

Patterns of head injury among drivers and pillion riders of motorised two-wheeled vehicles in Bangalore

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Abstract: Pattern of injuries among pillion riders are not well studied. A limited number of studies do indicate that there is no significant difference in the severity of injuries sustained by pillion riders and drivers. Very few cities in India have mandatory helmet law for pillion riders. The aims of the present study were to study the pattern of head injuries in patients involved in two wheeler accidents and to compare injuries of drivers and pillion riders; drivers with and without helmet. Two hundred and four consecutive patients admitted under trauma unit of NIMHANS (102 pairs of drivers and pillion riders) were included in the study from April to mid-June 2009. In the second part, records of 116 patients who died in a two wheeler accident between July 2008 and July 2009 were retrieved from NIMHANS mortuary and retrospectively analysed. There was no significant difference between the GCS scores of drivers and pillion riders (mild head injury - 60.8% Vs 74.5%, moderate head injury- 32.3% Vs 22.5%, severe head injury- 6.9% Vs 2.9%). Both the groups also did not differ significantly with regards to CT scan findings. Only 44 drivers (43.1%) were wearing helmet at the time of injury. The postmortem study revealed that only 10/83 (12%) drivers were wearing helmet at the time of the fatal accident. To conclude, there is no significant difference between the head injuries sustained by the motorized two wheeler drivers and their pillion riders. Helmets must be made mandatory for pillion riders throughout the country.

Keywords: helmet; pillion rider; postmortem; two wheeler.

INTRODUCTION

Traffic in developing countries is different from that in developed countries. Motorized two wheeler accidents form a major component of all accidents in developing countries. Wearing helmet offers significant protection against head injuries^{1,2,3}. However, helmet regulation in India is not uniform and is poorly implemented. Helmet rule for drivers was implemented in the city of Bangalore in 2006.

Pattern of injuries among pillion riders are not well studied. A limited number of studies do indicate that there is no significant difference in the severity of injuries sustained by pillion riders and drivers^{1,4,5}. Very few cities in India have mandatory helmet law for pillion riders (Table 1). The aims of the present study were to study the pattern of head injuries in patients involved in two wheeler accidents and to compare injuries of drivers and pillion riders; drivers with and without helmet.

MATERIAL AND METHODS

The study was conducted in two parts. A prospective

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Table 1: Helmet regulation in major Indian cities

City	Helmet for Driver	Helmet for Pillion
New Delhi	Compulsory	Females & Sikhs Exempted
Mumbai	Compulsory	Compulsory
Kolkata	Compulsory	Compulsory
Chennai	Compulsory	Optional
Bangalore	Compulsory	Optional
Ahmedabad	Compulsory	Optional
Hyderabad	Compulsory	Optional

study was conducted at the casualty of National Institute of Mental Health and Neurosciences (NIMHANS) in which 114 consecutive pairs of drivers and pillion riders who sustained injury in a road traffic accident were enrolled from April to June 2009. In the second part, records from NIMHANS mortuary were retrospectively analysed from July 2008 to July 2009. An analysis of 116 patients who died in motorized two wheeler accidents during this period was performed.

RESULTS

A. Prospective study

Injuries of drivers with helmet was compared to those in drivers not wearing helmet. Even three years after implementation of the helmet rule only 48/114 drivers

(42.1%) were wearing helmet at the time of injury. However, in the prospective arm of the study, the spectrum of injuries was almost similar between the both groups (Table 2).

Injuries of 114 drivers was compared with 114 pillion riders. The incidence of mild head injuries was significantly higher in the pillion group (Table 3). The overall mortality rate was 10.5% (24/228). The mortality rate was 6 times higher in drivers without helmet as compared to drivers with helmet. The mortality rate of pillion riders was marginally higher when compared to drivers without helmet (Table 4).

B. Postmortem study

All head injury patients who expire in NIMHANS undergo postmortem at NIMHANS mortuary. The current study was conducted from July 2008 to July 2009. 348 patients dying due to head injury underwent postmortem during this period. 116/348 (33.3%) patients died because of two wheeler accidents. Despite the helmet rule implementation in 2006, the number of patients dying in two wheeler accidents increased from 81 (29.8%) in 2005 to 116 (33.3%) in 2009 (Table 5). Of these 116 patients who died, 83 (71.6%) patients were drivers and 33(28.4%) were pillion riders. Only 10 out of 83 (12%) drivers were wearing helmet at the time of the fatal accident. Of the 33 pillion riders, 14(42.4%) were females. Analysis of the mechanism of

injury in these fatal accidents revealed that 9 out of 10 drivers who were wearing helmet and died were involved in a major accident with a heavy vehicle (bus, truck, matador etc) or four wheeler. On the contrary, the most common mode of fatal injury in drivers without helmet was a skid and fall (34/73, 46.6%). Interestingly, the commonest mode of injury in pillion riders who died after a fatal accident was also skid and fall (15/33, 45.5%, Table 6). The most common postmortem finding was an acute subdural hematoma followed by cerebral contusions. Postmortem findings were similar in all the three groups (Table 7).

