ROAD SAFETY OBSERVATORY

UNDERSTANDING ROAD USERS' BEHAVIOUR AND ATTITUDE IN MAURITIUS

(PROJECT CODE K0531)

JULY 2021

UNIVERSITY OF MAURITIUS

TMRSU
Safer Roads and Mobility

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

Executive Summary

It is known that Road traffic injuries (RTIs) are one of the leading causes of death in the age of 5-29 years and; approximately 1.35 million people die each year from RTIs and 20-50 million are injured (WHO, 2018).There is a need to allocate due importance to priotising data collection and analysis on RTIs in a disaggregated way and key themes: demographic, age, gender, education level, seat- belt use, alcohol consumption, increased public awareness and outreach. An understanding of these will pave the way forward to the appropriate policy decision/s to enhance traffic road safety culture and any need for infrastructural changes within the particular environment.

Statistics Mauritius (2020) updates on RTIs as: "*the number of road traffic accidents registered during the year 2020 was 28,611 against 29,644 in the preceding year, showing a decrease of 3.5%. Among those accidents, in the majority, 25,525 (92.7%) there were no injury, 119 were fatal and 1,967 caused serious/slight injuries. In 2020 the accident rate, expressed as the number of accidents per 100,000 mid-year population was 2,341 compared to 2,425 in 2019.*

The aim of this research is to capture trends and statistics that will help to an understanding and possible applications of the findings to policy-makers, decision-makers, engineers and the police for an enhanced road safety.The objectives of this research are to:

- assess past historical data and main causes of road users' behaviour
- identify factors and predictors of road crashes
- identify major factors or clusters influencing road safety
- identify major risk factors or clusters contributing to road crashes
- contrast measures related to law enforcement, road infrastructure and awareness and education that could contribute to improve road safety;
- come up with appropriate recommendations and propose strategies and policies for population awareness programmes and campaigns

The research provides the conclusion that the number of road crashes has increased by 32.4% in the last decade while the number of fatal accidents has decreased by 14.5%. Most casualty accidents, about 24% occurred in the Port Louis district, followed by 20% in the Plaines Wilhems district. The 20-24 age group involved the highest number of fatal accidents by motorcycle (25%). Motorcycle riders in the age group 20-29 years were involved in 19 % of the fatal crashes.

The general perception on road safety influential clusters were related to infrastructural conditions of the road environment (lighting, traffic signs and road markings), traffic safety measures (helmets, road safety signs) and the vehicle safety measures (seat belts).It is observed that on average respondents are strongly agreeable that road lighting is a must for improved vision, security, safety, improving decision making and to reduce road crashes.

It is recommended that more educational and sensitisation campaigns, training, awareness programs and workshops among road users be conducted. Furthermore, Probationary Driving License may be given to beginner drivers or freshly qualified drivers while enforcing blood alcohol limits in public areas. There is a constant need to improve the infrastructure while ensuring that road users who are not law-abiding to road signs and road traffic rules must be given exact and swift penalties. Moreover, implementation of road safety actions in line with the United Nations Sustainable Development Goals as well as the safe system approach to road safety have been proposed.

ABBREVIATIONS

BAC Blood Alcohol Concentration

ESI Economic Social Indicators

MPF Mauritius Police Force

NTA National Transport Authority

RDA Road Development Authority

RTIs Road Traffic Injuries

RTAs Road Traffic Accidents

RSO Road Safety Observatory

SDGs Sustainable Development Goals

SM Statistics Mauritius

TMRSU Traffic Management and Road Safety Unit

TPB Theory of Planned Behaviour

UN United Nations

WHO World Health Organisation

1. Introduction

"Nothing is of greater importance than the conservation of human life." – Calvin Coolidge

1.1 Background

Road traffic injuries (RTIs) are one of the leading causes of death in the ages of 5-29 years. Approximately 1.35 million people die each year from RTIs and 20-50 million are injured (WHO, 2018). RTIs are the most important causes of death in low- and middle-income countries, with 93% of road traffic deaths occuring in these countries. The financial consequences of RTIs are also significant and the WHO reports that RTIs account for 2%-7% of gross domestic product (GDP) in low- and middle-income countries (Safarpour et al, 2020). Road traffic crashes are usually as a result of many interacting factors; however, the human factor is estimated to account for over 90% of all causes of traffic crashes (Pakgohar, 2007, cited in Anderson, 2021).

United Nations, under Goal 3 of the Sustainable Development Goals (SDGs) and target 3.6 in 2010 proposed to halve the number of global deaths and injuries from road traffic accidents by 2020. This was not met and the vision was shifted to beyond 2020. Hence as reported in Mohan et al (2020), there is a new call to member states at the Third Global Ministerial Conference on Road Safety—Achieving Global Goals 2030 to "*contribute to reducing road traffic deaths by at least 50% from 2020 to 2030 in line with the United Nations High Level Political Forum on Sustainable Development's pledge to continue action on the road safety related SDG targets, including SDG 3.6 after 2020, and to set targets to reduce fatalities and serious injuries, in line with this commitment, for all groups of road users and especially vulnerable road users such as pedestrians, cyclists and motorcyclists and users of public transport*". This reinforces the need for countries to allocate due importance to priotising data collection and analysis on RTIs in a disaggregated way and key themes: demographic, age, gender, education level, seat-belt use, alcohol consumption, increased public awareness and outreach. An understanding of these pave the way to the appropriate policy decision/s to enhance traffic road safety culture and any need for infrastructural changes within a particular environment.

Uzondu et al (2020) have supported hypotheses, indicating that the behaviour of drivers are interpretable in relation to their traffic safety culture, compared to changes in their driving environment. Thus, the research highlighted that Nigerian drivers with no experience of driving

in a UK road system would report and engage in more unsafe driving behaviour compared to the other two groups, and that increasing infrastructure would have little positive benefit. Data from 50 US states over 14 years was studied by Noland (2003) and it was reported that infrastructure improvements hadnot been effective at reducing total fatalities and injuries. On the other hand, it was found that demographic changes in age cohorts, increased seat-belt use, reduced alcohol consumption and increases in medical technology had accounted for a large share of overall reductions in fatalities.Peltzer (2011) reported that in Kenya, behavioural factors are responsible for 85% of all causes. Moreover, analysis from police reports in South Africa, Tanzania, and Nigeria show behavioural factors followed by road environment and vehicle factors, as major causes of road traffic accidents.

A report published on the78th session of Global Forum on Road Traffic Safety in March 2019 (UNECE, 2019), highlights "Road safety of all road users", as one of the main policies for the Republic of Mauritius. Thus, the Road Safety Strategy for Mauritius covering the period 2016-2025, has as one main objective to achieve a 50% reduction in the number of killed and serious injury crashes by the year 2025. The vision of an enhanced road safety contains the following missions: the setting up of a Research and Development Programme; the improvement of Safety Standards of the road infrastructure; the reorganisation of the roadworthiness control of vehicles; the setting up an effective communication strategy; the strengthening of the Road Traffic Law and Enforcement. Moreover, other avenues to be dealt in parallel include: Road Safety Education, the re-engineering of the Driving Licensing Scheme, the provision of post-crash trauma care and medical fitness to drive, the reduction of accident costs and the setting up of a Road Safety Academy (GIS, 2020).

Statistics Mauritius (SM, 2020) updates on RTIs as: "*the number of road traffic accidents registered during the year 2020 was 28,611 against 29,644 in the preceding year, showing a decrease of 3.5%. Among those accidents, in the majority, 25,525 (92.7%) there were no injury, 119 were fatal and 1,967 caused serious/slight injuries. In 2020 the accident rate, expressed as the number of accidents per 100,000 mid-year population was 2,341 compared to 2,425 in 2019. The number of accidents per 1,000 mid-year registered motor vehicles works out to 49 against 52 in 2019. The number of persons who died as a result of road accidents in 2020 went down by 9.0% compared to 2019. The fatality rate, expressed as the number of persons who died as a result of road accidents per 100,000 mid-year population, works out to 10.7, compared to 11.8 in 2019. Out of the 131 persons killed in road accidents during year 2020,*

the most vulnerable category of road users were riders/pillion riders of auto/motor cycles (65), followed by pedestrians (24).”

Infrastructural choices and safety of people travelling are of key importance. Hence, road users’ attitudes and behaviour entail taking stock of data, perceptions and projections on how to decrease road conflicts and injuries, inclusive of deaths. This report is a study on “Understanding Road Users Behaviour and Attitudes in Mauritius”. The aim of this research is to capture trends and statistics that will help to an understanding and possible applications of the findings to guide policy-makers, decision-makers, engineers and the police for an enhanced road safety.

1.2 Objectives

The objectives of this research are to:

- assess past data and main causes of road users’ behaviour
- identify factors and predictors of road crashes
- identify major factors or clusters influencing road safety
- identify major risk factors or clusters contributing to road crashes
- contrast measures related to law enforcement, road infrastructure and awareness and education that could contribute to improve road safety
- come up with appropriate recommendations.

1.3 Limitations

The data collected from iMAAP are incomplete for the year 2017 to 2020 on the characteristics of accidents included. These include crash severity, location of crashes, details about casualties (age, gender, severity) and details about the vehicles involved.

SM data were used in lieu to comment on road user bahaviour and crash involvement. There is limited data available from SM for serious and slight accidents and only taking into consideration data from Economic Social Indicators (ESI). The latest SM Digest is dates to 2017.

2. Brief Literature

This section provides some key literature on the topic.

2.1 The different factors affecting road users' behaviour and attitudes

There are many contributing factors in literature and these include: unsafe road infrastructure, unsafe vehicles, risk-taking behaviour, reckless driving, over-speeding, driving under the influence of alcohol and drugs, use of mobile phones while driving, non-use of seat belts and helmets, traffic violations, inadequate law enforcement of traffic laws, inadequate post-crash care as well as inefficient systems operations and management (Rolison et al, 2018).

Literature on this sub theme under different studies as highlighted by Elvik (2021) depicts the following:

- A huge number of factors influence the number of road accidents; and that some of these factors exert a similar influence in all countries.
- Higher speed increases the risk of accidents and their severity in all countries where studies have been reported.
- The effects of traffic volume on the number of accidents are similar across countries.
- Seat belts protect from injury everywhere.
- Despite the similarity of the effects of these factors, the level of road safety, as indicated by the number of traffic fatalities per 100,000 inhabitants, varies greatly between countries. It is known that this variation is related to national income level.
- Most traffic fatalities today occur in low- and middle-income countries. These countries also have the highest rate of traffic fatalities, both per 100,000 inhabitants and per 100,000 motor vehicles.
- High-income countries have succeeded in reducing the number of traffic fatalities.

2.2 Driver Behaviour

Driver behaviour is the biggest challenge to improve road safety (Shinar, 2007). According to the taxonomy of aberrant behaviour, driver behaviour is classified as an error or violation due to the different psychological origins (Reason et al, 1990). For example, errors are explained as failures of planned action of the individual cognitive processes whereas violations are actions that are deliberate to perform or not to perform a specific behaviour to norms, rules and regulations or other codes of practice (Ozkan and Lajunen, 2005; Reason et al, 1990). Likewise,

Nayum (2008), has termed “violation” as an intentional deviation from traffic rules, for instance when road users disrespecting the speed limit, disregarding and driving when red lights are appearing or even giving chase to another driver out of anger or frustration. Shiraev and Levy (2010) have noticed that behavior is strongly influenced by norms, habits and practices. Hence, Porter (2011) has argued that driver behaviour is considered an important component of the human factors in traffic safety.

2.3 Speed

It is important to distinguish between the concepts of speed and speeding. Speed is a physical characteristic which is a major determinant of crash energy and time to respond. Speeding is a created or legal concept which compares the speed to the speed limit (or to what is considered to be safe for the prevailing conditions). Legal speeds can be unsafe (even though they are not "speeding") if the speed limit is too high.

Speed determines the duration of the time-window of opportunity for drivers to detect, decide on and react to impending hazards (Aarts and Van Schagen, 2006). Thus, when drivers travel at high speeds, they are exposed to less time to identify risks present and to take immediate actions because the vehicles take a longer time to stop. The level of speed is associated with crash frequency (Lassarre & Stradling, 2005) and causes deaths or severe injuries to drivers themselves, including other road users too. The behaviour and culture of speeding can be interpreted in different ways:

1. the culture of speed within specific age groups and road users, for example, young men and motorcyclists
2. the culture of saving time to reach a destination.

Different factors affect drivers’ speed choice:

- driver- related factors (gender, age, alcohol consumption, drug consumption, number of people in the vehicle)
- road layout (bad road conditions), surface quality and type of vehicle (vehicle power, maximum speed)
- traffic density, prevailing speed, changing lanes, over-taking and
- environment (weather conditions such as heavy rainfall, fog, frosty).

Anderson et al (2021) have reported on salient beliefs towards speeding behaviour among commercial drivers in Nigeria that could be used as targets in speeding interventions. It was

reported that using the TPB (Ajzen, 1991) as a framework, focus group discussions provided an opportunity for participants to actively exchange anecdotes and experiences relating to speeding and speed limit compliance in a real-world decision- making context. Strategies have also been provided in the study that might serve as a key aspect in speed awareness campaigns targeted at this group of drivers and may play a critical part in modifying their choice of speed and ultimately reduce the road traffic crashes and resultant fatalities.

2.4 Drinking and Driving

Driving under the influence of alcohol consumption is seen as a major factor of road crashes worldwide (Brubacher et al, 2018). Although, some drivers may not show warning signs of being under the influence of small amounts of alcohol consumption, this is still considered as a risk factor and can lead to harmful situations. Bernhoft and Behrensdorff (2003) have reported that perceiving functions are weakened when the blood alcohol concentration is between 0.4 % and 0.5 %. Many drivers who tend to consume one or two glasses of alcohol might believe that it is not serious for accident causation. However, studies have shown that alcohol consumption can reduce drivers' functional capabilities, including reaction time, proper speed management, vision, divided attention, tracking ability, vigilance and can lead to increased crash risk on roads (Odgen & Moskowitz, 2004; Martin et al, 2013). In fact, due to the effect of alcohol present in the blood, drivers are unable to concentrate fully as their senses are weakened. The latter makes drivers drive either slowly or faster than expected on roads. In most cases, they are not capable to detect rapidly the proper estimation of speed and distance. This is a serious issue in Mauritius, as the rate of road accidents has been on the rise with drivers tested positive for alcohol consumption and driving. Peden et al (2004) have shown that drink- driving is the most contributing factor to the occurrence of unsafe behaviour and road accidents. Moreover, WHO (2014) states that alcohol remains a universal risk factor for road crashes although the methods of assessing drinking and driving are different across countries.

2.5 Physiological and Psychological Factors

Physical factors are responsible for human errors are: vision, fatigue, hearing, mental stress and emotional stress. Very often, drivers face these different physical factors which make them unable to respond to complex traffic situations. Thus, their lack of concentration is a relevant reason to increase their risks of accidents on roads. Other factors include overconfidence, sensation-seeking and peer influences which make drivers engage in risky and intentional

driving behaviours (Scott-Parker et al, 2013). On the other hand, factors like poor roads conditions, high traffic volumes, risk-taking of the individual, conflicts with other individuals, weather conditions can also cause stress. Besides, time pressures also create stressful situations for drivers and passengers, for example in the case of delivery times or while keeping vehicles on time in heavy traffic (Millies, 1998).

2.6 Use of Mobile Phones and Non-wearing of Seat Belts

The use of mobile phones has been exponentially increasing worldwide, and have become an integral part of our lives. However, the use of mobile phones while driving is quite common by road users even if it is illegal. This behaviour is dangerous and can be linked to road accidents. Recent research by Rahman et al (2018) has shown that the use of mobile phones increases road fatality rates of 6.6% to 100% and this reduces concentration for drivers and may result in causing accidents (Munusami, 2011).

Studies have also shown a high risk of accidents among individuals talking, texting, or listening to music on their phones (Brodsky & Slor, 2013; Nemme &White, 2010; Redelmeier & Tibshirani, 1997). A research carried out in Ghana, has found that the cause of accidents is associated with the use of mobile phones while driving as people ignored the dangers and risks (Haadi, 2014).

It is put on record that use of mobile phones or headsets or free hand is prohibited while driving in Mauritius.

2.7 The Safe System Approach to Road Safety

The Safe System approach to road safety puts the human being at its centre (Figure 1). It originates from the belief that every road death or serious injury is preventable and includes the following two basic facts about people: 1. people make mistakes, thus also mistakes when on the roads and, 2. people are vulnerable to being killed or seriously injured, if they are involved in a crash. Consequently, all elements of the road system - vehicles, infrastructure, speed limits, road users, and post-crash care - work together as one to minimise the chance of a crash, or, if a crash does take place, to prevent death or serious injury from occurring.

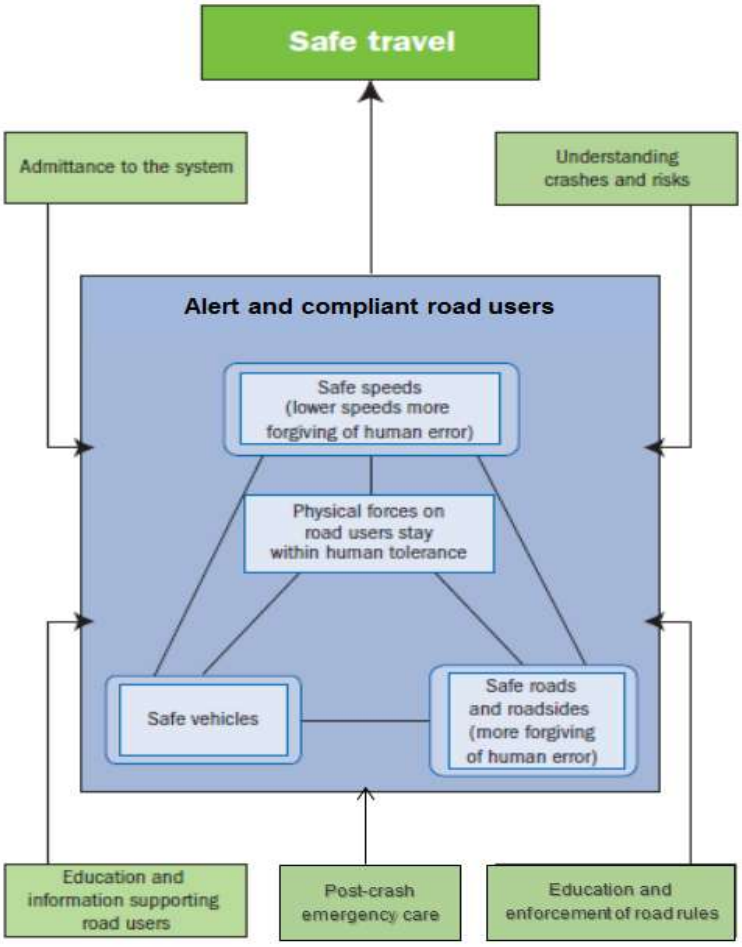


Figure 1: A model of the Safe System Approach (OECD, 2008)

3. Methodology

The methodology involvedquestionnaire design, surveysand secondary data collection from sources: Statistics Mauritius (SM), Police Station and iMAAP Accident Analysis software of the Traffic Management and Road Safety Unit (TMRSU). Microsoft Excel and IBM SPSS Statistics 20 software were used for data analysis. The questionnaire surveys were conducted at the identified blackspots in Mauritius.

The questionnaires are annexed in Appendix 1. Locations and information from iMAAP are included in Appendix 2.

4.0 Data Collection

Data collection is included in this section with section 4.1 on secondary data collection and section 4.2 on primary data collection or the questionnaire survey.

4.1 iMAAP and SM

4.1.1 Road Accidents

The number of accidents on our roads show a rise of 32.4% from **22,387** in 2011 to **29,644** in 2019[1]. Similarly, the number of vehicles on our roads increased steadily, a rise of **49.7%** since 2011. Figure 2 shows the number of vehicles registered and the number of road accidents (casualty and non-casualty) for the years 2011 to 2020.

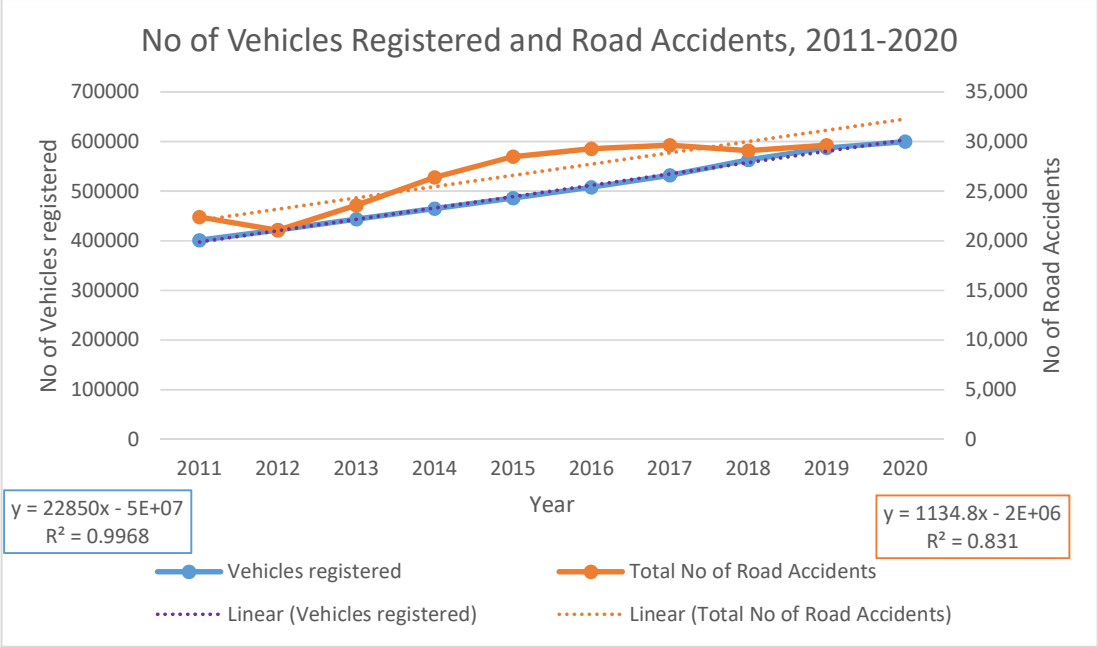


Figure 2: Total Number of Vehicles Registered and road accidents, 2011- 2020 (Source: SM 2021)

Since 2011, there has been many changes in our road infrastructure; as a result, there is a 31.2% increase in the length of roads. Figure 3 shows the trend in vehicles registered per km of road as well as the number of accidents.

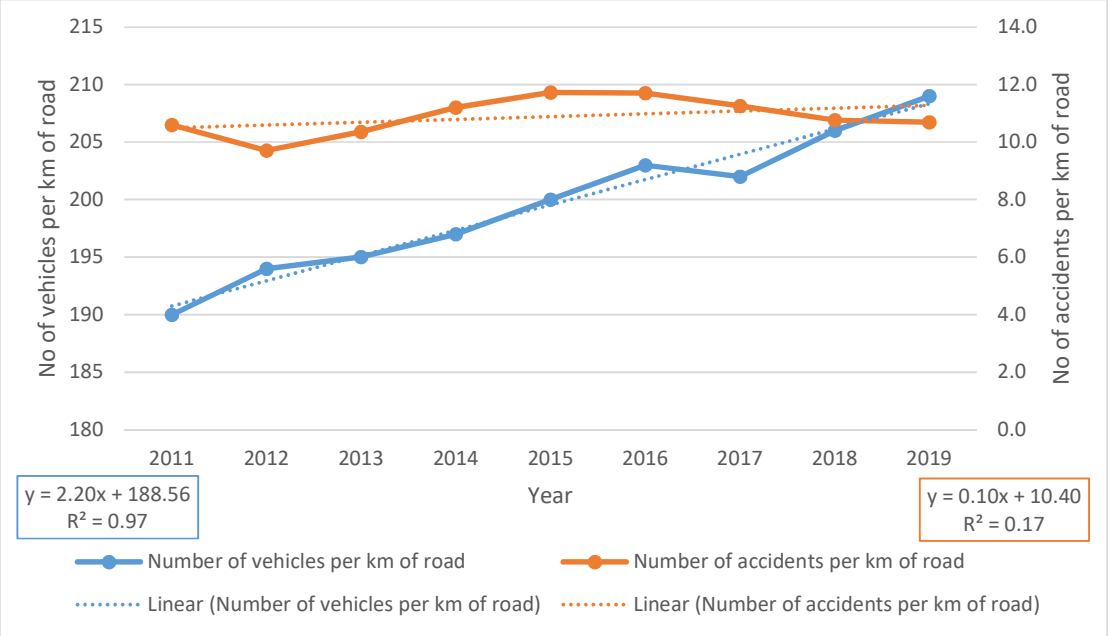


Figure 3: Vehicles registered and Road accidents per km of road, 2011-2020 (Source: SM)

Figure 4 shows the number of casualty accidents classified by crash severity, namely fatal, serious and slight as obtained from iMAAP. It is to be noted that the data available on iMAAP is incomplete for 2018 through 2020 for the number of serious and slight accidents.

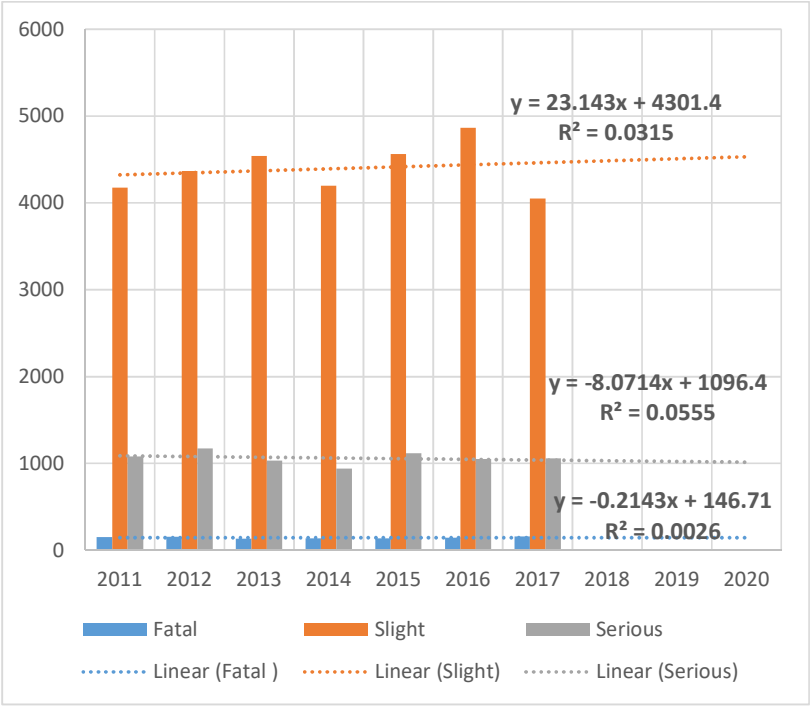


Figure 4: Casualty Accidents by Crash Severity, 2011-2017 (Source: iMAAP)

The number of fatal accidents has decreased by 14.5%, from 152 in 2011 to 130 in 2020[1]. The highest peak is 2017 with 157 fatal accidents. Figure 31 plots the number of fatal accidents as well as the number of fatal accidents per km of road for the years 2011-2019. Figure 5 displays the fatality index (2011 – 2020).

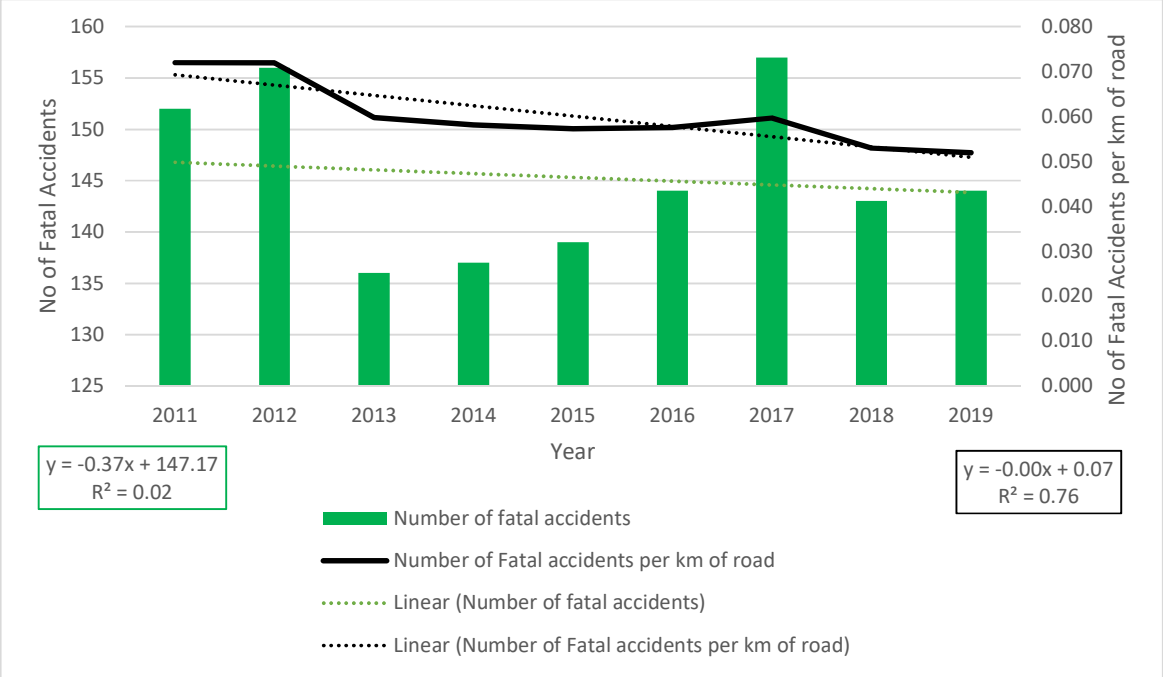


Figure 5: Fatal Accidents and Fatal Accidents per km of road, 2011-2020 (Source: iMAAP and SM)

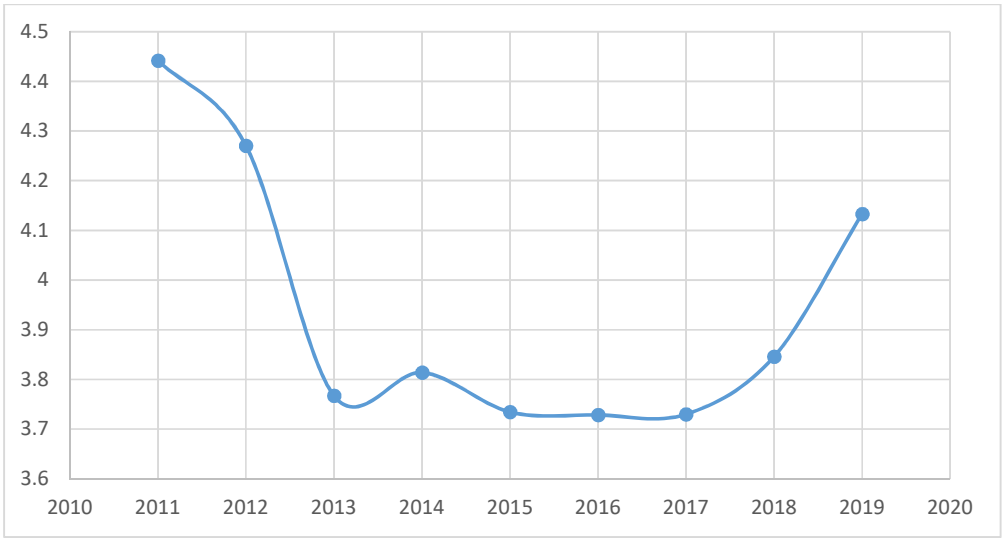


Figure 6: Fatality Index, 2011-2020 (Source: SM)

There are 3 classes of road users that are involved in road accidents: driver, passenger and pedestrian. The percentage of road users involved in casualty accidents and fatal accidents for the period 2011- 2022 has been reported in Figure 7.

