU and communities found alongside roads ("Our Work – Amend," 2021).

FIGURE 13 Road safety community engagement with children ("Our Work – Amend," 2021).

2.3.2 Encouragement

Encouragement strategies generate enthusiasm and excitement to increase safe walking and bicycling among the students through events, activities, and programs (Zimmerman & Lieberman, 2020). For example, in Tanzania, the Tanzania Traffic Police and road safety NGOs have encouraged road safety among school children through the following:

Road Safety Clubs

Many road safety clubs in several schools have been formed under road safety NGOs' guidance, for example, Amend, RSA and Helmet Vaccine Initiative Tanzania. Children are given road safety training in these clubs and are encouraged to share their knowledge with others. A designated teacher supervises the club activities (A. Nchimbi, personal communication, October 10, 2020).

Road Safety Kid' Courts

Road safety 'Kids' Courts were formed in the primary schools in Dar es Salaam and Tanga by Amend in cooperation with Traffic Police ("Our Work – Amend," 2021). The children Road Safety Ambassadors were trained on running a court and acting as child judges as presented in FIGURE 14. Drivers who were caught breaking the law by Traffic Police Officers at traffic stops set outside the programme schools were taken to be questioned by child judges in the kids' court instead of paying fines. According to their offences, the drivers were asked specific questions, including speeding, failing to stop at a zebra crossing, not wearing seat belts, and using a mobile phone while driving. They then signed a pledge that promised the pupils not to repeat their mistakes and received a written warning from the traffic police officers (SOS Children's Village International [S. C. V. I] & AMEND, 2020).

FIGURE 14 On the left, a Kids' Court session and on the right is a driver signing a pledge (S. C. V. I. & AMEND, 2020).

Junior Patrols

Junior patrols are part of the Traffic Police and NGO road safety education programmes set to reduce the risk of road traffic deaths and injuries among children. They are stationed on busy zebra crossings close to the schools (Daily News, 2020). Pupils are taught how to cross and walk safely on the roads to and from school. Fellow pupils are selected to assist other students in crossing the roads. The motorists stop when junior patrols are in progress. They have effectively ensured the safe crossing of pupils (D. W. Sokoni, personal communication, November 11, 2020). The schools are provided with stop and go signage which they use for this purpose (FIGURE 15 and 16). In other schools, an adult is appointed to supervise the pupils crossing the roads during the school opening and closing hours (FIGURE 17).

FIGURE 15 Primary school students with junior patrol signs near a school entrance (T. Lazaro, personal communication, February 23, 2021).

FIGURE 16 A pupil assisting other pupils in crossing a road at a zebra crossing (Safiri Salama, 2020).

FIGURE 17 An adult assisting pupils in crossing the road (P. Nchilla, personal communication, July 6, 2020).

Road Safety Events

As shown in FIGURES 18-20, several actors have organised several events to increase the children's interests in road safety matters. The Traffic Police have been organising the Road Safety Week, of which three-quarters of the attendees are children. Fun activities are contained in the event, including game competitions through singing, drawing, poems, e.t.c. Memorable road safety themed songs are composed for these events (D. W. Sokoni, personal communication, November 11, 2020). Road Safety NGOs and private companies also participate in or organise road safety events at the National or District level. Participating schools and children compete in fun activities and are awarded gifts. The 5th Dream Car Art contest (Figure 16) was launched at Mbuyuni Primary School in Dar es Salaam from November 2016 to January 2017. Road safety education was provided, along with sharing ideas about the future of mobility through drawings of dream cars in the contest (*Toyota Tanzania*, 2016).

FIGURE 18 Pupils during a road safety week event in Dar es Salaam (Emanuel, 2015).

FIGURE 19 A road safety art contest (*Toyota Tanzania*, 2016).

FIGURE 20 Pupils being awarded during road safety events ("Our Work – Amend," 2021).

2.3.3 Engineering

Physical changes are made to improve the walking or bicycling infrastructure through engineering solutions that include planning, designing and construction. Schools can work together with local government agencies to determine the needed improvements (Safe Routes to School, 2021).

Physical road engineering solutions have been the two road agencies' duty: Tanzania National Roads Agency (TANROADS) on national and regional trunk roads and Tanzania Rural and Urban Roads Agency (TARURA) on rural and urban roads accordingly. However, numerous schools located alongside the roads in Tanzania still face several challenges like lack of traffic signs, speed calming measures and sidewalks for children walking to and from school. This was the situation found in Kigamboni ward for the unpaved urban roads under TARURA alongside the primary schools. Immediate changes to remedy these deficiencies are never met by the respective authorities when approached by the teachers, parents or community. One of the common reasons is the infrastructural change being out of the agency's current budget. Civilians, in some instances, have opted to contribute to the funding of putting these physical changes like the installation of road signs in cases where immediate action is needed and cannot be met by the responsible authority.

On the other hand, Amend collaborated with the Puma Energy Foundation and the FIA Foundation from January 2017 to December 2019 to save children's lives through safe infrastructure and school zone advocacy in nine SSA countries, including Tanzania. School areas with elevated children RTI risk received Amend's proven-effective, award-winning School Area Road Safety Assessment and Improvements (SARSAI) programme. The programme provided safe infrastructure for schools and the surrounding communities, as illustrated in FIGURE 21 and 22 below. The program has faced several achievements, including legal changes of reducing speed limits around schools to 30km/h in six countries, a new nationwide 30km/h school zone speed limit in Zambia, and a citywide 30km/h school zone limit in Windhoek, Namibia. In the events to launch the new infrastructure, the importance of safe journeys to school was highlighted, and attention brought to it ("Our Work – Amend," 2021). More than 38,000 students, their less worried families and school area neighbourhoods have benefitted from safer pedestrian infrastructure (Galvin & Maassen, 2019).

SARSAI commenced in 2012 in two schools in Dar es Salaam and has since expanded to the city's other 26 high-risk school areas, which is 60% of the highest-risk schools and other eight cities in eight countries. Amend helped the World Bank incorporate SARSAI's principles into designing new roads financed by the bank in eight SSA cities (Galvin and Maassen, 2019). The programme showed a 26% reduction in paediatric RTI at schools that received the intervention (*SARSAI*, 2020).

FIGURE 21 Before SARSAI image of a P.S (G. Malekela, personal communication, October 26, 2020).

FIGURE 22 After SARSAI image of a P.S (G. Malekela, personal communication, October 26, 2020).

The programme demonstrated that scientifically-driven injury prevention programmes are feasible in a resource-constrained environment with high paediatric RTI rates for a reasonable investment. Infrastructural improvements paired with education can reduce RTI in school children, and replication in other settings is possible (Poswayo et al., 2019).

2.3.4 Enforcement

Enforcement strategies are meant to deter unsafe traffic behaviours and encourage safe habits from all road users in school neighbourhoods and school routes (Zimmerman & Lieberman, 2020). Enforcement is done by working with local law enforcement (Safe Routes to School, 2021).

Superintendent Deus. W. Sokoni, the then Head of Legal Department, Public Education and Awareness Department of the Traffic Police, said that they work to ensure the safety of schoolchildren who walk to school by assisting them in crossing the roads during school opening and closing hours. In addition, traffic police officers from neighbouring police stations are usually posted at points on the paved roads near the schools, where they also apprehend drivers who violate traffic laws.

2.3.5 Evaluation

Evaluation helps measure the impact or success of the approaches taken and identify unintended consequences or room for improvement (Zimmerman & Lieberman, 2020). In Tanzania, since different actors contribute to road safety individually or in collaboration in some projects, the evaluation of these projects is also done in the same manner. Most of these actors measure their successes in numbers. An example is road safety education, where the more schools or children reached by the actor through a project, the more successful that campaign or project is.

Superintendent Deus Sokoni said the Traffic Police's different road safety programmes displayed achievements as reflected in their annual reports from 2017-2019 that showed that the road traffic crashes involving children had reduced (D. W. Sokoni, personal communication, November 11, 2020). Deaths among children from 0 to 18 years old decreased from 294 in 2017 to 52 in 2019. In addition, RTIs decreased from 832 in 2017 to 177 in 2019 (Daily News, 2020).

Amend carried out and published research-based evaluations on some of their projects:

- Knowledge retention surveys to quantify a road safety education program's effectiveness and information retention rate in Dar es Salaam were done. The results showed sustained retention and increased road safety knowledge among the students ("Bethune Round Table 2012," 2012).
- A study in Dar es Salaam was done to evaluate the effectiveness of SARSAI in reducing vehicle speed and RTI in nine schools, its scalability, refining materials and implementation methods while measuring the change in the programme's interim indicators (speed and road use) for RTIs. The speed analysis found a 27% and a 30% reduction in average and 85th percentile speeds, respectively, on sites where SARSAI was implemented (Draisin et al., 2016).
- A study with the United States Centers for Disease Control and Prevention in 2015-2016 to evaluate Amend's SARSAI showed that the schools with SARSAI experienced 26% fewer traffic injuries and vehicle speeds in school zones reduced to 60%. The method was then proved to reduce RTI and death in Dar es Salaam and directly benefitted 70,000 primary school students in more than 50 high-risk school areas across 12 countries since 2014 (SARSAI, 2020).

Road safety interventions at the case study area

Personal communication with the deputy head teacher (principal) of Ufukoni P.S revealed that there are road safety clubs in the schools, but they are not active. This shows how road safety education has not been seen as a priority in the schools and Municipality. And no incentives or strategies have been set to assist in making these road safety clubs active. Some of the teachers from the schools have been to road safety awareness campaigns, and the schools were given the junior patrol signage. Children who lead the junior patrols go on the main road during school opening hours from 6:30 to 7:30 am, and this is done in turns among the schools in the Ward.

2.4 School Safety Zones

A School Safety Zone (SSZ) is a designated stretch of roadway that includes school safety zone signs and other measures such as speed signs, improved pavement markings and flashing beacons (*School Safety Zones - Vision Zero*, 2019). The traffic safety facilities are installed and managed inside a school zone to protect children and ensure they travel safely to and from schools, thereby providing safe routes. An SSZ is usually aimed to protect elementary (primary) and preschool children (Sul et al., 2014). FIGURE 23 shows an example of the beginning of an SSZ.

FIGURE 23 A school safety zone (BullpenAI, 2021).

The Korean Road Traffic Authority carried out research that found their school zone improvement project, which focused on installing various road safety measures, such as speed bumps, traffic signals and road signs, reduced road crashes involving children. In the report, a 2013 study's findings were recorded to have shown that "an increase of 100 designated school zones leads to an annual decrease of 17.8 accidents involving children. Its analysis also shows that implementation of improvement projects contributes to lowering the number of child-related traffic accidents by 31.8 per year" (Sul et al., 2014, p.132). In the same report, findings of a comparative study of 601 school zones in the Seoul metropolitan area in 2008 showed that the project led to a 39% reduction in road traffic crashes in school zones with implemented improvements (Sul et al., 2014).

2.2.1 Use of Signage in School Safety Zones

School zones are usually seen as a valuable measure for improving safety near schools by reducing driving speed. Transport and Main Roads (2014) suggested that when motorists are unfamiliar with the road, and in the absence of other cues, e.g., children's presence, they will have difficulty knowing if they are in an operating school zone. Therefore, special signage should be used to mark school zones and alert drivers of the high concentration of children.

A study to investigate the causes of traffic crashes in school zones mentioned unfavourable road conditions and the absence of traffic signs as the contributing factors. Even though reduced speeds near schools are reasonably standard, drivers do not always adhere to these limits. Supplemental signing in a school zone may act as an additional reminder for drivers to slow down. Hence, high visibility signing in school zones is one of the treatments that should be regularly implemented for this reason (Isebrands & Hallmark, 2007; Zhao et al., 2016).

Lacking road signs and markings were mentioned as one of the causes of road traffic crashes in Tanzania (Eliakunda et al., 2018). Daily News (2020) mentioned that road safety education programmes in Tanzania have led to the installation of road traffic signs along main and local roads near schools. The traffic signs give motorists warnings to ensure children's safety as they cross the roads bordering the schools; for instance, the 'Go' and 'Stop' signs.

Speed is one of the main risk factors in road crashes and is often cited as being the leading contributor to death and severe injury on the world's roads. This is because higher speed is associated with a significantly higher crash risk – even small increases in speed can have a big consequence, and the probability of injury and the severity of a crash increases rapidly with higher impact speeds. (*Streets*

for Life, 2021, para. 1) "The faster a vehicle is travelling upon striking a pedestrian, the more severe and potentially fatal the injuries will be" (Garder, 2004, as cited in Zhao et al., 2016, p.2). The Organisation for Economic Co-operation and Development (OECD) explains this through a Safe System speed defined as the impact speed where the chance of death is less than 10% (OECD, 2016). TABLE 3 shows the safe speed impacts for different roads and road users.

TABLE 3 Safe impact speeds (ECMT, 2006 as cited in OECD, 2016)

ROAD, SECTION TYPES AND ROAD USERS	TARGET SAFE SYSTEM SPEED
Roads and sections used by cars and vulnerable road users	30km/h
Intersections with possible side-impact collisions between cars	50 km/h
Roads with possible frontal collisions between cars	70km/h
Roads with no possible frontal or side-impact collisions between vehicles and no VRU	≥ 100km/h

Cameron and Elvik (2008, as cited by Transport and Main Roads, 2014) developed power estimates which suggested that in 50km/h urban zones, small changes in mean travel speeds will produce significant road safety changes. Other studies mentioned in research by Tapp et al. (2015) discovered that 30km/h or 20mph speed zones demonstrated a speed reduction of 9.3 mph, 40% and 60% reduction in casualties and crashes, respectively. In 2001, the Australian State of New South Wales decided to create 40km/h school zones for all roads with direct school or educational facility access. The end of 2003 saw the implementation of 40km/h speed limit zones in more than 3000 schools and educational facilities. This measure was associated with a significant child pedestrian trauma reduction in the identified school zones. The results showed that casualties among pedestrians aged 5-16 decreased by 46%, with the benefits extending to other road users (Graham & Sparkes, 2010). An evaluation study of flashing school zone signs in Queensland found that the signs were associated with reductions in mean (0.50 – 2.95 km/h) and 85th percentile (1.37 – 3.62 km/h) speeds during school zone times (Transport and Main Roads, 2014). An analysis in areas with high rates of RTI in Dar es Salaam was carried out to identify the effectiveness of speed management around school zones in decreasing RTI. Light traffic calming infrastructure, e.g. asphalt speed humps, school zone signage and zebra crossings, were implemented at nine public primary schools. Results showed a 27% and 30% reduction in mean and 85th percentile speeds, respectively (Draisin et al., 2016).

The effectiveness of speed limit signs in reducing school zones' speeds is mixed (Zhao et al., 2016). Strawderman et al. (2015) indicated that traffic engineers and city planners have utilised a variety of school zone signage in an attempt to improve compliance. Signs, flashers, and roadway markings have all been implemented. While some studies have shown a positive effect from utilising signs on reducing speed (Chrader, 1999; Aggarwal and Mortensen, 1993; Hawkins, 1993), others argue that signs have no effect on driver compliance with posted speed limits (Simpson, 2008; Burritt et al., 1990), leading to a lack of conclusive evidence on the value of school zone signage (Dumbaugh and Frank, 2007; Lee and Bullock, 2003). (p.2) Zhao et al. (2016) state that these findings may differ from one country to another. Draisin et al. (2016) identified the road condition as a contributing factor. Their study results found preintervention speeds to be lower on unpaved roads than paved roads; hence paved roads saw more significant post-intervention speed reductions.

3. METHODOLOGY

3.1 Introduction

In this section, the overall research design, procedure and the applied statistical data analysis are elaborated. The challenges and limitations faced in this stage are also mentioned to enable the reader to understand the chosen design, techniques, and analysis.

The study used semi-structured interviews, Focus Group Discussion (FGD), speed observation checklists and questionnaires to collect data from the field. The forms used in the performance of the mentioned data collection instruments not included in the chapter are shown in the Annex section. Semi-structured interviews with the traffic police and two Road Safety NGOs were performed. FGDs were done at the three primary schools to determine the pupils' critical challenges on their school journeys. Speed observations at the roads alongside the schools followed with the questionnaires administered to the surrounding community members.

3.2 Design and Procedure

Kigamboni ward, as described in 1.4, was selected as the case study area for the intervention. The three public P.S in the area are located alongside the unpaved urban roads under TARURA's authority.

Before the research could commence, permission to carry out the study had to be sought from the project's two crucial government actors: the Municipal Council of Kigamboni and TARURA. Through the Municipal Director of Kigamboni, the District's Education Officer permitted the research in the District's primary schools from November 02, 2020, to January 29, 2021. The researcher had to ensure the safety of the school children and not disrupt their study schedules. TARURA's Regional Coordinator also permitted the research and the interventions to be implemented on their roads in the District.

3.2.1 Semi-Structured Interviews

Three semi-structured interviews were done to gain some answers for research questions one (What are the road safety interventions used to improve schoolchildren road safety in Tanzania?) and two (What road safety interventions identified in (i) can be applied to make safer the routes to school in the case study area?). The topic list below was used with the topic order not fixed, i.e. it could be adjusted during the interview while leaving room for personal views and opinions of the interviewees.

1. Introduction (title, work and function of the organisation)
2. Topic: Safe and sustainable transport to school; Schoolchildren road safety in Tanzania. What are the road safety activities that your organisation is doing to promote safe and sustainable transport to school for the schoolchildren?
3. What are the successes and challenges you have faced or are facing?
4. What are the lessons to be learnt?
5. The way forward or what more needs to be done in the area?

The interviews were conducted face-to-face with a staff member from Amend, RSA and with Superintendent Deus. W. Sokoni Tanzania Traffic Police. The duration of the interviews varied between 30 and 90 minutes, depending on the input received. A fourth interview which was unstructured and open and was done once the permit from TARURA Dar es Salaam Regional offices was obtained. It was with an Engineer from TARURA Kigamboni. This interview aimed to introduce the study, its purpose and scope to the office. It was also to understand the road conditions found in the area and the requirements needed to implement the intervention. Among the fundamental questions asked were: which intervention would be best suited to the existing road condition, and where should it be placed?

3.2.2 Focus Group Discussions (FGDs)

FGDs were carried out once permission from the Municipal Council was obtained. Two limitations were faced, which were the group composition and discussion time. Another permit had to be gained from the ward's Education Officer to gather pupils, parents, and teachers outside the school premises. Time constraints made this impossible, and instead, the FGDs were organised for pupils per school. The discussions also had to be done during school hours while not interfering with their class schedule. Therefore, they had to be limited to not more than thirty minutes.