DISCUSSION

According to WHO⁶, Road Traffic Injuries (RTIs) are the sixth leading cause of death in India with a greater share of deaths, disabilities and socioeconomic losses in young populations. The growth of the motor vehicle

Table 5: Postmortem census at NIMHANS mortuary (2004-2008)

Year	Total deaths	Two wheeler deaths
2004	289	
2005	271	81(29.8%)
2006	400	
2007	485	
2008	380	

Table 6: Mode of injury in fatal accidents

	Skid & fall	Two wheeler	Four wheeler/ heavy vehicle	Others
Drivers without helmet (n=73)	34 (46.6%)	7 (9.6%)	25 (34.2%)	7 (9.6%)
Drivers with helmet (n=10)	0	1 (10%)	9 (90%)	0
Pillion riders (n=33)	15 (45.5%)	7 (21.2%)	9 (27.3%)	2 (6.1%)

Table 2: Injury severity of drivers with and without helmet

Severity of injury (GCS)	Drivers with helmet (n = 48)	Drivers without helmet (n = 66)
Mild	28 (58.3%)	34 (51.5%)
Moderate	13 (27.1%)	26 (39.4%)
Severe	7 (14.6%)	6 (9.1%)

Table 3: Injury severity of drivers and pillion riders

Severity of injury(GCS)	Drivers (n=114)	Pillion riders (n=114)
Mild	62 (54.4%)	81 (71.1%)*
Moderate	39 (34.2%)	26 (22.8%)
Severe	13 (11.4%)	7 (6.1%)

* significant p < 0.005

Table 4: Mortality rates

	Drivers with helmet (n = 48)	Drivers without helmet (n = 66)	Pillion riders (n = 114)
Mortality	2 (4.2%)	16 (24.2%)	6 (5.3%)

Table 7: Pattern of injuries (postmortem findings)

	SDH	EDH	Con-tusion	DAI	Depressed Fracture	Poly-trauma
Drivers without helmet (n=73)	55 (75.3%)	10 (13.7%)	32 (43.8%)	13 (17.8%)	2 (2.7%)	4 (5.5%)
Drivers with helmet (n=10)	8 (80%)	2 (20%)	6 (60%)	2 (20%)	3 (30%)	0
Pillion riders (n=33)	27 (81.8%)	4 (12.1%)	17 (51.5%)	5 (15.2%)	7 (21.2%)	3 (9%)

industry, liberalized economic policies of successive governments, aggressive media promotion, increasing purchasing power of Indian people, easy availability of loans and poor public transport systems have contributed to increasing motorization and a changing transportation scenario in India. The total number of registered vehicles increased by 14 times from 5.3 million in 1981 to 72.8 million by 2004⁷. The number of public transport buses has increased slightly from 331 000 in 1991 to 768 000 by 2004, while during the same period, motorized two-wheelers (MTWs – scooters, motorcycles and mopeds) increased 4 times from 14 million to 52 million. Overall, 71% of all vehicles are MTWs, 12% are cars, jeeps and taxis, 1% buses and the remaining are other vehicles. MTWs account for a large proportion of vehicles on the roads^{8,9}. A large number of road users in India are pedestrians, two-wheeler riders and bicyclists—vulnerable road users (VRUs). These groups of road users form the major bulk on Indian roads and hence their exposure is higher. Unlike occupants in cars and other heavy vehicles, these road users are directly exposed in traffic environments and are thus unprotected. In the event of a crash, they come in direct contact with the impacting vehicle and energy transfer is high (even in low velocity crashes) resulting in serious injuries and deaths¹⁰. Mohan¹¹ in a review of traffic injuries and fatalities in India in 2004 emphasized that nearly 80% of those killed in Delhi and Mumbai belong to the group of VRUs. Hospital studies in Bangalore during 1993, 1998 and 2005 have shown that pedestrians, occupants of MTWs and bicyclists are injured and killed to the extent of 25%–35%, 30%–40% and 7%–10%, respectively^{12,13,14}. A similar pattern is also reflected in studies reported from other centres in India^{15,16,17,18,19} and from population-based surveys^{20,21,22,23,24,25,26}.

