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Autopsy analysis of deaths in two-wheeler accidents

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Abstract
Background: Road traffic accidents (RTAs) are a global public health crisis, leading to significant fatalities and disabilities, particularly in low- and middle-income countries. These regions account for nearly 90% of RTA deaths despite having fewer vehicles than highly motorized countries. By 2020, RTAs were projected to become the 3rd leading cause of disability-adjusted life years lost worldwide. Two-wheeler accidents, especially in Southeast Asia, are a major contributor, with head injuries being the leading cause of death. Males aged 20-40 are most affected due to risky behaviors like speeding. Addressing this issue requires effective law enforcement and public health interventions.
Aim of the study: The study aims to determine the fatal injuries causing death, its relationship to demographic factors and the type of vehicles involved with two-wheelers.
Methods: This retrospective descriptive study at Dhaka Medical College and Hospital examined 455 road traffic accident cases, focusing on 123 deaths involving two-wheelers, during one year from January 2022 to December 2022. Conducted with meticulous data collection, the study only included cases from the DMC morgue, specifically involving pedestrian deaths caused by two-wheelers and deaths of two-wheeler drivers or passengers. Excluded were decomposed bodies and deaths from three or four-wheeler accidents. Data on injuries, causes of death, and accident details were collected from postmortem records and police reports and then analyzed using SPSS (V-26.0) to provide reliable descriptive statistics. The study highlights the need for further research and preventive measures.
Results: The study analyzes the age distribution, collision manners, injury types, accident timing, and causes of death among cases. Most participants were aged 30-39. Collisions mainly involved 4-wheelers (43.09%), with multiple-region injuries being the most common (75.61%). Drivers had the highest fatality rate (39.02%), followed by passengers (34.15%). Abrasions were the most frequent injury (21.39%), and intracranial hemorrhage was the leading cause of death (46.34%). Accidents primarily occurred between 12:00 AM and 5:59 AM (40.65%). Fractures and crush injuries contributed to 16.26% and 3.25% of deaths, respectively.
Conclusion: The study finds that two-wheeler accidents in Bangladesh mainly affect males aged 30-39, with drivers at the highest risk. Most fatalities involve head injuries from collisions with four-wheelers, with intracranial hemorrhage as the leading cause of death.

Keywords: Autopsy, deaths and two-wheeler

Introduction
Road traffic accidents (RTAs) have become a primary public health concern worldwide, causing significant fatalities and disabilities that impact socioeconomic development [1]. Worldwide, every day, about 3400 people die due to road traffic accidents (RTA), which is predicted to result in the death of around 1.9 million people annually by 2020 [2]. Nearly 90% of the world's RTA fatalities occur in low- and middle-income countries, whereas highly motorized countries contribute very little, although they accommodate over 60% of the world's vehicles [3]. The problem is so severe that by 2020, road traffic incidents are projected to rise from the 9th to the 3rd leading cause of disability-adjusted life years (DALYs) lost globally and become the 2nd leading cause in developing countries [4]. About more than 25% of global traffic accidental deaths occur in the South East Asia region [5]. Two-wheeler accidents, in particular, have emerged as a leading cause of RTA-related deaths, especially in low- and middle-income countries [6]. In a retrospective study conducted in Bangladesh, two-wheeler deaths accounted for 25.7% of all road-traffic accident fatalities autopsied over five years [7]. Another study in Dhaka city found that motorcycle accidents with casualties involving riders and pedestrians (3,390) were the most common type of road traffic accident [8]. Two-wheeler riders are more susceptible to injuries due to the lack of an external protective shell, unlike those in light motor and heavy motor vehicles.

Additionally, losing balance during two-wheeler accidents significantly heightens the risk of injury [9]. Studies have reported that most two-wheeler accident fatalities occur in the 20 to 40 years age group, with males being disproportionately affected due to their role as the primary breadwinners in many families and their tendency to engage in risky behaviors like over-speeding [1, 10-12]. This, combined with their propensity for engaging in risky behaviors such as speeding, makes them more frequently involved in road traffic accidents [13]. Those involved in vehicular crashes may develop a wide range of injuries. These injuries often assume a definitive pattern in the case of a pedestrian or a driver, or a passenger; such accidents are so common nowadays that a doctor may be asked to draw an opinion from the injuries found on the body [14]. Head injuries have been consistently identified as the leading cause of death in two-wheeler accidents, accounting for up to 67.4% of fatalities [1, 8]. Skull fractures, particularly fissure fractures on the calvaria and comminuted fractures, are commonly observed, along with intracranial hemorrhages, predominantly of the subdural and subarachnoid types. Collisions between two-wheelers and four-wheelers have been reported as the most common type of accident, resulting in the highest number of fatalities. Other collision types, such as two-wheelers with pedestrians and self-falls from two-wheelers, have also been documented [1]. A multifaceted approach is necessary to address the growing concern of two-wheeler accident fatalities. Effective law enforcement is crucial, including establishing, regularly updating, and enforcing laws with clear penalties. Against this backdrop, the present study was conducted to determine the fatal injuries causing death, their relationship to demographic factors, and the types of vehicles involved in two-wheeler accidents in Bangladesh. The findings from this analysis can help develop evidence-based interventions to improve road safety and reduce the burden of two-wheeler accident fatalities in the country.

