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A Preliminary Study on Motor Vehicle Crash Characteristics Involving Motorcycle and Passenger Vehicle in Malaysia

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Abstract – *Motorcycle is the primary mode of motor transportation in ASEAN countries including Malaysia. Nonetheless, motorcycle crashes have contributed more than 50% of the total number of fatalities due to motor vehicle crashes. High numbers of fatalities in motor vehicle crashes are a significant concern to Malaysia. On average, the number of fatalities increased by 4% every year. To address this problem, more intervention shall be taken to reduce motorcycle-related motor vehicle crashes. Passenger vehicle is the most frequent crash partner of motorcycle in Malaysia, thus, the characteristics of this kind of crashes shall be studied holistically to understand the contributing factors to crashes involving passenger vehicle and motorcycle. To achieve the objectives, this study has analysed 55 cases of crash involving motorcycle and passenger vehicle, which are obtained from in-depth crash investigation process from June 2016 until July 2017. The in-depth crash investigation has collected and analysed vehicle and site parameters including the crash configuration. It was found that the passenger vehicle was at fault in more than 60% of the investigated cases. The crashes mostly occurred whenever the passenger vehicle was changing lane to the left and was making a right turn in the junction. This indicated that the passenger vehicle drivers were unaware or overestimated the distance between the motorcycle and their vehicle. Therefore, new technology, which can detect the position and distance of motorcycles around the passenger vehicle, can possibly alert the driver from making inaccurate decisions while attempting to change lane or making a right turn.*

Keywords: Motorcycle, Passenger Vehicle, Motor Vehicle Crash, Blind Spot.

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1.0 INTRODUCTION

Motor vehicle accident is one of the most prevalent issues in Malaysia. On average, the number of fatalities due to motor vehicle accident increase annually by 4%. Being the most commonly used transport vehicles, motorcycle is type of vehicle that exposed to high risk of motor vehicle accident, in which more than 60% of the fatalities was motorcycle riders (Royal Malaysian Police, 2017).

Concerning motorcycle safety in Malaysia, studies were conducted to understand the characteristics of motor vehicle accidents involving motorcycle. It was reported that the majority of the fatal motorcycle riders were male, at the age of 16 years old and 25 years old (Manan & Várhelyi, 2012; Pang et al., 2000). These male youngster riders were classified as the high-risk group and most of them obtained driving license for less than three years. In this kind of fatal crashes, more frequently occurred during traffic peak hour and night time.

The most frequent motor vehicle accident involving a motorcycle was lateral impact (Manan & Várhelyi, 2012). Nevertheless, the same report has pointed out that head-on collision resulted highest fatality rate among all types of impact configuration. However, the study on the causation of the crashes involving motorcycles was seldom being done. The current study aimed to explore the contributing factors to the crash causation in relation to at-fault status. According statistics provided by Royal Malaysia Police, most of the fatal crashes involving motorcycle were not caused by the motorcyclist. Instead, approximately 84% the motorcyclists were not at fault for these cases (Royal Malaysian Police, 2017). Ten years of Florida crash data also revealed that crash partner was more like at fault in motor vehicle accidents involving motorcycle (Lee & Lamb, 2015). In other words, the mistake of the crash partner caused fatal crashes involving a motorcycle. In this study, at fault is defined as the situation which the driver or rider made a wrong decision and had caused the occurrence of the motor vehicle accident. The wrong decision can be unaware of the presence of crash partner, underestimate the speed of incoming vehicles, and overestimate the distance between self and crash partner.

2.0 MATERIALS AND METHODOLOGY

The data for the current study is collected through on-the-spot crash investigation. A crash investigation team is stationed in the Emergency Department of Hospital Kajang, Malaysia. The team would dispatch to the crash site along with the ambulance if the hospital received any notification regarding motor vehicle accidents involving passenger cars. The duration of the data collection was one year. In the crash site, detail information of the particular accident was collected which including the rest position of the vehicles, the point of impact, the initial position of the vehicles, vehicle damage, occupant injuries and position of important marking such as skid marks, gouge mark and scratch mark. In the data collection, 59 motor vehicle accidents were investigated and documented, in which 55 of the cases were collision between passenger car and motorcycle and 4 of the cases were collision between two passenger cars. For the purpose of this study, the analysis has omitted accidents without motorcycle. Thus, the sample size of current study is 55.

