

# Case Study in Fatal Motorcycle Injury Patterns

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## Abstract

Crash injury is one of the leading causes of premature death globally. In Indonesia, a motorcycle crash is the main cause of road traffic injuries. As a city with a high number of motorcycles, Yogyakarta needs the right mitigation approach based on the local characteristics. The aim of this study was to evaluate the patterns of injury in a fatal motorcycle crash in Yogyakarta. Data were described from five dead motorcyclists that were brought to the mortuary of Bhayangkara Hospital.

**Key words:** injury; injury patterns; motorcycle accident.

## Introduction

Motor crash makes an abundance of needless deaths and disabilities. WHO reported 1.35 million deaths a year or nearly as 3700 deaths every day from road traffic accidents<sup>1</sup>. In Indonesia, road injuries are the eighth and tenth leading cause of premature mortality and when combined with morbidity, respectively<sup>2</sup>. As a popular vehicle, the motorcycle demand in Indonesia is very high. Data from 2016 showed that more than 5 million motorcycles were produced annually<sup>3</sup>.

Yogyakarta is a city in Indonesia that motorcycles were extensively used. Hence, a crash is the greatest cause of road traffic injuries in Yogyakarta<sup>4</sup>. The right mitigation approaches are needed based on local characteristics. Therefore, we conduct this study to describe the patterns of injury in a fatal motorcycle crash in Yogyakarta.

## Material and Methods

All of the deceased that would be discussed was brought to the mortuary of Bhayangkara Hospital in

Yogyakarta from the scene of the crash, from April 1<sup>st</sup> to June 30<sup>th</sup>, 2020. The deceased were motorcyclists that had perished at the crash scene without received any medical attempts beforehand. The details had been summarized in Table 1. Approval of this study was given by the Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health and Nursing University Gadjah Mada/dr Sardjito General Hospital.

## Results

### Case 1: contusions on the chest

On Monday, April 6<sup>th</sup>, 2020, the body of 37 years old male was brought by the police after a motorcycle crash that took place in a rural area at 12 PM. The deceased was still wearing an intact helmet on its head, no wounds were found underneath. From the examination, we found bruises, 8x4.2 cm on the right and 1.1x1 cm on the left side of the chest. There was bluish color on the face and nail beds.

### Case 2: an app-based motorcycle taxi driver

A dead body of a 25-year-old male was brought to the mortuary on Thursday, April 9<sup>th</sup>, 2020. The motorcycle crash happened at 5:15 AM in a rural area. The deceased was still wearing an app-based taxi driver jacket and

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helmet. The examination revealed some abrasions, 10x5 cm on the left side of the chest, 19x15 cm on the left side of the abdomen, and 3x2 cm on the back of the left hand, and also closed fractures on the left upper arm, and left upper leg.

### **Case 3: open fracture of the head**

An examination was conducted on Tuesday, May 26<sup>th</sup>, 2020, on a dead body of 36 years old male. The guy was wearing a helmet while crashed a house wall fence that day, at 2:30 AM under clear weather, as the rider. The pillion passenger was a 19 years old male that survived while suffered from lacerations on the left cheek and the right foot. The crash scene was a dimly lit rural area. The examination exposed an open fracture on the front part of the head that extended to the backside. There was amputation at the first segment of the fifth finger of the left hand, and closed fractures with deformities on the nose, left upper arm, right upper leg, and left knee. We found multiple lacerations on the left side of the head, right and left cheek, and lower lip. There were multiple abrasions on the right shoulder, right hand, left upper leg, right and left knee, and left lower leg.

### **Case 4: multiple fractures**

On Sunday, May 31<sup>st</sup>, 2020, at 10:30 PM, in a rural area, a fatal road crash happened to a 69 years old male. The deceased was brought to undergo a forensic examination. The examination came out with multiple closed fractures on the lower jaw, upper left arm, the right side of the chest, left wrist, left ankle, and right knee. There was a laceration on the back part of the head 3x0.5 cm. We found numerous abrasions on the right side of the head, left knee and left upper arm.

### **Case 5: the broken helmet was still attached**

On Monday, June 22<sup>nd</sup>, 2020, the dead body of 51 years old male that was still wearing a broken helmet on its head was brought by the police. When the helmet had been released, we found an open comminuted depressed fracture 15x13 cm on the frontotemporal region of the skull, with brain tissues scattered around. Other injuries

were abrasions and bruises that were spread out on the neck, right elbow, right lower arm, right knee, left lower leg, upper right chest, and back. The crash happened in an urban area that day at 9:55 AM.

## **Discussion**

### **Demographical characteristics**

All of the cases that were discussed involved male motorcyclists, agreed with other studies that the majority of motorcycle crash casualties were male<sup>5</sup>. This finding happened because there were more male motorcyclists than females, that in accordance with Indonesia's condition<sup>6</sup>. But for a head injury, there was no considerably different risk for both sexes<sup>7</sup>.

Four from 5 cases (case 1, 3, 4, 5) associated with age $\geq$ 35, parallel to finding from Malaysia that this age was a significant predictor of death in a motorcycle crash<sup>8</sup>. This similar outcome could be because of the similarity of Indonesia and Malaysia that both countries have large numbers of motorcycles as transportation vehicles for working-class citizens<sup>6,9</sup>.