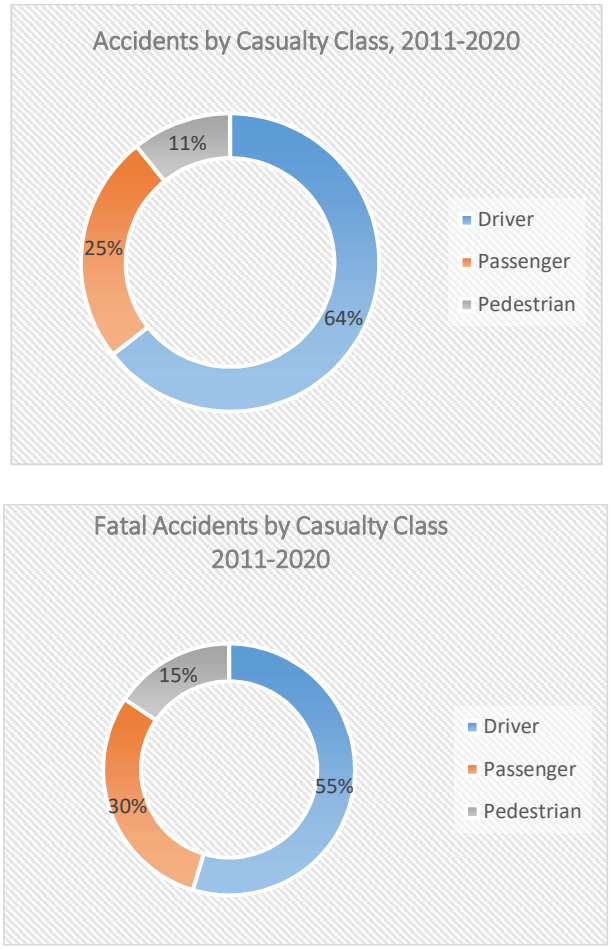


Figure 7: Accidents and Fatal Accidents by Casualty Class, 2011-2020 (Source: iMAAP)

4.1.2 Fatal Accidents by Vehicle Types and Registration Statistics

From Figure 8, it can be noted that fatal accidents involve mostly cars (35.3%).Motorcycle riders represent a significant proportion with 22% of road fatalities.

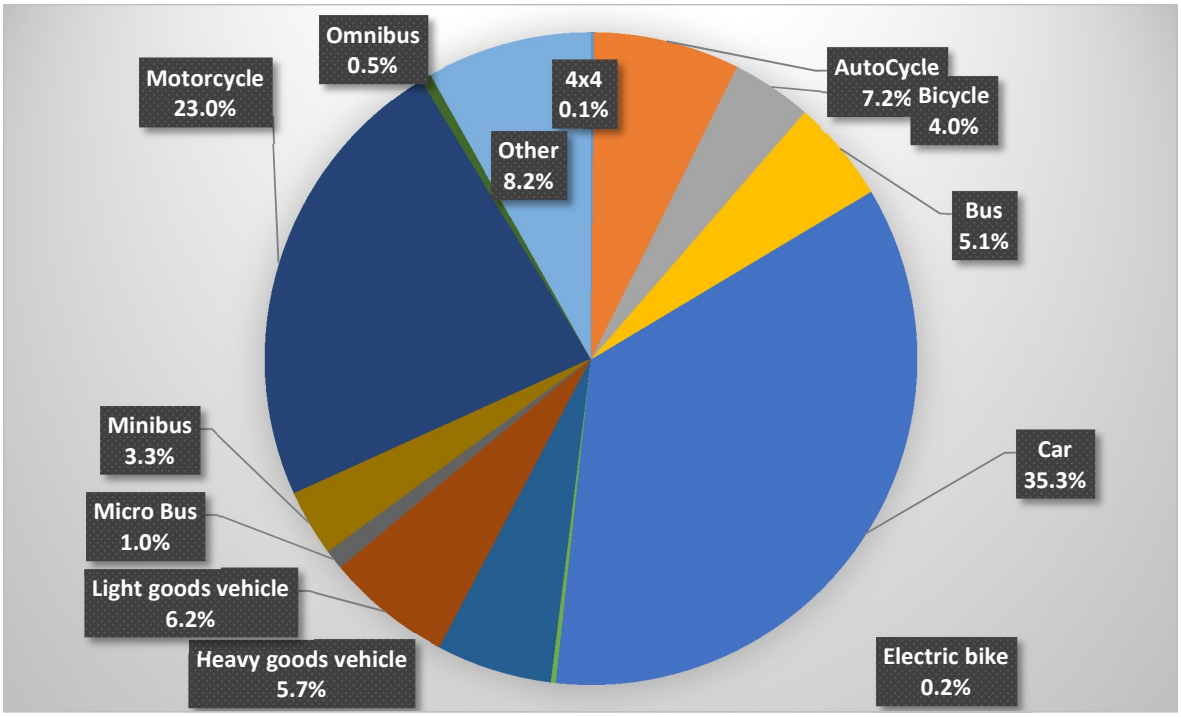


Figure 8: Fatal Accidents by Vehicle Type, 2010-2020 (Source: iMAAP)

In 2018, 93 fatalities were motorcyclists, accounting for 30.2% of fatalities that year (Appendix 3). This number is a 6% increase from year 2017. Motorcycles accounted for only 16.6% of Mauritius vehicle registrations in 2018, yet motorcyclists accounted for 30.2% of the state road fatalities.

Figure 9 displays the percentage of each type of vehicles registered from 2011 to 2020[2]. Details are in annexed in Appendix 3.

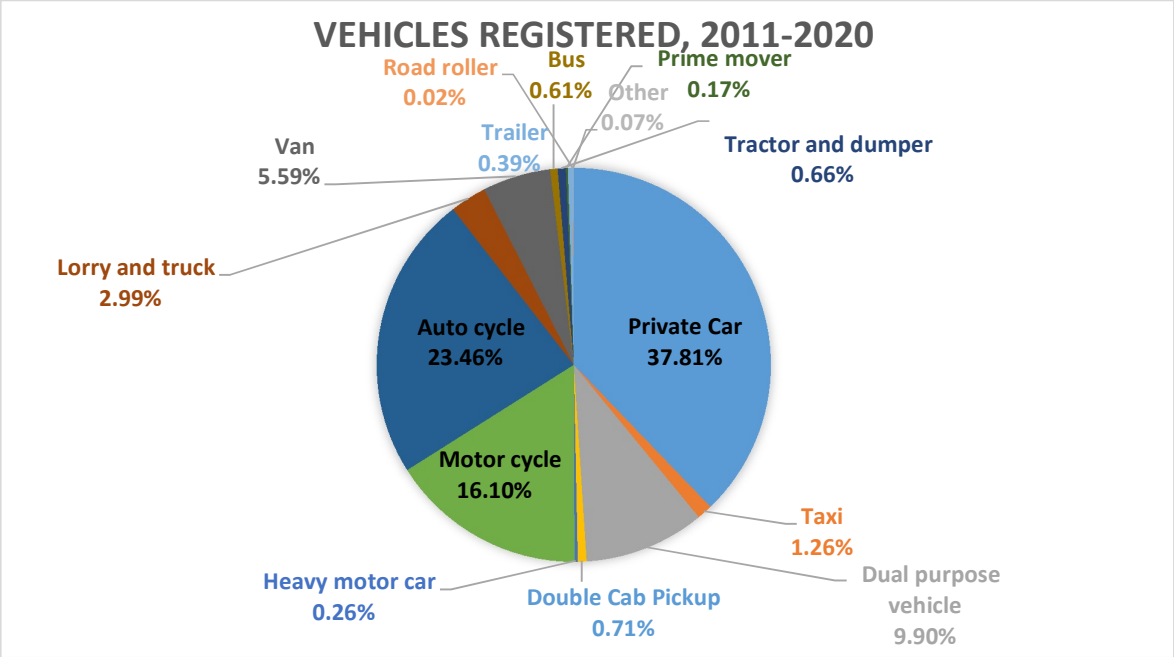


Figure 9: Total Vehicles Registered, 2011-2020 (Source: SM 2020)

[2] Information obtained from Statistics Mauritius for the years 2018-2020 are provisional (as confirmed with TMRSU).

4.1.3 Motorcycles and Statistics

The number of motorcycles registered from 2011 to 2020 shows a rise from ***53,410*** in **2011** to ***103,589***in **2020**; representing an increase of 94% (Figure 10).

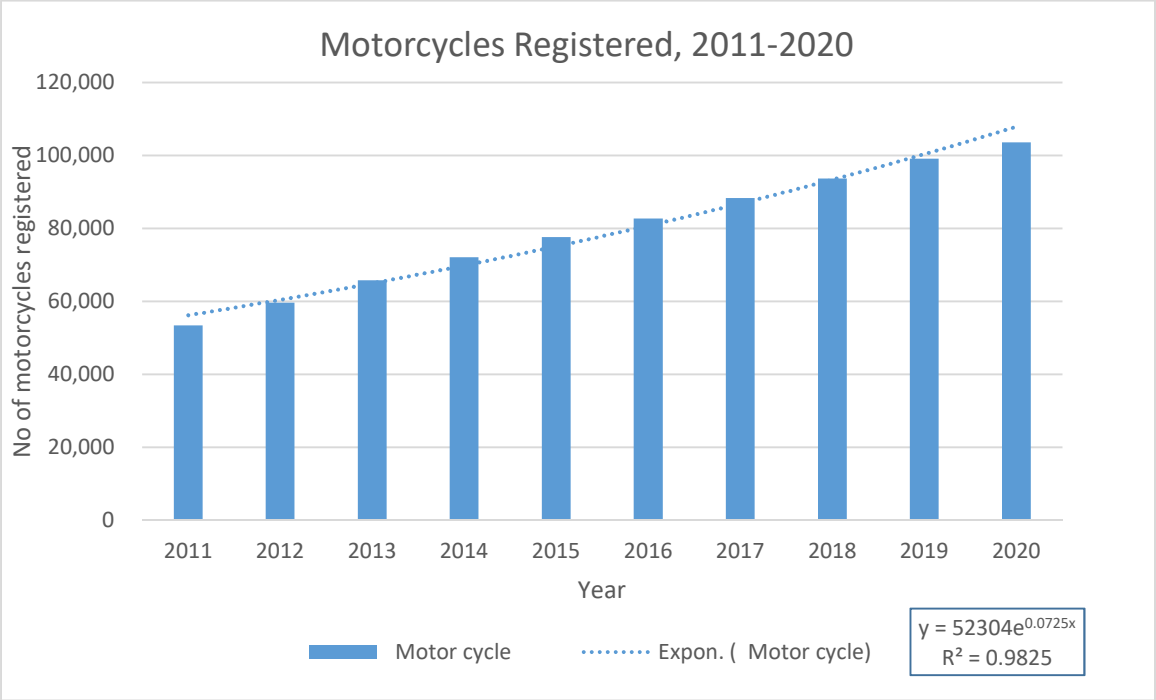


Figure 10: Motorcycles registered, 2011-2020 (Source: SM 2020)

The trend line for serious accidents is sharper with R= 0.71 compared to that for fatal accidents (Figure 11).

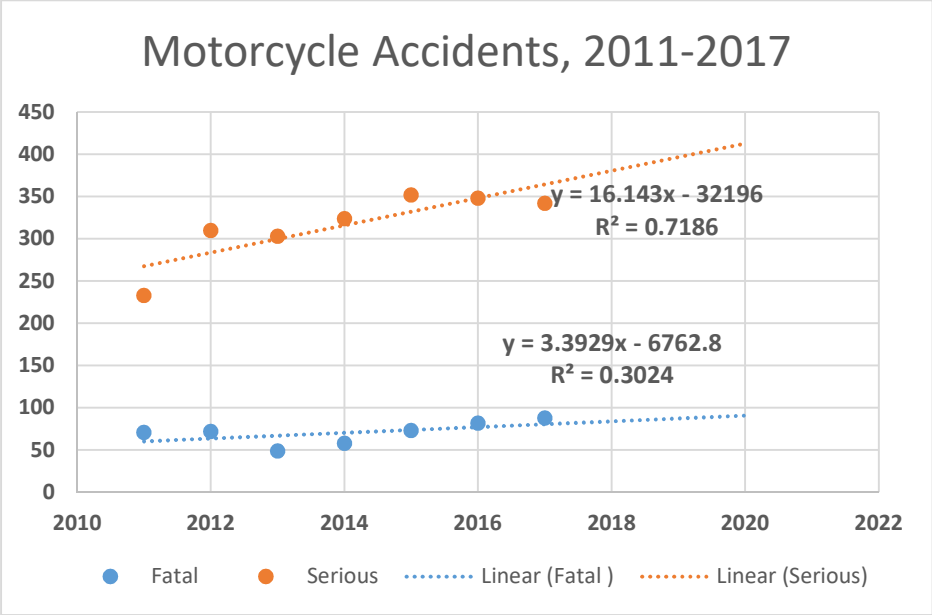


Figure 11: Fatal and Serious Motorcycle Accidents (iMAAP)

The rate of motorcyclist fatalities per registered motorcycle has been showing a downward trend for the last decade (Figure 12).

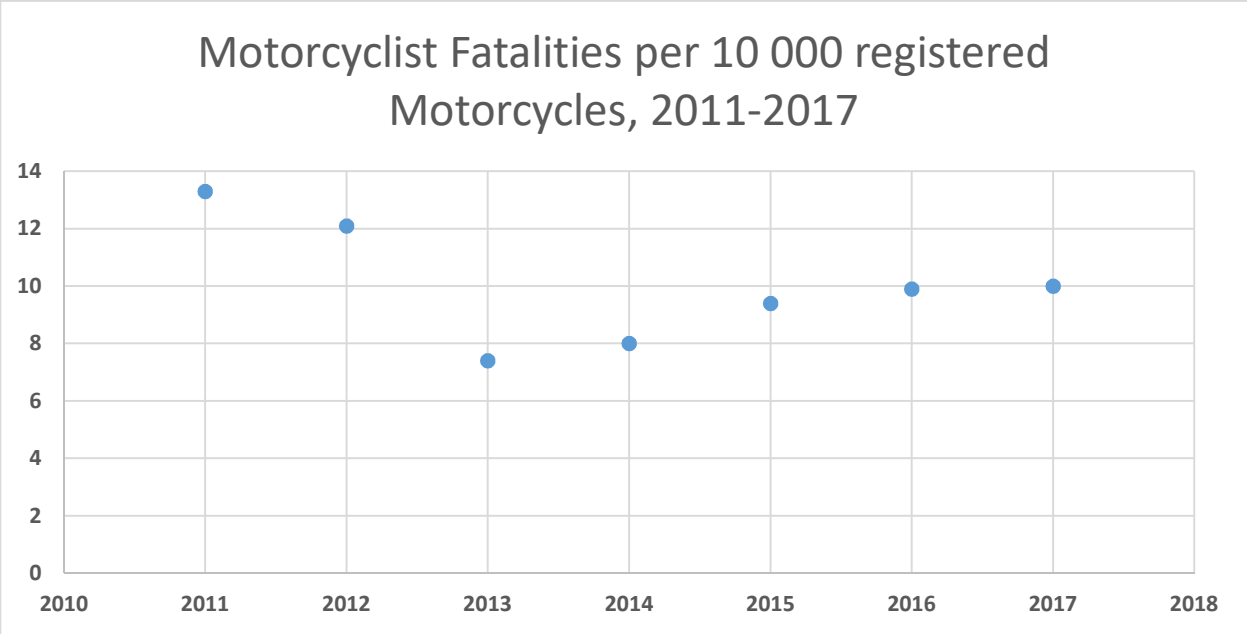


Figure 12: Motorcyclist Fatalities per 10 000 registered Motorcycles, 2011-2017 (Source: iMAAP & SM 2020)

Table 1 includes statistics of the fatal accidents by types for motorcycles.

Table 1: Fatal Accidents by license type for motorcycles, 2011-2020 (Source: iMAAP)

Vehicle Type	**Motorcycle License Type**		
Year	**Full License**	**Provisional License**	**No License**
2011	23	48	0
2012	23	48	1
2013	15	27	7
2014	35	19	4
2015	42	30	1
2016	43	33	6
2017	43	37	6
2018	42	46	3
2019	9	19	5
2020	6	16	9

Table 2 shows the number of fatal accidents classified into the rider`s age group for the last decade. It is observed that the 20-24 age group caused the highest number of fatal accidents (24.8%) followed by the 25-29 age group (19.3%).

Table 2: Motorcycles Fatal Accidents by Age, 2011-2020 (Source: iMAAP)

Age Group	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
<20	6	8	2	6	6	21	10	10	8	8	**85**
20-24	12	23	19	14	18	21	22	17	7	9	**162**
25-29	23	6	12	13	22	9	7	21	8	5	**126**
30-34	5	6	6	5	6	7	13	8	1	5	**62**
35-39	5	4	3	4	4	9	12	13	1	2	**57**
40-44	5	2	1	2	5	5	4	6	5	0	**35**
45-49	6	12	3	0	1	1	3	0	2	1	**29**
50-54	3	7	2	2	9	5	4	5	3	1	**41**
55-59	2	3	0	6	0	2	6	1	0	0	**20**
60-64	3	1	1	6	1	0	3	5	0	0	**20**
65-69	1	0	0	0	1	1	1	7	0	1	**12**
70-74	0	0	0	0	0	0	3	0	0	0	**3**
75-79	0	0	0	0	0	1	0	0	0	0	**1**
80-84	0	0	0	0	0	0	0	0	0	0	**0**
85+	0	0	0	0	0	0	0	0	0	0	**0**
Total	**71**	**72**	**49**	**58**	**73**	**82**	**88**	**93**	**35**	**32**	**653**

4.1.4 Drink Driving

Drink driving has been a contributing factor of traffic casualty accidents in Mauritius (Table 3 and Figure 13- 14).

Table 3: Accidents under Alcohol Influence by Crash Severity, 2011-2020 (Source: iMAAP)

Year	Fatal accidents under alcohol influence	Serious accidents under alcohol influence	Slight accidents under alcohol influence	Total No of accidents under the influence of alcohol	Total Casualty Accidents
2011	37	76	2497	2610	5773
2012	23	84	2653	2760	5943
2013	11	61	2780	2852	5852
2014	12	71	2578	2661	5483
2015	13	64	2701	2778	6050
2016	3	68	2924	2995	6245
2017	15	58	1207	1280	5548
2018	2	34	98	134	3380
2019	2	18	20	40	715
2020	5	10	21	36	736
Total	**123**	**544**	**17479**	**18146**	**45725**

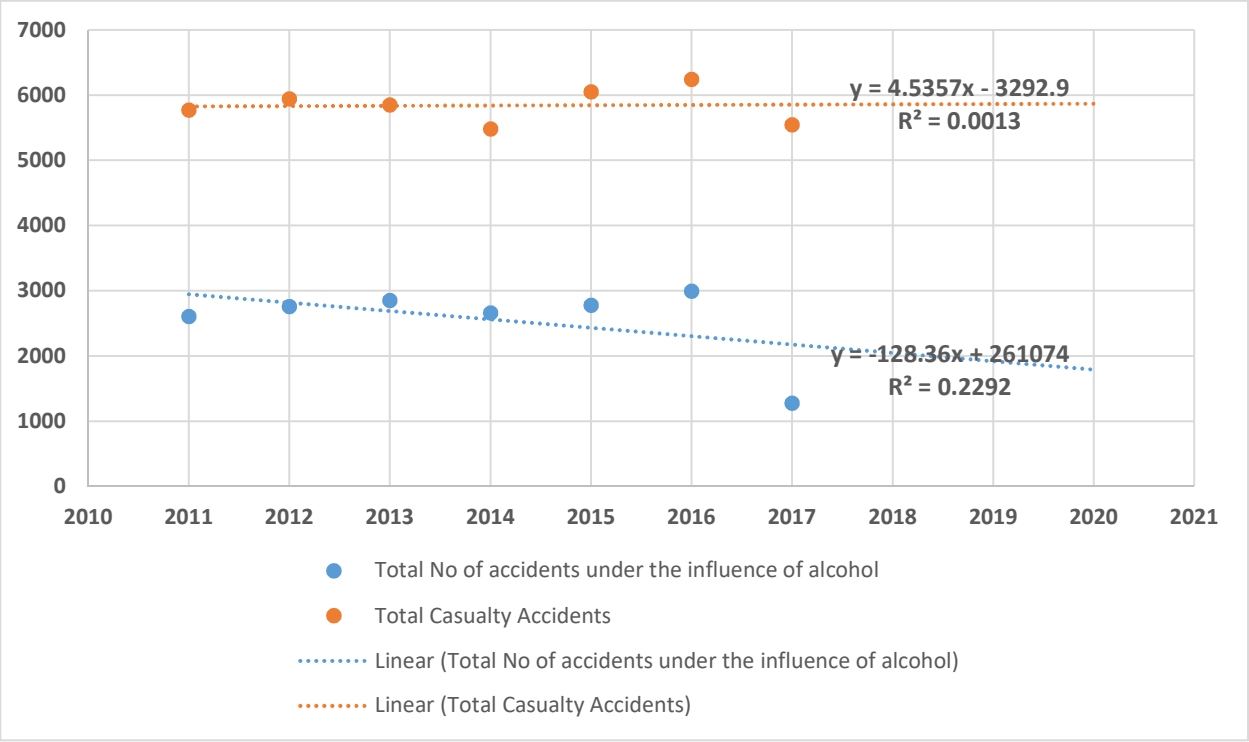


Figure 13: Casualty Accidents under Alcohol Influence, 2011-2017 (Source: iMAAP)

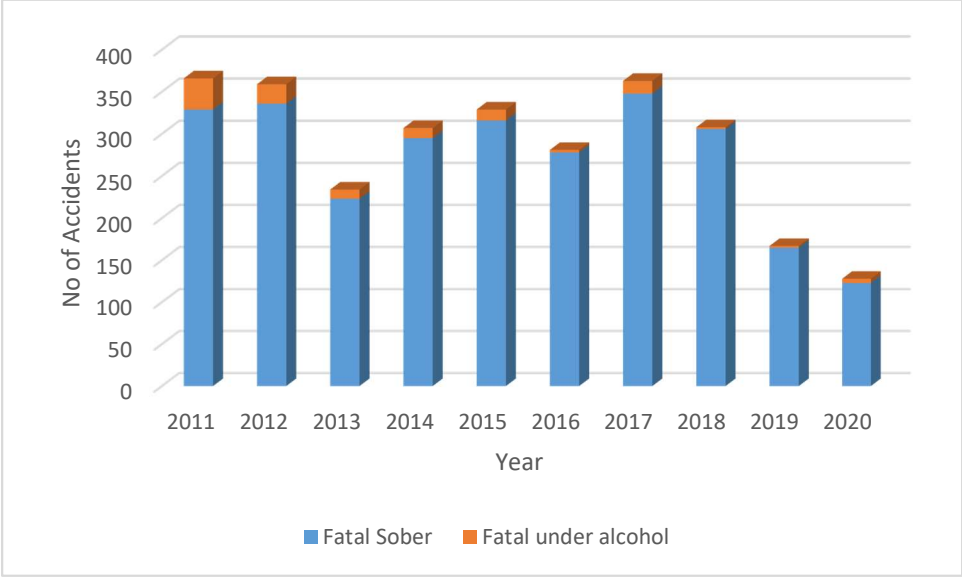


Figure 14: Fatal Accidents under alcohol influence as a proportion of total fatal accidents, 2011-2020 (Source: iMAAP)

Figure 15 shows the number of accidents that occurred when the driver was under the influence of alcohol classified by the 9 districts in Mauritius for the years 2011 to 2020. We can observe the highest peaks being in Port Louis district for almost every consecutive year, followed by Plaines Wilhems, Pamplemousses and Riviere du Rempart. This information is further analysed by calculating the number of accidents occurring under the influence of alcohol per unit area for each district in Table 4.

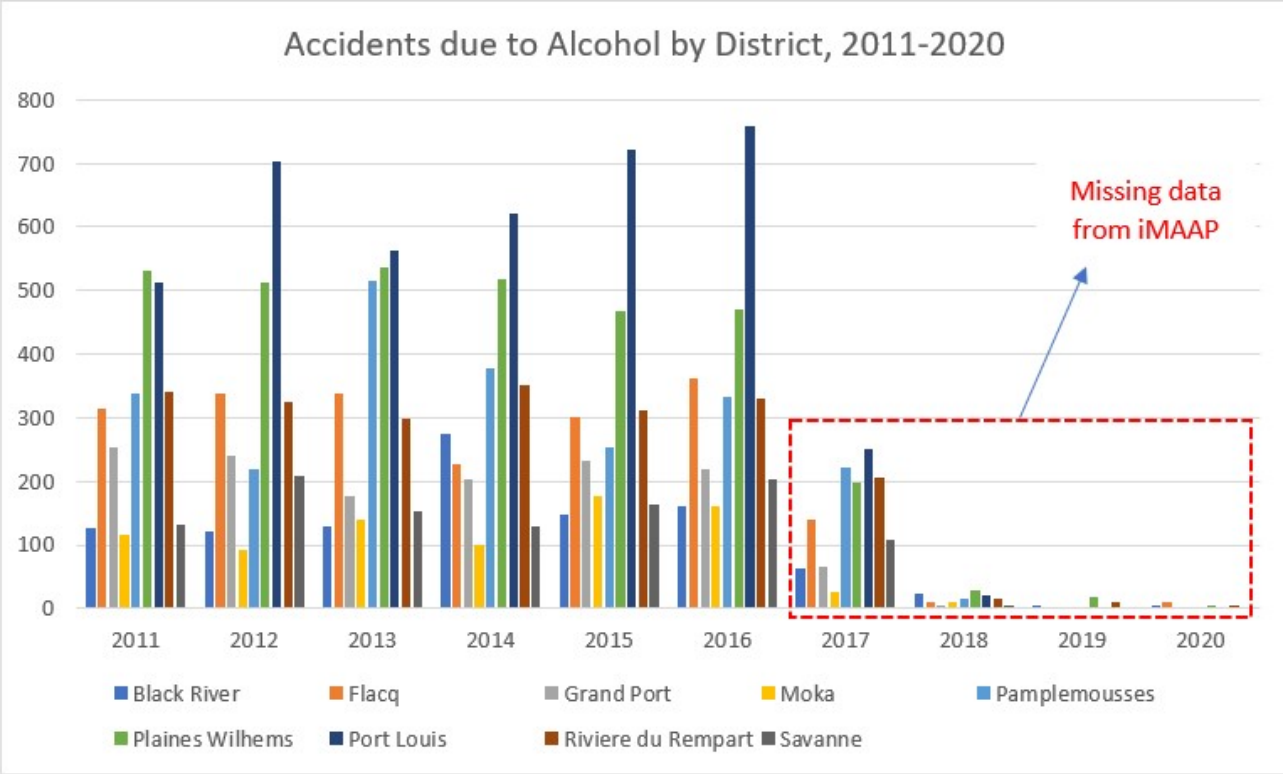


Figure 15: Accidents due to Alcohol by District, 2011-2020 (Source: iMAAP)

In the last decade, there has been **4156** accidents under the influence of alcohol in Port Louis; **97.3** accidents per km^2; accounting for nearly **10** accidents per year in every square km in the capital.

