การศึกษาความรุนแรงของการบาดเจ็บและโอกาสการรอดชีวิต ในแต่ละตำแหน่งการโดยสารรถจักรยานยนต์ขณะเกิดอุบัติเหตุ

Seating positions during motorcycle incident, severity of injury and probability of survival

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บทคัดย่อ

อุบัติเหตุจากรถจักรยานยนต์เป็นสาเหตุการบาดเจ็บที่พบบ่อยในประเทศไทย ประชาชนส่วนใหญ่เลือกที่จะใช้จักรยานยนต์ในชีวิตประจำวัน เพราะความสะดวก ประหยัดและรวดเร็วในการเดินทาง อย่างไรก็ตามผู้คนมีวิธีการใช้จักรยานยนต์มากกว่าวิธีการที่ทางบริษัทผู้ผลิตได้ออกแบบไว้ ได้แก่ การให้ผู้โดยสารยืนหรือนั่งหน้าผู้ขับขี่ ในตะกร้า หรือนั่งต่อท้ายหลายคน การโดยสารในตำแหน่งดังกล่าว อาจทำให้เกิดความเสี่ยงในการบาดเจ็บหรือโอกาสการเสียชีวิตที่มากขึ้น การศึกษานี้จึงจัดทำขึ้นเพื่อศึกษา ตำแหน่งที่นั่งบนรถจักรยานยนต์ขณะเกิดอุบัติเหตุกับความรุนแรงในการบาดเจ็บและโอกาสการรอดชีวิต ในผู้ได้รับบาดเจ็บที่มาถึงโรงพยาบาลนพรัตนราชธานี ตั้งแต่ เมษายน ถึง ธันวาคม 2565 โดยใช้คะแนน Injury Severity Score (ISS) และ Probability of survival (TRISS: Trauma Injury Severity Score) ในการคำนวณและเปรียบเทียบระหว่างแต่ละตำแหน่งที่นั่ง

ผลการศึกษาพบว่า ผู้ได้รับบาดเจ็บ 929 คน เข้าร่วมการศึกษานี้ พบผู้โดยสารใน 5 ตำแหน่ง ได้แก่ 1) หน้าคนขับ 2) คนขับ 3) คนนั่งต่อท้ายคนที่ 1 4) คนนั่งต่อท้ายคนที่ 2 5) คนนั่งต่อท้ายคนที่ 3 ในจำนวนนี้มีผู้เสียชีวิต 10 คน (1.08%) จากจำนวนผู้ได้รับบาดเจ็บ โดยผู้เสียชีวิตทั้งหมดเป็นคนขับ สำหรับผู้บาดเจ็บเกือบทั้งหมด (96.55%) ได้รับบาดเจ็บไม่รุนแรง (ISS <16)อยู่ที่ 96.55% จากการคำนวณโอกาสการรอดชีวิต ทั้งหมดมีค่ามัธยฐาน 99.67% (99.58-99.70) และไม่พบความแตกต่างในโอกาสการรอดชีวิตระหว่างแต่ละตำแหน่งที่นั่ง

คำสำคัญ : อุบัติเหตุจักรยานยนต์, ตำแหน่งที่นั่ง, โอกาสการรอดชีวิต, ความรุนแรงของการบาดเจ็บ

Abstract

Motorcycle incidents are one of the most common causes of injury. Due to the traffic conditions in Thailand, a large number of people choose motorcycles for commuting on a daily basis because it is economical, convenient, and fast. Nevertheless, people often ride motorcycles in many unusual ways especially in the aspect of seating; there are many seating patterns that differ from the manufacturer's intended design. These unusual seating positions might lead to more severe injury than in typical cases. To determine which seating position(s) on a motorcycle are associated with risk of injury and probability of survival. Prospective cohort study was conducted on motorcycle incident patients who arrived at Nopparat Rajathanee Hospital between April 2022 and December 2022, with the exclusion of unidentified seating positions. Injury Severity Score (ISS) and Probability of survival (TRISS: Trauma Injury Severity Score) were calculated and analysed to find out the differences in each seating position.