3.0 RESULTS AND DISCUSSION

The result showed that more than half of the total accident cases, the passenger vehicle was at fault. The distribution of at-fault status between motorcycle and the crash partner is tabulated in Table 1. This finding is difference from the public perspective which perceived motorcycle was the one who is at fault when a motor vehicle accident occurred. Approximately 64% of the crashes in the current study, the passenger vehicle was at fault. In other words, the occurrence of the crashes was more often due to bad decision making or reckless driving by the passenger vehicle rather than the motorcycle rider.

Table 1: At-fault status between motorcycle and the Passenger vehicle

At-fault Status	Frequency	Percent (%)
Motorcycle	20	36.3
Passenger vehicle	35	63.6
Total	55	100

In terms of impact configuration, if the passenger vehicle was at fault, approximately 73% of the crashes were side-impact, which 45% is nearside impact and 29% is the offside impact (Table 2). The impact configuration of nearside impact was 3.2 times more likely than other types of impact configuration. That's mean the motorcycles more frequently collided the side of the passenger cars when the passenger vehicle made mistake while driving. The distribution of the impact configuration was slightly different when the motorcycle was at fault. In this case, rear impact is dominant which was 55%. Thus, the motorcycles were more frequent impacting at the rear-end of the crash partner when they are the ones who made mistake.

Table 2: Impact configuration according to at-fault status

At Fault	Impact Configuration (Crash Partner)	Frequency	Percentage	Odds Ratio
Motorcycle	Rear	11	55.0	2.8
	Nearside	5	25.0	0.3*
	Frontal	2	10.0	0.4
	Offside	2	10.0	0.2*
Passenger vehicle	Nearside	16	45.7	3.2*
	Offside	10	28.6	5.0*
	Frontal	5	14.3	2.5
	Rear	4	11.4	0.4

$p < 0.05$

Before these crashes occurred, most of the time regardless of who is at fault, both vehicles were moving in the same direction and none of the vehicles was turning. If passenger vehicle was at fault, the second most frequent travelling direction was intersecting direction and at least one vehicle was turning. The distribution of direction of travel before crash according to at-fault status was tabulated in Table 3.

Table 3: Direction of travel before crash according to at-fault status

At Fault	Direction of Travel Before the Crash	Frequency (%)	Odds Ratio (conf_int)
Motorcycle	Same direction of travel (None of the vehicles turning)	13 (65.0)	0.7 (0.4, 1.5)
	Intersecting direction of travel (At least one vehicle turning)	3 (15.0)	0.38 (0.1, 1.4)
	Opposing direction of travel (Head on collision)	2 (10.0)	1.0 (0.1, 7.1)
	Opposing direction of travel (At least one vehicle turning)	1 (5.0)	0.2 (0.02, 1.7)
	Same direction of travel (At least one vehicle turning)	1 (5.0)	0.5 (0.04, 5.5)
Passenger Vehicle	Same direction of travel (None of the vehicles turning)	18 (51.4)	1.4 (0.7, 2.8)
	Intersecting direction of travel (at least one vehicle turning)	8 (22.9)	2.7 (0.7, 10.0)
	Opposing direction of travel (At least one Vehicle Turning)	5 (14.3)	5 .0 (0.6, 42.8)
	Opposing direction of travel (Head on collision)	2 (5.7)	1.0 (0.1, 7.1)
	Same direction of travel (at least one vehicle turning)	2 (5.7)	2.0 (0.2, 22.1)

If passenger vehicle was at fault, the most frequent (54%) movement before the crash was lane changing. This finding signified that the passenger vehicle may not aware the presence of the motorcycle while it was changing lane to the left or the right. The distribution of movement before crash according to at-fault status is tabulated in Table 4.

In order to further verify this argument, the relative position of the motorcycle to the passenger vehicle before crash was 181-225 degrees and 316-360 degrees which were far rear offside and nearside of the passenger vehicle. Both of these positions are the common blind of the passenger vehicle and the driver may not be able to notice the presence of the motorcycle (Cicchino, 2018). These could lead to making wrong decision to change lane by the passenger vehicle driver and collided at the incoming motorcycle especially while changing lane to the left. This explained high portion of the crashes was side impact. The distribution of the relative position of motorcycle was tabulated in Table 5.