Despite these minor setbacks, the FGDs were successfully done in Kigamboni, Kivukoni and Ufukoni Primary Schools. The groups typically consisted of seven to ten pupils and one or two teachers. Only three pupils from Ufukoni P.S were in standard 4; the rest were pupils from standard 5 and 6 in all the three schools. Usually, pupils in standard four range from 9-10 years, and standard 5 and 6 range from 10-13 years. In total, they were three groups, one from each school. The discussion time ranged from 30 to 40 minutes. The research study topic and focus area were explained to the group after the researcher's self-introduction. After that, more elaboration was done on the meanings of key terms (road safety and SSZs) and the target group (school children). A consent form (annexe 1) containing all information about the study was drawn and given to participating teacher(s) to be signed in duplicate (i.e. one document for the participant and the other for the researcher). The teacher signed on behalf of the pupils in attendance and the school. The form included general information (with contact details of the researcher), the purpose of the study, commissioner of the research, voluntary participation (rights of the participant) and consent (permission to participate in the study). The meeting then proceeded to the following five topics and questions as listed in the TABLE 4 below.

TABLE 4 Topic list and questions for the FGD

1.Transport modes used to go to school
What is the estimated percentage of the school's pupils who walk to school?
2. Routes used to and from school
Which routes or roads do they use to access the school?
3. School children Road Traffic Injuries (RTI) and fatalities in the case study area
What is the rate of RTI or fatalities among these school children (numbers you remember in the past six months or year)? What are the causes or contributing factors for the above?
4. Interventions to promote safe and sustainable transport to school
What should be done to improve safe and sustainable transport to school in your area? Do you think creating a school safety zone by installing signs will be a sustainable solution to improve safe and sustainable transport to school in your area? Why?

The following script was used during the discussion to guide participants on time management.

TABLE 5 FGD Script

ITEM	DURATION	REQUIREMENTS
Welcome & reception	Prior	Study permit
Introduction of the moderator(s) and the study, the topics and how the discussion will be organised Explanation of the Informed Consent. The signing of the Informed Consent	3-4 minutes	Form and pen
Introduction of the participants. Who are they and their standard, e.g. standard 4, 5 or 6?	1-2minutes	
Content section Follow the sub-topic list and ask the assigned questions Allow all participants to respond Ask more questions on interesting remarks	20 minutes	Paper and pen for notes Recording equipment to record discussions
Conclusion Explain follow-up steps, implementation of interventions (campaign and road signs) Ask if people have any questions or comments. Thank participants for their participation	5 minutes	

3.2.3 Speed Observations

The project's time constraints influenced the design for the travel speed observations to evaluate the speed limit signs in the allocated data collection and permit periods. A pre and post-intervention study design with one treatment (n=1) and two comparisons (n=2) sites was selected. The treatment site chosen was the route alongside Ufukoni P.S, whereas the routes alongside Kigamboni and Kivukoni Primary Schools were the comparison sites. The design compared travel speeds in the school zones before and after installing the school zone and speed limit signs to determine if speeds were affected. A speed observation checklist was developed (annexe 2) and used during the observations.

Six observation locations were selected, two sites for each school. These points were chosen because they were 100m before and after the primary schools' gates. School zone signs are to be placed 100m before and after a school's gate or entrance. At each location, data was collected during two time periods on Tuesday, Thursday and Friday, over one hour and a half. The periods corresponded with school opening and closing times: 6:30 am to 8:00 am and 1:30 pm to 3:00 pm, which was the same for the three schools. The aim was for the observations to be done in the middle of the week, i.e. Tuesday, Wednesday and Thursday, leaving out Monday and Friday. There is rush hour for work

traffic going out to the Central Business District or elsewhere on Monday and the weekend traffic from Friday. But, the Wednesday of the observational week was a public holiday and schools were closed; hence the observations had to be moved to Thursday and Friday.

Observations were done on a particular location for 60 minutes on vehicles travelling in one direction and the remaining 30 minutes on vehicles travelling in the opposite direction. This coincided for each period, either school opening or closing times. The lane that tended to be used most or with more traffic during the observation times was given more time (60 minutes). Each day was dedicated to a particular location. For instance, Tuesday was for the Ufukoni P.S site, Thursday for Kigamboni P.S and Friday for Kivukoni P.S. In cases where two or more vehicles passed simultaneously, only the speed of the vehicle closest to the observer was recorded. As shown in FIGURE 24, handheld speed radar equipment was used to take the speed measurements, and an observation checklist (FIGURE 25) was used to record the speed measurements.

FIGURE 24 An observer using speed radar.

FIGURE 25 An observer with an observation checklist.

Pre-intervention speed data was collected at each location before installing the signs from December 8, 2020. In contrast, the post-intervention speed data was collected nearly five months after the intervention, from May 4, 2021. Travel speed data was collected at the same periods and locations for both study periods to control confounders or general changes in travel speeds that may have occurred due to reasons other than installing the signs.

3.2.4 Questionnaires

The questionnaire survey, just like the speed observations, was a pre and post-intervention study. Annexe 3 shows both the pre and post-intervention questionnaires. The questionnaire had two main sections. Section one contained questions about the socio-demographic background on age, gender and level of education, number of children and school level, distance from school, mode of transport for the main part of the journey, routes to school and knowledge of an SSZ. Section two contained twenty-nine items measuring the socio-cognitive variables (attitude, normative beliefs, Perceived Behavioural Control (PBC), behavioural intentions and behaviour) based on the TPB. The TPB section was developed to examine the association of the socio-cognitive variables in determining the road users' behaviour in complying with installed school zone and speed limit signs in a designated SSZ.

Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) was developed as an extension of the Theory of Reasoned Action (TRA) model (Francis et al., 2004). Forward (2009) declares the TPB model and its predecessor, the theory of reasoned action, are the most commonly used theoretical models to predict driving violations related to road crashes. According to Ajzen (1991), The TPB proposes that human action is guided by predicting a specific behaviour's occurrence provided that the behaviour is intentional. Intentions to perform kinds of behaviours can be predicted significantly from attitudes toward the behaviour, subjective norms, and perceived behavioural control. These intentions, together with perceptions of behavioural control, account for considerable variance in actual behaviour. This is illustrated in FIGURE 26 below.

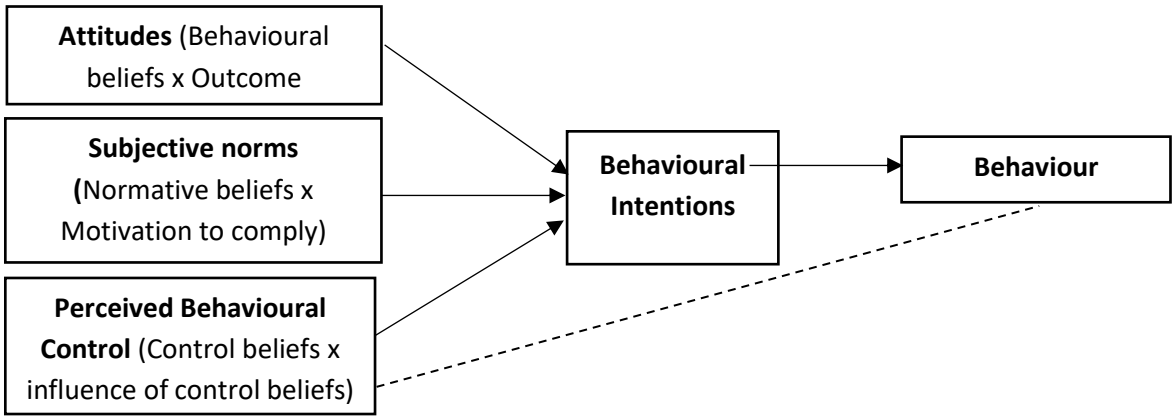


FIGURE 26 The Theory of Planned Behaviour according to Ajzen, 1991 (Francis et al., 2004).

The model defines attitude as the evaluations of behaviour, the subjective norm as the social pressure to act; in other words, the normative beliefs about the expectations and behaviours of others and PBC as the extent to which a person feels able to carry out the act (Forward, 2009; Francis et al., 2004). Francis et al. (2004) said these three variables would increase a person's intentions towards the desired behaviour if changed. Thus, the model can be essential in designing strategies that will help in adopting healthy behaviour. The authors continue to describe the behaviour predictors as

psychological constructs. The predictors may be measured directly or indirectly by questioning specific behavioural, normative and control beliefs (Forward, 2009; Francis et al., 2004). Both approaches measure different assumptions about the underlying cognitive structures (Francis et al., 2004).

It is not always the case that each variable contributes to intention prediction because their relative importance depends on the population and behaviour. Hence although there is no perfect relationship between behavioural intention and actual behaviour (Ajzen, 1991; Ajzen & Fishbein, 1980; Francis et al., 2004), intention can be used as a proximal measure of behaviour (Francis et al. 2004). This observation was one of the most important contributions of the TPB model compared to previous models of the attitude-behaviour relationship. Thus, "this model's variables can be used to determine the effectiveness of implementing interventions even if there is not a readily available measure of actual behaviour" (Francis et al., 2004, p.8).

Sample Size

Rashidian et al. (2006) indicated that published studies that applied the TPB model without sample size calculations used sample sizes that ranged from below 50 respondents to more than 750 respondents. Francis and colleagues (2008, as cited in Murenzi, 2020) recommended that a minimum sample of 80 recipients for TPB studies using a multiple regression approach should be used. The sample size in this study was determined using the following equation derived from Smith (2020):

$$\text{Necessary Sample Size} = (\text{Z-score})^2 - \text{StdDev}*(1-\text{StdDev}) / (\text{margin of error})^2$$

A necessary sample size of 119 was obtained using the population size of 30,496, a 95% confidence level, 9% margin of error, and Z=1.96 and Standard deviation=0.5. The respondents were physically approached by two interviewers trained on approaching and asking the participants who had consented. The first interviewer is a part-time employee of the Helmet Vaccine Initiative Tanzania Foundation (a road safety NGO). The second interviewer was a graduate student of a Bachelor's of Science in Mechanical Engineering. An undergraduate student was used as a replacement to assist the first interviewer during the post-intervention survey in which the second interviewer was absent. The permission from respondents was obtained when they clicked agree on the introductory page with a brief about the data protection procedure. Only data from respondents who agreed to participate was recorded. Anonymity and confidential treatment of the data was maintained. A series of questions and TPB based statements were asked, and answering took between fifteen and twenty minutes.

3.3 Statistical Data Analysis

Data was analysed using IBM SPSS Statistics version 26 and Microsoft Excel 365. The pre and post-intervention speed observations for each vehicle type in each school location were entered first in different spreadsheets. Summations of vehicles, mean and 85th percentile speeds were then calculated to provide descriptive statistics for travel speeds in treatment and comparison sites. Abbas et al. (2011) stated that the observed 85th percentile speed is the most frequently used measure of the operating speed associated with a particular location or geometric feature. They defined the operating speed as the speed at which drivers operate their vehicles in free-flow conditions. Finkelstein (2016) described the 85th percentile speed as the speed at or below 85 per cent of all vehicles travel under free-flowing conditions or with open roads and favourable conditions (Marohn, 2020). Traffic and Transportation Engineers use the 85th percentile speed as a guide to set the speed limit at a safe speed because the assumption underlying the 85th percentile speed is that most drivers will operate their vehicle at speeds they perceive to be safe. Therefore, 85th percentile speed will minimize crashes and promote

uniform traffic flow along a corridor (Finkelstein, 2016; Marohn, 2020). “Speed limits set above or below the 85th percentile speed will create unsafe conditions due to speed differential as some driver adhere strictly to the law while others drive the naturally-induced speed” (Marohn, 2020, para. 1).

In SPSS, non-parametric tests were used to analyse the survey data. Parametric tests assume a normal distribution of interval or ratio values, whereas nonparametric tests do not. Nonparametric tests test hypotheses when the data violates one or more assumptions for parametric tests (Chin & Lee, 2008; DePoy & Gitlin, 2016). In this study, the survey data was measured on an ordinal scale; it was partly skewed and not normally distributed, thus violating assumptions for parametric tests.

Before the analysis, data was screened for accuracy of coding or ranking and missingness. Listwise deletion of missing data was performed, whereby all incomplete surveys were removed. Three cases at pre and two cases at post-intervention surveys were removed, leaving 124 complete questionnaires each. The data was then analysed for descriptives to get an overall idea of socio-demographic variables and how respondents are oriented towards compliance with school zone and speed limit signs in an SSZ. An exploratory factor analysis of the items was done to identify highly intercorrelated variables and the underlying factors they measured. Cronbach's Alpha (α) was then calculated for the TPB constructs identified to obtain the questions' reliability. For constructs whose values were below the threshold of 0.70, some questions were removed to raise Cronbach's α. The items were then aggregated for each specific concept; attitude, normative beliefs, PBC, behavioural intentions and behaviour. A Spearman's correlation analysis then explored associations between variables followed by an ordinal logistic regression analysis to predict behavioural preferences and self-reported behaviour. The figure below shows the hypothesised TPB model for the study.

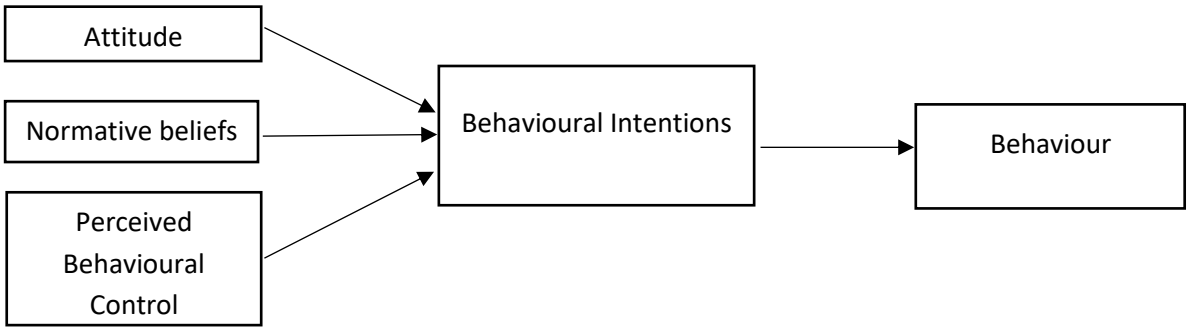


FIGURE 27 Hypothesized TPB model for road user compliance to school zone and speed signs.

A Mann Whitney U test was followed to compare the differences between two independent groups. The test assumes that the observations are separated with no relationship between the observations in each group or between the groups themselves, i.e. the participants in each group are different with no participant being in more than one group (Field, 2009; *Mann-Whitney U Test Using SPSS Statistics*, 2018; Smalheiser, 2017). The pre-and post-intervention respondents could not be matched or paired because on-site different people were approached in the pre and post-study surveys.

3.4 Intervention

A school safety zone using school zone and speed limit signs was established at Ufukoni P.S (treatment site) as a low-cost infrastructural solution to make routes to school safer for the school children. These signs were made by an accredited sign maker in the country who has made several traffic signs in the Municipality. The signs also followed the guidelines and standards of Tanzania Traffic Signing.

The signs were placed on the same pole, with the school zone sign as the primary sign and the speed limit sign as the secondary sign. The material for the signs is reflective and can be seen even in dim light conditions, for example, at night, when it is rains or is foggy. The signs were placed 100m before the school gate and a few meters less than 100m after the school gate. This was because the exact 100m distance ended at a point near the corner of the road. Hence the sign was placed a few meters back, ending at the gate of the police station. The images below show the school zone and speed limit signs placed at the treatment site.

FIGURE 28 School zone and speed limit sign Installation at the beginning and end of the SSZ.

FIGURE 29 A day and night time photo of the school zone and speed limit signs post-intervention.

4. RESULTS

The collected data was analysed as explained in 3.3 to evaluate the effect of the implemented intervention in so doing answering the third research question “What is the effect of the implemented intervention in making safer the routes to school and improving the schoolchildren' road safety in the case study area?.”

4.1 Focus Group Discussions

TABLE 6 shows the synthesized data from the three focus group discussions. During the FGDs, notes of the answers to the questions asked were taken. Since a teacher was present, it was easy to conduct a well-organized discussion where answers were heard from one person at a time. Later the answers for each question were compared and complied as shown below.

TABLE 6 Synthesized FGD data

QUESTIONS	RESPONSES
Transport modes used to go to school	
What is the estimated percentage of the school's pupils who walk to school?	The identified modes of transport mainly used were; walking, motorcycles, buses (daladalas) for those who did not live close and motor tricycles (Bajaj). The pupils who came with buses were dropped off at two bus stops; '*Machava'* closest to Kigamboni and Kivukoni P.S and '*Kwa Chagani*' closest to Ufukoni P.S. They then walked along the unpaved roads leading to the schools. From here on, the unpaved roads will also be referred to as the access roads. Across all answers, the percentage of pupils who walk to the schools was estimated at 80%.
Routes used to and from school	
Which routes or roads do you use to access the school?	Several routes were mentioned, but they all led to the two access roads alongside the schools. The standard for placement of school zone traffic signs is 100m before and after the school gate. In consideration of this, the access roads were divided into four routes. • Access road 1: Route 1 and 4 coded in blue and orange colour, respectively. • Access road 2: Route 2 and 3 coded in black and red colour, respectively.
School children RTI or fatalities in the case study area	
What is the rate of RTIs or fatalities among these school children (numbers you remember in the past six months or year)?	Ufukoni P.S: three road crashes Kwa Chagani and one at Mnadani Kivukoni P.S: four road crashes Kigamboni P.S: three road crashes Hence the pupils recalled three or four road crashes involving pupils in the past year

What are the causes or contributing factors for the above?	The crashes involved children and motorcycle drivers. The dominant contributing factor mentioned was the motorcycle drivers' speeding, especially in streets within the residential settlements where there are no traffic police officers. Other factors were: • Drivers not respecting zebra crossings; they do not stop at the crossings even when there are pedestrians, and some stop at the zebra crossings for passengers to board the vehicle • Unsafe road crossing behaviour by the children, e.g. running and holding hands while crossing • Non-compliance of drivers to the installed traffic signs • Missing traffic signs • Children playing while on the road • Careless and drunk driving or driving under the influence • Lack of road safety education or awareness
Interventions to promote safe and sustainable transport to school	
What should be done to improve safe and sustainable transport to school in your area?	• Traffic signs should be installed to alert the drivers of their presence • Creation of school zones and road safety education programmes • Traffic police officers should be posted on the main roads near the area during school opening and closing hours • Traffic calming measures to manage speed like provision of speed humps • Speed governors for motorcycle riders • Proper licensing of drivers because some drivers, especially motorcycle drivers, possess licenses with no background of formal driving training • Community road safety education or awareness should be given to everyone, especially motorcycle riders
Do you think creating a school safety zone by installing signs will be a sustainable solution to improve safe and sustainable transport to school in your area? Why?	A school safety zone is an intervention that should be promoted in the country. Having motorised transport users know that they are in a school zone and they have to respect traffic rules like reducing speed and driving carefully due to presence of children in the area is essential. We have witnessed road crashes happening with our fellow pupils being injured because they have been knocked by a motorcycle or were not careful while crossing. But the enormous responsibility of being careful lies with the drivers because of the characteristics that make children more vulnerable road users. Hence school zone and speed limit signs will be an excellent low-cost measure that will help to make safer the routes to school and improve schoolchildren's road safety in the area

4.2 Pre and Post Intervention Speed Analysis

The vehicles that were observed included primarily motorcycles, followed by cars and motor tricycles. Few trucks, six in total and three buses/minivans, were noticed, and this coincided with the previous statement made about the small presence of these vehicle types in the study area. TABLE 7 shows the total sample size of the observed vehicles during the pre and post-intervention periods at the treatment and comparison sites. The number of vehicles was lower post-intervention due to the reduced vehicle traffic at the road alongside Kigamboni P.S. The road has a pothole within the 100m after school gate distance, as shown in FIGURE 29. This pothole contributed to the low speeds observed (see TABLE 8) in this location. During the pre-intervention observations, motorists were seen to reduce their speeds as they approached the pothole and coincidently, their measured speeds by the speed radar were low. This was one reason why route two was not considered for the intervention. In post-intervention speed observations, this pothole had filled up with water from the rains of the week before. So, most motorists preferred to use route 1 (the road alongside Kivukoni P.S), leading to the observed increase in traffic on that route.

