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# School of Transportation Sciences

## Master of Transportation Sciences

***Master's thesis***

***Traffic Safety Implications of Bus Rapid Transit for Cities in Developing Countries; Case of Dar es Salaam, Tanzania***

**Katondo Salvatory Nambiza**

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

**SUPERVISOR :**

Prof. dr. Gerhard WETS

**CO-SUPERVISOR :**

Prof. dr. An NEVEN

**MENTOR :**

Mevrouw Lucy JOSEPH CHABARIKO

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**PREFACE**

This document describes and presents the work "Master's Thesis part 2" as part of the study program "Master of Transportation Sciences, Traffic Safety" at Hasselt University. All the views and opinions contained remains as a sole responsibility of the author and they do not necessarily represent those of Hasselt University.

**SUMMARY**

The Bus Rapid Transit (BRT) system is increasing its pick in many developing cities as it can provide high performance, capacity, and quality of service at affordable costs as compared to other rail-based alternatives (Kumar et al., 2011). It is believed that they are potential solutions to improve traffic safety through main three measures. (1) Organizing the transportation system by reducing motorization, eliminating crowded buses, and renovating infrastructure, (2) separating buses from other motor vehicles, and non-motorized transport, and (3) improving the quality of buses and normally their operations involve offering training to public transport drivers (Vecino-Ortiz & Hyder, 2015).

However, the review of relevant studies that evaluated the safety impacts of BRT systems indicated that BRT systems are not always a one-size-fits-all solution to road safety problems. Some cities have experienced significant reduction in traffic crashes, but also others have experienced significant increase in traffic crashes after implementing the BRT system. For instance, (Bocarejo et al., 2012) revealed that BRT in Bogota resulted to overall reduction in traffic crashes; i.e. 60% reduction at Caracas corridor, 48% reduction for Norte-Quito-Sur (NQS) corridor). Whereas (Duduta et al., 2012) indicated that in 2010 the BRT system in Delhi resulted to 50% road safety deterioration as compared to 6 years before its implementation, mainly due to insufficient engineering considerations to protect pedestrians in the BRT corridor.

The current study, primarily aimed at evaluating the safety impacts of the Dar es Salaam Rapid Transit system as compared to the period before its implementation, by incorporating both subjective and objective safety impacts of the system to its users. In addition, the study aimed at recommending potential safety measures that can be applied to improve the safety performance to all road users in both current operating and forthcoming BRT systems of similar context as the DART system.

The questionnaire study findings on the subjective safety evaluation of 377 respondents that included all main modes of transport of the DART system indicated that the safety perception of road users were significantly dependent on their main modes of transport they use. The demographic characteristics (i.e., age, education level, employment, etc.) and other travel characteristics (i.e., experience in the DART corridor both before and after DART implementation, experience with other BRT systems, frequency of travel in main modes of transport etc,) indicated no significant effects to the safety perceptions as perceived by DART system users.

The findings supported some of the existing theoretical concepts, i.e., the concept that BRT systems are not one-size-fits-all solution to road safety problems (Vecino-Ortiz & Hyder, 2015). The support of this argument was based only on subjective safety evaluation of questionnaire data obtained in this study. The findings indicated motorcyclists as the least safe road users in the DART system, who perceived their traffic safety in the DART corridor to have decreased significantly after the implementation of DART system. Correspondingly, the analysis of 927 police crash data recorded in the DART corridor from the year 2016 to 2019 after DART implementation, excluding crashes occured along Msimbazi Street and on the stretch along Morogoro road from UN road to Uhuru junction, indicated motorcyclists in second place after cars users for the road users who were mostly involved crashes. Therefore, based on the subjective safety analysis as perceived by motorcyclist, the DART system implementation

deteriorated traffic safety for motorcyclists as compared to the period before its implementation.

Nevertheless, the study indicated DART buses as among the modes of transport in the DART corridor that were perceived with highest sexual harassment. The DART buses were in second place after daladala that were perceived to with highest sexual harassment. These findings supported the existing body of literature that suggest that BRT buses especially when are overcrowded (the most cases for DART buses) have the highest sexual harassments (Orozco-Fontalvo et al., 2019).

On the other hand, the study also contradicted some of the existing theories that suggest that BRT systems are potential measures to improve the traffic safety for Non-Motorized Transport (NMT) users, especially when BRT system are designed to incorporate cycle path and walkways. However, the current study findings indicated otherwise, that; regardless of the provision for cycle paths and walkways dedicated to NMT in the DART system, a large proportion of both pedestrians and cyclists perceived their safety in the DART corridor to have decreased after the implementation of the DART system. The findings were mainly based on subjective safety evaluation; the researcher could not evaluate the objective safety impacts of the system in both before and after DART implementation because the researcher could not collect all data for the study due to the spread of corona in the study area during the study period. Yet, based on field observation during subjective data collection and the perceived cause of crashes by NMT as covered in this study, the author argues that these findings might be attributed to misuse of the NMT facilities in the DART system by Motorized Transport users and petty traders. Therefore, this study suggest that the efficiency of BRT systems in improving the traffic safety for NMT users are highly dependent on the operational accuracy of the system infrastructures on how well they are utilized and maintained to serve the design purposes of the project.

However, in the course of improving the traffic safety performance of DART system and other BRT systems of similar context, the study examined measures from users' perspectives, and came-up with the following measures among others that were likely recommended by system users to improve traffic safety in their main modes of transport. (1) To incorporate motorcyclists in BRT design aspects that intend to protect vulnerable road users (in cities like Dar es Salaam, motorcycles play a significant role to feed the BRT system). (2) To provide parking racks for bicycles close to BRT stations/terminals. (3) To reduce speed limits to 30km/h in zones with higher NMT users and in areas around BRT stations/terminals. (4) To provide regular road safety awareness campaigns for safer commuting in the BRT system. (5) To introduce overtaking priority for BRT buses at stations/terminal where express buses have to overtake local buses. (6) To implement a license system with penalty points for traffic violations that results to revocations of driving license from drivers after attaining a particular level of traffic violations. (7) To penalize severely all road users for traffic violation including pedestrians by crossing the roads in wrong places. (8) To install auto-traffic enforcement cameras in the BRT corridor. (9) To install CCTV cameras in BRT buses, stations and terminals.

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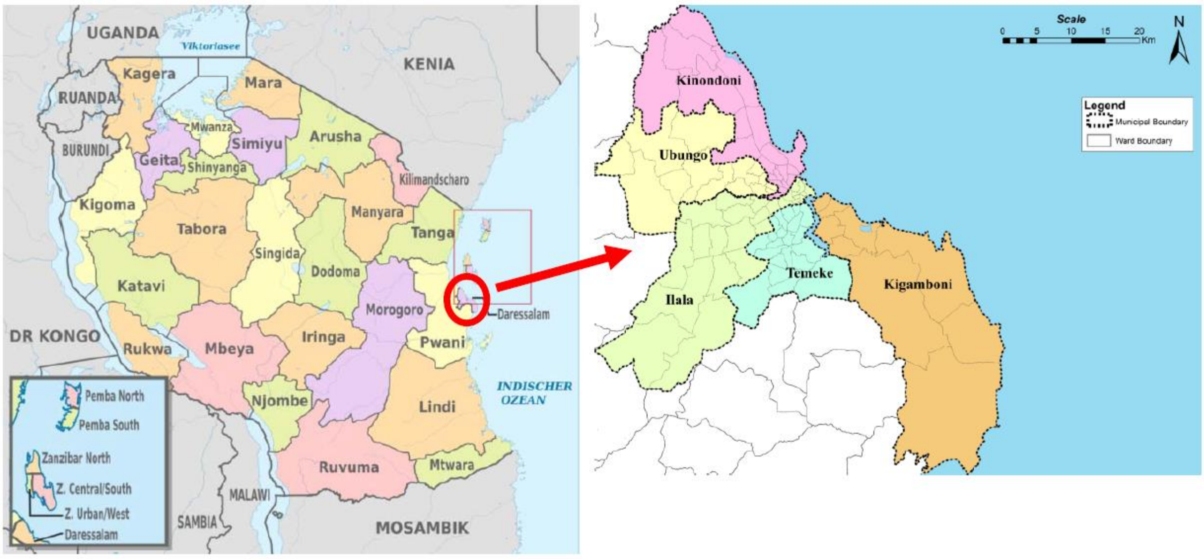
# 1 INTRODUCTION

## 1.1 Background Information

### *1.1.1 Description of the study location*

The study location (Dar es Salaam) is in Tanzania; an East African country located along the Indian Ocean, sharing borders with Kenya, Mozambique, Burundi, Rwanda, Uganda, DR Congo, Zambia, and Malawi. Dar es Salaam (DSM) a commercial city of Tanzania, once was a capital city as of 1974 when Dodoma named as the capital city of Tanzania. The city has five districts: Kinondoni in the north, Ilala in the center, Ubungo in northwest and Temeke in the south and Kigamboni in the Southeast as shown in Figure 1. The study coved part of Kinondoni, Ilala, and Ubungo; the areas covered by the DART system phase 1, as shown in Figure 2.



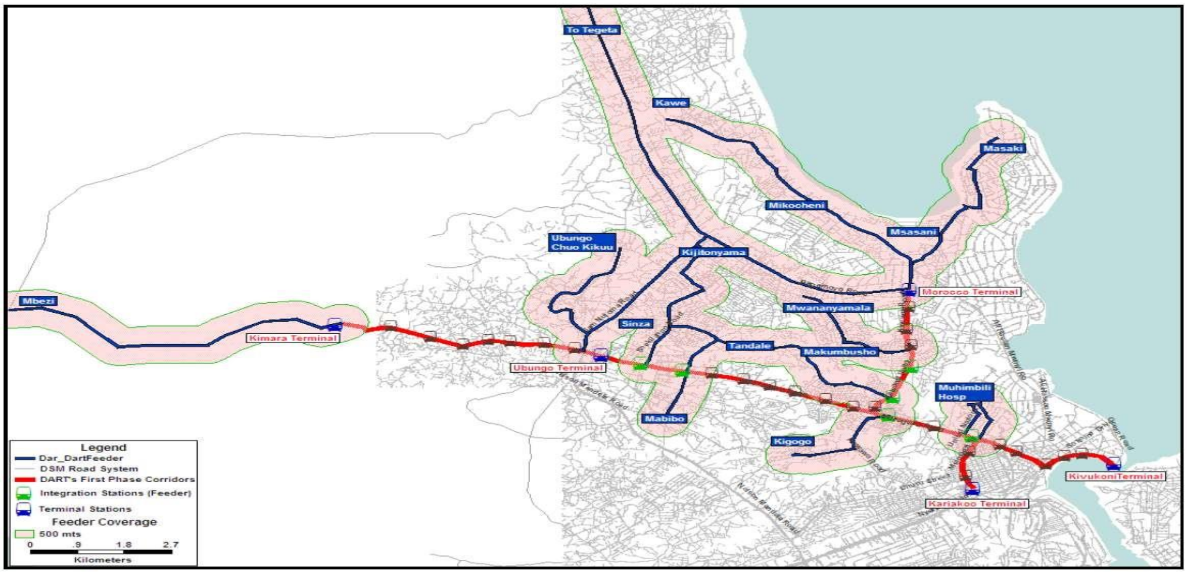

Source; (JICA, 2018)

Figure 1 Regions in Tanzania and Municipal Councils in DSM Region

### *1.1.2 Economy*

According to the Tanzania National Bureau of Statistics, the Tanzanian economy is growing at a stable rate. In the second quarter, April to June 2019, the GDP grew by 7.2% as compared to 6.1% in the same period of 2018 (Tanzania National Bureau of Statistics, 2019). The report indicates that the rapid growth rate was due to improved performance of construction (construction of motorways, streets, bridges, etc.), mining and communications sector. Subsequently, in 2018, the International Monetary Fund (IMF) ranked Tanzania as the 7$^{th}$ leading African economy after South Africa, Algeria, Morocco, Angola, Kenya, and Ethiopia (The Citizen, 2018). The economic activities in cities (DSM, Mwanza, Arusha, Dodoma, Tanga, and Mbeya) contribute approximately half of GDP, they also accounted for almost 56 percent of the economic growth from 1990 to 2004 (WB, 2019). The report by (Tanzania National Bureau of Statistics, 2019) attributed the growth of economic activities in cities to the increasing number of passengers carried and freight handled. For instance, the transport and storage activities that includes provision of passenger/freight transport, cargo handling, storage, etc. increased by 7% in the second quarter of 2019 as compared to 13.5% in the second quarter of 2018 due to increased number of passengers and freight handled over the period of consideration. Thus, the growth and stabilization of Tanzanian economy has a direct link to the transport related activities in cities. Therefore, improving transportation activities in this case the traffic safety in

Dar Rapid Transit system (DART) implies improving the economy of the city because to improve safety in the system would attract more passengers thus increasing revenue from fare collection.




Source; (JICA, 2018)

Figure 2 The DART system Phase 1; Route Coverage

#### *1.1.3 Demography*

Tanzania has a total area of 947,303 km$^2$, where DSM covers only 0.16% of the mainland area. In accordance with an official census of 2012, Tanzania has 44.9 million inhabitants with an estimate of population increase up to 55.9 million inhabitants in 2019. The distribution of the population shows that the majority of Tanzanians (96%) are relatively young (<65 years old) (Tanzania National Bureau of Statistics, 2012). In addition, the report shows that 10% of inhabitants are living in DSM; approximately 4.4 million inhabitants with a population growth rate of 5.6%. According to the travel demand forecast updates and the revised service plan of the DART system (LOGIT, 2018a), most people who use the DART system originate away from the proximity of the DART corridor and that their destinations are mostly in the Central Business District (CBD) areas as shown in Figure 3 & Figure 4.

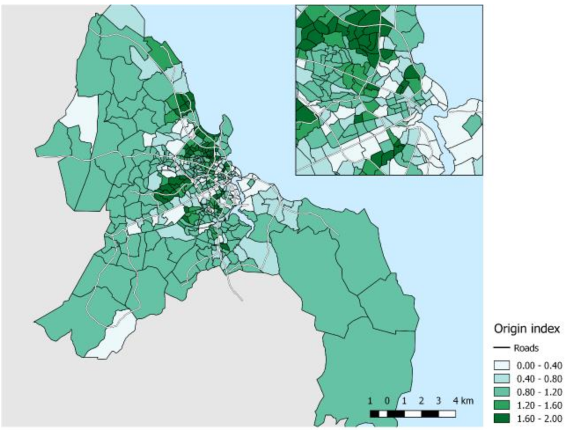



Figure 3 Trip Production (Origin) Potential Index per Transport Analysis Zone

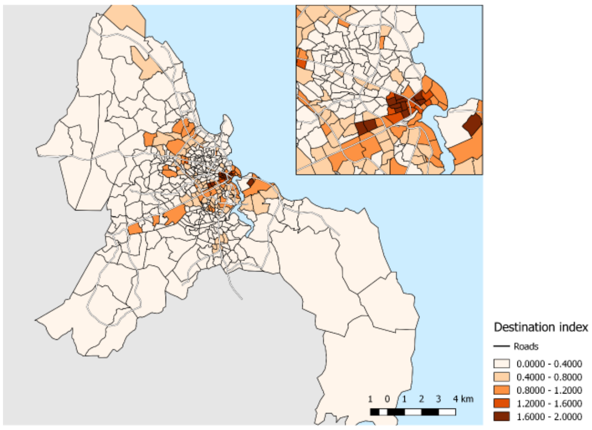



Figure 4 Trip Attraction (Destination) Potential Index per Transport Analysis Zone

Source; (LOGIT, 2018a)

The rate of urbanization in Tanzania is growing rapidly, according to the World Bank; by 2050, half of the Tanzanians will be living in urban areas (WB, 2019). The report also indicates DSM as the fastest growing city in Tanzania and the third fastest growing among cities in Africa. DSM grows at an average rate of 5.8 percent annually from 2002-2012. In addition, the report shows that DSM accounts for around 40 percent of the urban population in Tanzania, and that is expected to become a megacity by 2030 with a population of over 10 million.

Therefore, developing the urban infrastructures and services for cities like DSM with a population that increases so rapidly is a great challenge and requires considerable planning efforts to account additional transport demand that arise from rapid population increase. In that aspect, the population growth and rapid urbanization rate of DSM may be among the factors that affect the quality of public transport in the city. Therefore, planning and implementation of interventions to improve livability in cities has to sustain city's population including current and future population resulting from its rapid growth rates. In this case, projects like the Dar Rapid Transit system has to be sustainable by taking into account all aspect of design considerations including its safety performance for the city's inhabitants.

#### *1.1.4 Road registered motorized vehicles and model split to CBD*

From 2010 to 2014, the annual average growth rate of vehicles in Tanzania was 21%, where the number of registered motorbikes increased by an average growth rate of 28%, while passenger cars increased by 15% (JICA, 2018). According to (LOGIT, 2007, 2018a), before the DART system majority of the inner DSM trips were made by public transport and non-motorized transport modes, i.e. 43% of trips were made by public transport (daladalas/city buses), 45% by non-motorized transport and only 6% of trips were made by private cars. In addition, a survey conducted in 2011 by (LOGIT, 2018b), indicated before DART implementation, 9.8% of inner trips in DSM were made by cars, while 57.8% were made by daladala, and 32.4% by non-motorized transport. The report signposted the potential for city to improve its urban mobility through improving public transport as majority of its inhabitants were mostly dependent on public transport.

The most recent Urban Transport Master Plan (2018) surveys by LOGIT indicated that, after the implementation DART, the share for daladala were reduced to 47.9%. However, shares for non-motorized transport increased to 39%, while that of cars reduced to 3.7%, and the DART accounted for 3.3%, while motorcycles accounted for 4.9%, railway 0.4%, bicycle 0.5%, and 0.3% for ferry (LOGIT, 2018b).

The share of DART remains low compared to other main modes of transport in DSM due to its low coverage in the city. It is important to highlight that the increase in non-motorized transport shares in the period after DART implementation might be attributed to better facilities dedicated to non-motorized transport in the DART phase 1. Therefore, the DART system present an opportunity to enhance active society in the city. Likewise, the reduction in car shares might also be attributed to DART services, i.e. improving service quality in DART system may convince car users to shift to DART due to number of reasons including safety and financial servings. Therefore, improving DART services including its safety performance may be a potential measure to improve public transport services and to manage the rapid growth rate of vehicles in DSM.

### *1.1.5 Dar es Salaam Rapid Transit (DART) System*

The DSM Rapid Transit system is a bus-based mass transit system planned for six phases of implementations in DSM as shown in Figure 5. The construction of the system phase 1 began in April/2012 and completed in December/2015, it has a total length of 20.9 kilometers with dedicated bus lanes on seven trunk routes of 29 stations shown in Figure 6.

The bus operations of phase 1 began on 10 May 2016, it is operational with a total fleet of 140 Chinese-built Golden Dragon buses (39 articulated hybrid trunk buses (18m), 76 hybrid trunk buses (12m) and 25 hybrid feeder buses (12m)). The system provides express and local service for 18 hours daily from 05:00 am to 11:00 pm and has reached 14,000 passengers per hour per direction in the most loaded direction Kimara to CBD (LOGIT, 2018b).

Currently, a $160 million DART phase 2 is ongoing by China Civil Engineering and Construction Corporation under the supervision of the Tanzania National Roads Agency (TANROADS). The 36 months' project includes 2 flyovers of 24m width and 150m length each, 29 bus stations, a control center, and one depot. The system will be handed-over to the DART agency by TANROADS once completed. Likewise, the DART agency is ongoing with the design and preparation of tender documents for the construction of phase 3 (DART, 2019).

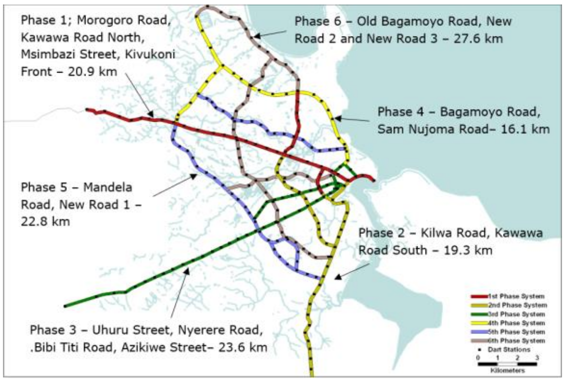



Figure 5 Implementation Phases of the DART system
Source; (LOGIT, 2009)

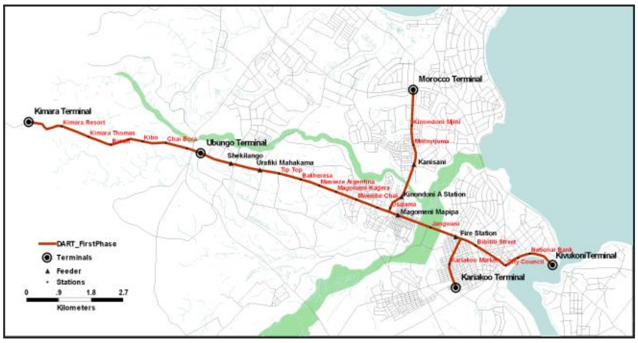



Figure 6 The DART System Phase 1, Trunk Corridor

### *1.1.6 Traffic Crash*

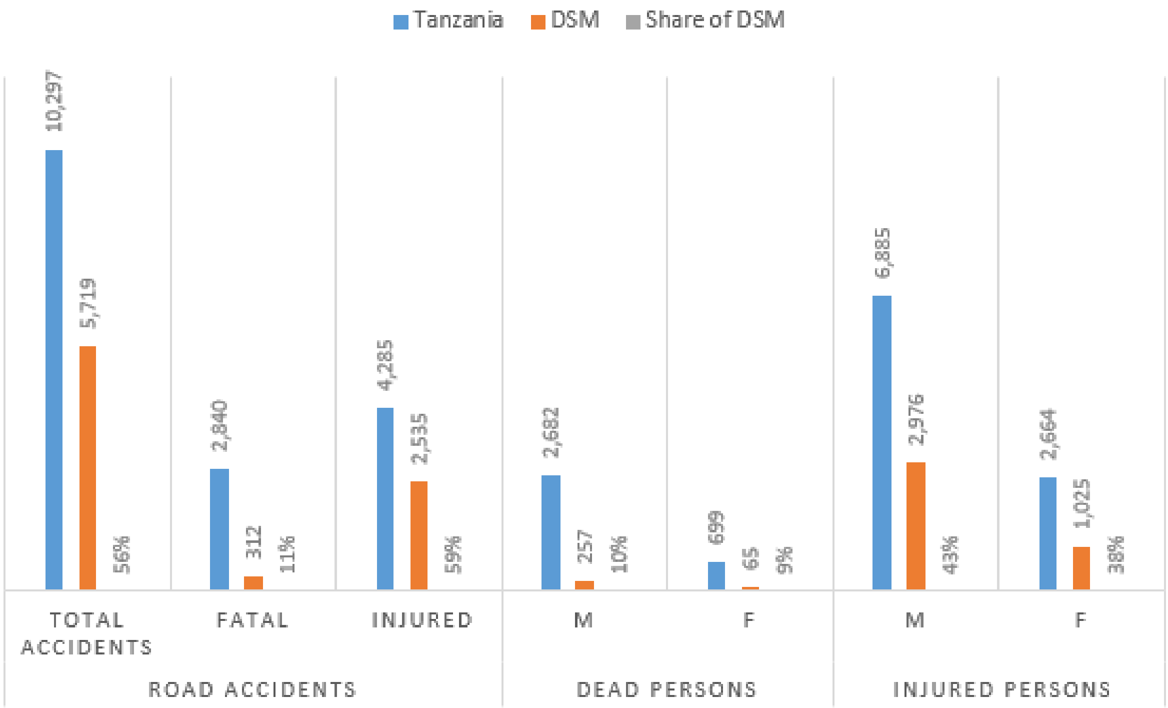
According to (Museru et al., 2002), in Tanzania, the road traffic crash accounted for 56% of all patients admitted to Muhimbili Medical Centre due to injuries. The authors indicated that between 1990 and 2000 the road traffic crashes in Tanzania rose from 10,107 to 14,548 crashes equivalent to an increase of almost 44%. The number of injuries increased by more than 42% from 9,910 to 14,094 injuries while the number of death increased by more than 64% from 1,059 to 1,737 deaths. A significant proportion of injured people were passengers constituting 56% (passengers from all modes of road transport, however, the report did not indicate shares of injured people from cars nor public transport) followed by pedestrians with 25%. In addition, the authors indicated among those who died, 40.1% were passengers and 38.4% were pedestrians, while cyclists accounted for 12.3% of all deaths and 6.5% were drivers and the rest (2.6%) were motorcyclists. Generally, the report indicated that DSM accounted for 18% of fatal crashes and 30% of injury crashes.

Moreover, (JICA, 2018), indicated that in 2015 Tanzania had 8,777 road traffic crashes with 3,574 road fatalities. The report also indicated almost the same rates from neighboring eastern

African countries; for instance, Kenya had 5,310 road crashes with 3,057 road fatalities while Uganda had 18,495 road crashes with 3,324 road fatalities. It also revealed that among recorded traffic crashes in 2015, DSM accounted for 41% of all traffic crashes, 25% of all injury crashes, 3% of fatal crashes and 4% of dead persons.

Nevertheless, a Tanzanian Police Crime and Traffic Incidents Statistics Report of January to December 2016 indicated a total of 10,297 road crashes nationwide compared to 8,777 road crashes in similar period of 2015. The report indicates 17.3% increase in road crashes between 2015 and 2016, however, it reveals a decrease in fatal crashes by 2.4% from 2,909 crashes in 2015 to 2,840 crashes in 2016. Likewise, it indicates a 5.4% decrease in road fatalities from 3,574 fatalities in 2015 to 3,381 fatalities in 2016.

Similarly, over the same period of January to December, the report shows a 4.4% decrease of injured persons i.e. 9,549 persons injured in 2016 compared to 9,993 persons injured in 2015. Furthermore, there is a 3.5% decrease in motorcycle crashes from 2,749 crashes in 2015 to 2,653 road crashes in 2016; however, there is a 2% increase in road fatalities by motorcyclists; from 971 fatalities in 2015 to 990 fatalities in 2016. The increase in fatalities is attributable to the increase of motorcycle usage in Tanzania. The authors point out that motorcycles dependence is increasing as an affordable means of transporting goods and passengers in both urban and rural areas (Tanzania Police Force, 2017).

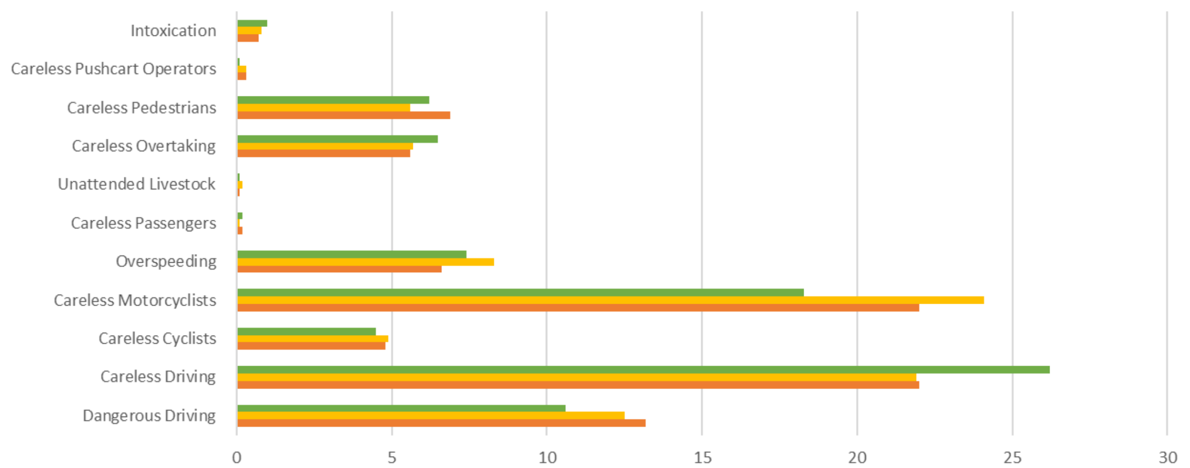



Source; (Tanzania Police Force, 2017)
Figure 7 Share of DSM in Road Traffic Crashes of Tanzania in the Year of 2016

Figure 7 shows the share of DSM in road traffic crashes of Tanzania in 2016. The figure indicates that out of all recorded crashes in Tanzania for the year 2016, 56% occurred in DSM, 11% of all fatal crashes and 59% of all crashes with injured persons occurred in DSM. In addition, 10% of all fatalities (10% male & 9% female) and 42% of all injured persons (43% male & 38 female) are the results of crashes in DSM.

Moreover, (Museru et al., 2002) analyzed the common causes of road traffic crashes in Tanzania from police reports for a period between 1990 and 2000. The findings indicate that 51.6% of crashes are attributable to reckless/dangerous driving, 15% to defective motor vehicles, 7% attributed to careless pedestrians, 3% careless motorcyclists and another 7% careless pedal cyclists. From this analysis, the authors argue that there is a weakness in crash causation reporting by police. They indicate the tendency of blaming victims especially the dead ones i.e. say “the dead are always wrong” seems to apply.

A Tanzanian Police Crime and Traffic Incidents Statistics Report of January to December 2016 indicate that most of the crashes are due to human factors (81.1% of all crashes), while those associated with defective motors vehicles accounted for 8.9% and environmental factors 10.0%. Among human factors, Figure 8 indicates that careless driving accounted for most crashes in both 2014, 2015 and 2016 followed by caress motorcyclists and dangerous driving.




| | Dangerous Driving | Careless Driving | Careless Cyclists | Careless Motorcyclists | Overspeeding | Careless Passengers | Unattended Livestock | Careless Overtaking | Careless Pedestrians | Careless Pushcart Operators | Intoxication |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 Percent | 10.6 | 26.2 | 4.5 | 18.3 | 7.4 | 0.2 | 0.1 | 6.5 | 6.2 | 0.1 | 1 |
| 2015 Percent | 12.5 | 21.9 | 4.9 | 24.1 | 8.3 | 0.1 | 0.2 | 5.7 | 5.6 | 0.3 | 0.8 |
| 2014 Percent | 13.2 | 22 | 4.8 | 22 | 6.6 | 0.2 | 0.1 | 5.6 | 6.9 | 0.3 | 0.7 |

■ 2016 Percent ■ 2015 Percent ■ 2014 Percent

Source; (Tanzania Police Force, 2017)

Figure 8 Main human factors causing Crashes in Tanzania

Moreover, the authors give details to support their argument that most of crashes might be attributable to other factors. For instance, they indicate that most roads have no provisions for cyclists nor for pedestrians (all road users use the same lanes). Furthermore, they indicate that there are few pedestrian crossing signs on streets, and that drivers usually do not give priority to pedestrians at crossings. Thus, the percentages attributed to careless pedestrians and cyclists can be due to infrastructure designs. In addition, according to police report only 1% of all crashes is attributable to alcohol abuse, however, the authors reveal an open secret that drivers drink and drive. They show that most admitted crash victims at Muhimbili Hospital including drivers, passengers, and pedestrians are normally in gross intoxicated alcohol situation levels unidentified by police. The study shows that few breath analyzers are routinely underutilized and that could be a source of underreporting on crashes attributable to alcohol abuse.

## 1.2 Problem statement

The implementation of high-capacity Bus Rapid Transit (BRT) systems in busiest cities aims to achieve significant improvements in the provision of public transport. This may include increasing capacity and speed, save travel time, reduce emissions, promote non-motorized transport and increase physical activities by the providing walkways and cycle paths. The great efficiency and value for money of BRT over other potential alternatives are among the driving facts for its priority in developing countries (Duduta et al., 2012).

For instance, (LOGIT, 2009) indicated that BRT systems can reach the capacity of up to 48 thousand passengers per hour per direction with a speed over 25 km/h and that construction cost for BRT ranges from 5 to 10% of the investment on metro or light rail system, and that its operational cost is around half of the cost of these systems. The report indicated that for the above reasons, officials from DSM visited the most successful existing BRT systems, including Curitiba (Brazil), Quito (Chile) and Bogotá (Colombia) and made their decision to implement the rapid bus transit system for the City as a way to improve the quality of life of its citizens. The design has higher considerations for both Motorized Transport (MT) and Non-Motorized Transport (NMT) safety. The design gives high priority to non-motorized transportation by the inclusion of bicycle lanes and walkways on both sides of the road.

The first phase of the DART system is under operation since May 10, 2016, of which the government of the United Republic of Tanzania spending a significant portion of its resources to operate and extend the system, i.e. the government is ongoing with the construction of phase 2, while designs and preparation for tender documents for construction of phase 3 are also ongoing (DART, 2019). The construction costs for the system are well known and quantified, however, its effects in the city mainly the traffic safety impacts are not yet systematically assessed.

Researchers have indicated the impacts of the DART system mainly on travel time, travel delays, and financial related aspects. For example, (Chengula & Kombe, 2017), indicated that the DART system over three years of its bus operations has reduced travel time by more than 50% in the DART corridor as compared to previous daladala operations. Likewise, (Mzee, 2017) in a Regional Workshop to Promote Soot-Free Bus and Sustainable Public Transport in Accra revealed that during peak period; in the longest route Kimara to Kivukoni (15.5 Km); daladala used 1-2 hours but the BRT buses use a maximum of 45 minutes. Furthermore, (Chengula and Kombe, 2017) indicate that the DART system resulted to a 60% reduction in delays (the waiting time during peak hours at daladala stops were more than 1 hour while for BRT buses are scheduled within 15 minutes).

Moreover, according to (Chengula & Kombe, 2017) the system resulted to 28% fare savings by passengers travelling between Kimara and CBDs/City center. The study indicates that the fare price for one adult trip in DART system is Tshs 650 (≈ € 0.26) and Tsh 200 (≈ € 0.078) for pupils set by the Land Transport Regulatory Authority (LATRA) former known as Tanzanian Surface and Marine Transport Regulatory Authority (SUMATRA). The study revealed that passengers traveling from Kimara to Kivukoni and Kariakoo terminals (CBDs and City center areas) have financial servings when they use the DART system. To arrive in CBDs or City center from Kimara by daladala, passengers had to board two daladala, one that cost Tshs 550 (≈ € 0.22) from Kimara to Ubungo terminal and the other costing Tshs 450 (≈ € 0.18) from Ubungo to CBDs or City center. Therefore, from Kimara to CBDs/City center by daladala passengers used to board two daladala with a total cost of Tshs 900 (≈ € 0.35) while for DART it is only Tshs 650 (≈ € 0.26) equivalent to 28% fare saving. However, the study indicated people living nearby CBDs/City center incurs approximately 31% fare loss because one trip to CBDs/City center by daladala were costing Tsh 450 while DART has a flat rate fare price of Tsh 650 per adult trip regardless of distance travelled.

As pointed out earlier, only the traffic safety impacts of DART have not yet systematically assessed. However, in the period before its bus operations, (Mwemezi & Rafiki, 2017) used the negative binomial regression (NB) model to predict the safety-related effects attributable to DART system. They used DSM Police crash data of 2008 - 2011 to predict the occurrence of crashes in the period after commencement of its bus operations. The findings indicated the overall reduction of crashes by 39.5%, however, some specific factors independently tended to increase and some to decreases the likelihood of crash occurrence. For instance, the reduction of daladala in the DART corridor was attributed to a reduction of crashes by 29.4%, while the increase of number of intersections along the DART corridor was attributed to an increase in bus crashes by 5.3%. However, since the commencement of the DART bus operations (May 10, 2016), there are no empirical studies conducted based on actual crash data to evaluate the safety performance nor to prove the predicted crash reduction of the system by (Mwemezi & Rafiki, 2017).

However, a study conducted by (Vecino-Ortiz & Hyder, 2015) on the literatures that shows the link between BRT systems and road safety; revealed that Bus Rapid Transit (BRT) systems are described as potential solutions to improve traffic safety through three measures which were also implemented in the DART system.

Firstly, is that the BRT system includes organizing the transportation system by reducing motorization, eliminating crowded buses, and renovating infrastructure. As detailed by (LOGIT, 2013), they indicated that once operational, the DART system phase 1 will reduce the demand for daladala in DSM by 26%. As of 2017 after DART bus operation, 1400 daladala have been removed from service. Some of daladala operators were compensated in monetary form to relocate their services to other parts of the city while others were integrated to the current DART bus operator (were asked to form an association and given 30% share of the company that provide DART bus services).

Secondly, the BRT systems involve separating buses from other motor vehicles, and provision of non-motorized transport lanes. The DART system is designed with segregated lanes for buses, dedicated lanes for mixed traffic, cycle lane, and pedestrian lanes.

Lastly, the authors indicate that the BRT system involves improving the quality of buses and offering training to drivers who operate the BRT buses. According to the specification of DART buses as stipulated by (DART, 2015), DART buses are among the modern and high quality buses; they have Euro 4 engines that are environmentally friendly as compared to conventional engine in most daladala, they have a modern passenger information system that includes bus bell buttons, displays and automated announcements for current and next stops. In addition, DART buses have provisions for disadvantaged/people with special needs including reserved seats, areas for wheelchairs, and boarding bridges for easy and safe boarding or alighting wheelchairs, which is not the case in daladala.

According to (The Citizen, 2019), before commencement of DART bus operations, first two weeks were reserved for trial services. The first week involved training to drivers in the BRT corridor without carrying passengers, i.e. how to align buses at stations or terminals and to maneuver in the corridor to understand the bus routes. In the second week, drivers were allowed to carrying passengers for free as part of the training to drive buses with different passenger loading, nevertheless, the DART system has regular training to upkeep the performance of its drivers as compared to daladala.

However, regardless of the interventions that are implemented parallel with BRT systems, the literature review still suggests that a one-size-fits-all formula does not apply with BRT in the effort to improve traffic safety. That is, BRT systems may result to significant increase in traffic crashes rather than improving safety. As detailed in the literature review; some of the BRT systems resulted to traffic safety deterioration, for instance the BRT system in Delhi resulted in road safety deterioration by 50% due to pedestrian exposure to buses.

