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## Original Article

# Differences between the sexes in motorcycle-related injuries and fatalities at a Taiwanese level I trauma center

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## ARTICLE INFO

## Article history:

Received 13 October 2015

Accepted 21 October 2016

Available online 4 May 2017

## Keywords:

Female

Male

Injury severity

Motorcycle

Trauma

## ABSTRACT

**Background:** Female patients present with unique physiological and behavioral characteristics compared to male patients. The aim of this study was to investigate and compare the injury patterns, injury characteristics, and mortality of male and female patients hospitalized for treatment of motorcycle accident-related trauma in a level I trauma center.

**Methods:** Retrospective analysis of motorcycle-related injuries from the Trauma Registry System was performed to identify and compare 4028 male and 2919 female patients hospitalized for treatment between January 1, 2009 and December 31, 2013.

**Results:** The female patients were younger, less often drunken, more often wore helmets, were transported by emergency medical services, and arrived at the emergency department between 7 a.m. and 5 p.m. compared to male patients. Analysis of Abbreviated Injury Scale scores revealed that female patients sustained significantly higher rates of injuries to the extremities, but lower rates of injuries to the head/neck, face, and thorax than male patients did. Female patients had a significant lower Injury Severity Score (ISS) and adjusted odds ratio of in-hospital mortality (AOR 0.83, 95% CI: 0.83–0.86) after adjustment by ISS. However, the logistic regression analysis of propensity score-matched patients with adjusted confounders including helmet-wearing status and alcohol intoxication revealed that the gender did not significantly influence mortality (OR 0.82, 95% CI 0.47–1.43;  $p = 0.475$ ), implying the an associated risky behaviors may attribute to the difference of odds of mortality between the male and female patients. In addition, a significantly fewer female patients were admitted to the intensive care unit (ICU), and female patients had a significantly shorter hospital and ICU length of stay.

**Conclusion:** Female motorcycle riders have different injury characteristics, lower ISS and in-hospital mortality, and present with a bodily injury pattern that differs from that of male motorcycle riders.

**Level of evidence:** Epidemiologic study, level III.

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Peer review under responsibility of Chang Gung University.

<http://dx.doi.org/10.1016/j.bj.2016.10.005>

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## At a glance commentary

### Scientific background on the subject

Although strong evidence indicates that the risk of road traffic injury varies by sex, there remains a lack of consensus over the detailed characteristics of injury pattern and injury severity between women and men in motorcycle traffic accidents.

### What this study adds to the field

This study revealed that the female motorcycle riders had a lower mortality than male motorcycle riders. However, analysis of propensity score-matched patients with adjusted confounders including helmet-wearing status and alcohol intoxication revealed that the associated risky behaviors, but not the gender, may attribute to the difference of odds of mortality.

Motorcycle use is popular in many cities as a less expensive, easier, and more fuel-efficient means of transportation. Road traffic accidents involving motorcycle riders often result in severe morbidity and mortality. Motorcyclists make up 13% and 16% of all annual traffic-related fatalities and inpatient injuries, respectively, despite being a small fraction of the travel [1]. The National Highway Traffic Safety Administration (NHTSA) reported that at the national level, motorcyclists were approximately 30 times more likely to die in a motor vehicle crash than a motor vehicle occupant in 2011 [2]. In addition, motorcycle riders were 8 times more likely to be injured per vehicle mile [3], and 58 times more likely to be killed on a per-trip basis [4]. Women have been reported to have a significantly higher risk of slight injury than men when travelling by bus, bicycle, and car, but no differences are observed between the sexes as pedestrians, nor as motorcycle or moped drivers [5]. Analysis using a travel-based measure of exposure in a U.S. state with a population with roughly equal numbers of men and women revealed that the women accounted for 39% of traffic-related inpatient injuries and 32% of traffic-related fatalities [1]. The higher risk of non-fatal injury among female drivers has also been reported in studies that used driving distance as a measure of exposure [6,7]. In contrast, some authors reported the male:female ratio in motorcycle injuries was as high as 4.8:1 [8]. However, although strong evidence indicates that the risk of road traffic injury varies by sex [4,5,9], there remains a lack of consensus over the detailed characteristics of injury pattern, and whether injury is higher among women or men in motorcycle traffic accidents.

Identifying high-risk injury patterns and gaining a greater understanding major trauma epidemiology in different sexes is vital to the integration of trauma knowledge in the trauma system to maximize the provision of services and the quality of care delivered [10,11]. Moreover, considering that nearly all motorcycles are forbidden on highways in Asian cities, and that most traffic accidents occur in relatively crowded streets

in these cities at relatively low speeds, we hypothesize that the discrepancy between the sexes might differ from those of previous Western studies. This study investigated the injury pattern, mechanisms, severity, and mortality of male and female patients treated for injuries sustained in motorcycle accidents in a level I trauma center in Taiwan using data from a population-based trauma registry.

## Methods

### Ethics statement

This study was approved by the hospital institutional review board (IRB) with approval number 103-3020B before its initiation. An informed consent was waived according to the regulation of IRB.

### Study design

This retrospective study reviewed all of the data added to the Trauma Registry System of a 2400-bed Level I regional trauma center, which provides care to trauma patients primarily from South Taiwan. Cases of hospitalization for trauma sustained in motorcycle accidents from January 1, 2009 to December 31, 2013 were selected. Among the 6947 registered patients entered in the database, 4028 (58.0%) were male and 2919 (42.0%) were female. Detailed patient information was retrieved from the Trauma Registry System of our institution, which included patient age, admission vital signs, injury mechanism, and helmet use. The method of transportation to the emergency department was also examined, and included emergency medical services (EMS), private vehicle, or transfer by ambulance from another hospital. Other data collected included the first Glasgow Coma Scale (GCS) in the emergency department, details of the procedures performed at the emergency department (cardiopulmonary resuscitation, intubation, chest tube insertion, and blood transfusion), an Abbreviated Injury Scale (AIS) of each body region, Injury Severity Score (ISS), New Injury Severity Score (NISS), Trauma-Injury Severity Score (TRISS), hospital length of stay (LOS), intensive care unit (ICU) LOS, in-hospital mortality, and associated complications. Adjusted odd ratios (AORs) and 95% confidence intervals (CI) for mortality according to age and stratified ISS were calculated. In our study, the primary outcomes were injury severity as measured by different scoring system (GCS, AIS, ISS, NISS, and TRISS) and in-hospital mortality. The secondary outcomes were the associated complications, and hospital and ICU LOS. The data collected were analyzed using SPSS v. 20 statistical software (IBM, Armonk, NY) for Pearson's chi-squared tests, Fisher's exact tests, or the independent Student's t-tests, as applicable. A 1:1 matched study group was created by the Greedy method using NCSS software (NCSS 10; NCSS Statistical software, Kaysville, Utah). After adjusting for confounding factors such as status of helmet-wearing and alcohol intoxication, a conditional logistic regression was used for evaluating the effect of gender on mortality. All results are presented as the mean  $\pm$  standard

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