TABLE 7 Total number of observed vehicle sample size

	SAMPLE SIZE	
Sample (Vehicles)	**Pre-intervention**	**Post-intervention**
Car	38	61
Motorcycle	252	194
Motor tricycle (Bajaj)	15	31
Bus/Minivan	1	2
Trucks	5	1
Total	**309**	**289**

FIGURE 30 Pothole on the road alongside Kigamboni P.S.

TABLE 8 shows the aggregate mean and 85th percentile speeds for the treatment and comparison sites pre and post-intervention periods. Changes between the two periods are highlighted in the shaded columns. The vehicle numbers with travel speeds at or less than 30km/h, between 30 and 50 km/h and between 50 and 80 km/h as asked in the questionnaire. The difference and

percentage difference of the vehicle numbers within these speed limit groups is also shown in the change column.

TABLE 8 Aggregate descriptive statistics for travel speeds in treatment and comparison sites

Treatment site : Ufukoni P.S (*n* = 1)						
	Pre-intervention (no school zone & speed limit signs)		**Post-intervention (school zone & speed limit signs)**		**Change**	
	n	*speed (km/h)*	*n*	*speed (km/h)*	*difference*	*%*
Mean speed	87	25.92	97	21.80	-4.12 km/h	-15.9%
85th percentile speed		32.2		27.0	-5.2 km/h	-16.5%
Vehicles at or <30km/h	65	75%	89	92%	+17%	+22.7%
Vehicles 30-50km/h	21	24%	8	8%	-16%	-66.7%
Vehicles 50-80km/h	1	1%	0	0%	-1%	-100%
Comparison sites (*n* = 2)						
	Pre-intervention (no school zone & speed limit signs)		**Post-intervention (no school zone & speed limit signs)**		Change	
	Kigamboni P.S					
	n	*speed (km/h)*	*n*	*speed (km/h)*	*difference*	*%*
Mean speed	130	20.16	59	14.98	-5.18 km/h	-25.7%
85th percentile speed		26		19	-7 km/h	-25.9%
Vehicles at or <30km/h	125	96%	59	100%	+4%	+4.2%
Vehicles 30-50km/h	5	4%	0	0%	-4%	-100%
	Kivukoni P.S					
	n	*speed (km/h)*	*n*	*speed (km/h)*	*difference*	*%*
Mean speed	92	25.08	133	20.30	-4.78 km/h	-19.1%
85th percentile speed		31		26	-5 km/h	-16.1%
Vehicles at or <30km/h	74	80%	125	94%	+14%	17.5%
Vehicles 30-50km/h	17	19%	8	6%	-13%	-68.4%
Vehicles 50-80km/h	1	1%	0	0%	-1%	-100%

In the pre-intervention speed observation period, 65 (75%) of the vehicles travelled at speeds below 30km/h at the treatment site, and 22 (25%) vehicles travelled at speeds above 30km/h. The mean and 85th percentile speeds of these vehicles was 26 and 32km/h, respectively. At post-intervention, a 22.7% increase of vehicles travelled below the speed limit of 30km/h, and a 66.7% reduction in vehicles travelled between 30-50km/h. No vehicle travelled above 50km/h post-intervention. The mean speed reduced by 4.12km/h (15.9%), and the 85th percentile speed reduced by 5.2km/h (16.5%).

The mean speeds and 85th percentile speeds also reduced post-intervention in the two comparison sites. At the Kigamboni P.S site, the pre-intervention speed observation period showed that 125 (96%) vehicles travelled below 30km/h and only 5 (4%) vehicles travelled above 30km/h. The mean and 85th percentile speeds of these vehicles was 20 and 26km/h, respectively. However, only 59 vehicles were observed in the post-intervention, and they all travelled at speeds below 30km/h. As a result, the mean speed reduced by 5.18km/h (25.7%), and the 85th percentile speed reduced by 7km/h (25.9%).

At the Kivukoni P.S site, the pre-intervention speed observation period showed that 74 (80%) vehicles travelled below 30km/h and 18 (20%) vehicles travelled above 30km/h, with 1 out of the 18 vehicles travelling above 50km/h. The mean and 85th percentile speeds of these vehicles was 25 and 31 km/h, respectively. In the post-intervention, there was an increase in vehicle numbers, as explained earlier. 125 (94%) vehicles travelled below 30km/h, 8 (6%) vehicles travelled between 30-50km/h and no vehicle travelled above 50km/h. This indicates a 14% increase of vehicles travelling within the 30km/h speed limit and a 13% decrease of vehicles that went above 30km/h. The mean speed reduced by 4.78km/h (19.1%), and the 85th percentile speed reduced by 5km/h (16.1%).

Since the number of vehicles observed varied according to type, the speed reduction in these vehicles differed. Three trucks and no bus/minivan were observed pre-intervention, and one bus/minivan and no trucks were observed in the post-intervention at the treatment site. In the comparison sites, two trucks and one bus/minivan were observed in pre-intervention, and one truck and a bus/minivan were observed post-intervention. Hence due to the small and varying numbers, the speed change in trucks, buses or minivans was not analysed. TABLE 9 shows the 85th percentile speed change at pre and post-intervention periods per three vehicle types (cars, motorcycles and motor tricycles) in comparison sites. FIGURE 30 illustrates this change for the treatment site.

TABLE 9 85th percentile speed change per vehicle type at the comparison sites.

VEHICLE TYPE	**SUM**		**85TH PERCENTILE SPEED (km/h)**	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
	Kigamboni P.S			
Car	7	15	15	14
Motorcycle	121	42	26	21
Motor tricycle	2	2	-	-
	Kivukoni P.S			
Car	16	27	34	21
Motorcycle	64	93	32	26
Motor tricycle	9	12	23	23

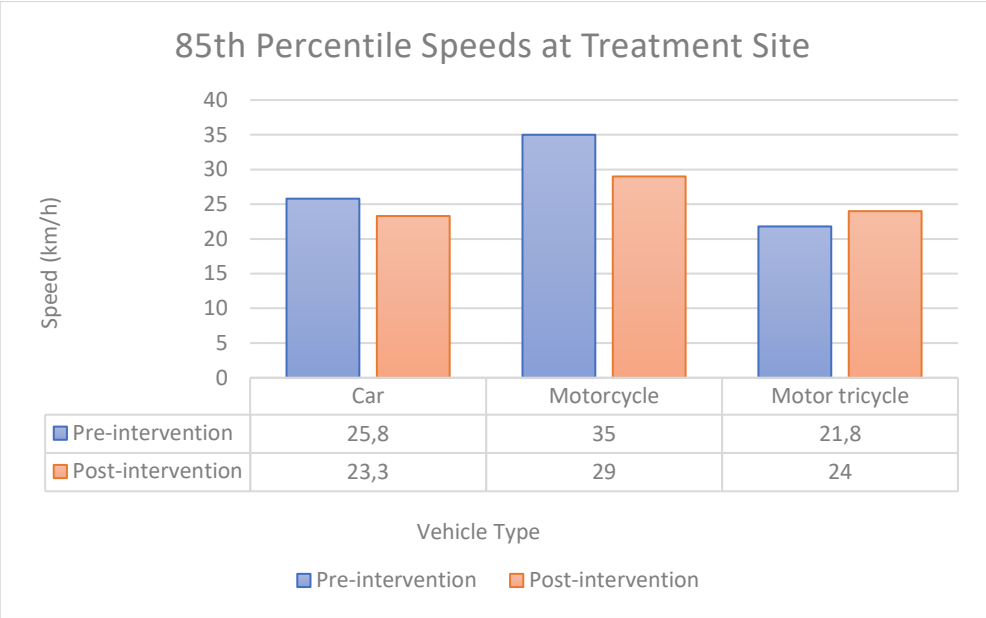


FIGURE 31 85th percentile speed change per vehicle type at the treatment site.

4.3 Pre and Post-Intervention Survey/Questionnaires

4.3.1 Participants

The survey participants included community members living, working or present in the case study area during the study. Only adults above 18 years old were approached to answer the questions. Parents with their children attending one of the three schools were asked additional questions related to their children and their journeys to school. Those who owned vehicles were also asked other questions to determine their driving behaviour along the schools' roads. In both pre and post-intervention surveys, 124 people participated in each survey.

Table 10 summarises the demographic data collected from the respondents' pre and post-intervention. The respondents included more males, 70 and 85 respectively, in the pre and post-intervention surveys and 54 and 39 females. The highest age counts were from 21-30 (56) and 31-40 (36) years old, and the lowest was from the 51-60 and above 60 age groups pre-intervention. In the post-intervention, most respondents were from the 31-40 age group (46), followed by the 21-30 age group (37). The lowest remained from the 51 and above age groups. The highest level of education reached by most was secondary school education (37.9%), and the least was university (5.6%), while others preferred not to specify (8.1%) or mention in the pre-intervention survey. In the post-intervention study, the highest education level reached was primary school education (35.5%), followed closely by secondary school (34.7%), and the least was the university level at 11.3%.

The percentage of parents in the sample during the pre-intervention survey was 63 (50.8%), making it slightly above half the sample and leaving those who were not parents at 61 (49.2%). Out of the 63 parents, most had two children (19.4%), followed by one child (14.5%). Parents with 1-3 children were 43.6% out of the 50.8%; 54 out of the 63 parents. Only 3 out of the 63 parents had more than five children. The children of 34 parents travelled less than 500m to go to school, the highest percentage (27.4%) followed by those who travelled between 500m-1km (15.3%). Four (3.2%) had children who travelled more than 1.5km to reach the schools. Most children were in standard 7 and 1 with equal number count and percentages, 20 (18.02%).

In the post-intervention survey, parents, 41 (33.1%) were lesser than not-parents, 83 (66.9%). Most parents had two children (12.9%) and one child (11.3%). Parents with 1-3 children were 39 (31.5%) out of the 33.1%. None had five or more children. The children of 17 parents travelled less than 500m to and from school. It was the highest percentage (13.7%), followed by those who travelled between 500m-1km (12.1%), and the least was 4 (3.2%) for those who travelled more than 1.5km. Most children were in standard 1 and 3 with an equal number count and percentage, 17 (13.7%).

TABLE 10 Demographics

		PRE-INTERVENTION		POST-INTERVENTION	
Characteristic	**Value**	**Frequency**	**%**	**Frequency**	**%**
Sex	Male	70	56.5	85	68.5
	Female	54	43.5	39	31.5
Age	18-20	11	8.9	19	15.3
	21-30	56	45.2	37	29.8
	31-40	36	29	46	37.1
	41-50	14	11.3	18	14.5
	51-60	3	2.4	4	3.2
	>61	4	3.2	0	0
Level of education	Primary school	45	36.3	44	35.5
	Secondary school	47	37.9	43	34.7
	College	15	12.1	23	18.5
	University	7	5.6	14	11.3
	Other	10	8.1	0	0
Parents	Yes	63	50.8	41	33.1
	No	61	49.2	83	66.9
	Total	124	100	124	100
Number of children	1	18	14.5	14	11.3
	2	24	19.4	16	12.9
	3	12	9.7	9	7.3
	4	5	4.0	2	1.6
	5	1	0.8	0	0
	>5	3	2.4	0	0
School distance	0m-500m	34	27.4	17	13.7
	500m-1km	19	15.3	15	12.1
	1km-1.5km	6	4.8	5	4.0
	1.5km-2km	2	1.6	1	0.8
	>2km	2	1.6	3	2.4
	Total	63	50.8	41	33.1
Child's grade in school	1	20	16.1	17	13.7
	2	15	12.1	13	10.5
	3	17	13.7	17	13.7
	4	15	12.1	5	4.0
	5	14	11.3	7	5.6
	6	10	8.1	8	6.5
	7	20	16.1	11	8.9

TABLES 11 and 12 show these children's travel mode from home to school and vice versa for the central part of their journey. Walking was the most common transport mode at 73% in the pre-intervention survey and 68.3% in the post-intervention survey. It was followed by motorcycles in both but with motor tricycles in the after study only. Bicycles and motor tricycles were the least used travel mode in the pre-intervention survey, whereas in the post-intervention survey, it was taxi and bus.

TABLE 11 Travel modes to and from school pre-intervention

	From home to school			**From school to home**		
Travel mode	*Frequency*	*Percent*	*Valid Percent*	*Frequency*	*Percent*	*Valid Percent*
Walk	46	37.1	73.0	46	37.1	73.0
Bicycle	1	.8	1.6	1	.8	1.6
Motorcycle	7	5.6	11.1	8	6.5	12.7
Motor tricycle	1	0.8	1.6	0	0	0
Car/Taxi	3	2.4	4.8	3	2.4	4.8
Bus	5	4.0	7.9	5	4.0	7.9
Parents	**63**	**50.8**	**100**	**63**	**50.8**	**100**
Missing (Not parents)	61	49.2		61	49.2	
Total	**124**	**100**		**124**	**100**	

TABLE 12 Travel modes to and from school post-intervention

	From home to school			**From school to home**		
Travel mode	*Frequency*	*Percent*	*Valid Percent*	*Frequency*	*Percent*	*Valid Percent*
Walk	28	22.6	68.3	27	21.8	65.9
Bicycle	4	3.2	9.8	3	2.4	7.3
Motorcycle	2	1.6	4.9	4	3.2	9.8
Motor tricycle(Bajaji)	4	3.2	9.8	4	3.2	9.8
Car/Taxi	1	0.8	2.4	2	1.6	4.9
Bus	2	1.6	4.9	1	0.8	2.4
Parents	**41**	**33.1**	**100**	**41**	**33.1**	**100**
Missing (Not parents)	83	66.9		83	66.9	
Total	**124**	**100**		**124**	**100**	

The parents were then shown a map with the four coded routes and the names of the schools, as seen in Figure 23. Route 1(blue) is the road alongside Kivukoni P.S, route 2 (black) runs alongside Kigamboni P.S, route 3 (red), and route 4 (orange) runs alongside Ufukoni P.S on the right and left-hand side, respectively.

FIGURE 32 Map showing the routes to the three schools.

In the pre-intervention survey, Route 2 had the highest percentage (31.75%) of schoolchildren using it, while route 1 had the smallest amount (14.29%).

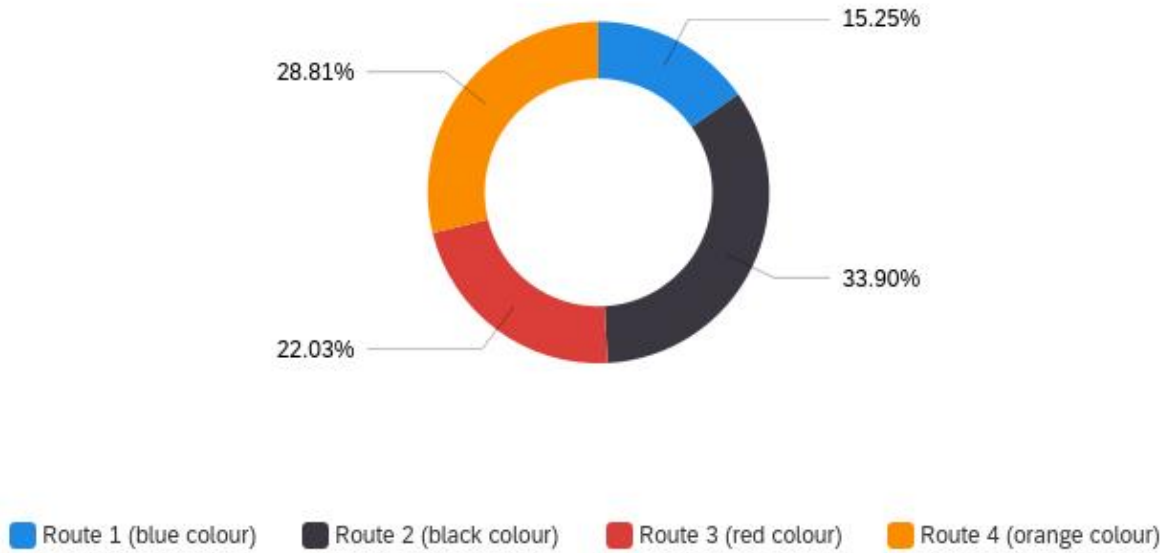


FIGURE 33 Pre-intervention survey routes to school.

One access road was divided into two routes. The division was done considering the 100m distance before and after the school gate for each route. So in the map (FIGURE 32), the blue(route 1) and orange (route 4) make up one road which we shall term access road 1. And the black (route 2) and red (route 3) make up another access road we shall term access road 2. Therefore taking the sum of routes for each access road, the percentage use of access road 2 (summation of route 2 and 3) is 52.4% which is higher than 47.61% for access road 1 (summation of route 1 and 4). Thus access road two was considered for the intervention. A decision then had to be made for either route 2 or 3. Route 2 could come up as the most obvious choice due to the highest percentage of pupils using it, but it was not chosen, and instead, route 3 (red) was selected for three main reasons:

- Most social and health facilities which account for significant traffic in this access road are along route three, and they include: a church, a secondary school, Ufukoni P.S, a school playground, Qualitas polyclinic, small businesses, Kigamboni hospital and Police station.
- There was a pothole on route two, as seen in FIGURE 30, which affected vehicle speeds, as clarified in section 4.2.
- The engineer from TARURA Kigamboni recommended route 3 to be used.

When asked the question, 'Before today did you ever see or hear of a School Safety Zone (SSZ)?' many (81) answered no, which was 65.3% out of the total and 43 (34.7%) answered yes.

In the post-intervention study, Route 2 still had the highest percentage (29.27%) of pupils using it, followed by route 3 (26.83) with the minimum levels (21.95%) on route 1 and 4.