Table 4: Accidents under Alcohol Influence per unit area (Source: iMAAP)

District	Area / km²	Accidents under Alcohol Influence (2011-2020)	Accidents under Alcohol Influence per unit area / (km^ (-2))	Average Number of Accidents under Alcohol Influence per unit area per year/ (km^ (-2) year^ (-1))
Pamplemousses	178.7	2279	12.8	1.28
Riviere du Rempart	147.6	2197	14.9	1.49
Port-Louis	42.7	4156	97.3	9.73
Plaines-Wilhems	203.3	3284	16.2	1.62
Moka	230.5	823	3.6	0.36
Flacq	297.9	2041	6.9	0.69
Black-River	259.0	1058	4.1	0.41
Savanne	244.8	1107	4.5	0.45
Grand-Port	260.3	1400	5.4	0.54

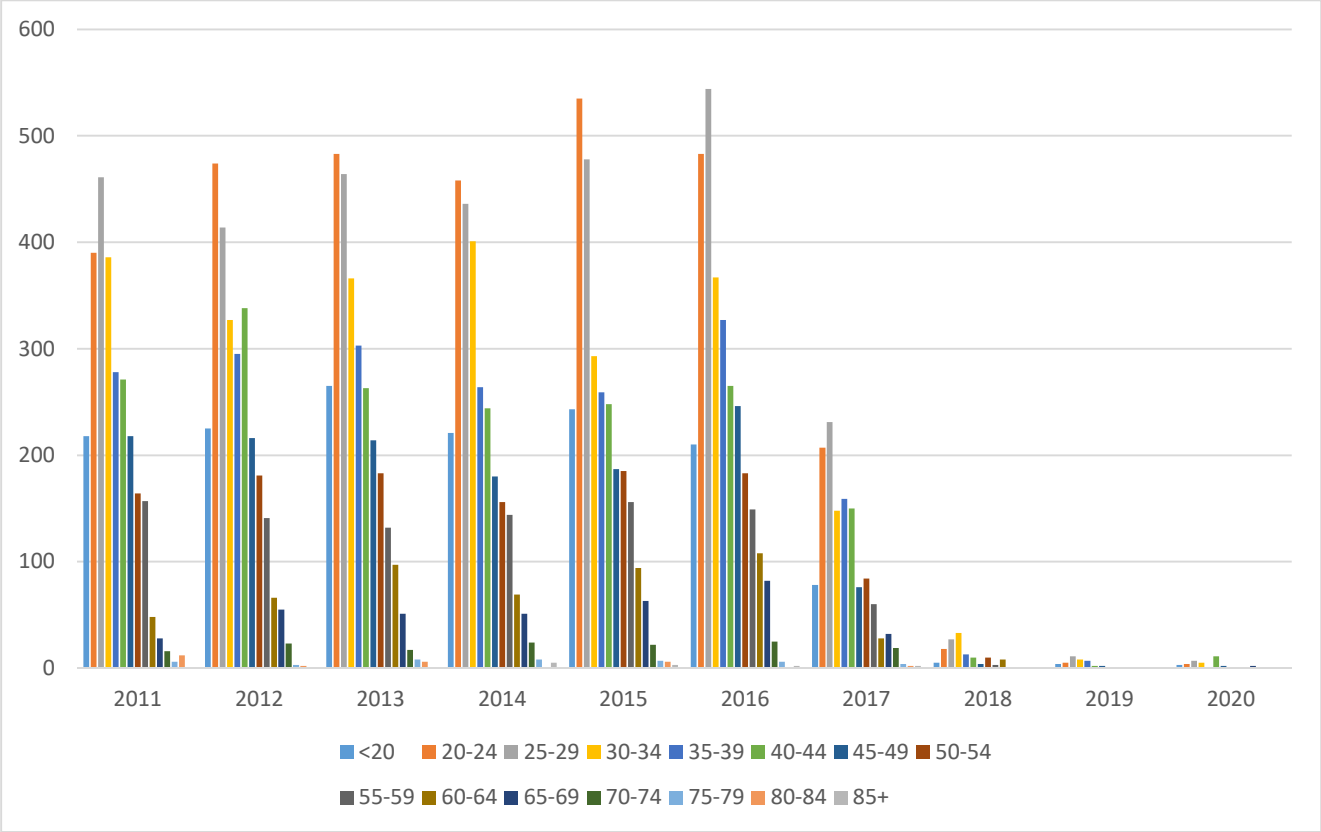


Figure 16: Accidents under Alcohol Influence by Age Group, 2011-2020 (Source: iMAAP)

The 20-24 and 25-29 age groups are the most involved in casualty road crashes under alcohol influence, followed by the 30-34 age group from information in Figure 16. The number of adolescents (<20 age group) involved is also alarming since the legal drinking age in Mauritius is 18.

Table 5: Accidents under alcohol influence per age group per year, 2011-2020 (Source: iMAAP)

Age	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
<20	218	225	265	221	243	210	78	5	4	3	**1472**
20-24	390	474	483	458	535	483	207	18	5	4	**3057**
25-29	461	414	464	436	478	544	231	27	11	7	**3073**
30-34	386	327	366	401	293	367	148	33	8	5	**2334**
35-39	278	295	303	264	259	327	159	13	7	1	**1906**
40-44	271	338	263	244	248	265	150	10	2	11	**1802**
45-49	218	216	214	180	187	246	76	4	2	2	**1345**
50-54	164	181	183	156	185	183	84	10	0	0	**1146**
55-59	157	141	132	144	156	149	60	3	1	1	**944**
60-64	48	66	97	69	94	108	28	8	0	0	**518**
65-69	28	55	51	51	63	82	32	0	0	2	**364**
70-74	16	23	17	24	22	25	19	0	0	0	**146**
75-79	6	3	8	8	7	6	4	0	0	0	**42**
80-84	12	2	6	0	6	0	2	0	0	0	**28**
85+	0	0	0	5	3	2	2	0	0	0	**12**
Total	**2653**	**2760**	**2852**	**2661**	**2779**	**2997**	**1280**	**131**	**40**	**36**	**18189**

Figure 17 shows that 43.2% of road fatalities occurring under the influence of alcohol was by car followed by 18.9% by motorcycle.

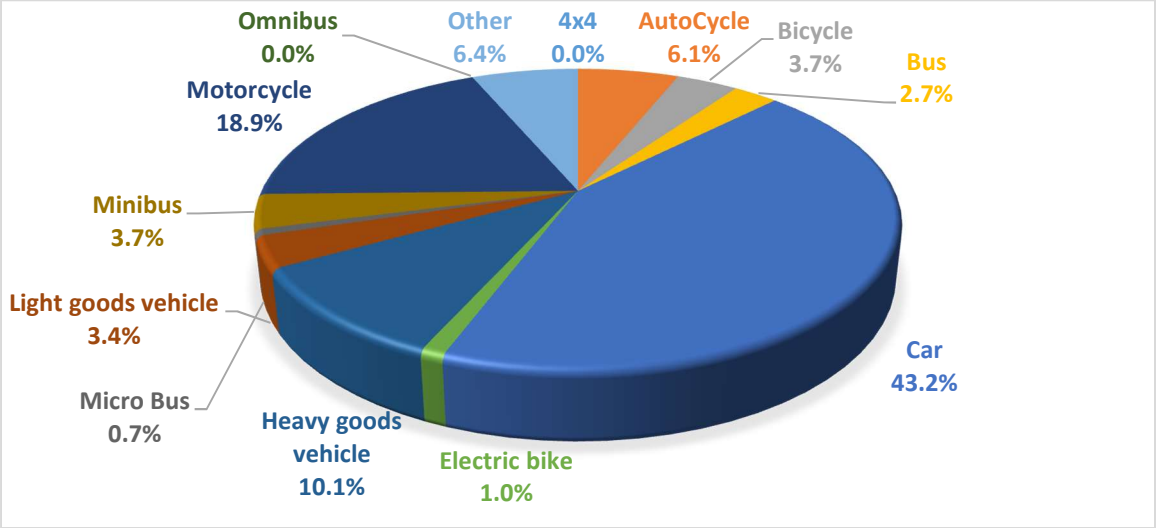


Figure 17: Fatal Accidents under alcohol influence by vehicle type, 2011-2020 (Source: iMAAP).

4.1.5 Young People

Perspectives regarding the age range of 'adolescents' range vary from study to study, often starting in the early teens and ending in early-adulthood. We will consider 'young people' as referring from the age group 5-29 years old as according to the WHO. Road accidents are the leading cause of death globally for this age range of children and young adults. Mauritius is no exception as young drivers accounted for 36% of road fatalities from 2011 to 2020 (Figure 18).

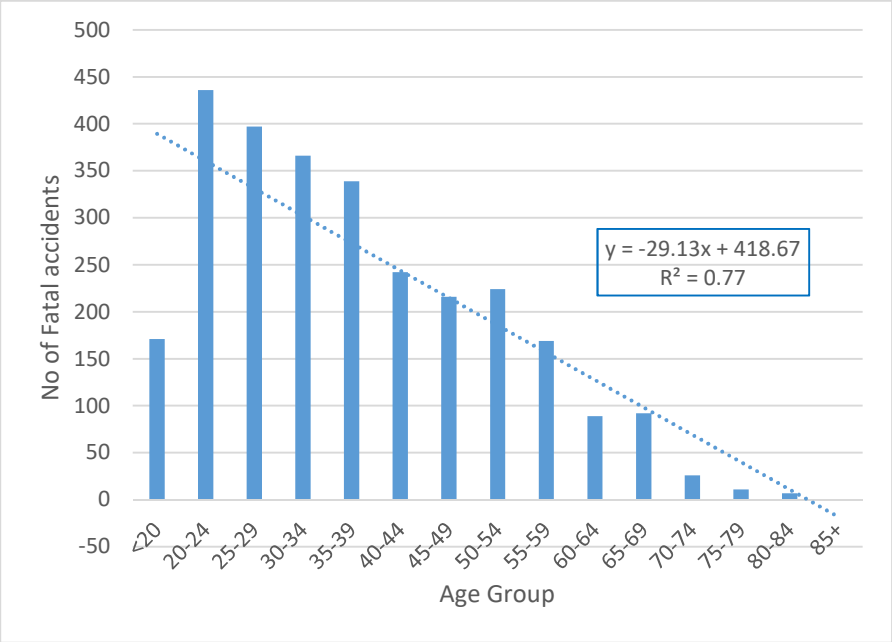


Figure 18: Total Fatal Accidents by Age group, 2011-2020 (Source: iMAAP)

There is a peak at the 20-24 age group with over 425 deaths during the last decade, accounting for 16% of total road fatalities.

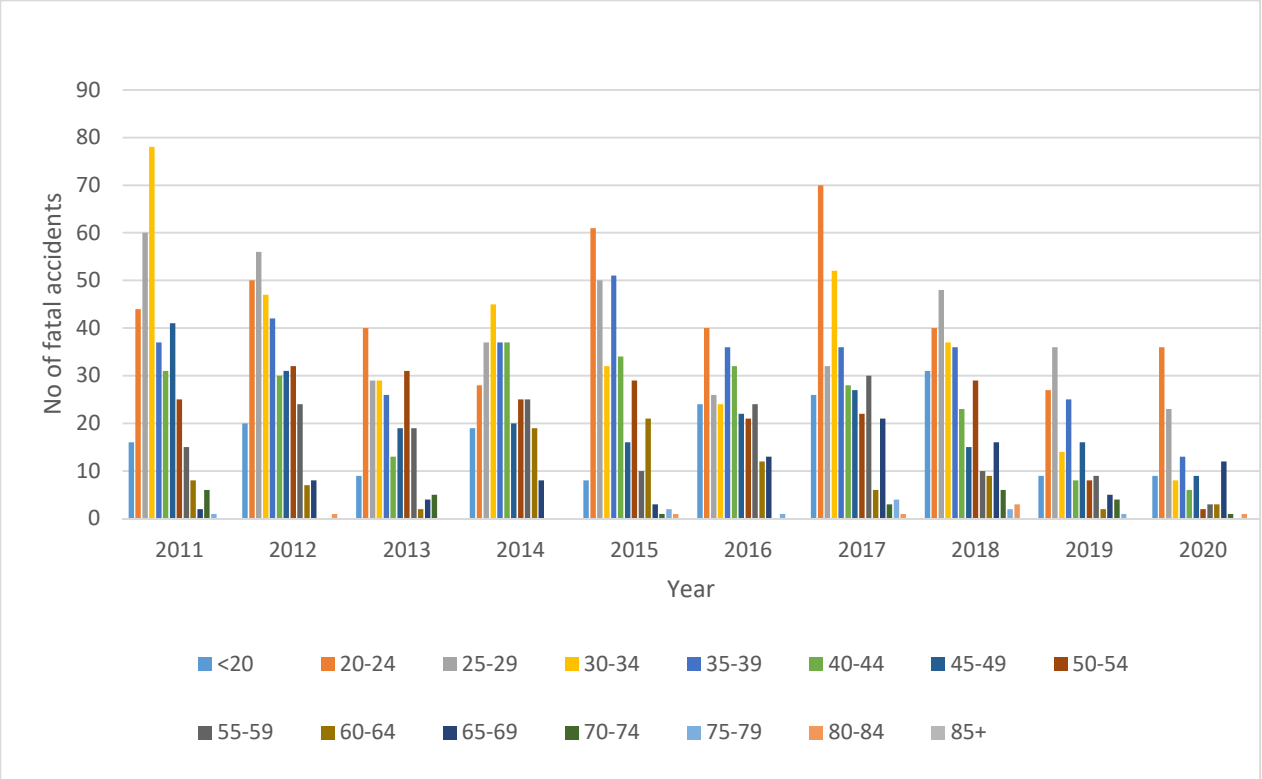


Figure 19: Fatal Accidents by Age per year, 2011-2020 (Source: iMAAP)

In 2011and 2014, the 30-34 age range peaked and since then decreased. The 20-24 age range peaked in 2015, 2017 and 2020; while the 25-29 age range peaked in 2012, 2018 and 2019. The trends for other years have been included in Figure 19.

Figure 20 shows the distribution of vehicles driven by young people when they met with fatal accidents during the last decade. Hence, **37.2%** of fatal accidents by young people occurred by motorcycles (373 accidents) and **35%** occurred by car (351 accidents).

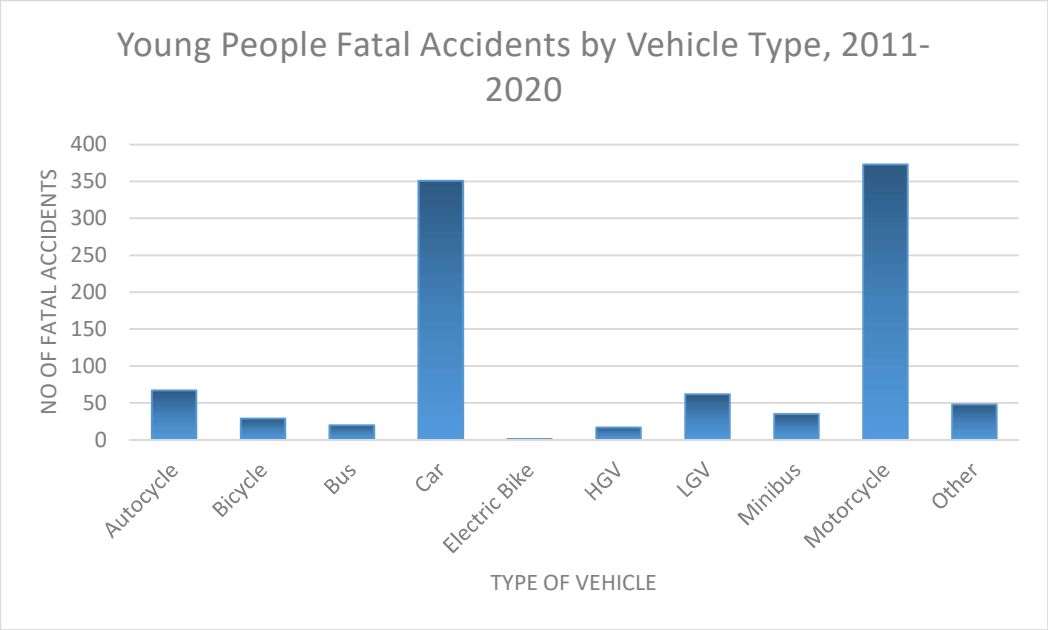


Figure 20: Young People Fatal Accidents by Vehicle Type, 2011-2020 (Source: iMAAP)

4.2 Questionnaire Survey

4.2.1 Target Population

The target population for this research is the general public of Mauritius. The survey is carried out in the 9 districts of Mauritius with a prime focus on the blackspots.

4.2.2 Sample Size

The population size of Mauritius for the year 2021 is estimated as 1,273,945 (Worldometer, 2021). For this research, the sample size calculated was 1535 based on a confidence level of 95% and margin of error to be 2.5%, excluding respondents who have participated in the pilot testing. A sample size of 1631 consisting of 1250 interviewed responses and 381 online responses were obtained that met the target sample size requirement. The target population was stratified by 41 blackspots (Appendix 4 for details on number of questionnaires per blackspot and questionnaire design).

5. Data Analysis- Questionnaire Survey

This chapter presents an analysis with emphasis on the questionnaire survey.

5.1 Demographic Characteristics of Respondents

5.1.1 Gender

Among the 1631 valid respondents, 767 (47.0%) are males, 861 (52.8%) are females and 3 (0.2%) are others. This discrepancy is due to the factthat the study has been carried out at random, representing a stratified sampling methodology. The survey has been carried out in different districts in Mauritius whereby 1250 copies have been given to respondents in hand, while the other 381 questionnaires have been distributed on online.

Females (52.8%) have been more receptive and interested to participate as compared to men and others. Females make up a little more than half of the population that is 50.5% according to the latest figures by SM (2020). It has been noted while doing surveys on sites that men had lacked the motivation to engage fully in the participation of surveys. On the other hand, females had positive attitudes, but, remained sensitive regarding road crashes.

5.1.2 Age

Respondents are divided into age categories for males, females and others (Figure 21). The highest response in the age range falls into 25-29 (16.2%), 30-34 (15.0%) and 40-44 (11.6%) years. This is closely followed by those aged 20-24 (11.5%), 35-39 (10.6%), 45-49 (8.2%) and 50-54 (6.9%) years. However, the lowest response is for respondents aged 70-74 (0.9%), 75-79 (0.2%), 80-84 and 85+ (0.1%) years old.

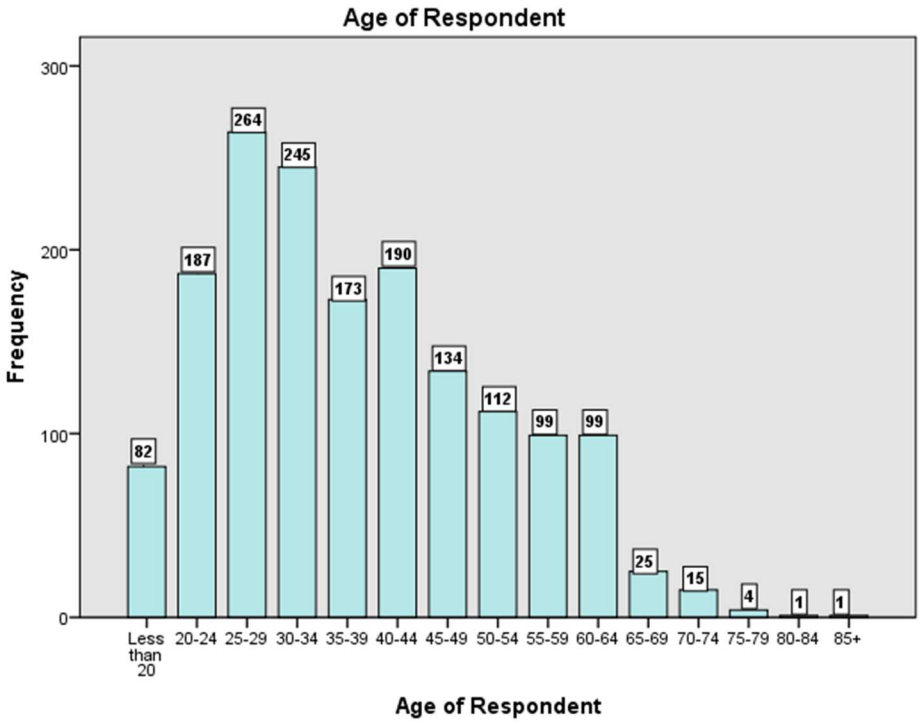


Figure 21: Age of respondent

5.1.3 Study Region

The study has taken into account respondents living in both rural and urban areas in the 9 districts of Mauritius.It is perceived that the highest percentage of respondents (28.82%) is in Plaines Wilhems. This is followed by (14.59%) Black River, (13.61%) Flacq, (10.06%) Pamplemousses, (8.46%) Grand-Port, (7.36%) Riviere du Rempart and (6.81%) Port-Louis. The lowest response is found to be in Moka (6.07%) and Savanne (4.23%) districts.

Surveys have been carried out district-wise with the iMAAP findings for serious and fatal accidents. In terms of fatalities, Plaines Wilhems and Port-Louis are considered to be the two vulnerable and problematic areas.

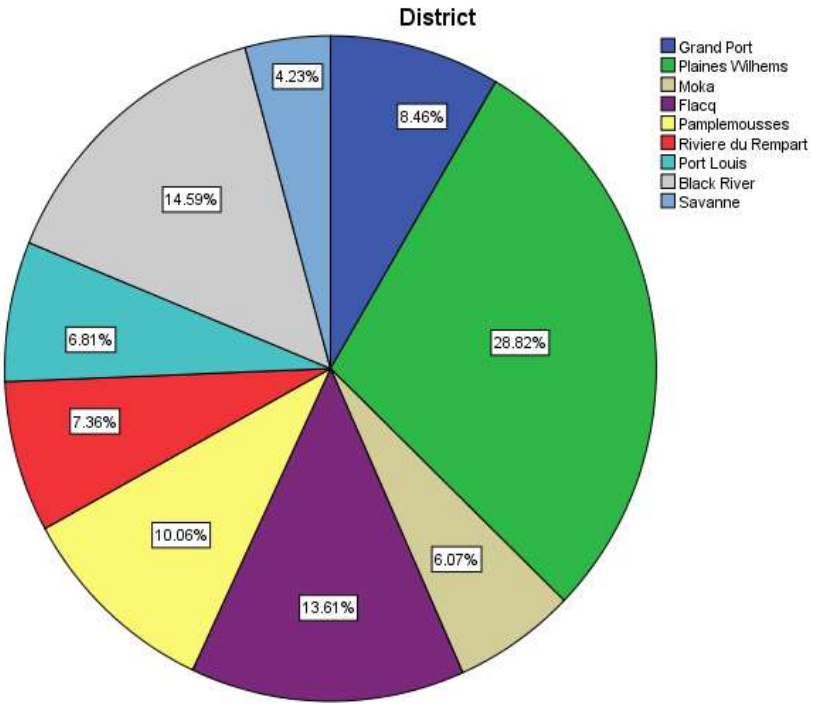


Figure 22: District of Respondent

5.1.4 Education

Education is an important factor to reduce road fatalities in our society. Individual differences in terms of age, gender and educational level play a significant role in safe performance as road users. For both field and online surveys, the respondents had a relatively educational attainment level, with the majority having studied up to Secondary (612 respondents), Diploma (212 respondents), Bachelor's Degree (498 respondents), Master's Degree (241 respondents) and Pre-Vocational (4 respondents) and PhD (16 respondents) level. As compared to respondents having a low literacy level for primary (41 respondents) or who have not been attending schools (7 respondents), researchers had to take more time in explaining the questions to respondents to understand and to answer the questionnaire. Access to technology and respondents' level of literacy have made the study successful for online surveys in terms of time-saving, wide scope, quick results, cost-efficiency and online-system accessibility.

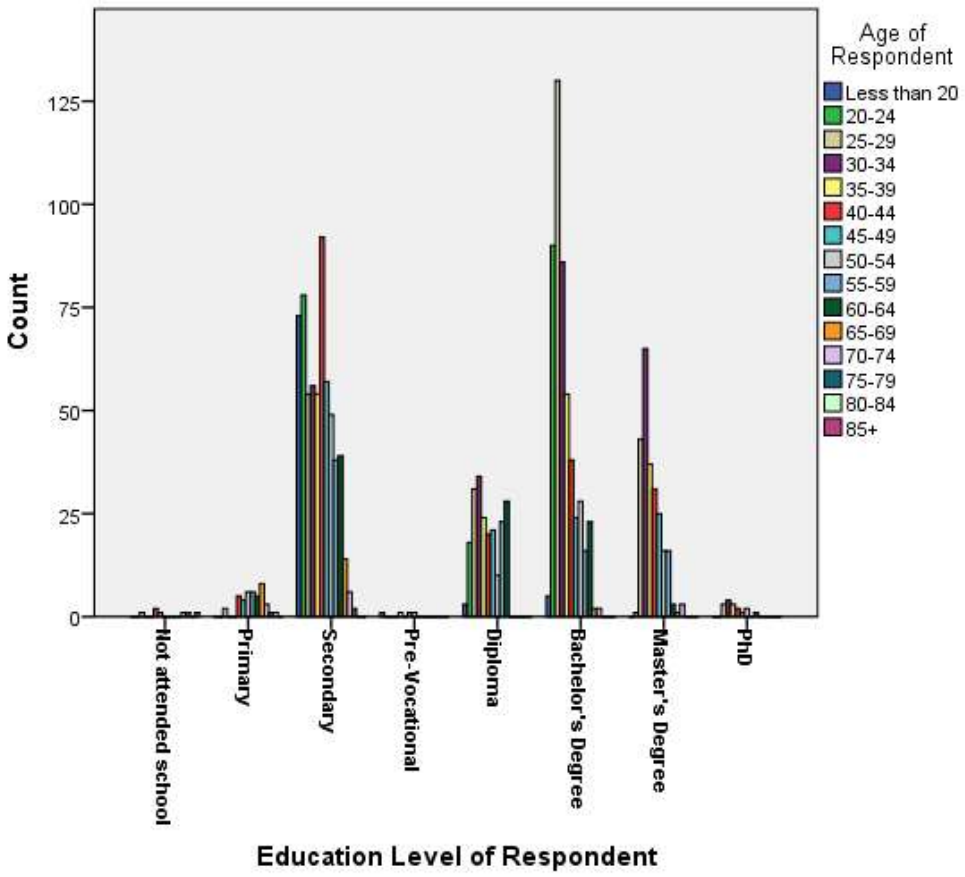


Figure 23: Education level of respondents

5.2 Respondents' Perception Regarding Young Drivers Involvement in Road Crashes

By gender, 562 male respondents (50.04%), 559 female respondents (49.78%) and 2 other respondents (0.18%) have the perception that young drivers are more likely to be involved in road crashes in Mauritius. According to WHO Report 2020 on Road Traffic Injuries, about 73% of all road traffic deaths occur among young males under the age of 25 years who are almost 3 times as likely to be killed in a road traffic crash as young females.

Aa per survey results, 562 male respondents (50.04%), 559 female respondents (49.78%) and 2 other respondents (0.18%) think that young drivers may more likely to be involved in road crashes. Reason et al (1993) have found that the tendency to commit violations can decrease with increasing age but errors cannot.

*Table 6: Gender of Respondent * Young Drivers Crosstabulation*

Gender of Respondent * Young Drivers Crosstabulation

Count

		Young Drivers			Total
		No	Yes	Maybe	
Gender of Respondent	Other	1	2	0	3
	Male	64	562	141	767
	Female	77	559	225	861
Total		142	1123	366	1631

5.3 Respondents' Perception Regarding Motorcyclists Involvement in Road Crashes

In this survey, over 90% of the female (782) and male (719) respondents have mentioned that motorcyclists' and cyclists'are more vulnerable in road crashes. According to SM (2018), the number registered for motorcycles and autocycles had reached the figure of 205,493 at the end of December 2017. This value represents about 38.6% of the overall number of registered vehicles, that is, 531,797. Among the casualties, 157 were fatal, 560 seriously injured and the remaining 3,492 slightly injured. Thus, out of the 157 persons killed in road accidents in 2017, the most vulnerable category of road users were pillion riders of motorised two-wheelers. Authors like Chang and Yeh (2007) have argued that male motorcyclists have a higher probability of getting involved in a road crash because they tend to neglect traffic rules and safety element while riding. For instance, young riders or pillion riders tend to seek thrills and hence, violate the traffic safety codes or exceed the safety limits.

In Mauritius, we note that motorcyclists often travel between lanes and overtake vehicles more easily, either on the left or right on motorways and on roads without signals. Motorcyclists' choice to ride on a specific location along the road can be hazardous. For example, riding on the rear left

or right corner of another vehicle can make the motorcyclist ends up in the other vehicle's blind spot.

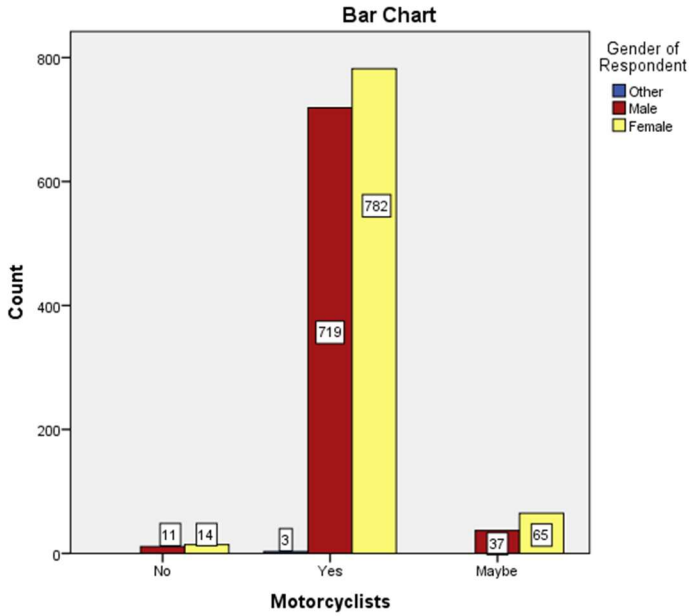


Figure 24: Responses for "Do you think that motorcyclists and cyclists are more vulnerable in road crashes?"

