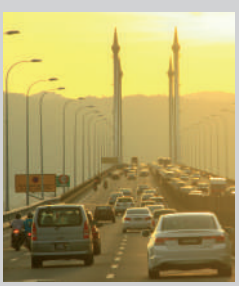
MRR No. 368



Research Report

Motorcycle Fatal Crashes During Focused Enforcement Intervention: Ops Selamat 1/2012

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Published by:
Malaysian Institute of Road Safety Research (MIROS)
Lot 125-135, Jalan TKS 1, Taman Kajang Sentral,
43000 Kajang, Selangor Darul Ehsan, Malaysia.

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Fauziana Lamin
Motorcycle Fatal Crashes During Focused Enforcement Intervention:
Ops Selamat 1/2012 / Fauziana Lamin, Ahmad Noor Syukri Zainal Abidin,
Siti Atiqah Mohd Faudzi, Afiqah Omar, Norlen Mohammed.
(Research Report; MRR No. 368)
ISBN 978-967-2078-99-9
1. Motorcycling accidents--Research--Malaysia.
2. Traffic accidents--Research--Malaysia.
3. Motorcycling injuries--Research--Malaysia.
4. Government publications--Malaysia
I. Ahmad Noor Syukri Zainal Abidin. II. Siti Atiqah Mohd Faudzi.
III. Afiqah Omar. IV. Norlen Mohammed.
V. Title. VI. Series.
363.12590720595

Printed by:
VISUAL PRINT SDN BHD (186281-A)
No 47,47-1, Jalan Damai Raya 1,
Alam Damai, 56000 Cheras,
Kuala Lumpur.

Typeface: Calibri
Size: 11 pt.

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Abstract

Motorcycle crashes have gained considerable attention due to a significant increase in numbers in each year over the last ten (10) years. These alarming figures have led road safety practitioners to strategise effective intervention measures. A good understanding of motorcycle crashes could help in instituting possible countermeasures that are more effective. For that reason, crash data involving fatal motorcycle crashes during Ops Selamat 1/2012 were collected. Crash factors that included the three (3) main road safety elements i.e. human, vehicle and road, were accordingly observed. This resulted in dominant crash characteristics being captured and highlighted including crash parameters that were not available in the existing police database. These findings play an important role in recognising motorcycle crash patterns in Malaysia, with a focus on festive seasons. These data will also assist in providing a basis for strategising road safety interventions.

1. Introduction

Motorcyclists have become more prone to road crashes in Malaysia in the past two decades. In the early 1980s to 1992, fatalities involving other road users recorded higher numbers than those involving motorcyclists. However, an obvious change in motorcycle crash frequency can be observed for three consecutive years from 1993 to 1994, 1994to 1995 and 1995 to 1996, with an annual increment of 22%, 12% and 14% respectively (MIROS, 2011). This appears to be a consistent trend. Total fatalities among motorcyclists exhibited a 2% increment each year over the last ten years.

These alarming figures triggered the respective authorities to continuously conduct comprehensive enforcement, especially during festive seasons. In 2012, an enforcement operation was conducted during Hari Raya Aidilfitri, namely Ops Selamat 1/2012. The Ops Selamat 1/2012 took place from 12 to 26 August 2012.

Ops Sikap that played a vital role in the implementation of laws and road safety over 25 festive seasons was replaced by Ops Selamat, a more comprehensive safety campaign that included road and public safety. This operation involved a minimum of 6,000 personnel including traffic police and Road Transport Department (RTD) officers.

The perception of being caught approach was implemented by locating police officers at 150 black spot locations nationwide, based on both the static and dynamic concepts. A canopy was set up in R&R and lay-by locations, serving also as a meeting point for officers from multiple related agencies such as RTD and Jabatan Bomba dan Penyelamat which were involved in the operation.

As the agency responsible for conducting road safety research, the Malaysian Institute of Road Safety Research (MIROS), in collaboration with the Polis Diraja Malaysia (PDRM), jointly carried out a study on motorcycle crashes. The study on fatal motorcycle crash patterns carried out during the 2011 Ops Sikap-24 (Mohammad et

al., 2011) served as a comparison. This study was conducted for Ops Selamat 1/2012 with the aim of continuously reviewing motorcycle crash patterns during the festive season.

1.1 Objectives of the Study

The main purpose of this report is to assist the relevant agencies to structure effective countermeasures to prevent further motorcycle crashes. This will be achieved through the aims of this study, which are:

i. To identify motorcycle crash patterns during a festive season
ii. To compare crash patterns between two consecutive festival enforcement interventions, Ops Bersepadu-24 and Ops Selamat 1/2012
iii. To recommend countermeasures, especially aspects related to motorcyclist safety for the operation of future Ops

1.2 Scope of the Study

The study was conducted to study fatal motorcycle crashes in the festive holidays of Hari Raya Aidilfitri 2012. Data collection was carried out based on a sampling of cases reported at District Police Head Quarters (IPD) of PDRM Traffic Department Malaysia. Under-reported cases were not considered in the data collection. All states in Peninsular Malaysia were included in this study.

2. Literature Review

This section focuses on literature reviews of road crash factors including human, vehicle, environment and system. Figure 1 shows the overall structure of the literature review. Findings from previous studies con motorcycle crashes on the Malaysian population, road profile, road crash and casualties, legislation as well as initiatives and mitigation measures to reduce the number of fatal crashes were among the topics reviewed. This is essential to support research findings, which will be presented in the following section.

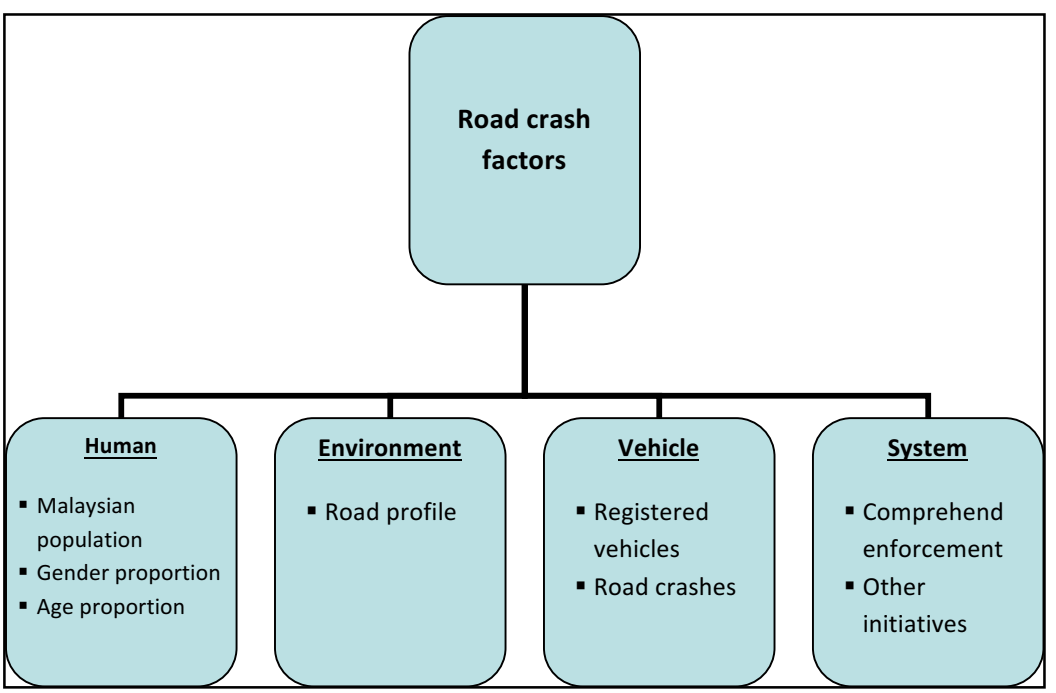


Figure 1 Road crash factors

The Social Statistics Bulletin (2012) was mostly referred to present the following statistics. It should be noted that figures in the following tables were independently rounded up. Hence, the constituent parts may not total up.

2.1 Previous Studies on Motorcycle Crashes

The motorcycle is one of the most common types of vehicles used especially in the Asian regions due to its convenience of size and affordable retail price. These trademarks have made it the top choice, especially for youngsters or low-income road users, though it significantly lacks occupant safety protection features. Motorcycle safety is one of the most discussed issues in previous studies in relation to automotive safety.

A study by Corrin et al. (1996) revealed that motorcycle crashes, particularly those involving 'approaching turn collision' or when a vehicle turns left into the path of an oncoming vehicle tend to increase injuries related to the lower extremities and abdomen. Moreover, injury severity was highest for riders in these types of collisions with the exception of head-on crashes. Another study by Pang et al. (1999 stated that most of the fatal motorcycle crashes occurred during weekends and between 1200 to 1859 hours. On the other hand, the majority of deaths involved young males and novice riders and most of the collisions occurred along slower posted speed limit roads. In terms of injury pattern, several studies by Berg et al. (1993), Braddock et al. (1992) and Kasantikul et al. (2003) discussed that head injury was the primary cause of death for motorcyclists, while the highest injuries were recorded for both lower limbs and head for hospitalised cases. In terms of frequency of injury occurrence, extremities were highlighted as the highest percentage, particularly for the lower limbs.

A numbers of motorcycle studies conducted by MIROS also concluded that among the main contributing factors for motorcycle single-vehicle crashes were inattentiveness and the driving under influence (DUI) effect on the rider. The same study also found that for rear-end collisions, there was a high incidence of truck and trailers being hit in the rear by motorcycles as compared to other types of vehicles. This finding is also

supported by a study carried out by Abdel-Aty and Abdelwahab (2004) that explained that because truck drivers experience obscure visibility in relation to other drivers, in particular motorcycle riders, it makes them more susceptible to collisions with trucks if they were to apply brakes suddenly. Also, as explained earlier, the 'opposite direction approach turn' results in the most severe crash outcomes with the greatest injuries sustained when an approaching motorcycle collides with a turning vehicle, either towards the left or right.

2.2 Overview of Motorcycles in Malaysia

Socio-economic effects in this region and the continued rise of car prices in Malaysia has further increased the demand and use of motorcycles on national roads. According to the National Automotive Policy (NAP) (2014), the targets for the Malaysian domestic automotive industry in 2020 is a total production volume of 800,000 units of motorcycles annually (2013 Forecast: 430,000 units) with 650,000 units being Energy Efficient Vehicles (EEV). Figure 2 depicts the comparison of volume between the 2003 production and the 2020 target. As can be seen, production targeted for 2020 is almost double that of 2003.

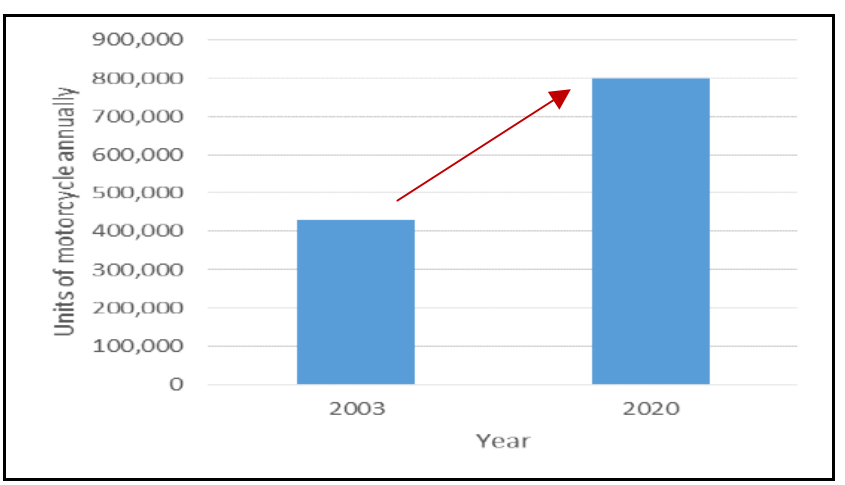


Figure 2 Production volume for motorcycles in 2003 and the 2020 target in Malaysia (NAP, 2014)

With reference to other types of vehicles on the roads, motorcycles recorded 46.7% of all registered vehicles in 2012, as shown in Figure 3.

