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The problem of the pillion rider: India's helmet law and New Delhi's exemption

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ABSTRACT

Background: In India, motorized two-wheeler (MTW) road traffic accidents injure or kill 72,000 women annually. Before the Motor Vehicle Act of 1988, which required mandatory helmet use for MTW riders, a study found 0.6% of all MTW pillion (backseat passengers) were helmeted. Citing religious protests to the legislation, Delhi's high court exempted the city's 12 million women from the law. We hypothesize that currently male pillion use helmets more frequently than females, and that overall pillion helmet usage has increased over the last 20 y.

Methods: Continuous video was recorded in half-hour blocks at four locations in Delhi on separate days, totaling 8 hours of high- and low-volume traffic. Videos were reviewed with at least two reviewers extracting the number of MTW pillion, as well as their gender, approximate age, and helmet usage.

Results: Of 4010 pillion identified, 63.8% were male, 32.4% female, and 3.3% children. Among males, there were significantly more helmeted pillion (88.4%, $P < 0.001$); among females, there were significantly more unhelmeted pillion (99.4%, $P < 0.001$). Among unhelmeted pillion, significantly more were female (81.4%) than male ($P < 0.001$). Current overall pillion helmet use is significantly higher than historical rate ($P < 0.001$).

Conclusions: The significantly higher male pillion helmet usage compared with females indicates Delhi's helmet law is associated with increased compliance among those who fall under its jurisdiction. This augments the growing body of evidence that mandatory helmet laws are efficacious, thus repealing the exemption of women is an important step in increasing female pillion helmet usage.

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1. Introduction

In the United States, where many mandatory helmet laws have been repealed for infringing on motorcyclists' freedoms, head injury-associated mortality, and overall mortality rates in motor vehicle collisions rose to their

prehelmet law levels [1]. India is currently facing a similar situation. India's Motor Vehicle Act of 1988 made helmet use mandatory for motorized two-wheeler riders (MTWs), including drivers and pillion (backseat passengers) [2]. The capital city, New Delhi, implemented this law in 1997. Two years later, the New Delhi High Court exempted all women

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Table 1 – Pillion rider gender differentiation cues.

Men pillion	Women pillion	Children pillion
Short hair (unhelmeted only)	Long hair (unhelmeted/seen out of helmet)	Seating position (between driver and handle bars)
Seated straddle-style	Seated side-saddle	Held by another pillion
Turban/topi cap	Headscarf	Smaller stature
Suit/tie apparel	Sari/skirt apparel	
Masculine body habitus	Feminine body habitus	

pillion and Sikhs wearing turbans from mandatory helmet use after opponents argued the requirement infringed on religious expression, particularly headscarf and turban use [3]. It was argued that according to Sikh religious practices, no further head coverings may be placed over turbans or scarves.

Before federal helmet laws, Mohan *et al.* [4] conducted a study of helmet use patterns among MTW users in New Delhi. They found pillion riders had a helmet use rate of 0.6% without consideration of gender or age. This metropolis of nearly 22 million persons saw traffic volume grow by approximately 8% per year since 1984, with MTWs consistently comprising one-third of vehicular traffic in that time period [5]. Until late 2012, the fine for violation of the helmet law for those to whom it is applicable was 100 Indian rupees (INR; \$1.8 USD), in a city where the average annual *per capita* income is 201,000 INR (\$3715 USD) [6,7]. Despite recent attempts by the transport department to require helmets for women pillion on MTWs, the government of New Delhi declined to reconsider the law [8]. Notably, the government did increase the fine for helmet disuse among men to 500 INR (\$9 USD) indicating a willingness to take steps to further helmet use among men MTW users.

More than 500,000 Indians were reported injured or killed in motor vehicle collisions in 2011, including at least 72,000 women. MTWs comprised the majority of vehicles involved in fatal accidents [9]. We sought to identify the current patterns of MTW pillion helmet use. We hypothesized that adult male pillion helmet use would be higher than the historical rate, whereas the female pillion helmet use rate would be unchanged. We further hypothesized that male pillion helmet usage would be higher than female pillion helmet use and that female pillion were more likely to be unhelmeted than helmeted.

2. Methods

Thirty minutes of continuous video was filmed at four different intersections in New Delhi totaling 8 h of recorded traffic during the month of May 2011. Intersections were selected for empirically noted and transport department documentation of high traffic volume [5]. Recordings were made each on a different day at distinct times of day to capture morning and evening rush periods along with routine daytime traffic. Permission was obtained from both the local and home institutions' Ethics Board and Internal Review Board, respectively, and we verified that obtaining video recordings would not violate any local statutes.