Nine hundred twenty-nine patients were included. Five positions of seats were found from the incidents: 1) in front of the rider, 2) the rider, 3) the first person behind the rider, 4) the second person behind the rider and 5) the third person behind the rider. There are ten of them (1.08%) did not survive. The calculated probability of survival is 99.67% (99.58-99.70). Nearly all of them (96.55%) had minor injuries (ISS <16). There was no difference in the probability of survival across the different seating position. However, all of the observed fatalities (Dead) were found to be riders.

Keywords : motorcycle incident, seating position, probability of survival, injury severity

Introduction

Physical injury from a crash is a preventable cause and usually affects a healthy person. Traffic incidents, especially motorcycles, are the common causes of injury in Thailand.[1] Most people prefer motorcycles for commuting in daily life and recreation because of the economical, convenient and faster mode of travelling.[2] In Thailand, motorcycles are often used with various seating arrangements for riders and passengers. By design, one motorcycle can have only one rider and one passenger behind the rider. However, in real scenarios, some of the passengers are placed inside the basket in front of the console, some of them stand in front of the rider, or many people beyond the design sit behind the rider. These patterns of seating might lead to serious injury and it is impossible to prohibit these unsafe seatings.

According to an article from Khon Kaen, Thailand. It was revealed that unhelmeted and intoxicated rider increased risks for death, but riding at night did not increase risks.[3] There is a report that a child who sits in front of a rider has a higher chance of injury to their head and face compared to a child who sits behind the rider.[4] In western countries, the studies focused for seating positions of the passenger in the car.[5-8] In South-east Asia countries, we do more using motorcycle. Nopparat Rajathanee hospital is located at outer Bangkok. More than half of trauma patients in this area resulted from motorcycle accidents. In this article, we investigate the difference of severity of injury and probability of survival in each seating position of motorcycles.

Method

In this study, we collected data from motorcycle's victims who arrived or were treated in the emergency department at Nopparat Rajathanee hospital during 1 April-31 December 2022. Cases were excluded from the study if the researcher could not provide information about the patient's position during the crash. The demographic data, data of injury, and survival were continuously collected until the patient was discharged home from medical records (outpatient and inpatient data) by the researcher and assistant nurses.

We collected time of incident and seating position from either patient, witness or pre-hospital report. All injuries documented in medical records were assigned to their body regions, not just the region with the most severe injury. Abbreviated Injury Score

(AIS), Injury Severity Score (ISS), Revised Trauma Score (RTS), and Trauma Score-Injury Severity Score (TRISS) were calculated from the raw data.

To quantify severity of injury, the evaluation of injury severity and probability of survival were determined by Abbreviated Injury Scale (AIS)[9] for severity in each region. The Injury Severity Score (ISS)[10] that is more than 16 is considered to be severe and the value that is more than 25 is considered to be very severe. Revised Trauma Score (RTS)[11] less than 4 implies the probability is less than 60.00 %. And Trauma Score-Injury Severity Score (TRISS)[12] for determining the probability of survival. Previous study in developing countries (e.g. Thailand, India) stated TRISS score is accurate but it has a high false positive rate (suspected survival but death occurs)[13-14], therefore calculation for probability of survival should be done by checking the consistency with real data together. We use these scores to collect and analyse the data because it is well-known and common use in Thailand. All death within 30 days after injury were determined as the result of the motorcycle crash.

Statistical analyses were performed. Descriptive statistics were summarized as frequencies and percentages for categorical variables and as the median and interquartile range for continuous variables. Mann–Whitney U test and Kruskal–Wallis test were used to compare differences between two and more than two independent groups respectively because data did not have a normal distribution. The statistical significance was accepted at a p-value of less than 0.05.

