ORIGINAL ARTICLE

Accident Characteristics of Injured Motorcyclists in Malaysia

T Y Pang, B.Sc. (Hons)*, R S Radin Umar, Ph.D.*, A A Azhar FRCSED, M Megat Ahmad M.H, Ph.D**., MT Mohd. Nasir*, S Harwant, M.Ch. Orth., FRCSEd***, *Road Safety Research Centre, Faculty of Engineering, Universiti Putra Malaysia, 43400 UPM, Serdang, **Department of Accident and Emergency, Hospital Universiti Kebangsaan Malaysia, Jalan Tenteram, Cheras, 56000 Kuala Lumpur, ***Institute of Orthopaedics and Traumatology, Jalan Pahang, 50586, Hospital Kuala Lumpur**

Summary

This study examines the *accident characteristics of injured motorcyclists* in Malaysia. The aim of this study is to identify the characteristics of motorcyclists who are at higher fatality risk and subsequently be the targeted group for the fatality-reduction countermeasures. A total of 412 motorcycle crash victims with *serious* or *fatal injuries* were analysed. The results showed that the injured motorcyclists were predominant young, novice riders of less than 3 years licensure and male. A fatal outcome was more likely to be associated with a larger engine capacity motorcycle, collision with a heavy vehicle, head on collision, and collision at a non-junction road. In contrast, a non-fatal outcome was more likely to be associated with a small engine capacity motorcycle, collision with another motorcycle or passenger car, junction accidents, and side or rear collisions.

Key Words: Accident characteristics, Motorcyclists

Introduction

Motor vehicle crashes have received considerable attention by the Government following the Karak Highway tragedy in 1990[1]. A Cabinet Committee on Road Safety, with the Prime Minister as the chairman, was later formed and a target of reducing road fatalities by 30% by the year 2000 was set. Among the strategic actions taken in achieving the target is the National Motorcycle Safety Program (MSP) with a special attention on establishing the national crash-vehicle-injury database, and adopting comprehensive measures directed to motorcyclists[2]. Emphasis on motorcycles was given because of their high fatality rates, constituting about 60% of the nation's total road fatalities. In 1997 alone, 6,302 road accident fatalities were reported. This is a tremendous loss of resources as the fatalities involve young people and is estimated to cost 6 billion Ringgit in lost productivity and health costs. This study examines the *accident characteristics of the injured motorcyclists*, in an attempt to identify motorcyclists who are at higher fatality risk and subsequently be targeted for fatality-reduction and preventive measures.

Materials and Methods

This was a case series study involving 412 motorcycle crash victims with *serious* or *fatal injuries* admitted to Hospital Kajang, Hospital Universiti Kebangsaan Malaysia and Hospital Kuala Lumpur, between 1 January 1998 and 31 December 1998. Data was collected from Hospital Emergency Department records and subsequent ward records. Two outcomes were set for

this study; either (i) *fatal* or (ii) *seriously injured and surviving*. Where appropriate, post mortem reports were investigated. In addition, the police records were also investigated at the end of each week to capture data of all injured and killed motorcyclists, and to determine the circumstances of fatal crashes. Interviews were later carried out in the ward on the seriously injured but surviving victims, depending on their clinical conditions; with consent obtained from the victims and their doctors. Data was recorded on a standardised proforma sheet with the questions asked in a standard manner by the same investigator to reduce bias. Information on riding experience, motorcycle types, road conditions and speed of impact was specifically sought. The data was analysed with chi-square test using SPSS v7.5 and statistical significance was determined at $p<0.05$.

Results

Profile of the injured motorcyclist

There was a total of 958 motor vehicle accident (MVA) victims admitted as hospital in-patients for the period of 12 months from the 3 hospitals. Of these 958 cases, 226 (23.6%) were motorcyclists and pillion passengers who had been interviewed by the principal investigator. This was to establish the incident details in the ward and their medical notes being investigated to establish the details of injury patterns that they received. One hundred and eighty-six fatal motorcycle crashes were available for analysis, in which both the police and post-mortem reports were investigated to determine the circumstances of these crashes.

Of the 412 motorcyclists (both riders and pillion passengers) studied, 186 (45.15%) were fatally injured and the remaining 226 (54.85%) were seriously injured but survived. Fifty-five and a half percent of the fatally injured and 56.4% of the seriously injured but surviving riders were aged less than 25 years. The distribution of fatalities and survivors was similar throughout all age groups analysed (Table I). Among the fatalities, 92.5% were riders and 7.5% were pillion passengers. In the case of surviving victims, 85.8% were riders and 14.2% were pillions. Males accounted for 93.5% of all fatalities and 90.3% of seriously injured but surviving motorcyclists.

