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Original Research

Impact of compulsory helmet legislation on mortality rate and types of head and facial injuries in Jabalpur

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ABSTRACT

Background: Motorized two-wheeler users make up a high proportion of overall traffic injuries and deaths, particularly in India. Injuries to the head and neck are the main cause of death and severe disability among them. The objective of this study was to quantify the impact of compulsory helmet law imposed in Jabalpur city, for those driving two-wheelers, in reducing mortality, and head and facial injuries including the types of injuries often seen in road traffic accidents.

Materials and methods: People of all ages involved in motorcycle–moped–scooter accidents who reported to emergency department of eight major hospitals and trauma centers of Jabalpur city or were brought in dead to these hospitals during the eight months before and after helmet legislation were included in this study. The data were compiled into overall deaths and types of head and facial injuries noted in these hospitals before and after helmet legislation.

Results: Highly significant reduction in contused lacerated wounds of the scalp and face, upper and middle 1/3 facial fractures and head and traumatic brain injuries was noted in motorized two-wheeler accidents since September 2014 after compulsory helmet legislation. A significant reduction was also observed in cranial vault fractures with no significant reduction in lower 1/3 facial fractures and mortality rate after helmet law.

Conclusion: It has been confirmed through this study that mandatory use of helmets, with compulsory helmet law, is an effective measure for reducing soft tissue, head, brain and upper and middle 1/3 facial injuries in motorized two-wheeler accidents.

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1. Introduction

Road traffic injuries are a major public health problem and contribute significantly to mortality and morbidity throughout the world, particularly in developing countries [1]. Each year, nearly 1.2 million people die as a result of road crashes, and millions more are injured or disabled [2]. Motorized two-wheeler users make up a

high proportion of overall traffic injuries and deaths, particularly in low-to-middle-income countries like India, where motorized two-wheeler ownership is high. Injuries to the head and neck, following motorized two-wheeler crashes, are a common cause of severe morbidity and mortality [1]. In European countries, head injuries contribute to around 75% of deaths among motorized two-wheeler users; in some low-income and/or middle-income countries, head injuries are estimated to account for up to 88% of such fatalities [3,4]. While helmets reduce the risk of serious head and neck, and/or brain injuries by reducing the impact of a force or collision to the head, the correct use of a helmet considerably decreases the risk and severity of head and facial injuries. A review that evaluated the effectiveness of helmets in motorcycle crashes in September 2014 concluded that helmets reduce the risk of head injury by around 69%, and death by around 42% [1]. Although it was once speculated that wearing a motorcycle or scooter helmet increased the risk of neck and spinal injuries in crashes, recent evidence indicates

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that helmets protect against cervical spine injury [1,5]. Programmes that set and enforce mandatory helmet legislation are effective in increasing the frequency of wearing a helmet, thus reducing head injuries and/or fatality.

While most studies focussed on evaluating the incidence/rate and effectiveness of helmet use in the two-wheeler population in developed countries, the current study, conducted in India (a developing country), documented a low incidence of helmet use among the motorized two-wheeler population, where a large proportion of the population are motorized two-wheeler users and are greater in number than that observed in a developed country. In addition, the study took into account quantification of the impact of legislation mandating helmet use by motorized two-wheeler users (motorcyclists, scooterists and moped users), since its implementation in September 2014 in Jabalpur, a city in the state of Madhya Pradesh, in Central India.

2. Materials and methods

A compulsory helmet law was implemented in September 2014, in Jabalpur, for all motorized two-wheeler users (motorcycles, scooters and mopeds) to increase helmet use while driving and as a countermeasure to prevent head and/or facial injuries. Approval for the current study was obtained from the Department of Health, Jabalpur. In this study, data pertaining to deaths, and the number and type of head and/or facial injuries sustained by victims in motorized two-wheeler accidents were retrospectively analyzed from hospital records. Motorized two-wheeler types included mopeds (≤ 100 cc engine), scooterettes (60–105 cc engine), scooters (100–150 cc engine) and motor cycles (≥ 100 cc engine). Individuals of all ages involved in such accidents, and who reported at or were brought dead to the emergency bay area of eight major hospitals and trauma centers, in Jabalpur, over the last eight months before and after the law came into effect, were included. Head and neck injuries noted were classified in the following manner: contusions and/or lacerations of soft tissues, especially those of the face and scalp; traumatic brain injuries of varying severity with/without loss of consciousness [concussion, intracranial haemorrhage (subdural/subarachnoid) and intracranial mass lesions]; fractures of the cranial vault, and facial fractures – those confined to the lower 1/3, middle 1/3 and upper 1/3 of the face. These injuries were assessed using CT and/or MRI.