Ethical considerations

The study protocols were reviewed and approved by the Ethics Committee of Nopparat Rajathanee Hospital No. 27/2565. The data record forms were done without the name of the subjects. We recorded by subject ID instead to prevent identification of the identity. The only data we obtained more than normal medical record is only position of the patient. Thus, if they refuse to answer this question, we excluded them from this study.

Results

Nine hundred and twenty-nine patients were included in this study among nine months in 2022. More than half (72.87%) were men. Young adults (between15-35 years) were the major age group (57.59%). The median age of injured patients was 27 (IQR20-40) years old.

The number of crashes was high during the night, especially between sunset and midnight. Most of the victims were the riders. However, we found a maximum of three people behind the rider. Blunt mechanism was usually the force of injury but some victims had penetrating injuries from other objects. Fractures of the extremities were the most common injury. Only 2.05% and 1.40% of cases resulted in severe (ISS>16) and very severe (ISS>25) injuries, respectively. The median of calculated probability of survival (TRISS) is 99.67% (IQR 99.58-99.70). There were five and three persons who had a probability of survival less than 60.00% and 50.00% respectively. At the end of treatment (discharge status), ten patients were found to have passed away (Table 1).

Table 1. The characteristic data of motorcycle incident and victim

Characteristic		No (%) N=929
Sex		
	Male	677 (72.87%)
	Female	252 (27.13%)
Age (years)		
	0-15	76 (8.18%)
	15-25	317 (34.12%)
	25-35	218 (23.47%)
	35-45	135 (14.53%)
	45-55	107 (11.52%)
	55-65	57 (6.14%)
	More than 65	19 (2.04%)

Characteristic		No (%) N=929
Time of incident		
	Midnight- 6am	144 (17.93%)
	6am-noon	173 (21.54%)
	Noon-6pm	209 (26.03%)
	6pm- midnight	277 (34.50%)
Position of seating		
	In front of the rider	6 (0.65%)
	Rider	772 (83.10%)
	The first person behind the rider	137 (14.75%)
	The second person behind the rider	11 (1.18%)
	The third person behind the rider	3 (0.32%)
Mechanism of injury		
	Blunt	925 (99.57%)
	Penetrating	4 (0.43%)
Region of injury		
	Head	108 (11.63%)
	Face	120 (12.92%)
	Chest	60 (6.46%)
	Abdomen	16 (1.72%)
	Extremities	325 (34.98%)
	Superficial	849 (91.39%)
ISS		
	<16	897 (96.55%)
	16-<25	19 (2.05%)
	>25	13 (1.40%)

Characteristic		No (%) N=929
RTS		
	<4	5 (0.54%)
TRISS(Ps)		
	<50	3 (0.32%)

The severity of injury was slightly increased in incidents after midnight and for injuries that affected persons who sat in front of the rider (ISS =2) with statistical significance. However, the probability of survival was not different in each seating position (Table 2). Most victims suffered mild injury and had a high probability of survival.

Table 2. Comparison of median of severity of injury (injury severity score) in each group of injured patients

Characteristics	ISS (IQR)	P-value**	Probability of survival (IQR)	P-value**
Sex				
Male	1(1-5)	<0.001	99.67(99.58-99.70)	0.014
Female	1(1-2)		99.70(99.64-99.70)	
Age				
0-15	1(1-2)	0.003	99.70(99.67-99.70)	<0.001
15-25	1(1-3)		99.70(99.65-99.70)	
25-35	1.5(1-5)		99.67(99.58-99.70)	
35-45	2(1-5)		99.67(99.58-99.70)	
45-55	2(1-5)		99.67(99.58-99.70)	
55-65	1(1-5)		98.31(97.65-98.31)	
More than 65	1(1-5)		98.31(97.65-98.31)	