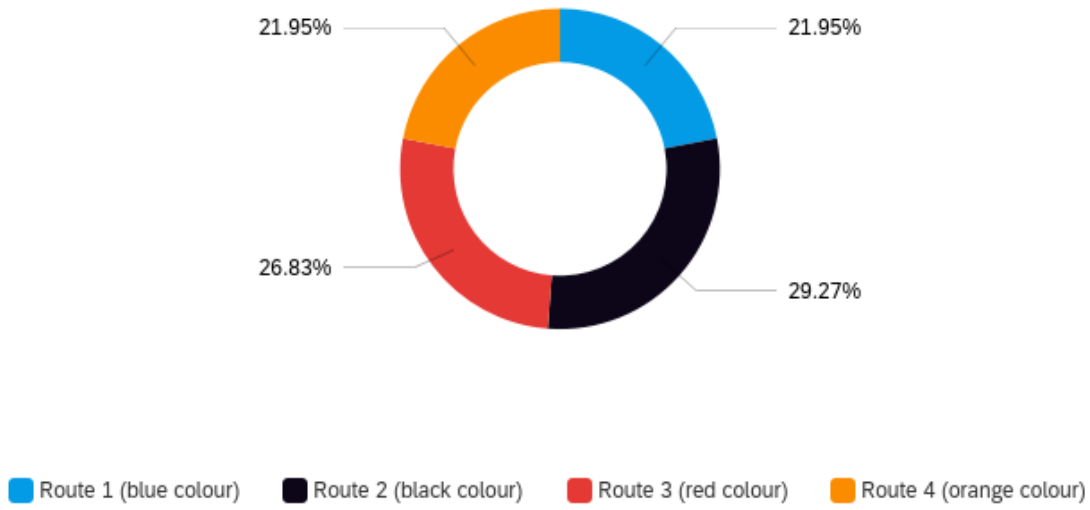


FIGURE 34 Post-intervention survey routes to school.

When asked the question, 'Before today did you ever see or hear of a School Safety Zone (SSZ)?' more (72) answered no, which was 58.1% out of the total and 52 (41.9%) answered yes.

4.3.2 Descriptive Statistics

TABLE 13 and 14 give an overview of the TPB constructs, items, ranking or scoring and their frequencies, the means and mode for each construct at the pre and post-intervention surveys. All variables were positively coded, meaning that higher values indicate more positive sentiments.

TABLE 13 Pre-intervention survey items, scoring, frequency, mean and mode

Concepts	Items	Scoring & Frequency	Mean	Mode
Attitude	The unpaved urban roads used by the schoolchildren are safe for them.	1 Disagree=89 2 Somewhat disagree=3 3 Neither agree nor disagree=6 4 Somewhat agree=11 5 Agree=15	1.87	1
	Motorists are aware of schoolchildren's presence in the area.	1 Disagree=25 2 Somewhat disagree=5 3 Neither agree nor disagree=3 4 Somewhat agree=21 5 Agree=70	3.85	5
	Most motorists maintain a speed limit of 30km/h around the schools.	1 Disagree=53 2 Somewhat disagree=7 3 Neither agree nor disagree=17 4 Somewhat agree=26 5 Agree=21	2.64	1
	I find the speed limit of 30km/h to be a safe speed for an area surrounding a school.	1 Disagree=11 2 Somewhat disagree=5 3 Neither agree nor disagree=6 4 Somewhat agree=35 5 Agree=67	4.15	5
	I find it easy to maintain a speed limit of 30km/h around a school area.	1 Disagree=15 2 Somewhat disagree=11 3 Neither agree nor disagree=12 4 Somewhat agree=23 5 Agree=63	3.87	5
	Creating a SSZ using a school zone sign will make the roads safer for the schoolchildren.	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=11 5 Agree=112	4.89	5

	Creating a SSZ using a speed limit sign will make the roads safer for schoolchildren.	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=9 5 Agree=114	4.90	5
	The community needs more awareness of road safety issues.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=0 4 Somewhat agree=1 5 Agree=123	4.99	5
Normative beliefs	My relatives think it is important to create a SSZ using school zone signs.	1 Disagree=0 2 Somewhat disagree=2 3 Neither agree nor disagree=24 4 Somewhat agree=41 5 Agree=57	4.23	5
	My relatives think it is important to create a SSZ using speed limit signs.	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree= 21 4 Somewhat agree=46 5 Agree=56	4.27	5
	My partner thinks it is important to create a SSZ using school zone signs.	1 Disagree=2 2 Somewhat disagree=3 3 Neither agree nor disagree=17 4 Somewhat agree=44 5 Agree=58	4.23	5
	My partner thinks it is important to create a SSZ using speed limit signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=18 4 Somewhat agree=44 5 Agree=59	4.27	5
	My friends think it is important to create a SSZ using school zone signs.	1 Disagree=1 2 Somewhat disagree=1 3 Neither agree nor disagree=13 4 Somewhat agree=49 5 Agree=60	4.34	5
	My friends think it is important to create a SSZ using speed limit signs.	1 Disagree=0 2 Somewhat disagree=2	4.34	5

		3 Neither agree nor disagree=14 4 Somewhat agree=48 5 Agree=60		
	My community thinks it is important to create a SSZ using school zone signs.	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=6 4 Somewhat agree=31 5 Agree=86	4.63	5
	My community thinks it is important to create a SSZ using speed limit signs.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=7 4 Somewhat agree=32 5 Agree=85	4.63	5
Perceived behavioural control	I am confident I would reduce my speed when I see a school zone sign.	1 Disagree=1 2 Somewhat disagree=0 3 Neither agree nor disagree=17 4 Somewhat agree=5 5 Agree=101	4.65	5
	I am confident I would reduce my speed according to the installed school zone speed limit sign.	1 Disagree=1 2 Somewhat disagree=0 3 Neither agree nor disagree=15 4 Somewhat agree=6 5 Agree=102	4.68	5
	I am confident I would reduce my speed in a SSZ even if other motorists do not.	1 Disagree=1 2 Somewhat disagree=0 3 Neither agree nor disagree=15 4 Somewhat agree=7 5 Agree=101	4.67	5
	I am confident I would reduce my speed in a SSZ even when there is no traffic police officer around.	1 Disagree=1 2 Somewhat disagree=0 3 Neither agree nor disagree=15 4 Somewhat agree=7 5 Agree=101	4.67	5
Behaviour	What speed do you normally use when you drive in the roads along the primary schools?	1 >80km/h = 1 2 50-80km/h = 2 3 30-50km/h = 10 4 <30km/h = 55	4.31	5

	Do you normally reduce your speed when you see a school zone sign in a school zone?	1 No = 13 2 Yes = 73	1.28	2
	Do you normally reduce your speed when you see a speed limit sign in a school zone?	1 No = 13 2 Yes = 73	1.28	2
Behavioural intentions	Next time when I see a school zone sign in a SSZ, I would be willing to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=13 4 Somewhat agree=9 5 Agree=102	4.72	5
	Next time when I see a speed limit sign in a SSZ, I would be willing to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree= 13 4 Somewhat agree=9 5 Agree=102	4.72	5
	Next time when I see a school zone sign in a SSZ, I intend to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=14 4 Somewhat agree=12 5 Agree=98	4.68	5
	Next time when I see a speed limit sign in a SSZ, I intend to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=14 4 Somewhat agree=12 5 Agree=98	4.68	5
	Next time when I see a school zone sign in a SSZ, I am likely to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=14 4 Somewhat agree=12 5 Agree=98	4.68	5
	Next time when I see a speed limit sign in a SSZ, I am likely to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree= 14 4 Somewhat agree=12 5 Agree=98	4.68	5

The means and frequencies of scores for attitude vary according to the question. Most of the respondents (89, 71.8%) disagreed that the unpaved urban roads alongside the schools are safe for the pupils (mean=1.87, mode=1). When asked if motorists knew the schoolchildren's presence in the area, most (91, 73.4%) agreed and somewhat agreed (mean=3.85, mode=5). More disagreed (60, 48.3%) that most motorists maintained a speed limit of 30km/h around the schools (mean=3.85, mode=5). A good number (17, 13.7%) were unsure of this because they neither agreed nor disagreed. Generally, participants (102, 82.2%) agreed that a speed limit of 30km/h is safe for an area surrounding a school (mean=4.15, mode=5). When asked if maintaining that speed limit around a school area is easy, they mostly (86, 69.3%) agreed (mean=3.87, mode=5). Although 12 (9.7%) neither agreed nor disagreed, and 26 disagreed (21%). Creating an SSZ using the signs received many positive reviews, and only one person somewhat disagreed, and no one disagreed. Roads will be made safer for the schoolchildren by creating an SSZ using a school zone sign, 112 (90.3%) agreed, 11 (8.9%) somewhat agreed (mean=4.89, mode=5), and for the speed limit sign, 114 (91.9%) agreed, and nine (7.3%) somewhat agreed (mean=4.90, mode=5). They all agreed that the community needs more road safety awareness.

Normative beliefs showed that overall the respondents agreed that their relatives, partners, friends and the community think it is vital to create an SSZ using school zone and speed limit signs (mean=4.37, mode=5). The community had the highest count (117, 94.3%) of agreement followed by friends (109, 87.9%) for school zone signs and 108 (87.1%) for speed limit signs, partner (102, 82.3%) for school zone signs and 103 (83.1%) for speed limit signs and relatives (98, 79.1%) for school zone signs and 106 (82.3%) for speed limit signs

PBC results showed that they agreed they would reduce their speeds in situations where they see a school zone sign or a speed limit sign in an SSZ, where other motorists do not reduce their speed and when there is no traffic police officer around. The overall mean was 4.67, and the mode was 5.

Behavioural intentions show that they were willing to reduce their speeds the next time they saw a school zone or speed limit sign in an SSZ (mean=4.72, mode=5), and they mostly agreed (111, 89.6%), and none disagreed. Thirteen (10.5%) neither agreed nor disagreed. The mean=4.68 and mode=5 were the same for intention and likelihood when asked the same question. Again, none disagreed; 14 (11.3%) neither agreed nor disagreed, and the rest (110, 88.7%) agreed.

Behaviour shows that 55 out of 68 motorists usually used a speed below 30km/h when driving on the roads alongside the primary schools for those who owned vehicles. This corresponds to the pre-intervention observed speeds (TABLE 8). The frequencies showed a considerable percentage, 56 (45.2%), did not own vehicles, 55 (44.4%) drove below 30km/h, 10 (8.1%) drove at 30-50km/h, 2 (1.6%) drove at 50-80km/h, and only 1 (0.8%) said they used a speed above 80km/hr. Most of them usually reduce their speeds when they see a school zone or speed limit sign. For school zone signs, 69 (55.6%) replied yes to reducing speed, and 4 (3.2%) said no. And for speed limit signs, 70 (56.5%) said yes to reducing speed, and 3 (2.4%) said no.

TABLE 14 Post-intervention survey items, scoring, frequency, mean and mode

Concepts	Items	Scoring & Frequency	Mean	Mode
Attitude	The unpaved urban road along Ufukoni P.S is safe for the schoolchildren using it.	1 Disagree=21 2 Somewhat disagree=14 3 Neither agree nor disagree=7 4 Somewhat agree=47 5 Agree=35	3.49	4
	The unpaved urban roads along Kigamboni & Kivukoni P.S are safe for the schoolchildren using them.	1 Disagree=23 2 Somewhat disagree=16 3 Neither agree nor disagree=7 4 Somewhat agree=45 5 Agree=33	3.40	4
	Motorists are aware of schoolchildren's presence in the area around Ufukoni P.S.	1 Disagree=14 2 Somewhat disagree=28 3 Neither agree nor disagree=5 4 Somewhat agree=42 5 Agree=35	3.45	4
	Motorists are aware of schoolchildren's presence in the area around Kigamboni & Kivukoni P.S.	1 Disagree=14 2 Somewhat disagree=27 3 Neither agree nor disagree=6 4 Somewhat agree=42 5 Agree=35	3.46	4
	Most motorists maintain a speed limit of 30km/h on the road along Ufukoni P.S.	1 Disagree=15 2 Somewhat disagree=35 3 Neither agree nor disagree=22 4 Somewhat agree=34 5 Agree=18	3.04	2
	Most motorists maintain a speed limit of 30km/h on the roads along Kigamboni & Kivukoni P.S.	1 Disagree=16 2 Somewhat disagree=36 3 Neither agree nor disagree=21 4 Somewhat agree=33 5 Agree=18	3.04	2
	I find the speed limit of 30km/h to be a safe speed for an area surrounding a school.	1 Disagree=4 2 Somewhat disagree=17 3 Neither agree nor disagree=12 4 Somewhat agree=36 5 Agree=55	3.98	5

	I find it easy to maintain a speed limit of 30km/h around a school area.	1 Disagree=5 2 Somewhat disagree=21 3 Neither agree nor disagree=9 4 Somewhat agree=39 5 Agree=50	3.87	5
	Creating a SSZ using a school zone sign will make the roads safer for the schoolchildren.	1 Disagree=2 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=6 5 Agree=115	4.86	5
	Creating a SSZ using a speed limit sign will make the roads safer for schoolchildren.	1 Disagree=2 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=6 5 Agree=115	4.86	5
Normative beliefs	My relatives think it is important to create a SSZ using school zone signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=9 4 Somewhat agree=12 5 Agree=100	4.68	5
	My relatives think it is important to create a SSZ using speed limit signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=9 4 Somewhat agree=14 5 Agree=98	4.66	5
	My partner thinks it is important to create a SSZ using school zone signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=8 4 Somewhat agree=14 5 Agree=99	4.68	5
	My partner thinks it is important to create a SSZ using speed limit signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=9 4 Somewhat agree=13 5 Agree=99	4.67	5
	My friends think it is important to create a SSZ using school zone signs.	1 Disagree=1 2 Somewhat disagree=1	4.69	5

		3 Neither agree nor disagree=8 4 Somewhat agree=15 5 Agree=99		
	My friends think it is important to create a SSZ using speed limit signs.	1 Disagree=1 2 Somewhat disagree=1 3 Neither agree nor disagree=8 4 Somewhat agree=15 5 Agree=99	4.69	5
	My community thinks it is important to create a SSZ using school zone signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=8 4 Somewhat agree=15 5 Agree=98	4.67	5
	My community thinks it is important to create a SSZ using speed limit signs.	1 Disagree=1 2 Somewhat disagree=2 3 Neither agree nor disagree=8 4 Somewhat agree=15 5 Agree=98	4.67	5
PBC	I am confident I would reduce my speed when I see a school zone sign.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=0 4 Somewhat agree=4 5 Agree=120	4.97	5
	I am confident I would reduce my speed according to the installed school zone speed limit sign.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=0 4 Somewhat agree=5 5 Agree=119	4.96	5
	I am confident I would reduce my speed in a SSZ even if other motorists do not.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=0 4 Somewhat agree=3 5 Agree=121	4.98	5
	I am confident I would reduce my speed in a SSZ even when there is no traffic police officer around.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree=0 4 Somewhat agree=3	4.98	5

		5 Agree=121		
Behaviour	What speed do you normally use when you drive on the road along Ufukoni P.S?	1 >80km/h = 0 2 50-80km/h = 0 3 30-50km/h = 12 4 <30km/h = 87	4.11	4
	Did your driving behaviour change due to the presence of school zone signs on the road along Ufukoni P.S?	1 No = 28 2 Yes = 71	1.72	2
	Did your driving behaviour change due to the presence of speed limit signs on the road along Ufukoni P.S?	1 No = 28 2 Yes = 71	1.72	2
	What speed do you normally use when you drive on the roads along Kigamboni & Kivukoni P.S?	1 >80km/h = 0 2 50-80km/h = 0 3 30-50km/h = 17 4 <30km/h = 80	3.85	4
	Did your driving behaviour change due to the absence of school zone signs on the road along Kigamboni & Kivukoni P.S?	1 No = 57 2 Yes = 40	1.41	1
	Did your driving behaviour change due to the absence of speed limit signs on the road along Kigamboni & Kivukoni P.S?	1 No = 56 2 Yes = 41	1.42	1
	Do you normally reduce your speed when you see a school zone sign in a school zone?	1 No = 3 2 Yes = 94	1.97	2
	Do you normally reduce your speed when you see a speed limit sign in a school zone?	1 No = 3 2 Yes = 94	1.97	2
Behavioural intentions	Next time when I see a school zone sign in a SSZ, I would be willing to reduce my speed limit	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=2 5 Agree=121	4.96	5
	Next time when I see a speed limit sign in a SSZ, I would be willing to reduce my speed limit	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=2 5 Agree=121	4.96	5
	Next time when I see a school zone sign in a SSZ, I intend to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=2 5 Agree=121	4.96	5

Next time when I see a speed limit sign in a SSZ, I intend to reduce my speed limit	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=0 4 Somewhat agree=3 5 Agree=120	4.95	5
Next time when I see a school zone sign in a SSZ, I am likely to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=1 3 Neither agree nor disagree=1 4 Somewhat agree=4 5 Agree=118	4.93	5
Next time when I see a speed limit sign in a SSZ, I am likely to reduce my speed limit.	1 Disagree=0 2 Somewhat disagree=0 3 Neither agree nor disagree= 0 4 Somewhat agree=5 5 Agree=119	4.96	5

The means and frequencies of scores for attitude vary according to the question. Most respondents somewhat agreed when asked if the unpaved urban roads for Ufukoni, Kigamboni and Kivukoni P.S are safe for the schoolchildren who use them. However, the mean of 3.49 for the treatment site was slightly higher than for the comparison sites (mean=3.40). Respondents somewhat agreed (mean= 3.45 and 3.46, mode=4) that motorists are aware of schoolchildren's presence in the case study area, but when asked if most motorists maintain a speed limit of 30km/h, the mean dropped to 3.04 and the mode to 2. Meaning they neither agreed nor disagreed. Generally, they (91, 73.4%) agreed that a speed limit of 30km/h is safe for an area surrounding a school (mean=3.98, mode=5) and that maintaining a speed limit of 30km/h around a school area is easy (mean=3.87, mode=5). Those who agreed to the latter were 89 (71.8%). Creating an SSZ using the signs was agreed upon, with 115 (92.7%) agreeing, six (4.8%) somewhat agreeing, one (.8%) somewhat disagreeing, and only two (1.6%) disagreeing (mean=4.86, mode=5).

Normative beliefs showed that the respondents agreed that their relatives, partners, friends and the community think it is vital to create an SSZ using school zone and speed limit signs (mean=4.68, mode=5).

PBC results showed that they agreed they would reduce their speeds in situations where they see a school zone sign or a speed limit sign in an SSZ, where other motorists do not reduce their speed and when there is no traffic police officer around. The overall mean was 4.97 and a mode of 5.

Behavioural intentions show that the respondents were more willing, likely and intended to reduce their speeds the next time they saw a school zone or speed limit sign in an SSZ. The overall mean and mode were (mean=4.95, mode=5).

Behaviour shows that for those who owned vehicles, 87 for the treatment site and 80 for the comparison sites usually used a speed below 30km/h when driving on the roads alongside the primary

schools (mode=4). This corresponds to the post-intervention observed speeds shown in TABLE 8. When asked if their driving behaviour changed due to the presence of school zone and speed limit signs on the road along Ufukoni P.S? 71 (57.3%) answered yes, and 28 (22.6%) said no. On the other hand, when asked if their driving behaviour changed due to the absence of school zone and speed limit signs on the road along Kigamboni & Kivukoni P.S? 40 (32.3%) said yes, and 57 (46%) said no to the school zone sign while 41 (33.1%) said yes, and 56 (45.2%) said no for the speed limit sign. Thus, most 75.8% out of 78.2% indicated that they usually reduced their speed when they see a school zone or speed limit sign in an SSZ (Yes=94, No=3).