The data were compiled into overall deaths and types of head and facial injuries noted in all hospitals and individual hospital wise records before and after helmet legislation as shown in Tables 1 and 2. Statistical analysis of the data was done using Chi-square tests and the *p* value was calculated. If the *p* value was >0.05 , no significant change was noted in the post-law period as compared to the pre-law period. The impact of helmet legislation on death, and on injuries to the head and face, was significant if $p < 0.05$, and highly significant if $p < 0.001$.

Table 1
Incidence of head and neck injuries and mortality rate before and after helmet legislation in Jabalpur.

S. No.		Before helmet	After helmet	<i>p</i> value
1	Contused lacerated wounds	55.37	66.07	$<0.001^{**}$
2	Lower 1/3	6.37	5.91	0.340 ^{NS}
3	Middle 1/3	6.32	3.37	$<0.001^{**}$
4	Upper 1/3	4.14	2.51	$<0.001^{**}$
5	Cranial vault	11.00	9.03	0.001 [*]
6	Head injury	14.08	10.82	$<0.001^{**}$
7	Death	2.72	2.28	0.162 ^{NS}

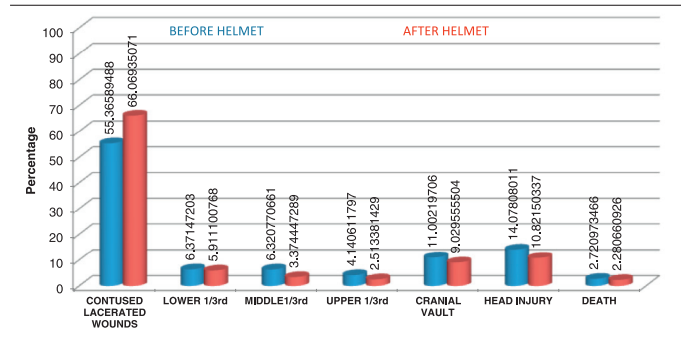
NS: $p > 0.05$, not significant.

^{*} $p < 0.05$; significant.

^{**} $p < 0.001$; highly significant.

Table 2

Bar diagram comparing the incidence of injuries and mortality rate before and after helmet use.



3. Results

The study documented a total of 4297 injuries to the head and/or face in victims of two-wheeler accidents, the same being recorded in eight hospitals/trauma centers in Jabalpur from September 2014 to April 2015 (post-law period), in comparison to the number of injuries recorded from January to August 2014 (pre-law period), i.e. 5917. A vast majority of these victims belonged to the age group of 20–40 years. Also noted was a (highly) significant reduction in the incidence of head and/or traumatic brain injuries, contusions/lacerations to the scalp and face and fractures of the upper and middle 1/3 of the face in victims riding a motorcycle, scooter or moped, during the post-law period when compared to the pre-law period. While a significant reduction in the incidence of cranial vault fractures was observed, no significant reduction in the incidence of lower 1/3 facial fractures was noted, in addition to the mortality rate, during the post-law period (Tables 3–5).

Overall, soft tissue contusions and/or lacerations to the scalp and face were the most common injury type, documenting incidence variations relative to time (i.e. 55.337% v/s 66.07% in the pre- and post-law periods, respectively). Head and traumatic brain injuries, the second most common injury type, had corresponding incidence rates (i.e. 14.08% vs 10.82%), followed by fractures to the cranial vault (11% v/s 9.03%).

With facial fractures documenting the least overall incidence relative to time (pre- and post-law period), the incidence of fracture to the lower and middle 1/3 of the face was greater, when compared to that of the upper 1/3 of the face. Of the eight hospitals included in the study, the incidence rates described relative to time were typically noted at Metro Hospital, Army Hospital and Government Medical College and Hospital, while in Jabalpur Hospital such incidence rates were recorded before law enforcement. Furthermore, relative to time, the incidence of fracture to the lower and middle 1/3 of the face was seen to be higher when compared to that of the cranial vault in Victoria and Railway Hospitals, while in Jabalpur Hospital such incidence was noted after law enforcement.

By contrast, head and traumatic brain injuries were the most common injury types, followed by soft tissue contusions and/or lacerations in Marble City Hospital. Also, here, the incidence of fracture to the upper 1/3 of the face was higher when compared to that of the middle and lower 1/3 of the face, cranial fractures being the least in terms of incidence. Bhandari Hospital observed similar incidence rates, considering facial fractures.

However, barring Marble City Hospital where the mortality rate increased despite helmet law enforcement, other institutions observed a decreased mortality rate after helmet law enforcement, thus underscoring the beneficial effect of helmet use by two-wheeler motorists.

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