Another situation in which the passenger vehicle driver made mistake was the moment when the passenger vehicle attempted to turning left or right. It is the second-highest movement before crash when the passenger vehicle was at fault. This finding implied that the passenger vehicle may overestimate the distance between the passenger vehicle and the motorcycle or did not aware the presence of the motorcycle while making the decision to turn left or right in the junction. Anyhow, it was reported that driver judgment on motorcycle time-to-arrival is dependent on the condition of daytime running headlights and colour of helmet and outfit (Law et al., 2015). On the other hand, if the motorcyclist was at fault, the most frequent movement was head to tail collision to a moving vehicle. This showed that the motorcyclist may overestimate the distance between the motorcycle and the passenger vehicle located in front. This means that overestimating distance between vehicles was common mistake made by the passenger vehicle drivers and the motorcyclist when the collisions occurred.

Table 4: Movement of motorcycle and passenger vehicle before crash according to at-fault status

At Fault	Movement Before Crash	Frequency (%)
Motorcycle	Head to tail collision with moving vehicle	8 (40.0)
	Changing lane to the left	3 (15.0)
	Changing lane to the right	3 (15.0)
	Travelling straight on intersecting roads	2 (10.0)
	Turning right in front of or into the side of oncoming vehicle	2 (10.0)
	Head-on collision on bend	1 (5.0)
	Head-on collision on the straight section of road	1 (5.0)
	Running off to right on the straight section of road	0
	Side impact collision while turning right	0
Passenger Vehicle	Changing lane to the left	12 (34.3)
	Changing lane to the right	7 (20.0)
	Turning right in front of or into the side of oncoming vehicle	5 (14.3)
	Side impact collision while turning right	3 (8.6)
	Travelling straight on intersecting roads	3 (8.6)
	Head-on collision on bend	2 (5.7)
	Running off to right on the straight section of road	2 (5.7)
	Head to tail collision with moving vehicle	1 (2.9)
	Head-on collision on straight section of road	0

Table 5: Position of motorcycle relative to passenger vehicle before impact according to at-fault status

At Fault	Position of Motorcycle Relative to PV Before Impact	Freq. (%)	Odds Ratio
Motorcycle (M)	181-225	10 (50.0)	0.9 (0.4, 2.1)
	316-360	4 (20.0)	0.4 (0.1, 1.1)
	0-45	2 (10.0)	0.3 (0.03, 3.2)
	136-180	2 (10.0)	0.25 (0.05, 1.2)
	226-270	1 (5.0)	2.0 (0.2, 22.1)
	46-90	1 (5.0)	1.0 (0.06, 16.0)
Passenger Vehicle (PV)	181-225	11 (31.4)	1.1 (0.5, 2.6)
	316-360	11 (31.4)	2.8 (0.9, 8.6)
	136-180	8 (22.9)	4.0 (0.8, 18.8)
	0-45	3 (8.6)	3.0 (0.3, 28.8)
	46-90	1 (2.9)	1.0 (0.06, 16.0)
	226-270	1 (2.9)	0.5 (0.05, 5.5)

4.0 CONCLUSION

The current study showed that when the passenger vehicle was at fault, it is more frequently due to the passenger vehicle was changing lane (especially to the left) and was making a right turn. While changing lane, the passenger vehicle may not be aware of the presence of the motorcycle because the position of the motorcycle might be in the blind spot of the passenger vehicle. For cases in which the passenger vehicles were making a right turn, the passenger vehicle may have seen the presence the motorcycle at far-left hand side, but overestimated the distance between them and underestimate the speed of the motorcycle. This finding indicates that human error in decision making is one of the main contributing factors to motorcycle-passenger vehicle crashes. This kind of crashes could possibly be reduced with the assistance from technology such as detection and warning system for motorcycle vehicle collision avoidance system (Rashid et al., 2019). However, the current findings were established only on a small sample size. A further study on the position of the motorcycle before crash should be conducted to verify the findings.

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