An open-ended question was added for the respondents in the post-intervention survey. The question was: Do you have any suggestion(s) concerning the project of creating a School Safety Zone using school zone & speed limit signs? All respondents were thankful for the intervention, but others gave suggestions, as presented in TABLE 15. The total suggestions got were 71.

TABLE 15 Suggestions concerning the intervention

N	Recorded Suggestions	No. of suggestions
1	Road safety education and awareness to be given to the schoolchildren and the community	36
2	The intervention should be implemented in other school zones by the government and/or the researcher(s)	17
3	Compliance with the signs and traffic laws by motorists to increase the road safety around the schools	5
4	Enforcement of the laws and punishment to people who break the laws in the SSZs	9
5	Enaction of new traffic laws or policies for road users, especially for schoolchildren	2
6	The government should improve the road infrastructure to increase the effectiveness of the intervention	1
7	Formation of road safety clubs	1

4.3.3 Validity and Reliability Tests

Exploratory Factor Analysis

Factor analysis is a statistical technique used to identify underlying factors measured by a (much larger) number of observed variables. These underlying factors are often variables known as confounding variables that cannot be directly measured, such as psychometric factors like IQ (Glen, 2014; Van den Berg, 2021). A Confirmatory Factor Analysis (CFA) could not be performed due to the small sample size as one of the reasons. The use of CFA could be impacted by the requirement of sufficient sample size ("Confirmatory Factor Analysis," 2021; Myers et al., 2011; Suhr, 2006), research hypothesis being tested, multivariate normality, distribution of variables, reliability of indictors and so on (Myers et al., 2011; Suhr, 2006). An exploratory factor analysis was done instead to identify the specific questions that do not measure the TPB constructs.

The exploratory factor analysis employed a Principal Components Analysis (PCA) with varimax (variation maximisation) rotation. The analysis identified groups of highly intercorrelated variables and their underlying factors. The tests selected for the correlation matrix analysis in SPSS were Kaiser-

Meyer-Olkin (KMO) and Bartlett's test of sphericity. At the same time, the extraction was done based on the Eigenvalues more significant than 1. An Eigenvalue is a quality score, and only components with high Eigenvalues are likely to represent a real underlying factor. The coefficient display format was sorted by size with the absolute value below the .40 set. Variables with communalities below .40 were removed because they do not measure the underlying factors or constructs (Van den Berg, 2021).

Five underlying factors (attitude, normative beliefs, PBC, behavioural intentions and behaviour) were identified. All communalities, except one in the pre-intervention survey, were higher than .40 for all items in both surveys. The item removed was “The community needs more awareness of road safety issues”, whose value was .334. Therefore, it was the only item that did not contribute much to measuring attitude.

TABLE 16 TPB items before and after PCA

	PRE-INTERVENTION SURVEY		**POST-INTERVENTION SURVEY**	
TPB Constructs	Number of items before validation	Number of items after validation	Number of items before validation	Number of items after validation
Attitude	8	7	10	10
Normative beliefs	8	8	8	8
PBC	4	4	4	4
Behavioural intentions	6	6	6	6
Behaviour	3	3	8	8
Total	**29**	**28**	**36**	**36**

Cronbach's Alpha

Cronbach's α was calculated to test reliability. It is the most common measure of internal consistency or reliability. It is used to test the reliability of multiple-question Likert scale surveys where it determines how closely related a set of test items are as a group (Glen, 2021a; Tavakol & Dennick, 2011). Tavakol & Dennick (2011) explained internal consistency as the extent to which all the items in a test measure the same concept or construct. Hence, it is connected to the inter-relatedness of the items within the test. Internal consistency should be determined before a test can be employed for research or examination purposes to ensure validity. (p.53)

The groups or TPB constructs that were identified were tested for internal consistency using Cronbach’s α. The minimum of Cronbach's α coefficient of more than 0.7 was used, which is usually acceptable according to Glen (2021a). In addition, Tavakol & Dennick (2011) mentioned the alpha range of 0.70 to 0.95 to be acceptable, according to various reports.

In the pre-intervention survey, five items from attitude were removed to increase reliability in attitude. They are: the unpaved urban roads used by the schoolchildren are safe for them, motorists are aware of schoolchildren's presence in the area, most motorists maintain a speed limit of 30km/h around the schools, creating an SSZ using a school zone sign will make the roads safer for the schoolchildren and creating an SSZ using a speed limit sign will make the roads safer for the schoolchildren. And one item,

"What speed do you normally use when you drive on the roads along the primary schools?" for behaviour, was removed.

All items for attitude, normative beliefs, PBC, and behavioural intentions were retained in the post-intervention survey. Whereas, behaviour had two items that reduced its Cronbach's α and had to be removed. These were "What speed do you normally use when you drive on the road along Ufukoni P.S?" and "What speed do you normally use when you drive on the roads along Kigamboni and Kivukoni P.S?"

TABLE 17 Cronbach's Alpha

	Pre-intervention Survey				**Post-intervention Survey**			
	Before		**After**		**Before**		**After**	
TPB Concepts	No. of items	Cronbach's α	No. of items	Cronbach's α	No. of items	Cronbach's α	No. of items	Cronbach's α
Attitude	7	.548	2	.848	10	.839	10	.839
Normative beliefs	8	.932	8	.932	8	.994	8	.994
PBC	4	.994	4	.994	4	.955	4	.955
Intentions	6	.994	6	.994	6	.966	6	.966
Behaviour	3	-.068	2	.995	8	.649	6	.721

4.3.4 Means of Factor Scores

Factor scores are often used as predictors in regression analysis (Van den Berg, 2021). The scores were computed as means over variables measuring similar underlying factors (TPB constructs). For example, the mean for all items measuring the underlying factor attitude was calculated, and the output variable was named attitude. It was done for all the items, and they were grouped into the TPB constructs, i.e. attitude, normative beliefs, PBC, behavioural intentions and behaviour.

4.3.5 Spearman Rank Correlation

Correlation is a bivariate analysis that measures the strength of association (± 1 indicates a perfect degree of association whereas a value towards 0 indicates a weaker association) between two variables and the direction of the relationship indicated by the sign of the coefficient ("Correlation," 2021). A Spearman rank correlation is a non-parametric correlation test. It is appropriate when analysing ordinal or continuous variables with a monotonic relationship, measured on at least an ordinal scale (Glen, 2021b; Field, 2009; *Spearman's Rank Order Correlation Using SPSS Statistics*, 2018). The test is used for ordinal or continuous variables that have failed the assumptions necessary for conducting Pearson's product-moment correlation (Field, 2009; *Spearman's Rank Order Correlation Using SPSS Statistics*, 2018).

The effect size or strength of the relationship/association can be determined using Cohen's standard, where correlation coefficients 0.10 - 0.29 represent a small association, 0.30 - 0.49 represent a medium association, above 0.50 represent a large association ("Correlation," 2021). In addition, Spearman's correlation was carried out to analyse the strength and direction of a monotonic

relationship between the TPB constructs. The results are shown in TABLES 18 and 19 for the pre and post-intervention surveys.

TABLE 18 Pre-intervention survey Spearman's correlation matrix

TPB Constructs	1	2	3	4	5
1 Attitude					
2 Normative_beliefs	.070				
3 Perceived behavioural control	.151	**.336****			
4 Behavioural intentions	.145	.110	**.597****		
5 Behaviour	-.130	.079	**.306****	**.322****	

Bold entries stand for statistically significant results
** Correlation is significant at the 0.01 level (2-tailed).

Spearman's rho is an example of a bivariate correlation coefficient representing a correlation between two variables (Field, 2009). The results above show that small, medium and large positive associations exist between different constructs. As stated in the previous paragraph, all Spearman's rho coefficients (r_s) less than 0.3 represent weak associations or relationships. The closer r_s is zero, the weaker the association between the ranks (*Spearman's Rank-Order Correlation*, 2018). A strong relationship was found between PBC and behavioural intentions. The other relationships were found to have a medium effect size or strength. These were those between normative beliefs and PBC, PBC and behaviour and behavioural intentions and behaviour. All relationships which were not very weak were found to be significant: a medium positive correlation between normative beliefs and perceived behavioural control ($r_s = .34$, $p < 0.01$), perceived behavioural control and behaviour ($r_s = .31$, $p < 0.01$), and between behavioural intentions and behaviour ($r_s = .32$, $p < 0.01$). One large positive correlation between behavioural intentions and perceived behavioural control ($r_s = .60$, $p < 0.01$).

A negative correlation means that as one variable increases, the other decreases (Field, 2009). For example, there was a negative relationship between attitude and behaviour, which meant that as attitude increased, the behaviour decreased. This may seem contrary, but it must be noted that some questions under attitude, although structured positively like all other questions in the survey, a negative answer with a low score like 1 for disagree was most appropriate. For example, the first question of attitude asking if the unpaved roads along the schools were safe for the schoolchildren using them? Disagreeing with this statement meant that the current road conditions are neither good nor safe for the schoolchildren who are then placed at more risk of suffering RTI or getting involved in a road crash, which was correct. The positive associations indicate that as one variable increases, the other also increases. Taking, for example, the significant positive associations, as normative beliefs increased, the PBC also increased. As PBC increased, the intentions and behaviour also increased respectively in their associations. And lastly, as intentions increased, the behaviour also increased.

TABLE 19 Post-intervention survey Spearman's correlation matrix

TPB Constructs	1	2	3	4	5
1 Attitude					
2 Normative_beliefs	.148				
3 Perceived behavioural control	-.078	-.105			
4 Behavioural_intentions	-.026	**.183***	-.046		
5 Behaviour	.110	.076	.053	-.048	

Bold entries stand for statistically significant results
* Correlation is significant at the 0.05 level (2-tailed).

The results above show that small positive and negative associations exist between the constructs. However, these relationships were not significant except for one. There was a small positive association between normative beliefs and behavioural intentions (r_s = .18, p < 0.05). This indicates that as normative beliefs increased, behavioural intentions increased. However, the association between the two variables, although significant, was very weak.

4.3.6 Ordinal Logistic Regression

Regression analysis is a way to find trends in data that help make predictions by using a set of data (Glen, 2021c). It is used to search for significant relationships between two variables or to predict a value of one variable for a given value of the other (Marquier, 2019). Logistic regression is a type of multiple regression with a categorical or ordinal outcome (dependent) variable and predictor variables (independent or explanatory) that are continuous or categorical (Field, 2009; Marquier, 2019). Ordinal logistic regression (often called ordinal regression) predicts an ordinal dependent variable given one or more independent variables. It can also use interactions between independent variables to predict the dependent variable (*Ordinal Regression Using SPSS Statistics*, 2018). It is for the above reasons that an ordinal regression was performed in this study. The ordinal regression helped determine the statistically significant effect of attitude, normative beliefs, perceived behavioural control on behavioural intentions and behaviour.

There are three types of well-known logistic regression models used to analyse the ordinal response variable, which are the proportional odds (PO) model, the continuation ratio (CR) model, and the adjacent categories (AC) logistic regression model. PO is the most commonly used, and it assumes that the logit coefficients for each predictor are the same across the ordinal categories. This is called the parallel lines or the PO assumption (Liu, 2014). The odds ratio indicates the change in odds resulting from a unit change in the predictor (Field, 2009). In logistic regression, it represents the constant effect of a predictor X on the likelihood that one outcome will occur (often, a remarkable impact of each X on Y is measured in regression models) (Grace-Martin, 2012). However, the PO assumption is often violated. The partial proportional odds (PPO) model or the generalised ordinal logit model can be used to deal with this (Liu, 2014).

This study's type of ordinal regression was the PLUM (Polytomous Universal Logit Model) procedure. PLUM is SPSS Statistics' dedicated ordinal regression procedure. Although, it has a drawback of not producing odds ratios and their 95% confidence intervals (*Ordinal Regression Using*

SPSS Statistics, 2018). To overcome this, as some of the models did not satisfy the PO assumption, e.g. $p < .035$ for behavioural intentions in the pre-intervention survey, generalised ordinal regression was carried out to produce generalised ordinal logistic models of the odds ratios and their 95% confidence intervals. Statistical significance of results of the test of parallel lines indicates that the P.O assumption is not satisfied (Crowson, 2019). Two ordinal regression analyses were performed to predict behavioural intentions and self-reported behaviour for each survey.

Pre-intervention Survey

TABLE 20 summarises the analysis results with behavioural intentions as the dependent variable and the TPB-predictors, attitude, normative beliefs and PBC as the independent variables. Finally, TABLE 21 summarises the analysis results with behaviour as the dependent variable and the four TPB-constructs (attitude, normative beliefs, perceived behavioural control and intentions) as the independent variables or predictors.

The Model Fitting information for both analyses gave statistically significant chi-square statistics; [$\chi^2(3)=41.024$, $p<.001$] for behavioural intentions and [$\chi^2(5)=21.252$, $p<.001$] for behaviour. This shows that the Final model gives a significant improvement in fit over the baseline Intercept only model (Crowson, 2019). "The p-value of less than 0.001 shows that the model is an outstanding finding on how well does the model fits the data" (Marquier, 2019, p. 3). The Pearson chi-square test was significant for both intentions [$\chi^2(265)=842.953$, $p=.000$] and behaviour [$\chi^2(211)=276.110$, $p=.002$]. In contrast to the Deviance test [$\chi^2(265)=109.859$, $p=1.000$] for intentions and [$\chi^2(211)=152.973$, $p=.999$] for behaviour was non-significant. Non-significant test results for the Goodness-of-Fit model presented by the Pearson and Deviance tests are indicators that the model fits the data well (Crowson, 2019). Hence the Deviance test results suggest a good model fit to the data.

The two Parameter Estimate tables present the regression coefficients, standard errors, the Wald test and associated p-values (Sig.), Exp(B), which are the odds ratios and their 95% confidence interval for each of the independent variables in the models. The regression coefficients are interpreted as the predicted change in log odds of being in a higher (as opposed to a lower) group/category on the dependent variable (controlling for the remaining independent variables) per unit increase on the independent variable (Crowson, 2019, slide 10). The Wald statistic is the square of the ratio of the coefficient to its standard error. The significance of the Wald statistic indicates the importance of the predictor variables in the model, and high values of the Wald statistic shows that the corresponding predictor variable is significant (Reddy & Alemayehu, 2015). The odds ratios reflect the multiplicative change in the odds of being in a higher category on the dependent variable for every one-unit increase on the independent variable, holding the remaining independent variables constant. An odds ratio > 1 suggests an increased probability of being higher on the dependent variable as values on an independent variable increase. A ratio < 1 suggests a decreasing probability with increasing values on an independent variable. "An odds ratio = 1 suggests no predicted change in the likelihood of being in a higher category as values on an independent variable increase" (Crowson, 2019, slide 26).

FIGURE 34 summarises the results of the prediction of behavioural intentions and behaviour in the pre-intervention survey.

TABLE 20 Parameter Estimates of Ordinal Logistic Regression for Behavioural Intentions

Parameter	B	Std. Error	Hypothesis Test				95% Wald Confidence Interval for Exp(B)	
			Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
Attitude	.182	.7873	.053	1	.817	1.199	.256	5.611
Normative beliefs	-.505	.4424	1.304	1	.254	.603	.254	1.436
PBC	2.069	.3901	28.143	1	.000	7.921	3.687	17.015

Attitude was not a significant predictor in the model. The regression coefficient indicates a predicted increase of .182 in the log odds of a person being in a higher level of the behavioural intentions (dependent variable) for every one-unit increase on attitude. The odds ratio indicates that the odds of being in a higher category on behavioural intentions increases by a factor of 1.199 for every one-unit increase in attitude. This suggests that as attitude increases, the likelihood of having higher behavioural intentions also increases, but it did not predict intentions since it was not significant.

Normative beliefs was not a significant predictor for behavioural intentions. There is a predicted decrease of .505 in the log odds of being in a higher level of intentions for every one-unit increase on normative beliefs. The odds ratio indicates that the odds of being in a higher category on Intentions increases by a factor of .603 for every one-unit increase on normative belief. Given that the odds ratio is < 1, there is a decreasing probability of being higher on the intentions variable as scores increase on normative beliefs. This indicates that as normative beliefs increase, the likelihood of having higher behavioural intentions decreases. The normative beliefs did not predict intentions because it was not a significant predictor in the model.

PBC was a significant positive predictor of behavioural intentions. There is a predicted increase of 2.069 in the log odds of a person being in a higher level of the dependent variable for every one-unit increase on PBC. The odds ratio shows that the odds of being in a higher category on intentions increases by a factor of 7.921 for every one-unit increase on PBC. This indicates that a person scoring higher on PBC is more likely to suggest more behavioural intentions and PBC predicted intentions.

TABLE 21 Parameter Estimates of Ordinal Logistic Regression for Behaviour

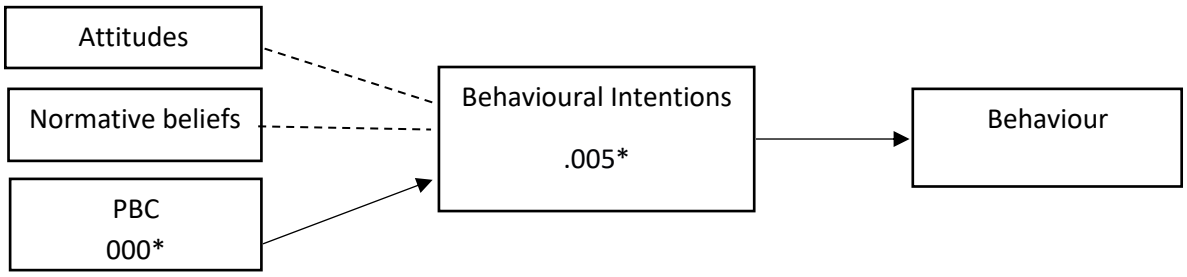
Parameter	B	Std. Error	Hypothesis Test				95% Wald Confidence Interval for Exp(B)	
			Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
Attitude	.291	.7195	.164	1	.686	1.338	.327	5.481
Normative beliefs	.023	.3107	.005	1	.941	1.023	.557	1.881
PBC	.141	.3085	.208	1	.648	1.151	.629	2.107
Intentions	1.001	.3544	7.984	1	.005	2.722	1.359	5.453

Attitude was not a significant predictor in the model. The regression coefficient indicates that for every one-unit increase in attitude, there is a predicted increase of .291 in the log odds of being in a higher level of the dependent variable. The odds ratio indicates that the odds of being in a higher category on behaviour increases by a factor of 1.338 for every one-unit increase on attitude. This indicates that a person scoring higher on attitude is more likely to display more positive behaviour. However, attitude did not predict behaviour.