### **The patterns of injuries**

The main objective of this study was to evaluate the patterns of injury in a fatal motorcycle crash in Yogyakarta. Studies from other countries showed that the most frequent cause of death in a fatal motorcycle crash was head injury<sup>5,10</sup>. In this study, we described 2 cases (case 3 and case 5) with a devastating fracture on the head that could be easily recognized from external examination.

The actual number of head injuries in this study could be bigger, considered that internal examination had not been done because of the police request. The study in Spain showed that when the internal examination was conducted, the prominent causes of death in a motorcycle crash were subarachnoid hemorrhage, followed by cerebral contusion and skull base fracture<sup>11</sup>. The past study found that the position as the rider had a higher head injury risk, compared to the pillion passenger<sup>12</sup>.

Helmet use had been reported to lower head risk injury, in the amount of 69%, 71%, and 53% reduction in skull fractures, cerebral contusion, and intracranial hemorrhage, respectively<sup>13</sup>. Contributing factors to the helmet's failure in preventing injuries in case 1, 2, 3, and 5 could be speeding, or using helmet without proper fixation. As the past studies showed that the helmet protective effect only effective when the speed of the motorcycle was less than 30km/h<sup>14</sup>, and securely fixed<sup>15</sup>.

For facial injury, the helmet had a protective effect against maxillary fracture, but for mandible fracture (case 4) was not significantly proven<sup>16</sup>. This finding might be because there was no consideration to the helmet types. Another study found that the full-face and modular helmet had a higher protective effect against head injury compared to open-face, half-helmet, and novelty helmets<sup>7</sup>. A study from Thailand reported that a full-face helmet reduced head injury risk by 64% compared with a half-coverage helmet, and 36% compared with

a half-coverage helmet<sup>17</sup>. In Indonesia, wearing a national standardized helmet for motorcyclist was made mandatory<sup>18</sup>, but the resident's habit of wearing a helmet while riding a motorcycle was just 33.7% and 41.8% in Indonesia and Yogyakarta in particular based on the report in 2018, respectively<sup>6</sup>.

Results from the past study showed that the majority of injury types were abrasions or bruises, followed by lacerations and bone fractures. Nearly agreed with our findings that all of the cases involved abrasions or bruises, 3 cases showed lacerations (case 3, 4, and 5), and bone fractures in 4 cases (case 2, 3, 4, 5). Amputation was relatively rare but happened in case 3, which might be because of the crushed effect during the collision<sup>12</sup>.

After the head injury, injuries in the chest and abdomen caused significant numbers in motorcycle crash mortality<sup>5</sup>, as we suspected from case 1, 2, and 5. But the actual cause of death could not be defined without internal examination.

**Table 1. the summary of the motorcycle crashes.**

Case	Sex	Age	Time	Place	Helmet	Crash circumstances	Injury types (sites)
1	Male	37	Monday; 12 PM	Rural	Present	N/A	- Bruises (chest)
2	Male	25	Thursday; 5.15 AM	Rural	Present	N/A	- Abrasions (chest, abdomen, and left hand) - Closed fractures (left upper arm, and left upper leg).
3	Male	36	Tuesday; 2.30 AM	Rural	Present	The guy crashed a fence while riding in a dimly lit area under clear weather.	- Open fracture (head) - Amputation (the first segment of the fifth finger of the left hand) - Closed fractures (nose, left upper arm, right upper leg and left knee) - Lacerations (left side of the head, right and left cheek, and lower lip) - Abrasions (right shoulder, right hand, left upper leg, right and left knee, and left lower leg).
4	Male	69	Sunday; 10.30 PM	Rural	Absent	N/A	- Closed fractures (lower jaw, upper left arm, chest, left wrist, left ankle and right knee) - Laceration (head) - Abrasions (right temple, left knee and left upper arm).
5	Male	51	Monday; 9.55 AM	Urban	Present	N/A	- Open fracture (head) - Abrasions (neck, chest, right elbow, right lower arm, right knee, and left lower leg) - Bruises (chest and back).

## Other factors

The crashes in this study happened at various times and days, with the only case that occurred at the weekend was case 4. A past study in Pakistan found that crash happened on weekdays and during rush hour (6 AM-9 AM in the morning and 3 PM-6 PM in the evening) had more fatal probability than minor injuries that might be because of the high traffic of daily commuters<sup>19</sup>. From this study, there was no crash that happened in rush hour, case 2 befell early in the morning, case 3 before dawn, and case 4 late at night, might have an association with speeding and off-peak hours that increased the probability of fatality<sup>20</sup>.

Application-based taxi drivers (case 2) had a higher risk of mobile phone-related crashed, associated with the high prevalence of mobile phone use while riding<sup>21,22</sup>. A factor that also contributed to motorcycle crashes was riding under alcohol influence, as it could increase the risk of losing control<sup>23</sup>, and associated with non-helmet use<sup>24</sup>. There were no data related to blood alcohol level obtained from this study.

## Conclusions

Knowing injury patterns and associated factors are important in developing mitigation strategy to reduce motorcycle crash fatalities. The demographical characteristics gave us knowledge of the people at risk. Some measures had been made, but the implementation seems still lacking. This study could be developed for a future investigation, with the additions of more samples and variables. Internal examinations and laboratory tests will give objective value that will enrich the study.

**Conflict of Interest** NIL

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**Ethical Clearance** taken from Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health and Nursing University Gadjah Mada/dr Sardjito General Hospital, Ref no: KE/FK/0369/EC/2021.

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