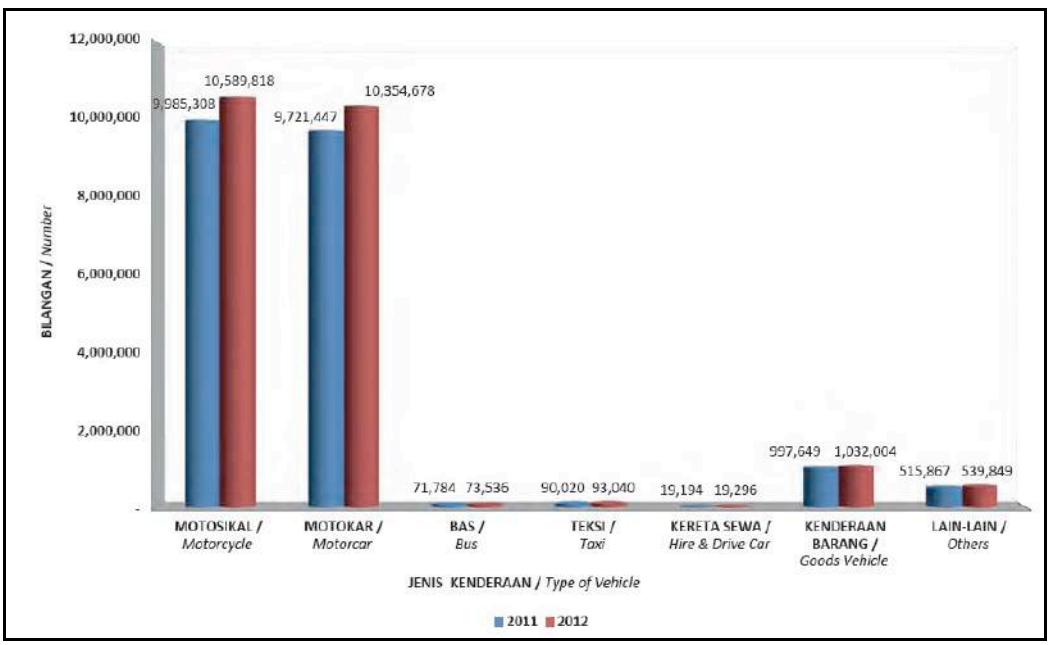


Figure 3 Total motor vehicles by type, 2011 – 2012 (Statistik Pengangkutan Malaysia, 2012)

However, due to the low level of safety protection and inferior structural integrity as compared to other types of vehicles, motorcycles are often exposed to their own vulnerability in terms of occupant safety protection. Data on road fatalities from PDRM for year 2011 has shown that motorcyclists, both riders and pillion, ranked top in terms of fatalities with the proportion being nearly 59% compared to other vehicle users (Figure 4). This trend has been consistent over a period of 5 years in terms of percentage of fatalities. The statistics also revealed that 48% of motorcycle fatalities involved youngsters between the ages of 16 - 30 years, which is a big loss of human resources to the nation (Table 1).

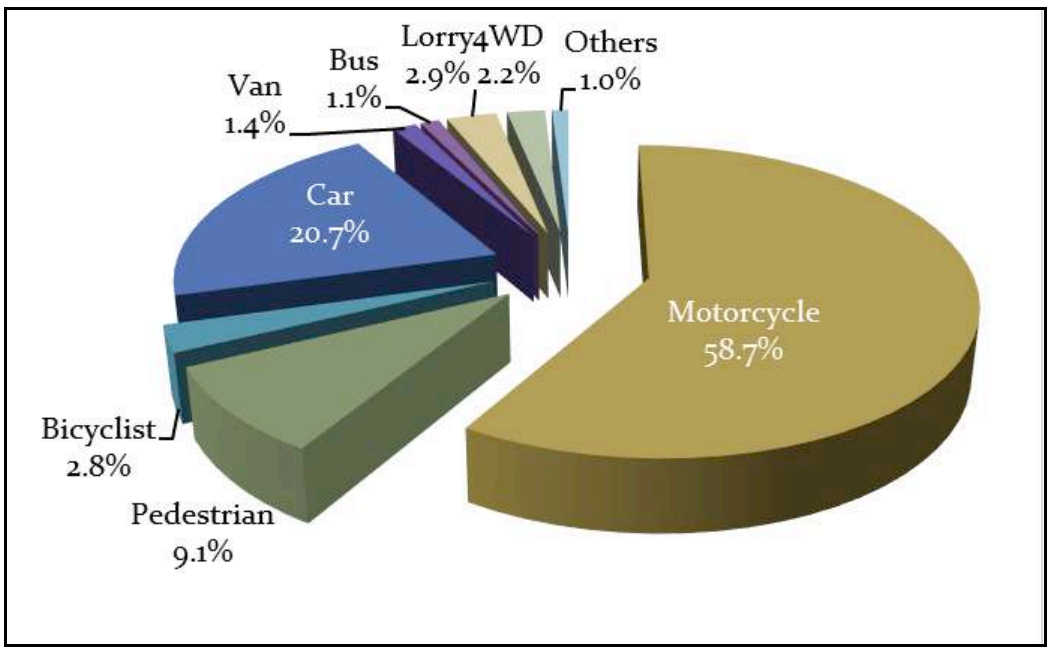


Figure 4 Fatalities by road user category for year 2011 (*Source*: Bahagian Trafik, PDRM & MROADS, 2011)

Table 1 Four-year fatality trend of motorcyclists in Malaysia

Year	Population	Registered vehicles	Fatality	Motorcycle fatality	%
2007	27,170,000	16,813,943	6,282	3646	58.0
2008	27,690,000	17,971,901	6,527	3898	59.7
2009	28,306,700	18,870,496	6,745	4067	60.3
2010	28,908,795	19,909,95	6,872	4036	58.7

2.3 Population, Gender and Age Distribution

Malaysia's population has seen a steady increase over the years. As presented in Table 2, Malaysia shows a 1.7% increase in population over the 5-year period from 2008 to

2012. The latest data shows that Malaysia's population stood at 29.3 million in 2012 (Social Statistics Bulletin, 2012).

Table 2 Time series socio-economic indicators for Malaysia, 2008 – 2012. (Social Statistics Bulletin, 2012)

Indicators	2008	2009	2010	2011	2012
Total population (million)	27.6	28.1	28.6	29	29.3
Population density (per sq. kilometre)	83	85	86	88	89
Population aged under 15 years (%)	28.7	28	27.4	26.9	26.4
Population aged between 15 and 64 years (%)	66.5	67.1	67.6	68	68.3
Population aged 65 years and above (%)	4.8	4.9	5	5.1	5.3
Sex ratio	106	106	106	106	106

Note: Population for 2008 to 2009 is an inter-censal mid-year population estimates based on the adjusted Population and Housing Census of Malaysia 2000 and 2010. Meanwhile, population for 2010 to 2012 is *a mid-year population estimate based on the adjusted Population and Housing Census of Malaysia 2010.*

Out of the total population, 26% of Malaysian are aged below 15 years and only 5% are aged 65 years and above. Another 69% constitute the remaining population aged between 15 and 64. These figures are depicted in Figure 5.

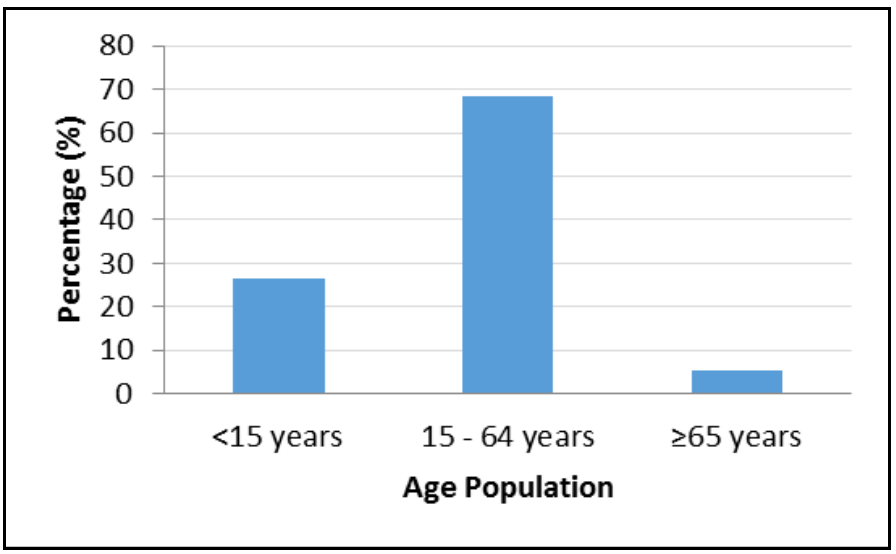


Figure 5 Age proportion of the Malaysian population

In terms of gender, the male and female proportion is calculated based on the sex ratio. The sex ratio refers to the ratio of males to females and it can be seen that the sex ratio has remained a constant 106, for the past four years. This indicates that the proportion of males and females in Malaysia is consistent, regardless of the increase in the population.

2.4 Road Profile

Good infrastructure is the backbone of economic growth of a country and therefore countries accord much priority to infrastructure. Road infrastructure in Malaysia is considered as good as found in other ASEAN countries (Runckel & Associates, 2007. There is good road infrastructure linkage between places, planned and carried out by the Public Works Department. Referring to the Social Statistics Bulletin (2012), data on road mileage provided by the Public Works Department are classified into paved, gravel and earthen road (refer to Table 3). Statistics on road mileage refers to the jurisdiction of roads by the Federal and State Governments.

Table 3 Road mileage by state and type of road, 2011 (*Source: Public Works Department, Malaysia)*

State	Area (km^2)	Federal	State			Total
		Paved	Paved	Gravel	Earth	
MALAYSIA		17,475	108,301	19,424	10,227	155,427
Johor	18,947	2,346	11,171	296	338	14,151
Kedah	9,425	1,103	5,300	143	323	6,869
Kelantan	15,024	1,259	12,885	1,912	1,104	17,160
Melaka	1,652	303	1,735	282	21	2,341
Negeri Sembilan	6,644	1,356	8,273	501	594	10,724
Pahang	35,965	3,745	12,532	386	786	17,449
Perak	21,005	1,511	7,043	690	56	9,300
Perlis	795	240	1,188	210	214	1,852
Penang	1,031	190	2,330	16	76	2,612
Sabah	73,619	1,502	8,210	10,641	1,394	21,747
Sarawak	124,450	1,424	15,326	3,778	4,126	24,654
Selangor	7,960	969	14,996	250	721	16,936
Terengganu	12,955	1,260	4,824	300	475	6,859
W.P.Kuala Lumpur	243	22	2,418	19	-	2,459
W.P. Labuan	92	98	70	-	-	168
W. P. Putrajaya	49	147	-	-	-	147

It is noted that Sarawak has the highest road mileage in Malaysia. However, considering the total area of a particular state, Wilayah Persekutuan Kuala Lumpur has the highest road mileage. It recorded 10.1 km road mileage/km^2 area of land, followed by Wilayah Persekutuan Putrajaya with 3 km road mileage/km^2 area of land. These two states have a dense road network due to their function as the economic and administrative capitals of Malaysia.

2.5 Registered Vehicles and Road Crashes

Documented figures on road accidents are only in respect of cases which have been reported to the RMP. These statistics are obtained from the Royal Malaysia Police (Traffic Department). Data given in the tables are on the number of road accidents, casualties (include deaths, minor and serious injuries), type of offences, road users and types of vehicles involved. The number of deaths as stated in the table refers only to instant death or within 30 days as a result of an injury accident.

Table 4 Number of road accidents, injuries and deaths reported by state, Malaysia, 2011 (*Source:* Polis Diraja Malaysia)

State	Number of road crashes	Injuries	Fatal	Total
MALAYSIA	449,040	18,693	6,877	25,570
Johor	59,501	1,746	1,073	2,819
Kedah	19,699	1,937	515	2,452
Kelantan	9,603	2,619	392	3,011
Melaka	14,720	704	240	944
Negeri Sembilan	21,157	1,789	374	2,163
Pahang	19,001	1,108	563	1,671
Perak	33,506	2,529	811	3,340
Perlis	1,791	547	79	626
Penang	37,158	577	392	969
Sabah[a]	16,585	1,385	398	1,783
Sarawak	17,964	972	442	1,414
Selangor	128,876	1,373	1,070	2,443
Terengganu	10,684	826	292	1,118
W.P.Kuala Lumpur[b]	58,795	581	236	817

[a]includes W.P.Labuan, [b]includes Wilayah Persekutuan Putrajaya

Table 5 Number of drivers/riders involved in road accidents reported by type of vehicle, Malaysia, 2011 (*Source:* PDRM)

Vehicle type	Fatal	Serious	Minor	Total
Bus	29	56	140	225
Jeep	151	120	224	495
Trailer	247	125	282	654
Motorcar	1,389	1,268	2,211	4,868
Motorcycle	4,169	4,060	8,011	16,240
Van	93	94	177	364
Bicycle	172	140	286	598
Pedestrian	530	419	910	1,859
Others	97	46	124	267
Total	6877	6328	12365	25570

Table 6 Number of deaths and injuries in road accidents reported by type of road user, Malaysia, 2011 (*Source:* Polis Diraja Malaysia)

Vehicle type	Injuries	Fatality
Pedestrian	1,329	530
Cyclist	347	160
Motorcar driver	1,972	828
Lorry driver	264	176
Taxi/bus driver	49	29
Motorcyclist	10,424	3,713
Pillion rider	1,647	456
Passenger	1,928	677
Others	733	308
Total	18,693	6,877

2.6 Traffic Enforcement During a Festive Season

In 2001, the Royal Malaysia Police (PRDM) started the first extensive traffic enforcement throughout Malaysia. *Ops Selamat*, which was formerly known as *Ops*

Sikap and *Ops Statik*, is a traffic safety operation carried out by the Royal Malaysian Police to ensure safety on all roads in Malaysia during festive seasons. It was conducted in conjunction with a high volume of traffic, prevalent during important public holidays i.e. Hari Raya Aidilfitri, Deepavali, Christmas and Chinese New Year. This pattern of traffic flow can be observed on routes heading towards rural areas and has emerged as a consistent scenario during extended festival public holidays.