Therefore, this study aimed at evaluating the safety impacts of the DART system to provide the evidence needed to justify whether the BRT system has improved or deteriorated the road safety in the DART corridor (for both objective and subjective safety). In addition, based on users' perspectives, the study targeted to recommendations potential measures that can be applied to improve traffic safety on the DART system and other BRT systems of similar characteristics.

## 1.3 Research objective and questions

### *1.3.1 Main objective of the study*

The main objective was to explore the traffic safety effectiveness (both objective and subjective safety) of the DSM Bus Rapid Transit (DART) system and based on users' perspectives to recommend potential traffic safety measures that can be applied to improve traffic safety in the DART system and other BRT systems of similar context.

### *1.3.2 Specific objectives*

In order to meet the main objective of the study, this research aimed to accomplish the following sub-objectives; -

i. To examine the objective safety effectiveness of the DART system (characteristics and trends of crashes over three years (January 2017-December 2019) of bus operations as compared to 3 years (January 2009-December 2011) before its implementation).
ii. To explore the subjective safety of the DART system (the perceptions of system users on how (un)safe they feel to use the DART system in their main modes of transport and to assess based on their perspective to whether the DART system has improved traffic safety in their main modes of transport as compared to the period before its implementation).
iii. To assess based on users' perspectives the main causes of crashes and potential safety measures that can be applied to improve traffic safety performance in the DART system and in other BRT systems of similar context.

### *1.3.3 Research questions*

This study mainly focused on answering the following research questions: -

i. What are the characteristics and trends of traffic crashes in the DART system over the period of three years of its bus operations (January 2017-December 2019) as compared to three years (January 2009-December 2012) before its implementation?

ii. Over three years of DART bus operations, how safe/unsafe do road users feel in their main modes of transport in the DART corridor?

iii. Comparing to the period before DART implementation, and based on users' perspectives did the DART system improved/deteriorated the traffic safety in their main modes of transport?

iv. Based on users' perspectives, what are the main causes of crashes in DART system and the potential safety measures to improve traffic safety performance in the DART system and in other BRT systems of similar context?

# 2 LITERATURE REVIEW

The literature review for this study comprised of two sections. The first section involved reviewing theories, and methods to evaluate the objective safety of road treatment. The second section reviewed the findings and methods applied in previous conducted studies to evaluate road safety effectiveness related to BRT projects.

## 2.1 Review of theories, and methods for objective safety evaluation of road treatments.

This section mainly reviewed the theories, and methods for investigating the effectiveness of road treatments mostly those intended to reduce the number of crashes and/or severity. Primarily, it focuses on theories, and methods to evaluate the effectiveness of road engineering infrastructure treatments.

### *2.1.1 Key concepts in quantifying the changes in crash outcomes*

i. Crash Modification Factors (CMFs)

In terms of road-based treatments, CMFs are multiplicative factors used to compute the expected number of crashes after implementing a given treatment at a particular site (Gross et al., 2010). The CMF represents the proportion of the relative change in crash frequency due to specific changes in the road or its surrounding environment. According to the Highway Safety Manual (HSM), the CMF is calculated using the equation below (AASHTO, 2010).

$$\text{CMF} = \frac{\text{Expected average crash frequency with treatment}}{\text{Expected average crash frequency with no treatment}}$$

(Gross et al., 2010) indicate that the CMF applies to the expected average crash frequency over a given specific period. The (AASHTO, 2010; Gross et al., 2010) defines the expected average crash frequency with no treatment as the crashes experienced at the site under investigation in the period prior to the installation of the treatment. While the expected average crash frequency with the treatment, it is referred as the number of crashes at the site in the after-treatment period.

The HSM indicates that if there were no changes in the road at the site under evaluation, the expected average number of crashes in the after-period would not change, therefore, the CMF would be 1.00. However, if a treatment applied to a site reduces the number of crashes; the CMF would be less than 1.00, but if a treatment applied increases the number of crashes, then the CMF would be greater than 1.00 (AASHTO, 2010). In addition, (AASHTO, 2010; Gross et al., 2010) indicated that a Crash Reduction Factor (CRF) calculated by the equation below expresses the percentage of crash reduction expected after applying a particular road treatment.

$$\text{CRF} = (1 - \text{CMF}) \times 100\%$$

According to (LOGIT, 2009), the DART system phase 1 involved multiple road treatments, for instance, changes in road geometry from four lanes divided roadway to six lanes roadways (two exclusive lanes for DART buses, and four lanes for mixed traffic; two lanes in either direction), it also involved construction of cycle paths, walkways, bus stations and/or terminals at the middle of the road segments, at-lever and overpass pedestrians' crossings. All these treatments may have individual impacts on the change of traffic crashes in the DART corridor. However, would have been difficult to apply the CMFs in the current study context because the CMFs that represent the relative changes in crash frequency due to individual specific treatments applied in the DART project are not readily available. In this study, developing specific CMFs was impractical due to time constraints.

ii. Safety Performance Function (SPF)

The HSM, defines the SPF as the mathematical model/equation for estimating or predicting the expected average crash frequency per year at a given location as a function of traffic volume and in some cases roadway or intersection characteristics e.g. number of lanes, lane width, shoulder width, traffic control, or type of median (AASHTO, 2010).

Based on the study context, the HSM indicates that the SPFs can be applied as part of a before-after study to evaluate the safety effectiveness of engineering treatments. In addition, (Srinivasan et al., 2013) revealed that most researchers accept before-after safety evaluation studies and that the before-after safety evaluation studies provide more reliable safety estimates to quantify the safety effectiveness of engineering road treatments. However, the authors argued that, in most cases, the engineering treatments applied to sites may be due to their higher crash count than normal, therefore, they indicated the requirement for before-after studies to account for potential bias due to regression to the mean. Yet, (Srinivasan et al., 2013), indicated that researchers may opt to use the Empirical Bayes (EB) procedures to evaluate objective safety impacts of road treatment of which the SPFs are an integral part in the evaluation. In addition, the HSM indicates that the SPF may be applied to better account the effects of changes in traffic volume in the study period when the before/after study with comparison group method is to be applied. Therefore, the SPFs remain as an important aspect for the current study.

- Options for obtaining SPF

According to (Srinivasan et al., 2013), there are two choices to obtain the SPFs for evaluating effectiveness of road safety engineering treatments; its either by calibrating the existing SPFs or developing site-specific SPFs.

a) Calibrating the SPFs

This option involves taking existing SPFs developed from other geographic areas (jurisdiction) and calibrate them for use in the site-specific area. (Srinivasan et al., 2013) indicate that the existing SPFs are available in Part C of the HSM for project-level analysis or from the *Safety Analyst* for network screening.

However, based on the context of this study, the SPFs from Safety Analyst are not discussed because the study focuses on evaluating the DART project effectiveness and not screening the DART project. Although, the HSM stipulates that to use the existing SPFs in conditions different from their base conditions, it is necessary to calibrate them to fit local conditions. The main reason for calibration is the trends of crash frequencies that may vary significantly from one jurisdiction to another for a range of reasons including crash reporting thresholds and differences in crash reporting system procedures (AASHTO, 2010).

Since the calibration of SPFs requires the application of CMF to reflect the local conditions in which the SPFs has to be applied; then based on the challenges associated with the use of CMFs as stipulated above, the current study did not consider calibrating the SPFs as an option to take.

b) Developing SPFs

Another option to obtain SPFs is to develop own SPFs. According to (Srinivasan et al., 2013) developing SPF specifically for the study context has higher potential of improving the accuracy of the predictions. In addition, the HSM shows that own SPFs have higher likelihood of enhancing the reliability of predictive methods detailed in Part C of the HSM (AASHTO, 2010). MOREOVER, developing own SPFs provides an opportunity of creating alternative crash prediction models based on the available data rather than using the default forms provided in the HSM.

However, (Srinivasan et al., 2013) indicated that, as a minimum requirement for developing SPFs, it is necessary to have an analyst with statistical expertise and experience with simple negative binomial regression models using generalized linear modeling techniques. In the current study, this experience could be earned through literature review and own extra effort to learn via different methods including YouTube tutorials, however, this option could require significant time to accomplish the study objective of which was very limited for the current study.

Nevertheless, (Srinivasan et al., 2013), indicated that developing SPFs it requires substantial data. As a minimum requirement, developing SPFs requires a sample size of 100-200 intersections or 100-200 miles of the road segment and at least 3 years of data with at least 300 crashes per year for the total group. However, developing SPFs in this study was considered impractical due to several reasons including time constraint and unavailability of crash data as explained in section 3.6.1.

### *2.1.2 Evaluation Quality of Road Treatments*

According to (Austroads, 2012), the evaluation quality of road treatment depends on the validity of the method used. It defined validity as the extent to which the selected evaluation method can approximate the truth. In addressing validity issues, it recommends the selection of study methods that can avoid systematic errors. Moreover, it identifies four main characteristics of validity that relates to road safety evaluation in the current study, i.e. the construct (theoretical) validity, internal validity, external validity, and statistical conclusion validity.

i. Construct (Theoretical) Validity

The (Austroads, 2012), indicate that the construct validity (or theoretical validity) refers to the conceptual soundness of an evaluation, including the way in which theoretical concepts are translated into real-world comparisons. In order to ensure high construct validity in the study, the authors recommended the following:

- To define the variables;

The independent variables as the variables that directly affect crash outcomes e.g. speed, while the dependent variables as the variables that are aspects of the crash outcomes e.g. severity of injuries etc. The current study, defined the independent variable as the roadway characteristics within the DART corridor over the period under considerations, the social-economic and demographic data, and traffic volume, while the dependent variables were defined as the crash frequency and crash severity.

- Secondly, author recommended to defining clearly the hypothesis to be tested e.g., speed humps improve road safety.

The current study, had the main hypothesis that the implementation of DART system has generally improved traffic safety by reducing the frequency of crashes in the DART corrido; however, traffic safety for specific road users such as motorists has deteriorated.

- Lastly, to specify the process by which the measure brings about a reduction in crash risks

As an example from the author, speed humps reduce vehicle speed, therefore, it reduces the risk of collision because drivers will have more reaction time and would not require long braking distance.

In the current study context, the process was defined that the DART system reduces crash frequencies due to multiple road treatment involved in its implementation, however, to some specific areas, the system could result to higher crash frequencies. To mention as an example, the DART system separated Motorized Transport (MT) from Non-Motorized Transport (NMT) users by constructing cycle paths and walkways on both sides of the road, it also involved construction of raised at level pedestrians' crossings, installation of pedestrians signals at signalized intersections, construction of overpass pedestrians crossing on high pedestrians' zones, etc. Therefore, these treatments reduce the traffic conflicts between motorists and NMT users' thus posing higher possibility for reducing the number of crashes involving NMT. These are few among the measures implemented in the DART corridor that can result to reduced crash occurrences, therefore, the author expected the DART system to have improved traffic safety in its corridor.

ii. Internal Validity

According to (Austroads, 2012) internal validity is the consistency of the pattern of findings, for instance, the consistent in reducing crashes by applying a specific treatment at different locations support the internal validity of the evaluation. The authors indicate that when the results of an evaluation are consistent with established theory or with the results of other similar studies, it suggests that the findings of the study are valid. However, when the findings contradict the existing theory or do not agree with other studies, it suggests that the logic and execution of the study needs to be re-examined.

iii. External Validity

The external validity of the study relates to the possibility of generalizing the study findings to situations beyond those examined. (Austroads, 2012) indicate that addressing external validity may involve comparing studies across different settings, when the study findings are similar then their external validity is high, but if they differ substantially, their external validity is doubtful. For instance, they indicate that the study findings presented several times in many different settings are more likely to be valid than those from two or three studies in a limited range of settings.

iv. Statistical Conclusion Validity

As stated by (Austroads, 2012), the validity of the statistical conclusion depends on the accuracy and representativeness of the results and their analysis. They indicated six criteria to assess the validity of statistical conclusion; (1) the use of appropriate sampling technique, (2) to have an adequate sample size, (3) specifying the evaluation whether is in terms of crash numbers or injury severity outcomes, (4) to report the uncertainty associated with estimates and (5) to use appropriate statistical testing techniques. The considerations of these requirements in the current study are detailed under the methodology section including the possible sample size for the study in DSM.

### *2.1.3 Main Threats to the Validity of an Evaluation*

In order to meet many evaluation criteria for validity, the (Austroads, 2012) recommend researchers to be aware of the threats to validity so as to make informed choices to maximize validity within available time and resources. The following section discusses the key threats to validity with respect to the current study.

i. Changes in Traffic Flow

According to (Austroads, 2012), the changes in traffic flow can have significant impacts on road safety evaluation. It indicates that the increase of traffic flows for whatever reasons in the study area needs considerations in the evaluation. The increase in traffic volume being related or unrelated to the treatment i.e. the overall growth in traffic over time, traffic volume changes due to the opening of an alternative route, or due to treatment itself are likely to affect the number of crashes. As an example, the (Austroads, 2012) indicate that increasing traffic has higher likelihood of increasing crashes while reducing traffic may reduce crashes, in addition, the authors reminded that it’s not always the case that crash risk increases or decreases in a linear fashion with vehicle flows. However, according to (AASHTO, 2010; Austroads, 2012; Carter et al., 2012; Gross et al., 2010), road safety evaluation using before/after with comparison group method ⍰, takes into account the effects of changes in traffic volume and all other crash contributing factors that are not related to the treatment itself.

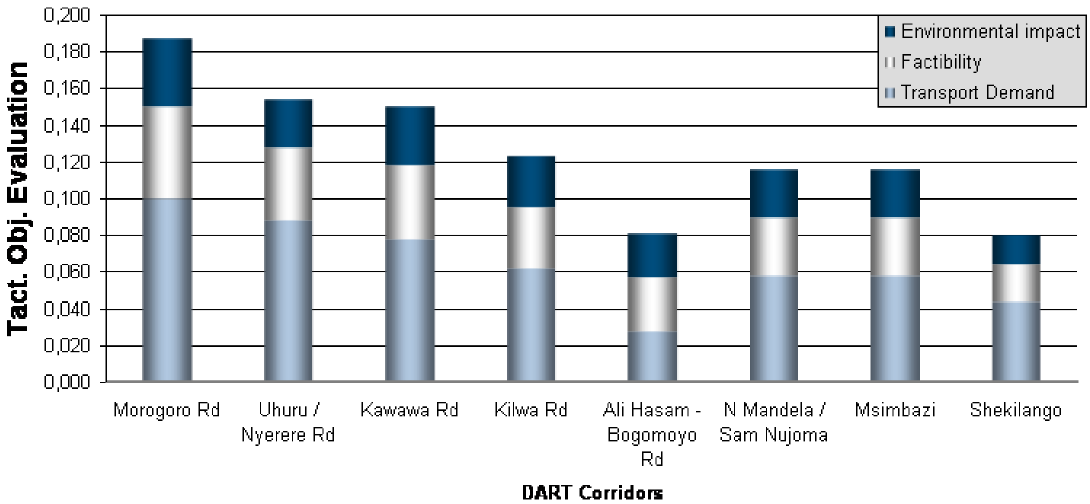
ii. General Crash Trends

According to the HSM, the general trends in transport system that are not related to the treatment itself can also affect the number of crashes at a treatment site. The general trends may include the introduction of safer vehicles, changes in driver’s behavior through enforcement or awareness programs, change in vehicle composition, i.e. increased usage of motorcycle which have higher risks of fatal or severe injuries when the crash is unavoidable (AASHTO, 2010). However, evaluating the road safety effectiveness using before/after with comparison group method takes into account all effects of crash contributing factors that are not related to the treatment itself including the general crash trends, (AASHTO, 2010; Austroads, 2012; Carter et al., 2012; Gross et al., 2010).

iii. Regression to the Mean (RTM)

According to the HSM, the RTM refers to a tendency of crash occurrence at a particular site to fluctuate up or down, over the long term, and to converge to a long-term average (AASHTO, 2010). The HSM reveals that this tendency introduces regression-to-the-mean bias into crash estimation and analysis, and that RTM bias can lead to overestimation of the treatment effectiveness. For instance, the (Austroads, 2012) indicate that applying treatments to sites with extremely high crash frequency, in the after-treatment period they may appear to be more effective than they truly are due to the effect of RTM.

(Srinivasan et al., 2013) revealed the significance of paying attention to RTM in road safety evaluations in the following example. For a site or group of sites selected for treatment based on higher crash counts, in the after-treatment period, there is a higher possibility that the number of crashes would reduce by chance alone as the effect of RTM, regardless of the treatment applied. Therefore, in this case, the treatment may give false improvement figures due to the RTM phenomenon implying that higher crash count in the before period may have been so as a matter of chance. Furthermore, (Srinivasan et al., 2013) show that the greatest effect of the RTM phenomenon can occur due to inappropriate selection of control sites. For instance, if sites are assigned to the control group because they have low or zero crash counts compared to other sites in the before period, the RTM effect is likely to result in an increased number of crashes in the after-treatment period.




Source; (LOGIT, 2009)

Figure 9 Multi-criteria evaluation for DART implementation – normalized results

In the current study, the author argued that the RTM effect would less likely affect the evaluation results because the priority analysis for implementing the DART system phase 1 was based on evaluation criteria other than crash counts. According to (LOGIT, 2009), the priority analysis were based on three main factors as summarized in Figure 9. (1) The first criteria were the transport demand (it included the current public transport demand on the corridor, the low-income demand in the city, and public transportation travel impact). (2) The second criteria were the feasibility of the project (easiness of implementation, financial viability, daladala routes to be canceled and the generalized costs benefits). (3) The third criteria were the assessment of the environmental impacts (demolitions, air and sound pollution, urban area development and the construction impacts).

## 2.2 Methods to evaluate the objective safety of road treatments

According to (AASHTO, 2010; Austroads, 2012; Carter et al., 2012; Gross et al., 2010), the objective safety evaluation study designs for road treatment fall into two broad categories; experimental and observational studies. The experimental study designs aim to evaluate safety improvements implemented to randomly selected sites solely for evaluating their effectiveness, while in observational studies, the site selection is not part of an experiment, instead, sites are selected for other reasons including safety improvements to improve the roadway system.

Based on the current study context, that involved evaluating the objective safety effectiveness of the DART system that was implemented for other reasons other than as an experiment, therefore, the experimental design was not applicable. However, the authors indicated that there are two classifications of observational studies namely before-after studies and cross-sectional studies as discussed below.

### *2.2.1 Cross-sectional studies*

According to (Carter et al., 2012), the cross-sectional studies include techniques to compare the safety of one group of entities that have some common feature (say, STOP controlled intersections) to the safety of a different group of entities without that feature (say, YIELD controlled intersections) in order to assess the safety effect of that feature (STOP versus YIELD signs). As indicated by the HSM, the validity of cross-sectional studies highly depends on selection of control sites; the control sites need to have similar characteristics as that of treated sites (AASHTO, 2010). For instance, the roadway class, road division type, state, municipality, area type, number of through lanes, speed limit, traffic volume range, traffic controls, intersection type, intersection and segment geometry, and other relevant details for control sites have to be similar with that of treated ones. The road corridors that are comparable to DART phase 1 are shown in Figure 13. The data necessary to identifying the characteristics of DART phase 1 and comparable sites as summarized in Table 3 which also indicate the source of data.

According to (AASHTO, 2010; Austroads, 2012; Gross et al., 2010), the cross-sectional study assumes that all sites with similar characteristics have the same safety performance if no treatment applied to one of them. They argue that if the treatment and control sites had similar characteristics in the period before treatment, then any deviation in their safety performance in the period after-treatment is attributable to the treatment applied to treated site.

However, (Elvik, 2011) indicate that the cross-section studies involve evaluating safety performance by comparing different sites that are possibly used by different road users, located in different places, and possibly subjected to different weather conditions. Therefore, revealing that these factors and any other unknown factors if not well controlled would affect the cross-section study evaluation. In addition, the author, shows that there is no assurance in cross-sectional studies that statistical analysis can capture all-important differences between treated sites and comparison sites and estimate their effects correctly. He recommended a cross-sectional study design only when data on the period before treatment are not available and when comparison sites have similar characteristics as much as possible with the treated sites.

Likewise, (Gross et al., 2010) recommended a cross-sectional study design to sites where the treatment was applied but there are no sufficient data to conduct a before-after study. Similarly, the HSM recommends a cross-sectional study design in situations where the before-after study is undesired. For instance, in situations with insufficient or no data in the period before treatment, i.e. the treatment installation dates are not available, crash and traffic volume data for the period before treatment implementation are not available, etc. (AASHTO, 2010).

However, in the current study context, this method could not apply because there were no sites that could fit the requirements of sites to be categorized as comparison sites. This has been explained in details in the methodology section.

Two main limitations of cross-sectional study designs as stipulated in the HSM; -

i. There is no good method to account for the potential effect of regression-to-the-mean bias introduced by site selection procedures.
ii. It is difficult to assess the cause and effect relationship, thus making it unclear to infer whether the observed differences in safety performances between the treatment and non-treatment sites are due to the treatment itself or are due to other unexplained factors.

#### *2.2.2 Observational Before-After study*

According to (AASHTO, 2010; Susan Herbel et al., 2010), the observational before/after studies are the most common approach used to evaluate the objective safety effectiveness of engineering road treatments. They are applicable for instance in situations where the agency has implemented a treatment i.e. constructed left-turn lanes to specific locations say on a two-lane highway where concerns about crash frequency had been identified (AASHTO, 2010).

However, the HSM indicates that observation before/after studies are highly likely to be affected by bias associated with site selection especially those related with regression-to-the-mean (RTM) effects due to site selection based on higher crash frequency. Though, it entails that the effects of RTM can be avoided by selecting sites for treatment not base on unusually high crash frequencies. Therefore, to avoid RTM bias, the sites selected for safety evaluation have to be the projects implemented in normal efforts to improve the operational and safety performance of the road transport system (AASHTO, 2010). This was the case in site selection to implement the DART system phase 1, the criteria for site selection were other than crash counts in the corridor as discussed in section iii. Therefore, RTM bias would have less likely to affect the validity of before/after study design for evaluating objective safety impacts of the DART system phase 1.

In addition, contrary to cross-sectional studies, (Elvik, 2011) indicated that the before-after study design evaluates the safety effectiveness of the same road located in the same place possibly subjected to same users and weather conditions in both periods of before and after treatment. Therefore, he argues that both the known and unknown factors that are highly likely to affect the cross-sectional evaluation are less likely to affect a before-after study, as they can be assumed constant or almost constant during the before-and-after periods.

Therefore, based on these facts, before/after study design was more relevant for the current study. However, the HSM indicates several types of before/after study designs. But before digging into types of before/after study to identify the desirable type for the current study, the author went through in details to understand the potential issues and biases associated with using before/after study methods.

i. Potential Issues and Biases with Before-After Studies

- Regression-to-the-mean (RTM)

As discussed above in section iii, RTM is the tendency of the occurrence of crashes at a particular site to fluctuate up or down over the long term and to converge to a long-term average. In other words, it can be defined as the tendency of sites with abnormally high or low crash counts to return (regress) to the usual mean frequency of crashes during the following years (Carter et al., 2012). According to (AASHTO, 2010; Carter et al., 2012; Susan Herbel et al., 2010), a before-after study is likely to have biased results due to RTM if the treatment sites are selected for treatment based on the high short-term crash count. They argue that, in such situations, crashes at treated sites may decrease by chance in the after-treatment period even if the treatment does not have any effect. Consequently, if bias due to RTM not well addressed, they indicate that a study may overestimate the safety effects of the treatment. Therefore, they infer that the effect of RTM is less likely to bias the results of evaluation if the sites to be treated are not selected based on a high crash history. In addition, (Carter et al., 2012) they revealed that other external effects including weather and changes in driver behavior during the study period need to be addressed through the use of a suitable comparison group.

- Changes in traffic volumes

The changes in traffic volumes during the study period are likely to affect the study findings if not appropriately addressed. Referring to (Carter et al., 2012), the authors indicated that traffic volume may increase or decrease in the after-period. If the change in traffic volume is significant the authors signpost that before/after study may underestimate or overestimate the safety effectiveness of the treatment by wrongly attributing the portion of crash change that may be due to traffic increase or decrease to the treatment effects.

In the context of DSM, the change in traffic volume in the study period was highly likely to be significant due to a higher rate of growth in vehicle fleets. According to the transport sector review in Tanzania between 2005 and 2010, Tanzania had an overall annual fleet growth exceeding 28% where tricycles and motorcycle had the extreme growth rates of 77.8% and 59.8% respectively (AFDB, 2013). The report indicated highest traffic flows in DSM especially on the central corridors (CBDs) with almost 50,000 annual average daily traffic (AADT) that drops to about 35,000 AADT close to Ubungo and to 27,000 AADT at about 27 km away from where the dual carriageway terminates. Therefore, they concluded that traffic is probably growing rapidly by reflecting the economic growth rate in DSM.

However, (Carter et al., 2012), recommended the use of annual traffic data to develop a crash prediction model to use in the analysis or to adopt a before-after study design with comparison sites. Therefore, based on the difficulties associated with developing a crash prediction model particularly the needs for SPFs and CMS as discussed in section 2.1.1 and ii, the current study targeted on using before-after study with comparison group method.

- History trends

When conducting before-after study design, (Carter et al., 2012) indicated that it is imperative to address the possible effects to crash counts that are associated with variation in weather, demography, gas prices, vehicle types, population growth, and other safety treatments, or other unknown factors. The authors argue that these factors may significantly change during the study period; therefore, if not well accounted, they would bias the evaluation findings. For instance, they illustrate the effect of weather conditions by considering a case for treating curves with high friction surface to decrease run-off-road crashes. They revealed that if the weather during the before period was snowy and icy winters followed by the after-period with much less precipitation, then a decrease in the rate of run-off-road crashes would be expected regardless of whether a high friction surface was applied. Therefore, they argued that in addressing the effects of historical trends, it is essential to use a reference or comparison group otherwise it would be difficult to separate the effect of the treatment from the effect of other underlying factors. However, applying a before/after with a comparison group method takes into accounts the effects of historical trends.

ii. Types of Before-After Study Design

There are several types of before-after studies; mostly all types require crash data and traffic volume data from both periods; before and after implementing safety treatment measures. Application of this study design as discussed in section iii, might result to biased conclusion due to the RTM phenomenon if the treatment sites were selected based on unusually high-crash frequency. The section below discusses types of before-after studies with respect to their suitability in the current study.

- Simple Before-After Study

According to the Highway Safety Improvement Program (HSIP) evaluation guide by (Gross, 2017), a simple before-after study involves a basic comparison of crashes before and after the implementation of a particular treatment. He claims that the safety effect of a countermeasure is evaluated by directly comparing the frequency of crashes in the after period and the crash frequency in the before period.

In addition, he reveals that the method does not account for the possible bias due to RTM and does not account for temporal effects or trends such as changes in traffic volume, changes in driver behavior, and changes in crash reporting as discussed in section 2.1.3 of this report. He argues that the method can address the effect of traffic volume change by incorporating the actual traffic volume data if they changed during the study period. For example, as one of the options mentioned, to account for changes in traffic volume during the study period it would involve multiplying the before period crashes by the ratio of average traffic volume in the after period to the average traffic volume in the before implementation period.

Therefore, this method was not preferred for the current study due to possible effects by RTM and other unknown factors unrelated to the treatment that could affect the crash frequencies and severity in the study period.

- Before/After with shifts in proportions of target collision types

According to the HSM, road safety evaluation by the before/after with shifts in proportions method aims to quantify and assess the statistical significance of a change in the frequency of a specific collision type expressed as a proportion of total crashes from before to the after period of implementing a specific countermeasure or treatment (AASHTO, 2010).

In addition, the HSIP Evaluation Guide by (Gross, 2017) indicates that this method is often useful to evaluate the shift in the proportions of crashes by type or severity levels when the treatment implemented targeted specific crashes. For example, the shift of proportions method would be useful in determining the safety effectiveness of projects such as cable median barrier and high-friction surface treatment. The author indicates that these countermeasures (cable median barrier and high-friction surface treatment) target specific crash types, the cable median barrier projects; targets cross-median crashes, while the high-friction surface treatment; targets wet-weather lane departure crashes. In addition, the author explains that in situations where the treatment involved replacing a two-way stop-controlled intersection with a roundabout to address fatal and serious injury crashes, it would be useful to know if the proportion of fatal and serious injury crashes has decreased after the conversion. Then the method could be applied in that case.

However, as the implementation of DART phase 1 was not specific in addressing particular crash or severity types, and generally not based on crash aspects, this method was not desired in the current study. Nevertheless, the HSM, indicate that the method uses data from treatment sites only, i.e. it does not require non-treatment or comparison sites, therefore, the validity of the study may be affected by other confounding factors unrelated to treatment and that it does not account for RTM, therefore, the author did not consider this method as suitable for the current study.

- Empirical Bayes Before/After Safety Evaluation Study

According to (Austroads, 2012), the Empirical Bayes (EB) method has been designed to take into consideration the effects of RTM and other factors which may affect crash outcomes when the allocation of sites to treatment and non-treatment is not done randomly. The authors indicated that the evaluation procedures were named after the eighteenth-century statistician; Thomas Bayes, who pointed out that the likelihood of something happening can be plausibly estimated by how often the event occurred in the past. (Gross et al., 2010), stipulated the strength of the EB method on its ability to address the regression-to-the-mean effect as compared to other methods. They also indicate that the method is better than the comparison group method in accounting the change in safety effectiveness attributable to trends in traffic volumes and time, by its ability to use SPFs.

The method uses SPFs to estimate the number of crashes that would occur at treatment sites if no intervention had taken place and compare with the actual number of crashes observed at the sites. In accordance with (AASHTO, 2010) the method applies similar principles of comparable sites/ comparison group as applied in before/after with comparison group method. However, the authors indicate that their difference between the two methods is that the EB method uses data from untreated "reference" group to estimate the SPF that can relate crashes experienced at the sites with their traffic and physical characteristics.

According to (AASHTO, 2010), the EB Method is only applicable in the following project condition;

a) To sites where no changes to roadway geometrics and traffic control (e.g., the "do-nothing" alternative).
b) In the projects that modify roadway cross-sections but the basic number of through lanes remains the same, i.e. treatment to widen lanes or shoulders or to improve the roadside environment.

c) In the projects that involves minor changes in alignment i.e. levelling individual horizontal curves while leaving most of the alignment intact.
d) In the projects that aim to add weaving section to a freeway, and;
e) In the projects that where the improvement combines the above treatments.

In addition, the HSM shows that the EB Method is not applicable to projects that involves the following road treatments: -

a) Development of new alignment for a substantial proportion of the project length
b) Changing the basic number of intersection legs or type of traffic control as part of a project.

The HSM reveals that in the above two types of projects; the observed crash data in the before treatment period is not necessarily indicative of the crash frequency likely to occur after a major geometric improvement in the after period (AASHTO, 2010).

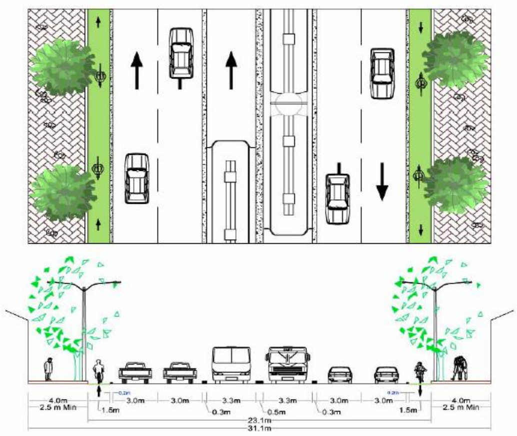


Figure 10 Standard Cross Section of DART system off-Station

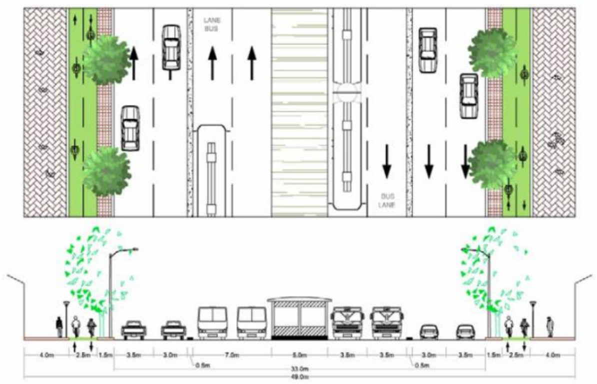


Figure 11 Standard Cross Section of DART system at Stations

Source; (LOGIT, 2009)

Based on the above two conditions, this method was considered inappropriate in the current study context. This is because the DSM Rapid Transit project involved major improvement in the road geometry including changing roadway segments in large proportion from four lanes divided roadway to six lanes roadways (of which two are exclusive lanes for DART buses, and four lanes are for mixed traffic; two lanes in either direction).

In addition, the project involved construction of cycle paths, walkways, bus stations/terminals at the middle of the road segments, at-lever pedestrians' crossings (at the ends of each station i.e. front and rear sides of each bus stations), and also the construction of overpass bridges at three busiest bus terminals (Kimara, Kuvukoni and Morocco terminals). The standard cross-section of the DART system at off-stations and at stations are as shown in Figure 10 and Figure 11 respectively.

- Before/After with Comparison Group method

Referring to (AASHTO, 2010; Gross, 2017; Gross et al., 2010), the Before-After with Comparison Group method uses a reference group of untreated sites that are comparable to the treatment sites in terms of traffic volume, geometrics, and other site characteristics in the before treatment period. They indicated that comparison sites are involved in the evaluation to take into account the changes in crashes unrelated to the treatment (i.e. changes due to traffic volume trends, weather conditions etc.).

According to (Austroads, 2012), the comparison group method has two principle assumptions;

a) The factors unrelated to treatment (i.e. changes due to traffic volume trends, weather conditions, etc.) affect the crash frequency and their severity at both the treatment and comparison sites at the same rates in both before and after the treatment period.
b) The factors unrelated to treatment have the same effects on crash outcomes at both treatment and comparison sites.

Therefore, the authors argued that; as both treatment sites and comparison sites are subjected to the same factors, then any differences in their safety performance in the period after treatment is attributable to the treatment itself (Austroads, 2012).

However, the HSM indicates that the precision of this method is highly dependent on the selection of the appropriate comparison group (AASHTO, 2010).

- Requirements for the sites to be categorized in comparison group

The (Austroads, 2012) provided the following requirements for the sites to be categorized in the comparison group;

- The rate of crashes and methods of measurement (including time frame/period) of any historical data must be consistent.
- The characteristics of comparison sites must be generally similar to the treatment sites (i.e. network set-up, geometry, nearby land use, enforcement, socio-economic characteristics etc.).
- Both comparison and treatment sites must have similar traffic flows.
- Comparison sites must not be subject to crash migration from the treatment sites.
- Comparison sites must not be in relatively close geographic proximity to the treatment sites.
- Comparison sites must remain untreated for the duration of the study.

- Limitation of the comparison group method

Referring to (AASHTO, 2010; Austroads, 2012), the method has mainly two limitations.

- It does not account for regression to the mean effect.

However, (Austroads, 2012) indicated that if the treatment and comparison sites are matched based on the observed crash frequency in the period before treatment or when the sites for treatment were not selected based on their unusual high crash frequencies as for the case of DART, the method would less likely provide biased results.

- The method does not consider treatment sites with zero crash frequency.

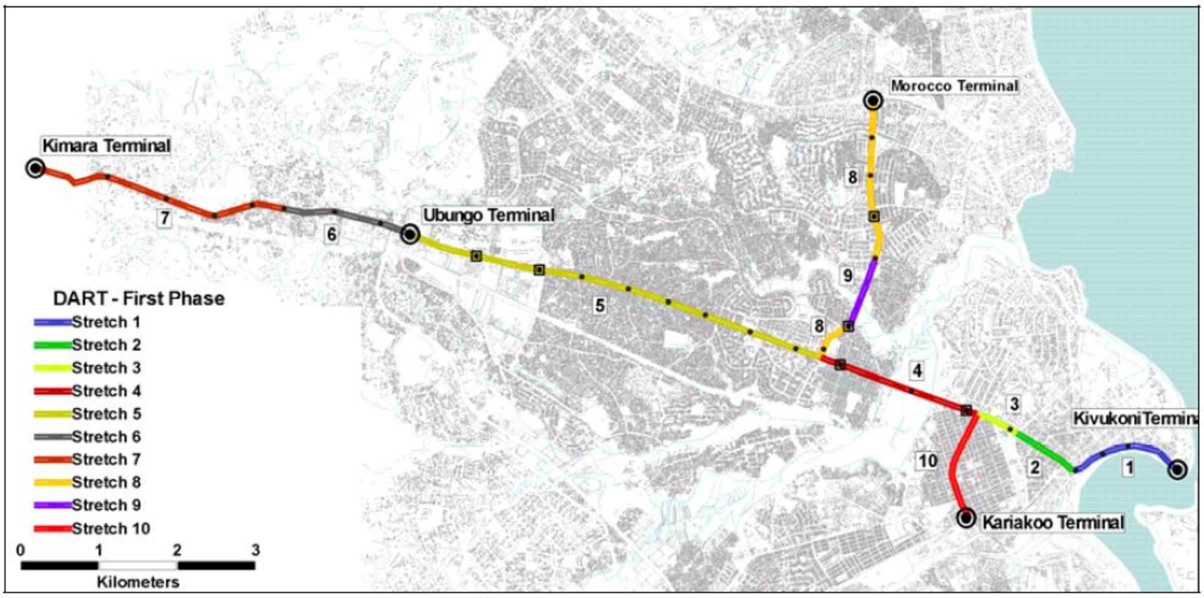
According to (AASHTO, 2010), involving sites with zero crash records increase the risk of overestimating the treatment effectiveness, i.e. sites with no crashes in the after treatment period would represent locations where the treatment had most effective. The current study aimed at excluding all sites with zero crashes in the evaluation.

- Assessing the comparison group method for the study context

The assessment was in accordance to (Gross et al., 2010), which indicate that when assessing the suitability of a before/after with comparison group method, the first question to ask would be whether the data about the treatment of interest are available. Based on the context of the current study, the data about the treatment sites (DART phase 1) were available from the DART agency as summarized in Table 3.

In addition, they indicated that the researcher has to find out whether there are sufficient sample (number of sites and crashes for both comparison and treatment sites) for the before-after study. According to the HSM, this method requires both treatment and comparison groups each to have at least 10-20 sites, and a minimum of 650 aggregate crashes at comparison sites. In addition, it requires at least 3-5 years of crash data for both before and after treatment.