Characteristics	ISS (IQR)	P-value**	Probability of survival (IQR)	P-value**
Time of incident				
Midnight- 6am	2(1-5)	0.005	99.67(99.55-99.70)	0.011
Midnight - 6 a.m.	1(1-4)		99.67(99.55-99.70)	
6 a.m.- noon	1(1-4)		99.70(99.58-99.70)	
Noon - 6 p.m.	1(1-5)		99.67(99.58-99.70)	
6 p.m.- midnight				
In front of the rider	2(1-4.5)	<0.001	99.67(99.60-99.70)	0.192
Rider	1(1-5)		99.67(99.58-99.70)	
The first person behind the rider	1(1-2)		99.70(99.67-99.70)	
The second person behind the rider	1(1-1)		99.70(99.70-99.70)	
The third person behind the rider	1(1-1)		99.70(99.70-99.70)	
Mechanism of injury				
Blunt	1(1-5)	0.406	99.67(99.58-99.70)	0.179
Penetrating	5.5(1-11.5)		99.53(99.26-99.70)	

**Mann–Whitney U test and Kruskal–Wallis test with significant statistic level at $P < 0.05$

There were 10 victims out of 929 found dead at the end of their treatment. All of them were men, riders, and blunt mechanisms of injury. High-graded head injury was observed in nine persons with ISS to be classified as very severe injury (>=25). However, the calculated probability of severity varied (Table 3).

Table 3. Details of motorcycle riders (fatal)

Sex	Age (yrs)	Time of incident	Seating position	Mechanism	AIS						ISS	RTS	PS
					Head	Face	Chest	Abdomen	Extremities	Superficial			
M	30	10:55	Rider	Blunt	5	2	2	0	0	1	33	0.00	3.90
M	41	21:00	Rider	Blunt	5	2	2	0	0	1	33	2.10	18.13
M	30	2:00	Rider	Blunt	5	0	0	0	0	1	26	2.93	43.74
M	39	7:00	Rider	Blunt	5	0	2	0	2	1	33	4.09	52.61
M	43	1:20	Rider	Blunt	5	2	0	0	0	1	30	3.80	52.99
M	23	2:00	Rider	Blunt	5	1	2	0	0	1	30	4.74	70.63
M	33	20:30	Rider	Blunt	3	2	0	5	2	1	38	5.97	76.88
M	14	16:00	Rider	Blunt	3	4	2	3	0	1	34	5.68	78.59
M	20	22:30	Rider	Blunt	5	0	0	0	0	1	26	5.97	90.06
M	45	17:00	Rider	Blunt	0	0	0	0	2	1	5	7.84	99.58

Focusing on children (under 15 years old), who are most sitting in the undesigned seat, the severity of injury tends to increase from the front to the back of the vehicle. Nearly all of the passengers in front of the rider were school-age children (Table 4).

Table 4. Children at each seating position

Position (n)	Sex (%)	Age, median (IQR)	ISS, median (IQR)	PS, median (IQR)
In front of the rider (5)	M 40.0%	5(4.5-5.5)	5.5(3.3-7.8)	99.53(99.45-99.62)
	F 60.0%	7(5-7)	3(1-5)	99.65(99.58-99.70)
Rider (30)	M 73.3%	13.5(13-14)	2(1-5)	99.67(99.58-99.70)
	F 26.7%	13(12.3-14)	2.5(1-5)	99.66(99.58-99.70)
First person behind the rider (32)	M 56.3%	11(6.5-13)	1(1-1)	99.70(99.70-99.70)
	F 43.7%	11(6.5-13)	1(1-1)	99.70(99.70-99.70)
Second person behind the rider (6)	M 50.0%	13(10.75-13)	1(1-1)	99.70(99.70-99.70)
	F 50.0%	13(10.75-13)	1(1-1)	99.70(99.70-99.70)
Third person behind the rider (3)	M 33.3%	10(10-10)	1(1-1)	99.70(99.70-99.70)
	F 66.7%	14(14-14)	1(1-1)	99.70(99.70-99.70)

Discussion

According to the injury and incident data, we found that the undesigned-seat was commonly used. Seating or standing in front of the rider were usually children with slightly higher Injury severity score (ISS=2) with statistically significant. We think that slightly high is not really different from other seating positions, corresponding with similar probability of survival. Following the data of Taiwan, there were more injury cases at head and face in this group.[4] Some parents believe that sitting in front of a rider is safer because of protection by the rider, which contradicts with our finding; our data may question the belief.