The extensive traffic enforcement operation began in 2001. It involves collaboration of personnel from PDRM, Malaysian Road Transport Department (JPJ), Land Public Transport Commission (SPAD) and the National Anti-Drugs Agency (NADA). Among measures taken during this operation include:

1. Special monitoring of express buses
2. Monitoring using unmarked patrol cars and observation towers on highways
3. Reducing the speed limit on federal roads from 90 km/h to 80 km/h and state roads from 80 km/h to 70 km/h
4. Restricting heavy vehicles from the road on certain days

Table 7 shows the details of each operation for the main festive season in Malaysia from 2001 until 2013. The extensive PDRM enforcement operation has been continuously conducted for more than 10 years. During the period, traffic police officers were positioned at several road locations for observation and enforcement. Among the main purpose is to increase traffic compliance among road users. In general, these extensive enforcement period take place about 15 days.
In total, road crash fatalities during this Ops decreased to 1,669 cases out of 19,606 cases in the same period the previous year. As recorded in the past years, motorcyclists contributed the highest percentage of motoring fatalities. It is to be noted that for Ops Selamat 1/2012, 153 fatal motorcycle crashes were recorded. In average, ~10 fatal crashes involving motorcycles occurred in a day.

Table 7 Extensive PDRM enforcement operation from 2001 to 2013

Year	Operation	Operation date	Duration (days)	Festive season
2001	Ops Sikap I	9 – 23 Dec	15	Christmas Day

2002	Ops Sikap II	5 – 19 Feb	15	Chinese New Year
2002	Ops Sikap III	29 Nov – 13 Dec	15	Aidilfitri
2003	Ops Sikap IV	25 Jan – 8 Feb	15	Chinese New Year
2003	Ops Sikap V	18 Nov – 2 Dec	15	Aidilfitri
2004	Ops Sikap VI	15 – 29 Jan	15	Chinese New Year
2004	Ops Sikap VII	7 – 21 Nov	15	Aidilfitri and Deepavali
2005	Ops Sikap VIII	2 – 16 Feb	15	Chinese New Year
2005	Ops Sikap IX	27 Oct – 10 Nov	15	Aidilfitri and Deepavali
2006	Ops Sikap X	23 Jan – 6 Feb	15	Chinese New Year
2006	Ops Sikap XI	17 – 31 Oct	15	Aidilfitri and Deepavali
2007	Ops Sikap XII	11 – 25 Feb	15	Chinese New Year
2007	Ops Sikap XIII	7 – 21 Oct	15	Aidilfitri
2007	Ops Sikap XIV	6 – 11 Nov	6	Deepavali
2007 2008	Ops Sikap XV	19 Dec – 2 Jan	15	Christmas and New Year's Day
2008	Ops Sikap XVI	31 Jan – 14 Feb	15	Chinese New Year
2008	Ops Sikap XVII	24 Sep – 8 Oct	15	Aidilfitri
2008	Ops Sikap XVIII	24 – 29 Oct	5	Deepavali
2009	Ops Sikap XIX	19 Jan – 2 Feb	14	Chinese New Year
2009	Ops Sikap XX	24 – 29 Oct	6	Aidilfitri
2010	Ops Sikap XXI	7 – 21 Feb	15	Chinese New Year
2010	Ops Sikap XXII	1 – 16 Sep	16	Aidilfitri and Malaysia Day
2011	Ops Sikap XXIII	27 Jan – 10 Feb	15	Chinese New Year
2011	Ops Sikap XXIV	23 Aug – 6 Sep	15	Aidilfitri and Merdeka Day
2012	Ops Sikap XXV	16 – 30 Jan	15	Chinese New Year
2012	Ops Selamat I	12 – 26 Aug	15	Aidilfitri and Merdeka Day
2013	Ops Selamat II	3 – 17 Feb	15	Chinese New Year
2013	Ops Selamat III	1 – 15 Aug	15	Aidilfitri and Merdeka Day

2.7 Other Motorcyclist Safety-Related Initiatives

2.7.1 Preventing Head Injuries

Besides traffic enforcement, other motorcyclist safety-related initiatives such as the use of the safety helmet have been successfully carried out in Malaysia. The use of the safety helmet is considered the best way to prevent head injuries among motorcyclists provided that it is correctly belted. In Malaysia, a number of helmet initiatives have been carried out by the authorities to counter head injuries among motorcyclists. The initiatives began with the introduction of the first Malaysian Standard in 1969 followed by the implementation of helmet law in 1973. In 1996, the second revision of the standard for adult helmets was instituted known as MS 1:1996. This standard reviewed the detailed specifications in order to meet new requirements for testing, given the development of new materials (Radin et al., 2005).

There have been frequent revisions to the Malaysian helmet standard to accommodate the UNECE R 22 standard and to comply with the international standard. The recent Malaysian Standard for helmet known as MS 1:2011, the third revision, was developed in relation to the approval of protective helmets and their visors for drivers and passengers of motorcycles and mopeds. This standard cancels and replaces MS 1:1996, Amd. 1:1998 (MS1-1:2011).

In Malaysia, proper usage of safety helmets is clearly stated in the road traffic law, as shown below:

According to Section 73 of the Road Traffic Ordinance, 1958, everyone, other than persons exempted under rule P.U. (B) 23/1975, who rides on a motorcycle on a road, is required to wear a safety helmet. The helmet must be fitted and securely fastened in the manner required by the nature and construction of the safety helmet. Exemption is given to a:

c) Haji, Hajjah and Lebai who wear "serban"
d) Sikh who wears a turban

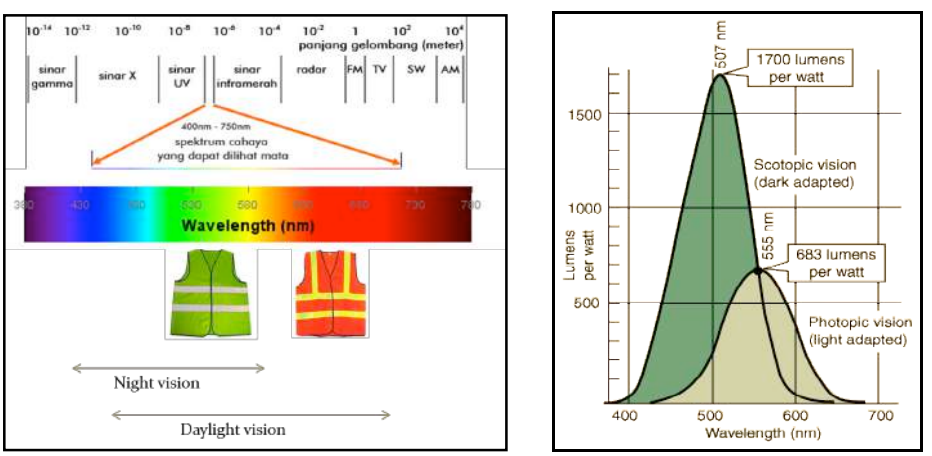
Violation of the helmet law is a compoundable offence with a maximum compound of RM300. However, the fine amount may vary depending on the discretion of the traffic police officer on duty (Kulanthayan et al., 2001; Radin et al., 2005).

Since the introduction of the helmet initiative, Radin et al. (2005) reported that the rate of proper usage of helmets has increased from 33% in 1995 to 41% in 1998 and 54% in 2000. However, if this rate is broken down to urban and rural areas, helmet wearing in rural areas was reduced to 33% (Kulanthayan et al., 2001). Therefore, Li et al. (2008) suggested that a new approach be introduced to increase helmet use. Ambak et al. (2010) in their study found that the Theory of Planned Behavior (TPB) model had goodness-of-fit indices that could be used to predict helmet use among motorcyclists. A strong predictor of safety helmet use among motorcyclists was a positive attitude towards intention to use the safety helmet. In 2011, a helmet wearing observation carried out by MIROS during OPS Bersepadu Hari Raya 2011 found the compliance rate to be 96.3% compared to 74.3% before the Ops. This proved that the presence of enforcement has an effect on the rate of helmet use.

2.7.2 Increasing Visibility

While it is critical that other drivers notice motorcyclists, it is equally critical that riders make themselves as conspicuous as possible. As shown in Figure 6(a), human eyes are sensitive to a narrow band of frequencies within an enormous electromagnetic spectrum. Light that is detectable by human eyes, namely visible light spectrum, consists of wavelengths ranging from 780 nm to 390 nm. The longest wavelength corresponds to light that is perceived by human eyes to be red, while the shortest is violet.

Existence of light intensity also has a significant effect on colour perception by the human eye. Under adequate light intensity, normally in usual daylight, human eyes have photopic vision which allows colour perception to be mediated by cone cells. Cone cells have a higher visual acuity, and also provide the eye's colour sensitivity, as depicted in Figure 6(b). Eyes are sensitive to wider bands of colour, from blue to red. On the other hand, scotopic vision is vision of the human eye under low light conditions. Cone cells do not function as well as rod cells in the low level of lighting. In this condition, eye sensitivity is narrower to blue-green bands of colour.



(a) (b)

Figure 6 Light and vision: (a) visible light spectrum, (b) light intensity for human vision

In order to increase visibility of motorcyclists, some proactive measures have been introduced worldwide. These include the mandatory use of Daytime Running Light (DRL), motorcycle reflector and safety vase. A DRL is a lighting device on the front of a motor vehicle (OECD 2013), which is automatically switched on when the vehicle moves forward. The DRL can be considered as a beneficial countermeasure for motorcycle crashes. Laboratory studies and field trials have demonstrated that motorcycles equipped with DRL are more easily seen than motorcycles without such equipment (Cairney & Styles, 2003). The standard requirement of DRL is clearly stated in the UN Regulation 48 (UN R48).

For example, in the United States, the 2008 – 2010 "Go High-Viz" Rider Conspicuity Campaign was initiated by the Minnesota Motorcycle Safety Center (MMSC) with assistance from citizens' advisory group, conspicuity product retailers and volunteer motorcyclists. Among the web-based campaign objectives were to educate riders on conspicuity products, techniques and strategies, increased use of reflective vest, white helmets and bright coloured clothing by year 2010 (Ron Lieback, 2010). Referring to Figure 6(b), at the wavelength of light on the electromagnetic spectrum of 555 nm, the photopic and scotopic vision sensitivity curves intercept optimally. This wavelength is perceived by human eyes as the green fluorescent colour, the standard colour of the safety vest. Scientifically, this could further explain the benefit of safety vest usage in improving motorcyclists' visibility under any lighting condition.

3. Methodology

This study focused on fatal motorcycle crashes during Ops Selamat 1/2012. In this particular Ops, extensive enforcement was carried out from 12 to 26 August 2012. At the initial stage, road crash casualty statistics during Ops Selamat 1/2012 were acquired from PDRM Bukit Aman Statistical Unit. In reviewing the statistics, three districts with the highest number of fatal motorcycle crashes were selected. Considering all the twelve states in Peninsular Malaysia, data from 36 District Police IPD were collected.

Four data collection teams were deployed to collect data. Every team was assisted by one police officer from PDRM Bukit Aman. Each team was responsible for conducting data collection in a dedicated region, namely North, Central, South and East of Peninsular Malaysia. One region consists of IPD for several states, as follows:

1. North – Perlis, Kedah and Perak
2. Central – Kuala Lumpur and Selangor
3. South – Negeri Sembilan, Melaka and Johor
4. East – Pahang, Terengganu and Kelantan

Figure 7 shows the overall flow of this study. Data collection was conducted using a checklist as presented in Appendix A. Two approaches were used in the process: (i) police report reviews and (ii) respective police investigation officer interviews.

Data were subjected to descriptive analyses to obtain data distributions and profiles. In addition, a comparative study was carried out between Ops Bersepadu-24 and Ops Selamat 1/2012. These two Ops were declared by relevant authorities as comprehensive enforcement initiatives during the festive season in two consecutive years, 2011 and 2012.

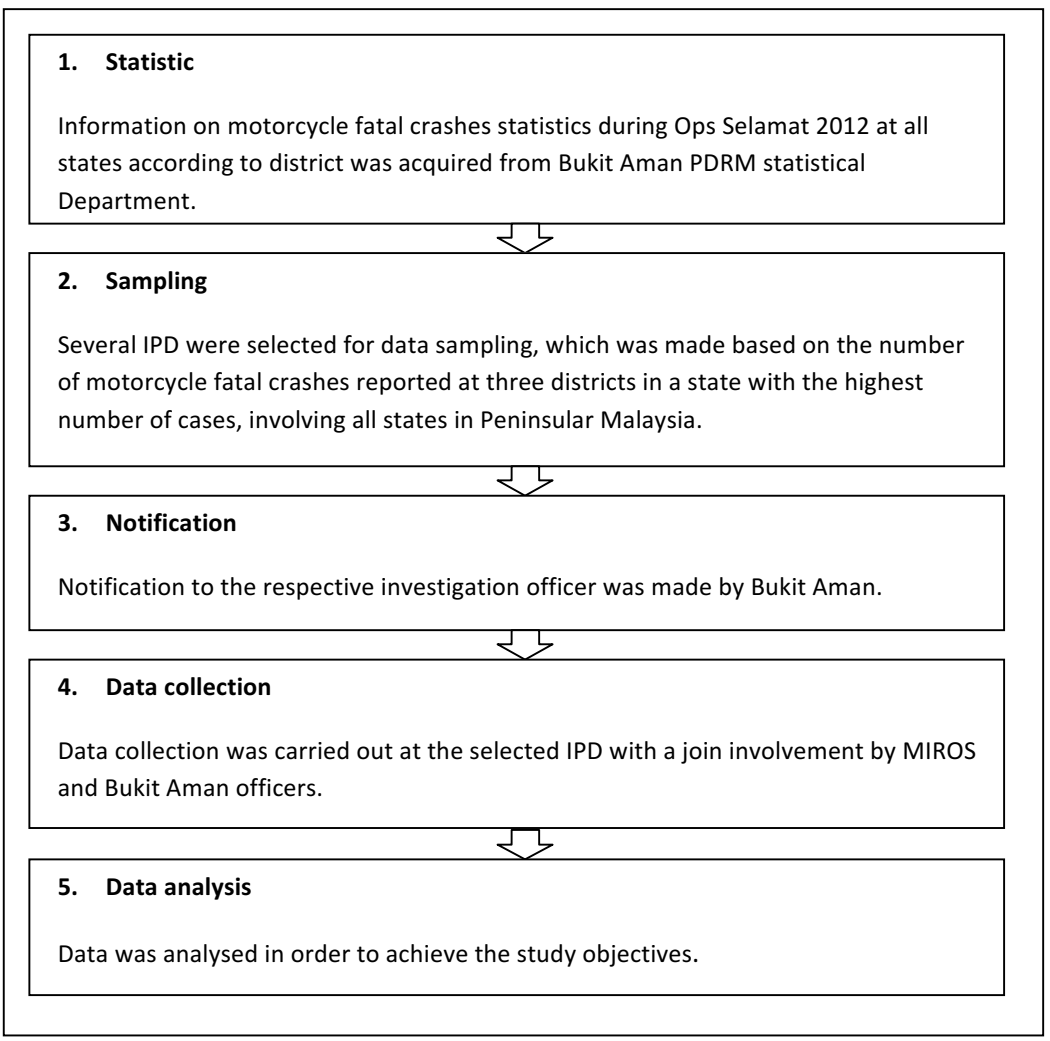


Figure 7 Methodology framework

4. Results and Discussions

A prevalence study on fatal motorcycle crashes was carried out to observe the crash pattern during Ops Selamat 1/2012. This operation was conducted for Hari Raya Aidilfitri 2012, one of the main festive seasons in Malaysia. For that purpose, the three (3) main factors of road safety were taken into account:

1. Human
2. Vehicle
3. Environment

This section discusses the results and findings of the study and is divided into four (4) subsections: (i) data sample (ii) human, (iii) vehicle and (iv) environment.