However despite the gravity of the situation, there are very few studies dedicated to motorized two wheeler accidents. Garg et al reviewed all the published data on road traffic injuries in India and found only two studies which focused on two wheeler accidents^{1,27,28}. Sood prospectively studied 302 cases after MTW accidents from New Delhi¹ and found that only 132/201 (65.6%) drivers wore helmet at the time of injury. The mortality rate in his series was 4.6%. Helmet users had a much lower incidence and severity of head injuries than riders who did not use helmet. Fitzharris et al reported the crash characteristics and injury patterns among MTW riders and pillion presenting to hospitals in the city of Hyderabad⁵. Out of 378 MTW users who were enrolled

to the study, majority (77%) had a Glasgow coma score (GCS) of 13-15, 12% a GCS of 9-12 and 11% a GCS of 3-8. No difference was seen in the severity distribution of injuries based on GCS among riders and pillion. The mortality rate was 11%. Only 74 (19.6%) MTW users had worn a helmet correctly and failure to wear a helmet was associated with a five times greater risk of intracranial injury. In the prospective arm of the present study, 62.7% patients sustained mild head injury, 28.5% had moderate head injury and 8.8% had a severe head injury. The mortality rate was 10.5%. Only 48/114 (42.1%) patients were wearing helmet at the time of injury. In the postmortem study, only 10/83 (12%) drivers were wearing a helmet at the time of the fatal accident. This clearly reflects the failure of law making authorities in implementing the helmet rule. The mortality rate has regrettably increased as time has passed: 4.5%¹ to 10.5%.

There is abundant published literature regarding the usefulness of helmet in preventing head injury^{1,2,3}. Newlands discussed the advantages and disadvantages associated with helmet use and propogated that full face helmets also decrease facial injuries²⁹. However full face helmets are expensive and not suited to tropical conditions. Patel et al designed a helmet for tropical conditions with better ventilation, additional side protection and a low cost locking design³⁰. In the study conducted by Sood, there were 28 drivers who were wearing turban¹. Their injury severity and incidence was in between those of drivers with and without helmet. This suggested that turbans offer some protection against head injury.

Sood noted in his study that the injury of pillion riders was slightly less severe as compared to the drivers¹. Interestingly, he also noted that females who sat sideways had fewer injuries and lesser mortality as compared to male passengers who sat astride, while Fitzharris et al noted that no difference in the severity distribution of injuries based on GCS among riders and pillion⁵. However, riders had a significantly lower risk of crush injuries of the lower extremity than pillion and female pillion were at a significantly lower risk of sustaining fractures of the lower extremity than male pillion. In the present study, the incidence of mild head injuries was higher in pillion rider group. The mortality of pillion riders was slightly higher as compared to helmeted drivers. However, the postmortem study revealed that 28.4% of patients dying in two-wheeler related accidents were pillion and 42.4 % of these were females.

It is alarming that 33–58% of crashes in two-wheeler injury do not involve a collision^{1,27,28}. The injury resulted from skidding of the two-wheeler or fall from the vehicle. Analysis of the mechanism of injury in the postmortem arm of the present study revealed that 9 out of 10 drivers who were wearing helmet involved in a major accident with a heavy vehicle (bus, truck, matador etc) or four-wheeler died. On the contrary, the most common mode of fatal injury in drivers without helmet was a skid and fall (34/73, 46.6%). The commonest mode of injury in pillion riders who died after a fatal accident was also skid and fall (15/33, 45.5%)(Table 6). Though we have not studied the role of alcohol and bad roads in these patients, it could account for a significant majority of these fatal accidents.

The issue of road traffic injuries in India is important and is clearly responsible for loss of life, disability, and an undefined impact on economic and social resources. It is time for this public health problem in a population of over a billion people to be recognized as a preventable cause of loss of healthy life. Thus, investments are needed to better define the specific characteristics of the problem in a uniform manner so that corrective measures could be tested and implemented accordingly. It is imperative that India stops further loss of life from road traffic injuries. A number of measures can be suggested to lower the injury rate and severity among motorized two wheeler drivers:

1. Helmet laws need to be implemented more strictly and to be introduced in areas where they are nonexistent.
2. It is high time that helmets should be made compulsory for pillion riders as well.
3. It has been seen that special education courses does have a great impact on the incidence of accidents and all MTW drivers should be encouraged to undertake them²⁹.