Considering the study context "DART project phase 1", the project covers a roadway of 20.9 km with the possibility of subdividing the corridor into more than 10 roadway segments of similar characteristics.




Source; (InterConsult et al., 2007)
Figure 12 Subdivisions of the DART system phase 1

For instance, Figure 12 shows 10 subdivisions of DART system phase 1 that can be among the selected treatment site, the details of these segments are summarized in Table 1. Figure 13, shows the DSM road network on the period before implementation of the DART project. Therefore, complying with the requirement that treatment and comparison group should have similar characteristics in the period before applying the treatment; then Figure 13, indicates the road segments that were comparable to the treatment sites before DART implementation. The treatment of DART system phase 1 was applied in the following roads; -

- Morogoro Road, four lane divided roadway between Kimara and Bibititi road
- Kawawa road, a four lane divided roadway, and

- Msimbazi road, mostly two lanes undivided roadway.

Referring to Figure 13, the comparison group for instance for the treatment sites along Morogoro road between Kimara and Bibititi may be drawn from Nyerere road, Ali Hassani Mwinyi road etc., these roads are among the roads that were not treated with the DART phase 1.

Therefore, adhering to the road characteristics required to assign a site into a comparison group, most road segments and intersections from the above-mentioned roadways were anticipated to fall into sites comparable to the treatment sites. However, in realistic, the current study could not have sufficient number of comparable sites as explained in detail in methodology section.

Table 1 Possible road segments for the treatment sites

| Segment | Treatment Sites | Length (km) |
|---|---|---|
| 1. | Kivukoni Front - (Kivukoni Terminal to City Council Station) | 1.46 |
| 2. | Morogoro road (City Council Station to Bibititi Road) | 0.82 |
| 3. | Morogoro road (Bibititi to United Nations) | 0.88 |
| 4. | Morogoro road (United Nations to Kawawa) | 1.8 |
| 5. | Morogoro road (Kawawa to Ubungo) | 6.16 |
| 6. | Morogoro road (Ubungo to Kibo, towards Kimara) | 0.99 |
| 7. | Morogoro road (Kibo to Kimara) | 3.46 |
| 8. | Kawawa Road branch | 2.67 |
| 9. | Kawawa Road branch (Kinondoni A to Kanisani) | 1.05 |
| 10. | Msimbazi Street branch | 1.68 |

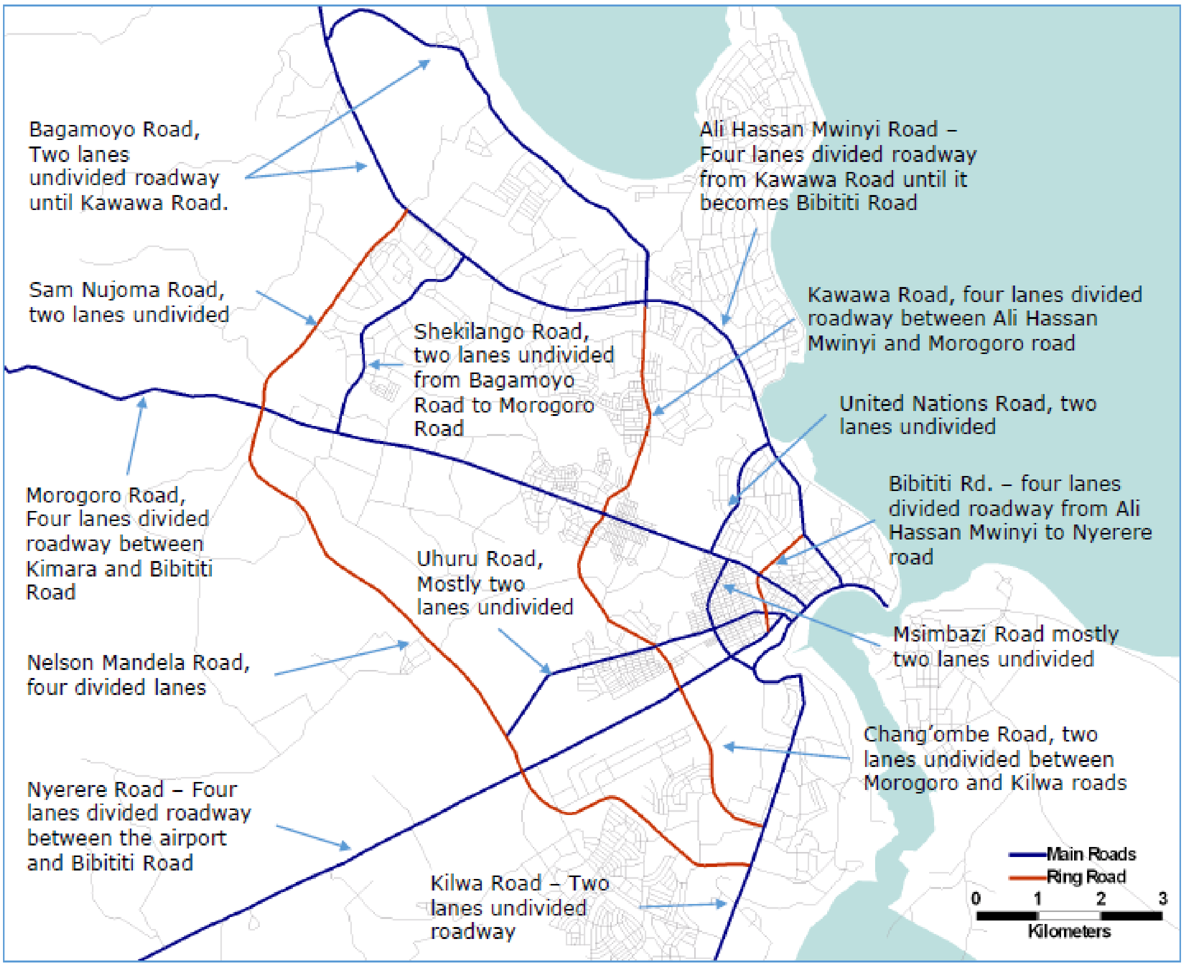
Source; (LOGIT, 2009)

Table 2 Intersections upgraded during construction of DART phase 1

| S/N | Intersecting roads | S/N | Intersecting roads3 |
|---|---|---|---|
| 1. | Morogoro and Bibititi | 2. | Kawawa and Kinondoni Junction |
| 3. | Morogoro and Lumumba | 4. | Kawawa and Mwinyjuma Junction |
| 5. | Morogoro and Msimbazi | 6. | Kawawa and Malongwe Junction |
| 7. | Morogoro and United Nations | 8. | Kawawa and Mlandizi Junction |
| 9. | Morogoro and Kawawa | 10. | Msimbazi and Swahili Junction |
| 11. | Morogoro and Mabibo | 12. | Msimbazi and Mafia Junction |
| 13. | Morogoro and Shekilango | 14. | Msimbazi and Uhuru Junction |
| 15. | Morogoro and Mandela/Sam Nujoma Junction | 16. | Msimbazi and Lindi Junction |
| 17. | Kawawa and Bagamoyo/Ali Hassam Junction | 18. | Msimbazi and Nyerere Junction |
| 19. | Kawawa and Dunga Junction | | |

Source; (LOGIT, 2009)

Therefore, a sufficient number of treatment sites (10-20 sites) were possibly available without doubts. However, the researcher carried out an analysis to verify the suitability of anticipated comparison sites, and as detailed in methodology section, most sites did not qualify in the group of comparison sites.




Source; (LOGIT, 2009)

Figure 13 Dar es Salaam road network

## 2.3 Review of previously conducted studies to evaluate road safety in the BRT context.

### *2.3.1 Review of studies that evaluated the objective safety impacts of BRT systems*

As discussed in section 1.2, the literature indicates that Bus Rapid Transit (BRT) systems are a potential solution for improving traffic safety, however, it revealed that a one-size-fits-all approach does not apply for improving road safety by BRT systems (Vecino-Ortiz & Hyder, 2015). For example, a study conducted by (Duduta et al., 2012) using data from nine BRT systems and busways around the world (including Curitiba, Brazil; Bogotá, Colombia; Mexico City, Mexico; and Delhi, India) examined the road safety impact of high-performance bus rapid transit and busway designs. The study involved crash frequency modeling using negative binomial regressions, road safety inspections and interviews with safety experts and staff from transit agencies. The study reveals that the exclusive centered bus lane systems as applied in the case of the DART system generally tended to be safer than curbside systems and that the counter-flow lane systems were the most dangerous BRT configuration.

Furthermore, they pointed out that some of the BRT features like multiple bus lanes and multiple docking bays at stations as applied in the DART system (a designed for higher passenger capacity) may introduce new types of conflicts and crashes. They indicated the need for trade-offs between capacity, safety, and pedestrian accessibility along the corridor for cities that are planning to implement a BRT system.

Moreover, (Duduta et al., 2012) indicated that as the consequence of less engineering considerations to protect pedestrians in Delhi BRT corridor, Delhi witnessed 17 fatal crashes in 2010, significantly higher than the annual average of 8.66 fatalities in 6 years before its implementation, this is equivalent to 50% road safety deterioration. However, this is contrary to the considerations made to the DART system, the system was designed with provision for walkways, at-level and overpass pedestrian crossing facilities. Therefore, the author in the current study expected reduced crashes that involves pedestrians. For the case of Delhi BRT, it was indicated that among the observed fatal crashes, the most common were pedestrians being-run over by buses operating in the busway.

Nevertheless, the authors revealed that, the BRT systems does not only have road safety impacts on its corridor but also to areas beyond its corridor. For example, (Duduta et al., 2012) showed that prohibiting left turns at all intersections by introducing loops to access side streets along the Macrobús corridor in Guadalajara resulted in significant reductions in crashes in the BRT corridor; however, there was an increase of crashes to some intersections along the loops. This approach was implemented in the DART corridor, where in some specific junctions right turning were prohibited and instead vehicles has to use loops in streets along the DART corridor. Therefore, the current study expects changes in crash frequency along the streets that are used by right turning vehicle from the DART corridor. However, this study was limited only to crashes within the DART corridor.

Nonetheless, regardless of possible negative road safety of BRT systems, a wide range of literatures indicate the BRT systems to have positive road safety impacts. For example, a study by (Bocarejo et al., 2012), a before-after road safety evaluation study using geographic information system techniques assessed the safety impact of TransMilenio BRT in Bogota. The findings indicated an overall reduction in traffic crashes; a 60% reduction of crash at the Caracas corridor and 48% reduction for Norte-Quito-Sur (NQS) corridor) and the average crash reduction in Bogota of 39%. However, the study indicated an increase in crashes for some specific areas i.e. areas around busiest stations and on roads where speed increased significantly due to wide space for private cars and the general upgrading of the road surface. The study gave more emphasis on the need to improve pedestrian facilities along high-speed corridors and around busy stations in the BRT designs.

The DART system segregates BRT lanes from mixed traffic by continuous installed curbstone (400mm high) in almost all corridor except at the intersections and in some stations where DART buses overtake using extra lane from mixed traffic lanes for express services. Therefore, based on the insights from the literature review especially the possibility of BRT system to increase crashes at some busiest stations; the current study aimed at inspecting the exact locations of crashes in the DART system, to have a clear picture to whether the crash frequency has significantly increased or decreased over the study period, however, this could not be achieved due to lack of specific details to locate the exact locations of most collected crashes.

Nevertheless, a study conducted by (Vecino-Ortiz & Hyder, 2015) by reviewing the available literature showing the links between BRT systems and road safety. The study used search engines in the review including MEDLINE, Google Scholar, EMBASE, and the Transport Research International Documentation database. The findings indicated that, majority of studies to evaluate the road safety effects of BRT systems were not addressing directly the effect of BRT on road safety nor providing empirical evidence to support such effect. The authors argued that in few available studies, the findings have mixed effect of BRT systems on road safety and they indicated that a one-size-fits-all formula does not apply on improving road safety by BRT systems. In addition, they indicate that the available studies have paid low attention to the effects of heterogeneity of the urban environment around the BRT lanes.

Therefore, in order to account for the effects of heterogeneity of the urban environment, the current study aimed of using the before/after study with a comparison group method that takes into account all other confounding factors unrelated to the treatment. The method uses untreated sites that are comparable to the treatment sites in the period before implementing the treatment, the method assumes all factors unrelated to treatment affect the crash frequency and severity at both treatment and comparison sites at the same rates in both periods before and after treatment. That is, the effects of heterogeneity of the urban environment around the BRT corridor on the observed crash frequency is assumed the same as the effects of heterogeneity of the urban environment on the observed crash frequency of comparison sites, this is because both treatment and comparison sites were similar thus would have the same trend if the treatment would not apply to one of the sites.

In other words, the method assumes that the rate of urban development between the treatment and comparison sites would have remained the same if no treatment applied to the treatment sites, therefore, the extra development (change) brought around the treatment sites than on the comparison sites are treated as part of the effects of implementing the BRT system. Therefore, the current study attributes all possible safety impacts from the extra development brought around the treatment sites in the after treatment period (for instance, the increase of retail business around the DART stations compared to comparison sites in the period after treatment etc.) as part of direct safety impacts of BRT system observed in the trends of crash frequency.

In addition, the study by (Vecino-Ortiz & Hyder, 2015) suggested that most studies lack tools to make inferences on causality using observational and non-experimental data, i.e. they usually make before/after studies with no real counterfactuals. The authors revealed that some of the existing literatures that supports the BRT effects on road safety are based on modeling infrastructure changes related to BRT systems, rather than on empirical data. Accordingly, they argue that BRT systems should reduce road traffic crashes and injuries by reducing the speed in their corridors, reducing circulations of mixed traffic, and by modifying the surrounding infrastructure. Therefore, they concluded by a call for more empirical studies to evaluate the BRT safety effectiveness based on observational data. This was the intention of the current study to enhance policymakers to make the best evidence-based decisions of improving traffic safety in BRT systems based on the strongest possible empirical findings.

#### *2.3.2 Review of studies that evaluated the subjective safety impacts of BRT systems*

Apart from the BRT impacts on objective safety, the literature indicate that BRT systems may results in increased or decreased level of subjective safety among system users. For instance a study conducted by (Cao et al., 2016) used a tri-variate ordered probit model to explore the satisfaction of BRT riders in respect to conventional bus and metro services. The study used revealed preference data from Guangzhou to finding out the top influential attributes for rider's satisfaction in BRT services. The findings indicated that safety while riding is among the top three attributes for passenger satisfaction in the BRT services. The authors recommend transit agencies to improve safety while riding by providing training and reinforce drivers' behaviors related to safer operation of buses and set reasonable rules including speed limits and restricting long driving hours to avoid fatigue driving.

In addition, a questionnaire study by (Nelloh et al., 2019) assessed the travel experience factors including safety, individual space, information provision, staff's skills, social environment, vehicle maintenance, off-board service, ticket line service, and waiting time on travel satisfaction and customer loyalty. The study findings indicate that among other factors, low perceived safety by passengers has a higher impact on their service satisfaction level. Passengers were highly satisfied during their trip due to high-perceived safety, comfortable spaces, and good skills of on-board and off-board staff, good vehicle conditions, and good ticketing service. However, they indicate low perceived safety as among the travel experience factors with poor passenger satisfaction. Therefore, as being the main objective of this study, identifying measures to improve the perceived safety would have significant contribution on improving BRT services.

Nevertheless, (Kuye et al., 2017) used questionnaires to examine the effect of BRT services in Lagos. The findings indicated that the BRT services reduced the cost for bus commuters and increased perceived safety and security in the city. The authors argue that the commuters' perceptions on safety and security were highly predetermined by the use of intelligent transport systems (ITS) in the BRT system, which is an integral part of the DART system infrastructures (i.e. the Automated Fare Collection System, Advanced Passenger Information System and Advanced Fleet Management System, however, they are not yet fully installed. This implies that there is the possibility of the positive subjective safety impact of the DART system to its users. Therefore, the current study focused on evaluating the safety feeling of DART system users including the feeling of how (un)safe DART passengers felt to use DART buses, this was compared to the feeling of other road users from their main modes of transport in the DART system.

Nonetheless, a study by (Arquez et al., 2017) used questionnaires, focus group discussion and surveys to explore the user preferences between BRT feeder services, motorcycle taxis and taxis in Bucaramanga city, Colombia. The findings indicated that the safety perception was the key variable for modeling travel choices. They indicated that travel fare and travel time were the most significant factors for passengers to switch to motorcycle taxi. However, the subjective factors including safety perceptions of riding a motorcycle taxi or BRT feeder services were the most important factors in choosing motorcycle taxis or BRT feeder service. They indicate that motorcycle taxis had higher preference due to its short travel time; though, its low perceived safety compared to BRT feeder services remained as among the constraints for passengers to use motorcycles.

Moreover, (Orozco-Fontalvo et al., 2019), explored the factors that influence women's perceived risk of sexual harassment in BRT system of Barranquilla, Colombia. The results indicated that more than 60% of respondents have been victims of sexual harassment in the BRT system; it showed that women experience more sexual harassments than men. The authors revealed that women felt more insecure than men when using bus stops and that the surveillance cameras and police did not increase the sense of security among women as compared to men. Overcrowded buses were indicated as having the most negative effect on the perceived risk of sexual harassment. They further revealed that travelling at night or travelling in lighting but being alone were all significant variables influencing sexual harassment in public transport.

Therefore, given the seriousness of sexual harassment problem and the lack of official data, the authors argue that it is important to integrate sexual harassment indicators in the evaluation of public transportation performance. Understanding the fact that sexual harassment in DSM may play a significant role in deteriorating the safety feeling particularly for female passengers in public transport; the current study aimed at exploring how safe different road users feels against sexual harassment in the DART system. Based on the insights and user perceptions on predefined measures of this study, the researcher will recommend potential safety measures that if implemented would increase the safety performance of specific users in the DART corridor and other BRT systems of similar context.

### 2.4 Summary of literature review

Generally, the review indicated that BRT systems have higher likelihood of improving road safety if proper engineering considerations are made to protect all road users' particularly the vulnerable road users (pedestrians, cyclists etc.). It also showed that BRT systems are no one-size-fits-all solutions to road safety problems, implying that some BRT resulted to an overall positive safety impacts while others resulted in negative safety impacts. Nevertheless, those with an overall positive safety impacts, on some specific areas resulted to increased crashes.

Nevertheless, apart from the impacts on crashes, the review also indicated that BRT systems have significant effects on the safety feeling of system users, i.e. passengers might feel safer/less-safe when on-transit with BRT buses as compared to other modes, this is highly dependent on the quality of BRT services offered. In addition, it indicated that the safety feeling of BRT system users is broadly affected by several factors including the lighting in BRT corridor especially in low lighting conditions. Moreover, apart from the crash risks, violence, protection against theft and sexual harassment are among the factors that greatly affect the safety feeling of road users.

In addition, the review indicated that we cannot conclude the safety performance of the BRT system implemented in a particular city based on the performance of the BRT system implemented in other city. This was mainly indicated as dependent on differences that may exist between the cities and levels of safety consideration between the two projects. This made the current study more relevant in order to provide the empirical evidence in understanding the safety impacts of the DSM BRT and at to recommend measures that would improve safety performance in DART system and in other BRT systems of context.

In addition, with exception to the RTM effects, the review indicated that before/after with comparison group method could address all confounding factors unrelated to road treatment that can affect the crash frequency in the study period. The method can address among other factors the effects of heterogeneity of urban environment surrounding the BRT corridor.

Moreover, the review indicated that the site selection for implementing DART phase 1 were based on factors other than crash counts in the DART phase 1 corridor. Therefore, making the current study less likely to be affected by RTM bias if an evaluation was to base on the before/after with comparison group method. Therefore, the before/after with comparison group method was the most desired method for the current study.

In addition, the review indicated among other methods, the Questionnaire as among the most used methods in evaluating the subjective safety effectiveness of BRT related projects. Therefore, the current study used the questionnaire based approach to evaluate the subjective safety effectiveness of the DART system.

# 3 RESEARCH METHODS

## 3.1 Research design

The research involved literature review and investigation of the road safety performance in DSM particularly in the DART corridor to identify the research problem for the study. Based on the research problem, research objectives and questions were formulated in order to give answers to the problem. Then key theories for the study were reviewed from the existing body of literatures using internet, mainly under UHasselt online library and Google Scholar.

In addition, through literature review the required data and methods for analysis were identified. The data were then collected during field work and then prepared for analysis using excel sheets. The data were statistically analyzed using SPSS to quantify both the subjective and objective aspect of the study to give answers to the research question.

## 3.2 Research methods for objective safety evaluation

As indicated in section 2.2, there are main two types of study designs for evaluating the effectiveness of road treatments;- experimental, and observation studies. Based on an in-depth review of the methods summarized in section 2.2 and the data available for the current study as summarized in Table 3, the researcher intended to apply the observational before-after study design.

After reviewing different methods under the observational before/after study design mainly their strengths and limitations; the researcher specifically aimed to use the before/after with comparison group method to evaluate the road safety effectiveness of the DART system due to the following reasons; -

i. Its ability to effectively evaluate the safety effectiveness of road treatments without using CMFs or SPFs which were considered difficult to get in the current study, (Austroads, 2012).
ii. Its ability to address the effects of all other confounding factors i.e. change in crashes due to change in traffic volume trends, weather conditions, heterogeneity of study sites, change in distribution of traffic, general changes in road users' characteristics due any other factors unrelated to the treatment, i.e. changes in crash due to increased awareness, enforcement, etc. over the study period, (AASHTO, 2010; Gross, 2017; Gross et al., 2010).
iii. The results for the before/after with comparison group method are less likely affected by RTM bias when sites for treatment are selected not based on their unusual higher crash frequencies, which was the case for the treatment sites in the DART system phase 1, (Carter et al., 2012).

Therefore, based on the above merits of the before/after with comparison group method over other before/after study methods, i.e. simple before/after, EB method, etc. the original plan for data collection was as summarized in Table 3.

However, based on the challenges encountered during data collection for the current study (i.e., spread of corona, lack of comparison sites for the study, unavailability of crash data in period before DART, insufficient details in recorded crashes) as explained in details in section 3.6.1., the researcher could not apply a before/after study design. As an alternative, on complementing the subjective part of this study, the researcher evaluated the safety performance of the DART system based on four-year crash data recorded in the DART corridor in the period after its implementation (2016 to 2019), excluding crash data recorded along Msimbazi street, and areas along Morogoro road from United Nation road to Jamhuri road where the data could not be collected due to same reasons explained in limitations sections.

In so doing, the study mainly focused on examining the trends and characteristics of crashes over the period of 2016 to 2019. This involved analyzing the crashes to identify the frequency and severity of crashes. Moreover, the analysis involved identifying most involved road users, areas with higher proportion of crashes, time when most crashes occurred, types of crashes in terms of number of vehicles involved (i.e., single vehicle crash, two vehicles, multiple vehicles (3 and above vehicles), etc.

Table 3. The sources and data required for the current study

| Type of Data | Details/level | Source | Timing |
|---|---|---|---|
| Crash Data | • Exact locations and time of crash<br>• Crash Severity (Fatal, Injury (all injuries categories) and property damage only)<br>• Crash type, i.e., head-on, side impact, rear end, and run-off road crashes.<br>• Details of Involved road users<br>• Types of vehicles involved, i.e. DART buses, Daladala, Bodaboda, Bajaj, cars, etc.<br>• Demographic data of people involved in crash i.e. age and gender. | Police departments in the study area i.e. Ilala, Kinondoni, Ubungo and Temeke police departments. | Data collection was anticipated for at most six weeks effective from 24th March to 28th April, 2020 |
| Site Characteristics | • Roadway class in the study sites, i.e. trunk roads (linking two or more regions), regional roads (linking trunk roads to District roads), or district roads (collector/feeder/community roads)<br>• Road Division Type of the study sites, i.e. Undivided, divided by raised median, divided by depressed/traversable median, Divided by barrier etc.<br>• Number of through lanes for study sites, i.e. 2 lane roads, 4 lane roads, 6 lane roads, etc.<br>• Speed limit on study site<br>• Range of traffic volume on study sites<br>• Traffic control at the study sites, i.e. signalized intersection, stop controlled intersections, roundabout, no control, etc.<br>• Intersection geometry, i.e. Cross intersection (4 or more than 4 legs), T or Y-intersection (3 legs) | DART agency | |

### 3.3 Data analysis strategy for objective safety

The crash data were prepared using excel and then statically analyzed using SPSS. The findings were then summarized in tables and charts using excel. The main focus in the analysis was to show the trends of crashes within the DART corridor from 2016 to 2019, indicating the exact locations of traffic crashes in the DART corridor, to whether they mostly occur at junctions, around or at stations/terminals areas, or between DART stations, and of course to indicate road users who are mostly involved in crashes. However, due to insufficient details in crash reports, the author could not identify the exact locations of crashes, instead the study identified areas with higher crash rates.

### 3.4 Research Methods for Subjective Safety Evaluation

#### *3.4.1 Research design*

The study used questionnaires to collect road users' perception on the safety and risk performance of DART system in their main modes of transport as compared to the period before its implementation. Mainly to understand how (un)safe different system users felt using their main modes of transport in the DART system. Opinions were collected from all main modes of transport in the DART system including both motorized and non-motorized transport. The data were then converted to excel format for data cleaning before statistical analysis using SPSS. The analysis covered the risky perceptions to identify modes which were perceived riskiest in the system as an input to understand users' safety perception that mainly focused on understanding how safe or unsafe they felt using their main modes of transport in the DART system. In addition, as discussed in the literature review, there were some shortcomings in crash causative factors from police reporting, then the study aimed on understanding from users' perspective the main causes of crash in the DART corridor.

Nevertheless, as an effort to understand how to improve safety performance in their main modes of transport, the study involved collection of users' opinion on how likely they would advise a particular safety treatment measure (from list of predefined measures) to be applied in order to increase their safety feeling. Therefore, from users' opinions, the researcher recommended potential measures that could improve traffic safety in the DART system and any other system of similar context.

#### *3.4.2 Research instruments*

This study used questionnaires (paper/pencil based method) to collect users' perceptions on risk and safety performance of the DART system, and on the main causes of crashes as well as on the potential measures that could be applied to improve safety performance in their main modes of transport in the DART system. since the study involved both Motorized Transport (MT) and Non-Motorized Transport (NMT) users, the questionnaires were different for the two categories. However, both questionnaires had some common safety aspects that made it possible to compare the opinions of bot motorized and non-motorized users.

The questionnaires had the same format, each with mainly five sections as shown in ANNEX 1: Questionnaire template. The first section was common to both MT and NMT users. It covered the introduction part that introduced the researcher and main purpose of the study. It also covered the part that collected the social demographic and travel behaviors of respondents. The social demographic and travel behavior sections collected profiles of all respondents to have an insight into the nature of the sample in relation to the population using the DART system and to be able to link the results to different social demographic profiles during data analysis.

The second section mainly focused on risk perceptions of different road users in the DART corridor. This section was also common to both MT and NMT users. It aimed at understanding how risky do road users perceived using their main modes of transport in the DART system. This provided useful insights on understanding the safety feeling of system users covered in the third section of the questionnaire, which was also common to both MT and NMT users. Mainly the third section aimed at understanding the safety feeling of road users when using the DART system both during the day and night times considering when they are on areas around DART stations/terminals and on other areas, including when on travel in-between DART stations or at road junctions.

The fourth section covered perception of road users on the main cause of crashes in the DART corridor. This section had some common aspects however, mostly different between MT and NMT. This was mainly to understand the perception of system users' both MT and NMT, on how frequently they thought a particular crash causative factor (from a list of predefined factors) was involved in causing crashes that ware recorded in the DART system involving commuter from their main modes of transport. This insight was very essential in drawing up recommendations that were covered in the fifth section.

The fifth section was also different for both MT and NMT users, however with some common aspects. It aimed at involving system users in drawing-up potential safety measures that they thought if implemented would improve their safety feeling in the system. Therefore, a link between forth (main cause of crashes) and fifth (potential measures) sections was very essential to reasonably understand whether the most perceived safety measures would address the main perceived causes of crashes in their main modes of transport.

## 3.5 Data collection Techniques

### *3.5.1 Data type and Sample Size for subjective safety evaluation*

This section of the study used primary data. The data that were collected using questionnaires administered face-to-face to respondents using paper/pencil technique. The study collected data from 400 respondents, including all modes of transport (pedestrians, cyclists, motorcycle as passengers, motorcycle as driver, Bajaj as passenger, Bajaj as driver, Car as passenger, car as driver, Daladala as passenger, and DART as passenger). The study focused on 40 respondents from each road user category. In addition, the sample was further classified according to age group, where it involved four age groups of at least 75 respondents from each group with at least 50-70% of male in each age group (less than 18 years old, 18-40 years old, 41-60 years old, and above 60 years old).

### *3.5.2 Field data collection*

Based on the time limit for the study, the researcher recruited six assistants as part of the research field team to help in data collection. Before commencement of the field data collection, the researcher trained the data collection team mainly focusing on enhancing the team members to understand the objective and methodology of the study. The training was divided into two part, the first part involved a lecture presentation of the subjective part of the research, mainly focusing on objectives and methodology of its data collection. The researcher presented to the team the questionnaire and elaborated in details what have to be done when on field data collection. The second part of the training involved going on site as part of the pilot study to also inspect if the team could effectively help in data collection.

### *3.5.3 Results of the Pilot study*

The main objective of the pilot study was to see whether the methodology for data collection would work effectively and to see whether the data collection team would collect the data precisely, especially by taking into account the fact that they were not supposed to influence responses from respondents. In that aspect, the pilot study involved seven respondents of which the first questionnaire was addressed by the researcher in presence of members of the field data collection team as a way to illustrate practical training on how to administer the questionnaire. Thereafter, each member administered one questionnaire in presence of the researcher to observe whether he/she could administer or explain the questions raised by respondent correctly.

Assessment on the team performance was excellent, however, the questionnaire seemed too long to finish within 15-20 minutes as was anticipated. In most cases, it involved translation and interpretation from English to Swahili the transport related terms. This made most questionnaire to be completed within 25 to 30 minutes, and one questionnaire could not be completed because respondent deemed taking much time to finish. Therefore, the researcher had to change the format of the questionnaire from a single questionnaire for all road users to two questionnaires format. First questionnaire was designed to address NMT and the other to address MT. In addition, the researcher had to reduce number of questions especially all those related with service satisfaction.

### *3.5.4 Actual field data collection*

After making changes to the questionnaire, the field data collection team restarted collecting data. Two team members were assigned to collect data from NMT users, while the rest five including the researcher collected data from MT users (8 categories of MT users, i.e. motorcyclists, car and Bajaj users; both passengers and drivers, daladala and DART passengers). The time for completing one questionnaire reduced to 15 to 20 minutes.

The research team collected data from DART passengers mainly at DART terminals and stations. Motorcyclists and Bajaj users, were easily spotted from their parking spots while daladala passengers on stations used by daladala along the DART corridor. Likewise, pedestrians and cyclists were easily spotted in the DART corridor mostly pedestrians who were walking along DART corridor while cyclist mostly were the petty traders who use non-motorized three wheelers to carry their products. The researcher had to combine non-motorized two wheelers and non-motorized three wheelers in one group as “cyclist”. The researcher argues that it was valid to combine them because both use the same lane (cycle lane) as in accordance to the DART system design.

Data from car users were mainly collected from taxi drivers and staffs who were working in offices located along the DART corridor. Taxi drivers were easily found at their parking areas along the DART corridor, while, staffs were spotted out by visiting restaurants set close to offices along the DART system phase 1. The visits were normally done during lunch periods 12:00 pm to 14:00 pm, the time when most officers were going to restaurants for lunch. After having a brief introduction and confirmation to whether they use the DART system as car drivers or passenger, the normal procedure for collecting data were started.

### *3.5.5 Language issues*

Since the collection of data for the subjective safety evaluation relied on the interaction between the research team and respondents; then the aspect of language brought an attention to ensure respondents understand the questions raised from the questionnaire. Generally, Tanzania has over 126 different tribes, each tribe has own local language (Brenzinger, 2012). However, only two languages other than the 126 tribal-languages are official (English and Swahili). Swahili is a national language spoken and that unites all tribes while English is a teaching language (English) from ordinal level studies to university-level studies. English language is not fluent to the majority, though most can read, write and understand English written sentences especially the elite group.

Considering the language challenges, the requirement for final study findings to be in English and the time constraints for the current study, the researcher presented questionnaires in English format but with the option for direct translation of questions to respondents when necessary. In this context, the direct translation referred to merely translating the meaning of the questions without affecting or influencing the opinion of respondents. In this case, the research team was reading out the questions and provide translation in Swahili when deemed necessary.

### *3.5.6 Selection of the research team for data collection*

The research team comprised graduate students from the National Institute of Transport (NIT) had reasonable knowledge about transportation. Thus, required less effort for them to understand the context of the study. The researcher recruited students who were working at the DART agency for their practical trainings, this was an added advantage because majority had better understand of the DART agency which was a key value in addressing questions from respondents especially those related with DART operations. As mentioned in section 3.5.2, the six recruited candidates received training from the researcher before commencing data collection.

## 3.6 Data analysis strategy for subjective safety

This part of the study intended to get the perceptions of road users mainly on safety performance of the DART system, i.e. on how (un)safe they felt when using their main modes of transport in the DART corridor. In addition, this part extended by exploring the risk perceptions as an inputs to further understand the safety feelings of road users, the perceived cause and potential safety measures that can be applied to improve the safety performance in the DART corridor.

The data were statistically analyzed using SPSS, by running different tests. The first test was the one-way MANOVA to understand how the demographic and travel behaviour characteristics of each respondent were related to the dependent variables i.e., safety perception, risk perceived, perceived cause of accidents.

After identifying characteristics of respondents that influenced perceptions of road users on a particular dependent variable, the univariate ANOVA test were carried out to get an insight of how the dependent variable varied based on the influencing factors (independent variables), i.e. to identify whether the influencing factors had significant differences in perceptions among respondents. After identifying factors with significant influence on the dependent variable (perceptions of different respondents), a Post Hoc analysis was carried out to understand the magnitude of differences in perceptions among different road users.

### *3.6.1 Limitation of the study*

The main limitations of this study were the spread of COVID-19 pandemic in Tanzania and insufficient number of comparison sites contrary to how was anticipated at research proposal stage.

i. The spread of COVID-19 pandemic in Tanzania

The spread of COVID-19 pandemic in Tanzania affected this study to its largest extent. The pandemic was confirmed to have reached Tanzania in March 16th 2020 almost one week before the date scheduled to start data collection. Based on the impacts of corona in the study area, the researcher had to postpone data collection until 21st May 2020, when the Tanzanian government declared corona to be under control. However, it was late for the researcher to resume data collection to finalize thesis within time limits. Therefore, the researcher requested to submit thesis report in second exam period to have ample time for data collection, analysis and report writing.

ii. Unavailability of crash data in the period before DART implementation

The researcher could not access on time crash data in the period before DART implementation and data from Msimbazi police station. The main reason was due to time constraint required for the researcher to collect crash data. The researcher could not access the data on time mainly due to data handling and storage at police station, it required more time for the researcher to wait for the appointments that were close to the time limit required to submit the thesis report. However, this was mainly due to corona problems, the researcher could not finish successfully the data collection, because he had to postpone data collection when corona problems became severe in the study area. The researcher resumed data collection after the corona situation became under control, however, the remained time was not sufficient enough to finish data collection.

iii. Insufficient details in available crash data.

The available crash data in police crash reports were not detailed enough to allow the researcher to identify the exact locations of crashes. Majority of crash locations were not specific enough to locate the point of crashes. For instance, crashes along morogoro road some were reported to occur at Kimara area, however Kimara is big, therefore, it was difficult for researcher to identify on which locations crashes occurred in Kimara areas, i.e. between stations, at stations, at junctions, etc.

iv. Insufficient number of comparison sites

The anticipated sites that were thought to fit the requirement for comparison sites could not meet the requirements. Based on feedback from TANROADS regional office in DSM, majority of main roads (trunk roads) did not remain untreated within the study period (2012 to 2019). Most roads had ongoing projects that started before 2012, some were finished while others were ongoing within the study period. He insisted that it was not likely possible to find the required number of sites especially on major trunk roads that remained untreated with similar features as that of the DART corridor in the period before implementation of DART system.

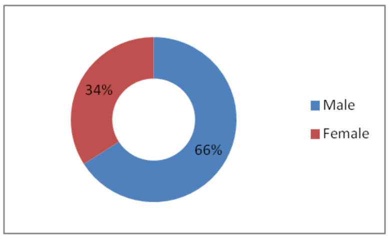
v. The DART system is not operating full bus operations

The author evaluated the safety performance of the DART system at its current stage of operations (Transition Operation). The full bus operations for DART system phase 1 was planned to operate with a total fleet of 305 buses with three service provider. One service provider for operating bus services, the second as the fund manager and the third operator as the fare collector. However, the current system operation is under interim service providers, with a total fleet of 139 buses, thus the system is not operating on its actual capacity. For instance, according to the operational plan of the DART system phase 1, the fare collector was once successfully procured will install an Intelligent Transport System (with mainly three compositions; Automated Fare Collection System (AFCS), Real Time Passenger Information System and establishment of Control Centre for Traffic Management). Therefore, evaluating the performance of the system at transition service operations might not give the exact safety impacts of the system to the city. Therefore, as the consequence, the findings of this study would not reflect on the exact safety impacts of the BRT system as the system is not fully operational to its capacity.

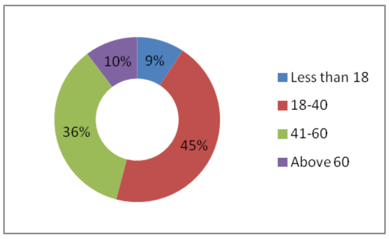
## 4 RESULTS

### 4.1 Demographic and travel behavior characteristics of the study sample

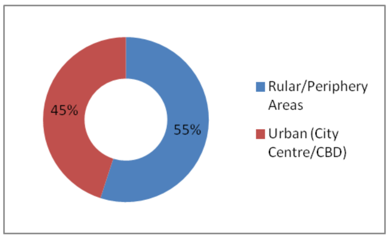
The results of the demographic and travel behavior characteristics are summarized Figure 14 and Figure 15. The study involved 400 respondents, 23 questionnaires were incompletely filled thus discarded during the analysis.