Normative beliefs was not a significant predictor in the model. There is a predicted increase of .023 in the log odds of being in a higher level of the intentions for every one-unit increase on normative beliefs. The odds ratio shows that the odds of being in a higher category on behaviour increases by a factor of 1.023 for every one-unit increase on normative beliefs. This indicates that a person scoring higher on normative beliefs is more likely to display more positive behaviour; though, normative beliefs did not predict behaviour.

PBC was not a significant predictor of behaviour. For every one-unit increase on PBC, there is a predicted increase of .141 in the log odds of a person being in a higher level of the dependent variable. The odds ratio shows that the odds of being in a higher category on behaviour increases by a factor of 1.151 for every one-unit increase on PBC. This indicates that a person scoring higher on PBC is more likely to display more positive behaviour. However, PBC did not predict behaviour.

Behavioural intention was a significant positive predictor for the model. There is a predicted increase of 1.001 in the log odds of a person being in a higher level of the dependent variable for every one-unit increase on intentions. The odds ratio shows that the odds of being in a higher category on behaviour increases by a factor of 2.722 for every one-unit increase on behaviour. This indicates that a person scoring higher on Intentions is more likely to display more positive behaviour and that intentions predicted behaviour in the model.



Dotted paths are not significant
Level of significance at value p < 0.05

FIGURE 35 Pre-intervention behavioural model.

Post-intervention Survey

TABLE 22 and 23 show the parameter estimates of the independent variables (attitude, normative beliefs and PBC) for the behavioural intentions and behaviour ordinal regression models. FIGURE 35 shows the behavioural model for road user compliance with school zone and speed limit signs.

The Model Fitting information for both analyses did not give significant chi-square statistics; [$\chi^2(3)=5.620$, $p=.132$] for behavioural intentions and [$\chi^2(5)=6.186$, $p=.186$] for behaviour. This shows that the Final model did not give a significant improvement in fit over the baseline Intercept only model. And this, according to Marquier (2019), shows that the model is not an outstanding finding on how well the model fits or predicts the data. The Pearson chi-square [$\chi^2(181)=80.237$, $p=1$] and Deviance chi-square [$\chi^2(181)=34.477$, $p=1$] tests were both non-significant for both behavioural intentions and behaviour where Pearson chi-square test was [$\chi^2(206)=131.279$, $p=1$] and Deviance chi-square test was [$\chi^2(206)=105.627$, $p=1$]. The non-significant test results indicate that the models fit or predict the data well.

TABLE 22 Parameter Estimates of Ordinal Logistic Regression for Behavioural Intentions

Parameter	B	Std. Error	Hypothesis Test				95% Wald Confidence Interval for Exp(B)	
			Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
Attitude	-.580	.5162	1.263	1	.261	.560	.256	5.611
Normative beliefs	.954	.4027	5.613	1	.018	2.597	.254	1.436
PBC	-65.516	59252.9368	.000	1	.999	3.523E-29	.000	

Attitude was not a significant predictor in the model. The regression coefficient indicates a predicted decrease of .580 in the log odds of a person being in a higher level of the dependent variable for every one-unit increase on attitude. The odds ratio indicates that the odds of being in a higher category on behavioural intentions increases by a factor of .560 for every one-unit increase in attitude. Given that the odds ratio is < 1, there is a decreasing probability of being higher on the intentions variable as scores increase on attitude. This suggests that as attitude increases, the likelihood of having

higher intentions decreases, and attitude did not predict intentions because it was not a significant predictor.

Normative belief was a significant positive predictor for behavioural intentions. There is a predicted increase of .954 in the log odds of being in a higher level of intentions for every one-unit increase on normative beliefs. The odds ratio indicates that the odds of being in a higher category on intentions increases by a factor of 2.597 for every one-unit increase on normative belief. Therefore, a person scoring higher on normative beliefs is more likely to have higher behavioural intentions. The normative beliefs predicted intentions.

PBC was not a significant positive predictor of behavioural intentions. There is a predicted decrease of 65.516 in the log odds of a person being in a higher level of intentions for every one-unit increase on PBC. The odds ratio shows that the odds of being in a higher category on intentions increases by a factor of 3.523E-29 for every one-unit increase on PBC. This indicates that a person scoring higher on PBC is more likely to suggest less behavioural intentions and that PBC did not predict intentions.

TABLE 23 Parameter Estimates of Ordinal Logistic Regression for Behaviour

Parameter	B	Std. Error	Hypothesis Test			Exp(B)	95% Confidence for Exp(B)	Wald Interval
			Wald Chi-Square	df	Sig.		Lower	Upper
Attitude	.354	.2894	1.493	1	.222	1.424	.808	2.511
Normative beliefs	.282	.2758	1.042	1	.307	1.325	.772	2.276
PBC	2.155	1.1738	3.370	1	.066	8.626	.864	86.097
Intentions	-.863	.8940	.931	1	.335	.422	.073	2.434

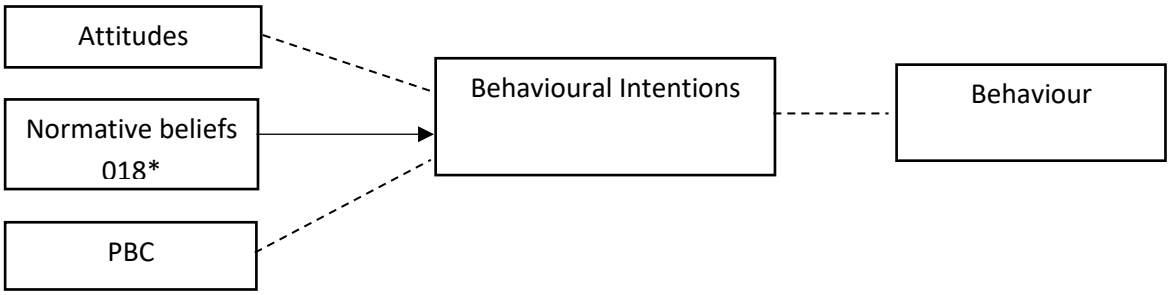
Attitude was not a significant predictor in the model. The regression coefficient indicates a predicted increase of .354 in the log odds of being in a higher level of the dependent variable for every one-unit increase in attitude. The odds ratio indicates that the odds of being in a higher category on behaviour increases by a factor of 1.424 for every one-unit increase on attitude. This indicates that a person scoring higher on attitude is more likely to display more positive behaviour. However, attitude did not predict behaviour.

Normative beliefs was not a significant predictor in the model. There is a predicted increase of .282 in the log odds of being in a higher level of the intentions for every one-unit increase on normative beliefs. The odds ratio shows that the odds of being in a higher category on behaviour increases by a factor of 1.325 for every one-unit increase on normative beliefs. This indicates that a person scoring higher on normative beliefs is more likely to display more positive behaviour; however, normative beliefs did not predict behaviour.

PBC was a non-significant positive predictor of behaviour. There is a predicted increase of 2.155 in the log odds of a person being in a higher level of the dependent variable for every one-unit

increase on PBC. The odds ratio shows that the odds of being in a higher category on intentions increases by a factor of 8.626 for every one-unit increase on PBC. This indicates that a person scoring higher on PBC is more likely to display more positive behaviour. However, PBC did not predict behaviour.

Behavioural intention was a non-significant negative predictor for the model. There is a predicted decrease of -.863 in the log odds of a person being in a higher level of behaviour for every one-unit increase on intentions. The odds ratio shows that the odds of being in a higher category on behaviour increases by a factor of .422 for every one-unit increase on behaviour. This indicates that a person scoring higher on Intentions is more likely to display less positive behaviour and that intentions did not predict behaviour in the model.



Dotted paths are not significant
Level of significance at value $p < 0.05$

FIGURE 36 Post-intervention behavioural model.

4.3.7 Mann-Whitney U test

The Mann-Whitney U test is the non-parametric version of the t-test, which gives the most accurate estimates of significance for comparisons between two independent groups when the ordinal or continuous dependent variable is not normally distributed (Field, 2009; *Mann-Whitney U Test Using SPSS Statistics*, 2018; McIntosh et al., 2010; Smalheiser, 2017). The test also assumes that each data point within a group is sampled independently from the same underlying distribution. The independent variables should consist of two categorical independent groups (*Mann-Whitney U Test Using SPSS Statistics*, 2018; Smalheiser, 2017).

The Mann-Whitney U test was performed for the three-item questions measured in two independent categories; sex, are you a parent and before today, did you ever see or hear of a School Safety Zone? These items were the independent variables measured against the four dependent variables (TPB constructs except for behaviour). Behaviour was exempted because it was measured among motorists only, and not all respondents owned vehicles. TABLE 24 and 25 show the results of this test for the pre and post-intervention surveys where the median (Md), Mann-Whitney U (U), Cohen's delta (r), Z and p values of the three items are presented. The r values above 0.1 indicate a small effect size, above 0.3 indicate a moderate effect size and above 0.5 indicate a large effect size (Cohen, 1988 as cited in Robinson, 2021).

TABLE 24 The Mann-Whitney U test - Sex

		Pre-intervention (n=124)						Post-intervention (n=124)					
	Q1 Sex	n	Md	U	Z	p-Value	r	n	Md	U	Z	p-Value	r
Attitude	1 Male	70	4.5	1788	-.544	.586	.049	85	3.8	1554	-.559	.576	.050
	2 Female	54	4.0					39	3.8				
Normative beliefs	1 Male	70	4.4	1854	-.188	.851	.017	85	5.0	1455	-1.533	.125	.138
	2 Female	54	4.3					39	5.0				
PBC	1 Male	70	5.0	1595	-2.160	.031	.194	85	5.0	1506	-2.392	.017	.215
	2 Female	54	5.0					39	5.0				
Intentions	1 Male	70	5.0	1610	-1.986	.047	.178	85	5.0	1527	-1.889	.059	.170
	2 Female	54	5.0					39	5.0				

There were no significant differences in attitude and normative beliefs between the males and females in the pre-intervention survey. But, PBC (U=1506, p=.031) and intentions (U=1610, p=.047) were significantly higher in males than females. It was the same in the post-intervention survey. All the effect sizes were small.

TABLE 25 The Mann-Whitney U test - Parents

		Pre-intervention (n=124)						Post-intervention (n=124)					
	Q4 Are you a parent?	n	Md	U	Z	p-Value	r	n	Md	U	Z	p-Value	r
Attitude	1 Yes	63	4.0	1499	-2.225	.026	.200	83	3.8	1659	-.226	.821	.020
	2 No	61	5.0					41	3.8				
Normative beliefs	1 Yes	63	4.6	1525	-2.051	.040	.184	83	5.0	1701	-.004	.997	.000
	2 No	61	4.3					41	5.0				
PBC	1 Yes	63	5.0	1858	-.465	.642	.042	83	5.0	1680	-.335	.738	.030
	2 No	61	5.0					41	5.0				

Intentions	1 Yes	63	5.0	1796	-.883	.377	.079	83	5.0	1700	-.021	.983	.002
	2 No	61	5.0					41	5.0				

In the pre-intervention survey, attitude (U=1499, p=.026) were significantly higher in non-parents than parents, whereas normative beliefs (U=1525, p=.04) were significantly higher in parents than non-parents. There were no significant differences in PBC and intentions between the parents and non-parents. In the post-intervention survey, there were no significant changes in all the four TPB constructs. All the effect sizes were small.

TABLE 26 The Mann-Whitney U test – SSZ Knowledge

		Pre-intervention (n=124)						**Post-intervention (n=124)**					
	Q14 Before today, did you ever see or hear of an SSZ?	n	Md	U	Z	p-Value	r	n	Md	U	Z	p-Value	r
Attitude	1 Yes	43	4.0	1532	-1.159	.246	.104	72	3.8	1796	-.386	.699	.035
	2 No	81	4.5					52	3.8				
Normative beliefs	1 Yes	43	4.4	1610	-.714	.475	.064	72	5.0	1686	-1.325	.185	.119
	2 No	81	4.3					52	5.0				
PBC	1 Yes	43	5.0	1579	-1.243	.214	.112	72	5.0	1866	-.089	.929	.008
	2 No	81	5.0					52	5.0				
Intentions	1 Yes	43	5.0	1558	-1.360	.174	.122	72	5.0	1778	-1.287	.198	.116
	2 No	81	5.0					52	5.0				

In both the pre and post-intervention surveys, there were no significant changes between those who answered yes and those who answered no in attitude, normative beliefs, PBC and intentions. In addition, all the effect sizes were small.

5.DISCUSSION

The discussion revolves around the results found to determine the impact of the installed school zone and speed limit signs in enhancing safer routes to school and improving the schoolchildren's road safety in the study area.

5.1 Interviews

From the semi-structured interviews conducted, much of the information got was used as input for the qualitative data presented in chapter 2 of this report. The chapter summarised the information about road safety status in Tanzania, road safety interventions for the motorists and school children and school safety zones. On discussing their challenges and successes faced as road safety practitioners in the country and the way forward or the lessons to be drawn from their experiences, the critical suggestions given were:

- Amendment of the Road Traffic Act Cap 168 R.E. 2002 of 1973 was a key factor mentioned as one of the solutions urgently needed in Tanzania to improve schoolchildren's road safety. The Traffic Act needs to be amended to meet the current road safety best practice laws and standards. This was also supported in the article written by Msuya (2018), where several stakeholders proposed this law to be amended. Likewise, children are hardly mentioned in this law. For example, there are no child helmet wearing or child restraint laws. And the improvement of other sections will also benefit the children, who are among the most vulnerable road user group.
- The political will to make road safety a priority was another. The GoT has the ultimate power to turn the tide swiftly. The advocacy, awareness, and other interventions done by the road safety practitioners will be more successful once the government agrees to direct its funds to create and support existing road safety strategies. The Director of WHO's Department of the Social Determinants of Health, Dr Etienne Krug, during the High-level panel event organized during the 6th UN Global Road Safety Week, emphasized how political will is essential in matters concerning road safety in countries (*Streets for Life*, 2021). It was similarly noted by Fell et al. (2017) in their report about the improvement of road safety in Tanzania mainland.
- The continued collaboration of the GoT through its authorities, for example, the Traffic Police, Road Agencies, Municipalities, with the road safety NGOs. This allows them to implement several interventions and provides a combined effort to improve road safety. However, the GoT needs to continue from where these NGOs have stopped by allocating funds to support the national implementation of the several road safety interventions that have proven successful in improving road safety. One good example is SARSAI which external donors like the FIA are currently funding. Superintendent Deus. W. Sokoni of the Traffic Police also stated the need for the traffic police to be given financial support by the GoT. This will increase their ability as enforcers and the main road safety stakeholder to nationalize and implement all their road safety targets and strategies. Allocation of funds by the government to set or fund road safety strategies was also advised by Fell et al. (2017)
- Road infrastructural improvements by the responsible authorities were mentioned to improve road safety for all road users in the country. And also the enhanced enforcement of the traffic laws and regulations. Fell et al. (2017) found this critical. In addition, a discussion among the high-level panellists mentioned infrastructural modifications that would also suit speed limits and law enforcement to be essential in improving road safety by countries worldwide (*Streets for Life*, 2021).

5.2 Focus Group Discussions

From the discussions, it was established that the pupils disagree that the current state of the roads near their school is safe enough for them. While the responses from parents in the survey confirmed that many children in the area walk to school. In the FGD, the average estimation was 80% of the children who walk to school, while it was 73% and 68% in the pre and post-intervention survey, respectively. This significant percentage of children are at high risk and vulnerability, as explained in the literature. And among the risks they face as pedestrians, speeding motorcycles was the leading threat, followed by careless driving and traffic violations at the zebra crossing. The literature (Eliakunda et al., 2018; Msuya, 2018; Muslim, 2020; Mutafungwa, 2021; Tanzania Police Force & National Bureau of Statistics, 2016) also confirmed human factors, notably speeding, are the leading causes of crashes in the country.

It was recommended in the discussions that the responsible government authorities and actors should solve the mentioned traffic challenges to ensure children's safety on their way to and from schools. The FGD participants agreed that creating an SSZ using school zone and speed limit signs will be a substantial intervention as one of the challenges faced is the lack of traffic signs in the area.

5.3 Speed Observations and Analysis

Ufukoni P.S (treatment site), where the school zone and speed limit signs were installed, showed a reduction of 4.12 km/h in mean speed and 5.2 km/h in 85th percentile speed, which equates to a percentage difference of 16% in mean speed and 17% in 85th percentile speed. At Kigamboni P.S, this decrease was 5.18km/h (25.7%) for mean speed and 7 km/h (25.9%) for 85^{th} percentile speed, while at Kivukoni P.S, it was 4.78km/h (19%) for mean speed and 5km/h (16%) for 85^{th} percentile speed. Travel speed research unrelated to school zones suggested that even small decreases of 1km/h mean travel speeds in 50 km/h zones would likely result in 8.23% reductions in fatalities (Transport and Main Roads, 2014). Hence, the observed speed reductions at the treatment site and comparison sites will considerably reduce the risk of suffering severe injuries or fatality by a road user in a road crash at the case study area.

85^{th} percentile speed reductions were witnessed in all vehicles, but it was highest in motorcycles for the treatment site and one comparison site. The motorcycle speed reduction was 6km/h at both the treatment and Kivukoni P.S comparison sites. It was 5km/h for the Kigamboni P.S comparison site. This is of interest because motorcycles constitute the highest traffic volume. As shown in the speed data analysis results, this road user group's speeds are highest among all motorists and were mentioned as a concern in the FGD discussions. For cars, the speed reduction change among car drivers was 2.5 km/h at Ufukoni and 1km/h at Kigamboni, which means this effect was higher by 1.5km/h at the treatment site than the Kigamboni P.S comparison site. The car speed reduction was highest (13km/h) at the Kivukoni P.S comparison site, implying that the effect change was more remarkable by 10.5km/hr and 12 km/h compared to the treatment and the Kigamboni P.S comparison sites. These 85^{th} percentile speed reductions in motorcycles show that the challenge mentioned above has been solved, especially for the treatment site. Albeit, speed reduction in all vehicle types has been observed in both the treatment and comparison sites.

However, the number of vehicle types observed at all sites varied among sites and between the pre-and post-intervention observation periods. For example, 121 motorcycles were observed at the Kigamboni P.S pre-intervention. In contrast, only 42 were observed post-intervention, and 64 and 93 motorcycles were observed at Kivukoni P.S pre-and post-intervention (refer to TABLE 9). Therefore,

this should be considered, and these changes in 85th percentile vehicle speeds among vehicle groups should not be taken as representative of the actual situation.

An increase in vehicles travelling within the 30km/h speed limit was seen in all locations, but it was highest, 17%, at the treatment site. In contrast, significant reductions in vehicles travelling above 30km/h were also seen. Vehicles travelling between 30 and 50km/h speed limit saw a percentage reduction of 67% at Ufukoni P.S, 68% at Kivukoni P.S and 100% at Kigamboni P.S routes. A 100% reduction for all vehicles that travelled before at speed above 50km/hr. Only two vehicles were observed to travel at speed above 50km/h, one at the treatment site and another at the Kivukoni P.S site. None was observed post-intervention speed observation, and therefore, the 100% speed reduction could be a coincidence. The school zone and speed limit signs were placed for the treatment site, which means that the signs effectively reduced the vehicle speeds in the area.