There is a general perception that motorcyclists/cyclists are more likely to be involved in road crashes by over 85% chance. Furthermore, a Chi-Square test indeed strongly supports the perception that motorcyclists/cyclists are significantly more likely to road crashes (p-value = 0.000). It is also noted that male and female respondents have more or less the same perception.

5.4 Past Involvement in Road Crash

In this survey, road crashes involved mostly drivers (260), passengers (54) and pedestrians (3) since 2010. Also, 22.6% of those having driving licenses (1128), 5.4% of those having provisional driving licenses (221) and 6.7% who did not have any of these (282) were involved in road crashes. 17.5% (286) of the respondents were involved with road crashes and out of these respondents a significant 73.8% were males. Pearson Chi-square test shows a significant relationship between involvement on road crashes and gender (p-value = 0.000).

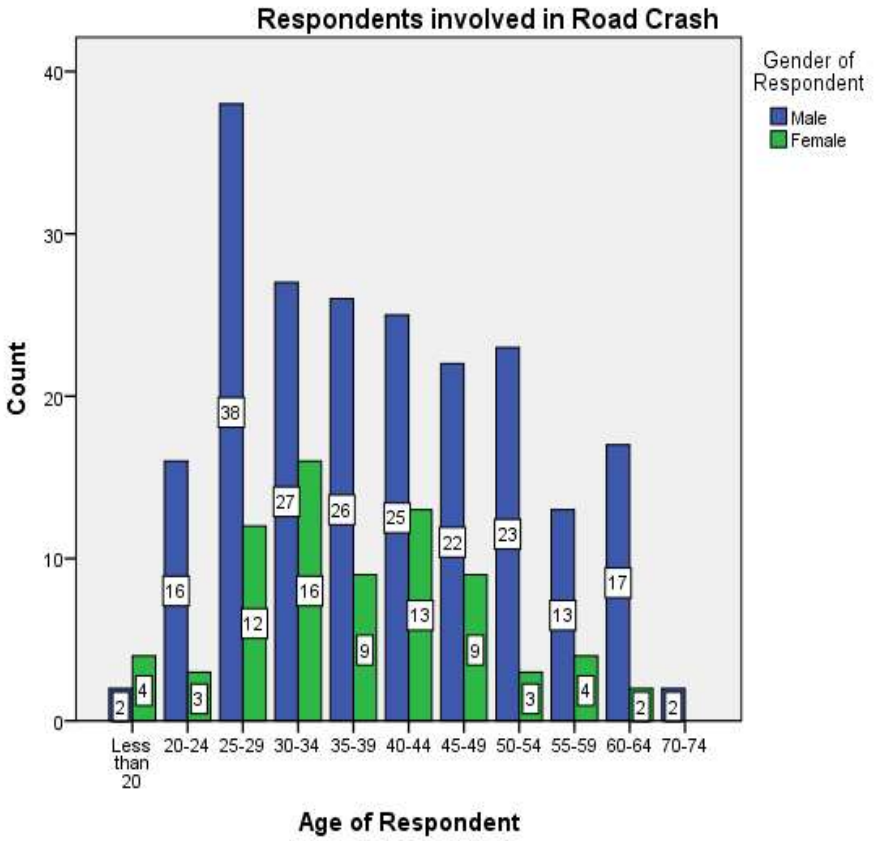


Figure 25: Respondents involved in Road Crash

Gender of Respondent * Road Crash Involvement Crosstabulation

Count

		Road Crash Involvement		
		No	Yes	Total
Gender of Respondent	Other	3	0	3
	Male	556	211	767
	Female	786	75	861
Total		1345	286	1631

Figure 26: Gender of respondents

Past involvement in road crashes has more significant effect in changing positively the behaviour and attitude towards a safer driving style for female drivers as compared to male drivers at 10% significance level (p=0.09) where female respondents have a higher mean score of 2.40 compared to mean score of 2.12 for males based on Analysis of Variance. Similar results were obtained for those respondents who were involved in serious injury (mean = 2.67) compared to slight injury (mean = 2.02).

Chi-square test reveals a significant (p=0.014) dependence of road crash involvement with different educational level where some categories were regrouped to ensure sufficient data. Diploma and degree holders are more involved in such accidents and categories had the ratios of yes to no road crash involvement of over 0.22 as compared to the primary or secondary levels having ratio around 0.17.

Education Level * Road Crash Involvement Crosstabulation

Count

		Road Crash Involvement		
		No	Yes	Total
Education Level	Not attended school or primary level	41	7	48
	Secondary level and pre-vocational	530	86	616
	Diploma	174	38	212
	Undergraduate	403	95	498
	Postgraduate	197	60	257
Total		1345	286	1631

Figure 27: Education level of respondent

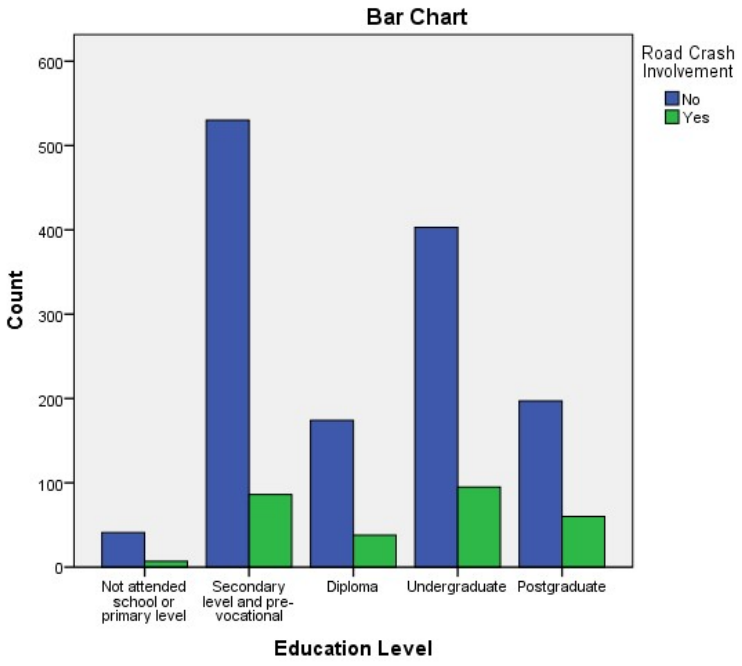


Figure 28: Road crashes per education level

Chi-square test shows a significant association (p-value = 0.002) between road crashes involvement since 2010 and age category. In fact, the percentage of involvement in an accident

was over 20% (higher) for each of the different groups of ages between 35-39 (20.2%), 40-44 (20.0%), 45-49 (23.1%) and 50-54 (23.2%) years.

A logistic regression model was developed gender, education level and driving license type were significant variables that influence road crashes. In fact, males, higher level of education and possessing driving licenses are the influential parameters to crashes. Age category was not an influential or significant factor in the predictive model despite it was ensured that each age category has sufficient data through regrouping.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	gender	-1.191	.150	63.187	1	.000	.304
	educationlevel	.092	.044	4.403	1	.036	1.097
	maritalstatus	.147	.159	.858	1	.354	1.158
	age	-.009	.032	.086	1	.769	.991
	drivinglicence	.588	.135	19.095	1	.000	1.801
	Constant	-1.403	.397	12.475	1	.000	.246

a. Variable(s) entered on step 1: gender, educationlevel, maritalstatus, age, drivinglicence.

Figure 29: Variables in the equation

5.5 Perceptions of Behaviours Contributing to Crashes

5.5.1 Over-Speeding

SM (2017), reports that there was 165 “hit and run” cases that caused casualties as compared to 145 in 2016. Out of these 165 cases, 56.4 % (93) involved vehicles only while the other 43.6% (72) involved both vehicles and pedestrians.

It should be noted that 77.56% of respondents in the surveys have rated over-speeding as a “Very High” risk factor to road crashes and followed by 19.93% for “High” (Figure 30).

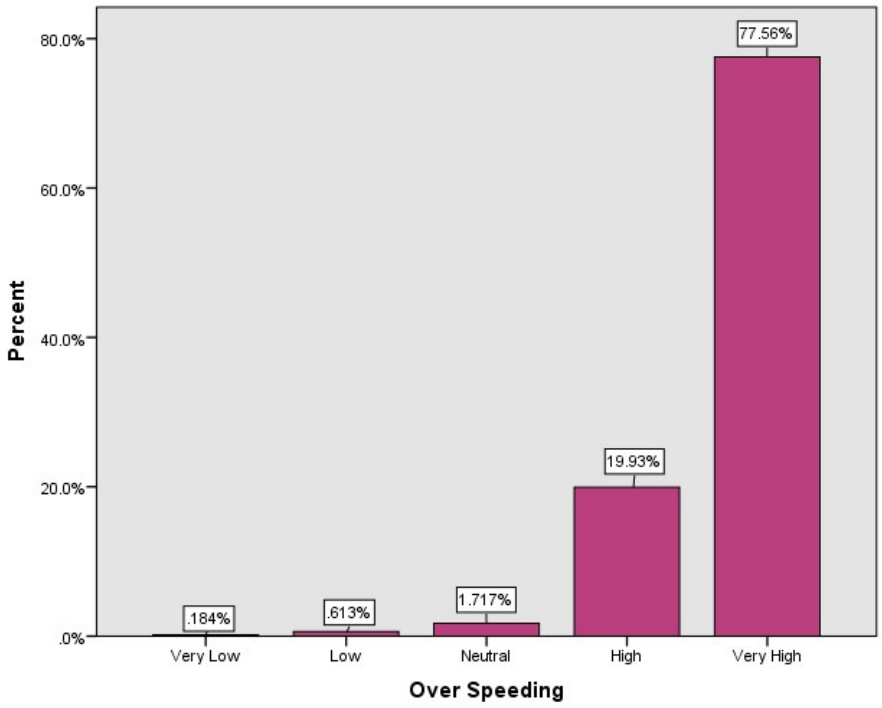


Figure 30: Responses for "How would you rate the contribution of Over-Speeding to road crashes?"

Mauritius is relatively a small island, just over 2066 km of roads of which 48.5% are main roads, 28.7% are secondary roads, 3.6% are motorway and the remaining 19.2% are other lateral roads. It is not difficult to travel and it has only one highway that starts in the South East of the island and ends in the North. In different parts of the island, the speed limit varies and road users must take into account speed limitations on main roads, secondary roads and residential roads. Speed limitations are 40 km/h in agglomerations and 80 km/h on the main roads. However, the three national speed limits are 60, 80 and 110 km/h.

Table 7: Speed limits by road type

Road Type	General Speed Limit
Main Roads (Urban/Rural)	40 km/h – 80 km/h
Highway	80 km/h – 110 km/h

Other countries that follow the speed limit within the same range for highways are Brazil (80-110km/h), Estonia (110 km/h), Hong Kong (80-110 km/h), Malaysia (110km/h) and New Zealand (100-110km/h).

In terms of speed cameras, around 53 are operational in 55 sites around the island and especially in accident-prone areas. These capture speed limitations for road users and those who exceed the speed limits have to pay fines. According to the Road Traffic Amendment Bill (2018):

"An increase in fines namely exceeding the speed limit by not more than 15 km per hour, the fine is being increased from Rs 1000 to Rs 2500; exceeding the speed limit by more than 15 km per hour but not more than 25 km/h, the fine is being increased from Rs 1500 to Rs 5000; and exceeding the speed limit by more than 25 km/h, the fine is being increased from Rs 2500 to Rs 10,000."

We note that in the sample around 43.2% "Agree" and 25.0% "Strongly Agree" that fines regarding over-speeding are severe enough. On the contrary, 5.8% "Strongly Disagree", 13.3% "Disagree" and 12.7% have answered "Neutral". The pie chart below shows respondents' opinions for fines for over speeding:

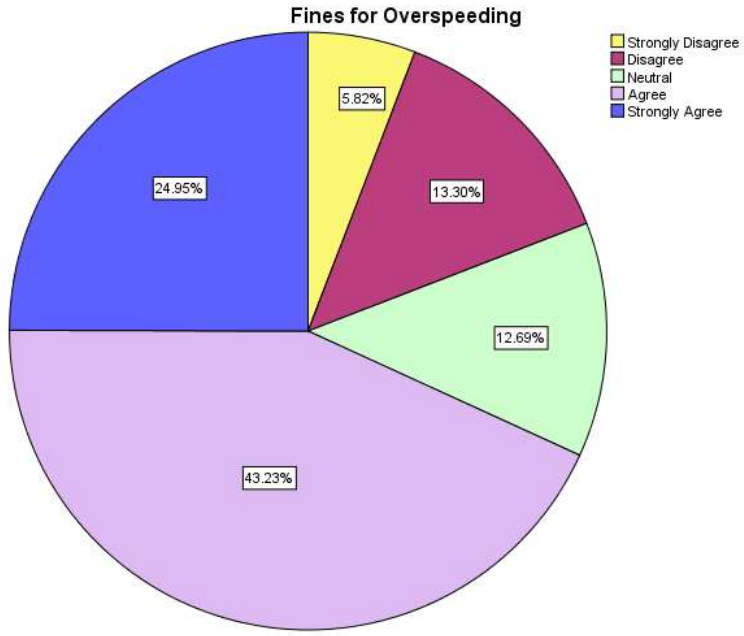


Figure 31: Responses for "How far do you agree that Fines regarding over speeding are severe enough?"

Some road users may slow down at places where there are speed cameras to escape a speeding fine and then drive fast again. This kind of behaviour affects driving performance and is risky in terms

of reaction times. Speeding behaviour can be controlled as it is associated with human factors which may be seen as a deliberate violation or as a result of an unintended error.

5.5.2 Alcohol Consumption

Alcohol consumption and driving are considered as a high probability that leads to serious accidents in many countries. Authors like Arnedt et al (2000) have found that even with a small amount of alcohol, drivers are twice likely to be involved in traffic accidents than sober drivers. For instance, the risk of a crash is about 1.4 times higher for a driver with a blood alcohol content (BAC) of 0.5% than for a sober driver. This is explained because at a BAC of 1.0% the risk is nearly 4 times higher, more than 20 times higher at 1.5%.

Around 87.7% of respondents for both males and females have strongly agreed that alcohol is the top cause of road crashes in Mauritius. Under the influence of alcohol, drivers engage in more impulsive and reckless driving as they cannot assess traffic situations well and perceive dangers less in terms of reacting time and as such, they cannot have control over their vehicles leading to accidents to happen.

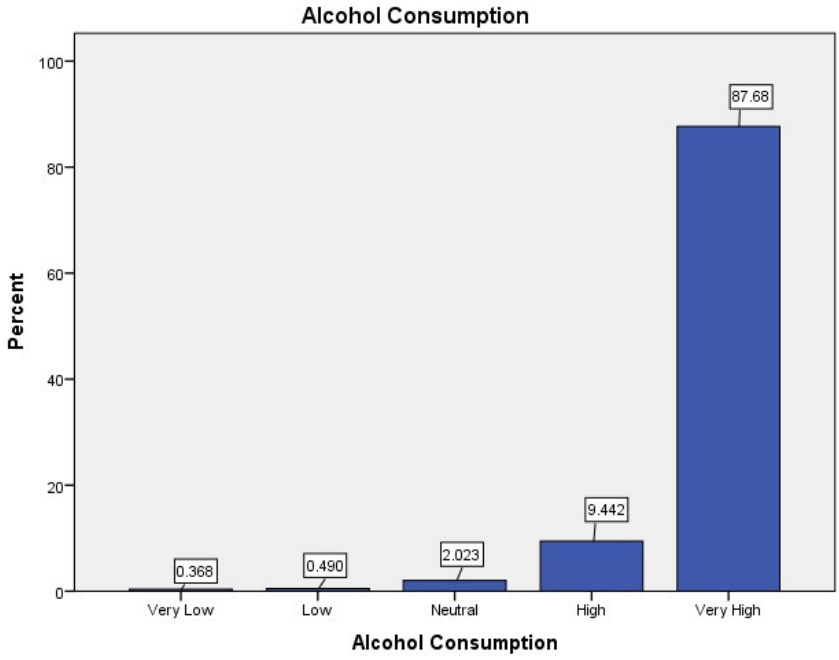


Figure 32: Responses for "How would you rate the contribution of Alcohol Consumption to road crashes?"

Alcohol is seen to be a contributory factor in the causation and severity of road crashes. Even in small amounts or doses of alcohol, this increases the risk of being involved in a road crash. This is because alcohol affects road users' skills in terms of reaction time to apply brakes, vision and impairing cognition (Peden et al, 2004). Other side effects of alcohol consumption include slurred speech, memory trouble, blackouts, loss of physical coordination, nausea, slowed reflexes, and reaction time.

It is easier for respondents to understand how many glasses they are allowed to take, that is, whether one glass of wine, beer, whisky or how many more glasses they can have in order not to exceed the standard set for alcohol of consumption. Many parts of Europe define a standard drink as any alcoholic beverage which contains 10 grams of absolute alcohol (Turner, 1990). Hence, it becomes difficult to know how many drinks can be consumed. It is important to clarify to the general population that the alcohol concentration of drinks may vary (e.g, vodka, whisky, beer, and wine) in terms of cans and bottles.

Alcohol laws and legal limitations for drink-driving vary greatly from one country to the next. According to the Road Traffic Amendment Bill Act (2019), drink-driving can have severe penalties and they are as follows:

(i) *"A person who commits an offence shall, on conviction, be liable to a fine of not less than Rs 5,000 nor more than Rs 25,000".*

(ii) *"The offender in the case of a second conviction, be liable to a fine of not less than Rs 25,000 nor more than Rs 50,000 and imprisonment for a term not exceeding 12 months".*

(iii) *"A person who commits an offence under subsection (1)(b), (c), (d) or (e) shall, on conviction, be liable to a fine of not less than 20,000 rupees nor more than 50,000 rupees and imprisonment for a term not exceeding 5 years".*

(iv) *"The offender under paragraph (a) shall, in the case of a second or subsequent conviction, be liable to a fine of not less than 50,000 rupees nor more than 75,000*

rupees together with imprisonment for a term of not less than 12 months nor more than 8 years".

Road users offenders who exceed the alcohol limit would have to pay fines and face severe penalties. Based on the responses of the survey, from Figure 33 we note that 39.3% of respondents know that offenders can pay more than Rs 50,000, while 35.4% have said for a fine of Rs 20,000 to Rs 50,000 and 25.0% of respondents have agreed for a fine Rs 5,000 to Rs 10,000 if they ever they exceed that legal limit for alcohol consumption.

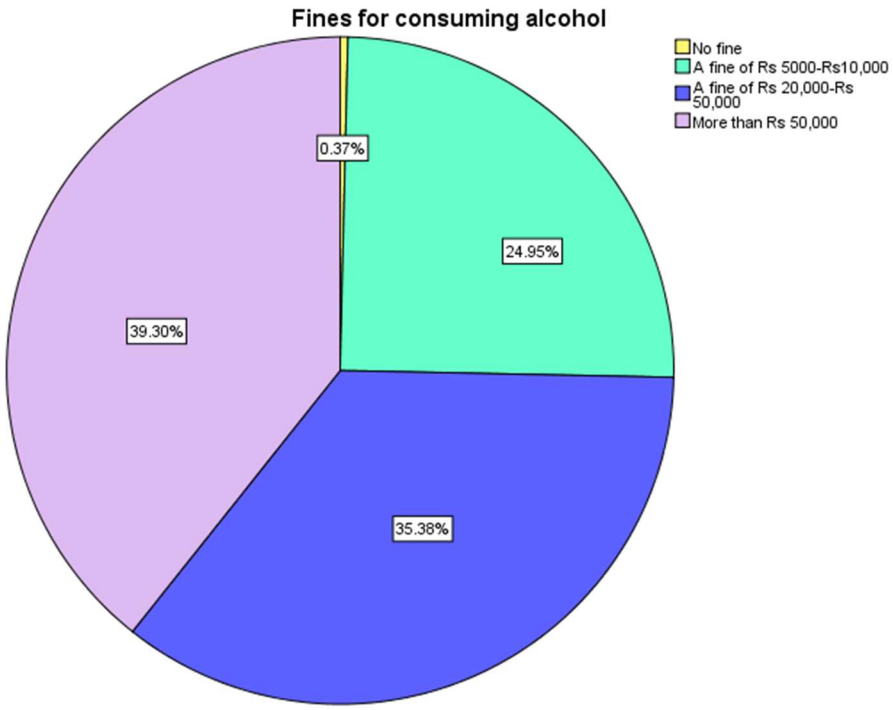


Figure 33: Responses for "Driving after consuming alcohol more than the legal limit will lead to..."

Although all countries have national policies on drink-driving, the lack of enforcement by the Police remains quite challenging. The European Commission (2004) reports, that random breath-testing should be done quite often (i.e., stopping and testing a random selection of drivers for BAC levels).

Penalties for drink-driving are not severe to act as a deterrent (WHO Regional Office for Europe, 2009). From the same point of view, authors like Ross et al (1984) have reported that the laws need to implement and quite intensively enforced, to achieve effective results. One of the reasons, of experiencing an increase in road crashes due to alcohol consumption is that enforcement of the laws is often weak. Based on this evidence, WHO (2010) has recommended establishing lower limits for novice and professional drivers and promoting sobriety checkpoints and random breath-testing, and administrative suspension of licenses to reduce alcohol-impaired driving.

It has been reported that 3.4% of fatal crashes have occurred due to alcohol-intoxicated drivers, pedestrians and cyclists although the maximum authorised BAC is 0.5 g/l and the lower limit of 0.2 g/l for professional drivers of public transport and public goods (Road Safety Report South Africa, 2019) and this demonstrates a short decrease and in terms of performance regarding road traffic casualties. Moreover, around 70% of responding countries supported a low BAC limit, that is, between 0.02% and 0.05% (WHO, 2016). Added to this, WHO Report (2016) has shown some countries that had a national maximum legal blood alcohol concentration when driving a vehicle within the range of 0.05% were Austria (0.05%), New Zealand (0.05%), Madagascar (0.04%), Belgium (0.05%), Denmark (0.05%), Italy (0.05%) and Mauritius (0.05%).

In contrast, Muslim countries such as Egypt, Saudi Arabia, United Arab Emirates, Pakistan and Bangladesh have a Zero Tolerance for alcohol, in other words, there is no BAC driving limit in countries where alcohol is illegal. Other countries, like the U.S, Canada and the U.K have a higher limit of 0.08% BAC for legal drink driving limit.

Another effective strategy to decrease drink-driving is to lower the legal limit for BAC for drivers. In many developed countries, legislation has prevented the sale of alcohol to youngsters and the Zero Tolerance of drink-driving for novice drivers has provided road safety benefits, especially in reducing drink-driving. This study has attempted to ask respondents in the survey whether they “Strongly Agree” or “Strongly Disagree” that the legally permissible limit of alcohol in the blood should be “0mg”, that is to have a Zero Tolerance in Mauritius.

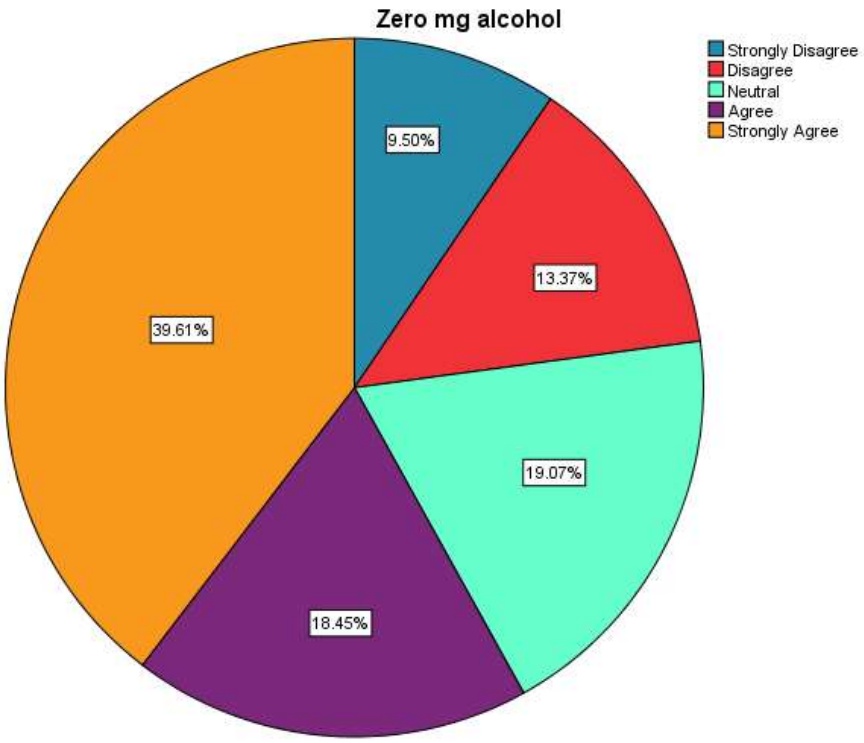


Figure 34: Responses to "Do you think that the legal permissible limit of alcohol should be 0 mg?"

Around 39.6% of respondents “Strongly Agree”, followed by 18.5% “Agree” and 19.1% have remained “Neutral”. On the other hand, 9.5% of respondents “Strongly Disagree” and 13.4% “Disagree”.

The data for the gender of respondents concerning Zero mg of alcohol provides an estimate of 364 females who “Strongly Agree” as compared to 71 females who “Strongly Disagree”. For male respondents 281 “Strongly Agree” in comparison to 83 males who “Strongly Disagree” and for both genders and including other, 311 have answered “Neutral”.

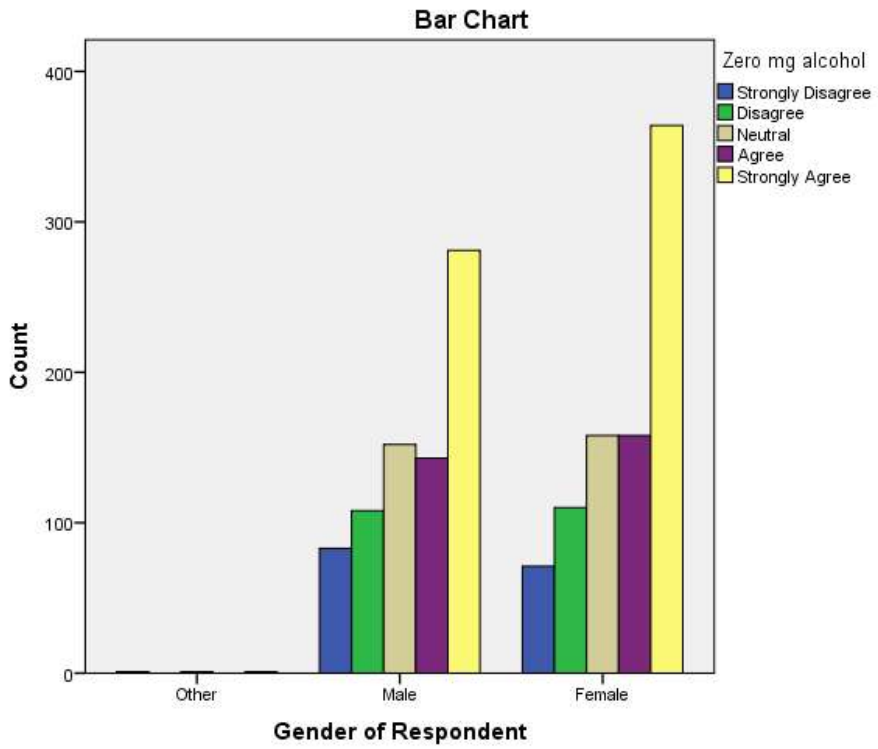


Figure 35: Responses to "Do you think that the legal permissible limit of alcohol should be 0 mg?" Gender-wise

It should be emphasized that younger people are more vulnerable to casualty road crashes. According to iMAAP data from 2011 to 2020, figures show that the age groups involved are 20-24, 25-29 and 30-34. However, less than 20 years old are also victims and are affected by alcohol consumption when compared to people of older ages. Shield et al (2015) have pointed out that alcohol consumption is a significant factor for a large proportion of the total mortality rate among younger ages. Therefore, age and gender should be important factors to consider when developing and implementing drink-driving policies.

Table 8 illustrates the different age groups who have answered the question of Zero mg alcohol.

*Table 8: Age of Respondent * Zero mg alcohol Crosstabulation (%)*

% within Zero mg alcohol

		Zero mg alcohol					Total
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Age of Respondent (Years)	Less than 20	4.9%	3.9%	7.2%	3.9%	5.7%	5.4%
	20-24	10.6%	12.3%	15.5%	12.3%	11.0%	12.2%
	25-29	16.9%	13.7%	19.3%	18.2%	17.0%	17.2%
	30-34	15.5%	18.6%	16.9%	16.8%	14.4%	16.0%
	35-39	8.5%	13.2%	10.3%	13.0%	11.0%	11.3%
	40-44	12.0%	10.8%	9.7%	12.3%	14.4%	12.4%
	45-49	9.9%	10.8%	7.2%	9.8%	8.0%	8.7%
	50-54	9.9%	7.8%	6.2%	4.9%	8.2%	7.3%
	55-59	7.7%	7.8%	5.2%	7.4%	5.9%	6.5%
	>=60	4.2%	1.0%	2.4%	1.4%	4.4%	3.0%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Research by Carpenter (2004) has highlighted that the zero-tolerance approach for drink-driving has been beneficial for individuals under the age of 21 and novice drivers in the U.S. Some other countries have also raised their legal minimum age for drinking alcohol from 18 years to 21 years and have enacted lower legal BAC levels for young adults and adolescents as well (WHO, 2009).