Riders constituted the largest group of injured individuals in this study. The raw data and calculated scores did not differ significantly from the other groups, although all of the deaths occurred in riders. We suggest that this seat may be dangerous but the effect group is very small from all population of riders.

The first person behind the rider was also the second most of all. They were still in the normal position of the passenger. The second and third person were also found in our patients. All of them had minor injuries and a high probability of survival. The loading of 3-4 persons on a motorcycle may reduce the speed of the vehicle, so the severity of injuries may be less than for the rider alone.

Focusing on the deaths, the victims were predominantly middle-age, male, riders who had sustained head injuries. The ISS was categorized in a severe injury group, except for the calculated probability of survival was range from 3.90% to 99.58%.

In Thailand, the motorcycle driving license can be applied to people having their age older than 15 years old. Nevertheless, we found that nearly half (40.00%) of child injuries were riders. Moreover, using an undesigned position was also found in this age group. We think it may be due to inappropriate knowledge of parents and risk-taking behaviour of adolescents. To prevent this scenario, the government or related officers may provide information via the mass media, school, or well-baby clinic. Despite the law, forcing the adolescent to not ride the motorbike is impractical, hence, getting them recognized for the risk is a more practical and possible solution.

Due to the hospital-based data collection, selection bias is a possibility. The victim who has no injury or no need medical treatment nor immediate death were not recorded on this data. Comparing with ThaiRCS data, there are 941,897 injured persons and 15,014 deaths in 2022 in Thailand. The ThaiRCS data stated that 55.99% were result from motorcycle crash. Our data has approximated 1.00% of death same as the nationwide data.

Helmet use, alcoholic, or drug intoxication may associate with the severity of the injury and be confounding factors of the outcome. According to ThaiRCS report, only 52.00% of rider and 20.00% of passenger wear helmet during motorcycle usage in Thailand despite there is the law to using it. However, we did not analyze in this aspect because we cannot collect the real data by asking patient or witness.

Once the crash occurs with multiple injured persons, our pre-hospital system uses triage and distribute the patient to multi-level of medical care. This system will help to maximize the capacity of medical care and improve the outcome. Major injured patients usually have separated to the different hospital, if possible. Matching and compare severity in the same crash of each position is our concerned for the robustness of the study but pairing only possible in minor injury (ISS 1-2).

Study strengths and limitations

One of the strengths of this study is the comprehensive data collection from the time of the victim's arrival until their discharge or death, ensuring that all injuries are detected and reported. The limitation of this study is missing immediate death. Trimodal pattern of trauma death: immediate, early and late death. The immediate deaths occur within seconds to minutes after injury and are usually unpreventable. The victims never reached the hospital. This study collects the data only on victims who arrive at the Emergency Department of Nopparat Rajathanee hospital, so we are missing the immediate deaths. Early deaths happened minutes to hours after injury and are typically related to hemorrhage. Deaths after days to weeks since injury are often due to multi-organ failure or sepsis. Owing to this study is hospital-based, as a clinician we can access to only patient who seek for the treatment. The passenger who need only first-aid care also do not come to the hospital. Our study is missing this group. If the data could be collected from all the incidents in the area, not just from one hospital, the dataset would be more complete. For further investigation, the complete integrated database is needed.

Conclusions

Regardless of seating position on a motorcycle, the probability of survival in the event of an incident is similar. There may be some factors that affect more than others (e.g., vehicle, road, and vulnerability of each passenger).

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Conflicts of interest

The authors declare that there are no conflicts of interest.

แนะนำการอ้างอิงสำหรับบทความนี้

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