4.1 Data Sample

Road crash statistics for Ops Selamat 1/2012 were obtained from the PDRM Bukit Aman Statistical Unit. Based on three districts with the highest motorcycle fatality in a state, 137 fatal crashes involving motorcyclist were recorded. Kedah recorded the highest, with 22 crashes followed by Selangor, 15 and Perak, 14. Table 8 shows three IPDs in every state in Malaysia that recorded the highest number of motorcycle fatalities. In this study, crash data involving 82 motorcycles were collected while cases where data were not available or incomplete were omitted. Data for Sabah and Sarawak were also excluded due to cost-effective considerations.

Table 8 Motorcycle crash fatalities according to IPD with highest fatalities in a state (*Source:* PDRM)

State	Number of fatalities	State	Number of fatalities
Perlis		Melaka	
Padang Besar	3	Melaka Tengah	4
Kangar	2	Alor Gajah	4
Kedah		Jasin	1
Baling	9	Johor	
Kuala Muda	7	Nusajaya	4
Kota Setar	6	Kluang	3
Penang		Muar	3
Seberang Perai Tengah	4	Pahang	
Timur Laur	3	Kuantan	5
Seberang Perai Utara	3	Jerantut	2
Perak		Bentong	1
Manjung	6	Kelantan	
Hilir Perak	4	Gua Musang	4
Tanjung Malim	4	Kota Bharu	3
Selangor		Machang	2
Klang Selatan	5	Terengganu	
Shah Alam	5	Kuala Terengganu	6
Gombak	5	Kemaman	5
W. P. Kuala Lumpur		Marang	1
Kuala Lumpur	8	Sabah	
Negeri Sembilan		Penampang	1
Seremban	4	Sarawak	
Tampin	5	Miri	2
Jempol	2	Sibu	1

4.2 Human Factor

Motorcyclist information and their travelling pattern are among the parameters observed. In Figure 8, motorcyclists with the highest injury severity are referred to as rider 1 while the crash opponent is referred to as rider 2 or driver. In terms of gender (Figure 8) and education level (Figure 9), males and secondary education level were dominantly recorded with 97.6% and 68.9% respectively. It can be observed that the percentage of males is higher than females for both rider 1 and rider 2 or driver.

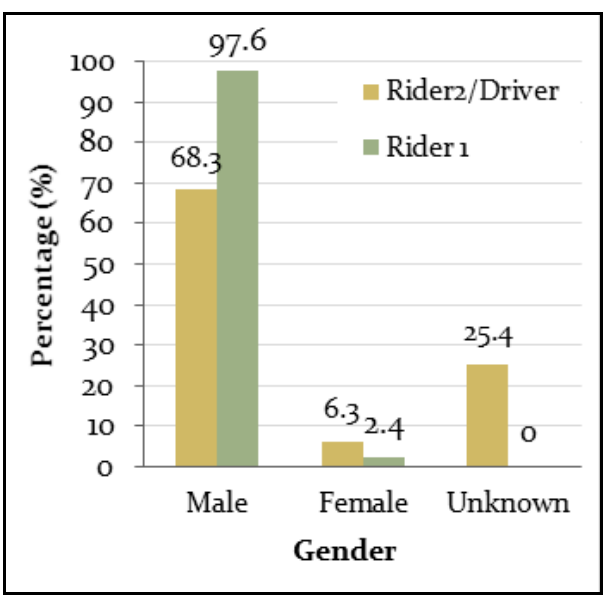


Figure 8 Gender information

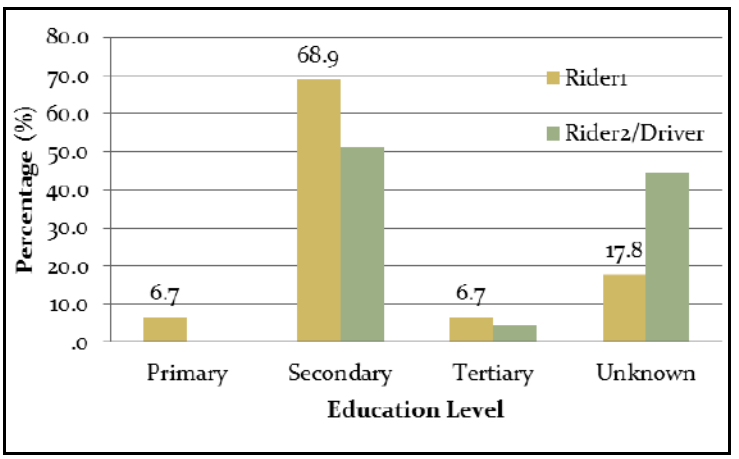


Figure 9 Education level

As the study focused on fatal crashes during a festive season, a hypothesis was that outsiders could have contributed significantly to fatal crashes for reasons of being non familiar with roads. However, it was found that most of the fatalities involved local residents, (85.4% for rider 1 and 79.2 for driver/rider 2), as shown in Figure 10. For purposes of the study, local means people who live in the district where the crash occurred.

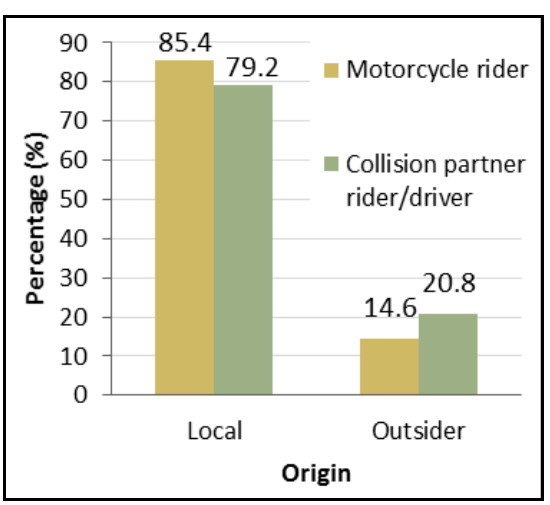


Figure 10 Rider and drivers' origin

In addition, the road familiarity factor may also be experienced by non-citizen rider/driver. Again, we were proven wrong as most of the fatal crashes involved Malaysians. As shown in Figure 11, only 7.3% of rider 1 were Indonesians and Thais with Indonesians contributing 6.1 and Thais 1.2%.

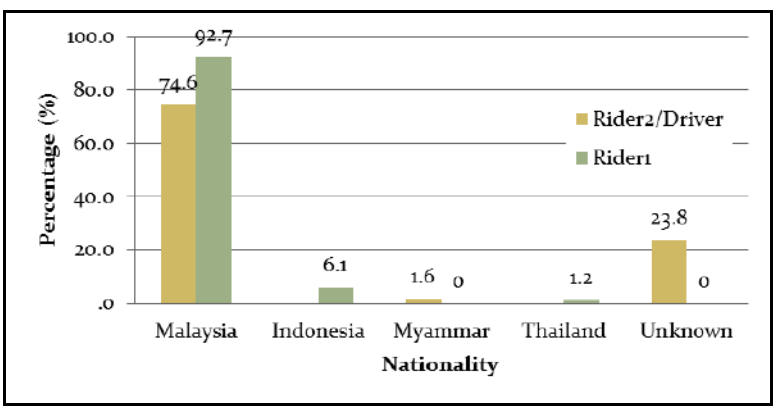


Figure 11 Nationality of the riders and drivers

According to the Road Transport Act 333 Rules Section 39 (2006), riders below the age of 16 are prohibited from driving on the road. This group is frequently classified as under-age, the lowest in an age classification. On the other hand, people who are 60 years old and above are classified as elderly, based on a working definition from the United Nations (UN) where though a standard criterion has not been adopted, generally 60+ years refers to the older population (personal comm 2001). Lacking an accepted and acceptable definition, in many instances the age at which a person became eligible for statutory and occupational retirement pensions has become the default definition. Based on these criterion, riders were classified by age as follows:

i. under-age – below 16 years old
ii. teenager – 16 to 23 years old
iii. adult – 24 to 59 years old
iv. elderly – 60 years old and above

Based on the age classification, Figure 12 shows that 41.5% of riders are adult riders closely followed by teenagers with 36.6% and the elderly at 15.9% (Figure 12). It is of

interest to note that under-age riders (below 16 years old) contributed 6.1% of the total data collected. The legal requirement for motorcycle riding is 16 years and above.

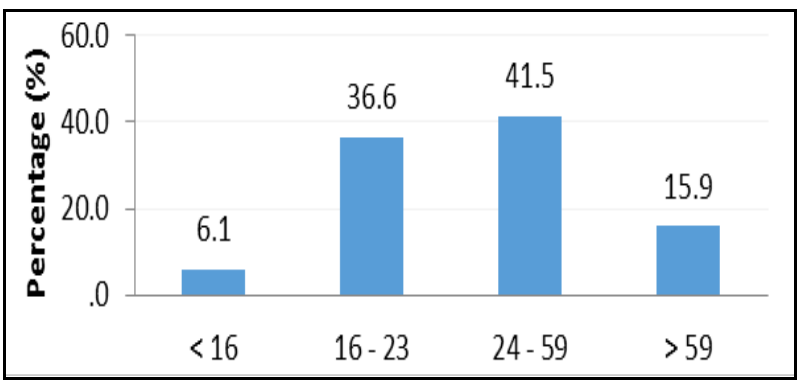


Figure 12 Fatal motorcycle crashes by age

In terms of licensing, Figure 13 depicts status of rider's driving license by age. Surprisingly nearly half of Rider 1 (42.7%) have no driving license while the Teenager group had the highest non-licensed riders at 46.7%. A high percentage of non-licensed riders was also observed among the elderly and adult groups, at 41.7% and 33.3% respectively. These figures indicate that rider incompetency may have contributed sigificantly to fatal crashes. This is because they do not have the experience of structured training on proper driving and may not have adequate knowledge of road safety rules to ensure their safety while on the road. A comparison of non-licensed riders for 2011 and 2012 Ops shows an almost consistent figure of 43% and 42.7% respectively (Figure 14).

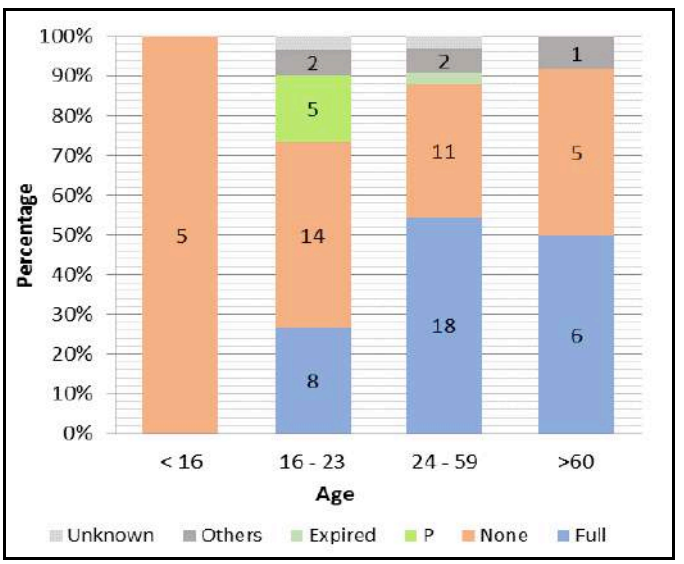
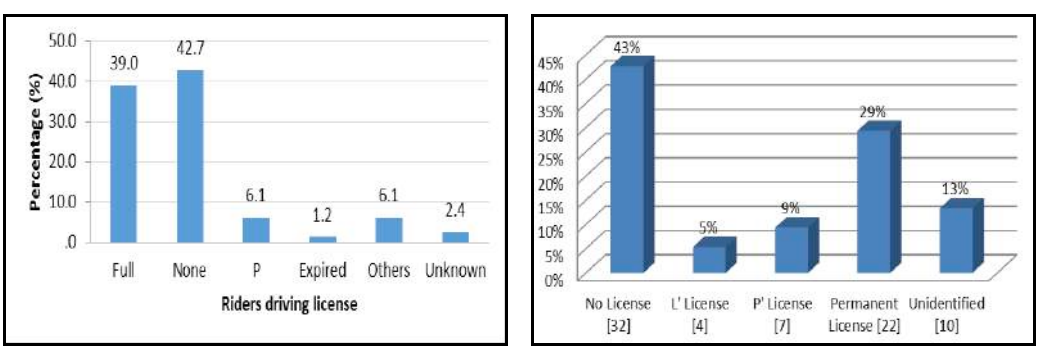


Figure 13 Status of riders' driving license by age



(a) (b)

Figure 14 Motorcyclists' driving license information during festive season in two consecutive years: (a) 2012, (b) 2011

On average, 3.38 fatal crashes involving motorcycles were recorded in an hour. As shown in Figure 15, most crashes occurred at night, in the time range of 20:00 to 23:59 midnight, with an average of 5 cases per hour. The second highest figure was captured in the time range of 14:00 to 23:59 with 4 fatal crashes per hour. Overall, the time

range between 14:00 to 23:59 had a high fatal crash occurrence as the number of crashes per hour was higher than the mean.

