Helmet Use and Concussion Severity among Two-Wheel Riders: A Retrospective Study From Karachi.

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ABSTRACT:

Objectives: Motorcycles provide a cost-effective and practical means of transportation in Karachi, Pakistan and are also linked with a notably higher risk of head injury. To compare the frequency and the severity of concussions in helmeted versus non-helmeted motorcyclists.

Methodology: A retrospective descriptive study from the year 2021 to 2023 was carried out at the medico-legal section of Police surgeon office Karachi. Medical records of 600 motorcyclists (18-60 years) with concussion after RTA for medico-legal examination were reviewed. Riders were categorized based on helmet use. Data collected on demographics, accident details and concussion severity using Glasgow Coma Scale (GCS) scores and graded symptom checklist. Statistical analysis included Chi-square and Mann-Whitney U tests to evaluate associations between helmet use, injury pattern and concussion severity.

Results: Amongst the 600 motorcyclists, the ratio of non-helmeted riders to helmeted riders were 7:1. Helmeted riders had remarkably lower concussion 5.55% in contrast to non-helmeted riders 8.79% (P<0.04). Severity analysis divulge helmeted riders solely presented with mild GCS score (13-15), while 37.5% of non-helmeted riders had severe scores <8. Symptom grading resulted in helmeted riders had only mild presentations, whereas non-helmeted riders revealed moderate 53.3% and severe 6.6% symptoms. Non-helmeted riders also exhibited higher demonstration of contusion, skull fractures and intracranial haemorrhages.

Conclusion: The lack of helmet use among motorcyclists strikingly boost the probability of concussions, severe cranial trauma and medico-legal complications. Perceived results stipulate that helmets can bring down the incidence of head injuries by up to 66.4%. Outcome of these injuries are often extended disability, which require considerable medical care, and place a substantial load on the healthcare substructure.

Keywords: Concussion, Helmet wearers, Traumatic brain injury, motorcycle accidents.

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Introduction:

According to the World Health Organization's (WHO) Global Safety Report, roughly 1.19 million road traffic accident deaths were reported worldwide in 2021. Among these, individuals using two and three-wheelers transportation reckon for 21% of the overall population, especially eminent in the Southeast Asian region, where they constitute approximately 48% of locally happen road traffic accident casualty.[1] In countries with stunted Gross Domestic Product (GDP), particularly in Asia, two-wheeled transportation are notably more accepted as a mode of travel as compared to their equivalents.[1-2] In countries undergoing development, such as Pakistan, there has been a six-fold increase in the registration of motorcycles, which is 74% of all registered vehicles. This surge can be attributed to the affordability of motorcycles, limited availability of public transportation, and the convenience of parking.[3]

Based on data collected by the National Disaster Management Authority (NDMA), in Pakistan, 9,701 reported road traffic accidents between 2019 and 2020, involving 12,849 registered vehicles and resulting in 5,436 casualties.[4] An autopsy-focused study found that among 246 autopsies conducted in the year 2019-2020 The number of RTA fatalities reported in 2019 (50.4%) was similar to that reported in 2020 (49.6%). Among these cases, (64.6%) suffered head injuries.[5]

Helmets are protective headgear registered for use in safeguarding against head injuries, and a motorcycle driver utilizes this as a full-face helmet while riding while Non-helmet wearers are those drivers who use either a standard safety helmet or nonstandard helmets such as half-face or open-face helmets during motorcycle operation. In a study encompassing 1,413 patients of road traffic accidents (RTAs), researchers observed that helmet wearers experienced a comparatively lower incidence of RTA (15.1%) in contrast to non-helmet wearers (26.2%). The majority of fatalities among non-helmet wearers were attributed to head and neck injuries.[6] A study carried out in 2023, it was noted that non-helmeted two-wheelers had a higher incidence of traumatic brain injury (50%) compared to those wearing helmets (7%).[7] Another study asserted that Mor-