5.5.3 Mobile Phones

The results from the questionnaire survey highlights that, respondents are aware that using mobiles for texting or calling while driving not just affect driving performance, but, may contribute to road crashes. Around 67% of respondents have ticked “Very High” and 26% for “High” for mobile phones causing a distraction to drivers and increase the risk for crashes substantially.

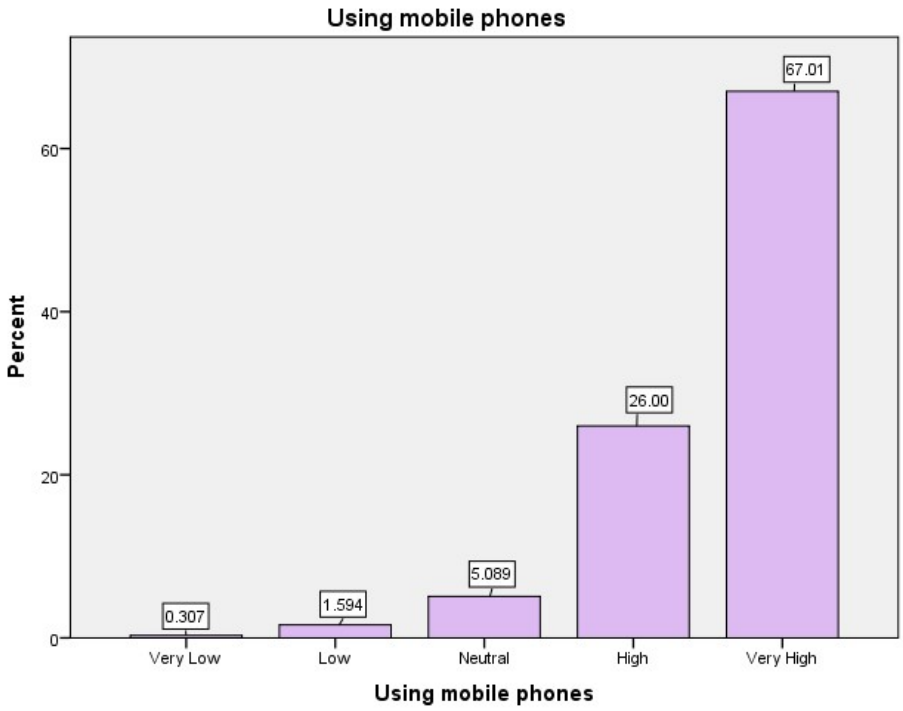


Figure 36: Responses for "How would you rate the contribution of Using mobile phones while driving to road crashes?"

It is strictly illegal to use mobile phones while driving a car or riding a motorcycle in Mauritius. Given that respondents already know that to use a hand-held mobile phone to call or text while driving, means that someone is against the law and can cause accidents, especially in traffic. Therefore, more actions and enforcement is needed by police officers to intensify routine traffic checks.

Around 40.2% of respondents strongly agree and 32.4% agree that more penalties must be given to drivers who are using mobile phones while driving as per Figure 67. On the contrary, 17.8% have answered neutral for this question, while 5.8% of respondents disagree and 3.9% strongly disagree with higher penalties for mobile phones.

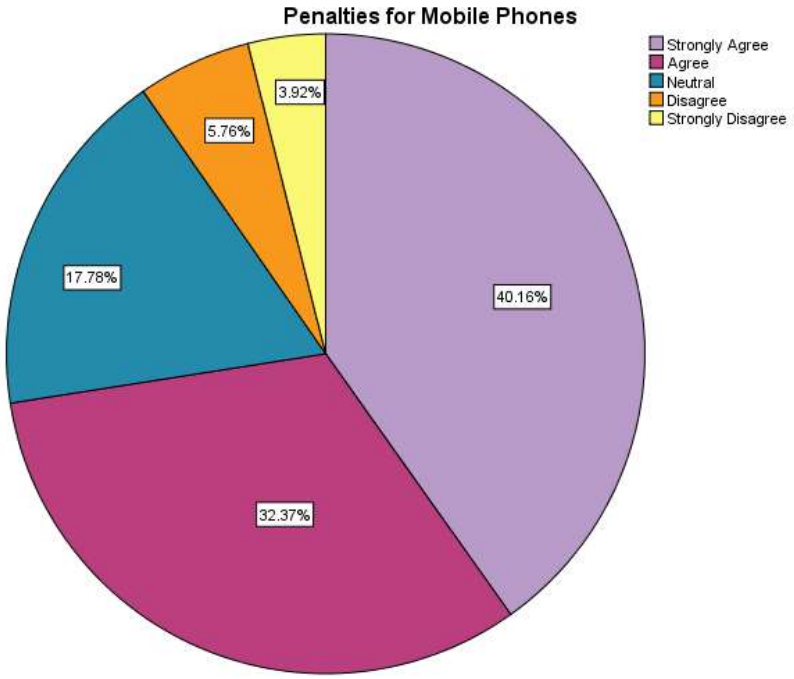


Figure 37: Responses for "How far do you agree that Higher penalties must be given for using mobile phones while driving?"

5.5.4 Road Infrastructure

As one of the fastest-growing economy in Sub-Saharan Africa and is classified by the World Bank as an upper-middle-income economy, roads are key to a thriving economy in Mauritius. Today the country is facing pressures to respond to urbanisation, more road construction, traffic flow, and to improve road safety for different road users. Several works of literature demonstrate that human, vehicles, roads and the environment are interlinked and are the causes of traffic accidents. Therefore, road infrastructures should be designed and constructed by considering safety for road users, so that, to minimise the risk of traffic accidents.

When asked whether the roads are safe in Mauritius, half of the number of respondents answered in the negative (40% Disagree and 17.5% Strongly Disagree). This is associated with road conditions, road markings, road lighting, traffic signs, road signs, pavement surface conditions, lane width and including weather conditions especially during heavy rainfall or torrential rain.

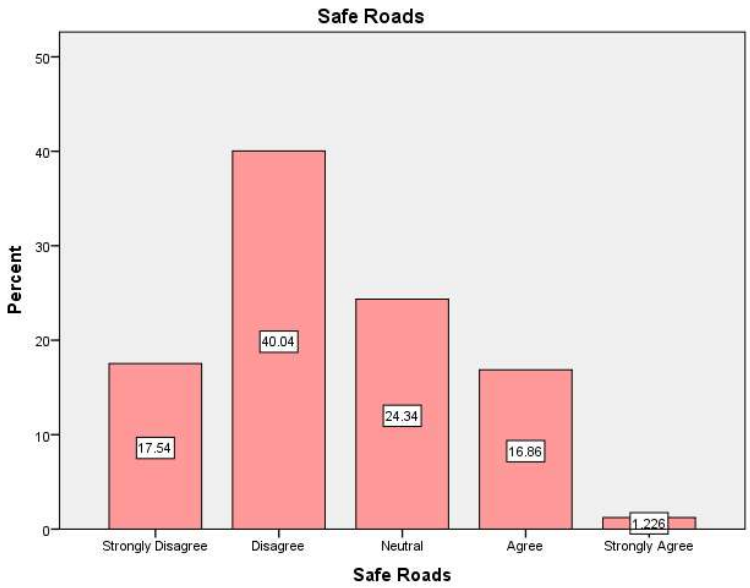


Figure 38: Responses for "How far do you agree that Roads are safe in Mauritius?"

According to Elliott et al (2003), inefficient road markings can induce instability for road users, especially for motorcycle riders. This is because the risk is associated with road geometry, for instance, curves or straight road sections. In terms of the function of road markings, it can be said that they play a significant role to maintain the safety of road users, both during day time and night time.

Figure 39 and Figure 40 are some of the observations we made when carrying out the survey, about faded and unclear road markings in Rose Hill, Central Flacq and Curepipe. Figure 74 reports the statistics on road markings.

Figure 39: Car stationed on FadedPedestrian Crossing road markings in Rose Hill

Figure 40: Faded Road Markings in (i) Central Flacq *(ii) Wooton, Curepipe*

Another striking observation we made was the high amount of damaged road signs all over the island but mostly in the eastern regions. Figure 41 to Figure 44 show some of the images we shot while carrying out our survey that clearly describe the gravity of the situation.

Figure 41: Broken Traffic Sign at Flacq

Figure 42: FadedRoad Traffic Signs at Valetta

Figure 43: FadedTraffic Signs at Flacq

Figure 44: FadedRoad Traffic Signs at Curepipe

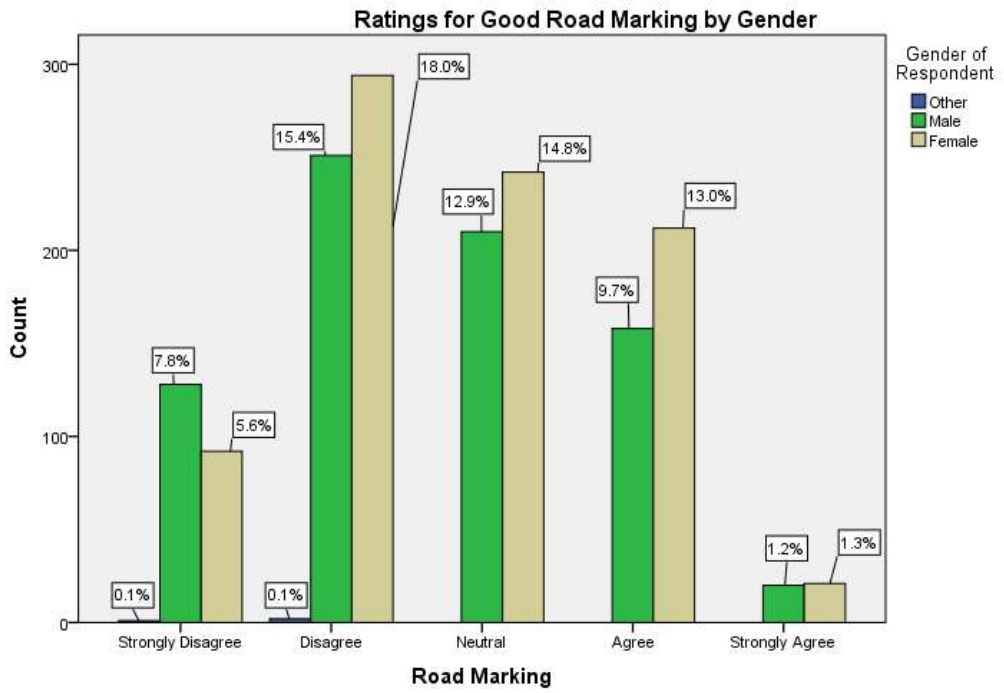


Figure 45: Responses for "How far do you agree that there are Good road markings?"

Other road defects include speed breakers, potholes and road digging. Pont St Remy in Constance is one problematic area where accidents occur frequently as the bridge is too narrow, dangerous and the presence of big trees also obstructs road signs. Road signs and motorway signs in Mauritius are not big enough and cause visibility problems to road users. This can also have an impact in terms of lack of concentration, as road users sometimes have to stop and look at road signs clearly before traveling. Added to this, billboards for advertising signs often distract road users and can provoke road crashes, in other words reducing safety for road users.

Road Development Authority (RDA) should carry regular checks for road condition, road markings, road lighting and road infrastructure so that these failures should not be delayed in response, in terms of safety and comfort for road users so that they do not contribute to the risk of human error. As such, a more holistic assessment is needed from government officers to make, design and paint better road markings for the safety and comfort of road users.

5.5.5 Road Lighting and Infrastructure

The effect of road lighting is an important factor to illuminate roads and motorways at night. It is observed that very often there is a great lack of proper lighting in Mauritius, which causes the problem of visibility to road users and may lead to fatal accidents. Around 45.2% of respondents disagree and 17% of respondents strongly disagree that there is good and proper lighting on the roads, motorways and residential streets.

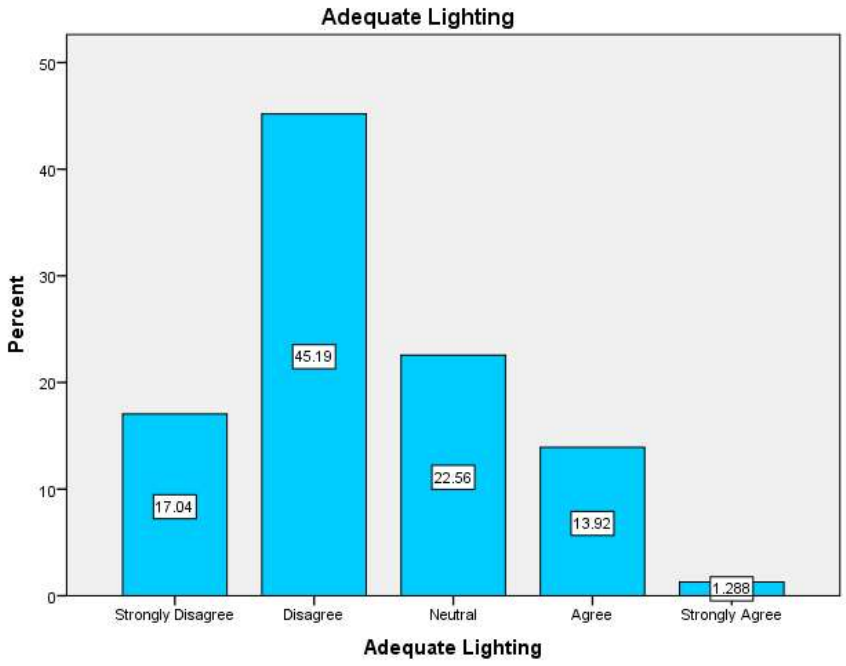


Figure 46: Responses for "How far do you agree that Roads have adequate lighting?"

Indeed, we observed a lack of road lighting all over the island when we set out to carry our surveys. When talking to respondents and inhabitants, many rose their concerns about the difficulties of driving at night on those unlit roads. Figure 47 shows 2 roads, namely Surinam *(left)* and 16eme Mille *(right),* where it is very dangerous to drive, particularly during bad weather and low visibility – as observed at 16eme Mille on that day.

Figure 47: Absence of Street Lighting at (i) Surinam (ii) 16eme Mille, Forest Side

Furthermore, in the evaluation for road crashes in Mauritius, 42.5% of respondents have rated weather conditions to be very high, and 55.2% of respondents have said that bad road conditions are considered to be high factors for accidents to happen.

Other problematic areas that have been identified while doing surveys and respondents have equally agreed that there is no proper road lighting are in 16eme Mille, Grand-Bassin, Constance, Quartier Militaire Roundabout, Chamarel, Bassin Blanc, Chemin Grenier, Bel Ombre, Midlands, Beau-Vallon, Coteau Raffin, L'Escalier, Case Noyale, Benares, Albion, The Vale, Riche-en-Eau, Dubreuil, Britannia and Surinam.

Figure 43 shows the poor road infrastructure on a road in Curepipe Central town. The presence of potholes not only increases the risk of accidents, but also harms vehicles' suspension systems and other vehicle parts. The absence of proper drainage also causes flooding of streets.

Figure 48: (i) Potholes at Curepipe *(ii) Flooding due to bad road conditions and poor infrastructure at Curepipe*

5.5.6 Risk Factors to Road Crashes

The factors for the occurrence and severity of accidents in Mauritius according to respondents' rating for "Very High" are over-speeding (77.6%), alcohol consumption (87.7%), drug consumption (86.9%), using mobile phones while driving (67%), bad road conditions (55.2%), weather conditions (42.5%), wearing headphones while walking (53%), not abiding by road signs (52.2%).

Table 9: Responses for "How would you rate the contribution of the following risk factors to road crashes?"

	Very Low	Low	Neutral	High	Very High
	Row N %	Row N %	Row N %	Row N %	Row N %
Over Speeding	0.2%	0.6%	1.7%	19.9%	77.6%
Drive close to vehicle	0.3%	2.2%	6.9%	50.3%	40.3%
Not abiding to road signs	0.4%	2.3%	5.8%	39.3%	52.2%
Eating and Drinking	2.5%	11.0%	27.3%	36.2%	23.0%
Smoking	6.1%	13.4%	28.9%	29.7%	22.0%
Using mobile phones	0.3%	1.6%	5.1%	26.0%	67.0%
Wearing Headphones	0.6%	2.3%	7.1%	37.0%	53.0%
Mental Stress	0.5%	2.3%	9.4%	48.3%	39.5%
Alcohol Consumption	0.4%	0.5%	2.0%	9.4%	87.7%
Drug Consumption	0.4%	0.6%	2.4%	9.8%	86.9%
Bad Road Conditions	0.4%	2.2%	6.4%	35.7%	55.2%
No Proper Maintenance of Vehicles	0.2%	2.9%	11.5%	44.1%	41.3%
Weather Conditions	0.4%	3.5%	10.5%	43.2%	42.5%

In terms of practical implications, for instance measures like educating our population through awareness campaigns, such as both in public education strategies and advertising could help to reduce road crashes and improve road users' behaviour and attitudes in Mauritius, have been summarized in Figure 49.

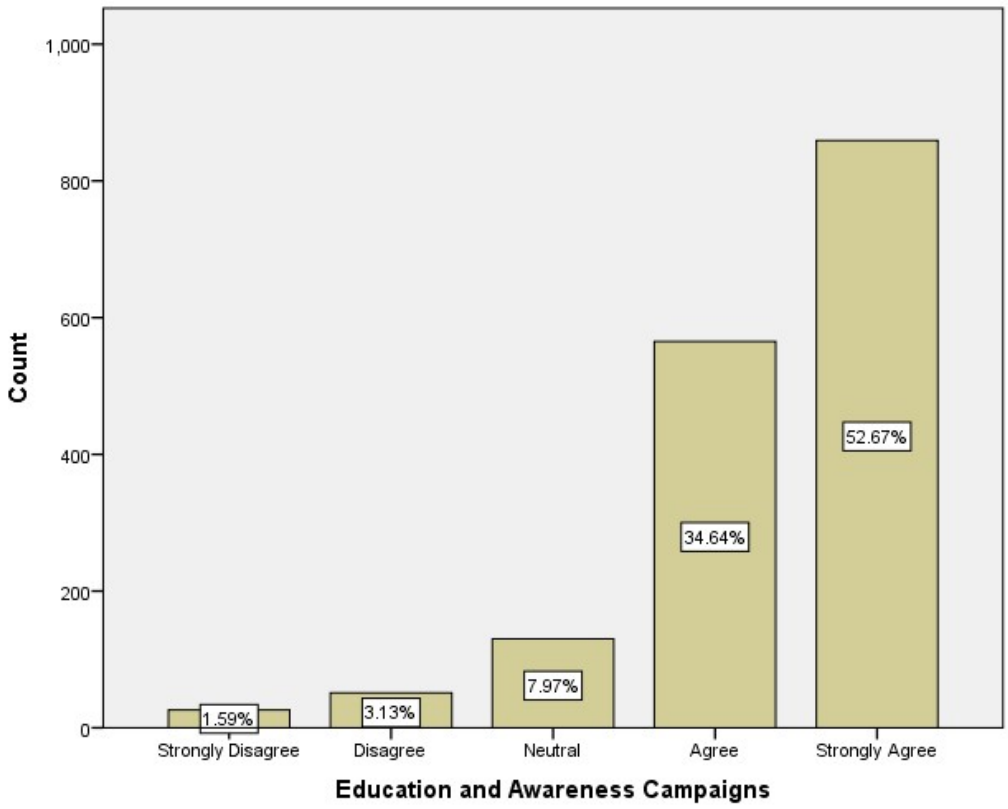


Figure 49: Responses for "How far do you agree that educating our population through awareness campaigns will bring an improvement in the road safety situation in Mauritius?"

Approximately 52.7% of respondents “Strongly Agree”, followed by 34.7% “Agree” that education and awareness campaigns reinforce the behaviour and attitudes of road users. Awareness campaigns should be done regularly to spread road safety awareness among the public in general, with youngsters and elderly people so that to secure their traveling. The public needs to know about traffic rule awareness and the consequences of road crash to ensure their safety. Workshops and training could be given to civil servants in best practices for road designs, safer mobility, and transport network management. According to WHO (2019), “Change is possible” when a comprehensive approach considers vehicles, road users, and the road environment. Meanwhile, all stakeholder engagements for road public safety, education and awareness campaigns must be applied to change the attitudes and behaviours although it is often considered as one of the most difficult setbacks of road safety.

The apparent difficulties in road infrastructure in terms of road lighting, road signs, road markings, pavement conditions and from the above-mentioned issues make it clear that the RDA needs to improve and maintain the road infrastructure in Mauritius. Road infrastructure appears to be an

important measure as 73.4% of respondents strongly agree and 23.3% agree to a proper evaluation of the condition of roads in both urban and rural regions in Mauritius.

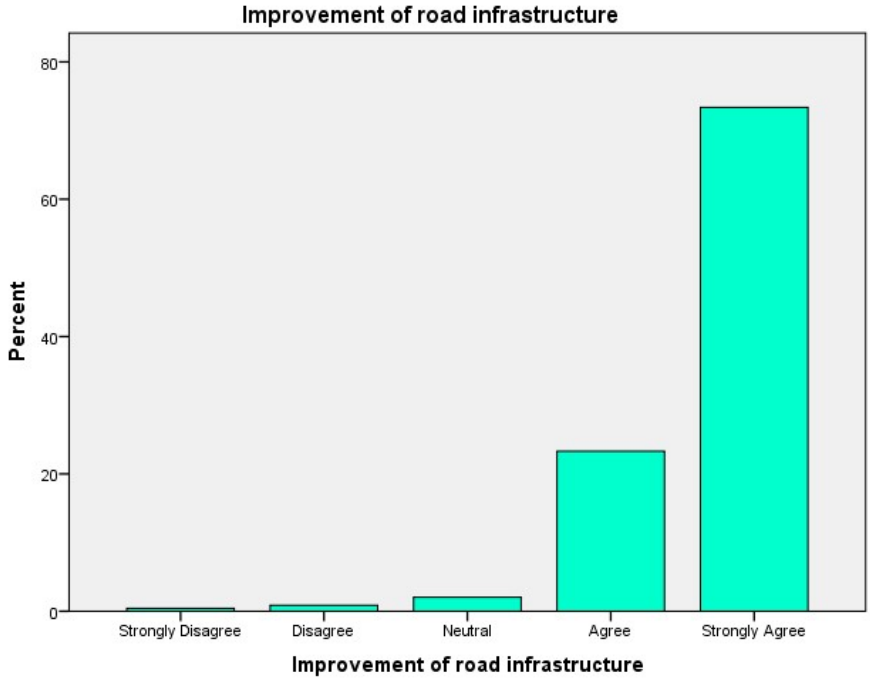


Figure 50: Responses for "How far do you agree that Improving our road infrastructure will bring an improvement in the road safety situation in Mauritius?"

Many countries have not stopped building roads as part of socio-economic progress, but the importance remains to improve the mobility of road users. As such, road planners or engineers need to consider how to use roads, for instance, a feasible transport plan must be taken into consideration, especially one that relieves traffic congestion and at the same time capable of increasing public mobility. However, it is observed that issues concerning road safety and road infrastructure are related to management, economic, and social factors. At least, to some degree, there is a lack of concern and priority given. In order, for concerns to be increased for road safety issues, more attention should be paid by the enforcement system and by coordinating all different Ministries for better planning and maintenance on road safety.

5.6 General Perception on Road Safety

Using the 95% confidence interval plots for the means of the different factors pertaining to the general perception on road safety, we note that there are three clusters (Figure 51) that drive the perception level of road users on road safety as follows:

(i) Cluster 1 with means score greater than 4 involving Abiding by Traffic Lights, Abiding by Road Safety Signs, Fluorescent Jackets and Wearing Helmet.

(ii) Cluster 2 with mean score greater than 3 but less than 4 involving Drivers Seatbelts and Understanding Signs.

(iii) Cluster 3 with mean score less than 3 involving Safe Roads, Adequate Lighting, Traffic Sign, Road Marking and Seatbelts at the back.

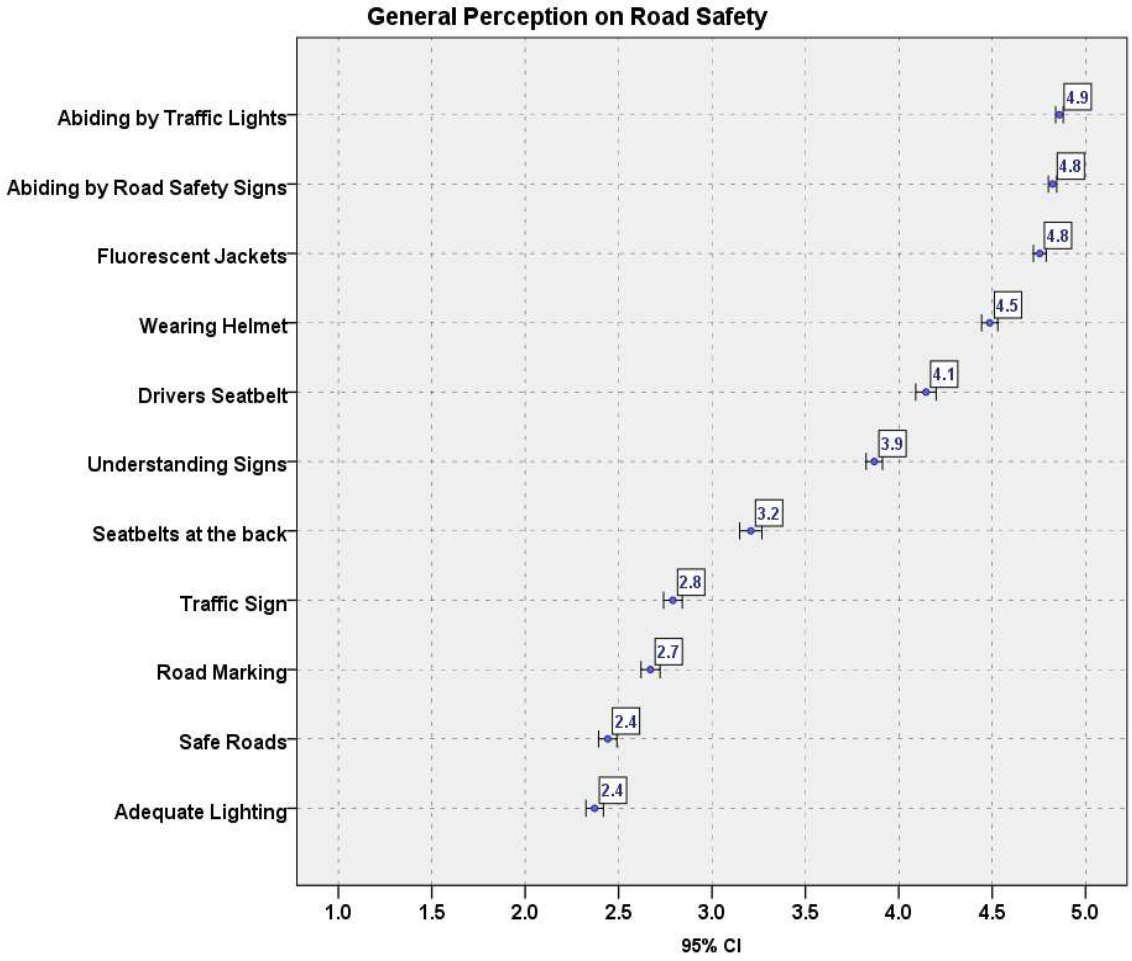


Figure 51: General perception on road safety

Key: (1: Strongly disagree, 5 Strongly Agree)

A principal component analysis (Table 10) was carried out and in fact more precisely four independent clusters were obtained that influenced the perception of road users on road safety as follows:

(i) Component 1: Safe Roads, Adequate Lighting, Traffic Sign and Road Marking contributing to 25.2% of the variability in the perception level which could represent in general driving infrastructural condition.

(ii) Component 2: Abiding by Traffic Lights, Abiding by Road Safety Signs and Wearing Helmet contributing 17.5% of the variability which could represent in general traffic safety measures

(iii) Component 3: Seatbelts at the back and Driver's Seatbelt contributing 12.0% of the variability representing inside vehicles safety measures.

(iv) Component 4: Fluorescent Jackets and Understanding Signs contributing 9.2% of the variability which could represent knowledge and awareness of road users.

Table 10: Component score coefficient matrix

Component Score Coefficient Matrix				
	Component			
	1	2	3	4
Abiding by Road Safety Signs	.002	.466	-.033	.091
Abiding by Traffic Lights	-.006	.473	-.027	.058
Wearing Helmet	.041	.367	-.015	-.386
Safe Roads	.301	.034	.038	-.128
Adequate Lighting	.305	-.006	.016	-.077
Traffic Sign	.297	.007	.020	.046
Road Marking	.309	.002	.016	.023
Seatbelts at the back	.034	-.033	.593	-.039
Driver's Seatbelt	.037	-.037	.595	.012
Understanding Signs	.076	-.086	.032	.580
Fluorescent Jackets	-.110	.009	-.043	.648
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				

5.7 Perception on Risk Factors Contributing to Road Safety

Using the 95% confidence interval plots (Figure 52) for the means of the different factors pertaining to the general perception on risk factors contributing to road safety, we observe that there exists three clusters as follows:

(i) Cluster 1 with mean score between 4.5 and 5 involving Alcohol Consumption, Drug Consumption, Over Speeding, Using mobile phones and Wearing Headphones.

(ii) Cluster 2 with mean score between 4 to 4.5 involving Drive close to vehicle, not abiding to road signs, Mental Stress, Bad Road Conditions, No Proper Maintenance of Vehicles and Weather Conditions.

(iii) Cluster 3 with mean score between 3 and 4 involving Eating and Drinking and Smoking.

Based on the Principal Component Analysis technique, we have obtained 3 components regrouping the risky factors to road crashes which are almost similar to what we observed previously but the Wearing of Headphones has been clustered to component 1. Thus component 1 could be representing distractors or inhibitors to reaction time to prevent crashes; component 2 could be representing physical conditions of vehicles and roads as well as stress and strain while driving. Component 3 represents some lesser significant distractors related to driver basic consumption.