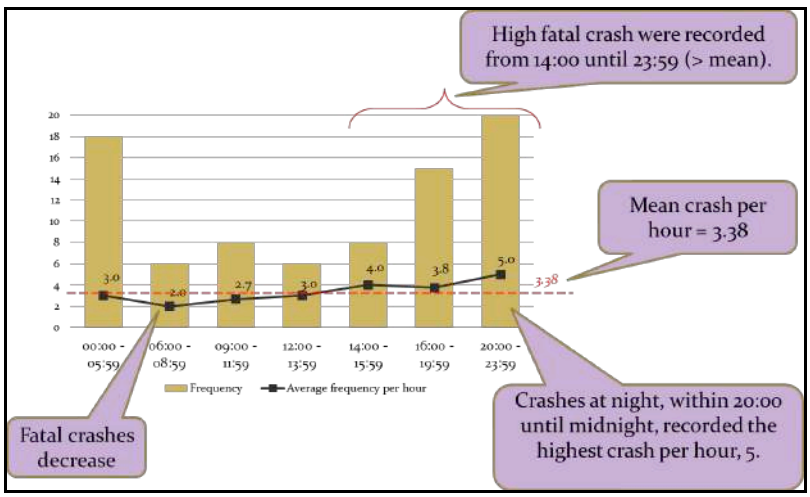
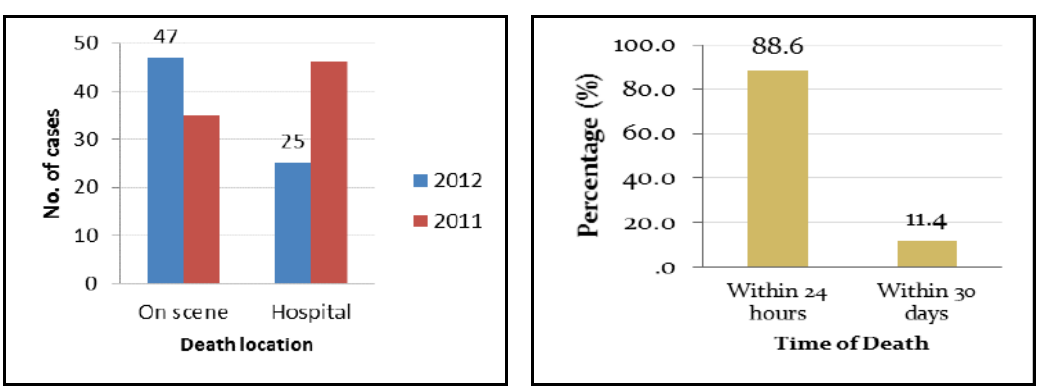


Figure 15 Time of crash

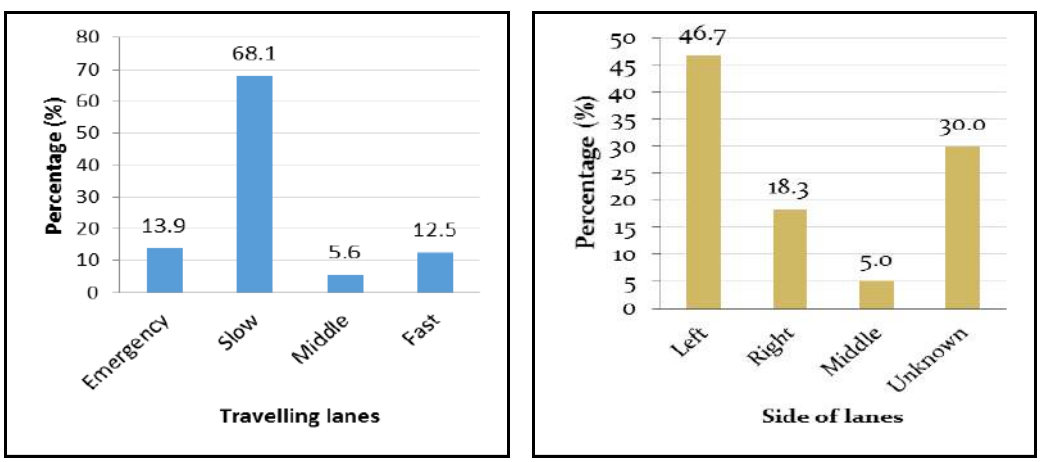
Injury severity was observed in terms of crash location and time of death. As shown in Figure 16, death location for the two (2) consecutive years did not exhibit a consistent trend. For 2012, 47 cases of severe crashes were observed,of which 65.3% died at the crash scene while 88.6% of the motorcyclists died within 24 hours after the crash.



(a) (b)

Figure 16 Comparison of (a) death location (b) time of death

For lane usage (Figure 17), 68.1% of the motorcyclists were travelling on the slow lane at the time of the crash. However, 18.1% were found to be at the lane considered risky for motorcyclists, with 12.5% and 5.6% of them travelling at the fast and middle lanes respectively, where mass incompatibility could be an issue. In terms of motorcycle positioning, various positions can be observed including left (46.7%), right (18.3%) and middle of the lane (5.0%).



(a) (b)

Figure 17 Details of lane usage: (a) travelling lane, (b) side of lane

Travelling distance of the crash victims was also observed. In this study, 3 km distance was randomly chosen as the cut-off distance to differentiate between short and long distance. As shown in Figure 18, a travelling distance of more than 3 km appears more dominant for the collision partner. Meanwhile, no significant difference was observed for rider 1. This data could be used for a longitudinal study for better pattern interpretation.

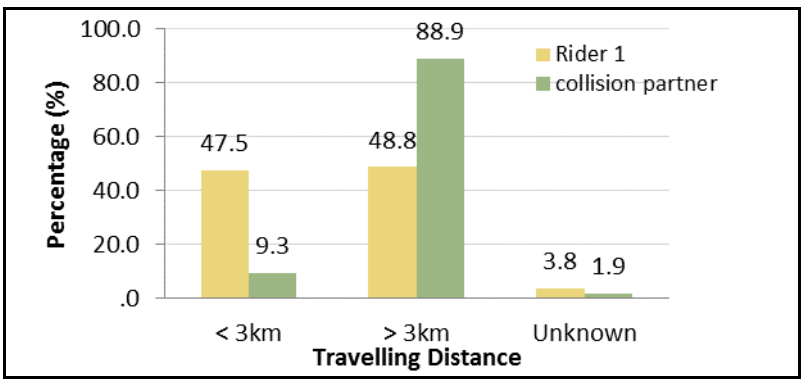


Figure 18 Travelling distance of rider 1 and collision partner

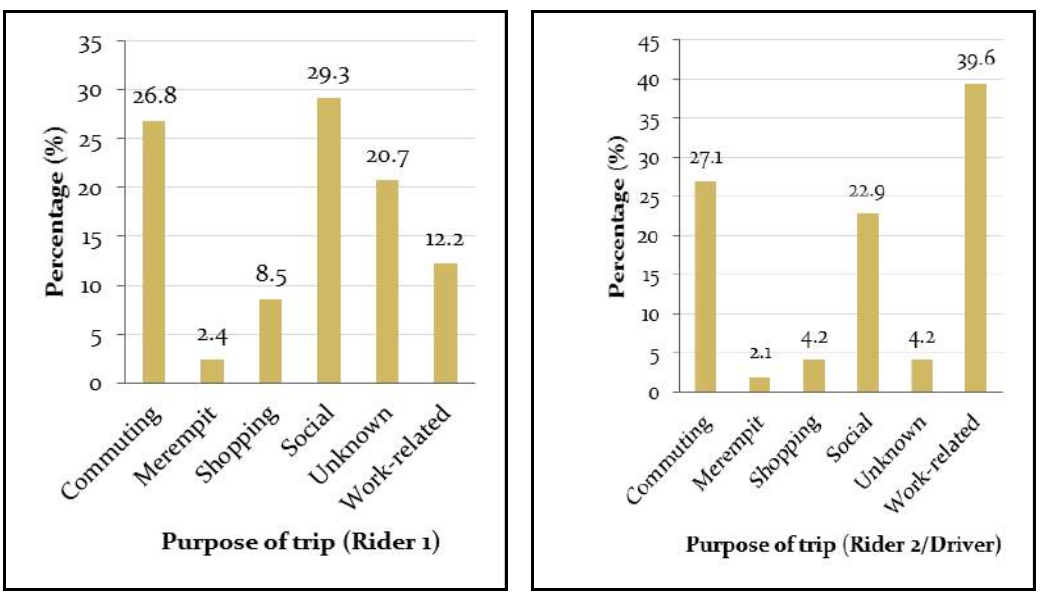
All journeys made whether intentionally or otherwise must have a purpose. Table 9 shows the purpose of trip of the motorcyclists during the OPS. Based on the availability of data recorded in the police report, the purpose of trip can be classified into six (6) categories: social, shopping, work-related, *merempit*, commuting and unknown.

Table 9 Definition of purpose of trip

Term	Definition
Social	Covers a number of activities; visiting friends and relatives, recreation, loitering, leisure, holidays and entertainment. It also includes going to cafes/restaurants and attending an event or visiting mosques.
Shopping	Motorcyclists who travel from or to grocery shop, for example.
Work-related	Motorcyclists who travel from or to work, including any delivery works.
Merempit	Motorcyclists who participate in illegal street racing.
Commuting	Any travel made by motorcyclists from or to home, without specifying the reasons.
Unknown	The information is not available or not made known by the police.

For both rider 1 and rider 2/driver, commuting shows a significant percentage of occurrence for purpose of trip, approximately 27%. Purpose of trip recorded by rider 1

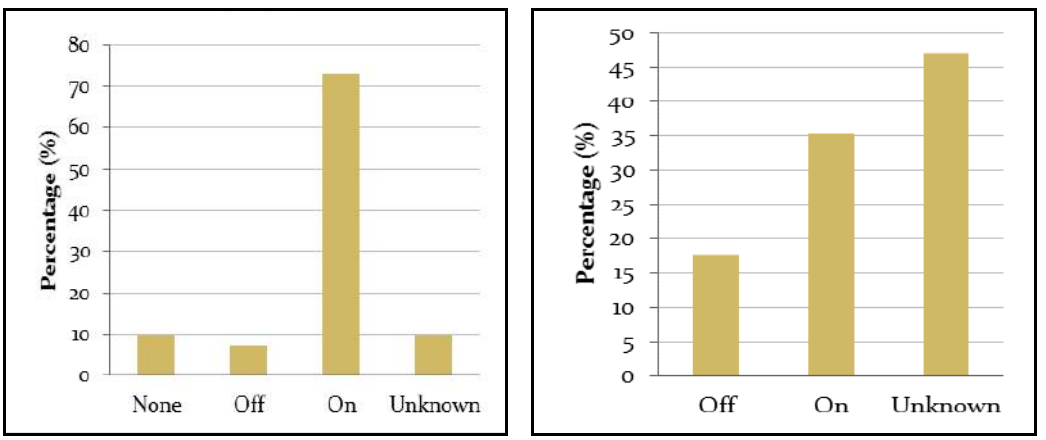
is social which constituted almost one-third of the total (29.3%). Meanwhile, for rider 2/driver, work-related recorded the highest, and this was more than one-third of the total (39.6%). Besides, fatal crashes related to '*merempit*' as purpose of trip have also been captured in the data. These data are shown in Figure 19.