Table I
Summary of Motorcyclist Profile and Outcome

		Survived N=226 (%)	Fatal N=186 (%)
Riders		194 (85.8)	172 (92.5)
Pillion passengers		32 (14.2)	14 (7.5)
		226 (100)	186 (100)
Male		204 (90.3)	174 (93.5)
Female		22 (9.7)	12 (6.5)
		226 (100)	186 (100)
Age	16 - 20 years	69 (30.5)	57 (30.6)
	21 - 25 years	56 (24.8)	48 (25.8)
	26 - 30 years	32 (14.2)	23 (12.4)
	>30 years	55 (24.3)	56 (30.1)
		212 (93.8)*	184 (98.9)*

* *Excluding 14 survived and 2 fatal whose data was not available*

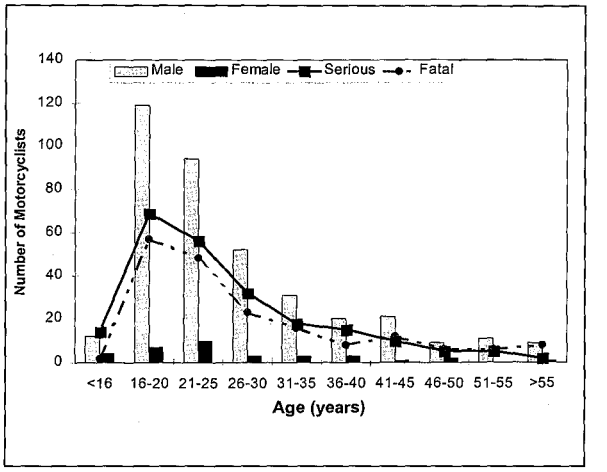

Fig. 1: Distribution of Motorcyclists by Age and Gender against Outcome.

The older motorcyclists (above 50 years), although fewer in number, had a higher fatality risk (Figure 1), whereas the younger motorcyclists had an only slightly decreased fatality risk.

Riding experience

Riding experience was defined as the number of years a motorcyclist held a valid licence. More than 50% of the fatally injured and seriously injured but surviving motorcyclists had a valid license of less than 3 years (Figure 2). The distribution of riding experience in both groups was also similar.

Motorcycle engine capacity

Large engine capacity machines (≥150cc engine displacement) accounted for 21% of all incidents. However, they had almost twice the number of deaths compared to seriously injured. Significantly less fatalities occurred with smaller machines (<150cc). This is seen where in 290 'small' motorcycles, 43% were fatal and in 77 'large' motorcycles, 65% were fatal. This is significant at $p<0.05$ (Table II).

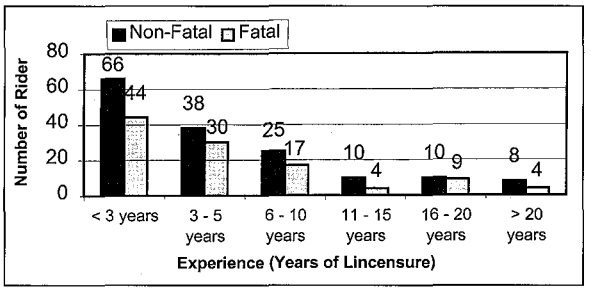

Fig. 2: Distribution of Years of Valid Licence against Outcome.

Object/vehicle struck

The most common vehicle struck was the passenger car which accounted for 39.7% of seriously injured motorcyclists and 26.6% of fatal riders. A motorcyclist colliding with a passenger car or another motorcycle however, was more likely to survive compared to a motorcyclist who collided with a Light or Heavy Commercial Vehicle. Collision with these vehicles was about four times as likely to result in fatality if compare to motorcycles and passenger cars. This is significant at $p<0.05$ (Table III).

Road type

Crashes in non-junction sites (i.e. straight and curved roads) were more likely to result in fatal outcome. Roundabouts had an equal outcome. However, incidents at cross-junctions and T- or Y-junctions had a lower fatal outcome rate. This is significant at $p < 0.05$ (Table IV).

Collision type

Side collisions were the commonest encountered. However, the highest fatality rate was seen in head-on collisions, which were four times as likely to cause death than serious injury. Rear-end collisions and side collisions were two-thirds more likely to survive. This is significant at $p<0.05$ (Table V).