Locations selected for recording were (Appendix 1; [10]):

1. The Rajiv Chawk Circle and Barakhamba Road intersection: a popular primarily shopping and commerce area
2. The AIIMS Trauma Center Road and Mahatma Gandhi Road intersection: a primarily business area adjacent to a main inlet of the Outer Ring Road Highway
3. The India Gate C Hexagon: a central tourist and business area
4. The Safdarjung Hospital Road and Mahatma Gandhi Road intersection: a primarily business and residential area

Two reviewers with extensive familiarity of South Asian male and female attire screened the video recorded traffic. Reviewers noted all observed MTWs carrying pillion extracting number of pillion, their gender, approximate age, and helmet use status (see Table 1). When one of these extracted data points was discordant between reviewers, video was slowed and/or replayed up to five times and if discordance was still present, that entry was not included in analysis. Where MTWs were noted to be present but extraction of pillion rider data was unobtainable due to poor visibility on the video, such as nighttime or an obstructing vehicle, those MTWs were entered as a single entry in an "obscured" count for each video and were excluded from analysis.

All data extracted were entered into Microsoft Excel (Redmond, WA) for pooling across the videos and for data analysis. Fisher exact test was used for determinations of statistical significance.

For a historical control rate of helmet use, we critically reviewed the observational study of MTW drivers and passengers conducted by Dinesh Mohan [4]. In that study, 3774 MTWs were observed with pillion passengers, constituting approximately one-third of all MTWs observed on the roadways at that time. Of those 377 pillion, 0.6% was helmeted. In the reported data, these pillion were not categorized by gender.

3. Results

A total of 3874 MTWs with pillion passengers were observed. From those, 4010 pillion riders were identified with 3868 adults identifiable by gender (Table 2). The gender of 11 pillion was unable to be determined by two reviewers, and these were excluded from analysis. There were 414 MTWs where the passenger load was obscured by traffic conditions and unable to be extracted.

Adult males represented 63.8% of the total observed pillion, adult females represented 32.4% of total observed pillion, and children represented 3.3% (Table 2).

Table 2 – Observed MTW pillion riders.

Pillion rider type	Proportion of pillions	n
Males	63.8%	2560
Females	32.6%	1308
Children	3.3%	131
Total	100%	4010 ^{*,†}

* This excludes the 414 obscured MTWs where pillions were unable to be extracted.

† Note that 11 pillions' genders were not distinctly identified by reviewers and so were excluded from analysis.

When evaluated by gender, significantly more male pillions were helmeted (88.4%) than unhelmeted ($P < 0.001$) and significantly fewer female pillions were helmeted (0.6%) than unhelmeted (99.4%, $P < 0.001$) (Table 3).

Unhelmeted pillions were significantly more likely to be female (81.4%) than male ($P < 0.001$) (Table 4). When the 58.7% rate of actual helmet usage among our current gender-pooled pillions was compared with the historical control rate of 0.6% [1], the observed increase in helmet usage was statistically significant ($P < 0.001$).

When our current data were separated into gender groups for comparison with the gender-neutral historical control, there was no significant change in female pillion helmet usage ($P = 1.0$), whereas the increase in helmet use among men was significantly higher ($P < 0.001$).

In addition, there were 120 MTWs with more than one pillion rider. Of those, the proportion of adult female pillion riders was 71% ($n = 97$), and the proportion of adult male pillions was 28% ($n = 30$) (data not shown). Of the 14 MTWs with three pillion riders, one adult female pillion and two children pillions were aboard 12 vehicles, and there were two vehicles where all three pillions were children.

4. Discussion

Although it is widely accepted that the helmet use results in improved outcomes for riders involved in collisions [11,12], it has further been shown that the presence of a helmet law alone results significantly fewer head injuries and fewer fatalities among MTW users [13,14]. When this mortality benefit was demonstrated in India [15], it was shortly followed by the Motor Vehicle Act of 1988 that mandated helmet use for all MTW pillions. Before 1988, helmets were mandatory for nonSikh MTW drivers only, with a driver helmet use compliance of nearly 80% [4]. The same study found overall pillion rider helmet use at a mere 0.6% noting that helmet use was higher in areas with stronger police presence.

Table 3 – Male and female adult pillion rider helmet usage ($n = 3868$).

Pillion rider type	Proportion helmeted (n)	Proportion unhelmeted (n)
Male pillions	88.4% (2262)	11.6% (298)
Female pillions	0.6% (8)	99.4% (1300)

Table 4 – Helmet use among adult pillion riders ($n = 3686$).