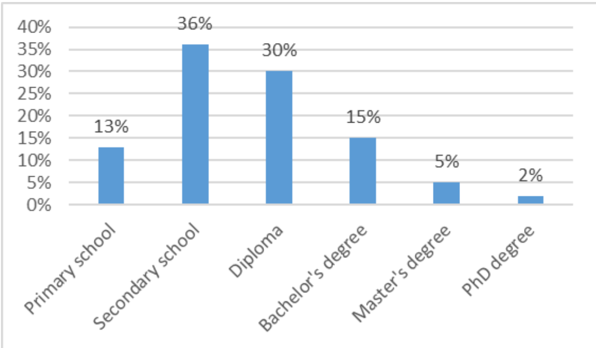

a) Gender



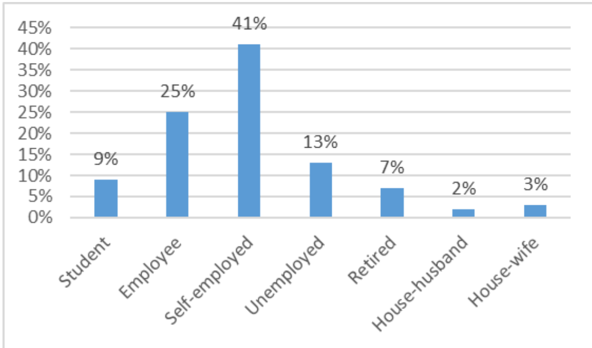

b) Age group



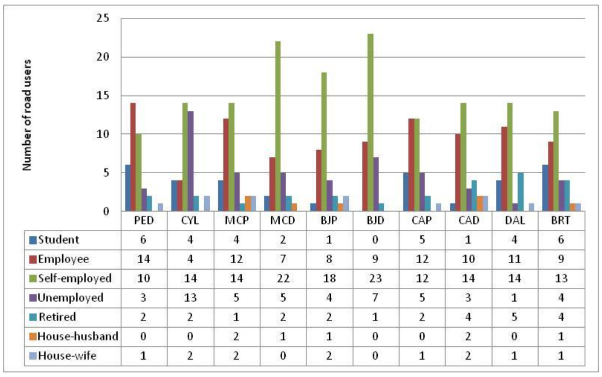

c) Place of living



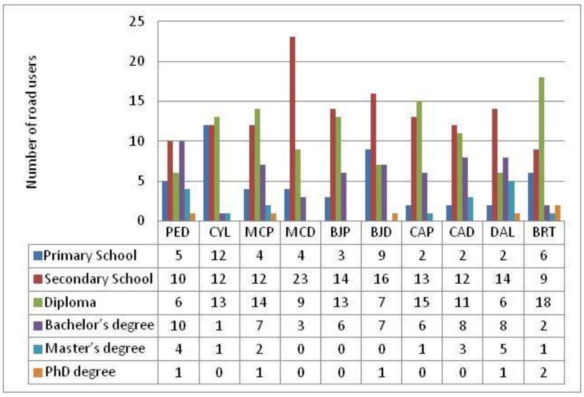

d) Education status



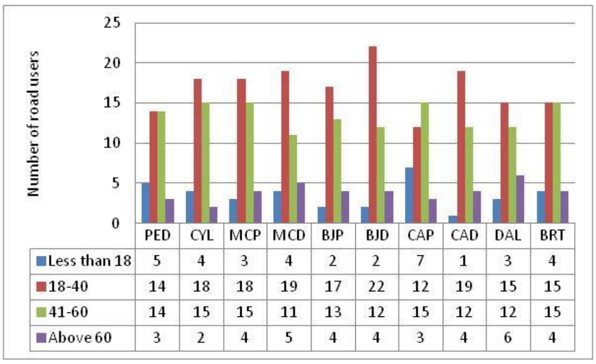

e) Employment status



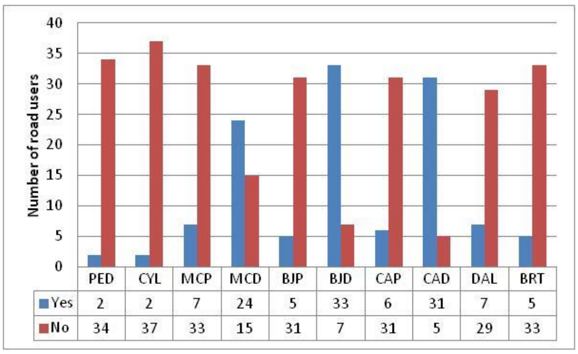

f) Employment status per road user category




g) Education status per road user category

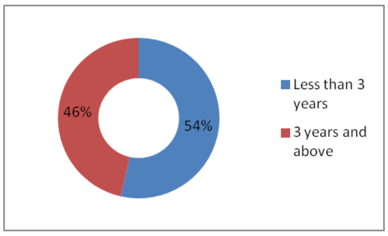



h) Age group per road user category

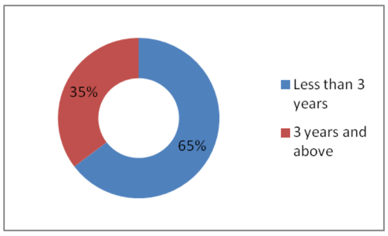



i) License status per road user category

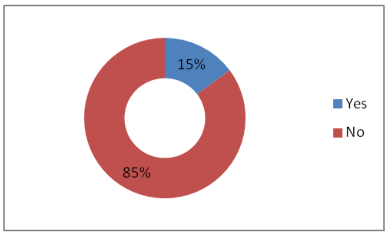
Figure 14 Demographic characteristics of the study sample



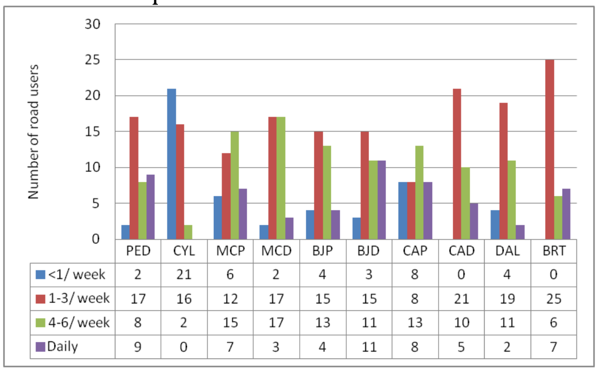

a) Experience in DART corridor before DART implementation



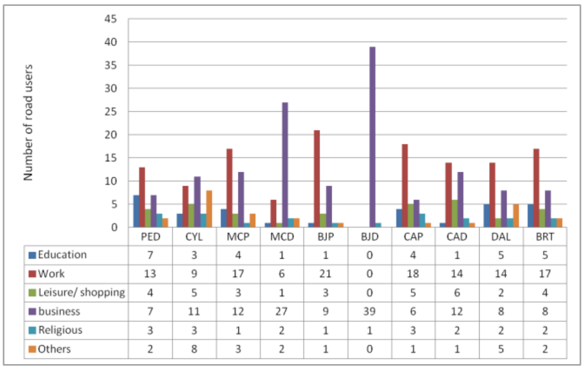

b) Experience in DART corridor after DART implementation




c) Experience with other BRT systems




d) Travel frequency per road user category




e) Travel purpose per road user category

Figure 15 Travel characteristics of the study sample

Note; the following codes stand for;-

| | |
|---|---|
| PED | Pedestrians |
| CYL | Cyclists |
| MCP | Motorcycle as a passengers |
| MCD | Motorcycle as a drivers |
| BJP | Bajaj as a passengers |
| BJD | Bajaj as a drivers |
| CAP | Car as a passengers |
| CAD | Car as a drivers |
| DAL | Daladala passengers |
| BRT | DART passengers |

The sample distribution by gender as indicated in Figure 14(a), majority of respondent were male (66%) while 34% were female, whereas Figure 14(b&h), shows the sample distribution by age groups, of which 45% of respondent were aged between 18-40 years, 36% between 41-60 years, 9% were less than 18 years while 10% were above 60 years old. In addition, Figure 14(d&g) shows the sample distribution per education status, indicating that 36% of respondents reported to have completed secondary school, 30% had diploma, 15% with bachelor's degree, 5% had masters and 2% had PhD level of education. Nevertheless, Figure 14(e&f) shows the sample distribution per employment status, 41% of respondents were self-employed, 25% employed, 13% reported unemployed, 9% were students, 7% retired, 2% as househusband and 3% were housewife.

Moreover, Figure 15(d) shows the sample distribution based on their travel frequency, of which 327 respondents equivalent to 86.7% of all respondents were regular users of the DART system, with travel frequency of at least 1 to 6 trips in every week. Likewise, Figure 15(e) indicates that a large proportion (36.9%) of trips made by respondents in the DART system were related to business activities, followed by trips made for work (34.2%). The trips made for leisure and education purposes accounted for 8.8% and 8.2% respectively, while those related to religious activities accounted for 5.3%.

Additionally, Figure 14(i) indicates a large proportion of respondents (355 respondents, equivalent to 68% of all respondents) had no driving license. Moreover, Figure 15(a&b) indicates over 50% of respondents had less than 3 years of experience in the DART corridor in both before and after DART implementation. While Figure 15(c), shows only 15% of respondents had experience with other BRT systems other than the DART system. This might be related to the fact that; the DART system is the first bus rapid transit system to be implemented in the East African region.

According to (LOGIT, 2018b), there are no specific demographic characteristics for DSM, thus the author could not check the sample representatives in most aspects using actual statistics of the city. In most cases, the researcher used country statistics from (Tanzania National Bureau of Statistics, 2012) and own reasoning to justify whether the sample was representative of the study population.

For example, as discussed in section 1.1.3, most people who use the DART system originate away from the proximity of the DART corridor and that their destinations are mostly in the Central Business District (CBD) areas (LOGIT, 2018a). Therefore, referring to the sample distribution by place of living as shown in Figure 14(c), majority of respondents (55%) reported their place of living in rural/ periphery areas, therefore, as the DART system provides a link between urban and rural areas, where the urban (CBD) areas are mostly populated with public offices, business and leisure places like beaches, restaurants, etc., the researcher concluded that majority of respondents used the DART system from rural (away from the proximity of the DART corridor) to CBD areas and that most of their trips were related to business and work as shown in Figure 15(e), in this aspect, the sample could be considered representative of the study population.

Nevertheless, using the country statistics (Tanzania National Bureau of Statistics, 2012), the census of 2012 indicated almost even population distribution by gender for Tanzanians, where 51.3% were female and 48.7% were male. However, the study sample indicate men were almost twice the number of female. Moreover, the sample distribution by age as shown in Figure 14(b), indicate only 10% of respondents were above 60 years old similar with country's statistics in 2012 that indicated only 9.5% of Tanzanians were aged above 60 years.

In addition, the statistics in 2012, (Tanzania National Bureau of Statistics, 2012) indicated that majority of Tanzanians (81.7%) had primary school as their highest level of education, followed by secondary school (14.4%), while University and above accounted for 2.3%. however, the study sample indicated majority (36%) of respondent had secondary school as their highest level of education followed by 30% with diploma. This is contrary to statistics in 2012 because significant effort has been done in education sector, including providing primary and secondary education for free. Therefore, in general, the author considered that had a heterogeneous sample.

## 4.2 Risk perception evaluation

### *4.2.1 Multivariate tests on risk perception*

The results of the One-way MANOVA on risk perception are summarized in Table 4, indicating only the factor that had significant influence on DART system users' risk perceptions. The findings indicated that the risk perception of DART system users were only significantly influenced by the mode of transport they use in the DART system. As shown in Table 4, the significant value of 0.000 for the mode of transport, implies that there was only a statistically significant difference in risk perception in different road user categories of the DART system $F(36,1253.39)=12.408$, $P<0.0005$; Wilk's Lambda = 0.319.

Table 4 Multivariate tests results for risk perception

Multivariate Tests[a]

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Wilks' Lambda | .259 | 239.442[b] | 4.000 | 334.000 | .000 |
| Mode_Trans | Wilks' Lambda | .319 | 12.408 | 36.000 | 1253.390 | .000 |

a. Design: Intercept + Gender + Age + Plac_Living + Edu + Empl + License + Car_Ownershp + Exp_DART_B + Exp_DART_A + Exp_OtherBRT + Mode_Trans + Trav_Freq + Trav_Purp + Companion

b. Exact statistic

### *4.2.2 Univariate tests on Risk Perception*

The univariate tests intended to show how the risk perception varied with respect to the independent variable (Mode of Transport). The results of the Univariate ANOVA are summarized in Table 5. The results indicate that the mode of transport had a statistically significant effect on risk perception of crash $F(9, 337)= 6.333$; $P<0.0005$, risk perception of sexual harassment $F(9, 337)= 6.994$; $P<0.0005$, risk perception of crime $F(9, 337)= 7.988$; $P<0.0005$, and risk perception of infectious diseases $F(9, 337)= 36.198$; $P<0.0005$.

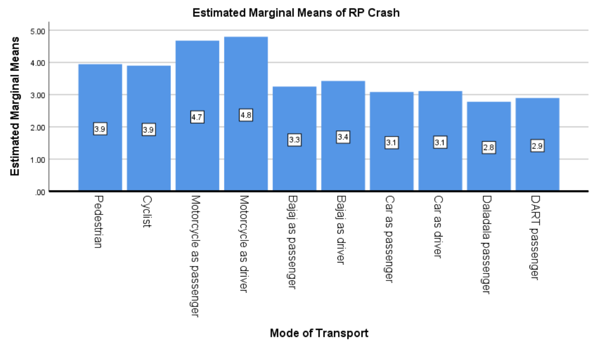
Table 5 Univariate tests results on Risk Perception

Tests of Between-Subjects Effects

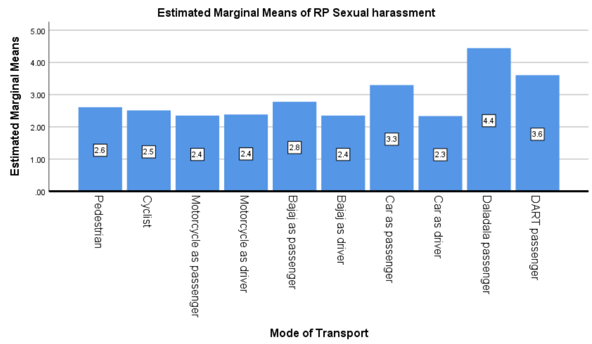
| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Mode_Trans | RP Crash | 147.840 | 9 | 16.427 | 6.333 | .000 |
| | RP Sexual harassment | 118.124 | 9 | 13.125 | 6.994 | .000 |
| | RP crime | 128.821 | 9 | 14.313 | 7.988 | .000 |
| | RP Infectious diseases | 458.167 | 9 | 50.907 | 36.198 | .000 |
| Error | RP Crash | 874.081 | 337 | 2.594 | | |
| | RP Sexual harassment | 632.389 | 337 | 1.877 | | |
| | RP crime | 603.892 | 337 | 1.792 | | |
| | RP Infectious diseases | 473.939 | 337 | 1.406 | | |

### *4.2.3 Post hoc test results for risk perception*

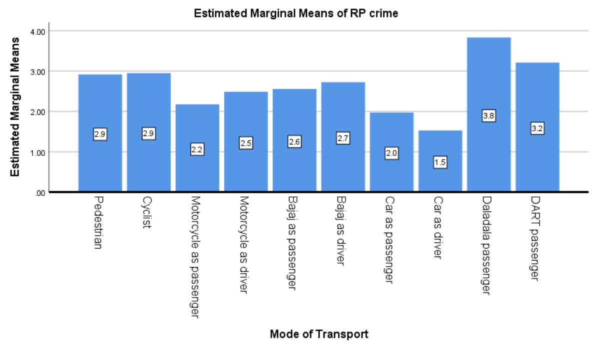
The post hoc tests aimed to show how the risk perceptions differed from different road users. The full results are indicated in ANNEX 2: Post Hoc Test results for risk perception. However, for interpretation and easy visualization of differences in risk perception, the graphical representations are summarized in Figure 16.



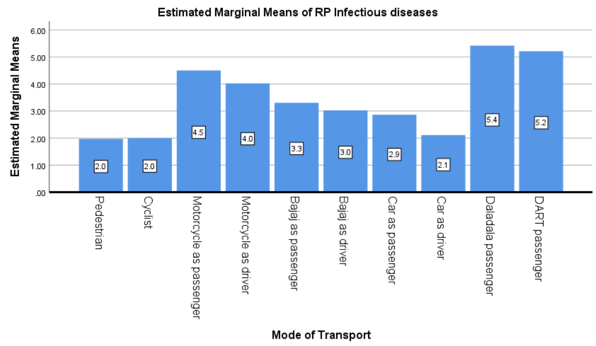

a) Risk perception of crash




b) Risk perception of sexual harassment




c) Risk perception of crime




d) Risk perception of infectious diseases

Figure 16 post hoc test results for risk perception

i. Risk perception of crash

The post hoc test results for risk perception of crash summarized in Figure 16(a) indicated statistical significant difference in risk perception between DART passengers, and pedestrians, cyclists, and motorcyclists (both passengers and drivers). That is, between DART passengers and pedestrians, cyclists, and motorcyclists there was a statistically significant difference in risk perception of crash with p-value less than 0.05. The difference are easily visualized in Figure 16(a), pedestrians had significantly higher risk perceptions of crash than DART passengers. Though, motorcyclists had the highest risk perception of crash than any other road user in the DART system. in addition, the results of the post hoc tests indicated no statistically significant differences in risk perception between DART passengers and Bajaj, cars, and daladala users, in all cases the p-value was greater than 0.05, in other words, DART passengers, Bajaj, car and daladala users, had almost the same risk perception of crash in the DART corridor.

ii. Risk perception of sexual harassment

The post hoc test results summarized in Figure 16(b), with exception of car as a passenger, the results indicated a statistical significant difference in risk perception of sexual harassment between DART passengers and all other modes of transport in the DART corridor. As indicated in Figure 16(b), passengers in DART buses had more risk perception of sexual harassment as compared to other modes of transport, with exception of daladala passengers who had the most risk perception of sexual harassment than any other road users in the DART system. Therefore, Daladala were perceived riskiest for sexual harassment followed by DART buses.

iii. Risk perception of Crime

The post hoc test results summarized in Figure 16(c), indicated a statistical significant difference in risk perception of crime between DART passengers and all other modes of transport with exception of pedestrians, cyclists, and bajaji as drivers. The results show that DART buses were perceived the second riskiest mode of transport on crime after daladala.

iv. Risk perception of infectious diseases

Following the impact of COVID19, the current study included the risk of infectious diseases as would be perceived by road users in main modes of transport of the DART system. the results of the post hoc test summarized in Figure 16(d), indicated a statistically significant difference in risk perception of infectious diseases between DART passengers and all other road users in their main modes of transport, with exception of passengers in Daladala. The result shows that the DART buses were perceived the second riskiest mode of transport for infectious diseases after daladala.

## 4.3 Results of safety perception evaluation

### *4.3.1 Results for multivariate tests on safety perception*

The multivariate tests on safety perception aimed to understand the main factors that influenced safety perceptions of system users in their main modes of transport. The results are summarized in Table 6.

Table 6 Multivariate tests results for Safety perception

Multivariate Tests[a]

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Wilks' Lambda | .206 | 322.137[b] | 4.000 | 334.000 | .000 |
| Mode_Trans | Wilks' Lambda | .519 | 6.664 | 36.000 | 1253.390 | .000 |

a. Design: Intercept + Gender + Age + Plac_Living + Edu + Empl + License + Car_Ownershp + Exp_DART_B + Exp_DART_A + Exp_OtherBRT + Mode_Trans + Trav_Freq + Trav_Purp + Campanion
b. Exact statistic

The results indicated only the mode of transport used by road users in the DART system had statistical significant effects on their safety perception, $F(36.000, 1253.390) = 6.664$, $P<0.0005$; Wilk's Lambda = 0.519. In other words, the safety perceptions of different respondents were significantly different when were compared based on their main modes of transport.

### *4.3.2 Results of the univariate tests on Safety Perception*

The univariate tests aimed to understanding how the dependent variable (safety perception) of system users varied based on the independent variable (mode of transport), i.e. to show how the perceptions differed for the independent variable (Mode of Transport). The results for the Univariate ANOVA on safety perception are summarized in Table 7.

Table 7 Univariate test table for safety perception

Tests of Between-Subjects Effects

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Mode_Trans | SP at station/terminal (Day) | 198.379 | 9 | 22.042 | 11.340 | .000 |
| | SP In-vehicle (Day) | 151.671 | 9 | 16.852 | 9.307 | .000 |
| | SP at station/terminal (Night) | 142.374 | 9 | 15.819 | 7.895 | .000 |
| | SP In-vehicle (Night) | 108.995 | 9 | 12.111 | 7.071 | .000 |
| Error | SP at station/terminal (Day) | 655.045 | 337 | 1.944 | | |
| | SP In-vehicle (Day) | 610.193 | 337 | 1.811 | | |
| | SP at station/terminal (Night) | 675.218 | 337 | 2.004 | | |
| | SP In-vehicle (Night) | 577.196 | 337 | 1.713 | | |

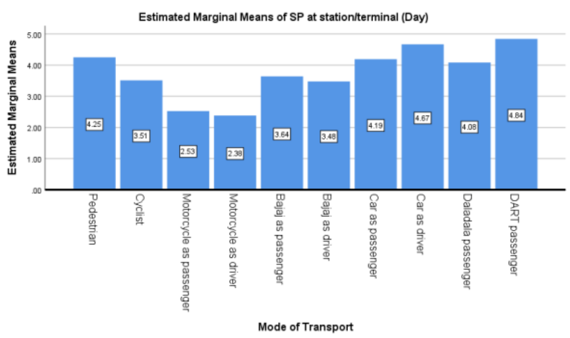
The results for the univariate tests ANOVA on safety perception indicate that the modes of transport had a statistically significant effect on all aspects of safety that were under investigation.

The mode of transport had statistical significant effect on;

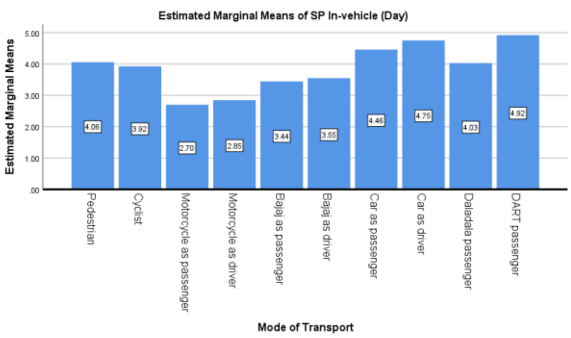
- Safety perception at station/terminal during the day (SP at station/terminal (Day)) $F(9, 337)= 11.340$; $P<0.0005$,
- In-vehicle safety perception during the day (SP In-vehicle (Day)) $F(9, 337)= 9.307$; $P<0.0005$,
- Safety perception at station/terminal during the night (SP at station/terminal (night)) $F(9, 337)= 7.895$; $P<0.0005$, and,
- In-vehicle safety perception during the night (SP In-vehicle (night)) $F(9, 337)= 7.071$; $P<0.0005$.

### *4.3.3 Results of the post hoc tests for safety perception*

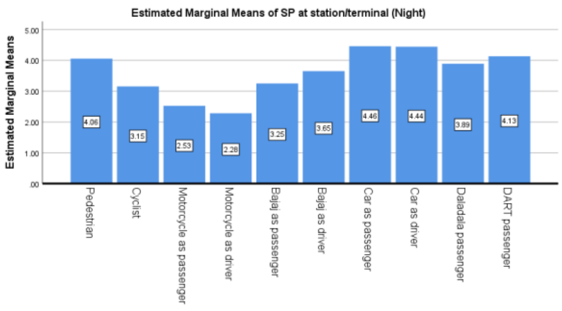
The post hoc tests were conducted to understand how the safety perception differed among different road users. The results are summarized in Figure 17 for clear visualization of the differences in safety perceptions among different road users.



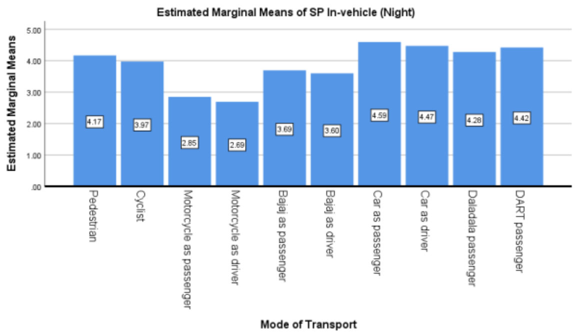

a) Safety perception at station/terminal during the day time




b) In-vehicle safety perception during the day time




c) Safety perception at station/terminal during night times




d) In-vehicle safety perception during night times

Figure 17 Post hoc test results for safety perception at stations/terminals during the day

i. Safety perception at station/terminal

The results summarized in Figure 17(a), indicated a statistical significant difference in safety perception at station/terminal during the day between DART passengers and cyclists, motorcyclists, Bajaj users, daladala passengers, and car as a passenger, in all differences the p-value is less than $0.0005 < 0.05$. However, the differences were not significant in safety perception between DART passengers and car as drivers. In addition, the results indicated that the estimated marginal means of safety perception between DART passengers and daladala passengers were almost the same and were the most perceived safest mode of transport when at stations/terminals during the day.

However, during the night as indicated in Figure 17(c) cars were the most safest modes as perceived by car users (both car as passengers and car as a driver). Between passengers in daladala and DART buses, passengers in DART buses perceived to be safer than passengers in daladala when at stations/terminals during the night. This might be related with differences in station/terminal designs for both DART buses and Daladala, DART stations/terminals were built with higher safety considerations including features to ensure safety transit of disabled persons than in daladala stations/terminals.

In all periods (during the day and night times), motorcyclists both passengers and drivers, were perceived less safe than any other mode of transport in the DART system when at stations/terminals during the day and night. Therefore, motorcycles were the least safe mode of transport in the DART system.

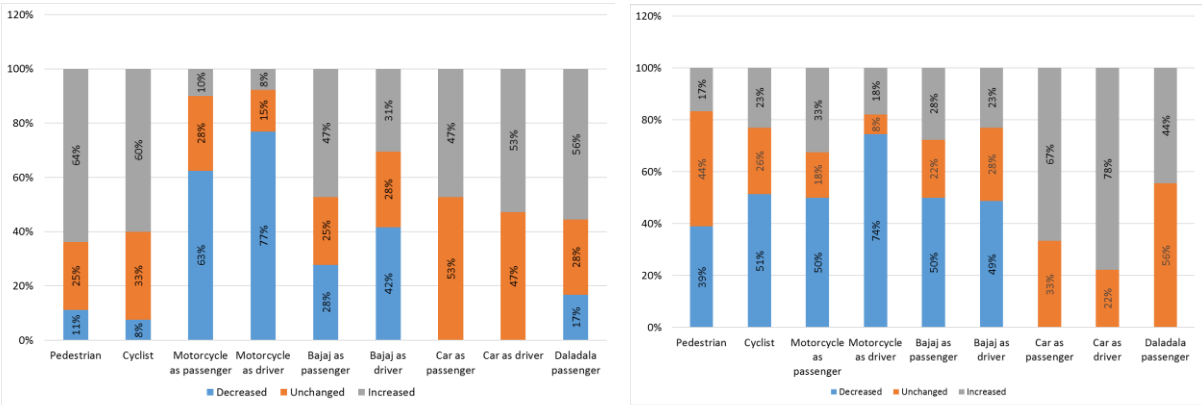
ii. In-vehicle safety perception

The post hoc test results summarized in Figure 17(b) indicated that, at 95% confidence interval, there was a significant difference in in-vehicle safety perception during the day between DART passengers and all other road users in their main modes of transport with p-value less than 0.05, with exception of cars where p-value was greater than 0.05. Furthermore, the results indicated that the in vehicle safety perceptions during the day time were significantly higher in DART passengers compared to other modes. Therefore, passengers in DART buses and car users had almost the same in-vehicle safety perception.

However, during the night, significant difference in in-vehicle safety perception between other road users and DART passengers were observed. For instance, when DART passengers' perceptions were compared with safety ratings from Motorcyclists and Bajaj users, the p-values were less than 0.05, thus, the differences in in-vehicle safety perception were significant at 95% confidence interval. On the other hand, the differences were not significant between DART passengers and pedestrians, cyclists, cars, and daladala users. However, on a Likert scale, they all scored approximately the same "4" which implied that road users felt slightly safer when using the DART system. Similarly, motorcycles were rated the least safety mode of transport in the DART corridor when travelling in both day and night times.

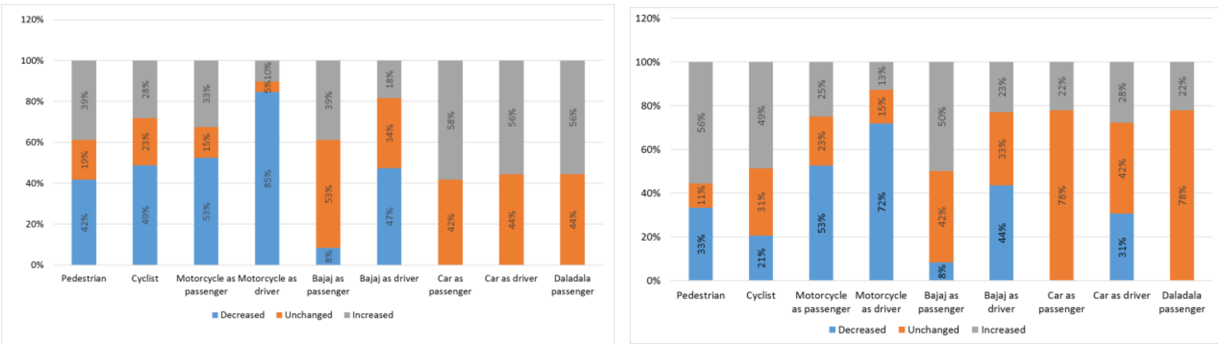
### *4.3.4 Change in safety performance in the DART corridor as perceived by DART system users.*

This section summarizes the findings on an evaluation based on users' perspectives to whether the DART system increased or decreased the safety performance in the main modes of transport as compared to period before its implementation.




a) During the day b) During the night

Figure 18 Safety perception at stations/terminals as compared to the period before DART




a) During the day b) During the night

Figure 19 In-vehicle safety perception as compared to the period before DART

### *4.3.5 Change in safety perceptions for NMT users as compared to the period before DART*

The NMT users in this study refers to pedestrians and cyclists. Most surprisingly, the results as shown in Figure 18, and Figure 19, a large proportion of NMT users perceived the safety performance in their modes of transport has deteriorated after the DART implementation. Regardless of the DART system to have dedicated lanes for NMT as contrary to the period before DART implementation, Figure 19 and Figure 18 show 39% of pedestrians, 51% of cyclists, and 42% of pedestrians, 49% of cyclists who indicated that the safety performance in their modes of transport to have decreased after the DART implementation. However, Figure 18 indicates a significant proportion of NMT (64% of pedestrians and 60% of cyclists) who perceived their safety along/close to DART stations/terminal during the day has increased. While Figure 19, indicates (56% of pedestrians and 49% of cyclists) who deemed the safety performance in their modes has increased when using the DART system during the night in areas other than those close to stations or terminals.

### *4.3.6 Safety perceptions for motorized transport users as compared to the period before DART*

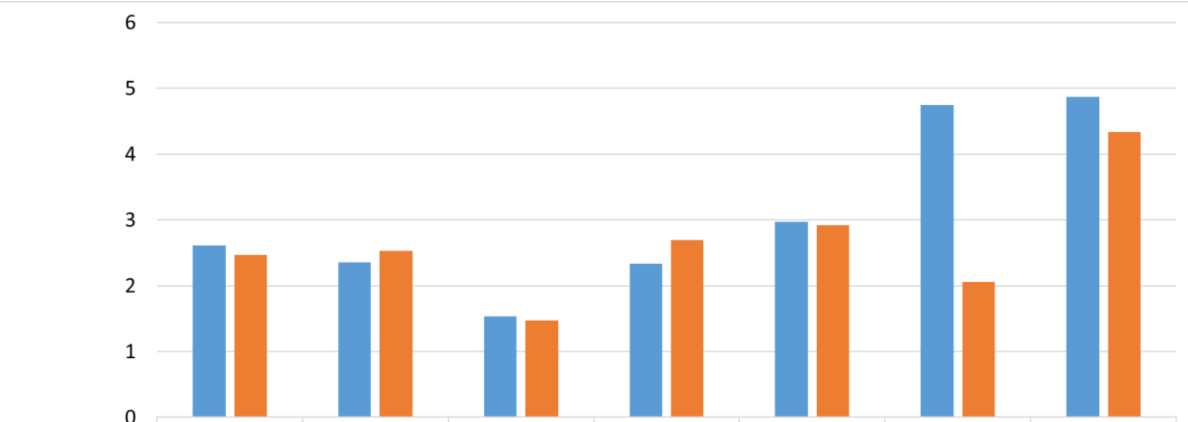
The motorized transport in this section of the study included motorcycles, Bajaj, Cars, and Daladala. As indicated in Figure 18, and Figure 19, among all motorized transport users; a large proportion of motorcyclists both passengers and drivers perceived the safety performance in their mode has deteriorated after the DART system implementation. Therefore, the discussion will mainly focus on motorcyclists, the mode that a large proportion of its users perceived their safety to have decreased as compared to other modes.

Majority of motorcycle drivers (85%) indicated the safety when driving a motorcycle during the day in areas other than DART stations or terminals has decreased, while 72% indicated the same result during the night. In addition, 77% and 74 of motorcycle drivers indicated the safety performance for motorcyclists at stations/terminals during the day and night respectively to have decreased as compared to the period before DART. The same trends of results were observed from passengers riding motorcycles. During the day, 63% and 50% indicated safety for motorcyclists has decreased when at stations/terminal areas and at areas other than stations/terminal respectively. And during the night, 53% of motorcycle passengers indicated the safety for motorcyclists has decreased as compared to the period before DART.

## 4.4 Perceived cause of crashes

### *4.4.1 Perceived cause of crashes involving NMT*

A list of possible factors were kept as short as shown in Figure 20, which summarizes the results of the analysis of NMT perceptions. The results in Figure 20, summarizes the findings on an evaluation of the opinions of NMT users' based on a 6 level Likert scale (Never (1), Rarely (2), Sometimes (3), Often (4), Very often (5), and Always (6) that indicate how frequently the NMT users perceived a particular factors caused crashes over the period of four years (2016 to 2019) of DART operations that involved NMT users.




| | Mobilephone usage | Red light running | Bad weather | Poor visibility | Usage of musical devices | Crossing road in wrong places | Misuse of NMT lanes by MT |
|---|---|---|---|---|---|---|---|
| Pedestrians | 3 | 2 | 2 | 2 | 3 | 5 | 5 |
| Cyclists | 2 | 3 | 1 | 3 | 3 | 2 | 4 |

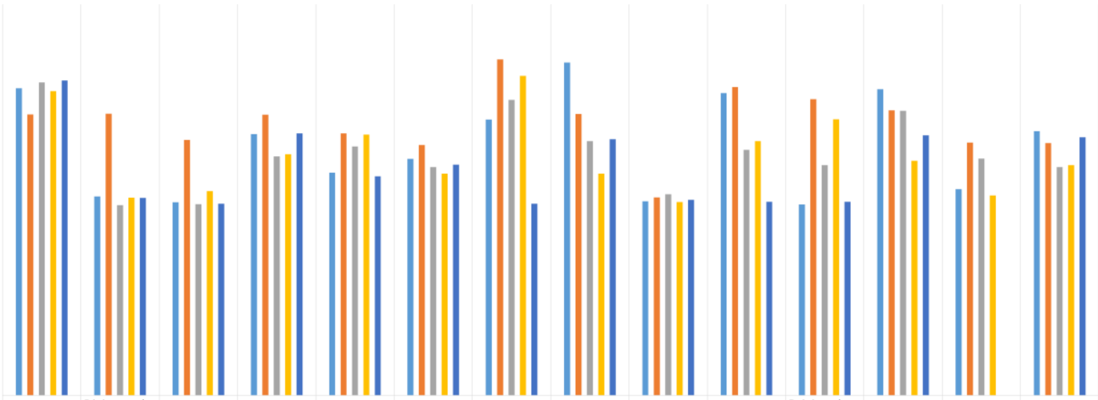
Figure 20 Perceived cause of crashes that involves NMT

Based on the results, NMT users indicated that the misuse of NMT lanes by MT users as the most causative of crashes that involved NMT users. In addition, crossing the road in wrong places was identifies as the top second factor that often caused crashes that involved pedestrians. Moreover, the results indicated that crashes that involve pedestrians and cyclists were sometimes caused by usage of musical devices, and mobile phones. While, red-light running, bad weather, and poor visibility were rarely causing crashes that involved pedestrians

### *4.4.2 Perceived cause of crashes involving Motorized Transport (MT)*

The results of an evaluation of perceived cause of crashes that involved MT users are shown in Figure 20. The cause of road traffic crashes that involved MT users were evaluated based on a 6 levels Likert scale; “Never (1), Rarely (2), Sometimes (3), Often (4), Very often (5), and Always (6)” which indicate how frequently the MT users perceived a particular factors caused crashes that involved MT users.