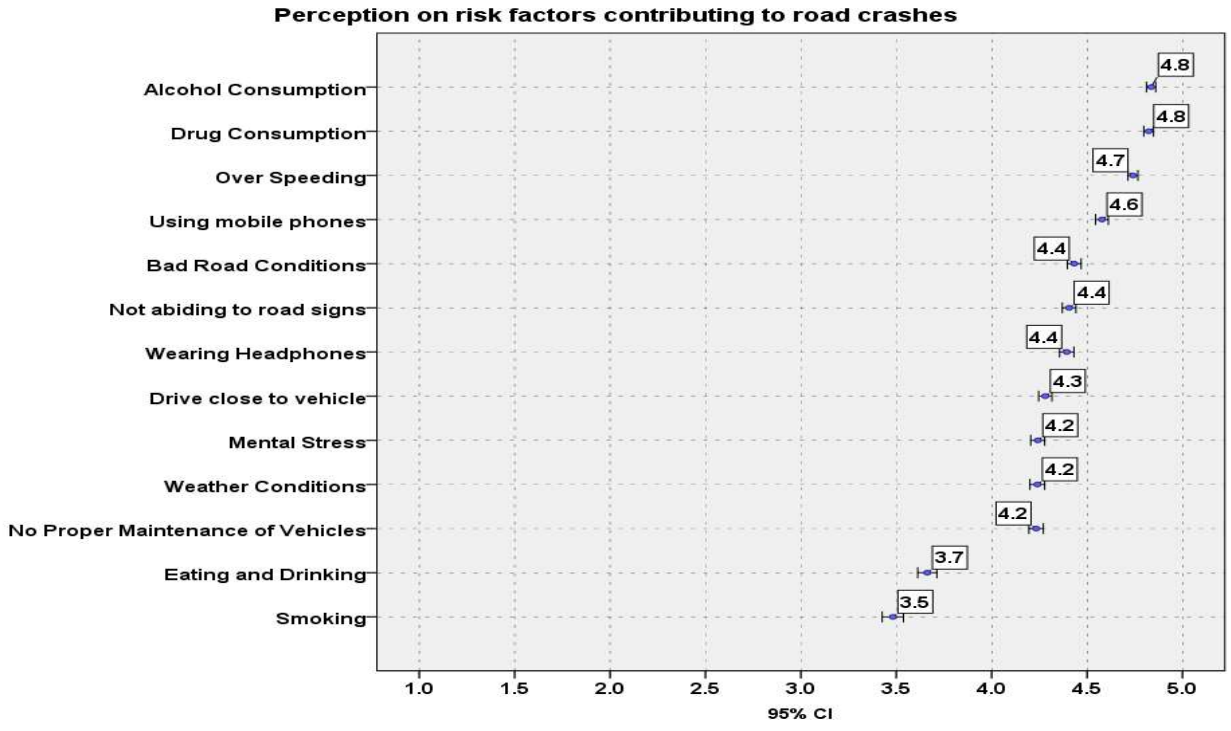


Figure 52: Perception on risk factors contributing to road crashes

Key: (1: Very Low, 5 Very high)

Table 11: Component score coefficient matrix

Component Score Coefficient Matrix			
	Component		
	1	2	3
Over Speeding	.306	-.107	-.052
Using mobile phones	.217	-.120	.167
Wearing Headphones	.159	-.124	.218
Alcohol Consumption	.396	-.084	-.130
Drug Consumption	.358	-.030	-.143
Drive close to vehicle	.022	.119	.064
Not abiding to road signs	.060	.112	.067
Mental Stress	.011	.165	.039
Bad Road Conditions	-.157	.403	-.053
No Proper Maintenance of Vehicles	-.128	.388	-.049
Weather Conditions	-.082	.390	-.125
Eating and Drinking	-.118	-.020	.430
Smoking	-.146	-.060	.480
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			

Over speeding, use of mobile phones, alcohol consumption and drug consumption are the major risk factors as perceived by over 65% of the road users by using the binomial test (at 5% significance level). However, it is with concern that respondents do not rate the other important risk factors in reality like weather conditions, smoking, eating and drinking, do not abide to road signs, mental stability and others. It is therefore very important to sensitize people about the latter risk factors.

5.8 Perception on Risk Factors Related to Road Lighting that Contributes to Road Safety

It is observed that on average respondents are strongly agreeable (mean = 4.5-4.8) that road lighting is a must for improved vision, security, safety, improving decision making and to reduce road crashes.

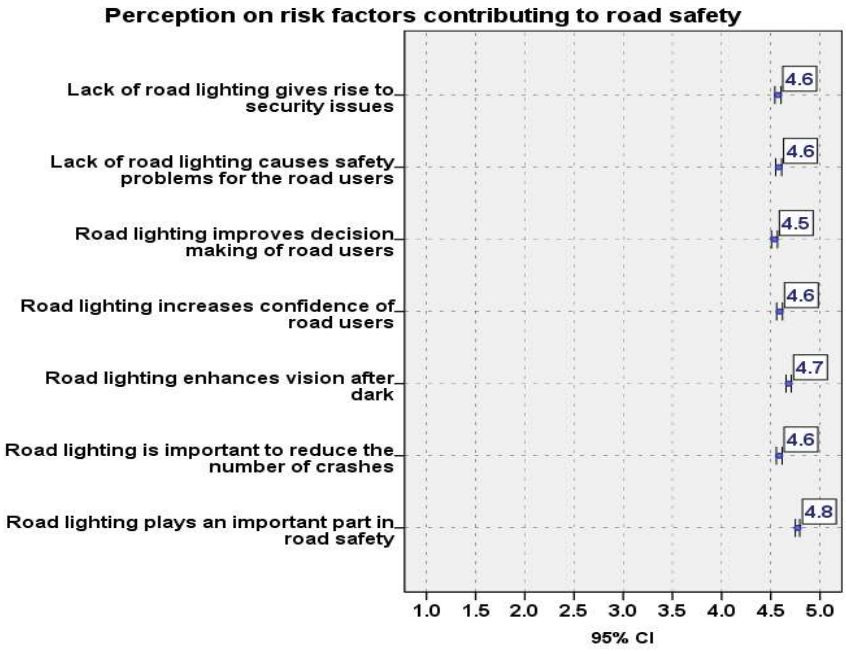


Figure 53: Perception on risk factors contributing to road safety

Key: (1: Strongly disagree, 5 Strongly Agree)

Respondents disagree, on average with a score ranging from 3.8 to 4.2, that overtaking on the left, changing lanes frequently on roads and motorways without signals, speeding up to get through a yellow or green light and driving over the speed limit on residential streets as acceptable behaviour of road users.

5.9 Perception on Acceptable Road User Behaviours

Respondents disagree on average (mean = 3.8-4.2) that over-taking on left, changing lanes without signals, speeding up yellow lights and driving over the speed limit on residential streets are

acceptable behaviour of road users. We observe a general increasing trend with age and thus showing the effect of maturity and experience.

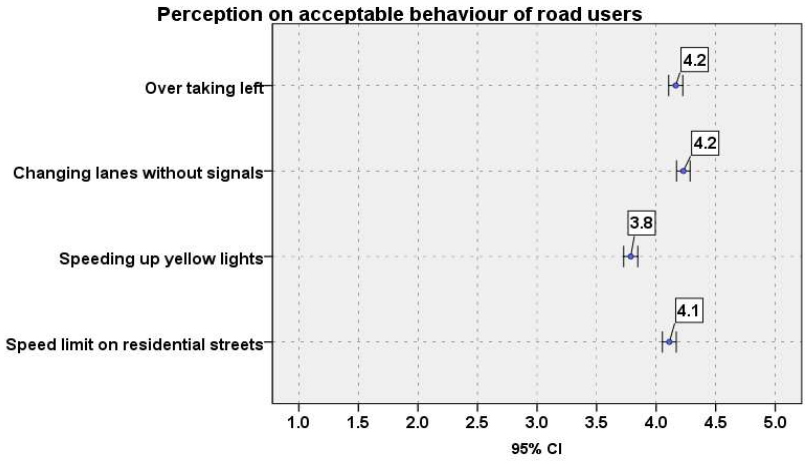
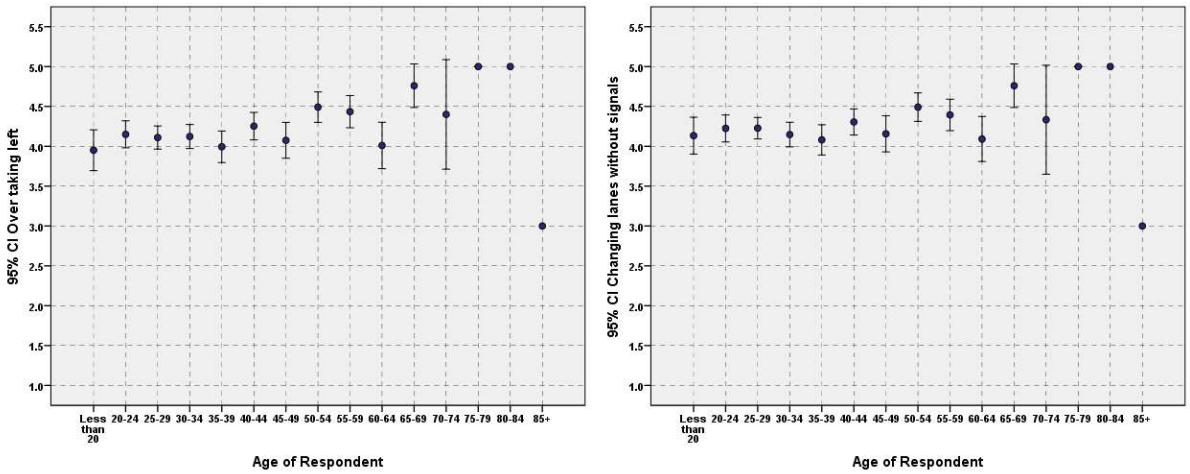


Figure 54: Perception on acceptable behaviour of road users

Key: (1: Strongly Agree, 5 Strongly disagree)



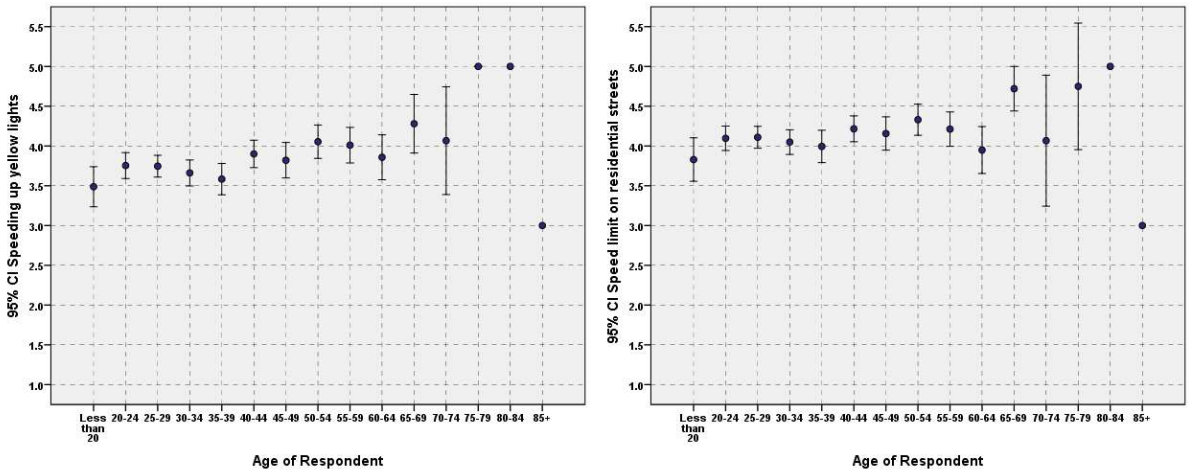


Table 12: 95% confidence plots for acceptable behaviours of road users

On average respondents strongly agree that in order to improve road safety, measure such as improving road infrastructure is primary. They also agree that more law enforcement and education and awareness campaigns are as well important.

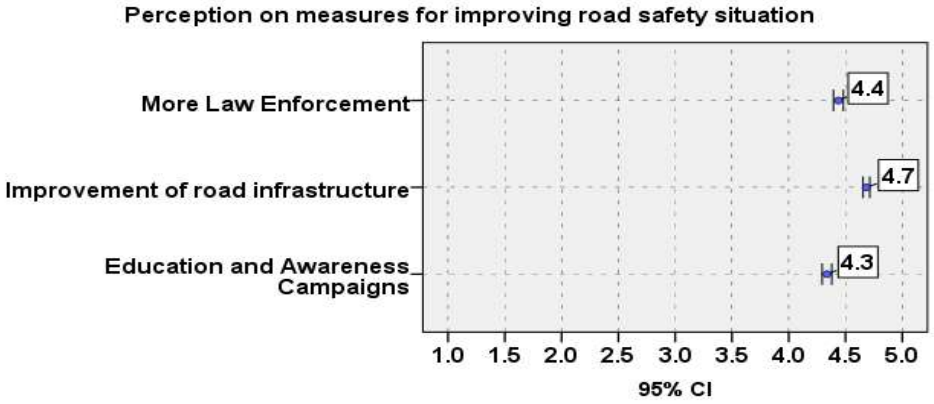


Figure 55: Perception on measures for improving road safety situation

Key: (1: Strongly disagree, 5 Strongly Agree)

5.10 General Opinion Regarding Laws and Enforcement for Road Safety in Mauritius

Respondents are agreeable that road advertising signs and billboard images have an impact on road users and that fines regarding over speeding are severe enough. Respondents are neutral to the fact

that the laws regarding safety are strict enough and enforcement against lawbreakers is adequate. However, respondents disagree with the fact that higher penalties must be given for using mobile phones while driving and this is a general consensus throughout all the age categories.

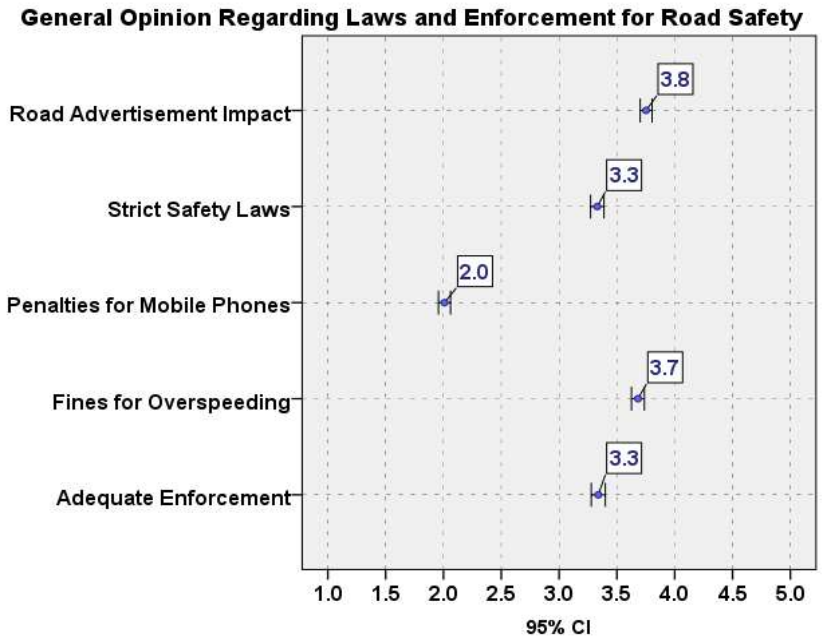


Figure 56: General opinion regarding laws and enforcement for road safety

Key: (1: Strongly disagree, 5 Strongly Agree)

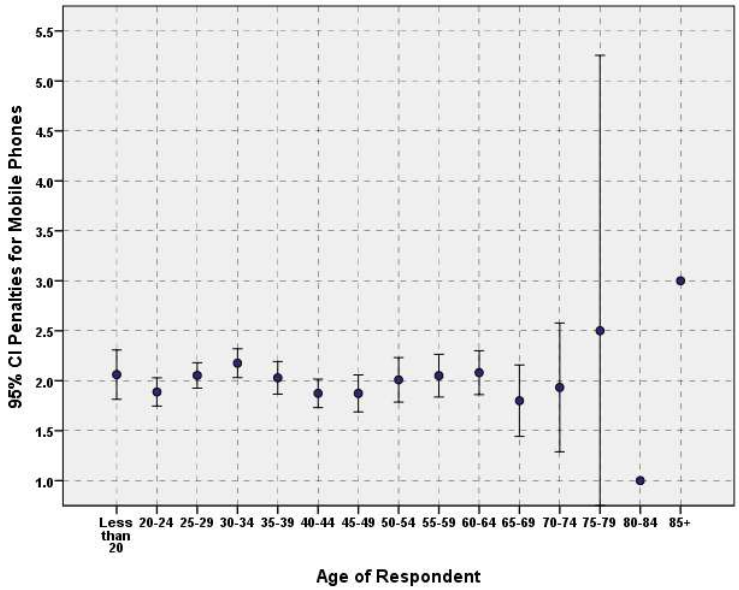


Figure 57: 95% confidence plots for acceptable behaviours of road users

6. Conclusion

Findings from iMAAP and SM revealed that the highest mortality of road crashes occurred for age groups of below 35 years old. Among the factors identified regarding road users' behaviour and attitudes in Mauritius are: risk-taking behaviour, over-speeding, drink-driving, neglecting road safety measures and traffic regulations, using mobile phones while driving, not wearing proper fluorescent jackets and safety helmets for motorcyclists and cyclists, and not adjusting driving behaviour to prevailing weather condition. Other factors include non- behavioural ones, such as, weather conditions, absence of road lighting in certain urban and rural regions, no proper road markings and a lack of maintenance of road infrastructure.

The following key objectives have been met:

1) Identify the past and present situation regarding crash trends

   This objective has been achieved through in-depth analysis of road crashes and several factors surrounding a road crash using the iMAAP software. Data for the last 10 years, 2011 to 2020 have been extracted, compiled, re-organized, classified into different sections and analyzed in order to obtain a thorough understanding of the trends in Mauritius, as has

been presented in detail in Chapter 4. The research provides the conclusion that the number of road crashes has increased by 32.4% in the last decade while the number of fatal accidents has decreased by 14.5%. Fatal accidents (2011 to 2018[3]) by car have decreased by 11.5%, while it has increased by 31.0% for motorcycles.

Similarly, the number of cars registered increased by 104% and motorcycles by 94%. Motorcyclist fatalities have been trending upwards over the decade with a rise of 98%. On the other hand, the rise in the number of fatalities involving car users was only 3%. The number of casualty accidents occurring under the influence of alcohol (2011-2016[4]) increased by 14.8%.

2) Assess the characteristics of crashes

This objective has been achieved through a thorough review of literature; analysis of data obtained from iMAAP as well as analysis of data collected from survey.

From iMAAP, we found that, in the last decade:

- Most casualty accidents, about 24% occurred in the Port Louis district, followed by 20% in the Plaines Wilhems district.
- Drivers represented 64% of casualties in road crashes and 55% of fatalities while passengers accounted for 30% of fatalities and pedestrians were 15%.
- 92% of drivers involved in casualty accidents were male although only 64% of licenses were issued to male drivers.
- 35.3% of fatal accidents involved car users; followed by 23.0% by motorcyclists. Motorcycles account for only 15% of total vehicles registered, following Cars (35%) and Autocycles (25%). As a result, motorcyclists form part of the group of road users most vulnerable to road crashes.
- The 20-24 age group involved the highest number of fatal accidents by motorcycle (25%). Motorcycle riders in the age group 20-29 years were involved in 19 % of the fatal crashes.
- Drink driving has been a contributing factor in over 40% of traffic casualty accidents in Mauritius in the last decade; Port Louis being the hub for accidents under alcohol influence with nearly 10 accidents per square km per year.

[3] Information lacking from iMAAP for 2019 and 2020.

[4] Information lacking from iMAAP for 2017 to 2020.

- Driving under the influence of alcohol as a contributing factor was present in 43% of fatal crashes involving cars and in 19 % of fatal crashes involving motorcycles.
- 36% of road fatalities were either drivers or riders in the age band 16-25 years (young drivers). 37% of fatal motorcycle crashes and 35% of fatal car crashes involved these young persons.
- 13.4% of all fatal accidents involved male motorcyclists.
- 42% of casualty crashes involved legally alcohol impaired young drivers.

3) Identify factors and predictors of self-reported crash involvement

   Results based on perceptions show that given an accident occurs, males are at least twice riskier to be involved in it than females. A significant positive change in behaviour was noted for those respondents who were involved in serious injury compared to those involved in slight injury. Also, diploma and degree holders are more involved in such accidents due to may be their high activity level in terms of mobility. Statistical model developed showed that males, higher level of education and possessing driving licenses are the influential parameters to crashes.

4) Identify major factors or clusters influencing road safety based on the general perceptions of road users.

   The general perception on road safety influential clusters were related to infrastructural conditions of the road environment (lighting, traffic signs and road markings), traffic safety measures (helmets, road safety signs) and the vehicle safety measures (seat belts).

5) Identify major risk factors or clusters contributing to road crashes based on the perceptions of road users.

   Three risk factors were identified: (i) inhibitors to reaction time to prevent crashes, (ii) physical conditions of vehicles and roads as well as stress and strain while driving and, (iii) inhibitors related alcohol consumption while driving. Over speeding, use of mobile phones, alcohol consumption and drug consumption were the very high level risk factors towards road crashes. However, other important risk factors such as weather conditions, smoking, stress, as well as, passivity to road signs and signals were not held as very high risk factors. It is therefore very important to sensitize people about the latter risk factors.

6) Assess the perception of road users on road lighting that influences road safety.

It is observed that on average respondents are strongly agreeable that road lighting is a must for improved vision, security, safety, improving decision making and to reduce road crashes.

7) Contrast measures related to law enforcement, road infrastructure and awareness and education that could contribute to improve road safety.

   Respondents were of the opinion that road advertising signs and billboard images have an impact on road users and that fines regarding over speeding are severe enough. But they disagree with the fact that higher penalties must be given for using mobile phones while driving.

Researchers, engineers and policy-makers are aware that they need to look beyond initiatives such as improved road infrastructure (with focus on two wheelers locally), road safety management capacity, vehicle conditions, road users' education, enhancing the behaviour of road users and improving post-crash response. Countries such as the Sweden, U.K, Norway and Ireland are very pro- active and effective concerning road safety legislation and enforcement system. In recommending solutions locally, road safety policymakers and the different stakeholders need to further rely on systematic data capture and progressive analysis to justify strict adherence to existing laws or promotion for other more strict countermeasures and laws. It is also appropriate to inculcate the correct road safety awareness and culture amongst the various road users.

Moreover, it is important to adhere and constantly update to international best practices and policies. These are well summarised to reflect global situations, as in the case of United Nations stating the following on road safety as part of the pillars of the sustainable development goals: *" To achieve this, the strategy has outlined a safe-system approach with 12 key actions spread across five pillars that will address major road safety issues for United Nations personnel. The strategy seeks to demonstrate a balance between the inputs received, resources available and what research shows can have an impact. United Nations organizations will work to introduce the strategy and to improve road safety, but all personnel are urged to make safety a top priority when using roads. This will allow United Nations personnel to have safer journeys and deliver programmes and activities through a safe road system* (UN 2018)".

Table 13: The pillars and action plan points (UN 2018)

PILLARS	12 ACTION PLAN POINTS
1. Road Safety Management	Establish a Road Safety policy addressing all pillars
	Establish governance mechanism
	Improve data collection and analysis
	Review Funding
2. Safer Fleets	Encourage investment in Fleet management
	Encourage the acquisition and use of safer vehicles
3. Safer Road Users	Develop standar training and awareness-raising methods and materials
	Develop driver-authorization standards
	Develop enforcement mechanism
4. Post-crash Response	Increase responsiveness to post-crash emergencies
5. Safer Driving Environment	Promote safe operation, maintenance and improvement of roads in local communities
	Improve driving conditions in areas under the control of the UN

7. Recommendations

Based on the results of the research, the following recommendations can be addressed to achieve and promote road safety in Mauritius:

(1) Education - The need to conduct more educational and sensitisation campaigns, training, awareness programs and workshops among road users. For instance, adequate discipline and awareness on social concerns must be introduced at a very young age in pre-primary and primary schools. Competitions comprising of poetry, music, slam, and writing can also be held to train the youth and to make them aware of road safety issues and by preventing road injuries and deaths. Hence, road safety as a curriculum and training should be reinforced in primary and secondary schools. Campaigns can influence the mass audience through billboards and pamphlets and involvement elderly people and youngsters for reflective group discussions.

(2) Probationary Driving License must be given to beginner drivers or freshly qualified drivers because they lack the driving skills and experience to drive in traffic situations, during night-time, heavy rainfall, fog and torrential rain. The purpose is to protect beginner drivers and to encourage them to obtain driving experience on the road.

(3) Enforcing blood alcohol limits is essential. For instance, carrying out random breath tests near night clubs, pubs and restaurants should be done frequently during weekdays and weekends. Restrictions of alcohol to young drivers should be reviewed in an effort of making young people reduce drink-driving. This strategy can be done through appropriate taxation and pricing mechanisms in shops, pubs and night clubs to target illegal sales and service of alcohol to young people. In other words, raising the legal drinking age.

(4) Introducing better road infrastructure for motorcyclists and cyclists. In Mauritius, no road design and planning have taken into consideration motorcyclists and cyclists. For motorcyclists and cyclists, there must be careful adherence to reflectors on bicycles, especially at night. In terms of engineering solutions, more support is needed for traffic-calming measures, for example with speed humps. A closer examination is required from engineers, planners and the Government.

(5) To improve infrastructure measures- for example: billboards and road signs.

(6) In terms of more enforcement, road users who are not law-abiding to road signs and road traffic rules must be given exact and swift penalties. This will help in reducing the risk of road crashes

because they are linked to human errors and are deliberately breaking the laws, for example not wearing seatbelts, drink-driving, using mobile phones while driving and exceeding the speed limit.

(7) Improving post-crash response must be given a priority to all road users. This includes medical services through ambulances and hospital care. Basic first aid techniques can be introduced to the population and this can be done by different NGOs, the public sector and the private sector to teach road users how to react at a scene of a road crash, to call for help and provide the basic first aid until formally trained health-care personnel arrive.

(8) The iMAAP software could cater for more details with identifiers that can not only provide hotspots where accidents occur but can also identify drivers who have been involved with a significant number of road accidents for follow-ups.

(9) A dedicated team should be responsible in order to ensure the regular updates of the iMAAP database which is vital for further studies.