The Ufukoni primary school route signs may have caused the motorists to maintain the 30km/h speed limit even past the end of the Ufukoni school safety zone. And this is because both schools are located on the same road. The end of the Ufukoni P.S route marks the beginning of the Kigamboni P.S route. The pothole present on the Kigamboni P.S route resulted in low vehicle speeds on this route during pre and post-intervention observation periods.

Creating an SSZ using the school zone and speed limit signs at the Ufukoni P.S route may have induced a behavioural change among the motorists in the area. For example, it may have made them develop a habit of complying with a 30km/h speed limit when using a road inside a school zone, thus caused them to travel at reduced speeds even in the comparison sites near the treatment site. Therefore, it may be easy for motorists to maintain the 30km/h speed limit towards or after the Ufukoni SSZ. This assumed conclusion may be supported by a finding from a study by Abdul Hanan et al. (2013) about drivers' intention to comply with the speed limit in school zones in Malaysia. They found out that "drivers who had developed a habit (as conceptualised according to Verplanken & Aarts, 1999) of complying with the speed limit were more likely to intend to comply with the SZSL" (School Zone Speed Limit) (p.10).

Lastly, speeds used by motorists on unpaved roads are usually lower compared to those on paved roads. A study on unpaved and paved sites where speed calming measures and other low-cost interventions, including signs, were placed showed that pre-intervention speeds were lower on unpaved roads than paved roads (Draisin et al., 2016). Hence the unpaved road conditions may be another reason for the observed low speeds.

5.4 Questionnaires

5.4.1 Descriptive Statistics

The sample demographics depicted that the area population consists of many youths or young adults (18-39). The high number of respondents was between 21-30 years and 31-40 years of age, and a minimal number was above 51 years of age. In the 2012 census, the number was highest in the 15-65 age group. The Municipal needs to start engaging more in road safety strategies for its people as currently, RTI are the number one killer for children and young adults between 5-29 years (WHO, 2018).

Most children travelled a distance between 0-500m to school followed by 500m-1km, and very few travelled more than 1.5km to school. Therefore, it is no surprise that it was found that most

children walk to and from school. Since pedestrians are the most vulnerable road user group in Tanzania and Africa, the intervention to be implemented in the area was thought of with this in mind.

Before the intervention, the results showed that most people agreed that the roads alongside the three schools are not safe routes for the schoolchildren. However, post-intervention, the opinion changed. The number of people who somewhat agreed and agreed for the routes to be safer increased at a significant rate of 68.3% for the treatment site and 66.7% for the comparison sites indicating that the presence of the school zone and speed limit signs at the treatment site contributed to changing this opinion significantly. Post-intervention, fewer people disagreed to finding the speed limit of 30km/h to be a safe speed and one easy to maintain in a school zone and the number of those who agreed dropped. Yet, the speed observation results showed that many people are maintaining this speed limit. Why do some people think it is not easy to maintain this speed limit or that the speed limit is not safe enough? This could be an area of research for future studies. Fleiter & Watson (2005) called this mismatch between speed beliefs and behaviours the speed paradox. Tapp et al. (2015) referred to it as the attitude-behaviour incongruity. They gave an example of a survey that found 91% of participants agreed that people should drive within the speed limit, but the obtained free-flow figures showed 47% of the cars had exceeded the 30mph speed limits. In this research's context, I believe that low road safety awareness in this community contributes to this discrepancy. It was also among the recommendations suggested by the respondents during the post-intervention survey. Therefore, road safety actors have an opportunity to carry out research to gain an understanding of underlying contributing factors to speeding, as advised by Fleiter & Watson (2005). And can develop road awareness campaigns targeted at road safety and compliance to traffic laws (Eliakunda et al., 2018; Fell et al., 2017; Tapp et al., 2015).

Attitude towards creating an SSZ using school zone and speed limit signs to improve schoolchildren road safety remained high in pre-and post-survey. The number of people who had never heard of an SSZ decreased from 65.3% to 58.1 % post-intervention. The change was by 7.2%, nearly five months after the installation of the signs. Maybe more time is needed for the lesson to be learnt before making conclusive remarks on if this minor effect is significant or not. But, as noted above, if road safety awareness is to be done in the study area on SSZs and schoolchildren road safety, a more conclusive significant change may be found. The group comparison in the Mann-Whitney U test also showed no significant differences in the TPB concepts between the group of people who answered no and those who answered yes to the knowledge of an SSZ in the pre and post-surveys. These statistics further prove the need for road safety awareness in the area.

The mean of normative beliefs, PBC, behavioural intentions and behaviour all increased post-intervention, indicating that the people in the study area have been receptive to the intervention. Not only did the respondents believe it to be a good measure towards making routes to school safer for the children in the area, but they showed intentions to comply with the traffic signs in the designated SSZ and the other two school zones without the intervention. In contrast, the mean of attitude did not increase but instead dropped post-intervention. This decrease has previously been explained. For example, as noted in section 4.3.5 paragraph 4, some statements required a negative sentiment (disagree or somewhat disagree) as a correct answer. Since these statements were mainly answered with the lower scores of 1 and 2 denoting disagree or somewhat disagree, this contributed to lowering the overall attitude mean. This will be remarked as a limitation.

The last question of the post-intervention survey asking for the respondent's suggestion to the study regarding the implemented intervention, road safety awareness, and education to the whole community, including the schools, was the most suggested recommendation. This further proves the assumption of a need for road safety awareness made earlier. Eliakunda et al. (2018), in their study, found out that voluntary compliance of traffic laws and regulations in Tanzania is inadequate and that more awareness programs need to be done to rectify this among vehicle owners and drivers. They also advised for increased enforcement of traffic laws and regulations. Fell et al. (2017) referred to the use of awareness campaigns and long-life education in schools and drivers and other road users to change their behaviour and enforcement. Tapp et al. (2015) listed some challenges in supporting and compliance with speed limits in their study. Among them was awareness and appreciation of the benefits of low speeds and the contested risks posed by speeding. The other recommendations were the implementation of the intervention in other school zones, especially by the government and enforcement, to ensure compliance with the traffic signs.

5.4.2 Validity and Reliability Tests

The validity and reliability tests showed that one item from attitude was not valid for the exploratory factor analysis in the pre-intervention. This item was; The community needs more awareness of road safety issues. The statement does not measure attitude, but instead, it wanted to test a speculated theory from the onset that the community of the study area had inadequate road safety awareness. Hence this statement was not included in the post-intervention survey. The post-intervention survey had all former questions except for this item found invalid and other added questions to account for the implemented intervention. All questions for post-intervention were found to be valid.

The Cronbach's α, on the other hand, during the pre-intervention survey was low for attitude, and some items had to be removed to raise it. These items, as earlier mentioned, were: the unpaved urban roads used by the schoolchildren are safe for them, motorists are aware of schoolchildren's presence in the area, most motorists maintain a speed limit of 30km/h around the schools, creating an SSZ using a school zone sign will make the roads safer for the schoolchildren and creating an SSZ using a speed limit sign will make the roads safer for the schoolchildren. However, in the post-intervention study, all these items were reliable in measuring attitude as the alpha was high.

Tavakol & Dennick (2011) pointed out that the number of test items, item inter-relatedness and dimensionality can affect the value of Cronbach's alpha, i.e. a low number of items, poor inter-relatedness between items, or heterogeneous constructs can lower the alpha value. In this study, more items were added in the post-intervention survey under attitude and behaviour constructs. This was done to account for the difference between the presence and absence of the intervention. These added items made the questions more reliable, and no item was deleted for attitude. Hence the fewer number of items in attitude pre-intervention may have been the cause of the low alpha. On the other hand, a poor inter-relatedness may have existed between these items at pre-intervention as the difference in presence or absence of the intervention was not included. At pre-intervention, a decision was yet to be made which site will act as the treatment site to receive the intervention and which will act as the comparison site that will not receive the intervention.

Another TPB construct, behaviour, had a low Cronbach's α in both the pre-and post-intervention studies. Unlike attitude, the same item lowered the alpha in behaviour and was removed to raise it. The items were "What speed do you normally use when you drive in the roads along with the primary schools?" in the pre-intervention survey. "What speed do you normally use when you drive

on the road along Ufukoni P.S?" and "What speed do you normally use when you drive on the roads along Kigamboni and Kivukoni P.S?" in the post-intervention survey. From the explanations given by Tavakol & Dennick (2011), it can be concluded that the reason these items lowered the alpha was that they had a poor inter-relatedness with the other items measuring the construct and had to be removed.

5.4.3 Spearman Rank Correlation

Spearman's correlation analysis revealed that at pre-intervention, the significant positive associations, which were moderate, existed between behavioural intentions and behaviour and between PBC and normative beliefs or behaviour. A strong positive association existed between PBC and Behavioural intentions. These results mean that as one variable increased, the other also increased. So a person having high normative beliefs pre-intervention had also high PBC. At the same time, a person having high PBC also had high behavioural intentions and behaviour. And a person having high intentions also had high ranks in behaviour. PBC was the only variable with significant moderate to strong relationships with the other three variables: normative beliefs, intentions and behaviour. Its strong relationship with intentions explains why it was a predictor for intentions in the pre-intervention regression model.

On the other hand, normative beliefs and attitude did not have any significant relationships with intentions or behaviour; hence they did not predict the two dependent variables in the regression model. However, the moderate positive association between intentions and behaviour implied that the higher the intentions, the higher the behaviour of compliance to the school zone and speed limit signs made intentions a predictor of behaviour in the pre-intervention regression model. Post-intervention, the results of Spearman's rho indicated that only normative beliefs had a significant association with intentions. Hence in the post-intervention regression model, only normative beliefs predicted intentions.

All other relationships between variables in the post-intervention survey were weak and non-significant. This means that based upon the used sample, there is no evidence to suggest that a monotonic correlation is present in the population (*Spearman's Correlation*, n.d.), which in this case it is the relationship between the independent variables; attitude and PBC with the dependent variables; intentions and behaviour. However, a comparison to explain this difference in Spearman's correlation between the samples in the pre-and post-intervention studies cannot be made because two different samples were used. Thus the two groups and results are independent of each other as independent groups or samples were used.

5.4.4 Ordinal Logistic Regression

The regression analysis showed that pre-intervention, only PBC had a significant effect on behavioural intentions, which predicted the people's behaviour. Both attitude and normative beliefs had no significant effects and were not predictors in the model. Normative beliefs were the only significant predictors of intention post-intervention, but the intentions did not predict behaviour. It is to be noted that two different samples were used in this study. The participants approached at pre-intervention were different from the participants approached post-intervention, with the only constant being the number of participants. Thus, the observed variation in the regression analysis may be due to this fact. When combined, the predictors for the behavioural model of compliance to school zone and speed limit signs were normative beliefs and PBC for behavioural intentions and intentions for behaviour.

Previous researches studying driver's intentions with the use of TPB found similar results. Abdul Hanan and colleagues (2013), in analysing the driver's intention to comply with the speed limits in school zones, also found out that normative beliefs and perceived behavioural control significantly predicted the driver's intention to comply. Another study by Atombo et al. (2016) demonstrated that TPB constructs made significant contributions in predicting drivers' intentions to speeding and overtaking. Subjective norms or normative beliefs and PCB were among the TPB variables found to relate positively to intention and behaviour regarding ensuring drivers' compliance with road traffic regulations (Poulter et al., 2008).

Attitude was not a significant predictor of behaviour. This is not in line with other studies that found it to be a significant predictor (Abdul Hanan et al., 2012; Atombo et al., 2016; Poulter et al., Tapp et al., 2015). According to the Psychology Professor Francis McAndrew of Knox College, hundreds of studies done over time have found out that attitudes are strong predictors of behaviour when: they are strong or stable, the time between attitude assessment and behaviour is short, measured attitude is specific, they are accessible, the individual is high in private self-awareness, the measured attitude is salient, and it is better at predicting patterns of behaviour over time than for a single predicting situation (McAndrew, 2020). Regarding attitude not being a predictor in this study, the result may be explained in two ways: the first is that the mean of attitude was lowest compared to the other TPB constructs and dropped post-intervention as elaborated in section 5.4.1. The second reason may be the correlation for attitude being less significant and very weak, thus having a negligible effect on the other TPB constructs at both pre-and post-intervention surveys.

5.4.5 Mann-Whitney U Test

The differences in the TPB constructs between groups showed that, for gender, males had higher PBC and intentions than females. This could be because more males than females participated in the survey, and most motorists were males. Since a motorist than a non-motorist could easily relate to the PCB and intentions, they can be higher in the motorists (primarily men) than non-motorists (primarily women). Attitude pre-intervention were lower in parents than those who were not parents, and this could be because of the deep concern of safety for their children in the school routes. Post-intervention saw a reduction of the concerns as there was an increase in the ranking of the socio-cognitive constructs. The normative beliefs pre-intervention were higher in parents than non-parents because the parents most likely believe that the people close to them, e.g. partners, relatives or community, would want the same thing for their children like them. And that is for the children to travel safely to and from school. Abdul Hanan et al. (2013) came to a similar conclusion in their study where drivers who believed that people important to them would approve of their behaviour were more likely to intend to comply with the speed limit in school zones. But in all these comparisons, the Cohen's delta was less than 0.2, meaning the effect sizes were small. This also means that the differences, even if statistically significant, are negligible (McLeod, 2019).

6. RECOMMENDATIONS, LIMITATIONS AND FUTURE RESEARCH

6.1 Recommendations

The 2020 Stockholm Declaration calls for governments worldwide to focus on setting up maximum speed limits of 30km/h (20mph) on streets where vulnerable road users mix with traffic to make them liveable, healthy and green. Furthermore, on the open letter under the street for life #Love30 campaign, low speeds have been highlighted as essential and urgent because they save lives. For example, a child hit by a car at 30km/h can survive but will most likely die when struck at a speed of 80km/h (*People Are Signing up to Streets for Life!*, 2021). Hence the Tanzanian government should consider setting up SSZs using school zone and speed limit signs for all schools, especially those close to urban, rural and regional roads. The respondents, among their recommendations, also suggested that the school zone and speed limit signs be installed for the other two schools in the area and other schools elsewhere.

Infrastructural changes to provide for safer NMT facilities should go hand in hand with the signs in creating the SSZ. The SARSAI project by Amend, as elaborated in chapter 2, has proved this to be the most effective way of reducing child RTI. At the same time, poor road conditions in the school zones have been identified as a setback in ensuring safer routes to schools.

It has been established that there is a need for more community road safety awareness in the study area. In the pre-intervention survey, all the respondents agreed that road safety awareness for the community was critical, whilst in the post-intervention survey, it was the most suggested recommendation given by the respondents. It was also mentioned among the solutions in the FGDs.

Future road safety interventions concerning the compliance of school zone and speed limit signs such as the educational or awareness campaigns may be most successful if they focus on an individual's normative beliefs, perceived behavioural control and intentions as implied by the results. Abdul Hanan and colleagues (2013) advised using strategies that reinforce the positive consequences of compliance, increasing the perception that a range of referents would approve of this behaviour while emphasizing the ease of performing this behaviour. Few studies have applied the TPB to develop and evaluate interventions despite its usefulness and potential in developing behaviour change interventions (Hardeman et al., 2002). The following TPB road safety based interventions were proved to have potential in changing behaviour by targeting attitudes, subjective norms (normative beliefs), PBC and intentions:

- Tapp et al. (2015) mentioned that social marketing designs had made a modest contribution to considerable intervention literature on driver behaviour. Stead et al. (2005) analysed a 3-year mass media Scottish Road Safety Campaign in 1998 called the Foolsspeed campaign intending to reduce speeding on Scotland's roads and shaped by TPB's three main predictors: Attitude, Subjective Norms and Perceived Behavioural Control. The advertising effectively triggered desired communications outcomes and was associated with significant changes in attitudes and other determinants of intentions and behaviour. The study demonstrated that it is possible to design consumer- and theory-based road safety advertising campaigns. And that lowkey empathetic and credible road safety advertising or highly emotional graphic depictions of accidents can work out.
- Quine et al. (2001) carried out an intervention that analysed the immediate and long-term effects of a TPB based intervention on beliefs, intentions, and behaviour. The intervention used persuasive messages on the identified salient beliefs to encourage protective helmets in school-age cyclists. The results showed a significant effect on behaviour. Furthermore, the behavioural, normative

and control beliefs and intentions of intervention participants became more favourable than those of control participants, with the effect maintained over time.

- Educational programs or interventions to change a particular behaviour according to identified TPB predictors (Evans & Norman, 2003; Sheehan et al., 1996)

There is a necessity for more political will from the GoT in matters concerning road safety as this will prompt more action to be taken by the government in the area. It was also noted as one of the suggestions from the interviewees in the semi-structured interviews. Fell et al. (2017) and the High-level Panel during the "Streets for life: Saving lives on the road through safe speeds" event organized by World Bank's Global Road Safety Facility (*Streets for Life*, 2021) identified it as a crucial element in improving a country's road safety.

Continued collaboration of the government with the road safety practitioners in the country was recognized as vital in improving road safety in Tanzania. However, this collaboration should also exist between and among road safety NGOs in the country. Having a solid coalition of these organisations will increase their strength in convincing the policymakers and the citizens in matters concerning road safety.

6.2 Limitations

Initially, a social media campaign to raise road safety awareness via WhatsApp was planned to be used and studied as another intervention in this research. However, most participants were unwilling to give out their numbers leading to the elimination of this option. Furthermore, many people were not willing to participate in the survey when approached. The respondents needed the conviction, which contributed to the small sample size and led to more fieldwork time for the survey data collection process. It is not uncommon for people in Tanzanian communities to not be willing to participate in questionnaire surveys. The inadequate knowledge of the importance of research and the lack of familiarity with research studies of the sort could be one reason.

Parametric tests were noted to be used in many research studies because they are more robust than non-parametric tests. But, they could not be performed due to their assumptions not being met.

The pre-intervention surveys participants could not be matched for the post-intervention survey. These participants were chosen at random in the pre-intervention study mostly because it was hard to convince some of them to participate. Therefore the pre-intervention study participants could not be traced for the post-intervention survey. Another reason for this is that one of the interviewers who participated in the pre-intervention survey was unavailable for the post-intervention survey period and was replaced.

The items measuring attitudes faced the limitation of being phrased differently. A few questions required an answer to be a lower score and others a higher score. This should be avoided. The mistake was realized later on in the research after the mean of attitude reduced, and its correlations were negative and weak.

The poor road conditions were another limitation. The roads are unpaved with no drainages and an enormous pothole on the route alongside Kigamboni P.S. This factor caused a confounding effect on the speed observations, especially for the Kigamboni route.

There is limited research on road safety in Tanzania, as mentioned among the road safety challenges of the country. As a result, some of the references used to state the research's problem statement were more than a decade ago. But even if the studies were done that long ago, some of the identified problems in the studies, e.g. schools being located close to major urban and trunk roads and schoolchildren being at high risk of suffering RTI, still exist hence the justification of this study.