REFERENCES

1. Sood S. Survey of factors influencing injury among riders involved in motorized two-wheeler accidents in India: A prospective study of 302 cases. *J Trauma* 1988; 28:530–4.
2. Bowman SM, Aitken ME, Helmkamp JC, Maham SA, Graham CJ. Impact of helmets on injuries to riders of all-terrain vehicles. *Inj Prev* 2009; 15:3-7.
3. Liu BC, Ivers R, Norton R, Boufous S, Blows S, Lo SK. Helmets for preventing injury in motorcycle riders. *Cochrane Database Syst Rev*. 2008; 1:CD004333.
4. Murphy J, Nyland J, Lantry J, Roberts C. Motorcyclist "biker couples" : A descriptive analysis of orthopaedic and non-orthopaedic injuries. *Injury* 2009; 40:1195-9.
5. Fitzharris M, Dandona R, Kumar GA, Dandona L. Crash characteristics and patterns of injury among hospitalized motorised two-wheeled vehicle users in urban India. *BMC Public Health*. 2009; 9:11.
6. Ministry of Health and Family Welfare. *Integrated Disease Surveillance Project: Project Implementation Plan 2004–09*. New Delhi: Government of India; 2004:1–18.
7. Ministry of Shipping, Transport and Highways. Available at <http://morth.nic.in/writereaddata/sublinkimages/table-12458822488.htm> (accessed on 2 October 2007).
8. Tiwari G. Traffic flow and safety: Need for new models in heterogeneous traffic. In: Mohan D, Tiwari G (eds). *Injury prevention and control*. London:Taylor and Francis; 2000: 71–88.
9. Mohan D. Road safety in less motorised environments: Future concerns. *Int J Epidemiol* 2002; 31:527–32.
10. Gururaj G. *Road traffic injury prevention in India*. Bangalore:National Institute of Mental Health and Neuro Sciences; 2006. Publication No. 56.
11. Mohan D. *The road ahead: Traffic injuries and fatalities in India*. Delhi:Transportation Research and Injury Prevention Programme, Indian Institute of Technology; 2004.
12. Gururaj G, Channabasavanna SM, Das BS, Kaliaperumal VG. *Epidemiology of head injuries—Project report*. Bangalore: NIMHANS, KSCST; 1993. Publication no. PR/3/93.
13. Gururaj G, Reddi MN, Aeron Thomas A. Epidemiology of road traffic injuries in Bangalore. In: *Proceedings of the 5th world conference on injury prevention and control*. New Delhi: Macmillan; 2000.
14. Gururaj G, Shastry KVR, Chandramouli AB, Subbakrishna DK, Kraus JF. *Traumatic brain injury*. Bangalore:National Institute of Mental Health and Neuro Sciences; 2005. Publication no. 61.
15. Maheshwari J, Mohan D. Road traffic injuries in Delhi: A hospital based study. *J Traffic Med* 1989; 17:23–7.
16. Sidhu DS, Sodi S, Banerjee AK. Mortality profile in trauma victims. *J Indian Med Assoc* 1993; 19:16–18.
17. Jha N, Srinivasa DK, Roy G, Jagadish S. Injury pattern among road traffic accident cases: A study from south India. *Indian J Commun Med* 2003; 28:85–90.

18. Sathiyasekaran BWC. Study of the injured and injury pattern in road traffic accident. *Indian J Forensic Sci* 1991; 5:63–8.
19. Dandona R, Kumar GA, Raj TS, Dandona L. Patterns of road traffic injuries in a vulnerable population in Hyderabad, India. *Inj Prev* 2006; 12:183–8.
20. Verma PK. *An epidemiological study of accidents among rural population*. MD thesis Delhi: University of Delhi; 1998.
21. World Health Organization. *Injury prevention and control. An epidemiological survey of injuries in area of Municipal Corporation of Delhi, New Delhi*. SEA injuries- 5, 2003.
22. Varghese M, Mohan D. Transportation injuries in rural Haryana, North India. In: *Proceedings of the international conference on traffic safety*. New Delhi: Macmillan India; 2003:326–9.
23. Sathiyasekaran BWC. Population-based cohort study of injuries. *Injury* 1996; 27:695–8.
24. Gururaj G. Epidemiology of injuries—A population based survey in Bangalore. In: *Proceedings of the 6th World Conference on Injury Prevention and Control*. Montreal; 2002.
25. Aeron Thomas A, Jacobs GD, Sexton B, Gururaj G, Rahman F. The involvement and impact of road crashes on the poor: Bangladesh and India case studies. Crowthorne, United Kingdom: Transport research laboratory; 2004. Published project report, PPR010.
26. Gururaj G, Suryanarayana SP. Burden and impact of injuries: Results of population based survey. In: *Proceedings of the 7th World Conference on Injury Prevention and Control*. Vienna; 2004:275–6.
27. Garg N, Hyder AA. Road traffic injuries in India: A review of the literature. *Scand J Public Health* 2006; 34:100–6.
28. Mishra BK, Mohan D. Two wheeler injuries in Delhi, India: A study of crash victims hospitalized in neurosurgery ward. *Accid Anal Prev* 1984; 16:407–16.
29. Newlands G. Motorcycling morbidity and mortality – An unstudied epidemic. *S Afr Med J* 1983; 64:155–8.
30. Patel R, Mohan D. An improved motorcycle helmet design for tropical climates. *Appl Ergon*. 1993; 24:427–31.