Helmet usage	Males (n)	Females (n)	Total (n)
Helmeted	99.6% (2262)	0.4% (8)	58.7% (2270)
Unhelmeted	18.6% (298)	81.4% (1300)	41.3% (1598)

The current actual helmet use rate of male pillions in our study, regardless of location or time of day, was significantly higher than both the historical rate for all pillions and our current actual helmet use rate of female pillions. This indicates that having a legal mandate in India results in increased helmet use within the targeted group. Furthermore, that the current helmet use rate among female pillions was unchanged from the 1984 rate supports the assertion that helmet compliance is unlikely to increase without legal requirements.

A recent survey conducted by our group demonstrated that most of New Delhi's women favor repealing their own exemption from mandatory helmet laws [16]. Although most women reported helmet disuse because they felt it uncomfortable or unattractive, nearly one in five reported not using a helmet because she was not legally required to do so. As demonstrated by its efficacy in improving helmet use among the city's men, mandatory helmet law clearly contributes to higher helmet compliance. Although the government of New Delhi and the Federal Government of India have not promoted any public health campaigns encouraging helmet use to date, the recent efforts to increase the penalty for men riding MTWs unhelmeted appears to indicate that the government may be willing to take stronger action to prevent head injuries. Given that the average cost of helmets meeting government standards is 800 INR, and the current fine assessed for unhelmeted male pillions is 200 INR, there is room for improvement in the economic incentive for legal compliance and safe roadway practices.

However, it is clear from international experiences that an unsupported legislative approach may result in helmet compliance increases that are less than desired. In China, where mandatory helmet laws were implemented without adequate law enforcement and public education, there was no significant increase in helmet use [17]. However, in Taiwan and Vietnam, where helmet laws were implemented concurrent with adequate enforcement, punitive fines and a strong public awareness campaign, helmet use rates have risen substantially [18,19].

The economic incentive for promoting helmet use to the governing body may be clearer than for the individual user. As head injury is the most common injury among female pillions in preliminary data from the AIIMS in 2011 [20], helmet use will reduce the impact of traumatic brain injury among New Delhi's women. Whereas individual users may lack the insight to weigh the immediate costs of helmet use against the long-term costs of dealing with traumatic brain injury, the costs supporting those affected with brain injuries on a societal level is likely to be far more than the costs of implementing a multidisciplinary helmet use campaign.

This study was limited by our inability to extract passenger data from obscured vehicles ($n = 414$, 10.7%). Although every

effort was made to minimize the risk of errors in data extraction from the video, that possibility remains. It seems unlikely, however, that such errors were prevalent enough to alter our findings. Furthermore, although helmet use was identifiable, recommended safety features and the proper use of those features were not. For the purpose of comparison with the historical referent, we assumed the proportion of male and female pillions at the time of that study is not significantly different from ours.

5. Conclusions

In line with encouraging the establishment of uniform legislation requiring helmet use by all MTW pillions, we hope to encourage the development of public awareness and education campaign to improve public desire to use protective headgear in New Delhi. It is our belief that these changes, if brought about, may result in a reduced burden of injury and mortality among women in India. In addition, we hope our distinct findings between males and females brings attention to the variance in road user safety practices between genders and encourages future road safety and road injury studies to be more attentive to this distinction.

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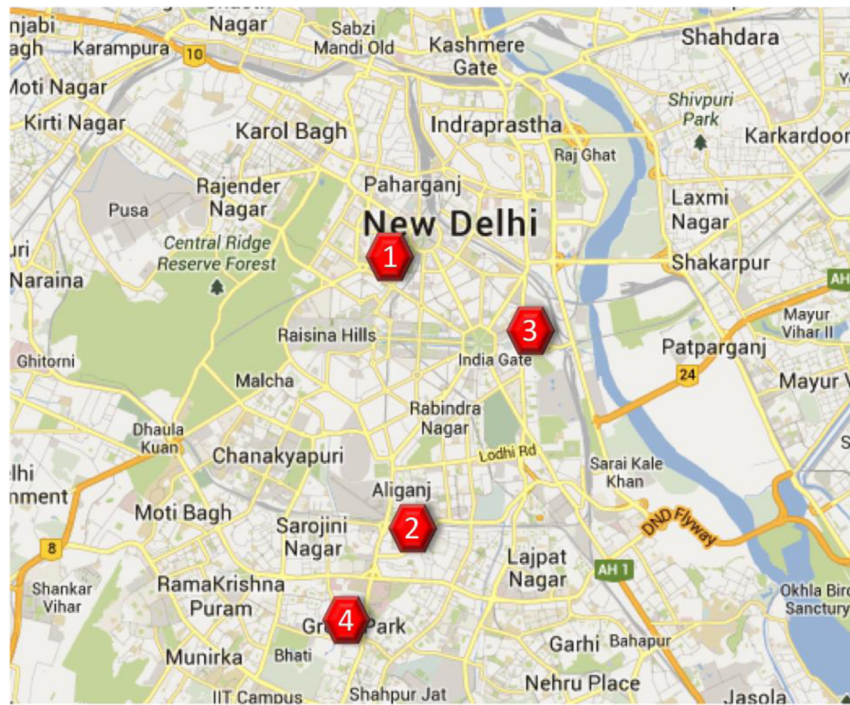
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REFERENCES

