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Patterns of injury among motorized two-wheeler pillion riders in New Delhi, India

Selma Marie Siddiqui, MD,[a,*] *Sushma Sagar, MBBS, MS,*[b] *Mahesh C. Misra, MBBS, MS, FACS, FRCS,*[b] *Amit Gupta, MBBS, MS,*[b] *Marie Crandall, MD, MPH, FACS,*[c] *and Mamta Swaroop, MD, FACS*[a]

[a] *Department of Surgery, Northwestern University Feinberg School of Medicine, Chicago, Illinois*
[b] *Department of Surgery, All India Institute of Medical Sciences, New Delhi, India*
[c] *Department of Surgery, University of Florida Jacksonville, Jacksonville, Florida*

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ABSTRACT

Background: Motorized two-wheelers (MTWs) such as scooters and motorcycles place drivers and passengers at significant risk of injury and death in the event of a road traffic accident. In India, where road traffic is poorly regulated and consists of vehicles ranging from semitrucks to animal carts, the MTW pillion rider (backseat passenger) is particularly vulnerable. Annually, approximately 140,000 Indians are injured or killed in MTW road traffic accidents. In 2011, the city of New Delhi renewed a mandatory helmet use exemption for its 8 million women. We sought to identify the patterns of injury among MTW pillion riders in the city of New Delhi, including differences between helmeted and unhelmeted male and female pillion riders.

Methods: All records of incoming trauma patients to the Jai Prakash Narayan Apex Trauma Center, New Delhi, were reviewed for the 23-mo period from April 1, 2009 until March 1, 2011. More than 3000 charts were reviewed selecting for patients who were MTW pillion riders involved in road traffic accidents. Data including Glasgow Coma Scale score, number of surgical procedures performed, length of stay, and demographic information were collected from charts that met the criteria. Fisher's exact test was used for categorical variables and Kruskal–Wallis test for continuous variables.

Results: A total of 466 charts of MTW pillions in road traffic accidents were identified with 108 helmeted males, 161 unhelmeted males, three helmeted females, and 194 unhelmeted females. Females, both unhelmeted and helmeted, were more likely to have head and neck injury than unhelmeted males or helmeted males (66.0% and 66.7% *versus* 53.4% and 27.8%, $P < 0.001$). Unhelmeted females were most likely to suffer inhospital mortality (17.6%, $P = 0.008$) and require intensive care unit admission (40.0%, $P = 0.004$). Unhelmeted pillions, both male and female, had significantly lower Glasgow Coma Scale scores than helmeted pillions (12.6 and 12.8 *versus* 13.8 and 15, $P = 0.04$).

Conclusions: Female pillions are more likely to have head and neck injury than male pillions, and unhelmeted pillions are more likely to have injuries resulting in their death. This firmly establishes the protective benefit of helmet use for pillions. Encouraging helmet use

* *Corresponding author*. Department of Surgery, Northwestern University Feinberg School of Medicine, 676 N. Saint Clair Street, Suite 650, Chicago, IL 60611. Tel.: 1-312-695-4835; fax: 1-312-695-3644.
E-mail addresses: selmamsiddiqui@gmail.com, Selma.siddiqui@fsm.northwestern.edu (S.M. Siddiqui).
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among all pillions may prevent a significant number of injuries and deaths, and mandatory helmet laws may decrease morbidity and mortality of MTW road traffic accidents for the women of New Delhi and all of India.

Introduction

India is home to one in six people on Earth today. It faces many problems as the world's largest democracy, including difficulties developing laws that suit the needs and wants of all 1.2 billion residents. Road traffic injuries (RTIs) cause the deaths of 500,000 people each year with countless other RTI-related deaths that are unreported. Motorcycle and scooter (motorized two-wheelers [MTWs]) riders and passengers are by far the most vulnerable roadway users aside from pedestrians and consistently represent the dominant group in both volume of roadway users and volume of roadway users injured or killed in RTIs.[1–3]

Helmet use for two-wheeler riders and passengers was not mandatory in India in the early 1980s, and several groups demonstrated both poor helmet compliance[4] and that helmet use reduced the likelihood of death and traumatic brain injury morbidity.[5] Once these data were available, the federal government generated and passed the Motor Vehicle Act of 1988 (The Act) mandating helmet use for all persons seated on MTWs.[6] However, the federal government stipulated that states could implement The Act at their discretion.