6.3 Future Studies

The socio-cognitive constructs predicting intentions to comply with the school zone and speed limit signs were normative beliefs, and PBC and intentions predicted behaviour. Therefore to maintain or increase compliance to the installed school zone and speed limit signs, future studies or behavioural interventions should aim at interventions that will increase normative beliefs and PBC of the target group. These will, in turn, increase behavioural intentions and the needed positive behaviour. For example, mass-media campaign or advertisements targeting the TPB constructs (Stead et al., 2005; Transport Accident Commission Victoria, 2009; Transport Accident Commission Victoria, 2020). Road safety awareness educational based interventions (Evans & Norman, 2003; Sheehan et al., 1996). Use persuasive messages on the identified salient beliefs to change health behaviours (Quine et al., 2001).

Tapp et al. (2015) mentioned an incongruence between attitudes to speeding (general disapproval) and behaviour (general speeding) to be a bottom line of factors affecting lack of compliance to 30km/h speed limits. Other studies like Poulter et al. (2008) aimed at self-reported driving behaviour and Abdul Hanan et al. (2013) aimed at intentions and compliance to speed limit signs in a school zone have shown that attitude, normative beliefs and perceived behavioural control significantly predict intentions or behaviour. In this study, attitude was not a significant predictor in the behavioural model. There is a chance for a study focusing on driver's attitudes towards compliance with traffic signs or regulations to be done.

Studies looking to use a similar aim or focus area should consider using the same interviewers and sample population at pre and post-intervention to avoid some of the study limitations mentioned earlier. And also, great care must be taken in structuring the questions to avoid questions requiring a different score to be mixed in a given construct while also avoiding poor item inter-relatedness.

It was noted that the unpaved road condition might have had an impact on the observed operating speeds. Therefore future studies can focus on carrying out a similar study on schools alongside a paved road to evaluate the impact of these signs in making routes to school safer.

Interventions based on implementing zebra crossings on roads opposite or near schools and the drivers' intentions to respect the zebra crossings can be another focus area for studies.

7. CONCLUSIONS

This study shows that the intervention was positively received by the community in the case study area and was considered effective in making school routes safer and improving school children's road safety.

There was an increase post-intervention in the mean of normative beliefs, PBC, intentions and behaviour but a decrease in the mean of attitude. PBC and normative beliefs were the predictors of intentions, and intentions predicted behaviour to comply with the school zone and speed limit signs. A minimal difference in frequencies, mean, and mode results for the answered items of the TPB constructs between the school zone and speed limit signs can be seen in the results. Speed limit signs seemed to carry more weight to enhance safer routes to schools than school zone signs among the respondents. This variance is no surprise since most people have never seen or heard of a school zone sign. School zone signs are very few in the city and the country, whereas speed limit signs are common and known to almost everyone. Hence it is easier for them to be more compliant to a sign they are familiar with than a sign they are not. Overall, attitude did not predict intentions, but normative beliefs and perceived behavioural control did. Thus, respondents who expressed firmer beliefs that significant others would want them to comply and more confidence in control of their speed were more likely to report an intention to comply with the school zone and speed limit signs. The intentions subsequently imparted the behaviour of compliance with the installed signs.

The speed analysis found that the signs were associated with speed reductions in mean speed of 4.12 km/h (16%) and 85^{th} percentile speed of 5.2 km/h (17%) at the treatment site. Also, speed reductions were observed at the comparison sites. A 5.18km/h (25.7%) speed reduction for mean speed and 7 km/h (25.9%) for 85^{th} percentile speed at the Kigamboni P.S comparison site. And 4.78km/h (19%) speed reduction for mean speed and 5km/h (16%) for 85^{th} percentile speed at the Kivukoni P.S comparison site. Hence the school zone and speed limit signs were particularly beneficial in reducing higher speeds at the case study area.

Most vehicles travelled within the posted speed limit at the treatment site and even at the comparison sites that did not receive the intervention. This was interpreted as an effect of behaviour change among motorists due presence of school zone and speed limit signs at the treatment site close to the comparison sites. As mentioned before, the limitations of the road condition were a contributing cause for this speed reduction at one of the comparison sites.

The motor vehicle speed reductions at the treatment site show compliance to the installed school zone and speed limit signs among motorists. In addition, the increase in some attitude concepts, all normative beliefs, perceived behavioural control, behavioural intentions, and behaviour among the respondents from the community also shows that using the signs in creating an SSZ impacts a positive behavioural change in a community. These results show that school zone and speed limit signs can be used as an effective, low-cost intervention for creating an SSZ to make routes to school safer and improve schoolchildren's road safety.

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8. ANNEXES

8.1 CONSENT FORM

www.uhasselt.be/imob
Instituut voor Mobiliteit | Universiteit Hasselt
Wetenschapspark 5 bus 6 | 3590 Diepenbeek
T +32 (0)11 26 91 11 | E-mail: imob@uhasselt.be

INFORMED CONSENT FORM

Consent to participate in a research study

Greetings! My name is **Gladness Rwejumura,** a Master's student of Transportation Sciences: Road Safety in Low and Middle-Income Countries at Hasselt University, Belgium. Currently, I am working on a research project that focuses on activities to promote safe and sustainable transport to school. The objectives include implementing two road safety interventions (a social media campaign and road signs) to make routes safer and improve school children's road safety in the Kigamboni district. In addition, the study will address the existing road safety problem in the study area and implement an intervention.

If you agree to join the study, your participation will be through a focus group discussion.

All information recorded will be purely for the research study purposes, and anonymity will be maintained. Reference numbers or occupation will be used in place of names, and no names will be published. We do not expect you to suffer any harm by participating in this study; we only ask for your valuable time.

Taking part in this study is entirely your choice. You can decide to stop participating at any time you wish, even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve any penalty.

There are no direct benefits that you will get from this study, but we believe the information you will provide will help improve the safe and sustainable transport to school for our children. The study will be monitored by the researcher and her university supervisors under the permission of the concerned government authorities.

If you have any more questions or comments you can contact me through email: gladness.rwejumura@student.uhasselt.be or by mobile number: 0715363490

Signature

I, _____ have read the content in this form. My questions have been answered. I agree to participate in this study

Signature of participant_____

Signature of witness (if participant cannot read) _____

Signature of researcher_____

Date of signed consent_____

Thank you very much for your participation!!!

8.2 SPEED OBSERVATION CHECKLIST

SPEED OBSERVATION SURVEY DATASHEET

Date: _____ - _____ - 2020 **Observer's Name:_____**

Day: _____

Site Identification:

Site Location: _____

City_____ District:_____ Ward:_____

GPS coordinates: _____

Site Description:

Assigned traffic flow: North South East West

Road : _____

Total number of lanes: _____ Number of lanes observed: _____

Weather Conditions:

Clear Cloudy Windy Light Rain Heavy Rain Other

Start time: ___6:30 am or 1:30 pm ___ End time: ___8:00am or 3:00pm ___am/pm

Vehicle	**Vehicle code**	**Speed (km/hr)**
Car	01	
Motorcycle	02	
Motor tricycle	03	
Bus/Minivan	04	
Trucks	05	

8.3 QUESTIONNAIRES

The questions were similar for both surveys but, the extra questions added for the post-intervention survey are displayed under the post-intervention questionnaire; extra questions

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Start of Block: Default Question Block

Dear Participant,

I trust this survey finds you well, and thank you for considering your participation.

This study's research topic is about **improving safe and sustainable transport to school**, and the research is in collaboration with Hasselt University, Belgium.

Many schoolchildren in Dar es Salaam walk to school, and many of these schools are located along busy trunk roads(highways) or urban roads. These journeys place children at high risk of suffering road traffic injuries or fatalities because they are exposed to unsafe conditions like proximity to speeding traffic in equally unsafe roads (e.g., roads lack road traffic). This study aims to know if creating a school safety zone will be a good measure for the primary schools of Ufukoni, Kivukoni and Kigamboni in the Kigamboni ward**. A school safety zone** is a designated stretch of the roadway that includes school safety zone signs 

and various other measures like speed signs, improved pavement markings, etc.

You will receive a series of statements to be evaluated for that purpose. All opinion-related statements are accompanied by a 5-point answering scale that allows you to respond effortlessly and straightforwardly. You can **tick the box that best represents your personal opinion regarding the statement** as illustrated below

1	My friends think that it is important to create a school safety zone using speed limit signs.				
	1 Disagree	2 Somewhat disagree	3 Neither agree nor disagree	4 Somewhat agree	5 Agree
	o	o	o	√	o

The questionnaire contains two sections. Section 1 is about socio-demographic background factors relevant to put answers into perspective and categories, whereas the central section 2 includes the to be evaluated statements. ***Please notice there are no right or wrong answers! Your honest personal opinion is what matters.*** The study's findings will provide essential leads to developing an intervention program for the schools mentioned above.
The duration needed to answer the questionnaire is about 5 minutes. The researcher and the university supervising team would be very grateful if you could participate and respond to all the

questionnaire questions and statements.

Before starting the survey, please read the information below thoroughly:

- I have read the above information about this study (e.g. research objective) and understand the study purpose and what is expected of me.
- I understand that my participation in this study is voluntary and that I have the right to discontinue my participation at any time during the intake (by closing the browser window). I do not have to explain this, and I know that no disadvantage can arise for me.
- I understand that these research results may be used for scientific purposes and may be published. My name will not be published, and my data's confidentiality is guaranteed at every stage of the research.
- I know that these research results will be kept during the research period of 1 year and will be deleted after this period.
- For questions I know I can contact after my participation: Gladness Rwejumura (gladness.rwejumura@student.uhasselt.be; +255715363490) or Hélène Dirix (research supervisor: helene.dirix@uhasselt.be)
- For any complaints or other concerns regarding the processing of personal data, I can contact the UHasselt data protection officer: dpo@uhasselt.be

For more information about exercising my rights or submitting a complaint, please see our Privacy statement. I have read and understood the above information and received answers to my questions regarding this study.

I agree to take part in this study and that my data/answers will be registered.

○ Agree

○ Disagee

Skip To: End of Survey If Consent = Disagee

Q1 Sex

○ Male

○ Female

Q2 Age?

○ 18-20

○ 21-30

○ 31-40

○ 41-50

○ 51-60

- ○ 61 and above

Q3 Level of education

- ○ Primary school
- ○ Secondary school
- ○ College
- ○ University
- ○ Other (specify) _____

Q4 Are you a parent with children in one of these schools: Ufukoni, Kivukoni & Kigamboni P.S?

- ○ Yes
- ○ No

Skip To: End of Block If Are you a parent with children in one of these schools: Ufukoni, Kivukoni & Kigamboni P.S? = No

Q5 How many children do you have?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ More than 5

Q6 What grade/standard are your children in? (Multiple choice)

- ☐ 1
- ☐ 2
- ☐ 3

- [ ] 4
- [ ] 5
- [ ] 6
- [ ] 7

Q7 How far do they live from school?

- ○ 0 - 500m
- ○ 500m - 1km
- ○ 1km - 1.5km
- ○ 1.5km - 2km
- ○ Above 2km

Q8 How do your children usually travel from home to school (for the main part of the journey)?

- ○ Walk
- ○ Bicycle
- ○ Motorcycle
- ○ Motor tricycle
- ○ Car/Taxi
- ○ Bus

Q9 How do your children usually travel home after school (for the main part of the journey)?

- ○ Walk
- ○ Bicycle
- ○ Motorcycle
- ○ Motor tricycle
- ○ Car/Taxi
- ○ Bus

Q10 What route do they take to access the school? (Choose the most accurate route in the next question)

Q11 Route

- [ ] Route 1 (blue colour)
- [ ] Route 2 (black colour)
- [ ] Route 3 (red colour)
- [ ] Route 4 (orange colour)
- [ ] Other(please specify) _____

Q12 Before today did you ever see or hear of a School Safety Zone? An example is the road section along Ufukoni P.S

- ○ Yes
- ○ No

Q13 Disagree=1; Somewhat disagree=2; Neither agree nor disagree=3; Somewhat agree=4; Agree=5

	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree
The unpaved urban roads used by the schoolchildren of Ufukoni, Kivukoni & Kigamboni P.S. are safe for them.	○	○	○	○	○
Motorists (e.g. drivers, motorcyclists and tricyclists) are aware of school children's presence in the area.	○	○	○	○	○
Most motorists maintain a speed limit of 30km/hr around the schools.	○	○	○	○	○
I find the speed limit of 30km/hr to be a safe speed for an area surrounding a school.	○	○	○	○	○
I find it easy to maintain a speed limit of 30km/hr around a school area	○	○	○	○	○

Creating a school safety zone by putting a school zone traffic sign will make the roads safer for the schoolchildren.	○	○	○	○	○
Creating a school safety zone by putting a speed limit traffic sign will make the roads safer for the schoolchildren.	○	○	○	○	○
The community needs more awareness of road safety issues.	○	○	○	○	○

Q14 Disagree=1; Somewhat disagree=2; Neither agree nor disagree=3; Somewhat agree=4; Agree=5

	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree
My relatives (e,g parents, brothers and sisters) think it is important to create a school safety zone using school zone signs.	○	○	○	○	○
My relatives think it is important to create a school safety zone using speed limit signs.	○	○	○	○	○
My partner (e.g. wife, boyfriend, fiancé) thinks it is important to create a school safety zone using school zone signs.	○	○	○	○	○
My partner thinks it is important to create a school safety zone using speed limit signs.	○	○	○	○	○
My friends think it is important to create a school safety zone using school zone signs.	○	○	○	○	○
My friends think it is important to create a school safety zone using speed limit signs.	○	○	○	○	○
My community thinks it is important to create a school safety zone using school zone signs.	○	○	○	○	○
My community thinks it is important to create a school safety zone using speed limit signs.	○	○	○	○	○

Q15 Disagree=1; Somewhat disagree=2; Neither agree nor disagree=3; Somewhat agree=4; Agree=5

	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree

I am confident I would reduce my speed when I see a school zone sign.	○	○	○	○	○
I am confident I would reduce my speed according to the installed school zone speed limit sign.	○	○	○	○	○
I am confident I would reduce my speed in a school safety zone even if other motorists do not.	○	○	○	○	○
I am confident I would reduce my speed in a school safety zone even when there is no traffic police officer around.	○	○	○	○	○

Q16 Suppose you own a motor vehicle (e.g. car, motorcycle, e.t.c.). What speed do you normally use when you drive in the roads along Ufukoni, Kivukoni & Kigamboni P.S?

- ○ Below 30km/hr
- ○ 30-50km/hr
- ○ 50-80km/hr
- ○ Above 80km/hr
- ○ I don't have

Q17 Do you normally reduce your speed when you see a school sign?

- ○ Yes
- ○ No
- ○ N/A

Q18 Do you normally reduce your speed when you see a speed limit sign in a school zone?

- ○ Yes
- ○ No
- ○ N/A

Q19 Disagree=1; Somewhat disagree=2; Neither agree nor disagree=3; Somewhat agree=4; Agree=5

	Disagree	Somewhat agree	Neither agree nor disagree	Somewhat agree	Agree

Next time when I see a school zone sign, I would be willing to reduce my speed limit.	○	○	○	○	○
Next time when I see a speed limit sign in a school safety zone, I would be willing to reduce my speed limit.	○	○	○	○	○
Next time when I see a school zone sign, I intend to reduce my speed limit.	○	○	○	○	○
Next time when I see a speed limit sign in a school safety zone, I intend to reduce my speed limit.	○	○	○	○	○
Next time when I see a school zone sign, I am likely to reduce my speed limit.	○	○	○	○	○
Next time when I see a speed limit sign in a school safety zone, I am likely to reduce the speed limit.	○	○	○	○	○

Q20 Would you like to collaborate further by participating in a road safety awareness campaign through a WhatsApp group?

○ Yes

○ No

Display This Question: If Would you like to collaborate further by participating in a road safety awareness campaign through... = Yes

Q21 Please provide us with your WhatsApp number _____

Q22 Would you like to receive the results of this research study?

○ Yes

○ No

Skip To: End of Survey If Would you like to receive the results of this research study? = No

Q23 Please provide us with your email address _____

POST-INTERVENTION QUESTIONNAIRE: EXTRA QUESTIONS

Q13 Disagree=1; Somewhat disagree=2; Neither agree nor disagree=3; Somewhat agree=4; Agree=5

	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree
The unpaved urban road along Ufukoni P.S. is safe for the schoolchildren using it.	○	○	○	○	○
The unpaved urban roads along Kivukoni & Kigamboni P.S. are safe for the schoolchildren using them.	○	○	○	○	○
Motorists (e.g. drivers, motorcyclists and tricyclists) are aware of school children's presence in the area around Ufukoni P.S	○	○	○	○	○
Motorists (e.g. drivers, motorcyclists and tricyclists) are aware of school children's presence in the area around Kivukoni & Kigamboni P.S.	○	○	○	○	○
Most motorists maintain a speed limit of 30km/hr on the road along Ufukoni P.S.	○	○	○	○	○
Most motorists maintain a speed limit of 30km/hr on the roads along Kivukoni and Kigamboni P.S.	○	○	○	○	○
I find the speed limit of 30km/hr to be a safe speed for an area surrounding a school.	○	○	○	○	○
I find it easy to maintain a speed limit of 30km/hr around a school area.	○	○	○	○	○
Creating a school safety zone by putting a **school zone sign** makes the roads safer for the schoolchildren.	○	○	○	○	○
Creating a school safety zone by putting a **speed limit sign** makes the roads safer for the schoolchildren.	○	○	○	○	

Q16 What speed do you normally use when you drive on the road along Ufukoni P.S?

- ○ Below 30km/hr
- ○ 30-50km/hr
- ○ 50-80km/hr
- ○ Above 80km/hr
- ○ I don't own a motorised vehicle

Skip To: Q24 If What speed do you normally use when you drive on the road along Ufukoni P.S? = I don't own a motorised vehicle

Q17 Did your driving behaviour change due to the **presence** of **school zone signs** on the road along Ufukoni P.S?

- ○ Yes
- ○ No

Q18 Did your driving behaviour change due to the **presence** of **speed limit signs** on the road along Ufukoni P.S?

- ○ Yes
- ○ No
- ○ N/A

Q19 What speed do you normally use when you drive on the roads along Kivukoni & Kigamboni P.S?

- ○ Below 30km/hr
- ○ 30-50km/hr
- ○ 50-80km/hr
- ○ Above 80km/hr
- ○ I don't own a motorised vehicle

Skip To: Q24 If What speed do you normally use when you drive on the roads along Kivukoni & Kigamboni P.S? = I don't own a motorised vehicle

Q20 Did your driving behaviour change due to the **absence** of **school zone signs** on the road along Kivukoni and Kigamboni P.S?

- ○ Yes
- ○ No

Q21 Did your driving behaviour change due to the **absence** of **speed limit signs** on the road along Kivukoni and Kigamboni P.S?

- ○ Yes
- ○ No

Q25 Do you have any suggestion(s) concerning the project of creating a School Safety Zone using school zone & speed limit signs? If yes, please write in the space below. If no, you can proceed to the last question.

_____