(a) (b)

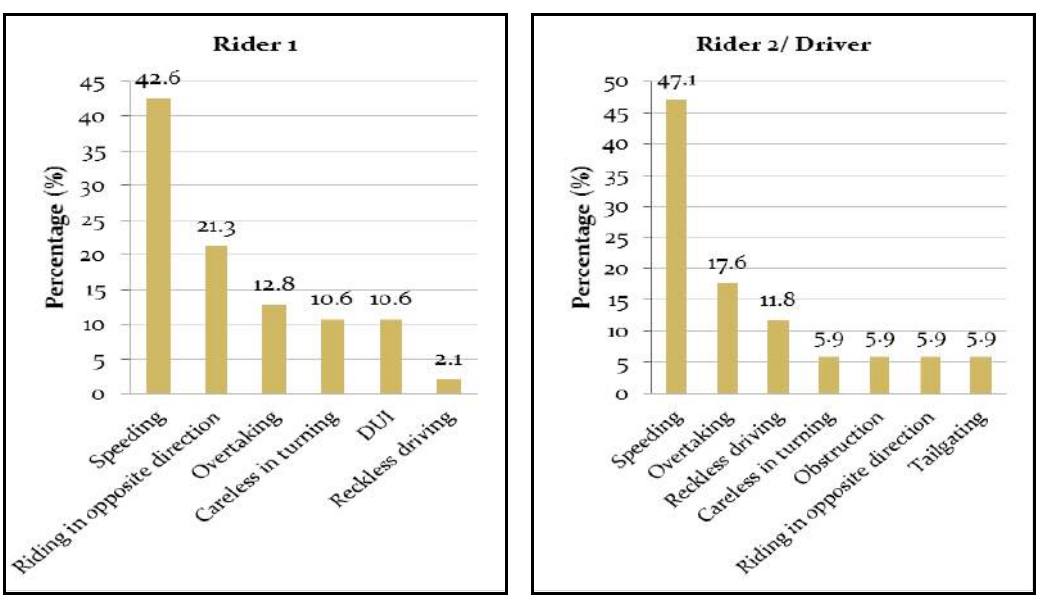
Figure 19 Purpose of trip for collision partners: (a) rider 1, (b) rider 2

According to police reports, helmet wearing is not an issue for both rider and pillion (Figure 20). Nature of violation by both crash participants was also observed. Referring to Figure 21, it can be seen that speeding recorded the highest violation compared to other categories. Surprisingly, opposite direction riding also showed a high percentage (21.3%) for rider 1. Other than that, crashes related to driving under influence (DUI) recorded 10.6%. This figure of 10.6% for DUI can be considered high as the sample for this study was comparatively small.



(a) (b)

Figure 20 Helmet wearing by motorcyclists: (a) riders, (b) pillion



(a) (b)

Figure 21 Nature of violation by crash participants: (a) Rider 1 (b) Rider 2/driver

Our observation also revealed that in 54% of the fatal cases, the motorcyclists were wearing a dark shirt at night. Figure 22 shows the colour of the attire of motorcyclists

as reported in the police report. Colours highlighted in red are ideally more sensitive to the human eye during a specific lighting condition.

It is noted that a high percentage of attire colour with low acuity to human eyes was recorded. This may lead to low visibility from the perception of other road users. Human eye sensitivity was briefly discussed in Section 2.7.2.

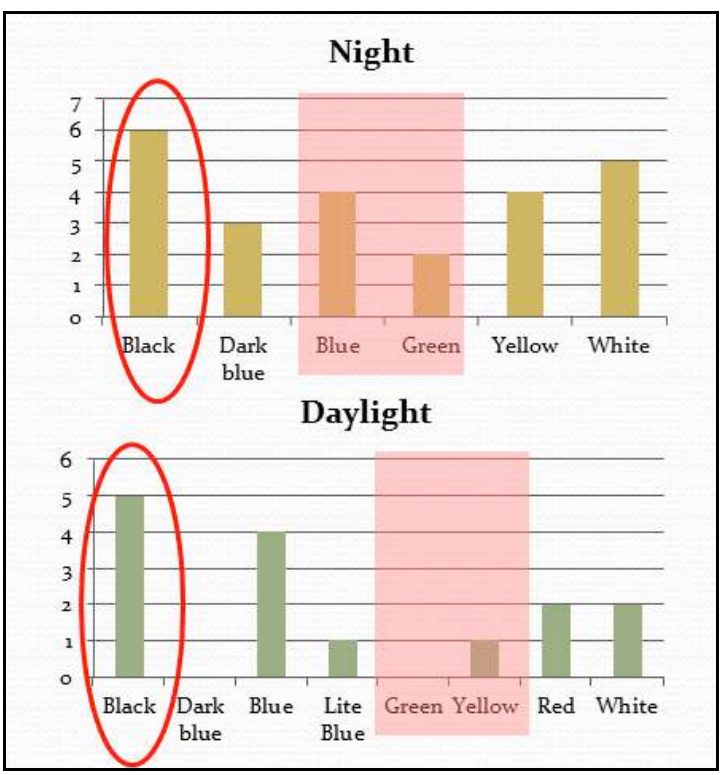


Figure 22 Motorcyclists' attire colour

4.3 Vehicle Factor

The model of the motorcycle was one of the parameters observed for vehicle factor. As presented in Figure 23, most of the motorcycles recorded were Honda (45.1%)

followed by Yamaha (35.4%). However, the data may over-represent these two famous registered motorcycles in Malaysia.

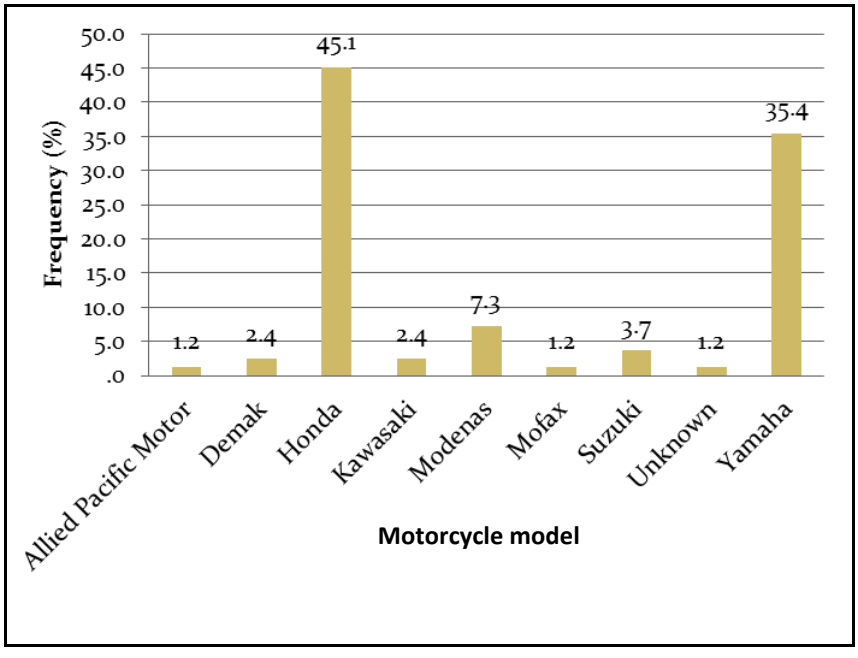


Figure 23 Motorcycle model

In terms of engine capacity, 100 cc and 110 cc engine capacity recorded the highest fatal crash occurrence, at 39.2% and 31.6% respectively (Figure 24). This data may not reveal that these small capacity motorcycles are prone to fatal crashes compared to the higher capacity models. This is because the total number of register motorcycles according to engine capacity should be taken into account.

In this study, vehicle modification data were not adequate except for information on the existence of the side mirror. As shown in Figure 25, more than half of the motorcycles (51.2%) were not equipped with proper side mirror, either only one side (15.8%) or even worse, none (29.2%). These figures may reflect inadequate view of the riders which which could have led to lack of anticipation and poor decision making while riding.

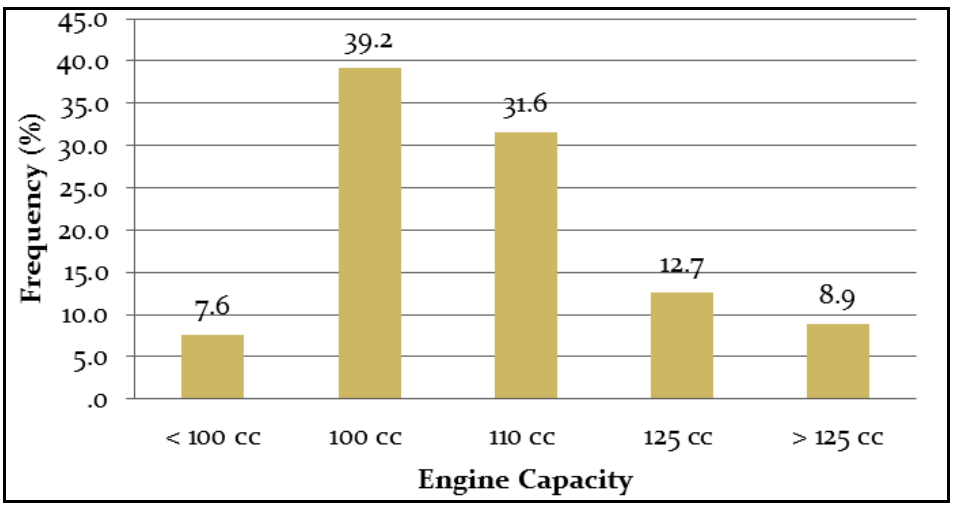


Figure 24 Motorcycle engine capacity

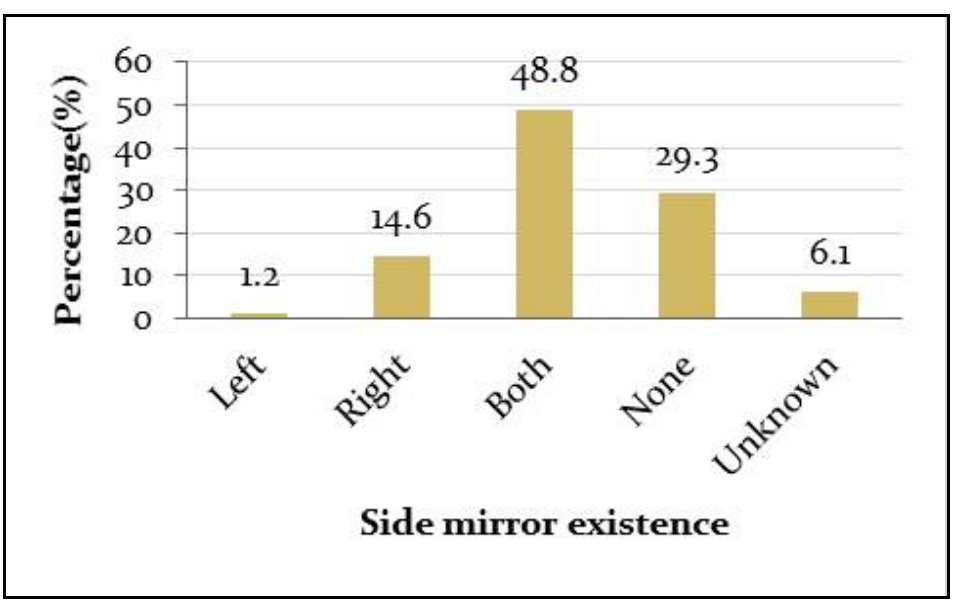
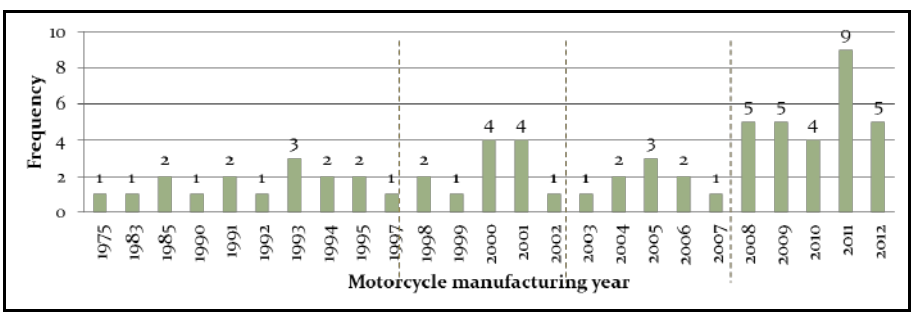


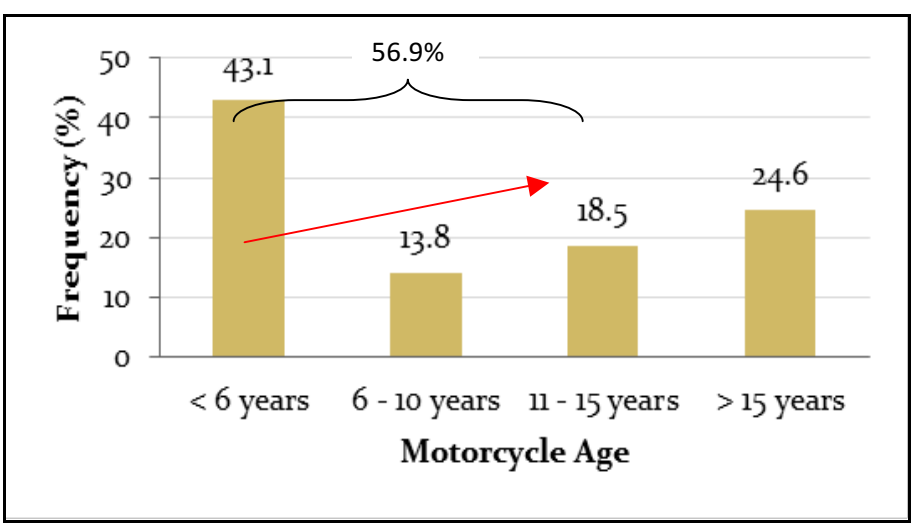
Figure 25 Side mirror existence

Motorcycle age may be reflected in its performance. Figure 26(a) shows the manufacturing year of all the motorcycles involved in the investigated fatal crashes.