- [1] Derrick AJ, Faucher LD. Motorcycle helmets and rider safety: a legislative crisis. *J Public Health Policy* 2009;30:226.
- [2] The Motor Vehicle Act, 1988. Ministry of road transport and highways. New Delhi, India: Government of India; 1988.
- [3] Delhi High Court. Judgment of the Honorable Dalveer Bhandari: Parmanand Katara vs Union of India on 1/9/1997. <http://www.indiankanoon.org/doc/1103622/>; [accessed 15.06.2013].
- [4] Mohan D. A study of helmet and motorized two-wheeler use patterns in Delhi. *Am Assoc Automot Med* 1984;5:29.
- [5] Jalihal SA, Ravinder K, Reddy TS. Traffic characteristics of India. *Proc East Asia Soc Transportation Stud* 2005;5:1009.
- [6] Delhi Traffic Offense and Penal Section: <http://www.delhitrafficpolice.nic.in/offenses-penalties.htm> [accessed 30.03.2013].
- [7] Hindustan Times. Delhi sees 16% rise in per capita income, <http://www.hindustantimes.com/India-news/NewDelhi/Delhi-sees-16-rise-in-per-capita-income/Article1-1028967.aspx>; 2013 [accessed 30.06.2013].
- [8] Hindustan Times. Sheila shoots down mandatory helmet cover for women, <http://www.hindustantimes.com/India-news/NewDelhi/Sheila-shoots-down-mandatory-helmet-cover-for-women/Article1-846806.aspx>; 2012 [accessed 30.04.2012].
- [9] Road Accidents in India in 2011. New Delhi: Transport Research Wing Ministry of Road Transport and Highways, New Delhi, India. Government of India; 2012.
- [10] Google Maps. "New Delhi, India." Google Incorporated, <https://maps.google.com/>; 2013 [accessed 22.06.2013].
- [11] Ouellet JV, Kasantikul V. Motorcycle helmet effect on a per-crash basis in Thailand and the United States. *Traffic Inj Prev* 2006;7:49.
- [12] World Health Organization. Global status report on road safety 2013: supporting a decade of action http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/index.html; 2013 [accessed 31.03.2013].
- [13] Fleming NS, Becker ER. The impact of the Texas 1989 motorcycle helmet law on total and head-related fatalities, severe injuries, and overall injuries. *Med Care* 1992;30:832.
- [14] Coben JH, Steiner CA, Miller TR. Characteristics of motorcycle-related hospitalizations: comparing states with different helmet laws. *Accid Anal Prev* 2007;39:190.
- [15] Mishra BK, Banerji AK, Mohan D. Two-wheeler injuries in New Delhi, India: a study of crash victims hospitalized in a neuro-surgery ward. *Accid Anal Prev* 1984;16:407.
- [16] Siddiqui S, Arora S, Peipert J, Sagar S, Crandal M, Swaroop M. Survey of helmet influence of female pillions in New Delhi. *J Surg Res* 2013;184:404.
- [17] Xuequn Y, Liang K, Ivers R, Du W, Senserrick T. Prevalence rates of helmet use among motorcycle riders in a developed region in China. *Accid Anal Prev* 2011;43:214.
- [18] Tsai MC, Hemenway D. Effect of the mandatory helmet law in Taiwan. *Inj Prev* 1999;5:290.
- [19] Passmore JW, Nguyen LH, Nguyen NP, Olive JM. The formulation and implementation of a national helmet law: a case study from Viet Nam. *Bull World Health Organ* 2010;88:783.
- [20] Siddiqui S, Peipert J, Sagar S, Crandall M, Swaroop M. Patterns of injury: motorized two wheeler pillion riders in New Delhi, India. Abstract. *J Surg Res* 2013;179:340.

Appendix 1.

Map of New Delhi with Locations of Video Recordings Marked



Map Courtesy of Google Maps.