Discussion

The accident profile of the injured motorcyclists on Malaysian roads in this study is comparable to the data of Royal Malaysia Police[3]. Majority of the motorcyclists

Table II
Motorcycle Engine Capacity and Outcome

Engine Capacity	Outcome		Total	Relative Index
	Seriously Injured	Fatal		
< 150	165 (85.9%)	125 (71.4%)	290 (79%)	0.76
≥ 150	27 (14.1%)	50 (28.6%)	77 (21%)	1.85
Total	192 (100%)	175 (100%)	367 (100%)**	

($x^2 = 11.66$, df = 1, $p = 0.000639$)

***Excludes 34 seriously injured and 11 fatal incidents whose data was not available*

Table III
Vehicles / Objects Struck by Motorcyclists and Outcome

Vehicle Struck	Outcome		Total	Relative Index
	Seriously Injured	Fatal		
Passenger car	85 (39.7%)	48 (26.5%)	133 (33.7%)	0.56
Other Motorcycle	31 (14.5%)	17 (9.4%)	48 (12.1%)	0.55
Light Commercial Vehicles	16 (7.5%)	36 (19.9%)	52 (13.2%)	2.25
Heavy Commercial Vehicles	19 (8.9%)	36 (19.9%)	55 (13.9%)	1.89
Others	63 (29.4%)	44 (24.3%)	107 (27.1%)	0.70
Total	214 (100%)	181 (100%)	395 (100%) #	

(x^2 = 31.4, df = 4, p= 0.00000254)
#Excludes 12 seriously injured and 5 fatal incidents whose data are not available

Table IV
Road Type and Outcome

Road Type	Outcome		Total	Relative Index
	Seriously Injured	Fatal		
Straight	92 (50%)	104 (56.5%)	196	1.13
Curve	19 (10.3%)	40 (21.7%)	59	2.11
Roundabout	2 (1.1%)	2 (1.1%)	4	1.00
Cross Junction	12 (6.5%)	6 (3.3%)	18	0.50
T/Y junction	59 (32.1%)	32 (17.4%)	91	0.54
Total	184 (100%)	184 (100%)	368 ##	

(x^2 = 18.24, df = 4, p = 0.001)
##Excludes 42 seriously injured and 2 fatal incidents whose data are not available

Table V
Collision Type and Outcome

Collision Type	Outcome		Total	Relative Index
	Seriously Injured	Fatalities		
Head-on	9 (4.4%)	39 (21.4%)	45	4.33
Rear-end	30 (14.6%)	19 (10.4%)	48	0.63
Side Collision	98 (47.6%)	69 (37.9%)	145	0.70
Hitting Object	23 (11.2%)	12 (6.6%)	33	0.52
Loss Control	46 (22.3%)	43 (23.6%)	77	0.93
Total	206 (100%)	182 (100%)	348 #*	

(x^2 = 27.05, df = 4, p = 0.0000194)
*#*Excludes 20 seriously injured and 4 fatal incidents whose data was not available*

involved were young, predominantly male and had a period of valid license of 3 years or less. Norghani *et al*[4]. found that young riders in general had poorer attitudes toward traffic rules and speeding compared to the older age group. They also showed that the majority of the active road-using motorcyclists had only 3 years of valid license or less, and these young riders tended to speed if they were on larger capacity machines. Speeding increases both the risk of being involved in a crash and suffering more severe injuries in the event of a crash. This may explain why larger motorcycles were significantly associated with greater fatality risk. This is because larger engine capacity machines have greater speeds; and as a consequence, larger forces on impact. Head-on collisions were more likely to be fatal because maximum forces are encountered in these situations.

With regards to crash circumstances, almost 70% of motorcycle crashes occurred at non-junction sites (straight and curved roads). The fatality risk at non-junction sites was greater than junction sites. This could due to the higher travelling speed at non-junction sites compared with the straight road. At greater speeds, riders have less time to react, have less control of the vehicle and need longer stopping distance[5]. Furthermore, speeding increases the severity of the crash since the force of impact sustained by motorcyclists increases by the square of the velocity (Kinetic Energy, $KE=\frac{1}{2}mv^2$, where m=mass of an object, and v=velocity).

Collisions with Commercial Vehicles commonly result in rider fatalities. This could due to the mass ratio and the mismatch in the height of vehicle structures[6]. The higher the mass ratio of the colliding vehicles, and the higher the closing speed of the smaller vehicle; the more severe damage to the smaller vehicle in the collision. In addition, the presence of stiff and relatively open structures contribute to the injuries to riders as the motorcyclists are in direct contact with these stiff structures. As such, improvement in the mass ratio and structure mismatching could reduce the injuries among motorcyclists.

Rider attitude, behaviour and speed could not be correlated to outcome as it was impossible to obtain accurate and objective self-reported data from riders after they sustained an injury. The data for fatalities were more complete as each death had to be reported. However, the data for injured riders was not as complete because these patients sometimes took their own discharge from hospital, or did not make police reports.

Conclusion

The injured motorcyclists on Malaysian roads are mainly young, novice riders of less than 3 years license and predominantly males. A fatal outcome was more likely on a large engine motorcycle, collision with a heavy vehicle, head on collision, and collision on a non-junction site. A non-fatal outcome was more likely with a small engine motorcycle, collision with other motorcycle or passenger car, collision at junction sites, and involved in side or rear collisions.

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