The oldest motorcycle was manufactured in 1975, giving it a age of 38 years at the time of the crash. The occurrence of crashes gradually increased from 13.8% to 24.6% with increasing age of the motorcycle, from 6 years and onwards. In summary, it can be observed that motorcycles aged 6 years and more showed a greater occurrence of crashes at 56.9% of the total cases studied (Figure 26(b)).



(a)



(b)

Figure 26 Motorcycle age by (a) discrete year and (b) five-year group

In terms of vehicle control, road familiarity eficiency is among the crash contributing factors. This may be indicated by ownership of the motorcycle. It can be seen that 60% of local motorcyclists are not owners of the motorcycles they ride. While vehicle

handling could be an issue for outsiders who ride motorcycles they do not own, road familiarity could be an additional issue as 50% of the motorcyclists were outsiders (Figure 27). In addition, 31.3% of the motorcyclists had an invalid road tax (Figure 28).

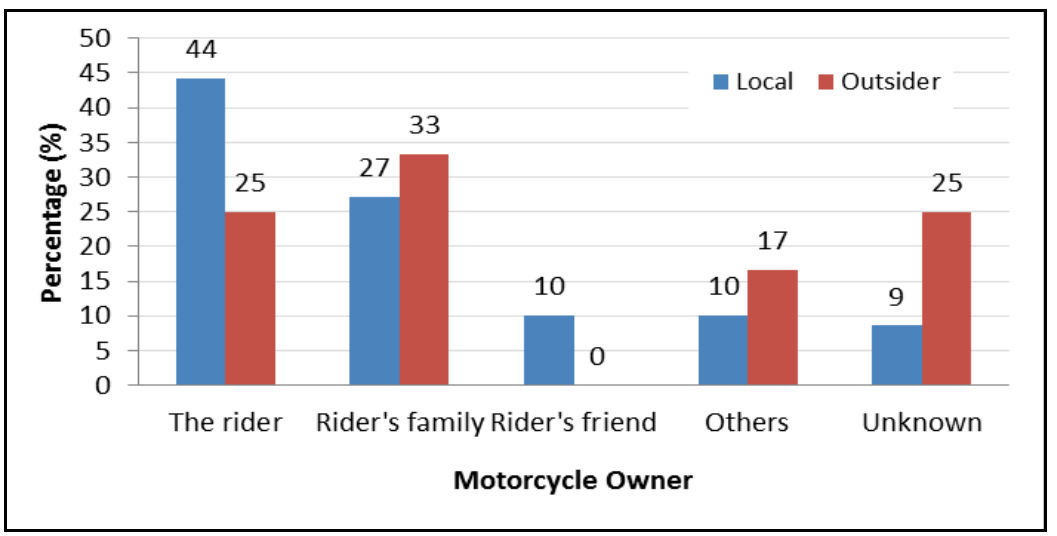


Figure 27 Motorcycle ownership

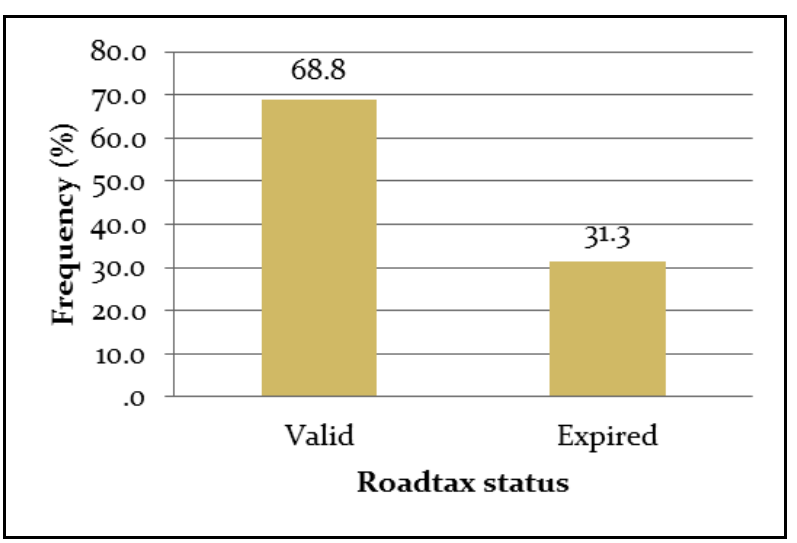
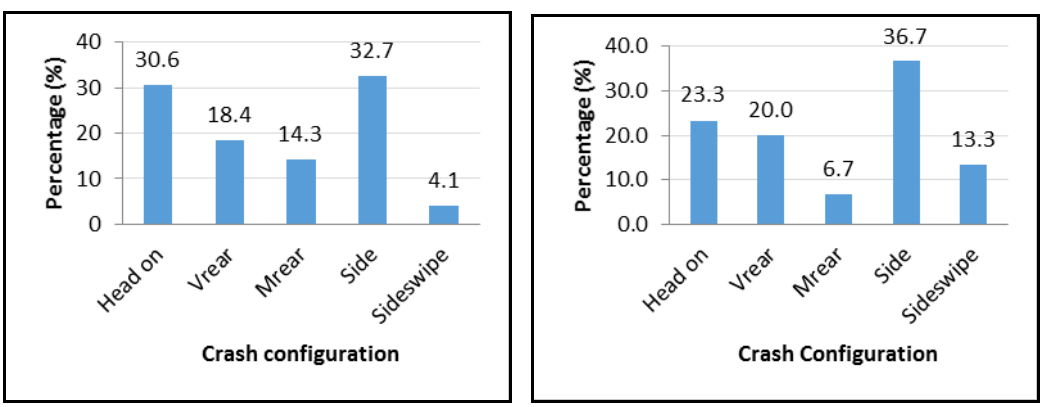


Figure 28 Road tax validation status

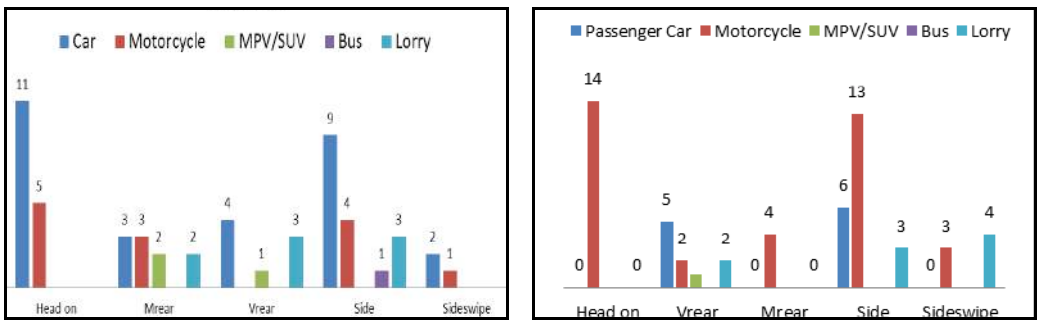
As shown in Figure 29, side impact recorded the highest cause of crashes for both 2011 and 2012 Ops with 32.7% and 36.7% respectively. This is followed by rear impact with 32.7% and 26.7% for 2011 and 2012 respectively. These figures are regardless of the motorcycle being hit by another vehicle (refered to as 'Vrear') or otherwise (refered to as 'Mrear'). It is interesting to note that a higher number of motorcycles were hit from the rear compared to motorcycles being hit by other vehicles for both Ops.



(a) (b)

Figure 29 Crash configuration profile for Ops in different years: (a) 2011 (b) 2012

In relation to motorcycle collision partners, lorries shows a lower crash occurrence compared to motorcycles and cars. This could be due to enforcement of banning heavy vehicles from the roads during the festive season in Malaysia. The collision partner trend is not consistent for the two Ops. As shown in Figure 30, the car significantly occurred in crashes with motorcycles for 2011 but was replaced by the motorcycle for the 2012 Ops.

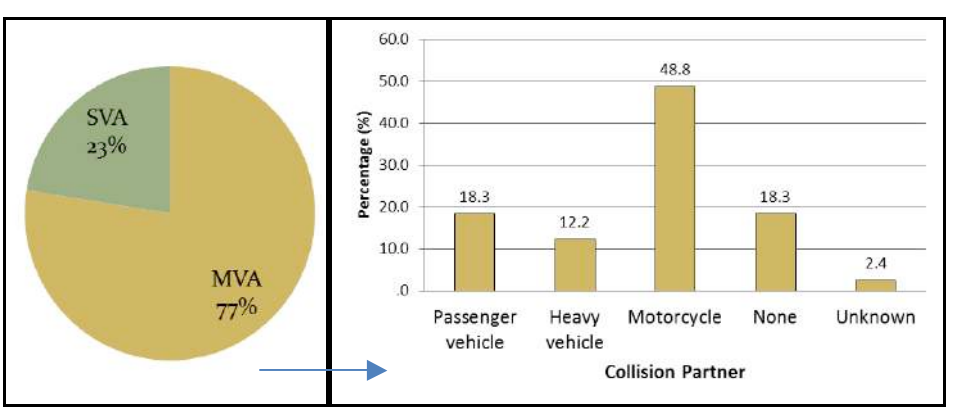


(a) (b)

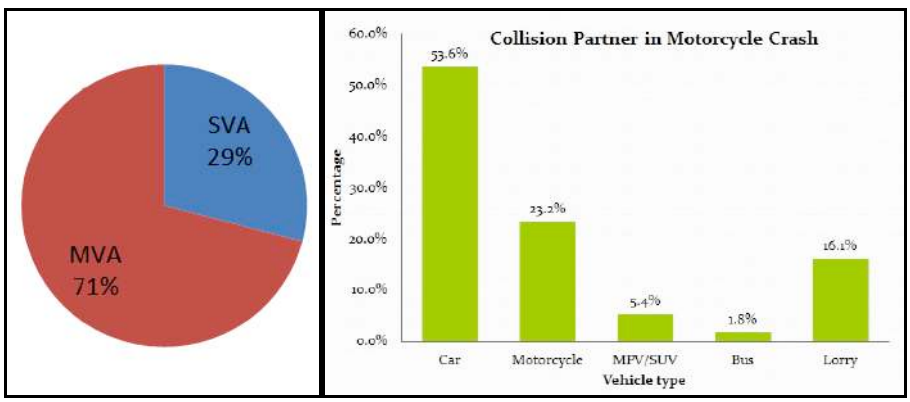
Figure 30 Crash configuration by collision partner

Of the 82 motorcycle crashes, 77% collided with other vehicles, which is classified as multiple vehicle accident (MVA). The remaining 23% were involved in single vehicle accidents (SVA). As illustrated in Figure 31, MVA was dominant in the two (2) years of study with quite a similar contribution. More interesting, for 48.8% of the crashes which is almost half of the MVA cases, the motorcycle was found to be the motorcycle collision partner.

This indicates that the construction of an exclusive motorcycle lane may not be the best intervention strategy for decreasing motorcycle crashes. However, this pattern of motorcycle-motorcycle crashes did not occur for the 2011 Ops, as the car (53.6%) recorded the highest collision partner.



(a)



(b)

Figure 31 Motorcycle collision partner: (a) 2012 (b) 2011

In addition, it is interesting to note that most of the motorcycles were black, blue & red, as depicted in Figure 32. Black comprise of 32.9% out of all while both red and blue have the similar proportion, 26.8%, respectively. Black, dark blue and dark red obviously could lead to a low visibility by other vehicles. Therefore, the use of proper reflector on the motorcycle and safety vase for the motorcyclists are recommended to improve visibility and avoiding crash.

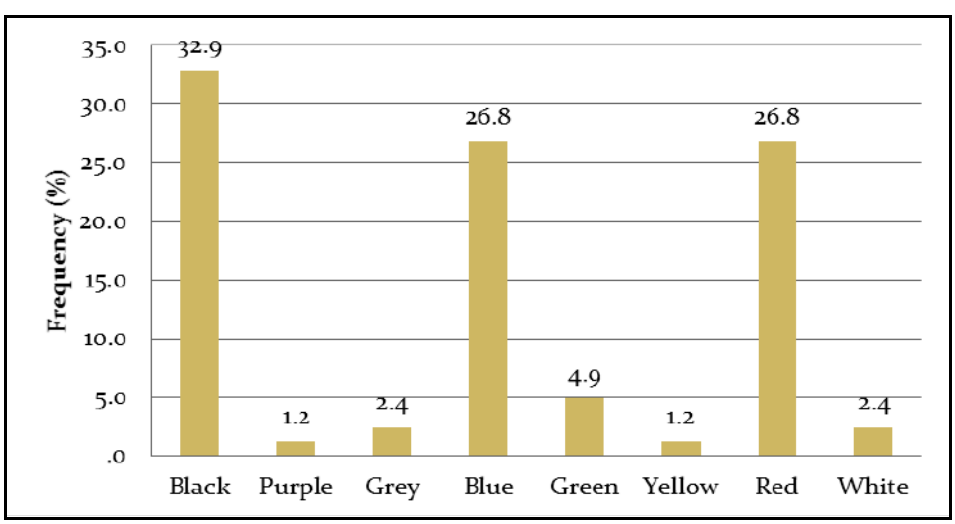


Figure 32 Motorcycle colour

4.4 Environment Factor

Dominant factors related to road environment have also been observed. For non-daylight cases, 53.2% of the crashes occurred on lighted roads while 34% occurred on roads without lamp posts (refer to Figure 33). Bad weather was found to be insignificant in contributing to motorcycle fatal crashes, as 91.3% of the crashes occurred in good weather (Figure 34).