As shown in Figure 21 speeding, aggressive driving, and overtaking in the left were perceived as the factors that often caused crashes that involved motorcyclists, bajaji, car, daladala users. In addition, inexperience (less than 1 year of driving) and red-light running were also indicated as the factor that involved both motorcyclists and bajaj users into road traffic crashes in the DART corridor. DART passengers perceived that crashes that involved DART buses were often caused by speeding of DART drivers.



| | Speeding | Diving under influence of alcohol | Poor road maintenance | Vehicle defects | Driving when tired | Mobilephone usage | Aggressive driving | Red light running | Bad weather | Inexperience | Driving close to front vehicle | Overtaking in left side | Wrong lane driving | Poor visibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motorcyclists | 4 | 3 | 2 | 3 | 3 | 3 | 4 | 4 | 2 | 4 | 2 | 4 | 3 | 3 |
| Bajaj | 4 | 4 | 3 | 4 | 3 | 3 | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 3 |
| Cars | 4 | 2 | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 | 3 | 3 |
| Daladala | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 2 | 3 | 4 | 3 | 3 | 3 |
| DART Buses | 4 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | | 3 |

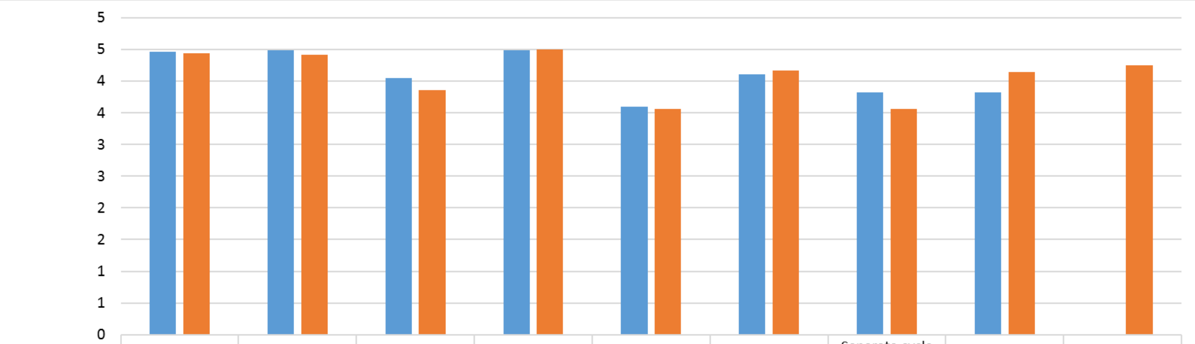
Figure 21 Perceived cause of crashes involving motorized transport

## 4.5 Perceived intervention

The perceived interventions were evaluated using a six levels Likert scale “Very unlikely (1), Unlikely (2), Neutral (3) Likely (4) and Very Likely (5). The results for perceived interventions are summarized in Figure 22 and Figure 23 for both NMT and MT users respectively

### *4.5.1 Perceived interventions to improve the safety performance for NMT*

As shown in Figure 22, the perception of both pedestrians and cyclists, indicate that they were likely to recommend all measures, except for cyclists who were very likely to recommend reducing speed limit to 30km/h in areas with higher number of NMT users.

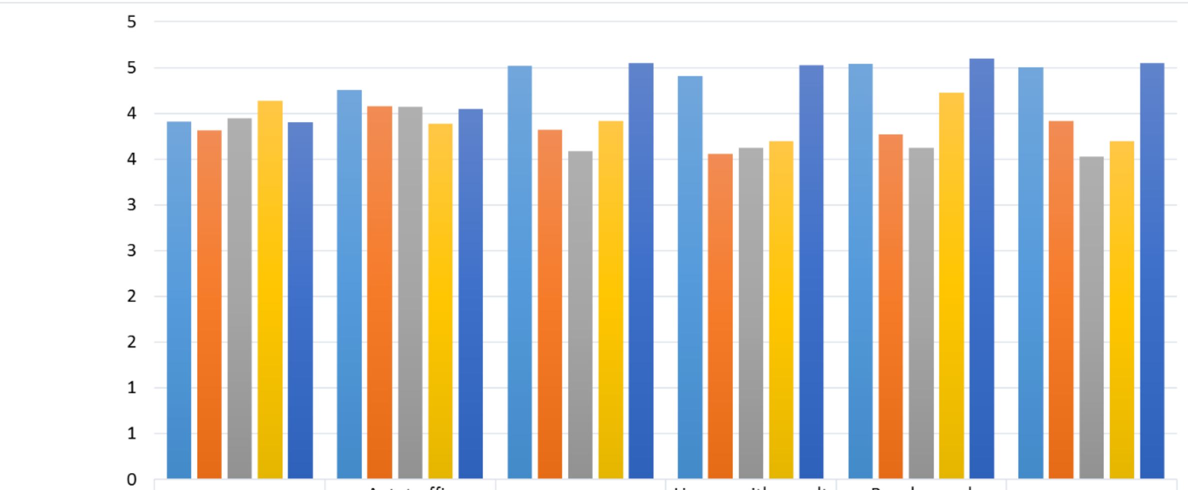



| | Safety awareness campaigns | Auto traffic enforcement camera | Severe penalty for traffic violations | Reduce speed limit to 30km/h in high NMT users | Fence BRT in area with high NMT users | Provide more zebra crossings in area with higher NMT users | Separate cycle path and walkway at different ground level | Improve lighting at intersection and pedestrian crossings | Mandatory reflective cloth for cyclists during dark times |
|---|---|---|---|---|---|---|---|---|---|
| Pedestrians | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Cyclists | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 |

Figure 22 Perceived intervention to improve safety performance for NMT users in DART corridor

*4.5.2 Perceived interventions to improve the safety performance for MT users*

The results of an analysis of users' perception on measure to improve safety performance for motorized transport users are shown in Figure 23. The results indicate that, on average, all motorized transport users are likely to recommend all measures. However, pedestrians and DART passengers were very likely to recommend severe penalty for traffic violations, regular vehicle road worthiness inspection, and breath test for alcohol usage. In addition, DART passengers were very likely to recommend license with penalty points for traffic violations.




| | Safety awareness campains | Autotraffic enforcement camera | Severe penalt for traffic violations | Licence with penalt point for traffic rule violation | Regular road worthness inspection | Breath test for alcohol usage |
|---|---|---|---|---|---|---|
| Motorcyclists | 4 | 4 | 5 | 4 | 5 | 5 |
| Bajaj | 4 | 4 | 4 | 4 | 4 | 4 |
| Cars | 4 | 4 | 4 | 4 | 4 | 4 |
| Daladala | 4 | 4 | 4 | 4 | 4 | 4 |
| DART Buses | 4 | 4 | 5 | 5 | 5 | 5 |

Figure 23 Perceived intervention to improve safety performance for MT users in DART corridor

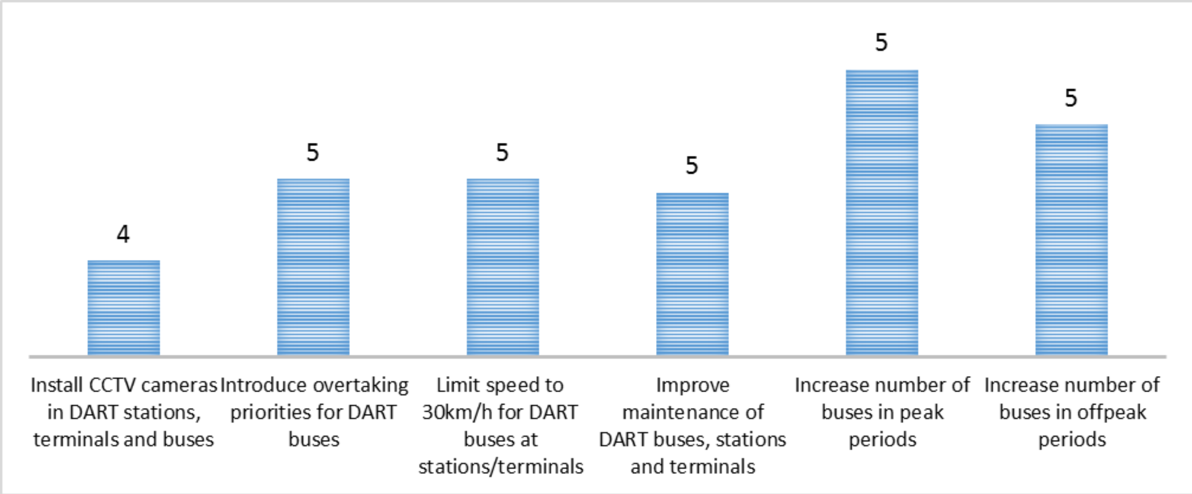



Figure 24 Perceived interventions to improve safety performance for DART passengers

In addition, as shown in Figure 24, passengers of DART buses were very likely to recommend all measures in Figure 24 to the DART agency with exception of installing CCTV cameras in DART stations, terminals and buses which they indicated a likely score on Likert scale.

## 4.6 Results on Objective Safety evaluation

### *4.6.1 Collected Crash Data*

The author collected four years' crash data (2016 - 2019) from five police stations in the study area (Central Police, Oysterbay, Urafiki, Gogoni, and Mburahati with exclusion of Msimbazi Police station of which could not be collected due to reasons explained in section 3.6.1). The collected crash data covers all crashes occurred in the DART corridor from 2016 to 2019 with exclusion of crashes that occurred along Msimbazi street, and along Morogoro road from United Nations junction (UN and Morogoro roads junction) to the junction of Uhuru and Morogoro roads. In total, the author collected 927 crashes summarized in Figure 25.

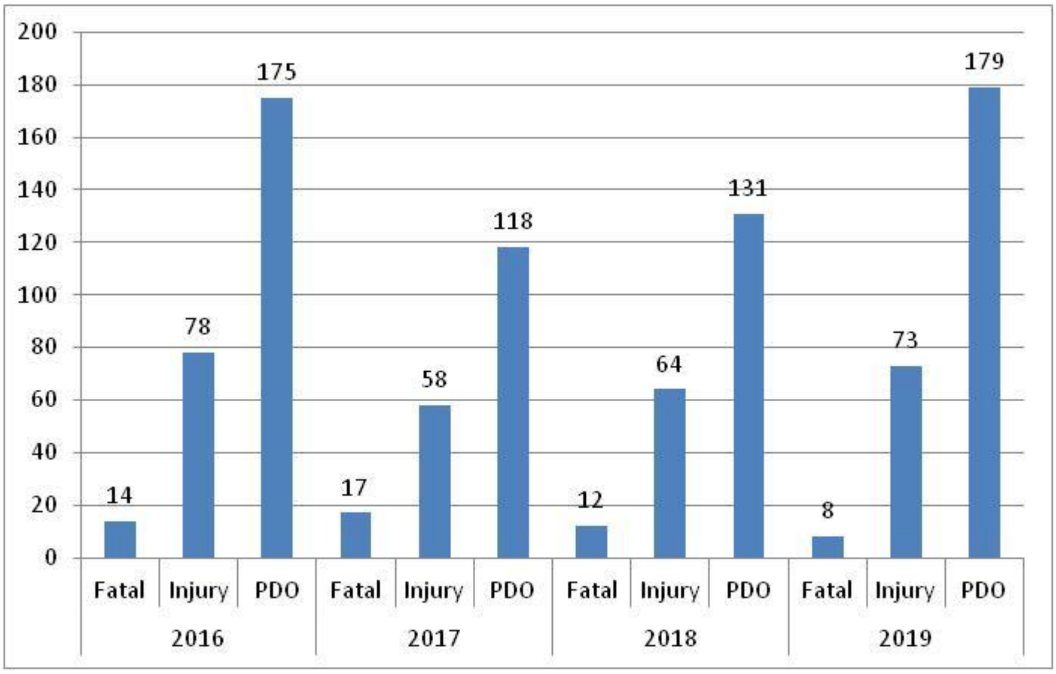



Figure 25 Collected Crash Data

#### *4.6.2 Trends of Traffic crashes over four year of DART operation*

As indicated in Figure 25, excluding crashes along Msimbazi street and along morogoro road from UN junction to Uhuru junction, in 2016 the DART system was reported with 267 traffic crashes (14 fatal crashes, 78 injury crashes, and 175 PDO crashes). However, in 2017, the system experienced a decline in total crashes, it was reported with 193 crashes equivalent to 28% reduction in total crashes as compared to 2016. Likewise, it experienced 26% and 33% decrease in injury and PDO crashes respectively. However, there was an increase in fatal crashes in 2017 by 21%.

In 2018, the system experienced a 7% increase in total traffic crashes from 193 crashes in 2017 to 207 crashes in 2018. Likewise, the system experienced 10% and 11% increase in both injury and PDO crashes respectively, i.e. from 58 to 64 injury crashes and 118 to 131 PDO crashes. As a positive aspect, the system experienced 29% decrease in fatal crashes, from 17 fatal crashes in 2017 to 12 fatal crashes in 2018.

In 2019, there was similar characteristics in the trend of traffic crashes as for 2018. The system experienced overall increase in traffic crashes of 26%, from 207 crashes in 2019 to 260 crashes in 2019. Injury crashes increased by 14% from 64 crashes to 73 crashes, while PDO crashes increased by 37% from 131 crashes in 2018 to 179 crashes in 2019. As for the case of 2018, in 2019 the system experienced a decrease in fatal crashes by 33% from 12 fatal crashes in 2018 to 8 fatal crashes in 2019. Overall, there has been no significant decline in the number of crashes over the period of four years of DART system operation. On average, over 230 crashes were reported in each year, of which approximately were 13 fatal crashes, 69 were injury crashes and 151 were PDO crashes.

#### *4.6.3 Areas with highest crash frequency*

The author aimed at understanding the exact locations of crash occurrence in order to identify problematic locations that requires immediate measures to improve traffic safety in the DART corridor, i.e. road junctions, turning facilities, stations, terminals, or specific midblock (specific sections between DART stations). However, the details provided in crash reports were not sufficient enough for the author to locate the exact points of crash occurrence. In most cases, crashes were reported in general indicating areas of crash occurrence.

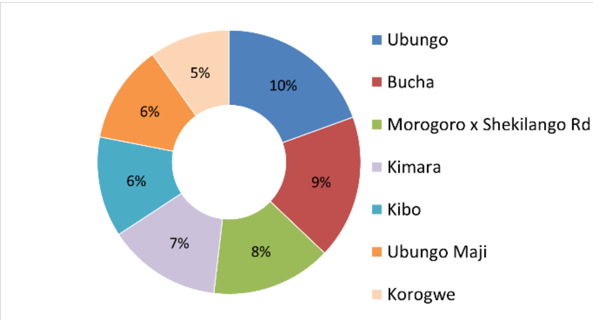
For example, reported crashes say at Bucha, by indicating Bucha as the location of crash was not sufficient enough for the author to conclude whether the crash occurred at Bucha BRT station, or section between Bucha BRT station and next nearby BRT station, or at Bucha turning facility. Most crashes were reported in such details, thus making it difficult for the researcher to identify exact location of crash occurrence. Therefore, the author identified crash locations in their general details as reported by police.

Figure 26 (a) shows locations with at least 5% of all 927 crashes, while Figure 26 (b&d) shows areas with at least 5% of all 273 injury and all 603 PDO crashes respectively, but Figure 26 (c) shows all areas reported with fatal crashes.

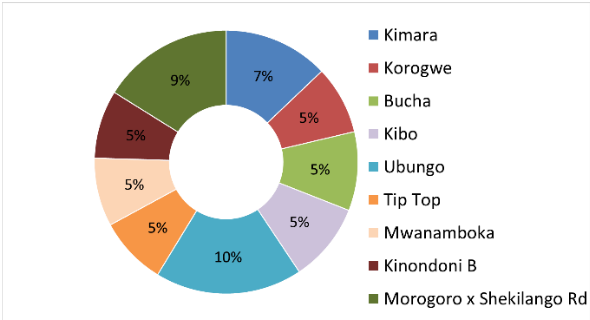
As shown in Figure 26 (a), Ubungo and Bucha were reported with highest crashes frequicy equivalent to 10% of all reported 927 crashes. Ubungo areas covers Ubungo junction (the junction of Morogoro, i.e., Nelson Mandela and Samnujoma roads), Ubungo BRT terminal and areas between Ubungo junction and Ubungo BRT terminal. Likewise, Figure 26 (c) indicates

Ubungo and Bucha areas with highest fatal crashes, each with approximately 14% of all 51 fatal crashes.

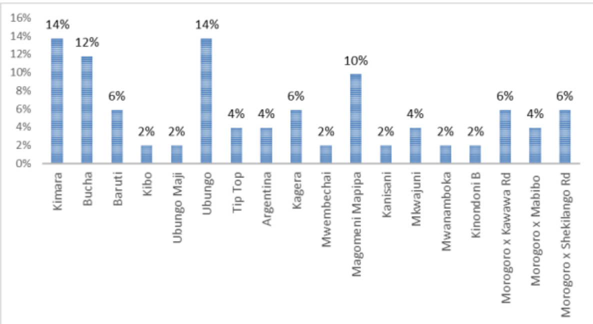
In addition, Figure 26 (b) indicate ubungo as the area with highest injury crashes equivalent to 10% of all 273 injury crashes. The area was also reported as the second top among areas with highest crash frequency that resulted to Property Damage Only (PDO), with approximately 10% of all 603 PDO crashes.



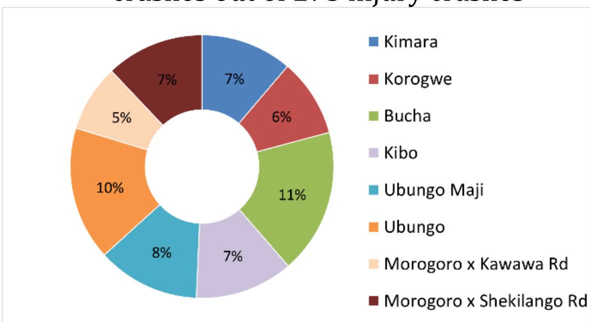

a) Areas with highest proportions of crashes out of 927 total crashes




b) Areas with highest proportions of injury crashes out of 273 injury crashes




c) Areas reported with fatal crashes and their proportions out of all 51 fatal crashes




d) Areas with highest PDO crashes out of 603 PDO crashes

Figure 26 Areas with highest crash frequency

Moreover, Figure 26 (a), shows Bucha in top second areas with highest total crash frequency with approximately 9% of all 927 crashes, however, Bucha was ranked in first place for areas with highest PDO crashes with approximately 11% of all 603 PDO crashes. Nevertheless, Bucha was ranked in second place after Ubungo for areas with highest fatal crashes, with 6 fatal crashes equivalent to 12% of all fatal crashes. Bucha area includes the Bucha BRT station, Bucha turning facility and section between Bucha turning facility and Bucha BRT station.

Nevertheless, Shekilango was reported in third place for areas with highest total crash frequency, with 72 crashes equivalent to 8% of all crashes, but was ranked in second place for areas with highest injury crashes with 25 crashes, approximately 9% of all crashes that resulted to injuries. In addition, Shekilango area was ranked in fourth place for areas with highest fatal crashes, it had 3 fatal crashes equivalent to 6% of all fatal crashes. Shekilango area, included areas at Shekilango BRT station and Shekilango junction (the junction between Morogoro road and Shekilango road).

Other areas that reported with higher crash frequency were Kimara (68 total crashes i.e., 7 fatal, 20 injuries and 41 PDO crashes), Kibo (60 crashes, i.e. 1 fatal, 15 injury and 44 PDO crashes), Ubungo Maji (59 crashes, 1 fatal, 12 injury and 46 PDO crashes), Korogwe (48 crashes, i.e. 13

injuries and 35 PDO Crashes). Morogoro and Kawawa roads junction with 40 crashes i.e. 3 fatal, 7 injury and 30 PDO crashes), Mwanamboka, 34 crashes, i.e. 1 fatal, 13 injury and 20 fatal crashes), Kinondoni B with 33 crashes, Baruti and Mkwajuni both with 32 crashes each, Mwembechai with 29 crashes, Magomeni Mapipa with 27 crashes (5 fatal crashes, 6 injury and 16 PDO crashes).

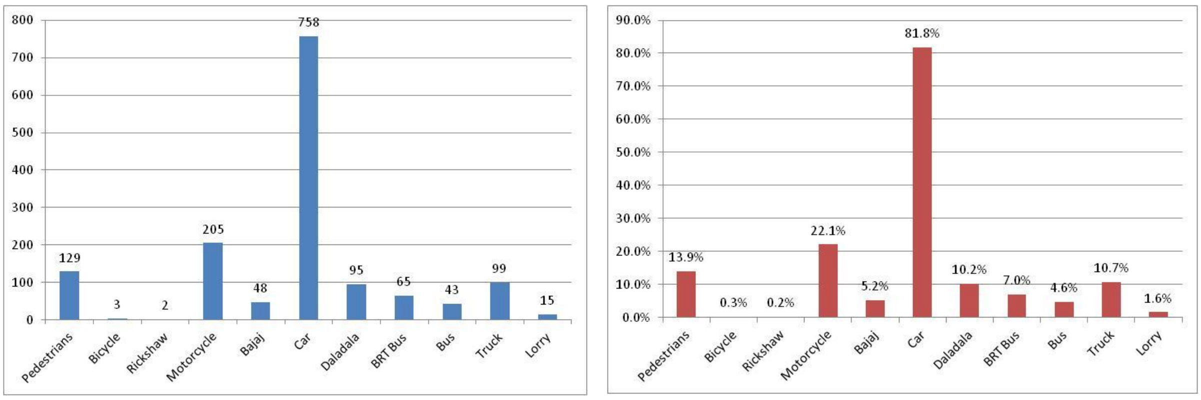
### *4.6.4 Most involved road users*

In this section, the author intended to examine the proportions of crash involvement for road users involved in road traffic crashes in the DART corridor and to locate critical areas on which specific road users are mostly involved in crashes. In so doing, in each recorded traffic crash, the author identified all involved road users. Figure 27 summarizes the proportions of road users' involvement in road traffic crashes. Figure 28 shows areas with highest proportions of road users' involvement in traffic crashes.

From Figure 27 it is shown that car were the most involved in traffic crashes as compared to other modes of transport. Out of 927 crashes, cars were involved in 758 crashes, equivalent to 81.8% of all crashes. Nevertheless, out of 758 crashes that involved cars, Figure 28 shows Ubungo, Bucha, Kimara, Kibo and Shekilango as the top five areas with highest proportion of crashes that involved cars, i.e., 9%, 9%, 8%, 7%, and 7% respectively.

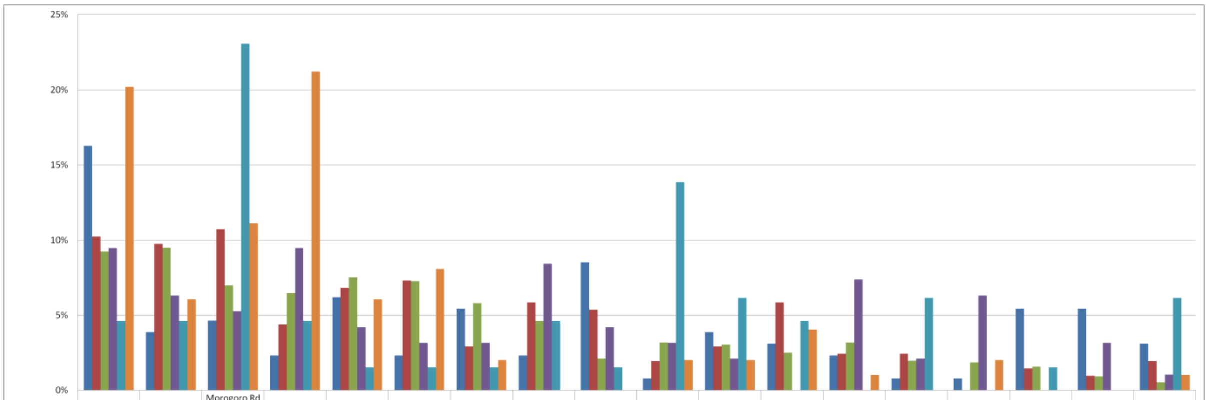
Motorcycles was the top second most road users involved in road traffic crashes as shown in Figure 27, motorcycles were involved in 205 crashes equivalent to 22.1% of all 927 crashes. Figure 28, indicates that Shekilango, Ubungo, Bucha, Kibo, and Kimara as the top five areas with highest proportions of traffic crashes that involved motorcycles with 11%, 10%, 10%, 7%, and 7% of all 205 crashes that involved motorcycles respectively.

In Figure 27, pedestrians were recorded as the third road user category who was mostly involved in road traffic crashes in the DART corridor. Pedestrians were involved in 129-traffic crashes equivalent to 13.9% of all 927 crashes. However, Figure 28, shows Ubungo, Kagera, Kimara, Shekilango and Korogwe as the areas with higher proportions of crashes that involved pedestrians by 16%, 9%, 6%, 5% and 5% of all 129 crashes that involved pedestrians respectively




(a) (b)

Figure 27 Proportion of road users' involvement in crashes out of all 927 crashes




| | Ubungo | Bucha | Morogoro Rd x Shekilango Rd | Ubungo Maji | Kimara | Kibo | Korogwe | Morogoro Rd x Kawawa Rd | Kagera | Mwembechai | Magomeni Mapipa | Tip Top | Mkwajuni | Kisutu | Morogoro Rd x Mabibo Rd | Kivukoni | Manzese | Argentina |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pedestrians | 16% | 4% | 5% | 2% | 6% | 2% | 5% | 2% | 9% | 1% | 4% | 3% | 2% | 1% | 1% | 5% | 5% | 3% |
| Motorcycle | 10% | 10% | 11% | 4% | 7% | 7% | 3% | 6% | 5% | 2% | 3% | 6% | 2% | 2% | | 1% | 1% | 2% |
| Car | 9% | 9% | 7% | 6% | 8% | 7% | 6% | 5% | 2% | 3% | 3% | 3% | 3% | 2% | 2% | 2% | 1% | 1% |
| Daladala | 9% | 6% | 5% | 9% | 4% | 3% | 3% | 8% | 4% | 3% | 2% | | 7% | 2% | 6% | | 3% | 1% |
| BRT Bus | 5% | 5% | 23% | 5% | 2% | 2% | 2% | 5% | 2% | 14% | 6% | 5% | | 6% | | 2% | | 6% |
| Truck | 20% | 6% | 11% | 21% | 6% | 8% | 2% | | | 2% | 2% | 4% | 1% | | 2% | | | 1% |

Figure 28 Areas with highest proportions of crashes per total crashes that involved specific road users

Nevertheless, Figure 27, indicate trucks ranked in fourth place for road users involved in traffic crashes in the DART corridor after being involved in 99 crashes, equivalent to 10.7% of all 927 crashes. Figure 28 shows Ubungo Maji, Ubungo, Shekilango, and Kibo as the areas with highest proportions of crashes that involved trucks, i.e., 21%, 20%, 11%, and 8% of 99 crashes respectively and 6% for both Kimara and Bucha. the areas recorded with highest crashes involving trucks.

In addition, Figure 28 shows the areas with highest proportions of crashes involving BRT buses, mostly BRT buses were involved in traffic crashes at Shekilango area, i.e., out of 65 crashes that involved BRT buses, 23% occurred at Shekilango area and 14% at Mwembechai, 6 % at Kisutu, another 6% at Magomeni Mapipa, and again 6% at Manzese Argentina. The junctions of Morogoro road and Kawawa road, and Morogoro and Bibi Titi roads each had approximately 5% of all crashes that involved BART buses.

## 5 DISCUSSIONS

The main objective of this study was to examine the safety performance of the Dar es Salaam Rapid Transit system to whether its implementation in DSM has improved or deteriorated the road safety performance in its corridor as compared to the safety performance in the same corridor in three years before its implementation. The study considered both objective and subjective safety impacts of the system.

Early researches on Bus Rapid Transit (BRT) systems suggest that there are safety benefits to implement BRT systems especially where significant consideration is given to protect vulnerable road users i.e., pedestrians and cyclists (Bocarejo et al., 2012). Considerations for Intelligent Transport (ITS) systems were revealed as potential measures to improve safety performance in BRT systems (Kuye et al., 2017). Still, other studies clearly warn that BRT systems do not provide a one-size-fits-all solution to road safety problems (Vecino-Ortiz & Hyder, 2015). Safety performance in BRT systems can be compromised in different stages of its implementation, being at design stages by either insufficient engineering consideration to protect all road users, etc., up to the operational stages by mainly failing to meet the operational standards of the BRT systems. For instance, overcrowded BRT buses can pose the most negative effect on perceived risk of sexual harassment (Orozco-Fontalvo et al., 2019).

The results of this study revealed significant differences in road safety perceptions among road users of the DART system. Some of the results support the notion that BRT systems improve traffic safety in its corridor as compared to the period before its implementation (Vecino-Ortiz & Hyder, 2015), while on the other side the study suggest that implementation of BRT systems may deteriorate safety performance of some specific road users or to some specific areas within the system (Duduta et al., 2012).

The results indicated significant differences in safety perception among DART system users when travelling or waiting for transport at DART stations/terminal and when travelling in their main modes of transport. The findings as detailed in ANNEX 3: Post Hoc Test results for safety perception, indicated significant differences in safety perceptions among NMT users (pedestrians and cyclists), and between NMT users and MT (motorcyclists and Bajaj users).

#### *5.1.1 Differences in safety perception among NMT users*

Exploring the difference in safety perception among NMT users, pedestrians felt safer than cyclist did. The differences in their safety perception were significant as shown in ANNEX 3: Post Hoc Test results for safety perception. This was quite surprising that their safety perception was significantly different. The author expected no significant differences because as per system design, both were designed to use raised zebra crossings across the mixed traffic lanes for their safety when crossing mixed traffic and BRT traffic to integrate into DART bus services or when crossing the road to the other side. Likewise, at terminals especially those constructed at the middle of the road i.e., Kimara, Ubungo and Morocco terminals, the system was constructed with overpass pedestrians' bridges, dedicated to pedestrians and cyclist to safe cross the road or access the terminals. Nevertheless, the authors expectations were in line with the risk perception of NMT users as shown in ANNEX 2: Post Hoc Test results for risk perception. The researcher assumed that the risk perceived by road users has direct impact on their safety perception in the system. Therefore, as the results for risk perception indicated both pedestrians and cyclists to have no significant differences in risk perception for crash, crime, sexual harassment and infectious diseases, he expected no significant differences in safety perception.

However, the researcher argues that the observed significant differences in safety perception among NMT users at stations might be related with the design considerations for cyclists. The DART system implementation provided cycle path and walkways, however, it did not include parking facilities close to the DART stations/terminal for bicycles, nevertheless, there was no parking racks for cyclist elsewhere whether close nor far from the DART system. Therefore, the author suggests that, lack of parking facilities for bicycles may play a significant role in affecting the safety feeling of cyclists in a negative way. The author argues that cyclists would not feel safer for their bicycles especially when they have to integrate in the DART bus services if no provision for protection of their bicycles. This was somewhat shown in the risk perception of crime between pedestrians and cyclist, cyclist perceived higher risk perception of crime in the DART system as compared to pedestrians, however their differences in risk perception were not significant.

Nevertheless, the research suggests that the significant differences in safety feeling between cyclists and pedestrians might be related with usability of the zebra crossings especially at stations. Pedestrians might have the safety feeling significantly than that of cyclists because when crossing the road close to stations at zebra crossings pedestrians in most cases they do it by walking contrary to cyclist who mostly cross the road on their bike while cycling. Since zebra crossings close to DART stations are not signalized and the fact that crossing the road requires significant attention from the road users especially in observing incoming motorized traffic before making decision to cross. The author suggest that this task might be easier for pedestrians as compared to cyclists especially those who cross the road while cycling because they have to concentrate on both controlling the bicycle at the same time checking for incoming traffic if any, pedestrians only concentrate on checking for incoming traffic.

On the other side, the safety perceptions of both pedestrians and cyclist in the DART system in areas other than stations/terminals were not significantly different. However, the author argues that the lack of established evidence that compares the safety impacts of BRT system to both pedestrians and cyclists leaves the door wide open for further exploration.

#### *5.1.2 Difference in safety perceptions between NMT and MT users*

Looking into perception of both NMT as compared to MT users, the study indicated significant difference in safety perception. There was a significant difference in safety perception between NMT users (pedestrians and cyclists) and MT users (motorcyclists, car users, DART passengers). NMT users felt significantly safer than motorcyclists (both motorcyclist as passengers and drivers). The author argues that the difference in safety feeling between NMT users and motorcyclists might be related with design considerations for the DART system. The DART system made more emphasis to protect NMT users (LOGIT, 2009), however, the system did not consider protection of motorcyclists from mixed traffic. The DART system focused on providing facility for BRT buses, NMT users and mixed traffic on which motorcyclist falls. However, the existing body of literature, indicates motorcyclists as among vulnerable road users especially when mixed with other motorists (cars, trucks, buses, etc.). They are vulnerable mainly due to significant differences in weights between motorcycles and other vehicles, and the low level of occupant protection in monocycles as compared to other vehicles in case of road traffic crashes (Care, 2014; George et al., 2017; WHO, 2018).

Since, motorcycles in the DART system were treated as motorized transport, thus, are required to use mixed traffic lanes in the system, the author suggests that this operation plan poses the likelihood of higher crash severities (i.e., severe injuries or death to motorcyclist) in case of crashes that involve motorcyclists and other motorized vehicles.

This argument was also supported by the risk perception of crash perceived by motorcyclists as shown in ANNEX 2: Post Hoc Test results for risk perception, both motorcyclists (passengers and drivers) perceived significantly higher risks of crashes as compared to NMT users. Nevertheless, the analysis of the objective safety impacts of the DART system in Figure 27 complemented the safety feeling of motorcyclists as compared to NMT users. Motorcyclist were in top second place for road users who were mostly involved in road traffic crashes after the DART implementation while NMT, i.e., pedestrians in top third place and cyclists in second place for road users who were least involved in road crashes after being involved in only 3 crashes out of 927 recorded crashes. As indicated in Figure 21, motorcyclists perceived that over the period of four years of DART system operations (2016 to 2019), motorcyclist were often involved in road crashes due to speeding, aggressive driving, inexperience, red-light running and overtaking in the left. However, as shown in Figure 23, under the existing setting of the DART system, treating motorcyclist as part of motorized transport regardless the fact that they are vulnerable when mixed with other motorized transport, motorcyclists indicated that would likely support awareness campaigns, severe penalty for traffic violations, license system with penalty point that results to license revocation after attaining a particular number of traffic violations, etc. Therefore, these are among the potential measures that can be implemented to improve traffic safety for motorcyclists.

However, based on the authors observations, regardless of no special considerations for motorcyclists in the DART system, in the current bus operations monocycles plays a significant role to feed the DART system with passengers especially from areas where the system does not operate its feeder services. Yet the system did not consider parking facilities for motorcycles close to DART stations/terminals, motorcycle drivers established unplanned parking areas within road reserve areas and in some specific areas they established parking in dedicated areas for pedestrians and cyclists. Therefore, since the political perspective acknowledge monocycles as the source of employment to majority of young population, and the fact that they play a significant role to feed the DART system; the author argues that the current operating DART system phase 1 should acknowledge the contribution of motorcycles in feeding the system with passengers and make considerations especially by providing motorcycle parking lots in both current operating and upcoming DART system phases.

Nevertheless, the study findings indicated significant differences in safety perception among NMT users and car users and DART passengers. NMT users felt less safe as compared to car users and DART passengers. This is partly explained with the results of the objective safety evaluation in Figure 27. Regardless the fact that cars were the mode mostly involved in large proportion of recorded crashes as compared to both pedestrians and cyclists, the study findings support the theory of vulnerability among pedestrians, cyclists and cars. Cars might be involved in large proportion of crashes, yet might not feel the risk as compared to pedestrians or cyclist who are involved in less crashes due to the fact that in most crashes depending on who cars involved with in crashes. This was shown in ANNEX 2: Post Hoc Test results for risk perception, where NMT users indicated higher risk perception of crash as compared to cars. In most cases, car users do not experience higher severities compared to NMT users due to its higher level of protection against crash severity as compared to protection for NMT users.

However, regardless of significant higher risk perception of sexual harassment, and infectious diseases, as perceived by DART passengers compared to NMT, yet DART passengers had significantly higher safety perception compared to NMT users. This can be explained with the facts applied when comparing the safety feeling of NMT users and car users. Though, based on the perceived cause of crashes that involved NMT, both pedestrians and cyclists perceived that NMT users are often involved in road traffic crashes in the DART system due to misuse of the NMT lanes by MT.

However, based on site observations during data collection, the NMT lanes are not only misused by motorist (especially motorcycles), but also misused by petty traders. The primary use of NMT facilities as per DART system design was to accommodate pedestrians and cyclists only, however, large proportion of NMT facilities are used as business places by petty traders. In such conditions, mostly pedestrians and cyclists are forced to use mixed lanes, which increases the risk of crash that involves NMT users. Nevertheless, pedestrians indicated that they are often involved in crashes due to crossing in wrong places than zebra crossing. Based (LOGIT, 2009), majority of DART stations are spaced at 500m, on each side of the station, the system was designed with pedestrians crossings thus making a maximum walking distance of 250m for pedestrian at the middle of two stations. (LOGIT, 2009) indicate that pedestrians are willingly to walk a distance not more than 300m to a pedestrian crossing. Therefore, the author argues that, pedestrians perceived often involved in road crashes by crossing in wrong places due to insufficient law enforcement to prohibit passengers from violating traffic rules. Therefore, as perceived by NMT users in Figure 22, awareness campaigns, severe penalty for traffic violations, reduce speed limit to 30km/h in areas with higher NMT users, mandatory use of reflective clothing for cyclist during dark times etc., could be potential measures to improve traffic safety of NMT users

#### *5.1.3 Change in safety performance as compared to the period before DART implementation*

The findings of this study indicated majority of NMT (pedestrians (64%) and cyclists (60%)) both perceived that their safety especially when around DART stations or terminal to have increased during the day after the implementation of DART. However, during the night large proportions NMT indicated their safety at stations/terminals to have decreased after DART implementation. Likewise, in area other than station/terminal large proportions of NMT users (pedestrians (42%) and cyclists (49%)) indicated that their safety decreased after the implementation of DART system. These findings clearly contradict some of the earlier research that supported the notion that the BRT system improves traffic safety for NMT users by providing walkways and cycle lanes as in the DART system (Vecino-Ortiz & Hyder, 2015).

However, it should be noted that, this notion can be debated from both perspectives depending on the system operational aspects that can affect the safety perception of NMT users. As for the case of DART system, regardless of providing cycle lanes and walkways, the study indicated that a significant proportion of walkways and cycle paths are misused by MT and petty traders, thus forcing NMT users to use mixed lanes in some specific areas, especially in areas with higher NMT users where petty traders target pedestrians for business purposes. Therefore, poor BRT infrastructure management to ensure that they operate to serve the design purposes may significantly affect the safety performance for other road users. In addition, lack of proper policy and the interventions of political leaders to let petty traders work along the roads without disturbance, increases the burden to NMT users as the results of safety challenges associated with trading in NMT facilities.