Methodology and Materials

This retrospective descriptive study was conducted at the Department of Forensic Medicine in Dhaka Medical College and Hospital, Dhaka, Bangladesh. A total of 455 cases due to road traffic accidents autopsied during the period between January 2022 to December and among these 123 cases of deaths were due to two-wheelers.

Inclusion criteria

- Only cases of DMC morgue.
- Death involving pedestrians caused by two-wheelers.
- Death cases of two-wheeler drivers and pillion passengers.

Exclusion criteria

- Decomposed bodies in two-wheeler road traffic accident cases.
- Death in 3 or 4-wheeler road traffic accidents.

Data on injuries and cause of death were collected from postmortem records. Details of victims, such as rider or pillion occupant, time, and information of collisions between two-wheelers and other types of vehicles, were noted from the first information report and postmortem requisition of police. Such collected data was separated and entered into Excel. All the data were analyzed using SPSS (Statistical Program for Social Science, V-26.0). Descriptive statistics such as mean and standard deviation for continuous variables and number and percentage for categorical variables were calculated.

Results

Table 1 illustrates the age distribution of the study's cases. Most of the 39(31.71%) participants fall within the 30-39 age range. Concerning the collision manner, the predominant involvement was with 4-wheelers (43.09%), followed by slips (38.21%). Collisions with 3-wheelers and 2-wheelers occurred at frequencies of 15(12.20%) and 8(6.50%), respectively. Regarding the anatomical region of fatal injuries, the majority of cases suffered injuries in multiple areas (75.61%), and cases with fatal injuries confined to a single region represented 30(24.39%). Regarding fatality distribution, drivers had the highest percentage at 48(39.02%), closely followed by passengers at 42(34.15%). Cases involving driver and passenger fatalities accounted for 33(26.83%) of the total (Table 2). Table 3 displays the types of injuries observed among the study cases. Among the identified injuries, abrasions were the most prevalent at 74(21.39%). Lacerations were slightly higher, constituting 58(16.76%); skull fractures and intracranial haemorrhages each accounted for 57(16.47%) of the cases. Organ injuries were observed in 41(11.85%) of the cases, while Contusions represented 38(10.98%) of the cases, followed by long bone fractures at 21(6.07%). Table 4 shows how the accidents are distributed among the study cases; accidents that transpired between 12.0 AM and 5.59 AM comprised the most significant percentage (40.65%). Following this, accidents occurred from 6.0 AM to 11.59 AM (31.71%). Accidents between 6.0 PM to 11.59 PM and 0.0 AM to 5.59 AM constituted 39(11.38%) and 20(16.26%) cases, respectively. In Table 5, intracranial hemorrhage (ICH) was identified as the leading cause of death (46.34%). Following this, internal organ injuries emerged as the second most prevalent cause (34.15%). Fractures were responsible for fatalities in 20(16.26%) of the cases, while crush injuries accounted for a smaller percentage at 4(3.25%).

Table 1: Age distribution of the study cases (N=123)

Age (Years)	Frequency (n)	Percentage (%)
0-9	4	3.25
10-19	6	4.88
20-29	15	12.20
30-39	39	31.71
40-49	28	22.76
50-59	20	16.26
60-69	6	4.88
≥70	5	4.07
Total	123	100.00

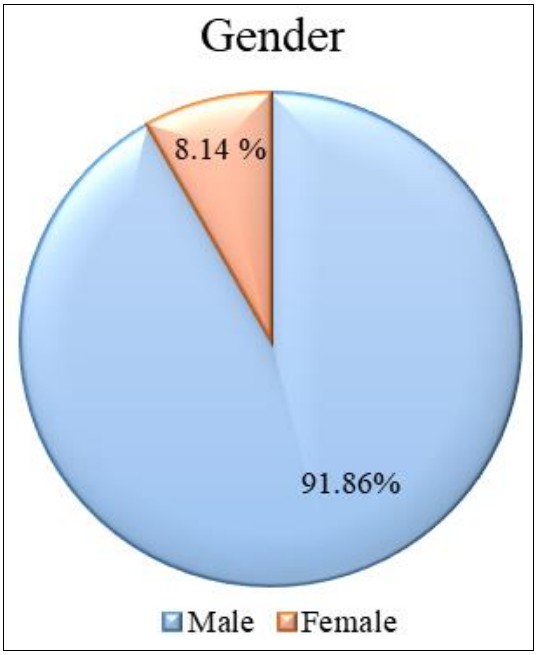

Fig 1: Gender distribution of the study population.