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tality was higher among non-helmeted, in 878 two-wheeler accident cases only (6.49%) cases were with helmet.[8] As per McCrory, concussion is "a complex physiological disturbance in brain activity caused by traumatic mechanical impact." There is stretching or breaking of neurons which is the key to impaired or disrupted synaptic reactions.[9] This can result in physical symptoms like headaches, nausea, dizziness, balance issues, blurred vision, and memory loss.[10] The drastic jump and usage of motorcycle usage in Karachi, Pakistan, combined with the prevalent lack of actual safety wear, such as helmets, underscores the relative risk of individual's affliction from concussions. Productive measures must be addressed to this acute issue and ensure the safety and well-being of all road users.

By assessing concussion severity with the Glasgow Coma Scale (GCS) scores and graded symptom checklists, this study will accord to the enforcement of helmet wearing policies and trauma prevention strategies. The findings will help healthcare professionals, policymakers, and road safety advocates implement effective interventions to reduce motorcycle-related head injuries.

Objective:

To compare the frequency and severity of concussions between helmeted and non-helmeted motorcyclists.

Methodology:

A descriptive retrospective study was conducted in the medico-legal section of the Police surgeon's office in Karachi from the year 2021 to 2023 after receiving permission from the office of the Chief police surgeon (# 874). This study is focused on individuals with concussion after RTA in the age group of 18 to > 60 years of either gender for medico-legal examination. We employed a convenience sampling technique and included riders of two-wheel motorcycles, with or without prior driving experience. Patients riding other two-wheeled vehicles (Hoverboards, Scotties, Bicycles, etc.), patients with pre-existing cerebrovascular accidents, and cognitive decline due to dementia, drug Intoxication, psychiatric disorders, or a lack of mental capacity, Pillion riders/pedestrians or those with other forms of TBI (Traumatic Brain Injury) were excluded.

The sample size was calculated using the Open Epi tool. With a two-sided significance level of 95% and a power of 80% to detect an odds ratio of 0.46, with a sample size ratio of Unexposed/Exposed as 7.04, the sample size of Exposed was 75, and non-exposed was 525, yielding a total sample size of 600.[11] Dependent variables included were concussion severity, GCS scoring, type of crush injury, and pattern of RTA, while independent variables included were age, sex, and helmet usage. A preformed proforma was developed based on patients' demographics, time and day of injury, pattern of head injury, and type of crush injury, area of RTA, concussion assessment tool included a graded symptom checklist of clinical presentation of concussion at the time of injury and were graded mild having 1 symptom, moderate included 3 symptoms and severe with 6 or more symptoms (SCAT6) along with GCS (Glasgow coma scale) scoring at the time of presentation.

Data was analysed using SPSS version 22. Descriptive statistics of socio-demographic variables and the association of helmet and non-helmet wearer variables were computed as frequencies with percentages. Chi-Square Test was used to analyse associations between patterns, crash impact, and type of head injury in helmet and non-helmet wearers. The Mann-Whitney U Test was applied to compare severity levels between helmeted and non-helmeted riders

Results:

The ratio of helmet vs non-helmet wearers was 7:1. Motorcycle riders aged 19-30 years old comprised the largest demographic, constituting 37.33% (n=28) of helmet wearers and 35.61% (n=187) of non-helmet wearers. Interestingly, there were no female riders among helmet wearers, compared to 44 (8.38%) among non-helmet wearers. In terms of injury timing, the majority occurred between 7 am to 12 pm, with 28% (n=21) in helmet wearers and 42.47% (n=223) in non-helmet wearers. Weekday recorded the highest incidence of injury for both helmet and non-helmet wearers (86.6% and 70.02%) as shown in table 1.

Table No 1: Association of demographics with helmet vs. non-helmet wearers.