Looking into differences in safety perception among road users, the most critical and significant differences were observed between motorcyclists and other all other road users. However, in most cases there was no significant differences in safety perception among other road users, i.e., between cyclists and pedestrians, or pedestrians and car users, etc. The study findings show that motorcyclists perceived their safety in the DART corridor to have decreased after the implementation DART system. However, the study could not compare the crash records that involved motorcyclists in both periods, before and after DART implementation, the study only evaluated the safety impacts of the system using crash records in the period after DART implementation. Among road users who were mostly involved in crashes after DART implementation, motorcyclists were in second place after cars users. However, as discussed above, between motorcyclists and cars users, motorcyclists are vulnerable to crashes, therefore, measuring the impact of crashes, motorcyclists bear a significant impact from crashes compared to car users. Therefore, lack of evidence on the safety impacts of BRT systems by comparing crashes that involved motorcyclists in both before and after BRT implementation remains as an area for further exploration. However, as discussed above, based on perceived intervention to improve safety performance for MT, the safety for motorcyclists can be improved in the DART system by safety awareness campaigns, severe penalty for traffic violations including severe penalty for driving motorcycle without driving license, etc.

# 6 CONCLUSION

The primary objective of this study was to evaluate the safety impacts of the Dar es Salaam Rapid Transit system as compared to the period before its implementation, and to recommend potential safety measures that can improve the safety performance of all road users in both current operating and forthcoming DART systems and other BRT systems of similar context.

The study findings indicated that the safety perception of road users in the DART system were significantly dependent on their main modes of transport they use. Demographic characteristics (age, gender, etc.) and other travel characteristics (i.e., experience in the DART corridor both before and after DART implementation) had no significant effects on their safety perception.

The study findings both support and contradict some of the existing theoretical concepts. The study supports the concept that BRT systems are not one-size-fits-all solution to road safety problems. This was based on the analysis of questionnaire data obtained in this study, which indicated motorcyclists as the least safe road users in the DART system. Motorcyclists indicated that their safety in the DART corridor decreased as compared to the period before DART implementation. Similarly, the analysis of crash data from 2016 to 2019, in the period after DART implementation, indicated motorcyclists in second place after cars users for road users who were most involved in crashes after the implementation of DART system. Therefore, based on subjective safety evaluation as perceived by motorcyclists, the DART system implementation has deteriorated safety for motorcyclists as compared to the period before its implementation.

Moreover, the study indicated DART buses among the modes of transport in the DART corridor that were perceived with highest sexual harassment, the DART buses were in second place after Daladala for modes with highest sexual harassments. These findings support the existing body of literature that BRT buses especially when overcrowded have the highest sexual harassments as compared to other modes.

Nevertheless, the study contradicted the notion that BRT systems are potential measures to improve the safety performance for NMT users, especially by incorporating cycle path and walkways in their designs. However, the study findings indicated that regardless of cycle path and walkways in the DART system that were dedicated to NMT, yet both pedestrians and cyclists perceived that their safety performance in the DART corridor decreased after the implementation of the DART system. Though, based on site observations during data collection, and main causes of crash in the DART system that involved NMT users as perceived by NMT users, the author argues that these findings might be related to misuse of the NMT facilities by MT and petty traders. Therefore, this study argues that the argument of BRT systems to improve the traffic safety for NMT users is highly dependent on the operational efficiency of the system including how well the system infrastructures are utilized and maintained to serve the design purposes.

## 7 RECOMMENDATIONS

The other main objective of this study was to recommend safety measures that can be implemented to improve the safety performance in the current operating and forthcoming BRT systems of similar context as DART. However, it is worth noting that during the study, the DART system was operating the transitional services. The DART bus services were the interim services operated below the design capacity of the system, i.e., instead of operating the full system with 305 buses, the system was only operating fully with only 139 buses. During the study period, the DART agency was proceeding with procurement procedures to procure service provider who will provide full bus services in the system. In addition, the study was conducted during corona period, therefore, the study findings especially on the subjective part, the author, argues that users' perceptions might likely be affected by the effects of corona.

However, since the effects of corona felt by all road users, regardless the fact that, system users had significant differences in risk perception for infectious diseases i.e. corona, and the fact that the system was operating the interim services (BRT bus services operated below the design requirements), all the facts cannot hinder applicability of measures recommended in this study in other BRT systems of similar context as DART.

In order to improve safety performance for all road users in BRT systems of similar context as of DART system, the study recommended the following measures; -

i. To provide regular safety awareness campaigns targeting on how to safely commute in the BRT system
ii. To design strategic policy by engaging political leaders as champions of the project, as a way to seek political will on supporting the implementation of the project
iii. To incorporate motorcyclists in BRT design aspects that intend to protect vulnerable road users
iv. To reduce speed limits to 30km/h in areas with higher NMT users and in areas around BRT stations/terminals
v. Installation of parking racks for cyclists close to BRT stations and terminals
vi. To provide regular road safety awareness campaigns for safer commuting in the BRT system
vii. To introduce overtaking priority for BRT buses at stations/terminal where express buses have to overtake local buses,
viii. To implement a license system with penalty points for traffic violations that results to revocations of driving license from drivers after attaining a particular level of traffic violations
ix. Fence BRT lanes in zones with higher NMT users
x. Regular road worthiness inspections for all motorized vehicles in the BRT system
xi. Regular breath test for alcohol usage to all drivers of motorized vehicles
xii. To penalize severely all road users for traffic violation including pedestrians who cross the BRT system in wrong places
xiii. To install auto-traffic enforcement cameras in the BRT corridor, and
xiv. To install CCTV cameras in buses, stations and terminals

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**APPENDIXES**

**ANNEX 1: Questionnaire template**

## 1. INTRODUCTION

***Good morning/afternoon!*** This questionnaire commissioned by Katondo S. NAMBIZA; a candidate for "Master of Transportation Sciences, Traffic Safety" at Hasselt University (Uhasselt), evaluates the impact of Dar es Salaam Rapid Transit (DART) system on the safety feeling of road users in their main modes of transport as compared to the period before its implementation. In that aspect, it is designed to collect individual safety opinions that are essential for subjective safety evaluation of the DART system and in proposing potential safety measures that can improve traffic safety in the DART corridor. Participation is entirely voluntary, your responses are highly appreciated and will be processed in a confidential manner for academic purposes only.

All concerns including questions about the study/questionnaire and request for the study findings can be directed to Katondo SALVATORY NAMBIZA via the following contacts; katondosalvatory.nambiza@student.uhasselt.be or +255-769 275 961

The questionnaire should take no more than 20 minutes of your precious time.

Would you like to participate in this study? Please check the box ☑ on the right hand-side to confirm. Yes ☐ No ☐

Thank you for your time and cooperation.

### 1.1. DEMOGRAPHIC DATA please check the box, ☑ that describes the most your details

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Gender | Male ☐ | Female ☐ | Other ☐ | | | | | |
| Age Group | Less than 18 ☐ | 18-40 ☐ | 41-60 ☐ | Above 60 ☐ | | | | |
| Place of Living | Urban (City Centre/Central Business District) ☐ | Rural/ Periphery Area ☐ | | | | | | |
| Highest Education Level | Primary School ☐ | Secondary School ☐ | Bachelor's degree ☐ | Master's degree ☐ | PhD degree ☐ | | | |
| Employment | Student ☐ | Employee ☐ | Self-employed ☐ | Unemployed ☐ | Retired ☐ | House-husband ☐ | House-wife ☐ | |
| Driving License | Yes ☐ | No ☐ | | | | | | |
| Household Private Car Ownership | Yes ☐ | No ☐ | | | | | | |
| Experience in DART corridor (before and After DART operations)[a] | Before, (< 3 year ☐, >3 year ☐) | After (<3 year ☐, >3 years ☐) | | | | | | |
| Experience in other BRT other than DART System | Yes ☐ | No ☐ | | | | | | |

**Note; "a"** refers to the approximate period of travelling along the roads covered by DART phase 1 in both before and after its implementation, i.e. regardless of the mode of transport you use, how long have you been travelling in the DART corridor in both periods; before and after its implementation?

### 1.2. TRAVEL BEHAVIOUR

In the following mode of transport, please tick the box ☑ to indicate one as your main mode of transport you use in the DART system

| Pedestrians | Cyclist | Motorcycle as a driver | Motorcycle as a passenger | Bajaj as a driver | Bajaj as a passenger | Private car as a driver | Private car as passenger | DART buses as passenger | Daladala as passenger |
|---|---|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

In your main mode of transport, please check the boxes, ☑ to describes the most your travel frequency, most purpose of your travel and whether you normally travel alone or with a companion).

| Modes of Transport | Frequency of travel | | | | | Most Purpose of travel (It is possible to check more than one box on each mode) | | | | | | Companion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily | 4-6/ week | 1-3/ week | <1/ week | Never | Education | Work | Leisure/ shopping | business | Religious | Others | Yes | No |
| Pedestrians (Walking) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cyclists; two or three wheelers | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private car as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private car as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Public Transport as DART passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Public Transport as Daladala passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

## 2. RISK PERCEPTION

How risky do you feel when using your main mode of transport in the DART system? Please check the boxes only in your main mode of transport ☑; one box for each risk category that describes the most your risk perception (i.e. risk associated with traffic crashes, sexual harassments, and crimes).

| Modes of transport/Risk Perception | Risk of Traffic Crashes | | | | | | | Risk of Sexual harassments | | | | | | | Risk of crimes (i.e. theft, violence etc.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not Risky at all | Slightly Risky | Somewhat risky | Moderate risky | Risky | Very Risky | Extremely Risky | Not Risky at all | Slightly Risky | Somewhat risky | Moderate risky | Risky | Very Risky | Extremely Risky | Not Risky at all | Slightly Risky | Somewhat risky | Moderate risky | Risky | Very Risky | Extremely Risky |
| Pedestrians (Walking) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cyclists; two or three wheelers | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private car as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Private car as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Public Transport as DART passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Public Transport as Daladala passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**3. SAFETY PERCEPTION**

How safe or unsafe do you feel using your main mode of transport in the DART system? Please check the boxes only in your main mode of transport that describes the most your safety feeling when travelling during the day time and night times. On each duration check one box that describes the most your perception at the station/terminal or when in-vehicle/walking.

| Modes of transport/Safety Perception | Safety perception travelling during the day | | | | | | | | | | | | Safety perception travelling at night | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Safety at stations/terminals | | | | | | In-vehicle/while walking | | | | | | Safety at stations/terminals | | | | | | In-vehicle/while walking | | | | | |
| | Very unsafe | unsafe | Slightly unsafe | Slightly safe | safe | Very safe | Very unsafe | unsafe | Slightly unsafe | Slightly safe | safe | Very safe | Very unsafe | unsafe | Slightly unsafe | Slightly safe | safe | Very safe | Very unsafe | unsafe | Slightly unsafe | Slightly safe | safe | Very safe |
| Walking | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cycling | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Car as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Car as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| DART as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Daladala as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Based on your own opinion on the safety performance of the DART system, please indicate whether you think the safety performance in your main mode of transport has increased, unchanged or decreased when compared to the period before its implementation. Please check one box to indicate your own opinion when travelling during the day and night in your main mode of transport for both safeties at stations/terminals and in-vehicle safety.

| Road users | Safety perception travelling during the day | | | | | | Safety perception travelling at night | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Safety at stations/terminals | | | In-vehicle safety | | | Safety at stations/terminals | | | In-vehicle safety | | |
| | Increased | Decreased | unchanged | Increased | Decreased | unchanged | Increased | Decreased | unchanged | Increased | Decreased | unchanged |
| Walking | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cycling | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Motorcycle as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bajaj as a passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Car as a driver | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Car as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| DART as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Daladala as passenger | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

## 4. PERCEIVED CAUSES OF ACCIDENTS

On your own opinion, how often do you think the following factors have caused road traffic crashes involving road users from your main modes of transport? Please check the box only in your main mode of transport to indicate your opinion

| Causes of Accident Involving Pedestrians/Cyclists (both 2 & 3 wheeler Cyclists) | PEDESTRIAN | | | | | | CYCLIST | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always |
| Mobile phone usage when on road | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Red light running | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bad weather | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Poor visibility | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Usage of musical devices when on road | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Crossing road in wrong places | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Misuse of Non-Motorized Transport (NMT) lanes by Motorized Transport (MT) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| Causes of crashes involving Motorized Transport users | BODABODA & BAJAJ | | | | | | CARS | | | | | | DALADALA | | | | | | DART BUSES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always |
| Speeding | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Diving under influence of alcohol | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Poor road maintenance | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Vehicle defects | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Driving when tired | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Mobile phone usage | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Aggressive driving | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Red light running | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Bad weather | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Inexperience (less than 1 year of driving) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Driving too close to the front vehicle | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Overtaking in left side | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Wrong lane driving | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Poor visibility | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| Causes of crashes involving Motorized Transport users | BODABODA & BAJAJ | | | | | | CARS | | | | | | DALADALA | | | | | | DART BUSES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always | Never | Rarely | Sometimes | Often | Very often | Always |
| Usage of musical devices | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

### 4.1. PERCEIVED INTERVENTIONS

Imagine that you advise the DART agency and the Traffic Planners of the Dar es Salaam City for safety improvement in your main mode of transport, how likely would you recommend the following measures to be implemented for traffic safety improvement in your main mode of transport?

| **PERCEIVED INTERVENTIONS FOR PEDESTRIANS AND CYCLISTS** | **Very unlikely** | **Unlikely** | **Neutral** | **Likely** | **Very Likely** |
|---|---|---|---|---|---|
| Safety awareness campaigns | ☐ | ☐ | ☐ | ☐ | ☐ |
| Auto traffic enforcement camera | ☐ | ☐ | ☐ | ☐ | ☐ |
| Severe penalty for traffic violations | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduce speed limit to 30km/h in high NMT users | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fence BRT in area with high NMT users | ☐ | ☐ | ☐ | ☐ | ☐ |
| Provide more Zebra crossings in area with higher NMT users | ☐ | ☐ | ☐ | ☐ | ☐ |
| Separate cycle path and walkway at different ground level | ☐ | ☐ | ☐ | ☐ | ☐ |
| Improve lighting at intersection and pedestrian crossings | ☐ | ☐ | ☐ | ☐ | ☐ |
| Mandatory reflective cloth for cyclists during dark times | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PERCEIVED INTERVENTIONS FOR MOTORIZED TRANSPORT USERS (Motorcycle, Bajaj, Car, Daladala and DART buses)** | **Very unlikely** | **Unlikely** | **Neutral** | **Likely** | **Very Likely** |
| Safety awareness campaigns | ☐ | ☐ | ☐ | ☐ | ☐ |
| Auto traffic enforcement camera | ☐ | ☐ | ☐ | ☐ | ☐ |
| Severe penalty for traffic violations | ☐ | ☐ | ☐ | ☐ | ☐ |
| Licence with penalty point for traffic rule violation that results in revocation of the license when a certain number of points are reached | ☐ | ☐ | ☐ | ☐ | ☐ |
| Regular road worthiness inspection | ☐ | ☐ | ☐ | ☐ | ☐ |
| Breath test for alcohol usage | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PERCEIVED INTERVENTIONS FOR DART BUSES ONLY** | **Very unlikely** | **Unlikely** | **Neutral** | **Likely** | **Very Likely** |

| PERCEIVED INTERVENTIONS FOR PEDESTRIANS AND CYCLISTS | Very unlikely | Unlikely | Neutral | Likely | Very Likely |
|---|---|---|---|---|---|
| Install CCTV cameras in DART stations, terminals and buses | ☐ | ☐ | ☐ | ☐ | ☐ |
| Introduce overtaking priorities for DART buses | ☐ | ☐ | ☐ | ☐ | ☐ |
| Limit speed to 30km/h for DART buses at stations/terminals | ☐ | ☐ | ☐ | ☐ | ☐ |
| Improve maintenance of DART buses, stations and terminals | ☐ | ☐ | ☐ | ☐ | ☐ |
| Increase number of buses in peak periods | ☐ | ☐ | ☐ | ☐ | ☐ |
| Increase number of buses in off-peak periods | ☐ | ☐ | ☐ | ☐ | ☐ |

**ANNEX 2: Post Hoc Test results for risk perception**

## Multiple Comparisons

LSD

| Dependent Variable | (I) DM Mode of Transport | (J) DM Mode of Transport | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| RP Crash | Pedestrian | Cyclist | .0470 | .36619 | .898 | -.6731 | .7671 |
| | | Motorcycle as passenger | -.7306* | .36398 | .045 | -1.4463 | -.0148 |
| | | Motorcycle as driver | -.8504* | .36619 | .021 | -1.5705 | -.1303 |
| | | Bajaj as passenger | .6944 | .37344 | .064 | -.0399 | 1.4288 |
| | | Bajaj as driver | .5194 | .36398 | .154 | -.1963 | 1.2352 |
| | | Car as passenger | .8634* | .37091 | .020 | .1340 | 1.5927 |
| | | Car as driver | .8333* | .37344 | .026 | .0990 | 1.5677 |
| | | Daladala passenger | 1.1667* | .37344 | .002 | .4323 | 1.9010 |
| | | DART passenger | 1.0497* | .36849 | .005 | .3251 | 1.7743 |
| | Cyclist | Pedestrian | -.0470 | .36619 | .898 | -.7671 | .6731 |
| | | Motorcycle as passenger | -.7776* | .35654 | .030 | -1.4787 | -.0764 |
| | | Motorcycle as driver | -.8974* | .35879 | .013 | -1.6030 | -.1919 |
| | | Bajaj as passenger | .6474 | .36619 | .078 | -.0727 | 1.3675 |
| | | Bajaj as driver | .4724 | .35654 | .186 | -.2287 | 1.1736 |
| | | Car as passenger | .8164* | .36360 | .025 | .1013 | 1.5314 |
| | | Car as driver | .7863* | .36619 | .032 | .0662 | 1.5064 |
| | | Daladala passenger | 1.1197* | .36619 | .002 | .3996 | 1.8397 |
| | | DART passenger | 1.0027* | .36114 | .006 | .2925 | 1.7129 |
| | Motorcycle as passenger | Pedestrian | .7306* | .36398 | .045 | .0148 | 1.4463 |
| | | Cyclist | .7776* | .35654 | .030 | .0764 | 1.4787 |
| | | Motorcycle as driver | -.1199 | .35654 | .737 | -.8210 | .5812 |
| | | Bajaj as passenger | 1.4250* | .36398 | .000 | .7092 | 2.1408 |
| | | Bajaj as driver | 1.2500* | .35428 | .000 | .5533 | 1.9467 |
| | | Car as passenger | 1.5939* | .36139 | .000 | .8833 | 2.3046 |
| | | Car as driver | 1.5639* | .36398 | .000 | .8481 | 2.2796 |
| | | Daladala passenger | 1.8972* | .36398 | .000 | 1.1815 | 2.6130 |
| | | DART passenger | 1.7803* | .35891 | .000 | 1.0745 | 2.4860 |
| | Motorcycle as driver | Pedestrian | .8504* | .36619 | .021 | .1303 | 1.5705 |
| | | Cyclist | .8974* | .35879 | .013 | .1919 | 1.6030 |
| | | Motorcycle as passenger | .1199 | .35654 | .737 | -.5812 | .8210 |
| | | Bajaj as passenger | 1.5449* | .36619 | .000 | .8248 | 2.2650 |
| | | Bajaj as driver | 1.3699* | .35654 | .000 | .6688 | 2.0710 |
| | | Car as passenger | 1.7138* | .36360 | .000 | .9988 | 2.4288 |
| | | Car as driver | 1.6838* | .36619 | .000 | .9637 | 2.4038 |
| | | Daladala passenger | 2.0171* | .36619 | .000 | 1.2970 | 2.7372 |
| | | DART passenger | 1.9001* | .36114 | .000 | 1.1900 | 2.6103 |
| | Bajaj as passenger | Pedestrian | -.6944 | .37344 | .064 | -1.4288 | .0399 |
| | | Cyclist | -.6474 | .36619 | .078 | -1.3675 | .0727 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Motorcycle as passenger | -1.4250* | .36398 | .000 | -2.1408 | -.7092 |
| | | Motorcycle as driver | -1.5449* | .36619 | .000 | -2.2650 | -.8248 |
| | | Bajaj as driver | -.1750 | .36398 | .631 | -.8908 | .5408 |
| | | Car as passenger | .1689 | .37091 | .649 | -.5605 | .8983 |
| | | Car as driver | .1389 | .37344 | .710 | -.5955 | .8732 |
| | | Daladala passenger | .4722 | .37344 | .207 | -.2621 | 1.2066 |
| | | DART passenger | .3553 | .36849 | .336 | -.3694 | 1.0799 |
| | Bajaj as driver | Pedestrian | -.5194 | .36398 | .154 | -1.2352 | .1963 |
| | | Cyclist | -.4724 | .35654 | .186 | -1.1736 | .2287 |
| | | Motorcycle as passenger | -1.2500* | .35428 | .000 | -1.9467 | -.5533 |
| | | Motorcycle as driver | -1.3699* | .35654 | .000 | -2.0710 | -.6688 |
| | | Bajaj as passenger | .1750 | .36398 | .631 | -.5408 | .8908 |
| | | Car as passenger | .3439 | .36139 | .342 | -.3667 | 1.0546 |
| | | Car as driver | .3139 | .36398 | .389 | -.4019 | 1.0296 |
| | | Daladala passenger | .6472 | .36398 | .076 | -.0685 | 1.3630 |
| | | DART passenger | .5303 | .35891 | .140 | -.1755 | 1.2360 |
| | Car as passenger | Pedestrian | -.8634* | .37091 | .020 | -1.5927 | -.1340 |
| | | Cyclist | -.8164* | .36360 | .025 | -1.5314 | -.1013 |
| | | Motorcycle as passenger | -1.5939* | .36139 | .000 | -2.3046 | -.8833 |
| | | Motorcycle as driver | -1.7138* | .36360 | .000 | -2.4288 | -.9988 |
| | | Bajaj as passenger | -.1689 | .37091 | .649 | -.8983 | .5605 |
| | | Bajaj as driver | -.3439 | .36139 | .342 | -1.0546 | .3667 |
| | | Car as driver | -.0300 | .37091 | .936 | -.7594 | .6993 |
| | | Daladala passenger | .3033 | .37091 | .414 | -.4261 | 1.0327 |
| | | DART passenger | .1863 | .36593 | .611 | -.5332 | .9059 |
| | Car as driver | Pedestrian | -.8333* | .37344 | .026 | -1.5677 | -.0990 |
| | | Cyclist | -.7863* | .36619 | .032 | -1.5064 | -.0662 |
| | | Motorcycle as passenger | -1.5639* | .36398 | .000 | -2.2796 | -.8481 |
| | | Motorcycle as driver | -1.6838* | .36619 | .000 | -2.4038 | -.9637 |
| | | Bajaj as passenger | -.1389 | .37344 | .710 | -.8732 | .5955 |
| | | Bajaj as driver | -.3139 | .36398 | .389 | -1.0296 | .4019 |
| | | Car as passenger | .0300 | .37091 | .936 | -.6993 | .7594 |
| | | Daladala passenger | .3333 | .37344 | .373 | -.4010 | 1.0677 |
| | | DART passenger | .2164 | .36849 | .557 | -.5082 | .9410 |
| | Daladala passenger | Pedestrian | -1.1667* | .37344 | .002 | -1.9010 | -.4323 |
| | | Cyclist | -1.1197* | .36619 | .002 | -1.8397 | -.3996 |
| | | Motorcycle as passenger | -1.8972* | .36398 | .000 | -2.6130 | -1.1815 |
| | | Motorcycle as driver | -2.0171* | .36619 | .000 | -2.7372 | -1.2970 |
| | | Bajaj as passenger | -.4722 | .37344 | .207 | -1.2066 | .2621 |
| | | Bajaj as driver | -.6472 | .36398 | .076 | -1.3630 | .0685 |
| | | Car as passenger | -.3033 | .37091 | .414 | -1.0327 | .4261 |
| | | Car as driver | -.3333 | .37344 | .373 | -1.0677 | .4010 |
| | | DART passenger | -.1170 | .36849 | .751 | -.8416 | .6077 |

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|---|---|---|---|---|---|---|---|
| | DART passenger | Pedestrian | -1.0497* | .36849 | .005 | -1.7743 | -.3251 |
| | | Cyclist | -1.0027* | .36114 | .006 | -1.7129 | -.2925 |
| | | Motorcycle as passenger | -1.7803* | .35891 | .000 | -2.4860 | -1.0745 |
| | | Motorcycle as driver | -1.9001* | .36114 | .000 | -2.6103 | -1.1900 |
| | | Bajaj as passenger | -.3553 | .36849 | .336 | -1.0799 | .3694 |
| | | Bajaj as driver | -.5303 | .35891 | .140 | -1.2360 | .1755 |
| | | Car as passenger | -.1863 | .36593 | .611 | -.9059 | .5332 |
| | | Car as driver | -.2164 | .36849 | .557 | -.9410 | .5082 |
| | | Daladala passenger | .1170 | .36849 | .751 | -.6077 | .8416 |
| RP Sexual harassment | Pedestrian | Cyclist | .0983 | .31453 | .755 | -.5202 | .7168 |
| | | Motorcycle as passenger | .2611 | .31263 | .404 | -.3537 | .8759 |
| | | Motorcycle as driver | .2265 | .31453 | .472 | -.3920 | .8450 |
| | | Bajaj as passenger | -.1667 | .32075 | .604 | -.7974 | .4641 |
| | | Bajaj as driver | .2611 | .31263 | .404 | -.3537 | .8759 |
| | | Car as passenger | -.6862* | .31858 | .032 | -1.3127 | -.0597 |
| | | Car as driver | .2778 | .32075 | .387 | -.3530 | .9085 |
| | | Daladala passenger | -1.8333* | .32075 | .000 | -2.4641 | -1.2026 |
| | | DART passenger | -.9942* | .31651 | .002 | -1.6165 | -.3718 |
| | Cyclist | Pedestrian | -.0983 | .31453 | .755 | -.7168 | .5202 |
| | | Motorcycle as passenger | .1628 | .30624 | .595 | -.4394 | .7650 |
| | | Motorcycle as driver | .1282 | .30817 | .678 | -.4778 | .7342 |
| | | Bajaj as passenger | -.2650 | .31453 | .400 | -.8835 | .3535 |
| | | Bajaj as driver | .1628 | .30624 | .595 | -.4394 | .7650 |
| | | Car as passenger | -.7845* | .31231 | .012 | -1.3986 | -.1703 |
| | | Car as driver | .1795 | .31453 | .569 | -.4390 | .7980 |
| | | Daladala passenger | -1.9316* | .31453 | .000 | -2.5501 | -1.3131 |
| | | DART passenger | -1.0924* | .31019 | .000 | -1.7024 | -.4825 |
| | Motorcycle as passenger | Pedestrian | -.2611 | .31263 | .404 | -.8759 | .3537 |
| | | Cyclist | -.1628 | .30624 | .595 | -.7650 | .4394 |
| | | Motorcycle as driver | -.0346 | .30624 | .910 | -.6368 | .5676 |
| | | Bajaj as passenger | -.4278 | .31263 | .172 | -1.0426 | .1870 |
| | | Bajaj as driver | .0000 | .30429 | 1.000 | -.5984 | .5984 |
| | | Car as passenger | -.9473* | .31040 | .002 | -1.5577 | -.3369 |
| | | Car as driver | .0167 | .31263 | .958 | -.5981 | .6314 |
| | | Daladala passenger | -2.0944* | .31263 | .000 | -2.7092 | -1.4797 |
| | | DART passenger | -1.2553* | .30827 | .000 | -1.8615 | -.6491 |
| | Motorcycle as driver | Pedestrian | -.2265 | .31453 | .472 | -.8450 | .3920 |
| | | Cyclist | -.1282 | .30817 | .678 | -.7342 | .4778 |
| | | Motorcycle as passenger | .0346 | .30624 | .910 | -.5676 | .6368 |
| | | Bajaj as passenger | -.3932 | .31453 | .212 | -1.0117 | .2253 |
| | | Bajaj as driver | .0346 | .30624 | .910 | -.5676 | .6368 |
| | | Car as passenger | -.9127* | .31231 | .004 | -1.5268 | -.2985 |
| | | Car as driver | .0513 | .31453 | .871 | -.5672 | .6698 |

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|---|---|---|---|---|---|---|
| | Daladala passenger | -2.0598* | .31453 | .000 | -2.6783 | -1.4413 |
| | DART passenger | -1.2206* | .31019 | .000 | -1.8306 | -.6107 |
| Bajaj as passenger | Pedestrian | .1667 | .32075 | .604 | -.4641 | .7974 |
| | Cyclist | .2650 | .31453 | .400 | -.3535 | .8835 |
| | Motorcycle as passenger | .4278 | .31263 | .172 | -.1870 | 1.0426 |
| | Motorcycle as driver | .3932 | .31453 | .212 | -.2253 | 1.0117 |
| | Bajaj as driver | .4278 | .31263 | .172 | -.1870 | 1.0426 |
| | Car as passenger | -.5195 | .31858 | .104 | -1.1460 | .1070 |
| | Car as driver | .4444 | .32075 | .167 | -.1863 | 1.0752 |
| | Daladala passenger | -1.6667* | .32075 | .000 | -2.2974 | -1.0359 |
| | DART passenger | -.8275* | .31651 | .009 | -1.4499 | -.2051 |
| Bajaj as driver | Pedestrian | -.2611 | .31263 | .404 | -.8759 | .3537 |
| | Cyclist | -.1628 | .30624 | .595 | -.7650 | .4394 |
| | Motorcycle as passenger | .0000 | .30429 | 1.000 | -.5984 | .5984 |
| | Motorcycle as driver | -.0346 | .30624 | .910 | -.6368 | .5676 |
| | Bajaj as passenger | -.4278 | .31263 | .172 | -1.0426 | .1870 |
| | Car as passenger | -.9473* | .31040 | .002 | -1.5577 | -.3369 |
| | Car as driver | .0167 | .31263 | .958 | -.5981 | .6314 |
| | Daladala passenger | -2.0944* | .31263 | .000 | -2.7092 | -1.4797 |
| | DART passenger | -1.2553* | .30827 | .000 | -1.8615 | -.6491 |
| Car as passenger | Pedestrian | .6862* | .31858 | .032 | .0597 | 1.3127 |
| | Cyclist | .7845* | .31231 | .012 | .1703 | 1.3986 |
| | Motorcycle as passenger | .9473* | .31040 | .002 | .3369 | 1.5577 |
| | Motorcycle as driver | .9127* | .31231 | .004 | .2985 | 1.5268 |
| | Bajaj as passenger | .5195 | .31858 | .104 | -.1070 | 1.1460 |
| | Bajaj as driver | .9473* | .31040 | .002 | .3369 | 1.5577 |
| | Car as driver | .9640* | .31858 | .003 | .3375 | 1.5904 |
| | Daladala passenger | -1.1471* | .31858 | .000 | -1.7736 | -.5207 |
| | DART passenger | -.3080 | .31430 | .328 | -.9260 | .3101 |
| Car as driver | Pedestrian | -.2778 | .32075 | .387 | -.9085 | .3530 |
| | Cyclist | -.1795 | .31453 | .569 | -.7980 | .4390 |
| | Motorcycle as passenger | -.0167 | .31263 | .958 | -.6314 | .5981 |
| | Motorcycle as driver | -.0513 | .31453 | .871 | -.6698 | .5672 |
| | Bajaj as passenger | -.4444 | .32075 | .167 | -1.0752 | .1863 |
| | Bajaj as driver | -.0167 | .31263 | .958 | -.6314 | .5981 |
| | Car as passenger | -.9640* | .31858 | .003 | -1.5904 | -.3375 |
| | Daladala passenger | -2.1111* | .32075 | .000 | -2.7419 | -1.4804 |
| | DART passenger | -1.2719* | .31651 | .000 | -1.8943 | -.6495 |
| Daladala passenger | Pedestrian | 1.8333* | .32075 | .000 | 1.2026 | 2.4641 |
| | Cyclist | 1.9316* | .31453 | .000 | 1.3131 | 2.5501 |
| | Motorcycle as passenger | 2.0944* | .31263 | .000 | 1.4797 | 2.7092 |
| | Motorcycle as driver | 2.0598* | .31453 | .000 | 1.4413 | 2.6783 |

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|---|---|---|---|---|---|---|---|
| | | Bajaj as passenger | 1.6667* | .32075 | .000 | 1.0359 | 2.2974 |
| | | Bajaj as driver | 2.0944* | .31263 | .000 | 1.4797 | 2.7092 |
| | | Car as passenger | 1.1471* | .31858 | .000 | .5207 | 1.7736 |
| | | Car as driver | 2.1111* | .32075 | .000 | 1.4804 | 2.7419 |
| | | DART passenger | .8392* | .31651 | .008 | .2168 | 1.4616 |
| | DART passenger | Pedestrian | .9942* | .31651 | .002 | .3718 | 1.6165 |
| | | Cyclist | 1.0924* | .31019 | .000 | .4825 | 1.7024 |
| | | Motorcycle as passenger | 1.2553* | .30827 | .000 | .6491 | 1.8615 |
| | | Motorcycle as driver | 1.2206* | .31019 | .000 | .6107 | 1.8306 |
| | | Bajaj as passenger | .8275* | .31651 | .009 | .2051 | 1.4499 |
| | | Bajaj as driver | 1.2553* | .30827 | .000 | .6491 | 1.8615 |
| | | Car as passenger | .3080 | .31430 | .328 | -.3101 | .9260 |
| | | Car as driver | 1.2719* | .31651 | .000 | .6495 | 1.8943 |
| | | Daladala passenger | -.8392* | .31651 | .008 | -1.4616 | -.2168 |
| RP crime | Pedestrian | Cyclist | -.0321 | .31095 | .918 | -.6435 | .5794 |
| | | Motorcycle as passenger | .7417* | .30908 | .017 | .1339 | 1.3495 |
| | | Motorcycle as driver | .4295 | .31095 | .168 | -.1820 | 1.0410 |
| | | Bajaj as passenger | .3611 | .31711 | .256 | -.2625 | .9847 |
| | | Bajaj as driver | .1917 | .30908 | .536 | -.4161 | .7995 |
| | | Car as passenger | .9437* | .31496 | .003 | .3243 | 1.5630 |
| | | Car as driver | 1.3889* | .31711 | .000 | .7653 | 2.0125 |
| | | Daladala passenger | -.9167* | .31711 | .004 | -1.5402 | -.2931 |
| | | DART passenger | -.2939 | .31291 | .348 | -.9092 | .3215 |
| | Cyclist | Pedestrian | .0321 | .31095 | .918 | -.5794 | .6435 |
| | | Motorcycle as passenger | .7737* | .30276 | .011 | .1784 | 1.3691 |
| | | Motorcycle as driver | .4615 | .30467 | .131 | -.1376 | 1.0607 |
| | | Bajaj as passenger | .3932 | .31095 | .207 | -.2183 | 1.0046 |
| | | Bajaj as driver | .2237 | .30276 | .460 | -.3716 | .8191 |
| | | Car as passenger | .9757* | .30876 | .002 | .3686 | 1.5829 |
| | | Car as driver | 1.4209* | .31095 | .000 | .8095 | 2.0324 |
| | | Daladala passenger | -.8846* | .31095 | .005 | -1.4961 | -.2731 |
| | | DART passenger | -.2618 | .30667 | .394 | -.8649 | .3412 |
| | Motorcycle as passenger | Pedestrian | -.7417* | .30908 | .017 | -1.3495 | -.1339 |
| | | Cyclist | -.7737* | .30276 | .011 | -1.3691 | -.1784 |
| | | Motorcycle as driver | -.3122 | .30276 | .303 | -.9075 | .2832 |
| | | Bajaj as passenger | -.3806 | .30908 | .219 | -.9883 | .2272 |
| | | Bajaj as driver | -.5500 | .30084 | .068 | -1.1416 | .0416 |
| | | Car as passenger | .2020 | .30687 | .511 | -.4014 | .8055 |
| | | Car as driver | .6472* | .30908 | .037 | .0394 | 1.2550 |
| | | Daladala passenger | -1.6583* | .30908 | .000 | -2.2661 | -1.0505 |
| | | DART passenger | -1.0355* | .30477 | .001 | -1.6348 | -.4362 |
| | Motorcycle as driver | Pedestrian | -.4295 | .31095 | .168 | -1.0410 | .1820 |
| | | Cyclist | -.4615 | .30467 | .131 | -1.0607 | .1376 |