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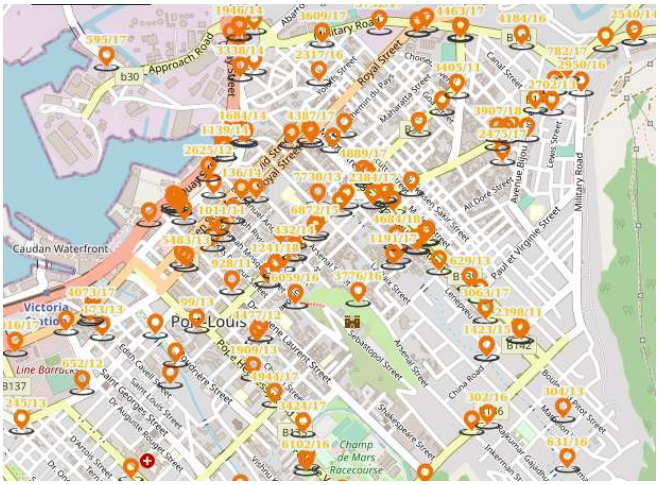
APPENDIX 1- Questionnaire (PDF)

APPENDIX 2

a. Locations

i. Port Louis



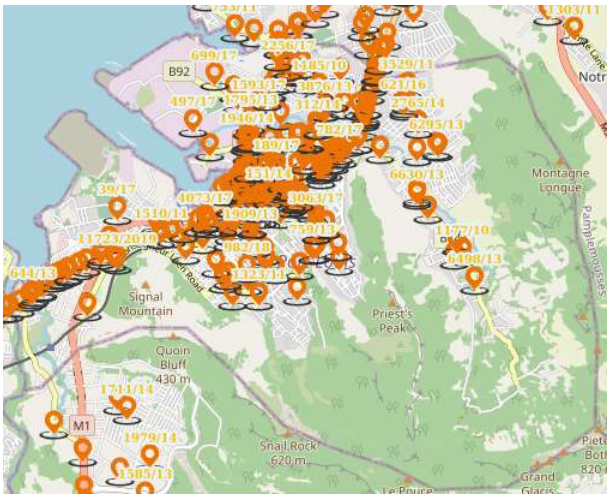


Figure 58: Port Louis District (i) Serious Accidents (ii) Cluster Focus

Table 14: Port Louis Serious Accidents

ROAD NAME	Location of Crashes
M1 Quay Street	Caudan Waterfront
M1/M2/B30/B140	Roundabout
A2 Royal Street	Bourbon Street Junction to David Street Junction
B32	Sir Seewoosagur Ramgoolam Street
B142	Sir Edgar Laurent Street
B141 Port Louis Central Flacq Road	Choiseul Avenue Junction to Bernardin de St Pierre Road Junction
B141 Pamplemousses Road	St Croix Road Junction to Riche Terre 1

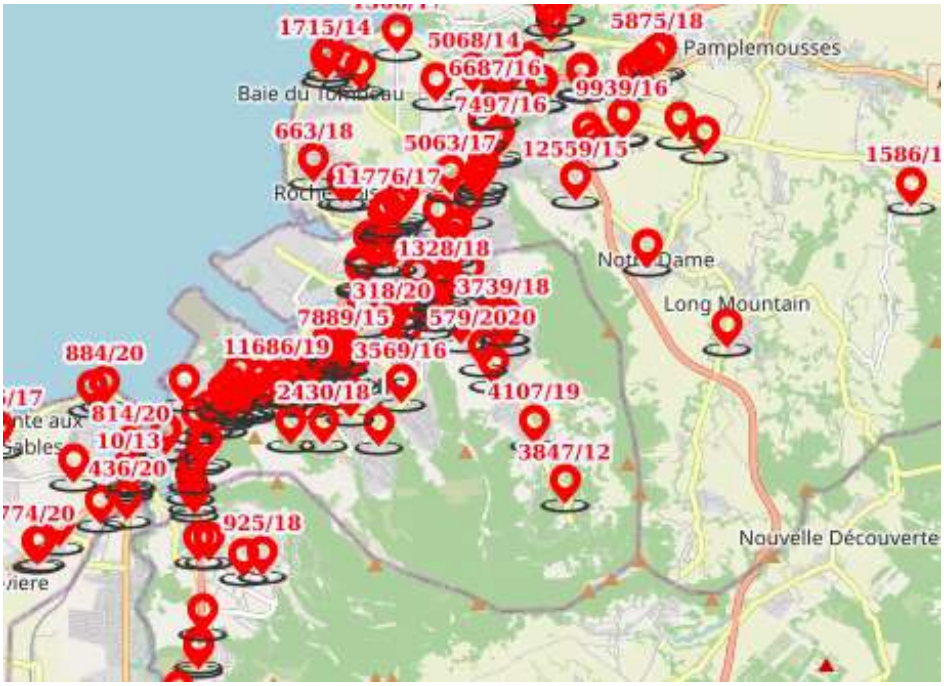
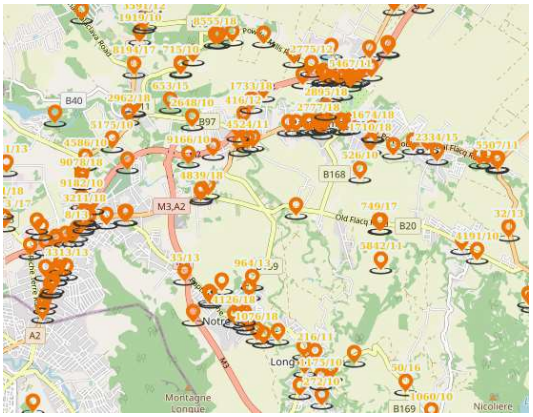


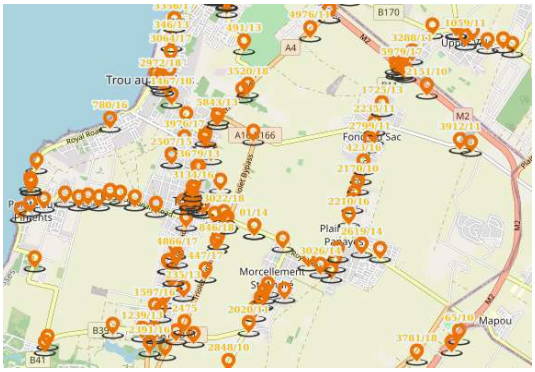
Figure 59: Port Louis Fatal Accidents (Source : iMAAP)

Table 15: Port Louis Fatal Accidents

Road Name	Location of Crashes
Quay Street	From Caudan Waterfront to Albion Docks
Farquar Street	In Between Louis Pasteur Street Junction and La Corderie Street Junction
Louis Pasteur Street	
Emmanuel Anquetil Street	Sir Seewoosagur Ramgoolam Street/ Emmanuel Anquetil Street Junction
Pamplemousses Road	From Abercrombie Police Station To Bernardin de Saint Pierre Road Junction
M2- Port Louis-Plaisance Dual Carriageway	Port Louis/Pamplemousses District Boundary
M1-Port Louis Plaisance Dual Carriageway	From RCPL to Rue Stevenson

ii. Pamplemousses





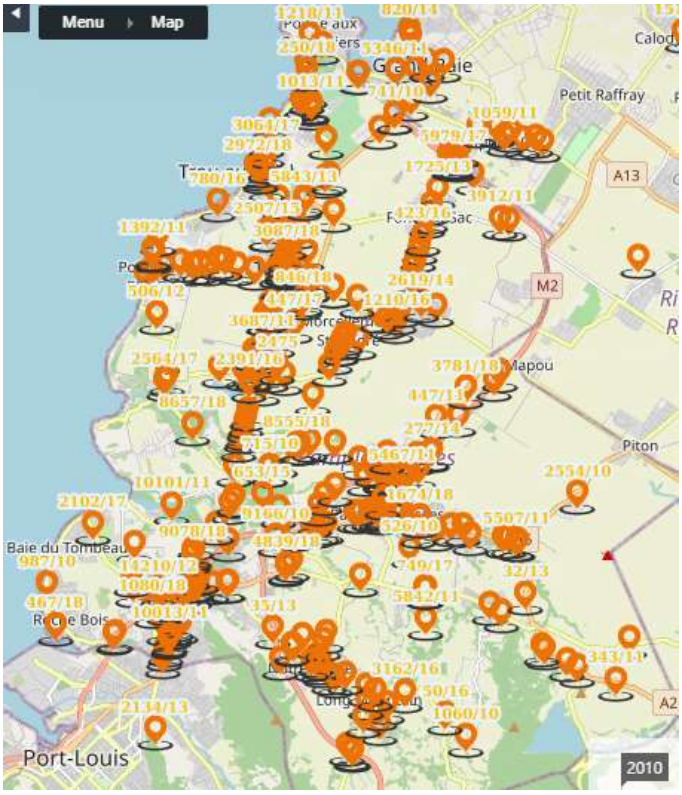


Figure 60: (i) Pamplemousses Serious Accidents (ii) Cluster Focus (Source: iMAAP)

Table 16: Pamplemousses Serious Accidents

Road Name	Location of accidents
B12 Plaines des Papayes Road	Upper Vale
B11 Royal Road	Fond du Sac to Plaines des papayes
A4 Royal Road **B35 Japonais Road**	Triolet Bonair Road Junction Japonais Road
M2 Port Louis Plaisance Dual Carriageway	A5/M2 Roundabout to M2/B18 Roundabout
A2 Port Louis Central Flacq Road	Camp des Embrevades Road junction to Masjid Taibah
A2 Port Louis Central Flacq Road	B19 Baptiste Lane Junction to Riche Terre 1 Junction
B19 Baptiste Lane	M3/B19 Roundabout to Mohabeer Foogooa Govt School

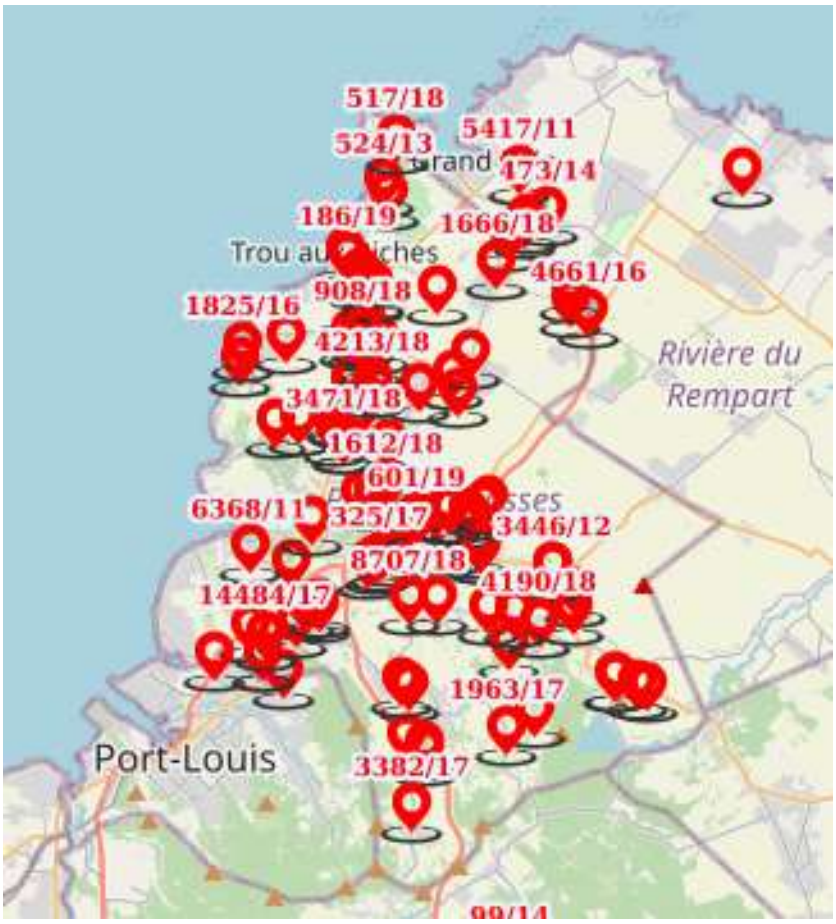


Figure 61: Pamplemousses Fatal Accidents (Source: iMAAP)

Table 17: Pamplemousses Fatal Accidents

Road Name	Location of Crashes
Pamplemousses Road	From Riche Terre Rd Junction to Dream Price
M2/A4/Pamplemousses Road Roundabout	Roundabout and Junctions
M2/M3 Roundabout	Calebasses Roundabout
B97 Calebasses-Arsenal Branch Road	B97/M2 Roundabout
B11/ Trou Aux Biches Road	B11/ B97/ Trou Aux Biches Road Junction
A4 Royal Road/ B36 Trou Aux Biches Road	From L'Allee Jacques Junction to Trou Aux Biches Road Junction

iii. Riviere du Rempart

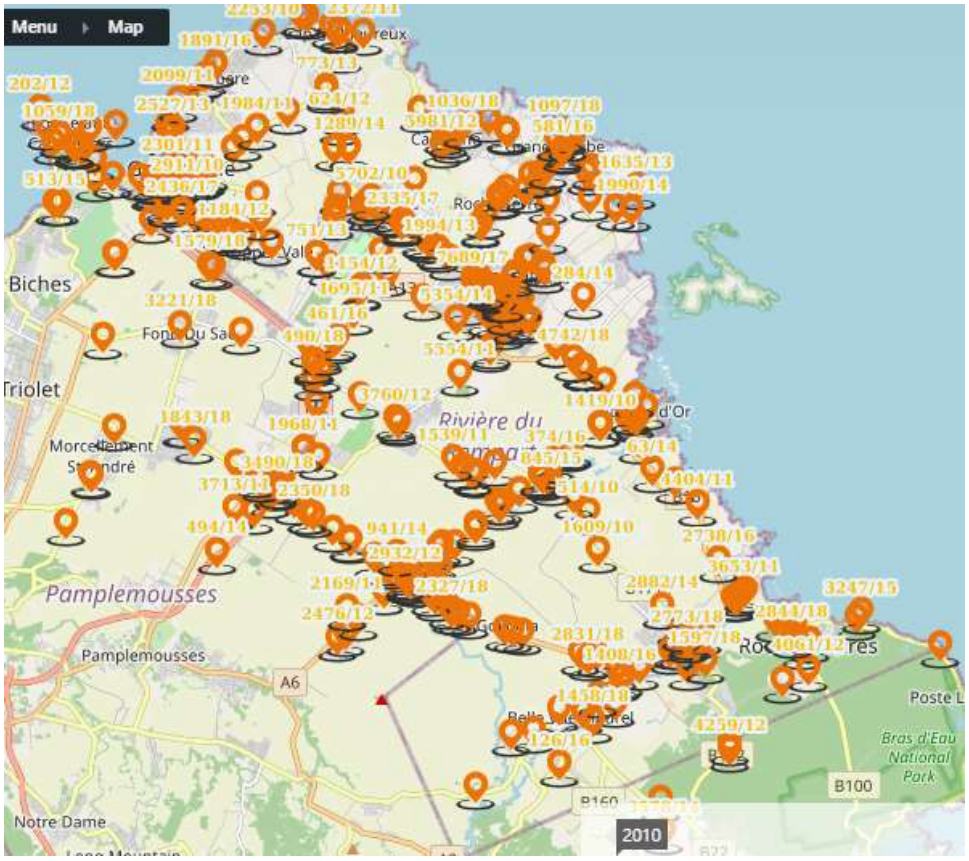


Figure 62: Rivière du Rempart Serious Accidents (Source: iMAAP)

Table 18: Rivière du Rempart Serious

Road Name	Location of crashes
B13 Royal Road	Pointe aux Canoniers Clinique du Nord To Avenue des Lauriers
B13 Royal Road	A4 Grand Baie Road Junction to B11 Route de la Salette Junction
B45 Vingt Pieds Road	A4/B45 Roundabout to B165 Vieux Moulin Road

A5	Pharma Goodlands to German Consulate Goodlands
A5 Plaines des Papayes Road	M2/ A5 Roundabout
B17	M2/B17 Roundabout Mapou to B17/B16/A6 Junction
A6 Royal Road	B15 Junction to B122 Junction

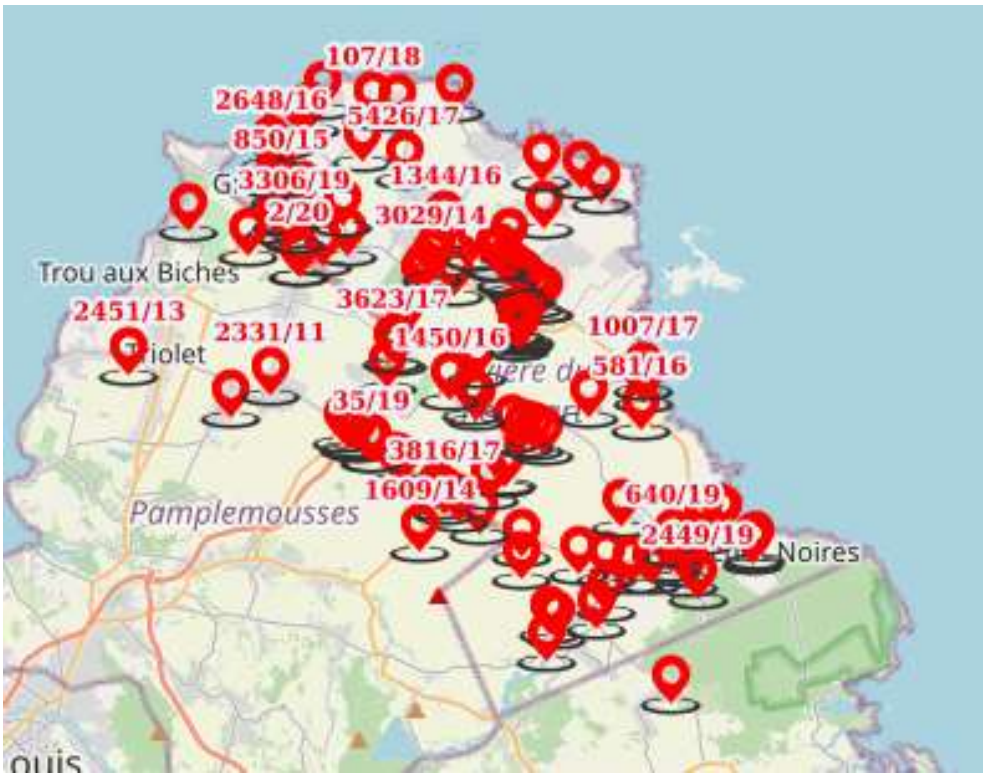


Figure 63: Riviere du Rempart Fatal Accidents (Source: iMAAP)

Table 19: Riviere du Rempart Fatal

Road Name	Location of Crashes
Vingt Pieds Road	From Vingt Pieds Road/Grand Baie Road Roundabout to Plaines des Papayes Road Junction
A5	Goodlands From B14 Junction to German Consulate Goodlands

A13 Goodlands Bypass road	Goodlands Bypass Road Roundabout
Forbach Road	Forbach Road/Poudre D'or Road Junction
B17/A6	Piton B17/A6 Junction (Near MITD)

iv. Flacq

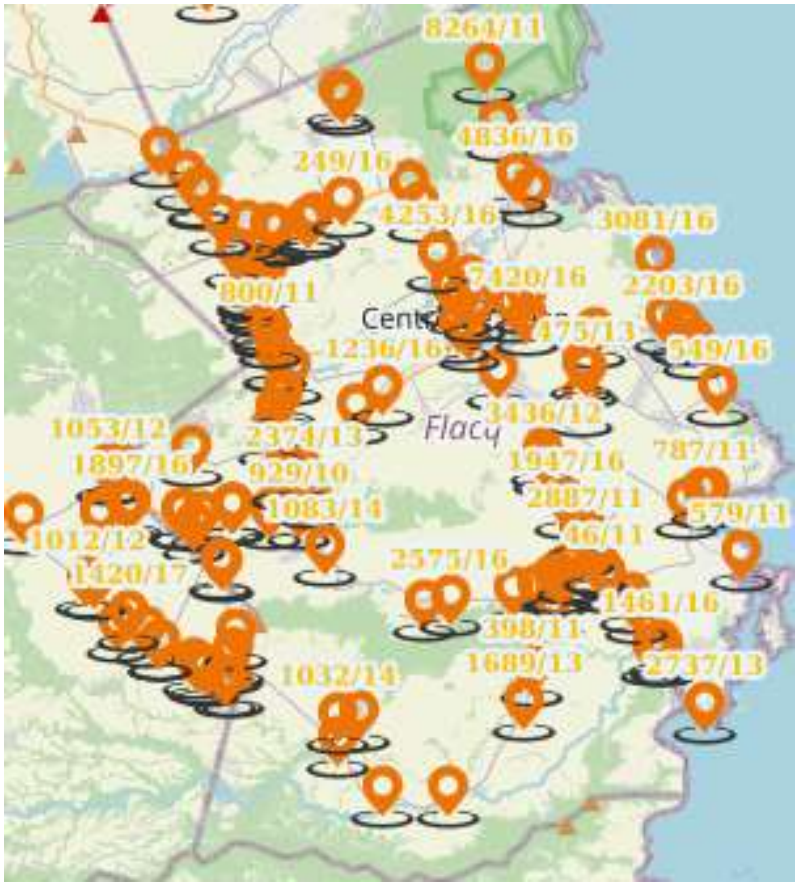


Figure 64: Flacq Serious Accidents (Source: iMAAP)

Table 20: Flacq Serious Accidents

Road Name	Location of Accidents
B23 Royal Road lallmatie	A2 Junction to Unite Road Junction

A2 Port Louis central Flacq Road	Armaury Branch Road Junction to Belle Vue road Junction
A7	B28 Junction to B117 Constance Link Road
B55 Camp de Masque Road	B27/B28 Roundabout
B27 Royal Road	Montagne Blanche

Figure 65: Flacq Fatal Accidents (Source: iMAAP)

Table 21: Flacq Fatal Accidents

Road Name	Location of Crashes
B22 Belle Vue Road	Belle Vue Road/Laventure Road Junction
Royal Road Lallmatie	From Mission Crossroad To Riviere Cere Road Junctions
B27	Bel Air Near Bazar and Savers
B59	Trou D'Eau Douce (Near Golden Shell Residence)

v. Grand Port

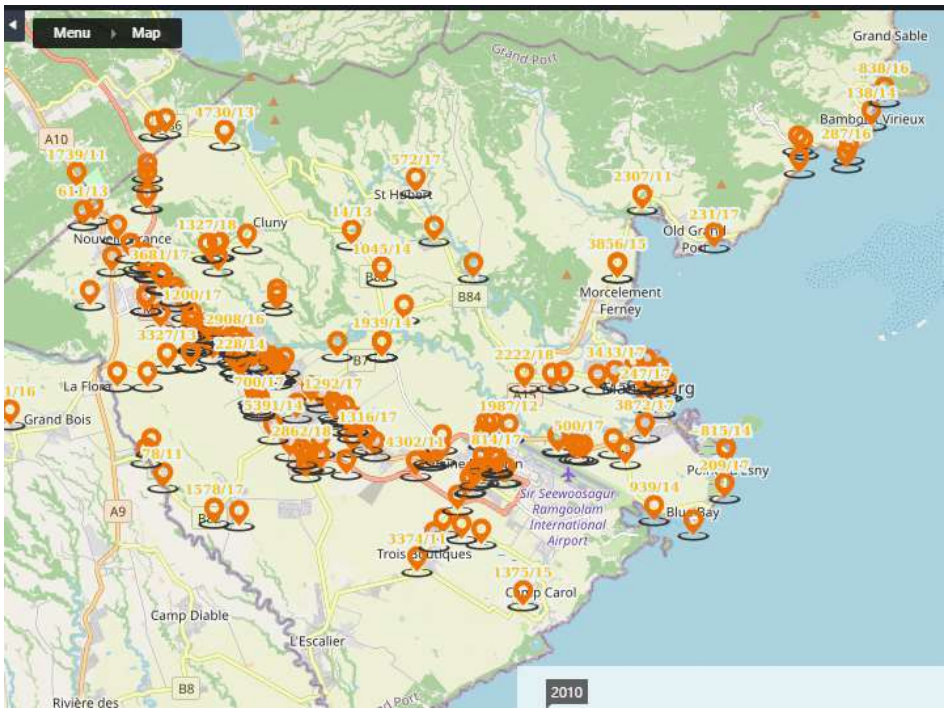


Figure 66: Grand Port Serious Accidents (Source: iMAAP)

Table 22: Grand Port Serious Accidents

Road Name	Location of Crashes
A10 Route Royale Nouvelle France	M1/A10/B95 Roundabout
M1 Port Louis Plaisance Dual carriageway	M1/B81 Roundabout
A10	M1/A10/B95 Roundabout to A10/B7 Junction
B8	Plaine Magnien
A12 Royal Road	Mahebourg

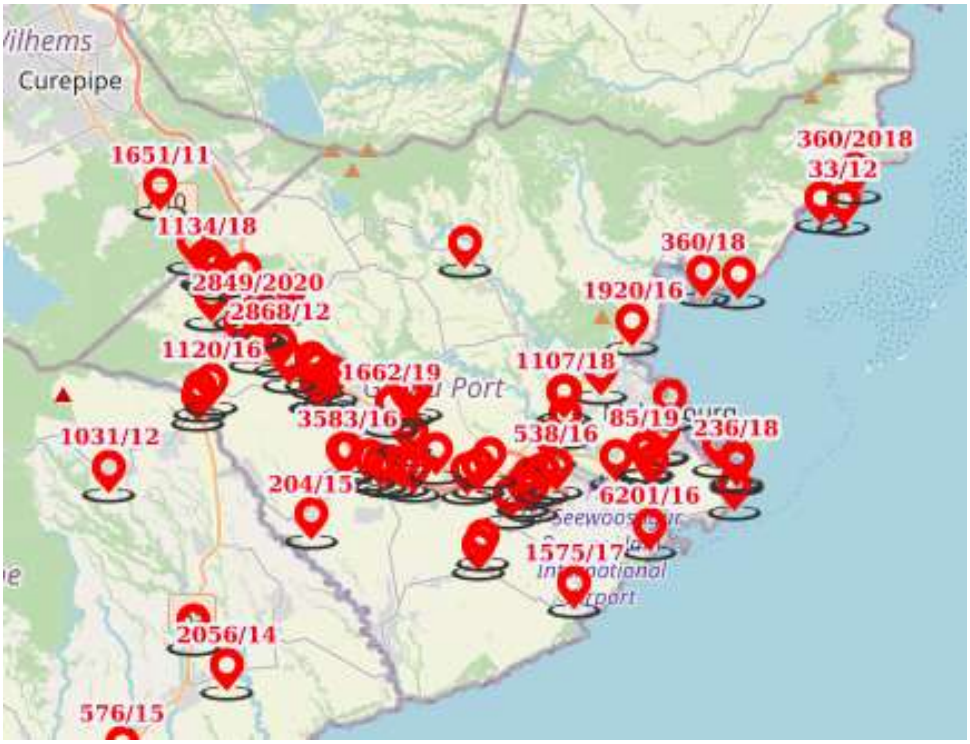


Figure 67: Grand Port Fatal Accidents (Source: iMAAP)

Table 23: Grand Port Fatal Accidents

Road Name	Location of Crashes
A9/A10	A9/A10 Junction Nouvelle France
B134	Rose Belle from James Burty David Market Place to A10 Junction (Near Engen Gas Station)
A10 Union Park	Between Junction Road and M1/A10/B95 Roundabout
M1 Union Park	Between Junction Road and M1/A10/B95 Roundabout
A12 Royal Road	Mahebourg A12/Kestrel Street Junction

vi. Savanne

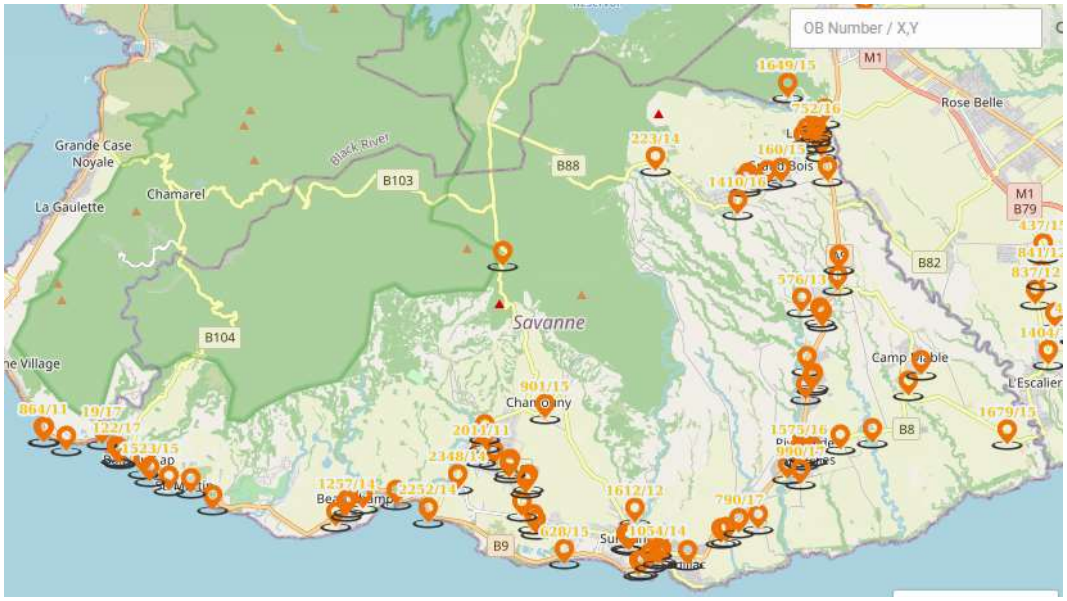


Figure 68: Savanne Serious Accidents (Source: iMAAP)

Table 24: Savanne Serious Accidents

Road Name	Location of crashes
B9	Bel Ombre to Baie du Cap
B10	Chemin Grenier
B9 Coastal Road Surinam	Souillac
B8	Riviere des Anguilles
A9	La FLora

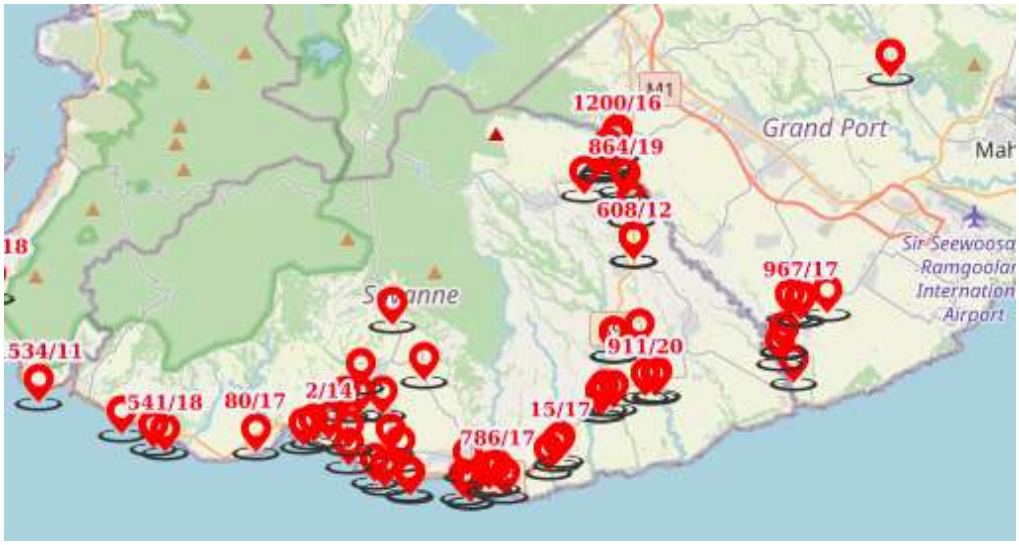


Figure 69: Savanne Fatal Accidents (Source: iMAAP)