New Delhi initially implemented the entirety of The Act including the mandatory helmet use law, but objections were immediately voiced as various groups protested the potential interference with cultural and religious practices. New Delhi's government then exempted all female pillion riders from mandatory helmet laws. Observational studies from 2011 demonstrated pillion rider helmet compliance of over 4000 pillions to be 58.7% overall, and 88.4% among male pillions and 0.6% among female pillions.[7] This difference in helmet use may account for a distinction in common injuries seen after RTIs in this population. We do note that as of August 2014 following multiple appeals and petitions, helmets are legally required for *all* passengers seated on MTWs unless the person is of Sikh faith and actively wearing a religious head covering.

As there is a paucity of data delineating pillion riders' injuries after RTIs in India, we sought to identify the patterns of injury among MTW pillion riders in the city of New Delhi. We specifically aimed to identify differences in injuries between helmeted and unhelmeted male and female pillion riders at a single centrally located trauma center. We hypothesize that unhelmeted pillions have higher rates of head and neck injuries, require intensive care unit admission more frequently, and have higher mortality rates than their helmeted counterparts. We further hypothesize that female pillions have different injury patterns than male pillions.

Methods

Established to serve the trauma needs of the large metropolitan city of New Delhi, the Jai Prakash Narayan Trauma Center (Trauma Center) has the capacity to handle eight level 1 (highest acuity) trauma patients simultaneously, with a dedicated trauma emergency department equipped to handle at least 32 other level 2 or lower trauma activations. The inpatient facility runs five fully equipped trauma operating rooms, a trauma intensive care unit (ICU) and a neurosurgical ICU with 30 beds, and a total inpatient capacity of over 210 beds. The Trauma Center is located off the main circumferential highway in New Delhi and is easily accessed from across the city. Annually, the Trauma Center sees more than 50,000 patients. For these reasons, this center was chosen for the chart review.

The Trauma Center instituted a center-wide standardized trauma intake form at its inception. Dedicated nurses at the Trauma Center, identified as trauma nurse coordinators, complete the paper intake form when an injured patient is brought in. These same nurse coordinators follow the patients throughout their course in the emergency department, the operating room, and on the inpatient ward until discharge using the same intake form. These forms have a numbered identifier separate from any link to the medical record. The intake form collects data including type of injury, mechanism, Glasgow Coma Scale (GCS), ICU stay, surgical procedures undergone, imaging/studies obtained, and inhospital mortality.

These paper charts were reviewed for the 23-month period from the opening of the trauma center in April 2009 to March 2011. More than 3000 were reviewed by two reviewers filtering for mechanisms of injury as MTW road traffic accident *and* pillion passenger. Four hundred sixty-eight charts were identified that met these two criteria. Data collected from the intake forms included age, gender, type of trauma activation in the emergency department, arrival GCS score, Injury Severity Score (if available), imaging obtained, diagnosed injuries, surgical interventions, hospital course, mortality, and end disposition. These data were entered into Microsoft Excel for collection (Redmond, WA).

Diagnoses were then categorized into five major groups and reviewed by three reviewers for consistency. Those five groups were assigned as head and neck injury, facial injury, thoracic injury, abdominal injury, and extremity or soft-tissue injury. Those patients who had multiple injuries were coded for each group their injuries fell under. Patients were additionally grouped into four classifications by gender and helmet use status: helmeted female, unhelmeted female, helmeted male, and unhelmeted male. Differences in proportions of objective end points between these patient classes were analyzed using Fisher's exact test for categorical variables and Kruskal–Wallis test for continuous variables using SAS version 9.3 (Cary, NC).

Results

Of the 468 charts identified meeting mechanism of MTW road traffic accident and pillion passenger, complete records on