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|---|---|---|---|---|---|---|---|
| | | Motorcycle as passenger | .3122 | .30276 | .303 | -.2832 | .9075 |
| | | Bajaj as passenger | -.0684 | .31095 | .826 | -.6798 | .5431 |
| | | Bajaj as driver | -.2378 | .30276 | .433 | -.8332 | .3575 |
| | | Car as passenger | .5142 | .30876 | .097 | -.0930 | 1.1214 |
| | | Car as driver | .9594* | .31095 | .002 | .3479 | 1.5709 |
| | | Daladala passenger | -1.3462* | .31095 | .000 | -1.9576 | -.7347 |
| | | DART passenger | -.7233* | .30667 | .019 | -1.3264 | -.1203 |
| | Bajaj as passenger | Pedestrian | -.3611 | .31711 | .256 | -.9847 | .2625 |
| | | Cyclist | -.3932 | .31095 | .207 | -1.0046 | .2183 |
| | | Motorcycle as passenger | .3806 | .30908 | .219 | -.2272 | .9883 |
| | | Motorcycle as driver | .0684 | .31095 | .826 | -.5431 | .6798 |
| | | Bajaj as driver | -.1694 | .30908 | .584 | -.7772 | .4383 |
| | | Car as passenger | .5826 | .31496 | .065 | -.0368 | 1.2019 |
| | | Car as driver | 1.0278* | .31711 | .001 | .4042 | 1.6514 |
| | | Daladala passenger | -1.2778* | .31711 | .000 | -1.9014 | -.6542 |
| | | DART passenger | -.6550* | .31291 | .037 | -1.2703 | -.0396 |
| | Bajaj as driver | Pedestrian | -.1917 | .30908 | .536 | -.7995 | .4161 |
| | | Cyclist | -.2237 | .30276 | .460 | -.8191 | .3716 |
| | | Motorcycle as passenger | .5500 | .30084 | .068 | -.0416 | 1.1416 |
| | | Motorcycle as driver | .2378 | .30276 | .433 | -.3575 | .8332 |
| | | Bajaj as passenger | .1694 | .30908 | .584 | -.4383 | .7772 |
| | | Car as passenger | .7520* | .30687 | .015 | .1486 | 1.3555 |
| | | Car as driver | 1.1972* | .30908 | .000 | .5894 | 1.8050 |
| | | Daladala passenger | -1.1083* | .30908 | .000 | -1.7161 | -.5005 |
| | | DART passenger | -.4855 | .30477 | .112 | -1.0848 | .1138 |
| | Car as passenger | Pedestrian | -.9437* | .31496 | .003 | -1.5630 | -.3243 |
| | | Cyclist | -.9757* | .30876 | .002 | -1.5829 | -.3686 |
| | | Motorcycle as passenger | -.2020 | .30687 | .511 | -.8055 | .4014 |
| | | Motorcycle as driver | -.5142 | .30876 | .097 | -1.1214 | .0930 |
| | | Bajaj as passenger | -.5826 | .31496 | .065 | -1.2019 | .0368 |
| | | Bajaj as driver | -.7520* | .30687 | .015 | -1.3555 | -.1486 |
| | | Car as driver | .4452 | .31496 | .158 | -.1742 | 1.0645 |
| | | Daladala passenger | -1.8604* | .31496 | .000 | -2.4797 | -1.2410 |
| | | DART passenger | -1.2376* | .31073 | .000 | -1.8486 | -.6265 |
| | Car as driver | Pedestrian | -1.3889* | .31711 | .000 | -2.0125 | -.7653 |
| | | Cyclist | -1.4209* | .31095 | .000 | -2.0324 | -.8095 |
| | | Motorcycle as passenger | -.6472* | .30908 | .037 | -1.2550 | -.0394 |
| | | Motorcycle as driver | -.9594* | .31095 | .002 | -1.5709 | -.3479 |
| | | Bajaj as passenger | -1.0278* | .31711 | .001 | -1.6514 | -.4042 |
| | | Bajaj as driver | -1.1972* | .30908 | .000 | -1.8050 | -.5894 |
| | | Car as passenger | -.4452 | .31496 | .158 | -1.0645 | .1742 |
| | | Daladala passenger | -2.3056* | .31711 | .000 | -2.9291 | -1.6820 |
| | | DART passenger | -1.6827* | .31291 | .000 | -2.2981 | -1.0674 |

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|---|---|---|---|---|---|---|---|
| | Daladala passenger | Pedestrian | .9167* | .31711 | .004 | .2931 | 1.5402 |
| | | Cyclist | .8846* | .31095 | .005 | .2731 | 1.4961 |
| | | Motorcycle as passenger | 1.6583* | .30908 | .000 | 1.0505 | 2.2661 |
| | | Motorcycle as driver | 1.3462* | .31095 | .000 | .7347 | 1.9576 |
| | | Bajaj as passenger | 1.2778* | .31711 | .000 | .6542 | 1.9014 |
| | | Bajaj as driver | 1.1083* | .30908 | .000 | .5005 | 1.7161 |
| | | Car as passenger | 1.8604* | .31496 | .000 | 1.2410 | 2.4797 |
| | | Car as driver | 2.3056* | .31711 | .000 | 1.6820 | 2.9291 |
| | | DART passenger | .6228* | .31291 | .047 | .0075 | 1.2381 |
| | DART passenger | Pedestrian | .2939 | .31291 | .348 | -.3215 | .9092 |
| | | Cyclist | .2618 | .30667 | .394 | -.3412 | .8649 |
| | | Motorcycle as passenger | 1.0355* | .30477 | .001 | .4362 | 1.6348 |
| | | Motorcycle as driver | .7233* | .30667 | .019 | .1203 | 1.3264 |
| | | Bajaj as passenger | .6550* | .31291 | .037 | .0396 | 1.2703 |
| | | Bajaj as driver | .4855 | .30477 | .112 | -.1138 | 1.0848 |
| | | Car as passenger | 1.2376* | .31073 | .000 | .6265 | 1.8486 |
| | | Car as driver | 1.6827* | .31291 | .000 | 1.0674 | 2.2981 |
| | | Daladala passenger | -.6228* | .31291 | .047 | -1.2381 | -.0075 |
| RP Infectious diseases | Pedestrian | Cyclist | -.0278 | .27762 | .920 | -.5737 | .5181 |
| | | Motorcycle as passenger | -2.5278* | .27595 | .000 | -3.0704 | -1.9851 |
| | | Motorcycle as driver | -2.0534* | .27762 | .000 | -2.5993 | -1.5075 |
| | | Bajaj as passenger | -1.3333* | .28312 | .000 | -1.8901 | -.7766 |
| | | Bajaj as driver | -1.0528* | .27595 | .000 | -1.5954 | -.5101 |
| | | Car as passenger | -.8926* | .28120 | .002 | -1.4456 | -.3397 |
| | | Car as driver | -.1389 | .28312 | .624 | -.6956 | .4178 |
| | | Daladala passenger | -3.4444* | .28312 | .000 | -4.0012 | -2.8877 |
| | | DART passenger | -3.2383* | .27937 | .000 | -3.7877 | -2.6889 |
| | Cyclist | Pedestrian | .0278 | .27762 | .920 | -.5181 | .5737 |
| | | Motorcycle as passenger | -2.5000* | .27030 | .000 | -3.0315 | -1.9685 |
| | | Motorcycle as driver | -2.0256* | .27201 | .000 | -2.5605 | -1.4907 |
| | | Bajaj as passenger | -1.3056* | .27762 | .000 | -1.8515 | -.7596 |
| | | Bajaj as driver | -1.0250* | .27030 | .000 | -1.5565 | -.4935 |
| | | Car as passenger | -.8649* | .27566 | .002 | -1.4069 | -.3228 |
| | | Car as driver | -.1111 | .27762 | .689 | -.6570 | .4348 |
| | | Daladala passenger | -3.4167* | .27762 | .000 | -3.9626 | -2.8707 |
| | | DART passenger | -3.2105* | .27379 | .000 | -3.7489 | -2.6721 |
| | Motorcycle as passenger | Pedestrian | 2.5278* | .27595 | .000 | 1.9851 | 3.0704 |
| | | Cyclist | 2.5000* | .27030 | .000 | 1.9685 | 3.0315 |
| | | Motorcycle as driver | .4744 | .27030 | .080 | -.0572 | 1.0059 |
| | | Bajaj as passenger | 1.1944* | .27595 | .000 | .6518 | 1.7371 |
| | | Bajaj as driver | 1.4750* | .26859 | .000 | .9468 | 2.0032 |
| | | Car as passenger | 1.6351* | .27398 | .000 | 1.0964 | 2.1739 |
| | | Car as driver | 2.3889* | .27595 | .000 | 1.8463 | 2.9315 |

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|---|---|---|---|---|---|---|---|
| | | Daladala passenger | -.9167* | .27595 | .001 | -1.4593 | -.3740 |
| | | DART passenger | -.7105* | .27210 | .009 | -1.2456 | -.1755 |
| | Motorcycle as driver | Pedestrian | 2.0534* | .27762 | .000 | 1.5075 | 2.5993 |
| | | Cyclist | 2.0256* | .27201 | .000 | 1.4907 | 2.5605 |
| | | Motorcycle as passenger | -.4744 | .27030 | .080 | -1.0059 | .0572 |
| | | Bajaj as passenger | .7201* | .27762 | .010 | .1742 | 1.2660 |
| | | Bajaj as driver | 1.0006* | .27030 | .000 | .4691 | 1.5322 |
| | | Car as passenger | 1.1608* | .27566 | .000 | .6187 | 1.7029 |
| | | Car as driver | 1.9145* | .27762 | .000 | 1.3686 | 2.4605 |
| | | Daladala passenger | -1.3910* | .27762 | .000 | -1.9369 | -.8451 |
| | | DART passenger | -1.1849* | .27379 | .000 | -1.7233 | -.6465 |
| | Bajaj as passenger | Pedestrian | 1.3333* | .28312 | .000 | .7766 | 1.8901 |
| | | Cyclist | 1.3056* | .27762 | .000 | .7596 | 1.8515 |
| | | Motorcycle as passenger | -1.1944* | .27595 | .000 | -1.7371 | -.6518 |
| | | Motorcycle as driver | -.7201* | .27762 | .010 | -1.2660 | -.1742 |
| | | Bajaj as driver | .2806 | .27595 | .310 | -.2621 | .8232 |
| | | Car as passenger | .4407 | .28120 | .118 | -.1123 | .9937 |
| | | Car as driver | 1.1944* | .28312 | .000 | .6377 | 1.7512 |
| | | Daladala passenger | -2.1111* | .28312 | .000 | -2.6678 | -1.5544 |
| | | DART passenger | -1.9050* | .27937 | .000 | -2.4543 | -1.3556 |
| | Bajaj as driver | Pedestrian | 1.0528* | .27595 | .000 | .5101 | 1.5954 |
| | | Cyclist | 1.0250* | .27030 | .000 | .4935 | 1.5565 |
| | | Motorcycle as passenger | -1.4750* | .26859 | .000 | -2.0032 | -.9468 |
| | | Motorcycle as driver | -1.0006* | .27030 | .000 | -1.5322 | -.4691 |
| | | Bajaj as passenger | -.2806 | .27595 | .310 | -.8232 | .2621 |
| | | Car as passenger | .1601 | .27398 | .559 | -.3786 | .6989 |
| | | Car as driver | .9139* | .27595 | .001 | .3713 | 1.4565 |
| | | Daladala passenger | -2.3917* | .27595 | .000 | -2.9343 | -1.8490 |
| | | DART passenger | -2.1855* | .27210 | .000 | -2.7206 | -1.6505 |
| | Car as passenger | Pedestrian | .8926* | .28120 | .002 | .3397 | 1.4456 |
| | | Cyclist | .8649* | .27566 | .002 | .3228 | 1.4069 |
| | | Motorcycle as passenger | -1.6351* | .27398 | .000 | -2.1739 | -1.0964 |
| | | Motorcycle as driver | -1.1608* | .27566 | .000 | -1.7029 | -.6187 |
| | | Bajaj as passenger | -.4407 | .28120 | .118 | -.9937 | .1123 |
| | | Bajaj as driver | -.1601 | .27398 | .559 | -.6989 | .3786 |
| | | Car as driver | .7538* | .28120 | .008 | .2008 | 1.3067 |
| | | Daladala passenger | -2.5518* | .28120 | .000 | -3.1048 | -1.9988 |
| | | DART passenger | -2.3457* | .27742 | .000 | -2.8912 | -1.8001 |
| | Car as driver | Pedestrian | .1389 | .28312 | .624 | -.4178 | .6956 |
| | | Cyclist | .1111 | .27762 | .689 | -.4348 | .6570 |
| | | Motorcycle as passenger | -2.3889* | .27595 | .000 | -2.9315 | -1.8463 |
| | | Motorcycle as driver | -1.9145* | .27762 | .000 | -2.4605 | -1.3686 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Bajaj as passenger | -1.1944* | .28312 | .000 | -1.7512 | -.6377 |
| | | Bajaj as driver | -.9139* | .27595 | .001 | -1.4565 | -.3713 |
| | | Car as passenger | -.7538* | .28120 | .008 | -1.3067 | -.2008 |
| | | Daladala passenger | -3.3056* | .28312 | .000 | -3.8623 | -2.7488 |
| | | DART passenger | -3.0994* | .27937 | .000 | -3.6488 | -2.5501 |
| | Daladala passenger | Pedestrian | 3.4444* | .28312 | .000 | 2.8877 | 4.0012 |
| | | Cyclist | 3.4167* | .27762 | .000 | 2.8707 | 3.9626 |
| | | Motorcycle as passenger | .9167* | .27595 | .001 | .3740 | 1.4593 |
| | | Motorcycle as driver | 1.3910* | .27762 | .000 | .8451 | 1.9369 |
| | | Bajaj as passenger | 2.1111* | .28312 | .000 | 1.5544 | 2.6678 |
| | | Bajaj as driver | 2.3917* | .27595 | .000 | 1.8490 | 2.9343 |
| | | Car as passenger | 2.5518* | .28120 | .000 | 1.9988 | 3.1048 |
| | | Car as driver | 3.3056* | .28312 | .000 | 2.7488 | 3.8623 |
| | | DART passenger | .2061 | .27937 | .461 | -.3432 | .7555 |
| | DART passenger | Pedestrian | 3.2383* | .27937 | .000 | 2.6889 | 3.7877 |
| | | Cyclist | 3.2105* | .27379 | .000 | 2.6721 | 3.7489 |
| | | Motorcycle as passenger | .7105* | .27210 | .009 | .1755 | 1.2456 |
| | | Motorcycle as driver | 1.1849* | .27379 | .000 | .6465 | 1.7233 |
| | | Bajaj as passenger | 1.9050* | .27937 | .000 | 1.3556 | 2.4543 |
| | | Bajaj as driver | 2.1855* | .27210 | .000 | 1.6505 | 2.7206 |
| | | Car as passenger | 2.3457* | .27742 | .000 | 1.8001 | 2.8912 |
| | | Car as driver | 3.0994* | .27937 | .000 | 2.5501 | 3.6488 |
| | | Daladala passenger | -.2061 | .27937 | .461 | -.7555 | .3432 |

Based on observed means.

The error term is Mean Square(Error) = 1.443.

*. The mean difference is significant at the .05 level.

**ANNEX 3: Post Hoc Test results for safety perception**

## Multiple Comparisons

LSD

| Dependent Variable | (I) DM Mode of Transport | (J) DM Mode of Transport | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| SP at station/terminal (Day) | Pedestrian | Cyclist | .7372* | .31541 | .020 | .1169 | 1.3574 |
| | | Motorcycle as passenger | 1.7250* | .31351 | .000 | 1.1085 | 2.3415 |
| | | Motorcycle as driver | 1.8654* | .31541 | .000 | 1.2452 | 2.4856 |
| | | Bajaj as passenger | .6111 | .32165 | .058 | -.0214 | 1.2436 |
| | | Bajaj as driver | .7750* | .31351 | .014 | .1585 | 1.3915 |
| | | Car as passenger | .0608 | .31947 | .849 | -.5674 | .6890 |
| | | Car as driver | -.4167 | .32165 | .196 | -1.0492 | .2158 |
| | | Daladala passenger | .1667 | .32165 | .605 | -.4658 | .7992 |
| | | DART passenger | -.5921 | .31739 | .063 | -1.2162 | .0320 |
| | Cyclist | Pedestrian | -.7372* | .31541 | .020 | -1.3574 | -.1169 |
| | | Motorcycle as passenger | .9878* | .30710 | .001 | .3839 | 1.5917 |
| | | Motorcycle as driver | 1.1282* | .30903 | .000 | .5205 | 1.7359 |
| | | Bajaj as passenger | -.1261 | .31541 | .690 | -.7463 | .4942 |
| | | Bajaj as driver | .0378 | .30710 | .902 | -.5661 | .6417 |
| | | Car as passenger | -.6764* | .31318 | .031 | -1.2922 | -.0605 |
| | | Car as driver | -1.1538* | .31541 | .000 | -1.7741 | -.5336 |
| | | Daladala passenger | -.5705 | .31541 | .071 | -1.1907 | .0497 |
| | | DART passenger | -1.3293* | .31106 | .000 | -1.9410 | -.7176 |
| | Motorcycle as passenger | Pedestrian | -1.7250* | .31351 | .000 | -2.3415 | -1.1085 |
| | | Cyclist | -.9878* | .30710 | .001 | -1.5917 | -.3839 |
| | | Motorcycle as driver | .1404 | .30710 | .648 | -.4635 | .7443 |
| | | Bajaj as passenger | -1.1139* | .31351 | .000 | -1.7304 | -.4974 |
| | | Bajaj as driver | -.9500* | .30515 | .002 | -1.5501 | -.3499 |
| | | Car as passenger | -1.6642* | .31127 | .000 | -2.2763 | -1.0521 |
| | | Car as driver | -2.1417* | .31351 | .000 | -2.7582 | -1.5252 |
| | | Daladala passenger | -1.5583* | .31351 | .000 | -2.1748 | -.9418 |
| | | DART passenger | -2.3171* | .30914 | .000 | -2.9250 | -1.7092 |
| | Motorcycle as driver | Pedestrian | -1.8654* | .31541 | .000 | -2.4856 | -1.2452 |
| | | Cyclist | -1.1282* | .30903 | .000 | -1.7359 | -.5205 |
| | | Motorcycle as passenger | -.1404 | .30710 | .648 | -.7443 | .4635 |
| | | Bajaj as passenger | -1.2543* | .31541 | .000 | -1.8745 | -.6340 |
| | | Bajaj as driver | -1.0904* | .30710 | .000 | -1.6943 | -.4865 |
| | | Car as passenger | -1.8046* | .31318 | .000 | -2.4204 | -1.1887 |
| | | Car as driver | -2.2821* | .31541 | .000 | -2.9023 | -1.6618 |
| | | Daladala passenger | -1.6987* | .31541 | .000 | -2.3189 | -1.0785 |
| | | DART passenger | -2.4575* | .31106 | .000 | -3.0692 | -1.8458 |
| | Bajaj as | Pedestrian | -.6111 | .32165 | .058 | -1.2436 | .0214 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | passenger | Cyclist | .1261 | .31541 | .690 | -.4942 | .7463 |
| | | Motorcycle as passenger | 1.1139* | .31351 | .000 | .4974 | 1.7304 |
| | | Motorcycle as driver | 1.2543* | .31541 | .000 | .6340 | 1.8745 |
| | | Bajaj as driver | .1639 | .31351 | .601 | -.4526 | .7804 |
| | | Car as passenger | -.5503 | .31947 | .086 | -1.1785 | .0779 |
| | | Car as driver | -1.0278* | .32165 | .002 | -1.6603 | -.3953 |
| | | Daladala passenger | -.4444 | .32165 | .168 | -1.0770 | .1881 |
| | | DART passenger | -1.2032* | .31739 | .000 | -1.8274 | -.5791 |
| | Bajaj as driver | Pedestrian | -.7750* | .31351 | .014 | -1.3915 | -.1585 |
| | | Cyclist | -.0378 | .30710 | .902 | -.6417 | .5661 |
| | | Motorcycle as passenger | .9500* | .30515 | .002 | .3499 | 1.5501 |
| | | Motorcycle as driver | 1.0904* | .30710 | .000 | .4865 | 1.6943 |
| | | Bajaj as passenger | -.1639 | .31351 | .601 | -.7804 | .4526 |
| | | Car as passenger | -.7142* | .31127 | .022 | -1.3263 | -.1021 |
| | | Car as driver | -1.1917* | .31351 | .000 | -1.8082 | -.5752 |
| | | Daladala passenger | -.6083 | .31351 | .053 | -1.2248 | .0082 |
| | | DART passenger | -1.3671* | .30914 | .000 | -1.9750 | -.7592 |
| | Car as passenger | Pedestrian | -.0608 | .31947 | .849 | -.6890 | .5674 |
| | | Cyclist | .6764* | .31318 | .031 | .0605 | 1.2922 |
| | | Motorcycle as passenger | 1.6642* | .31127 | .000 | 1.0521 | 2.2763 |
| | | Motorcycle as driver | 1.8046* | .31318 | .000 | 1.1887 | 2.4204 |
| | | Bajaj as passenger | .5503 | .31947 | .086 | -.0779 | 1.1785 |
| | | Bajaj as driver | .7142* | .31127 | .022 | .1021 | 1.3263 |
| | | Car as driver | -.4775 | .31947 | .136 | -1.1057 | .1507 |
| | | Daladala passenger | .1059 | .31947 | .741 | -.5224 | .7341 |
| | | DART passenger | -.6529* | .31518 | .039 | -1.2727 | -.0331 |
| | Car as driver | Pedestrian | .4167 | .32165 | .196 | -.2158 | 1.0492 |
| | | Cyclist | 1.1538* | .31541 | .000 | .5336 | 1.7741 |
| | | Motorcycle as passenger | 2.1417* | .31351 | .000 | 1.5252 | 2.7582 |
| | | Motorcycle as driver | 2.2821* | .31541 | .000 | 1.6618 | 2.9023 |
| | | Bajaj as passenger | 1.0278* | .32165 | .002 | .3953 | 1.6603 |
| | | Bajaj as driver | 1.1917* | .31351 | .000 | .5752 | 1.8082 |
| | | Car as passenger | .4775 | .31947 | .136 | -.1507 | 1.1057 |
| | | Daladala passenger | .5833 | .32165 | .071 | -.0492 | 1.2158 |
| | | DART passenger | -.1754 | .31739 | .581 | -.7996 | .4487 |
| | Daladala passenger | Pedestrian | -.1667 | .32165 | .605 | -.7992 | .4658 |
| | | Cyclist | .5705 | .31541 | .071 | -.0497 | 1.1907 |
| | | Motorcycle as passenger | 1.5583* | .31351 | .000 | .9418 | 2.1748 |
| | | Motorcycle as driver | 1.6987* | .31541 | .000 | 1.0785 | 2.3189 |
| | | Bajaj as passenger | .4444 | .32165 | .168 | -.1881 | 1.0770 |
| | | Bajaj as driver | .6083 | .31351 | .053 | -.0082 | 1.2248 |
| | | Car as passenger | -.1059 | .31947 | .741 | -.7341 | .5224 |
| | | Car as driver | -.5833 | .32165 | .071 | -1.2158 | .0492 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | DART passenger | -.7588* | .31739 | .017 | -1.3829 | -.1346 |
| | DART passenger | Pedestrian | .5921 | .31739 | .063 | -.0320 | 1.2162 |
| | | Cyclist | 1.3293* | .31106 | .000 | .7176 | 1.9410 |
| | | Motorcycle as passenger | 2.3171* | .30914 | .000 | 1.7092 | 2.9250 |
| | | Motorcycle as driver | 2.4575* | .31106 | .000 | 1.8458 | 3.0692 |
| | | Bajaj as passenger | 1.2032* | .31739 | .000 | .5791 | 1.8274 |
| | | Bajaj as driver | 1.3671* | .30914 | .000 | .7592 | 1.9750 |
| | | Car as passenger | .6529* | .31518 | .039 | .0331 | 1.2727 |
| | | Car as driver | .1754 | .31739 | .581 | -.4487 | .7996 |
| | | Daladala passenger | .7588* | .31739 | .017 | .1346 | 1.3829 |
| SP In-vehicle (Day) | Pedestrian | Cyclist | .1325 | .30820 | .668 | -.4736 | .7385 |
| | | Motorcycle as passenger | 1.3556* | .30635 | .000 | .7531 | 1.9580 |
| | | Motorcycle as driver | 1.2094* | .30820 | .000 | .6033 | 1.8155 |
| | | Bajaj as passenger | .6111 | .31431 | .053 | -.0070 | 1.2292 |
| | | Bajaj as driver | .5056 | .30635 | .100 | -.0969 | 1.1080 |
| | | Car as passenger | -.4039 | .31218 | .197 | -1.0178 | .2100 |
| | | Car as driver | -.6944* | .31431 | .028 | -1.3125 | -.0764 |
| | | Daladala passenger | .0278 | .31431 | .930 | -.5903 | .6458 |
| | | DART passenger | -.8655* | .31014 | .006 | -1.4754 | -.2556 |
| | Cyclist | Pedestrian | -.1325 | .30820 | .668 | -.7385 | .4736 |
| | | Motorcycle as passenger | 1.2231* | .30008 | .000 | .6330 | 1.8132 |
| | | Motorcycle as driver | 1.0769* | .30198 | .000 | .4831 | 1.6707 |
| | | Bajaj as passenger | .4786 | .30820 | .121 | -.1274 | 1.0847 |
| | | Bajaj as driver | .3731 | .30008 | .215 | -.2170 | .9632 |
| | | Car as passenger | -.5364 | .30603 | .080 | -1.1382 | .0654 |
| | | Car as driver | -.8269* | .30820 | .008 | -1.4330 | -.2209 |
| | | Daladala passenger | -.1047 | .30820 | .734 | -.7108 | .5014 |
| | | DART passenger | -.9980* | .30396 | .001 | -1.5957 | -.4003 |
| | Motorcycle as passenger | Pedestrian | -1.3556* | .30635 | .000 | -1.9580 | -.7531 |
| | | Cyclist | -1.2231* | .30008 | .000 | -1.8132 | -.6330 |
| | | Motorcycle as driver | -.1462 | .30008 | .627 | -.7363 | .4439 |
| | | Bajaj as passenger | -.7444* | .30635 | .016 | -1.3469 | -.1420 |
| | | Bajaj as driver | -.8500* | .29818 | .005 | -1.4364 | -.2636 |
| | | Car as passenger | -1.7595* | .30416 | .000 | -2.3576 | -1.1613 |
| | | Car as driver | -2.0500* | .30635 | .000 | -2.6524 | -1.4476 |
| | | Daladala passenger | -1.3278* | .30635 | .000 | -1.9302 | -.7254 |
| | | DART passenger | -2.2211* | .30208 | .000 | -2.8151 | -1.6270 |
| | Motorcycle as driver | Pedestrian | -1.2094* | .30820 | .000 | -1.8155 | -.6033 |
| | | Cyclist | -1.0769* | .30198 | .000 | -1.6707 | -.4831 |
| | | Motorcycle as passenger | .1462 | .30008 | .627 | -.4439 | .7363 |
| | | Bajaj as passenger | -.5983 | .30820 | .053 | -1.2044 | .0078 |
| | | Bajaj as driver | -.7038* | .30008 | .020 | -1.2939 | -.1137 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Car as passenger | -1.6133* | .30603 | .000 | -2.2151 | -1.0115 |
| | | Car as driver | -1.9038* | .30820 | .000 | -2.5099 | -1.2978 |
| | | Daladala passenger | -1.1816* | .30820 | .000 | -1.7877 | -.5756 |
| | | DART passenger | -2.0749* | .30396 | .000 | -2.6726 | -1.4772 |
| | Bajaj as passenger | Pedestrian | -.6111 | .31431 | .053 | -1.2292 | .0070 |
| | | Cyclist | -.4786 | .30820 | .121 | -1.0847 | .1274 |
| | | Motorcycle as passenger | .7444* | .30635 | .016 | .1420 | 1.3469 |
| | | Motorcycle as driver | .5983 | .30820 | .053 | -.0078 | 1.2044 |
| | | Bajaj as driver | -.1056 | .30635 | .731 | -.7080 | .4969 |
| | | Car as passenger | -1.0150* | .31218 | .001 | -1.6289 | -.4011 |
| | | Car as driver | -1.3056* | .31431 | .000 | -1.9236 | -.6875 |
| | | Daladala passenger | -.5833 | .31431 | .064 | -1.2014 | .0347 |
| | | DART passenger | -1.4766* | .31014 | .000 | -2.0865 | -.8667 |
| | Bajaj as driver | Pedestrian | -.5056 | .30635 | .100 | -1.1080 | .0969 |
| | | Cyclist | -.3731 | .30008 | .215 | -.9632 | .2170 |
| | | Motorcycle as passenger | .8500* | .29818 | .005 | .2636 | 1.4364 |
| | | Motorcycle as driver | .7038* | .30008 | .020 | .1137 | 1.2939 |
| | | Bajaj as passenger | .1056 | .30635 | .731 | -.4969 | .7080 |
| | | Car as passenger | -.9095* | .30416 | .003 | -1.5076 | -.3113 |
| | | Car as driver | -1.2000* | .30635 | .000 | -1.8024 | -.5976 |
| | | Daladala passenger | -.4778 | .30635 | .120 | -1.0802 | .1246 |
| | | DART passenger | -1.3711* | .30208 | .000 | -1.9651 | -.7770 |
| | Car as passenger | Pedestrian | .4039 | .31218 | .197 | -.2100 | 1.0178 |
| | | Cyclist | .5364 | .30603 | .080 | -.0654 | 1.1382 |
| | | Motorcycle as passenger | 1.7595* | .30416 | .000 | 1.1613 | 2.3576 |
| | | Motorcycle as driver | 1.6133* | .30603 | .000 | 1.0115 | 2.2151 |
| | | Bajaj as passenger | 1.0150* | .31218 | .001 | .4011 | 1.6289 |
| | | Bajaj as driver | .9095* | .30416 | .003 | .3113 | 1.5076 |
| | | Car as driver | -.2905 | .31218 | .353 | -.9044 | .3233 |
| | | Daladala passenger | .4317 | .31218 | .168 | -.1822 | 1.0456 |
| | | DART passenger | -.4616 | .30798 | .135 | -1.0672 | .1440 |
| | Car as driver | Pedestrian | .6944* | .31431 | .028 | .0764 | 1.3125 |
| | | Cyclist | .8269* | .30820 | .008 | .2209 | 1.4330 |
| | | Motorcycle as passenger | 2.0500* | .30635 | .000 | 1.4476 | 2.6524 |
| | | Motorcycle as driver | 1.9038* | .30820 | .000 | 1.2978 | 2.5099 |
| | | Bajaj as passenger | 1.3056* | .31431 | .000 | .6875 | 1.9236 |
| | | Bajaj as driver | 1.2000* | .30635 | .000 | .5976 | 1.8024 |
| | | Car as passenger | .2905 | .31218 | .353 | -.3233 | .9044 |
| | | Daladala passenger | .7222* | .31431 | .022 | .1042 | 1.3403 |
| | | DART passenger | -.1711 | .31014 | .582 | -.7809 | .4388 |
| | Daladala passenger | Pedestrian | -.0278 | .31431 | .930 | -.6458 | .5903 |
| | | Cyclist | .1047 | .30820 | .734 | -.5014 | .7108 |
| | | Motorcycle as passenger | 1.3278* | .30635 | .000 | .7254 | 1.9302 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Motorcycle as driver | 1.1816* | .30820 | .000 | .5756 | 1.7877 |
| | | Bajaj as passenger | .5833 | .31431 | .064 | -.0347 | 1.2014 |
| | | Bajaj as driver | .4778 | .30635 | .120 | -.1246 | 1.0802 |
| | | Car as passenger | -.4317 | .31218 | .168 | -1.0456 | .1822 |
| | | Car as driver | -.7222* | .31431 | .022 | -1.3403 | -.1042 |
| | | DART passenger | -.8933* | .31014 | .004 | -1.5032 | -.2834 |
| | DART passenger | Pedestrian | .8655* | .31014 | .006 | .2556 | 1.4754 |
| | | Cyclist | .9980* | .30396 | .001 | .4003 | 1.5957 |
| | | Motorcycle as passenger | 2.2211* | .30208 | .000 | 1.6270 | 2.8151 |
| | | Motorcycle as driver | 2.0749* | .30396 | .000 | 1.4772 | 2.6726 |
| | | Bajaj as passenger | 1.4766* | .31014 | .000 | .8667 | 2.0865 |
| | | Bajaj as driver | 1.3711* | .30208 | .000 | .7770 | 1.9651 |
| | | Car as passenger | .4616 | .30798 | .135 | -.1440 | 1.0672 |
| | | Car as driver | .1711 | .31014 | .582 | -.4388 | .7809 |
| | | Daladala passenger | .8933* | .31014 | .004 | .2834 | 1.5032 |
| SP at station/terminal (Night) | Pedestrian | Cyclist | .9017* | .32207 | .005 | .2684 | 1.5351 |
| | | Motorcycle as passenger | 1.5306* | .32014 | .000 | .9010 | 2.1601 |
| | | Motorcycle as driver | 1.7735* | .32207 | .000 | 1.1402 | 2.4068 |
| | | Bajaj as passenger | .8056* | .32845 | .015 | .1597 | 1.4514 |
| | | Bajaj as driver | .4056 | .32014 | .206 | -.2240 | 1.0351 |
| | | Car as passenger | -.4039 | .32623 | .216 | -1.0454 | .2376 |
| | | Car as driver | -.3889 | .32845 | .237 | -1.0348 | .2570 |
| | | Daladala passenger | .1667 | .32845 | .612 | -.4792 | .8126 |
| | | DART passenger | -.0760 | .32410 | .815 | -.7134 | .5613 |
| | Cyclist | Pedestrian | -.9017* | .32207 | .005 | -1.5351 | -.2684 |
| | | Motorcycle as passenger | .6288* | .31359 | .046 | .0122 | 1.2455 |
| | | Motorcycle as driver | .8718* | .31557 | .006 | .2512 | 1.4923 |
| | | Bajaj as passenger | -.0962 | .32207 | .765 | -.7295 | .5372 |
| | | Bajaj as driver | -.4962 | .31359 | .114 | -1.1128 | .1205 |
| | | Car as passenger | -1.3056* | .31980 | .000 | -1.9345 | -.6767 |
| | | Car as driver | -1.2906* | .32207 | .000 | -1.9239 | -.6573 |
| | | Daladala passenger | -.7350* | .32207 | .023 | -1.3684 | -.1017 |
| | | DART passenger | -.9777* | .31764 | .002 | -1.6023 | -.3531 |
| | Motorcycle as passenger | Pedestrian | -1.5306* | .32014 | .000 | -2.1601 | -.9010 |
| | | Cyclist | -.6288* | .31359 | .046 | -1.2455 | -.0122 |
| | | Motorcycle as driver | .2429 | .31359 | .439 | -.3737 | .8596 |
| | | Bajaj as passenger | -.7250* | .32014 | .024 | -1.3545 | -.0955 |
| | | Bajaj as driver | -1.1250* | .31160 | .000 | -1.7377 | -.5123 |
| | | Car as passenger | -1.9345* | .31785 | .000 | -2.5595 | -1.3094 |
| | | Car as driver | -1.9194* | .32014 | .000 | -2.5490 | -1.2899 |
| | | Daladala passenger | -1.3639* | .32014 | .000 | -1.9934 | -.7344 |
| | | DART passenger | -1.6066* | .31567 | .000 | -2.2273 | -.9858 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Motorcycle as driver | Pedestrian | -1.7735* | .32207 | .000 | -2.4068 | -1.1402 |
| | | Cyclist | -.8718* | .31557 | .006 | -1.4923 | -.2512 |
| | | Motorcycle as passenger | -.2429 | .31359 | .439 | -.8596 | .3737 |
| | | Bajaj as passenger | -.9679* | .32207 | .003 | -1.6013 | -.3346 |
| | | Bajaj as driver | -1.3679* | .31359 | .000 | -1.9846 | -.7513 |
| | | Car as passenger | -2.1774* | .31980 | .000 | -2.8063 | -1.5485 |
| | | Car as driver | -2.1624* | .32207 | .000 | -2.7957 | -1.5290 |
| | | Daladala passenger | -1.6068* | .32207 | .000 | -2.2402 | -.9735 |
| | | DART passenger | -1.8495* | .31764 | .000 | -2.4741 | -1.2249 |
| | Bajaj as passenger | Pedestrian | -.8056* | .32845 | .015 | -1.4514 | -.1597 |
| | | Cyclist | .0962 | .32207 | .765 | -.5372 | .7295 |
| | | Motorcycle as passenger | .7250* | .32014 | .024 | .0955 | 1.3545 |
| | | Motorcycle as driver | .9679* | .32207 | .003 | .3346 | 1.6013 |
| | | Bajaj as driver | -.4000 | .32014 | .212 | -1.0295 | .2295 |
| | | Car as passenger | -1.2095* | .32623 | .000 | -1.8510 | -.5680 |
| | | Car as driver | -1.1944* | .32845 | .000 | -1.8403 | -.5486 |
| | | Daladala passenger | -.6389 | .32845 | .053 | -1.2848 | .0070 |
| | | DART passenger | -.8816* | .32410 | .007 | -1.5189 | -.2442 |
| | Bajaj as driver | Pedestrian | -.4056 | .32014 | .206 | -1.0351 | .2240 |
| | | Cyclist | .4962 | .31359 | .114 | -.1205 | 1.1128 |
| | | Motorcycle as passenger | 1.1250* | .31160 | .000 | .5123 | 1.7377 |
| | | Motorcycle as driver | 1.3679* | .31359 | .000 | .7513 | 1.9846 |
| | | Bajaj as passenger | .4000 | .32014 | .212 | -.2295 | 1.0295 |
| | | Car as passenger | -.8095* | .31785 | .011 | -1.4345 | -.1844 |
| | | Car as driver | -.7944* | .32014 | .014 | -1.4240 | -.1649 |
| | | Daladala passenger | -.2389 | .32014 | .456 | -.8684 | .3906 |
| | | DART passenger | -.4816 | .31567 | .128 | -1.1023 | .1392 |
| | Car as passenger | Pedestrian | .4039 | .32623 | .216 | -.2376 | 1.0454 |
| | | Cyclist | 1.3056* | .31980 | .000 | .6767 | 1.9345 |
| | | Motorcycle as passenger | 1.9345* | .31785 | .000 | 1.3094 | 2.5595 |
| | | Motorcycle as driver | 2.1774* | .31980 | .000 | 1.5485 | 2.8063 |
| | | Bajaj as passenger | 1.2095* | .32623 | .000 | .5680 | 1.8510 |
| | | Bajaj as driver | .8095* | .31785 | .011 | .1844 | 1.4345 |
| | | Car as driver | .0150 | .32623 | .963 | -.6265 | .6565 |
| | | Daladala passenger | .5706 | .32623 | .081 | -.0709 | 1.2121 |
| | | DART passenger | .3279 | .32185 | .309 | -.3050 | .9608 |
| | Car as driver | Pedestrian | .3889 | .32845 | .237 | -.2570 | 1.0348 |
| | | Cyclist | 1.2906* | .32207 | .000 | .6573 | 1.9239 |
| | | Motorcycle as passenger | 1.9194* | .32014 | .000 | 1.2899 | 2.5490 |
| | | Motorcycle as driver | 2.1624* | .32207 | .000 | 1.5290 | 2.7957 |
| | | Bajaj as passenger | 1.1944* | .32845 | .000 | .5486 | 1.8403 |
| | | Bajaj as driver | .7944* | .32014 | .014 | .1649 | 1.4240 |
| | | Car as passenger | -.0150 | .32623 | .963 | -.6565 | .6265 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Daladala passenger | .5556 | .32845 | .092 | -.0903 | 1.2014 |
| | | DART passenger | .3129 | .32410 | .335 | -.3245 | .9502 |
| | Daladala passenger | Pedestrian | -.1667 | .32845 | .612 | -.8126 | .4792 |
| | | Cyclist | .7350* | .32207 | .023 | .1017 | 1.3684 |
| | | Motorcycle as passenger | 1.3639* | .32014 | .000 | .7344 | 1.9934 |
| | | Motorcycle as driver | 1.6068* | .32207 | .000 | .9735 | 2.2402 |
| | | Bajaj as passenger | .6389 | .32845 | .053 | -.0070 | 1.2848 |
| | | Bajaj as driver | .2389 | .32014 | .456 | -.3906 | .8684 |
| | | Car as passenger | -.5706 | .32623 | .081 | -1.2121 | .0709 |
| | | Car as driver | -.5556 | .32845 | .092 | -1.2014 | .0903 |
| | | DART passenger | -.2427 | .32410 | .454 | -.8800 | .3946 |
| | DART passenger | Pedestrian | .0760 | .32410 | .815 | -.5613 | .7134 |
| | | Cyclist | .9777* | .31764 | .002 | .3531 | 1.6023 |
| | | Motorcycle as passenger | 1.6066* | .31567 | .000 | .9858 | 2.2273 |
| | | Motorcycle as driver | 1.8495* | .31764 | .000 | 1.2249 | 2.4741 |
| | | Bajaj as passenger | .8816* | .32410 | .007 | .2442 | 1.5189 |
| | | Bajaj as driver | .4816 | .31567 | .128 | -.1392 | 1.1023 |
| | | Car as passenger | -.3279 | .32185 | .309 | -.9608 | .3050 |
| | | Car as driver | -.3129 | .32410 | .335 | -.9502 | .3245 |
| | | Daladala passenger | .2427 | .32410 | .454 | -.3946 | .8800 |
| SP In-vehicle (Night) | Pedestrian | Cyclist | .1923 | .29968 | .521 | -.3970 | .7816 |
| | | Motorcycle as passenger | 1.3167* | .29788 | .000 | .7309 | 1.9024 |
| | | Motorcycle as driver | 1.4744* | .29968 | .000 | .8851 | 2.0637 |
| | | Bajaj as passenger | .4722 | .30561 | .123 | -.1288 | 1.0732 |
| | | Bajaj as driver | .5667 | .29788 | .058 | -.0191 | 1.1524 |
| | | Car as passenger | -.4279 | .30354 | .159 | -1.0248 | .1690 |
| | | Car as driver | -.3056 | .30561 | .318 | -.9065 | .2954 |
| | | Daladala passenger | -.1111 | .30561 | .716 | -.7121 | .4899 |
| | | DART passenger | -.2544 | .30157 | .399 | -.8474 | .3386 |
| | Cyclist | Pedestrian | -.1923 | .29968 | .521 | -.7816 | .3970 |
| | | Motorcycle as passenger | 1.1244* | .29178 | .000 | .5506 | 1.6981 |
| | | Motorcycle as driver | 1.2821* | .29362 | .000 | .7047 | 1.8594 |
| | | Bajaj as passenger | .2799 | .29968 | .351 | -.3094 | .8692 |
| | | Bajaj as driver | .3744 | .29178 | .200 | -.1994 | .9481 |
| | | Car as passenger | -.6202* | .29757 | .038 | -1.2054 | -.0351 |
| | | Car as driver | -.4979 | .29968 | .098 | -1.0872 | .0914 |
| | | Daladala passenger | -.3034 | .29968 | .312 | -.8927 | .2859 |
| | | DART passenger | -.4467 | .29555 | .132 | -1.0279 | .1345 |
| | Motorcycle as passenger | Pedestrian | -1.3167* | .29788 | .000 | -1.9024 | -.7309 |
| | | Cyclist | -1.1244* | .29178 | .000 | -1.6981 | -.5506 |
| | | Motorcycle as driver | .1577 | .29178 | .589 | -.4161 | .7315 |
| | | Bajaj as passenger | -.8444* | .29788 | .005 | -1.4302 | -.2587 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Bajaj as driver | -.7500* | .28993 | .010 | -1.3201 | -.1799 |
| | | Car as passenger | -1.7446* | .29575 | .000 | -2.3262 | -1.1630 |
| | | Car as driver | -1.6222* | .29788 | .000 | -2.2080 | -1.0365 |
| | | Daladala passenger | -1.4278* | .29788 | .000 | -2.0135 | -.8420 |
| | | DART passenger | -1.5711* | .29372 | .000 | -2.1486 | -.9935 |
| | Motorcycle as driver | Pedestrian | -1.4744* | .29968 | .000 | -2.0637 | -.8851 |
| | | Cyclist | -1.2821* | .29362 | .000 | -1.8594 | -.7047 |
| | | Motorcycle as passenger | -.1577 | .29178 | .589 | -.7315 | .4161 |
| | | Bajaj as passenger | -1.0021* | .29968 | .001 | -1.5914 | -.4128 |
| | | Bajaj as driver | -.9077* | .29178 | .002 | -1.4815 | -.3339 |
| | | Car as passenger | -1.9023* | .29757 | .000 | -2.4874 | -1.3171 |
| | | Car as driver | -1.7799* | .29968 | .000 | -2.3692 | -1.1906 |
| | | Daladala passenger | -1.5855* | .29968 | .000 | -2.1748 | -.9962 |
| | | DART passenger | -1.7287* | .29555 | .000 | -2.3099 | -1.1476 |
| | Bajaj as passenger | Pedestrian | -.4722 | .30561 | .123 | -1.0732 | .1288 |
| | | Cyclist | -.2799 | .29968 | .351 | -.8692 | .3094 |
| | | Motorcycle as passenger | .8444* | .29788 | .005 | .2587 | 1.4302 |
| | | Motorcycle as driver | 1.0021* | .29968 | .001 | .4128 | 1.5914 |
| | | Bajaj as driver | .0944 | .29788 | .751 | -.4913 | .6802 |
| | | Car as passenger | -.9002* | .30354 | .003 | -1.4970 | -.3033 |
| | | Car as driver | -.7778* | .30561 | .011 | -1.3788 | -.1768 |
| | | Daladala passenger | -.5833 | .30561 | .057 | -1.1843 | .0176 |
| | | DART passenger | -.7266* | .30157 | .016 | -1.3196 | -.1336 |
| | Bajaj as driver | Pedestrian | -.5667 | .29788 | .058 | -1.1524 | .0191 |
| | | Cyclist | -.3744 | .29178 | .200 | -.9481 | .1994 |
| | | Motorcycle as passenger | .7500* | .28993 | .010 | .1799 | 1.3201 |
| | | Motorcycle as driver | .9077* | .29178 | .002 | .3339 | 1.4815 |
| | | Bajaj as passenger | -.0944 | .29788 | .751 | -.6802 | .4913 |
| | | Car as passenger | -.9946* | .29575 | .001 | -1.5762 | -.4130 |
| | | Car as driver | -.8722* | .29788 | .004 | -1.4580 | -.2865 |
| | | Daladala passenger | -.6778* | .29788 | .023 | -1.2635 | -.0920 |
| | | DART passenger | -.8211* | .29372 | .005 | -1.3986 | -.2435 |
| | Car as passenger | Pedestrian | .4279 | .30354 | .159 | -.1690 | 1.0248 |
| | | Cyclist | .6202* | .29757 | .038 | .0351 | 1.2054 |
| | | Motorcycle as passenger | 1.7446* | .29575 | .000 | 1.1630 | 2.3262 |
| | | Motorcycle as driver | 1.9023* | .29757 | .000 | 1.3171 | 2.4874 |
| | | Bajaj as passenger | .9002* | .30354 | .003 | .3033 | 1.4970 |
| | | Bajaj as driver | .9946* | .29575 | .001 | .4130 | 1.5762 |
| | | Car as driver | .1224 | .30354 | .687 | -.4745 | .7193 |
| | | Daladala passenger | .3168 | .30354 | .297 | -.2801 | .9137 |
| | | DART passenger | .1735 | .29947 | .563 | -.4153 | .7624 |
| | Car as driver | Pedestrian | .3056 | .30561 | .318 | -.2954 | .9065 |
| | | Cyclist | .4979 | .29968 | .098 | -.0914 | 1.0872 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Motorcycle as passenger | 1.6222* | .29788 | .000 | 1.0365 | 2.2080 |
| | Motorcycle as driver | 1.7799* | .29968 | .000 | 1.1906 | 2.3692 |
| | Bajaj as passenger | .7778* | .30561 | .011 | .1768 | 1.3788 |
| | Bajaj as driver | .8722* | .29788 | .004 | .2865 | 1.4580 |
| | Car as passenger | -.1224 | .30354 | .687 | -.7193 | .4745 |
| | Daladala passenger | .1944 | .30561 | .525 | -.4065 | .7954 |
| | DART passenger | .0512 | .30157 | .865 | -.5418 | .6442 |
| Daladala passenger | Pedestrian | .1111 | .30561 | .716 | -.4899 | .7121 |
| | Cyclist | .3034 | .29968 | .312 | -.2859 | .8927 |
| | Motorcycle as passenger | 1.4278* | .29788 | .000 | .8420 | 2.0135 |
| | Motorcycle as driver | 1.5855* | .29968 | .000 | .9962 | 2.1748 |
| | Bajaj as passenger | .5833 | .30561 | .057 | -.0176 | 1.1843 |
| | Bajaj as driver | .6778* | .29788 | .023 | .0920 | 1.2635 |
| | Car as passenger | -.3168 | .30354 | .297 | -.9137 | .2801 |
| | Car as driver | -.1944 | .30561 | .525 | -.7954 | .4065 |
| | DART passenger | -.1433 | .30157 | .635 | -.7363 | .4497 |
| DART passenger | Pedestrian | .2544 | .30157 | .399 | -.3386 | .8474 |
| | Cyclist | .4467 | .29555 | .132 | -.1345 | 1.0279 |
| | Motorcycle as passenger | 1.5711* | .29372 | .000 | .9935 | 2.1486 |
| | Motorcycle as driver | 1.7287* | .29555 | .000 | 1.1476 | 2.3099 |
| | Bajaj as passenger | .7266* | .30157 | .016 | .1336 | 1.3196 |
| | Bajaj as driver | .8211* | .29372 | .005 | .2435 | 1.3986 |
| | Car as passenger | -.1735 | .29947 | .563 | -.7624 | .4153 |
| | Car as driver | -.0512 | .30157 | .865 | -.6442 | .5418 |
| | Daladala passenger | .1433 | .30157 | .635 | -.4497 | .7363 |