Table 25: Savanne Fatal Accidents

Road Name	Location of Crashes
B9 Coastal Road Surinam	Near Mandhir Road
B9 Coastal Road Surinam	Near Social Welfare Centre road
B88	La Flora From Grand Bois Mosque To Cooperative Road Junction
A9/B88	A9/B88 Junction La Flora

vii. Moka

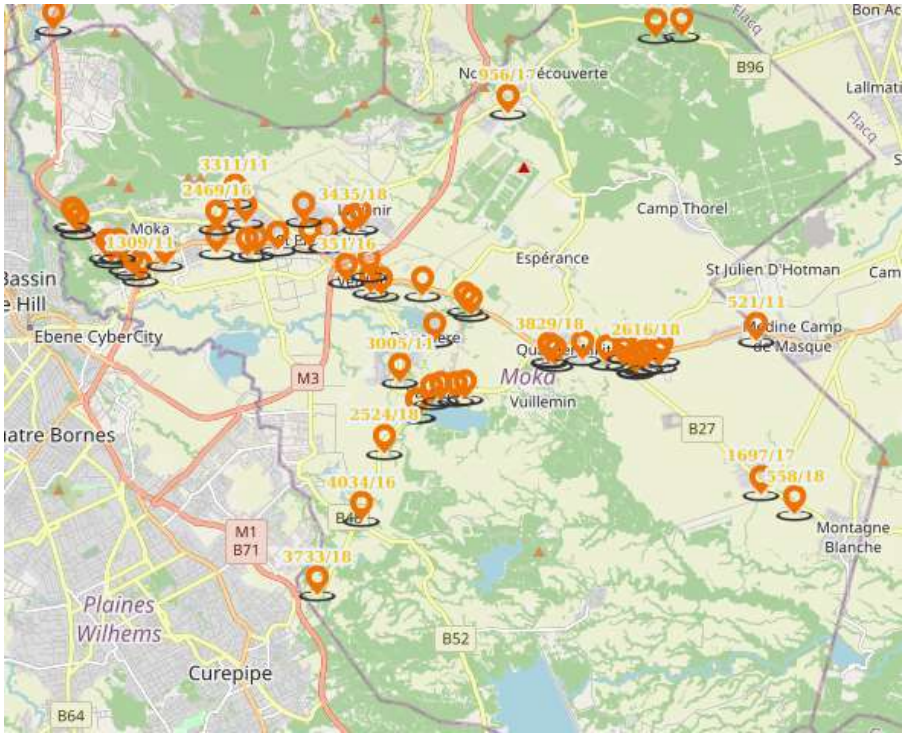


Figure 70: Moka Serious Accidents (Source: iMAAP)

Table 26: Moka Serious Accidents

Road Name	Location of Crashes
M1 Port Louis Plaisance Dual Carriageway	Reduit/Bagatelle
A7 St Pierre Bypass Road	St Pierre
A7	Providence
A7	Quartier Militaire
B6/B50 Roundabout	Valetta

Figure 71: Moka Fatal Accidents (Source: iMAAP)

Table 27: Moka Fatal Accidents

Road Name	Location of Crashes
B6/B24/A7 Roundabout	B6/B24/A7 Roundabout Quartier Militaire
Quartier Militaire Bypass Road	
A7	Near Quartier Militaire Bus Station

viii. Black River

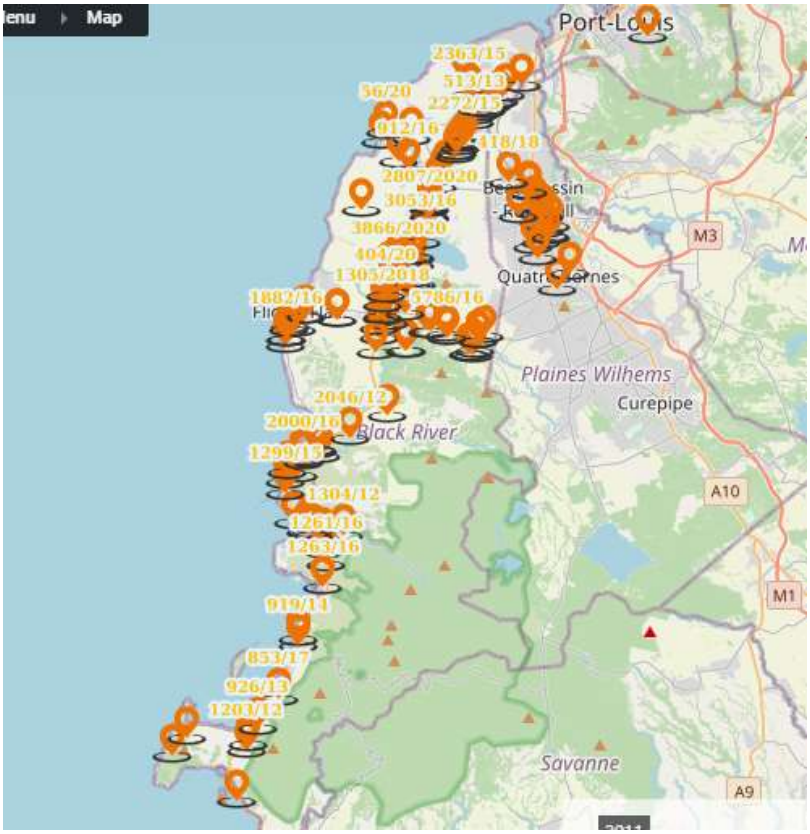


Figure 72: Black River Serious Accidents (Source: iMAAP)

Table 28: Black River Serious Accidents

Road Name	Location of Crashes
A3 Riviere Noire Road	Petite Riviere
A3 Riviere Noire Road	Gros Cailloux
A3 Riviere Noire Road	Saint Antoine
B34 Coastal Road	Flic en Flac
A3 Riviere Noire Road	Xavier/Cascavelle
B2 Palma Road	Beau Songes
A3 Royal Road	Grand Riviere Noire

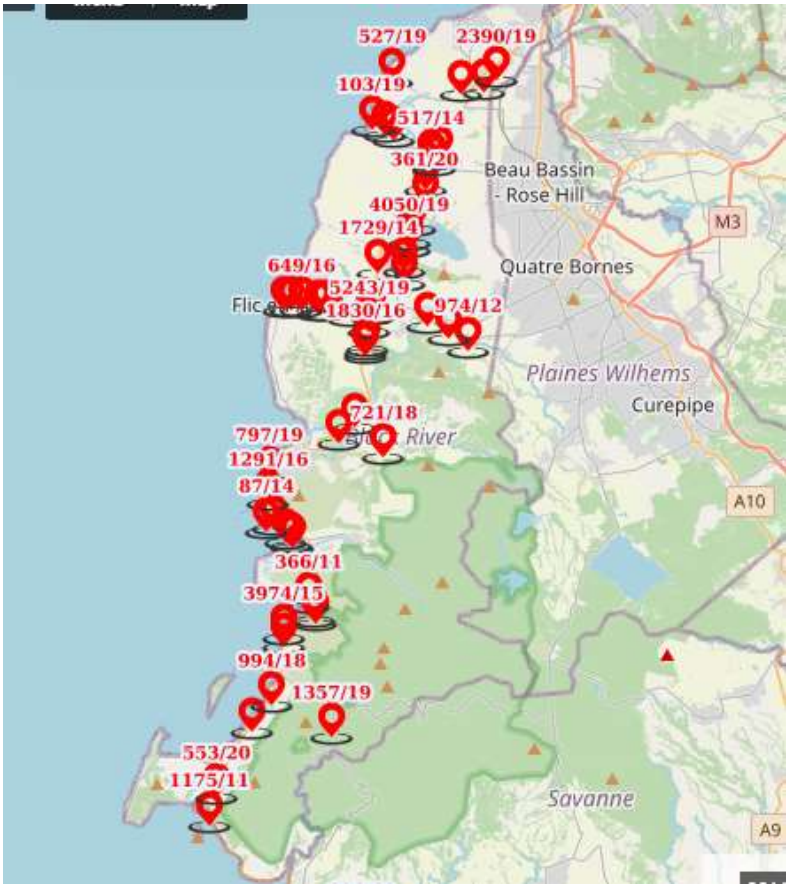


Figure 73: Black River Fatal Accidents (Source: iMAAP)

Table 29: Black River Fatal Accidents

Road Name	Location of Crashes
Flic en Flac Road	From Avenue Du Rempart Roundabout To Flic En Flac Govt School
A3 Riviere Noire Road	Near Casela Nature Park

ix. Plaines Wilhems

Figure 74: Plaines Wilhems Serious Accidents (Source: iMAAP)

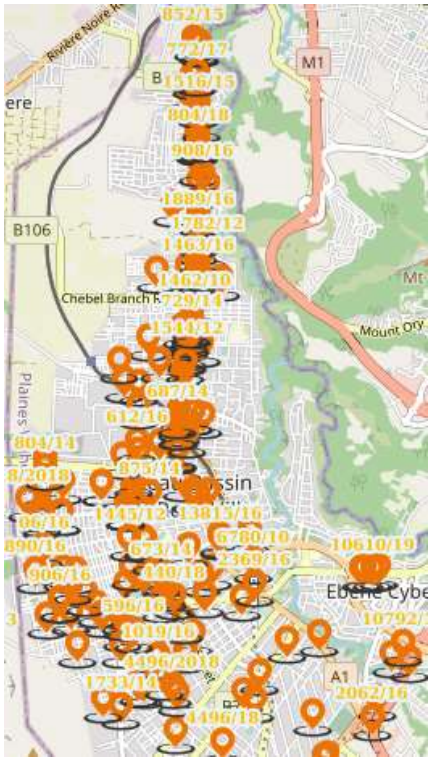


Figure 75: Beau Bassin Rose Hill Serious Accidents (Source: iMAAP)

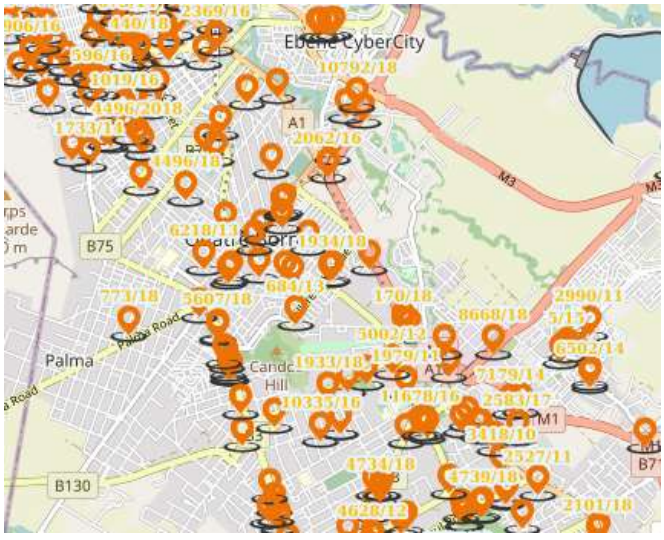


Figure 76: Quatre Bornes Serious Accidents (Source: iMAAP)

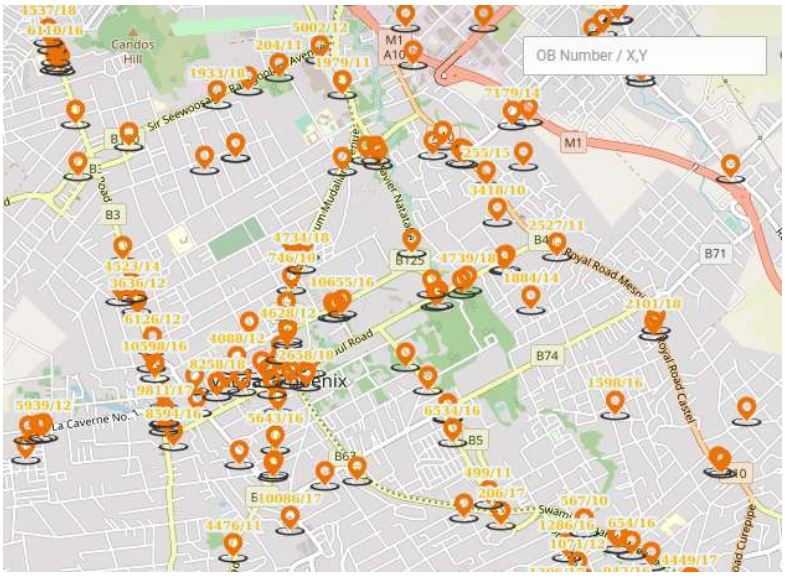


Figure 77: Vacoas Phoenix Serious Accidents (Source: iMAAP)

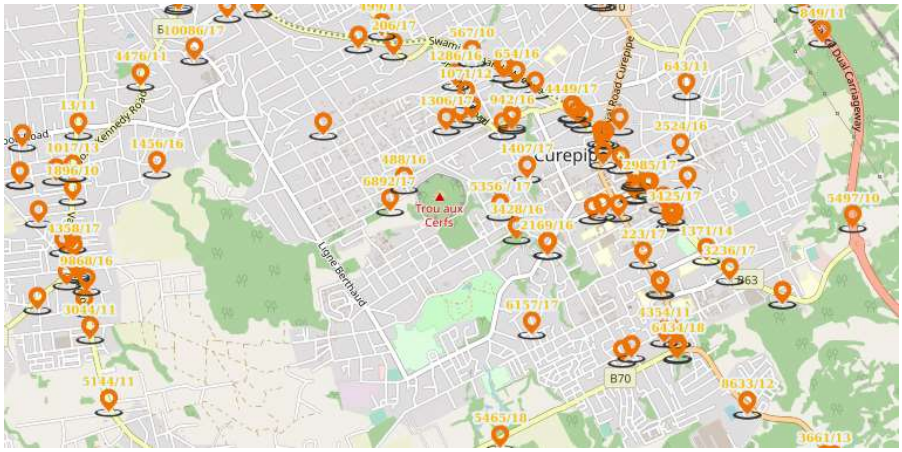


Figure 78: Curepipe Serious Accidents (Source: iMAAP)

Table 30: Plaines Wilhems Serious Accidents

Road Name	Location of crashes
A1 Grand River Road	Coromandel to Rose Hill Central
B1 Ebene	Ebene Cybercity
Saint Jean Road	Quatre Bornes
B3 Candos Vacoas Road	Candos to La Caverne
B4 Saint Paul Road	Vacoas Central
Royal Road Curepipe	Curepipe Central

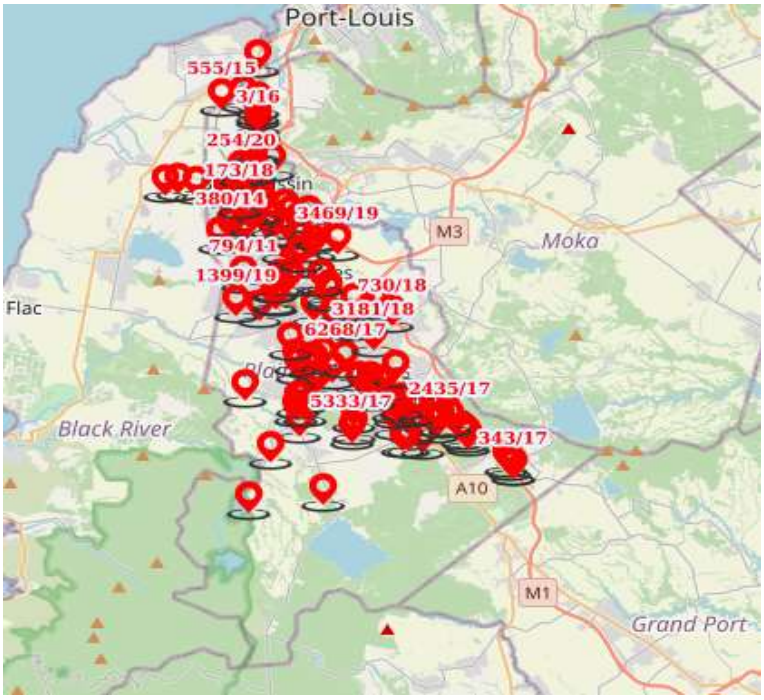


Figure 79: Plaines Wilhems Fatal Accidents (Source: iMAAP)

Table 31: Plaines Wilhems Fatal Accidents

Road Name	Location of Crashes
Swami Sivananda Avenue	Floreal Main Road Junction
Candos Vacoas Road	Hilary Blood Avenue Junction
St Jean Road	Tristan D'avis Avenue Junction
M2	Plaines Wilhems District Grand Port District Boundary
Robinson Street	Robinson Street/Robinson Lane/Sagar Street
B101	Pope Henessy Street Junction To Ariane Road

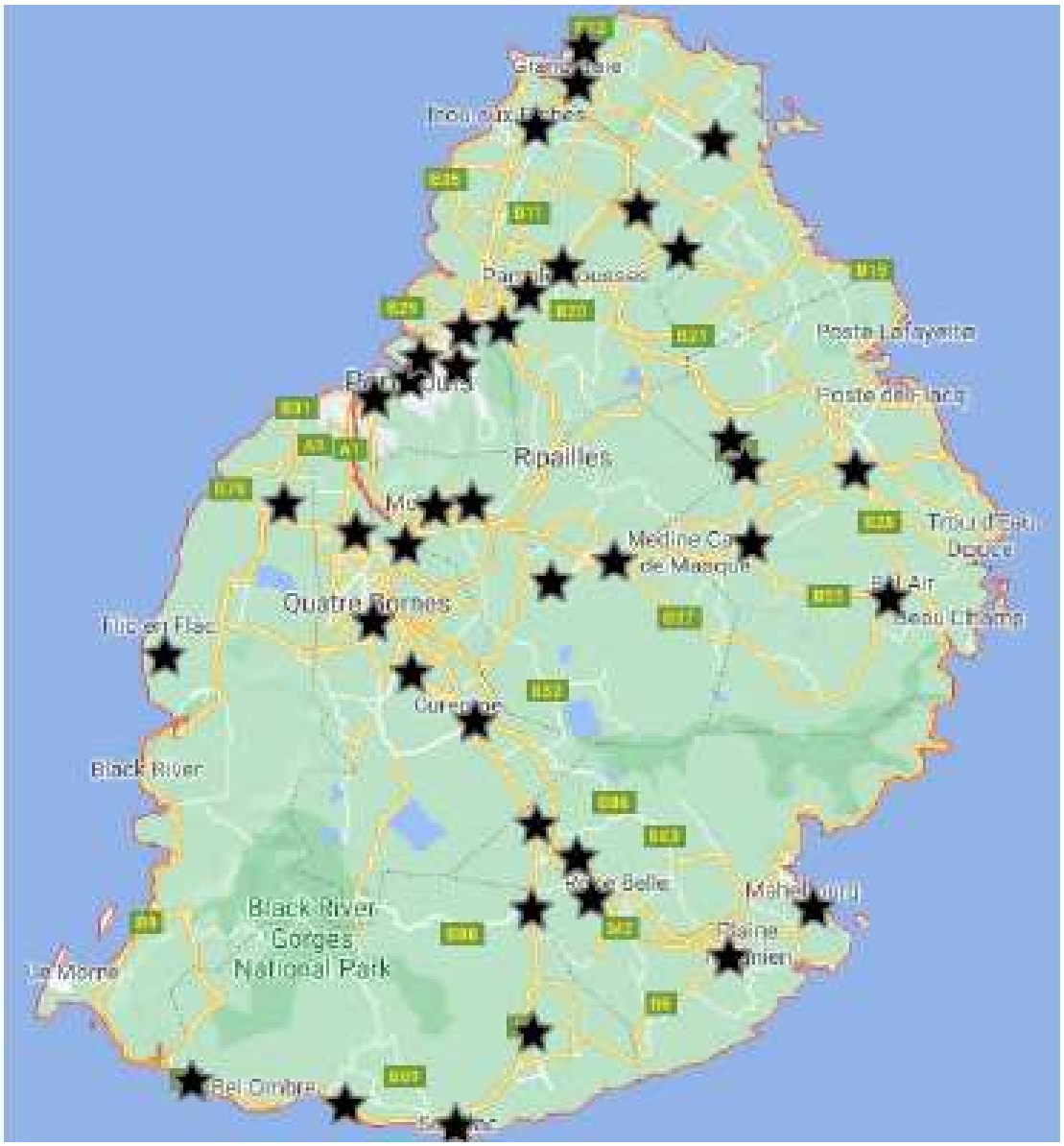


Figure 80: Blackspots in Mauritius

Forty blackspots were identified all over the island. Figure 27 shows the map on the blackspots in Mauritius; while, table 20 gives details about the locations of those blackspots.

Table 32: Blackspot details

Blackspot	Road Name	Location of Crashes
Calebasses	M2/M3 Roundabout	Calebasses Roundabout
Le Hochet	A1	Pamplemousses Road
Terre Rouge	A4/ M2 Roundabout	Terre Rouge Roundabout
Pamplemousses	M2/B18	Near Pamplemousses SSR Garden

Trou aux Biches	B13/A4	Trou aux Biches
Pereybere	B13	
Goodlands	A5	From B14 Junction to B15 (Near German Consulate)
	A13	Goodlands Bypass Road
Piton	B17/A6	Near MITD
Mapou	B17	M2/B17 Roundabout Mapou to B17/B16/A6 Junction
Vingt Pieds Road	B45	From A4 Grand Baie Road Roundabout to B165 Vieux Moulins Road Junction
Quay Street	Quay Street	From Caudan Waterfront to Albion Docks
Farquhar Street	Farquhar Street	From Louis Pasteur Street to La Corderie Street Junction
Sir Seewoosagur Ramgoolam Street	SSR Street	Emmanuel Anquetil Junction
Pamplemousses Road	A1	From Abercrombie Police Station to Bernardin de Saint Pierre Road
Lalmatie	B23	Royal Road Lalmatie
St Julien/Riche Fond	B24	B25 Junction
Camp de Masque	B55	B27/B28 Roundabout
Bel Air	B27	Near Bazar and Savers
Central Flacq	A2	Armuary Branch Road Junction to Belle Vue Road Junction
Mahebourg	A12 Royal Road	Kestrel Street Junction
Plaine Magnien	B8	Plaine Magnien
Rose Belle	B134	From James Burty David Market Place to A10
Union Park	A10/M1	From Junction Road and M1/A10/B95 Roundabout
Nouvelle France	A9/A10	A9/A10 Junction Nouvelle France
Riviere des Anguilles	B8	
Surinam	B9	Coastal Road Surinam/Souillac
La Flora	A9	A9/B88 Junction
Chemin Grenier	B10	
Baie du Cap	B9	Bel Ombre to Baie du Cap
Flic en Flac	B34 Coastal Road	Flic en Flac Road
Gros Cailloux	A3 Riviere Noire Road	
Quartier Militaire	A7	Near Quartier Militaire Bus Station
St Pierre	A7	St Pierre Bypass Road

Valetta	B6/B50	Roundabout
Reduit/Bagatelle	M1	Port Louis Plaisance Dual Carriageway
Ebene	B1	Cybercity
Rose Hill	A1 Grand River Road	From Coromandel to Rose Hill Central
Quatre Bornes	B3 Candos	Candos to Saint Jean
Vacoas	B4 Saint Paul Road	Vacoas Central
Curepipe	Royal Road	Curepipe Central

APPENDIX 3

Table 33: Fatal Accidents by vehicle type, 2011-2020 (Source: iMAAP)

Vehicle Type	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**TOTAL**
4x4	0	0	0	0	0	0	0	1	0	3	**4**
Autocycle	29	33	23	24	15	24	21	28	5	4	**206**
Bicycle	9	22	21	9	13	11	13	5	7	3	**113**
Bus	18	17	24	22	40	7	9	5	2	0	**144**
Car	121	101	81	123	107	82	173	107	63	45	**1003**
Electric bike	0	0	0	1	1	0	0	0	1	4	**7**
Heavy goods vehicle	29	32	7	16	13	17	18	16	14	1	**163**
Light goods vehicle	34	34	13	9	8	9	6	24	21	19	**177**
Micro Bus	0	0	0	0	0	0	1	8	8	11	**28**
Minibus	27	5	1	10	11	23	6	8	3	0	**94**
Motorcycle	71	72	49	58	73	82	88	93	36	33	**655**
Omnibus	0	0	0	0	0	0	0	10	3	2	**15**
Other	28	43	15	35	48	26	28	3	4	3	**233**
Total	**366**	**359**	**234**	**307**	**329**	**281**	**363**	**308**	**167**	**128**	**2842**

Table 34: Vehicles Registered, 2011-2020 (Source: SM 2020)

Year	Private Car	*Taxi*	Dual purpose vehicle	Double cab pickup	Heavy motor car	Motor cycle	Auto cycle	Lorry and truck	Van	Bus	Tractor and dumper	Prime mover	Trai r
2011	129,318	*(6,907)*	49,132	0	1,230	53,410	112,296	13,539	26,090	2,912	3,173	650	1,83
2012	140,828	*(6,905)*	50,116	0	1,244	59,637	113,871	13,902	26,293	2,957	3,202	689	1,84
2013	153,786	*(6,915)*	49,730	1,155	1,250	65,827	114,958	14,061	26,624	2,963	3,226	715	1,84
2014	167,043	*(6,911)*	49,503	2,065	1,271	72,067	115,784	14,243	26,890	3,006	3,254	734	1,84
2015	181,392	*(6,907)*	49,301	2,689	1,284	77,603	116,085	14,372	27,229	2,980	3,244	774	1,85
2016	195,791	*(6,905)*	48,961	3,542	1,316	82,746	116,653	14,645	27,656	3,107	3,251	817	1,85
2017	212,067	*(6,909)*	48,603	4,634	1,345	88,360	117,133	15,024	28,121	3,101	3,277	873	1,91
2018	235,598	*(6,907)*	48,200	5,878	1,367	93,636	117,489	15,505	28,506	3,086	3,351	947	1,99
2019	251,973	*(6,905)*	48,025	7,083	1,370	99,111	117,752	16,086	29,125	3,087	3,427	1,055	2,08
2020	264,120		47,908	8,036	1,377	103,589	118,399	16,512	29,744	3,101	3,474	1,120	2,21

APPENDIX 4

Table 35: Number of questionnaires per blackspot

Blackspot	Number of Questionnaires targeted
Calebasses	25
Le Hochet	25
Terre Rouge	25
Pamplemousses	25
Trou aux Biches	25
Pereybere	25
Goodlands	25
Triolet	25
Piton	25
Mapou	25
Vingt Pieds Road	25
Quay Street	50
Farquhar Street	50
Sir Seewoosagur Ramgoolam Street	50
Pamplemousses Road	50
Lalmatie	25
St Julien/Riche Fond	25
Camp de Masque	25
Bel Air	25
Central Flacq	25
Mahebourg	25
Plaine Magnien	25
Rose Belle	25
Union Park	25
Nouvelle France	25
Riviere des Anguilles	25
Surinam	25
La Flora	25
Chemin Grenier	25
Baie du Cap	25
Flic en Flac	25

Gros Cailloux	25
Quartier Militaire	25
St Pierre	25
Valetta	25
Reduit/Bagatelle	25
Ebene	50
Rose Hill	50
Quatre Bornes	50
Vacoas	50
Curepipe	50
	1250

Table 36: Number of questionnaires per district

DISTRICT	No of questionnaires
Pamplemousses	125
Riviere du Rempart	150
Port Louis	200
Flacq	125
Grand Port	125
Savanne	125
Black River	50
Moka	100
Plaines Wilhems	250

b. Questionnaire Design

A questionnaire is a research instrument consisting of a series of questions to gather data from respondents. For this particular study, the questionnaire consists of 18 closed-ended questions, from which respondents can choose from a list of answers that are being provided. The questions are kept short, precise for the respondents so that they are easily understood and answered the questionnaire quickly. It is an easier process for both the respondents and the interviewer to maintain uniformity and to meet the research objectives. The questionnaire has been vetted

internally by the University of Mauritius and externally by the TMRSU and Professor Narelle Haworth from CARRS-Q (Centre for Accident Research and Road Safety-Queensland).

i. Questionnaire Content

The questionnaire consists of 18 closed-ended questions and is divided into several parts, which are as follows:

(i) **Section A** includes **Demographics**. This consists of the personal information of respondents such as gender, age, the region where they live, educational level, marital status, no of children if applicable, if they have a driving licence and for which type of vehicle.

(ii) **Section B** is on the **Past Involvement in Road Crash**. This part of the questionnaire aims to obtain information from respondents, especially to know whether they have been involved in a road crash since 2010 and what type of crash was it? For instance, in the iMAAP Accident Analysis Software, we only know the severity of the crash involved injury. This part is to know whether there was non-injury (constat à l'amiable) that the iMAAP does not capture and if so, what type of road users were involved in the road crash and whether there was a change in their behaviour and attitudes after the road crash.

(iii) **Section C** is on the **General Perception of Road Safety**. This section is to explore the general perception of respondents regarding road safety in Mauritius. For example, questions are on whether young drivers are more likely to be involved in road crashes? Whether motorcyclists and cyclists are more vulnerable to road crashes? How far are roads safe in Mauritius? Does it involve in terms of having adequate lighting, good road markings and good traffic signs and lights?

(iv) Section D is on the **Perception of Risk Factors contributing to Road Safety.** This is an important section of the questionnaire as it determines the risk factors such as over-speeding, alcohol consumption, drug consumption, bad road conditions, no proper maintenance of vehicles, weather conditions, mental stress and fatigue, using mobile

phones while driving and not abiding by road signs which lead to road crashes. Added to this, there is another question that has been set to know whether the following measures such as educating our population through awareness campaigns, improving the road infrastructure and more law enforcement will bring an improvement in road users' behaviour and attitudes as well as for the road safety situation in Mauritius.

(v) Section E is on the **General Opinion Regarding Laws and Enforcement for Road Safety**. This section aims to know whether there is adequate enforcement against lawbreakers and if fines regarding over-speeding are severe enough? In cases of drivers who consume alcohol and drive, what can be done to reduce road fatalities? The final question of the questionnaire relates to the drink-driving behaviour in Mauritius and asks respondents whether the legally permissible limit of alcohol in the blood should be 0 mg?

c. Pilot Testing

A pilot test was carried out with 30 respondents to identify any difficulties that the respondents may face while answering the questionnaire. Respondents who had a high literacy level were able to fill the questionnaire easily and took around 8-10 minutes. On the other hand, for respondents who had low literacy, the researcher had to explain each question before they could give their answers. The time and minutes were recorded and the researcher had to spend around 15-25 minutes with respondents having a low literacy level. In order, to ensure that the study is representative, variables like gender, age groups, literacy level and different regions in Mauritius were taken into consideration. Moreover, pilot testing has been helpful to assess the clarity of the questions set and to determine the average time needed to complete the questionnaire. Thus, improvements and corrections have been done accordingly.