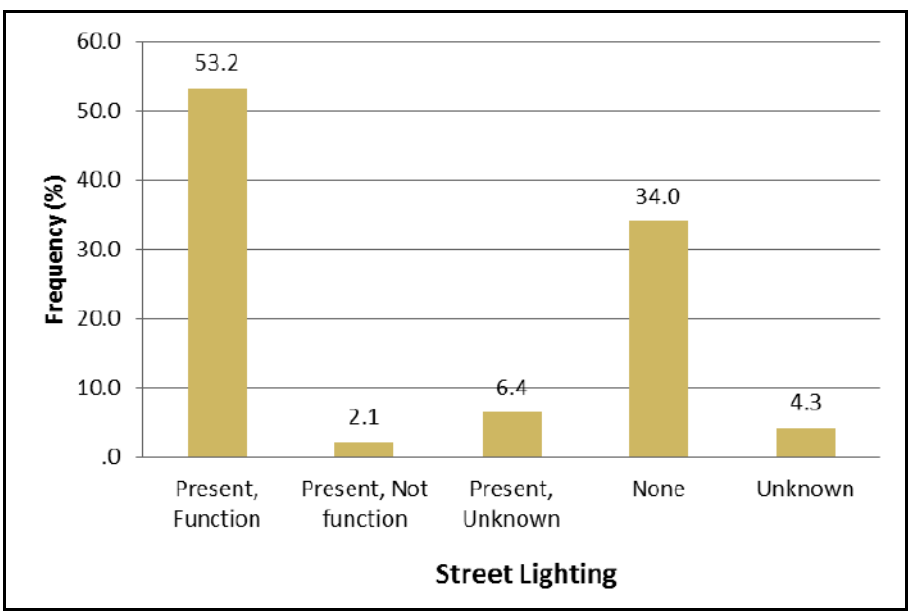


Figure 33 Street lighting

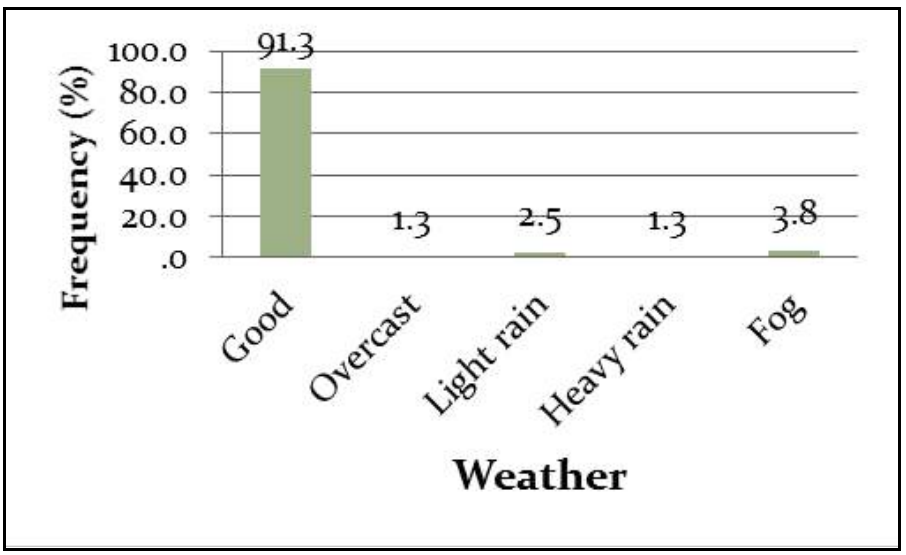
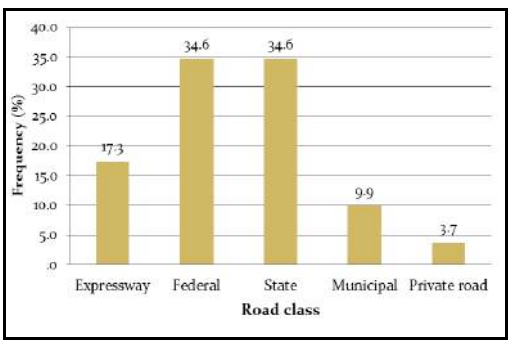
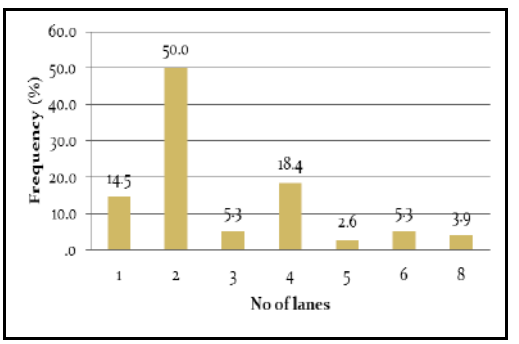


Figure 34 Weather

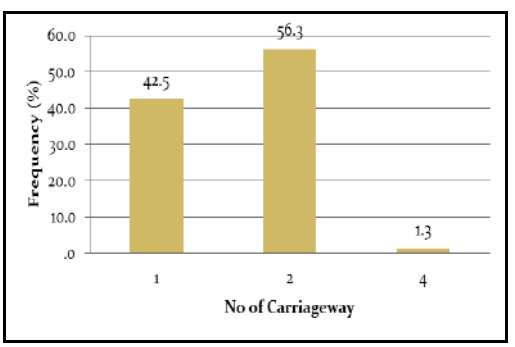
Figure 35 represents road design at the crash scene , that is road class, number of lanes, carriageway, lane width, intersection and presence of traffic signal. Federal and state roads recorded the highest fatal crash occurrences, with both road classes contributing 34.6% each to total crashes. In terms of road design, roads with two (2) lanes, dual carriageway, lane width between 2.75 m to 3.5m and roads without traffic signal show the highest percentage. Further, midblock type of road intersection recorded the most dominant percentage, 79%, with 70% of them having no junction within a 100m radius from the crash location. It is noted that a high percentage of crashes occurred in straight (78%) and an even (81%) road profile (Figure 36). These figures may be used in determining effective locations for future enforcement strategies.


Frequency (%)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
.0
17.3
34.6
34.6
9.9
3.7
Expressway
Federal
State
Municipal
Private road
Road class

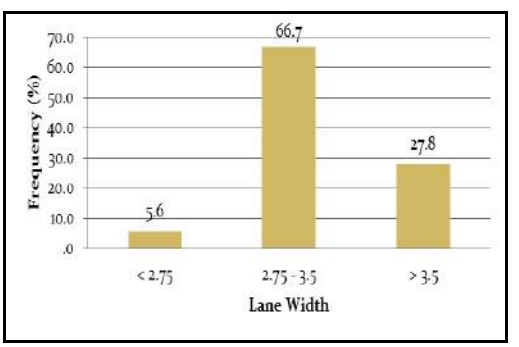
(a)


Frequency (%)
60.0
50.0
40.0
30.0
20.0
10.0
.0
14.5
50.0
5.3
18.4
2.6
5.3
3.9
1
2
3
4
5
6
8
No of lanes

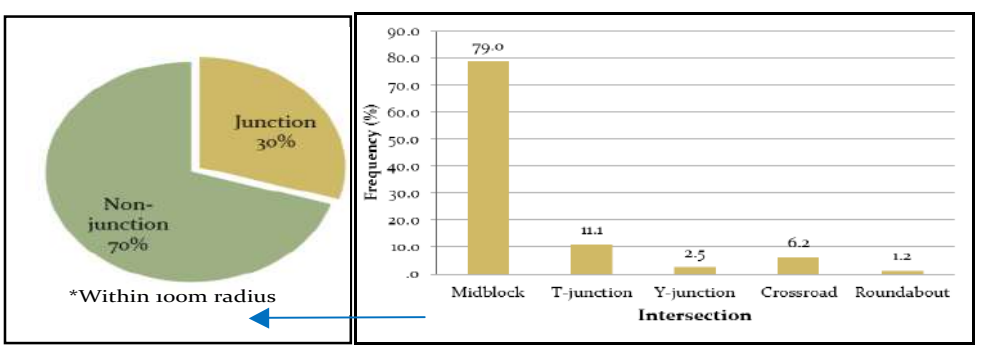
(b)


Frequency (%)
60.0
50.0
40.0
30.0
20.0
10.0
.0
42.5
56.3
1.3
1
2
4
No of Carriageway

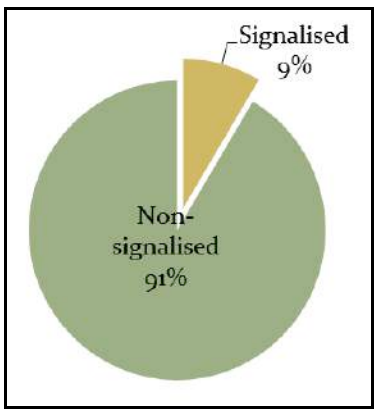
(c)


Frequency (%)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
.0
5.6
66.7
27.8
< 2.75
2.75 - 3.5
> 3.5
Lane Width

(d)


Junction
30%
Non-
junction
70%
*Within 100m radius
Frequency (%)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
.0
79.0
11.1
2.5
6.2
1.2
Midblock
T-junction
Y-junction
Crossroad
Roundabout
Intersection

(e)



(f)

Figure 35 Crash scene road design: (a) road class, (b) number of lanes, (c) carriageway, (d) lane width, (e) intersection, and (f) presence of traffic signal

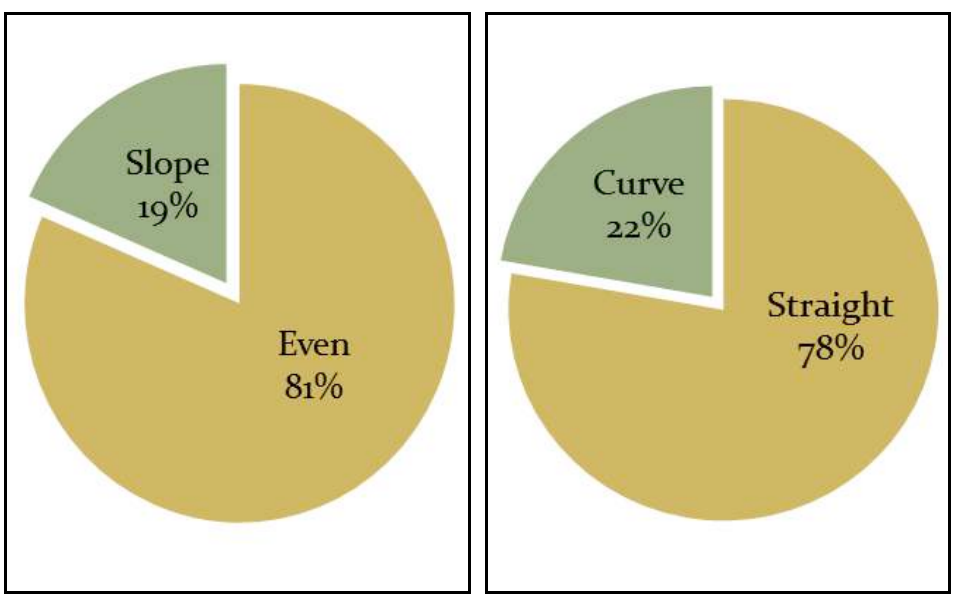


Figure 36 Road profile of the crash scenes

5. Conclusion

Crash patterns according to the main three crash factors i.e. human, vehicle and road have been discussed in depth. Findings from this study can be utilised for advocacy of road safety campaigns in the future. A focus target group can be determined based on the profile of the fatal cases which should include gender and age. This is indeed essential for a realistic, justified and reasonable basis for an effective awareness campaign. Besides, the actual issues highlighted can be considered as valid material content for such campaigns.

Secondly, the motorcycle crash pattern recognised from this study can be utilised for the next traffic enforcement strategy planning. Based on the most dominant crash occurrence at a specific time range, vehicle type and road profile, a more accurate placement of traffic enforcement officers can be achieved. In spite of the current approach, which specifies black spot areas for enforcement, the information contained in this study can be utilised to work out a detailed enforcement placement strategy.

Next, these findings could be used as a basis for regulation improvement. It may cover both motorcycle and riders. Since crash patterns related to conspicuity of motorcyclists were proven to be quite significant, it could be a trigger for the mandatory use of standard motorcycle reflectors and safety vests. This could help motorcyclists become as conspicuous as possible to other road users given the nature of their small size compared to other drivers. In conclusion, this study has achieved its objectives of (i) identifying motorcycle crash patterns during a festive season, (ii) comparing crash patterns between two consecutive festival enforcement interventions, Ops Bersepadu-24 and Ops Selamat 1/2012, and (iii) recommending countermeasures, especially aspects related to motorcyclist safety for the operation of future Ops.

Besides, valuable data that are not available in the current police database have been acquired and highlighted. Unlike the current police database that captures nationwide

data, this approach compensates by providing more in-depth crash information. These two approaches are definitely required for the road safety practitioner, in order to have a clearer picture of the actual crash pattern in Malaysia.

For a comprehensive recognition of motorcycle crash characteristics, it is recommended that the data sample should be larger to confirm the identified pattern representing the Malaysian motorcycle crash scenario. In addition, a comparative study between Ops and non-Ops data can be carried out to observe any other significant pattern of crashes.

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Research Report

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Ops Selamat 1/2012

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ISBN 978-967-2078-99-9
9 789672 078999