Based on observed means.

The error term is Mean Square(Error) = 1.681.

*. The mean difference is significant at the .05 level.

## Multiple Comparisons

LSD

| Dependent Variable | (I) DM Mode of Transport | (J) DM Mode of Transport | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|---|
| SP Change of safety at station/terminals (Day) before & after DART | Pedestrian | Cyclist | -.1624 | .13736 | .238 | -.4326 | .1078 |
| | | Motorcycle as passenger | .7556* | .13653 | .000 | .4870 | 1.0242 |
| | | Motorcycle as driver | .6345* | .13823 | .000 | .3626 | .9064 |
| | | Bajaj as passenger | .0278 | .14008 | .843 | -.2478 | .3034 |
| | | Bajaj as driver | .0684 | .13736 | .619 | -.2018 | .3386 |
| | | Car as passenger | .0833 | .14008 | .552 | -.1922 | .3589 |
| | | Car as driver | .0278 | .14008 | .843 | -.2478 | .3034 |
| | | Daladala passenger | .0000 | .14008 | 1.000 | -.2756 | .2756 |
| | Cyclist | Pedestrian | .1624 | .13736 | .238 | -.1078 | .4326 |
| | | Motorcycle as passenger | .9179* | .13374 | .000 | .6548 | 1.1811 |
| | | Motorcycle as driver | .7969* | .13547 | .000 | .5304 | 1.0634 |
| | | Bajaj as passenger | .1902 | .13736 | .167 | -.0801 | .4604 |
| | | Bajaj as driver | .2308 | .13459 | .087 | -.0340 | .4955 |
| | | Car as passenger | .2457 | .13736 | .075 | -.0245 | .5159 |
| | | Car as driver | .1902 | .13736 | .167 | -.0801 | .4604 |
| | | Daladala passenger | .1624 | .13736 | .238 | -.1078 | .4326 |
| | Motorcycle as passenger | Pedestrian | -.7556* | .13653 | .000 | -1.0242 | -.4870 |
| | | Cyclist | -.9179* | .13374 | .000 | -1.1811 | -.6548 |
| | | Motorcycle as driver | -.1211 | .13463 | .369 | -.3859 | .1438 |
| | | Bajaj as passenger | -.7278* | .13653 | .000 | -.9964 | -.4592 |
| | | Bajaj as driver | -.6872* | .13374 | .000 | -.9503 | -.4241 |
| | | Car as passenger | -.6722* | .13653 | .000 | -.9408 | -.4036 |
| | | Car as driver | -.7278* | .13653 | .000 | -.9964 | -.4592 |
| | | Daladala passenger | -.7556* | .13653 | .000 | -1.0242 | -.4870 |
| | Motorcycle as driver | Pedestrian | -.6345* | .13823 | .000 | -.9064 | -.3626 |
| | | Cyclist | -.7969* | .13547 | .000 | -1.0634 | -.5304 |
| | | Motorcycle as passenger | .1211 | .13463 | .369 | -.1438 | .3859 |
| | | Bajaj as passenger | -.6067* | .13823 | .000 | -.8786 | -.3348 |
| | | Bajaj as driver | -.5661* | .13547 | .000 | -.8326 | -.2996 |
| | | Car as passenger | -.5512* | .13823 | .000 | -.8231 | -.2792 |
| | | Car as driver | -.6067* | .13823 | .000 | -.8786 | -.3348 |
| | | Daladala passenger | -.6345* | .13823 | .000 | -.9064 | -.3626 |
| | Bajaj as passenger | Pedestrian | -.0278 | .14008 | .843 | -.3034 | .2478 |
| | | Cyclist | -.1902 | .13736 | .167 | -.4604 | .0801 |
| | | Motorcycle as passenger | .7278* | .13653 | .000 | .4592 | .9964 |
| | | Motorcycle as driver | .6067* | .13823 | .000 | .3348 | .8786 |
| | | Bajaj as driver | .0406 | .13736 | .768 | -.2296 | .3108 |
| | | Car as passenger | .0556 | .14008 | .692 | -.2200 | .3311 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Car as driver | .0000 | .14008 | 1.000 | -.2756 | .2756 |
| | | Daladala passenger | -.0278 | .14008 | .843 | -.3034 | .2478 |
| | Bajaj as driver | Pedestrian | -.0684 | .13736 | .619 | -.3386 | .2018 |
| | | Cyclist | -.2308 | .13459 | .087 | -.4955 | .0340 |
| | | Motorcycle as passenger | .6872* | .13374 | .000 | .4241 | .9503 |
| | | Motorcycle as driver | .5661* | .13547 | .000 | .2996 | .8326 |
| | | Bajaj as passenger | -.0406 | .13736 | .768 | -.3108 | .2296 |
| | | Car as passenger | .0150 | .13736 | .913 | -.2553 | .2852 |
| | | Car as driver | -.0406 | .13736 | .768 | -.3108 | .2296 |
| | | Daladala passenger | -.0684 | .13736 | .619 | -.3386 | .2018 |
| | Car as passenger | Pedestrian | -.0833 | .14008 | .552 | -.3589 | .1922 |
| | | Cyclist | -.2457 | .13736 | .075 | -.5159 | .0245 |
| | | Motorcycle as passenger | .6722* | .13653 | .000 | .4036 | .9408 |
| | | Motorcycle as driver | .5512* | .13823 | .000 | .2792 | .8231 |
| | | Bajaj as passenger | -.0556 | .14008 | .692 | -.3311 | .2200 |
| | | Bajaj as driver | -.0150 | .13736 | .913 | -.2852 | .2553 |
| | | Car as driver | -.0556 | .14008 | .692 | -.3311 | .2200 |
| | | Daladala passenger | -.0833 | .14008 | .552 | -.3589 | .1922 |
| | Car as driver | Pedestrian | -.0278 | .14008 | .843 | -.3034 | .2478 |
| | | Cyclist | -.1902 | .13736 | .167 | -.4604 | .0801 |
| | | Motorcycle as passenger | .7278* | .13653 | .000 | .4592 | .9964 |
| | | Motorcycle as driver | .6067* | .13823 | .000 | .3348 | .8786 |
| | | Bajaj as passenger | .0000 | .14008 | 1.000 | -.2756 | .2756 |
| | | Bajaj as driver | .0406 | .13736 | .768 | -.2296 | .3108 |
| | | Car as passenger | .0556 | .14008 | .692 | -.2200 | .3311 |
| | | Daladala passenger | -.0278 | .14008 | .843 | -.3034 | .2478 |
| | Daladala passenger | Pedestrian | .0000 | .14008 | 1.000 | -.2756 | .2756 |
| | | Cyclist | -.1624 | .13736 | .238 | -.4326 | .1078 |
| | | Motorcycle as passenger | .7556* | .13653 | .000 | .4870 | 1.0242 |
| | | Motorcycle as driver | .6345* | .13823 | .000 | .3626 | .9064 |
| | | Bajaj as passenger | .0278 | .14008 | .843 | -.2478 | .3034 |
| | | Bajaj as driver | .0684 | .13736 | .619 | -.2018 | .3386 |
| | | Car as passenger | .0833 | .14008 | .552 | -.1922 | .3589 |
| | | Car as driver | .0278 | .14008 | .843 | -.2478 | .3034 |
| SP Change of in vehicle safety (Day) before & after DART | Pedestrian | Cyclist | -.0940 | .13944 | .501 | -.3683 | .1803 |
| | | Motorcycle as passenger | .4444* | .13860 | .001 | .1718 | .7171 |
| | | Motorcycle as driver | .4181* | .14032 | .003 | .1421 | .6942 |
| | | Bajaj as passenger | .0278 | .14220 | .845 | -.2520 | .3075 |
| | | Bajaj as driver | -.1453 | .13944 | .298 | -.4196 | .1290 |
| | | Car as passenger | -.1389 | .14220 | .329 | -.4186 | .1409 |
| | | Car as driver | -.1111 | .14220 | .435 | -.3909 | .1686 |
| | | Daladala passenger | .1389 | .14220 | .329 | -.1409 | .4186 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cyclist | Pedestrian | .0940 | .13944 | .501 | -.1803 | .3683 |
| | | Motorcycle as passenger | .5385* | .13576 | .000 | .2714 | .8055 |
| | | Motorcycle as driver | .5121* | .13752 | .000 | .2416 | .7827 |
| | | Bajaj as passenger | .1218 | .13944 | .383 | -.1525 | .3961 |
| | | Bajaj as driver | -.0513 | .13662 | .708 | -.3200 | .2175 |
| | | Car as passenger | -.0449 | .13944 | .748 | -.3192 | .2294 |
| | | Car as driver | -.0171 | .13944 | .903 | -.2914 | .2572 |
| | | Daladala passenger | .2329 | .13944 | .096 | -.0414 | .5072 |
| | Motorcycle as passenger | Pedestrian | -.4444* | .13860 | .001 | -.7171 | -.1718 |
| | | Cyclist | -.5385* | .13576 | .000 | -.8055 | -.2714 |
| | | Motorcycle as driver | -.0263 | .13667 | .847 | -.2952 | .2425 |
| | | Bajaj as passenger | -.4167* | .13860 | .003 | -.6893 | -.1440 |
| | | Bajaj as driver | -.5897* | .13576 | .000 | -.8568 | -.3227 |
| | | Car as passenger | -.5833* | .13860 | .000 | -.8560 | -.3107 |
| | | Car as driver | -.5556* | .13860 | .000 | -.8282 | -.2829 |
| | | Daladala passenger | -.3056* | .13860 | .028 | -.5782 | -.0329 |
| | Motorcycle as driver | Pedestrian | -.4181* | .14032 | .003 | -.6942 | -.1421 |
| | | Cyclist | -.5121* | .13752 | .000 | -.7827 | -.2416 |
| | | Motorcycle as passenger | .0263 | .13667 | .847 | -.2425 | .2952 |
| | | Bajaj as passenger | -.3904* | .14032 | .006 | -.6664 | -.1143 |
| | | Bajaj as driver | -.5634* | .13752 | .000 | -.8340 | -.2929 |
| | | Car as passenger | -.5570* | .14032 | .000 | -.8331 | -.2810 |
| | | Car as driver | -.5292* | .14032 | .000 | -.8053 | -.2532 |
| | | Daladala passenger | -.2792* | .14032 | .047 | -.5553 | -.0032 |
| | Bajaj as passenger | Pedestrian | -.0278 | .14220 | .845 | -.3075 | .2520 |
| | | Cyclist | -.1218 | .13944 | .383 | -.3961 | .1525 |
| | | Motorcycle as passenger | .4167* | .13860 | .003 | .1440 | .6893 |
| | | Motorcycle as driver | .3904* | .14032 | .006 | .1143 | .6664 |
| | | Bajaj as driver | -.1731 | .13944 | .215 | -.4474 | .1012 |
| | | Car as passenger | -.1667 | .14220 | .242 | -.4464 | .1131 |
| | | Car as driver | -.1389 | .14220 | .329 | -.4186 | .1409 |
| | | Daladala passenger | .1111 | .14220 | .435 | -.1686 | .3909 |
| | Bajaj as driver | Pedestrian | .1453 | .13944 | .298 | -.1290 | .4196 |
| | | Cyclist | .0513 | .13662 | .708 | -.2175 | .3200 |
| | | Motorcycle as passenger | .5897* | .13576 | .000 | .3227 | .8568 |
| | | Motorcycle as driver | .5634* | .13752 | .000 | .2929 | .8340 |
| | | Bajaj as passenger | .1731 | .13944 | .215 | -.1012 | .4474 |
| | | Car as passenger | .0064 | .13944 | .963 | -.2679 | .2807 |
| | | Car as driver | .0342 | .13944 | .806 | -.2401 | .3085 |
| | | Daladala passenger | .2842* | .13944 | .042 | .0099 | .5585 |
| | Car as passenger | Pedestrian | .1389 | .14220 | .329 | -.1409 | .4186 |
| | | Cyclist | .0449 | .13944 | .748 | -.2294 | .3192 |
| | | Motorcycle as passenger | .5833* | .13860 | .000 | .3107 | .8560 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Motorcycle as driver | .5570* | .14032 | .000 | .2810 | .8331 |
| | | Bajaj as passenger | .1667 | .14220 | .242 | -.1131 | .4464 |
| | | Bajaj as driver | -.0064 | .13944 | .963 | -.2807 | .2679 |
| | | Car as driver | .0278 | .14220 | .845 | -.2520 | .3075 |
| | | Daladala passenger | .2778 | .14220 | .052 | -.0020 | .5575 |
| | Car as driver | Pedestrian | .1111 | .14220 | .435 | -.1686 | .3909 |
| | | Cyclist | .0171 | .13944 | .903 | -.2572 | .2914 |
| | | Motorcycle as passenger | .5556* | .13860 | .000 | .2829 | .8282 |
| | | Motorcycle as driver | .5292* | .14032 | .000 | .2532 | .8053 |
| | | Bajaj as passenger | .1389 | .14220 | .329 | -.1409 | .4186 |
| | | Bajaj as driver | -.0342 | .13944 | .806 | -.3085 | .2401 |
| | | Car as passenger | -.0278 | .14220 | .845 | -.3075 | .2520 |
| | | Daladala passenger | .2500 | .14220 | .080 | -.0297 | .5297 |
| | Daladala passenger | Pedestrian | -.1389 | .14220 | .329 | -.4186 | .1409 |
| | | Cyclist | -.2329 | .13944 | .096 | -.5072 | .0414 |
| | | Motorcycle as passenger | .3056* | .13860 | .028 | .0329 | .5782 |
| | | Motorcycle as driver | .2792* | .14032 | .047 | .0032 | .5553 |
| | | Bajaj as passenger | -.1111 | .14220 | .435 | -.3909 | .1686 |
| | | Bajaj as driver | -.2842* | .13944 | .042 | -.5585 | -.0099 |
| | | Car as passenger | -.2778 | .14220 | .052 | -.5575 | .0020 |
| | | Car as driver | -.2500 | .14220 | .080 | -.5297 | .0297 |
| SP Change of safety at station/terminals (Night) before & after DART | Pedestrian | Cyclist | -.0726 | .13614 | .594 | -.3405 | .1952 |
| | | Motorcycle as passenger | .4389* | .13532 | .001 | .1727 | .7051 |
| | | Motorcycle as driver | .5205* | .13700 | .000 | .2510 | .7900 |
| | | Bajaj as passenger | -.2500 | .13884 | .073 | -.5231 | .0231 |
| | | Bajaj as driver | -.2778* | .13614 | .042 | -.5456 | -.0099 |
| | | Car as passenger | .0000 | .13884 | 1.000 | -.2731 | .2731 |
| | | Car as driver | .0000 | .13884 | 1.000 | -.2731 | .2731 |
| | | Daladala passenger | -.0556 | .13884 | .689 | -.3287 | .2176 |
| | Cyclist | Pedestrian | .0726 | .13614 | .594 | -.1952 | .3405 |
| | | Motorcycle as passenger | .5115* | .13256 | .000 | .2508 | .7723 |
| | | Motorcycle as driver | .5931* | .13427 | .000 | .3290 | .8573 |
| | | Bajaj as passenger | -.1774 | .13614 | .194 | -.4452 | .0905 |
| | | Bajaj as driver | -.2051 | .13339 | .125 | -.4675 | .0573 |
| | | Car as passenger | .0726 | .13614 | .594 | -.1952 | .3405 |
| | | Car as driver | .0726 | .13614 | .594 | -.1952 | .3405 |
| | | Daladala passenger | .0171 | .13614 | .900 | -.2507 | .2849 |
| | Motorcycle as passenger | Pedestrian | -.4389* | .13532 | .001 | -.7051 | -.1727 |
| | | Cyclist | -.5115* | .13256 | .000 | -.7723 | -.2508 |
| | | Motorcycle as driver | .0816 | .13344 | .541 | -.1809 | .3441 |
| | | Bajaj as passenger | -.6889* | .13532 | .000 | -.9551 | -.4227 |
| | | Bajaj as driver | -.7167* | .13256 | .000 | -.9774 | -.4559 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Car as passenger | -.4389* | .13532 | .001 | -.7051 | -.1727 |
| | | Car as driver | -.4389* | .13532 | .001 | -.7051 | -.1727 |
| | | Daladala passenger | -.4944* | .13532 | .000 | -.7607 | -.2282 |
| | Motorcycle as driver | Pedestrian | -.5205* | .13700 | .000 | -.7900 | -.2510 |
| | | Cyclist | -.5931* | .13427 | .000 | -.8573 | -.3290 |
| | | Motorcycle as passenger | -.0816 | .13344 | .541 | -.3441 | .1809 |
| | | Bajaj as passenger | -.7705* | .13700 | .000 | -1.0400 | -.5010 |
| | | Bajaj as driver | -.7982* | .13427 | .000 | -1.0624 | -.5341 |
| | | Car as passenger | -.5205* | .13700 | .000 | -.7900 | -.2510 |
| | | Car as driver | -.5205* | .13700 | .000 | -.7900 | -.2510 |
| | | Daladala passenger | -.5760* | .13700 | .000 | -.8455 | -.3065 |
| | Bajaj as passenger | Pedestrian | .2500 | .13884 | .073 | -.0231 | .5231 |
| | | Cyclist | .1774 | .13614 | .194 | -.0905 | .4452 |
| | | Motorcycle as passenger | .6889* | .13532 | .000 | .4227 | .9551 |
| | | Motorcycle as driver | .7705* | .13700 | .000 | .5010 | 1.0400 |
| | | Bajaj as driver | -.0278 | .13614 | .838 | -.2956 | .2401 |
| | | Car as passenger | .2500 | .13884 | .073 | -.0231 | .5231 |
| | | Car as driver | .2500 | .13884 | .073 | -.0231 | .5231 |
| | | Daladala passenger | .1944 | .13884 | .162 | -.0787 | .4676 |
| | Bajaj as driver | Pedestrian | .2778* | .13614 | .042 | .0099 | .5456 |
| | | Cyclist | .2051 | .13339 | .125 | -.0573 | .4675 |
| | | Motorcycle as passenger | .7167* | .13256 | .000 | .4559 | .9774 |
| | | Motorcycle as driver | .7982* | .13427 | .000 | .5341 | 1.0624 |
| | | Bajaj as passenger | .0278 | .13614 | .838 | -.2401 | .2956 |
| | | Car as passenger | .2778* | .13614 | .042 | .0099 | .5456 |
| | | Car as driver | .2778* | .13614 | .042 | .0099 | .5456 |
| | | Daladala passenger | .2222 | .13614 | .104 | -.0456 | .4901 |
| | Car as passenger | Pedestrian | .0000 | .13884 | 1.000 | -.2731 | .2731 |
| | | Cyclist | -.0726 | .13614 | .594 | -.3405 | .1952 |
| | | Motorcycle as passenger | .4389* | .13532 | .001 | .1727 | .7051 |
| | | Motorcycle as driver | .5205* | .13700 | .000 | .2510 | .7900 |
| | | Bajaj as passenger | -.2500 | .13884 | .073 | -.5231 | .0231 |
| | | Bajaj as driver | -.2778* | .13614 | .042 | -.5456 | -.0099 |
| | | Car as driver | .0000 | .13884 | 1.000 | -.2731 | .2731 |
| | | Daladala passenger | -.0556 | .13884 | .689 | -.3287 | .2176 |
| | Car as driver | Pedestrian | .0000 | .13884 | 1.000 | -.2731 | .2731 |
| | | Cyclist | -.0726 | .13614 | .594 | -.3405 | .1952 |
| | | Motorcycle as passenger | .4389* | .13532 | .001 | .1727 | .7051 |
| | | Motorcycle as driver | .5205* | .13700 | .000 | .2510 | .7900 |
| | | Bajaj as passenger | -.2500 | .13884 | .073 | -.5231 | .0231 |
| | | Bajaj as driver | -.2778* | .13614 | .042 | -.5456 | -.0099 |
| | | Car as passenger | .0000 | .13884 | 1.000 | -.2731 | .2731 |
| | | Daladala passenger | -.0556 | .13884 | .689 | -.3287 | .2176 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Daladala passenger | Pedestrian | .0556 | .13884 | .689 | -.2176 | .3287 |
| | | Cyclist | -.0171 | .13614 | .900 | -.2849 | .2507 |
| | | Motorcycle as passenger | .4944* | .13532 | .000 | .2282 | .7607 |
| | | Motorcycle as driver | .5760* | .13700 | .000 | .3065 | .8455 |
| | | Bajaj as passenger | -.1944 | .13884 | .162 | -.4676 | .0787 |
| | | Bajaj as driver | -.2222 | .13614 | .104 | -.4901 | .0456 |
| | | Car as passenger | .0556 | .13884 | .689 | -.2176 | .3287 |
| | | Car as driver | .0556 | .13884 | .689 | -.2176 | .3287 |
| SP Change of in-vehicle safety (Nigh) before & after DART | Pedestrian | Cyclist | -.0299 | .13511 | .825 | -.2957 | .2359 |
| | | Motorcycle as passenger | .2028 | .13430 | .132 | -.0614 | .4670 |
| | | Motorcycle as driver | .3041* | .13597 | .026 | .0366 | .5716 |
| | | Bajaj as passenger | .0278 | .13779 | .840 | -.2433 | .2988 |
| | | Bajaj as driver | -.0299 | .13511 | .825 | -.2957 | .2359 |
| | | Car as passenger | .0556 | .13779 | .687 | -.2155 | .3266 |
| | | Car as driver | .3056* | .13779 | .027 | .0345 | .5766 |
| | | Daladala passenger | .0556 | .13779 | .687 | -.2155 | .3266 |
| | Cyclist | Pedestrian | .0299 | .13511 | .825 | -.2359 | .2957 |
| | | Motorcycle as passenger | .2327 | .13155 | .078 | -.0261 | .4915 |
| | | Motorcycle as driver | .3340* | .13325 | .013 | .0719 | .5961 |
| | | Bajaj as passenger | .0577 | .13511 | .670 | -.2081 | .3235 |
| | | Bajaj as driver | .0000 | .13238 | 1.000 | -.2604 | .2604 |
| | | Car as passenger | .0855 | .13511 | .527 | -.1803 | .3513 |
| | | Car as driver | .3355* | .13511 | .014 | .0697 | .6013 |
| | | Daladala passenger | .0855 | .13511 | .527 | -.1803 | .3513 |
| | Motorcycle as passenger | Pedestrian | -.2028 | .13430 | .132 | -.4670 | .0614 |
| | | Cyclist | -.2327 | .13155 | .078 | -.4915 | .0261 |
| | | Motorcycle as driver | .1013 | .13243 | .445 | -.1592 | .3618 |
| | | Bajaj as passenger | -.1750 | .13430 | .193 | -.4392 | .0892 |
| | | Bajaj as driver | -.2327 | .13155 | .078 | -.4915 | .0261 |
| | | Car as passenger | -.1472 | .13430 | .274 | -.4114 | .1170 |
| | | Car as driver | .1028 | .13430 | .445 | -.1614 | .3670 |
| | | Daladala passenger | -.1472 | .13430 | .274 | -.4114 | .1170 |
| | Motorcycle as driver | Pedestrian | -.3041* | .13597 | .026 | -.5716 | -.0366 |
| | | Cyclist | -.3340* | .13325 | .013 | -.5961 | -.0719 |
| | | Motorcycle as passenger | -.1013 | .13243 | .445 | -.3618 | .1592 |
| | | Bajaj as passenger | -.2763* | .13597 | .043 | -.5438 | -.0088 |
| | | Bajaj as driver | -.3340* | .13325 | .013 | -.5961 | -.0719 |
| | | Car as passenger | -.2485 | .13597 | .068 | -.5160 | .0189 |
| | | Car as driver | .0015 | .13597 | .991 | -.2660 | .2689 |
| | | Daladala passenger | -.2485 | .13597 | .068 | -.5160 | .0189 |
| | Bajaj as passenger | Pedestrian | -.0278 | .13779 | .840 | -.2988 | .2433 |
| | | Cyclist | -.0577 | .13511 | .670 | -.3235 | .2081 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Motorcycle as passenger | .1750 | .13430 | .193 | -.0892 | .4392 |
| | Motorcycle as driver | .2763* | .13597 | .043 | .0088 | .5438 |
| | Bajaj as driver | -.0577 | .13511 | .670 | -.3235 | .2081 |
| | Car as passenger | .0278 | .13779 | .840 | -.2433 | .2988 |
| | Car as driver | .2778* | .13779 | .045 | .0067 | .5488 |
| | Daladala passenger | .0278 | .13779 | .840 | -.2433 | .2988 |
| Bajaj as driver | Pedestrian | .0299 | .13511 | .825 | -.2359 | .2957 |
| | Cyclist | .0000 | .13238 | 1.000 | -.2604 | .2604 |
| | Motorcycle as passenger | .2327 | .13155 | .078 | -.0261 | .4915 |
| | Motorcycle as driver | .3340* | .13325 | .013 | .0719 | .5961 |
| | Bajaj as passenger | .0577 | .13511 | .670 | -.2081 | .3235 |
| | Car as passenger | .0855 | .13511 | .527 | -.1803 | .3513 |
| | Car as driver | .3355* | .13511 | .014 | .0697 | .6013 |
| | Daladala passenger | .0855 | .13511 | .527 | -.1803 | .3513 |
| Car as passenger | Pedestrian | -.0556 | .13779 | .687 | -.3266 | .2155 |
| | Cyclist | -.0855 | .13511 | .527 | -.3513 | .1803 |
| | Motorcycle as passenger | .1472 | .13430 | .274 | -.1170 | .4114 |
| | Motorcycle as driver | .2485 | .13597 | .068 | -.0189 | .5160 |
| | Bajaj as passenger | -.0278 | .13779 | .840 | -.2988 | .2433 |
| | Bajaj as driver | -.0855 | .13511 | .527 | -.3513 | .1803 |
| | Car as driver | .2500 | .13779 | .071 | -.0211 | .5211 |
| | Daladala passenger | .0000 | .13779 | 1.000 | -.2711 | .2711 |
| Car as driver | Pedestrian | -.3056* | .13779 | .027 | -.5766 | -.0345 |
| | Cyclist | -.3355* | .13511 | .014 | -.6013 | -.0697 |
| | Motorcycle as passenger | -.1028 | .13430 | .445 | -.3670 | .1614 |
| | Motorcycle as driver | -.0015 | .13597 | .991 | -.2689 | .2660 |
| | Bajaj as passenger | -.2778* | .13779 | .045 | -.5488 | -.0067 |
| | Bajaj as driver | -.3355* | .13511 | .014 | -.6013 | -.0697 |
| | Car as passenger | -.2500 | .13779 | .071 | -.5211 | .0211 |
| | Daladala passenger | -.2500 | .13779 | .071 | -.5211 | .0211 |
| Daladala passenger | Pedestrian | -.0556 | .13779 | .687 | -.3266 | .2155 |
| | Cyclist | -.0855 | .13511 | .527 | -.3513 | .1803 |
| | Motorcycle as passenger | .1472 | .13430 | .274 | -.1170 | .4114 |
| | Motorcycle as driver | .2485 | .13597 | .068 | -.0189 | .5160 |
| | Bajaj as passenger | -.0278 | .13779 | .840 | -.2988 | .2433 |
| | Bajaj as driver | -.0855 | .13511 | .527 | -.3513 | .1803 |
| | Car as passenger | .0000 | .13779 | 1.000 | -.2711 | .2711 |
| | Car as driver | .2500 | .13779 | .071 | -.0211 | .5211 |

Based on observed means.

The error term is Mean Square(Error) = .342.

*. The mean difference is significant at the .05 level.