Helmet	Wearer (n=75)	Not wearer (n= 525)	Total	p value
	n(%)	n(%)		
Age				
≤18	9(12)	72(13.71)	81	0.267
19- 30	28 (37.33)	187(35.61)	215	0.041
31-40	19 (25.33)	100(19.04)	119	0.018
41- 50	5(6.66)	95 (18.09)	100	0.007
51- 60	12 (16)	48 (9.14)	60	0.015
61 onwards	2(2.66)	23(4.38)	25	0.321
Gender				
Male	75 (100)	481(91.61)	556	0.002
Female	-	44(8.38)	44	0.002
Time of Injury				
12 am - 6am	11 (14.66)	55(10.47)	66	0.089
7am – 12pm	21(28)	223 (42.47)	244	0.003
1pm – 6pm	18(24)	118 (22.47)	136	0.276
7pm-12 am	25 (33.33)	129 (24.57)	154	0.017
Day of injury				
Weekday	65 (86.6)	369 (70.2)	434	0.001
Weekend	10 (13.33)	156 (29.7)	166	0.001

A chi-square test of independence was performed to examine the association of demographics with helmet vs. non-helmet wearers between these variables was significant ($p < 0.05$)

Accidents involving helmet wearers were more likely to occur with buses (40%), while non-wearers had a higher incidence of motorcycle vs. 4-wheeler accidents (44.95 %). Among helmet wearers, the majority of crash impacts (38.66%) experienced rear-end crashes, whereas most non-helmet wearers (37.33%) were involved in head-on collisions. Concussion cases were significantly lower among helmet wearers (5.55%) compared to non-helmet wearers (8.79%) as shown in table 2.

Helmet wearers had exclusively mild GCS scores (100%), while non-helmet wearers had a significant proportion (37.5%) with severe GCS scores (≤8). Concussion severity was graded using a symptom checklist, revealing majority of helmet wearers had mild symptoms (100%), and non-helmet wearers, 53.33% had moderate concussion symptoms, and 6.66% had severe symptoms as shown in table no 3.

Table No 2: Association of Pattern of RTA, crash impacts, and type of injury in helmet vs non-helmet wearers.

Helmet	Wearer (n=75)	Not wearer (n= 525)	Total	p Value
	n(%)	n(%)		
Pattern of RTA				
Motorcycle vs motorcycle	7(9.33)	94(17.90)	101	0.004
Motorcycle vs 3 wheelers	13 (17.33)	49(9.33)	62	0.011
Motorcycle vs 4 wheelers	25 (33.33)	236(44.95)	261	0.002
Motorcycle vs Bus/trucks	30(40)	146(27.80)	176	0.001
Crash impact				
Head-on	16 (21.33)	196(37.33)	212	0.003
Rear end	29 (38.66)	191(36.38)	220	0.145
Hit object/ Skid	18(24)	82(15.61)	100	0.005
Side/merging	12(16)	56(10.66)	68	0.021
Type of head Injury				
Concussion	1(5.55)	24(8.79)	25	0.043
Contusion	3(16.66)	133(48.71)	136	0.001
Extradural haemorrhage	00	34(12.45)	34	0.002
Subdural haemorrhage	00	18(6.59)	18	0.008
Skull fracture	00	41(15.01)	41	0.001
Facial fracture	1(5.55)	23(8.42)	24	0.049

A chi-square test of independence was performed to examine the relationship between helmet wearer and non-wearer between these variables was significant ($p < 0.05$)

Table No 3: Concussion severity assessment.

Helmet	Wearer	Not wearer	Total	p value
	n(%)	n(%)		
Patients with GCS (n=25)				
Mild (13-15)	1(100)	13 (54.16)	14	0.002
Moderate (9-12)	00	2(8.33)	2	0.015
Severe (</=8)	00	9(37.5)	9	0.001
Graded Symptom Checklist (n=16)				
None (0 symptoms)	00	4(26.66)	4	0.005
Mild (1 symptom)	1(100)	2(13.33)	3	0.012
Moderate (3 symptoms)	00	8(53.33)	8	0.003
Severe (6 or more symptoms)	00	1(6.66)	1	0.008

Discussion:

Motorcycle is a popular mode of transportation in Pakistan, making it the 6th largest country with motorcycle use (17.5M). [12] With the imminent rise in motorcycle usage, the number of motorcycle accidents has also risen, with an average of 725 motorcycle accidents per day.[13] One possible explanation for the higher fatality index in men versus women is the higher propensity of men for risky behaviours. The pattern of age distribution demonstrated people of all ages were affected, the peak incidence was however observed in the age group of the second and third decade possibly due to the most agile period of life where people manage to remain outside to search their means of income which is similar to study by Shruthi et al. [14]

The study observed that the timing of the injury for both helmet and non-helmet wearers increased between 7:00 am-12:00 pm, similar to a study from Karachi.[15] This may be due to heavy traffic during these hours and because the majority of office workers, students, and business handling usually commute during this time. However, we discovered this opposite to another study by Kutty et al[16] in which major accidents occurred between 6-9 pm. Regarding the frequency of motorcycle accidents with respect to the day of the week, it was noted that most accidents happened on weekdays due to increased peak hours and heavy traffic, which was similarly found in another research conducted in Karachi. [17]

Our study showed that most accidents were between motorcycles vs 4 wheelers which was similarly noticed in another study from Karachi[18] which signified that Motorcycle vs car accidents were prevalent. This might be due to a lack of motorcycle-only lanes and failure to comply with traffic laws even if separate lanes are provided.

The pattern of crash impact was mostly rear end and these results are unlike other study[19,20] where head-on collisions and hits on an object were more prevalent since most accidents usually occurred during night time and undue weather conditions, but for rear end the cause may be distracted driving, following another vehicle too closely and overtaking during a lane change.

Helmets provide significant protection against head injury as it is depicted in our study which is similar to a study in Ghana[21] as it reduces potential injury by linear or direct impact forces by dissipating energy using the foam and shell.[22] Compared with helmet wearers, non-helmet wearers suffered a significant burden of head injuries with contusion and skull fracture, leading the frequency and proving that wearing a helmet has proven to reduce the severity and associated mortality of head injuries.[23] Need for interventions and ICU admissions for traumatic brain injury were mostly found in those riders without helmet usage (45.8 %) with moderate or severe GCS compared to helmeted riders as reported also in a study by Barki et al. [24]

Different levels of severity were observed in the research between helmet-wearing and non-helmet-wearing drivers. For those who wore helmets, only one person had a mild form of the condition (grade=1). On the other hand, eight people among non-helmet wearers had moderate forms of the condition (grade=3) while two individuals had mild forms of it as opposed to other cases. It is important to note that very little work has been done on graded symptom severity as it relates to motorcycle-related traumatic brain injuries (mTBI) and GCS scores even though we did learn most mTBI patients have severe GCS scores (Score ≥ 6). This may be due to the later study done among the paedi-

atric population that had more impactful traumatic brain injury than our study.[25]

Despite being informative, this study has a number of drawbacks that should be noted. Because the study is retrospective, it relies on pre-existing medical-legal records, which creates a recall influence and restricts data control. Convenience sampling restricts the findings' generalizability, particularly with regard to Karachi motorcycle riders. The unequal distribution of helmeted and non-helmeted riders (75 to 525) is a significant barrier that distorts qualified analysis. Additionally, the study did not account for detrimental environmental factors that may affect the outcome of a concussion, such as the kind and quality of helmets, speed at the moment of contact, the climate, or alcohol consumption. These drawbacks highlight the necessity of conducting further prospective studies using larger population samples and a wider range of factors in order to draw more thorough findings.

Conclusion:

Absence of helmet use while using a motorcycle could result in concussion, morbidity and mortality. Hence, protective equipment like helmets must be used while bestriding motorcycles. This not only lessen face, neck, and head trauma but also stave off permanent brain injury and the need for an Intensive Care management. As upholder for public safety, we firmly urge officeholders to order the ratification and imposition of laws directing at expanding helmet usage among motorcyclists. Thereby, we can considerably lessen the likelihood of extreme head injuries and save innumerable lives on the roads.

Conflict of Interest:

None.

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