Table 2: Manner of collision, fatality of the study cases (N=123)

Characteristics	Frequency (n)	Percentage (%)
Collision against		
2-wheeler	16	13.01
3-wheeler	3	2.44
4-wheeler	69	56.10
Slip	16	13.01
Pedestrian	18	14.63
Anatomical region of fatal injuries		
Single Region	30	24.39
Multiple Region	93	75.61
Fatality		
Driver	48	39.02
Pillion	42	34.15
Pedestrian	33	26.83

Table 3: Types of injuries of the study cases.

Type of injuries out of 123	Frequency (n)	Percentage (%)
Skull fractures out of 123	57	16.47
Intra cranial hemorrhages	57	16.47
Lacerations out of 123	58	16.76
Abrasions	74	21.39
Contusions	38	10.98
Long bone fracture	21	6.07
Organ injury	41	11.85

Table 4: Duration of the study cases (N=123).

Time of accident	Frequency (n)	Percentage (%)
0.0-5.59 AM	20	16.26
6.0-11.59 AM	39	31.71
12.0-5.59 AM	50	40.65
6.0-11.59 PM	14	11.38

Table 5: Cause of death of the study cases (N=123).

Causes of death	Frequency (n)	Percentage (%)
ICH	57	46.34
Internal organ	42	34.15
Fracture	20	16.26
Crush injury	4	3.25

Discussion

Two-wheelers are the most frequently involved road users in developing countries, significantly contributing to the burden of road traffic accidents. This is mainly due to their inherent instability, higher speeds, and riders' thrill-seeking behavior, often characterized by "reckless driving" [15]. This study presents a comprehensive analysis of deaths resulting from two-wheeler accidents, focusing on demographic characteristics, collision dynamics, injury patterns, and causes of death among autopsied cases. Our study's age distribution reveals that most fatalities occurred in the 30-39-year age group (31.71%), followed by the 40-49-year age group (22.76%). The higher incidence of fatalities in these age groups aligns with findings from other studies, such as one by Naik *et al*., which reported a peak in deaths among the 20-29 age group (30.00%) and a significant presence of victims aged 30-39 years (15.9%) [16]. Notably, younger individuals (0-19 years) and older adults (≥60 years) had shown fewer fatalities in our studies. It does not agree with the study by Beird and Sundaram, who observed that the age group of 0-9 years was more commonly involved [17]. The gender distribution of the study population highlights a significant gender disparity, with males (91.86%) predominantly represented in two-wheeler accident fatalities. This predominance of male subjects aligns with the findings of most studies on two-wheeler accidents conducted in other regions. As the primary financial providers for their families, combined with a propensity for risky behaviors such as excessive speeding, overconfidence, and thrill-seeking, males are more frequently involved in road traffic accidents [1,18-20]. The analysis of the manner of collision revealed that the majority of fatal accidents involved a collision with four-wheelers (56.10%), followed by pedestrian-related accidents (14.63%) and slips (13.01%). The high incidence of collisions with four-wheelers may be due to the significant speed differential between two-wheelers and larger vehicles, increasing the severity of injuries sustained in such accidents. Jakhar *et al*. from Haryana (71.7%), Zargar *et al*. from Iran (64.6%), Arjun P *et al*. (36%), and George *et al*. have reported that the majority of victims were involved in collisions between four-wheelers and two-wheelers [21-23]. The fact that 75.61% of the cases involved multiple regions of fatal injuries indicates the severity of these accidents, often resulting in complex trauma that leads to death. The fatality rates of drivers (39.02%) compared to pillions (34.15%) and pedestrians (26.83%) highlight the increased risk faced by drivers, possibly due to their exposure to more severe impact. Marak *et al*. observed that motorcyclists are frequently involved in such accidents, with pedestrians suffering the most casualties [24]. These findings indicate an increased mortality rate in collisions between two-wheelers and larger vehicles. Additionally, George *et al*. identified skidding and falling as common incidents among two-wheeler accidents [23]. The types of injuries observed include skull fractures and intracranial hemorrhages, each affecting 16.47% of the cases. This indicates a significant occurrence of head injuries, which are often fatal in high-impact accidents [25]. Similar findings in a study by Sahu *et al*. with 108 cases of fissure fracture, 28 cases of comminuted fracture, and 47 cases of isolated base of skull fracture were noted [26, 27]. Lacerations and abrasions were also common, affecting 16.76% and 21.39% of cases, respectively, while long bone fractures were less frequent (6.07%). The

presence of organ injuries (11.85%) further reflects the severe nature of collisions, where multiple injury types are often present due to the high energy involved in the accidents [28]. A study by Sahu *et al*. shows abrasion (37.8%) as a predominant injury in two-wheeler accidents. This denotes the severity of the injury mechanism causing fractures and intracranial hemorrhages as these injuries have penetrated the skull and reached the meninges [27]. The time distribution of accidents reveals that the majority occurred between 12:00 pm and 5:59 am (40.65%), followed by the early morning hours of 6:00 am to 11:59 am (31.71%). Similar finding was noted by Chourasia *et al*., who showed most cases between 12 pm and 6 pm (115, 43.7%) followed by 6 pm and 12 am (78, 29.6%). This finding suggests that daytime riding poses a higher risk, possibly due to increased traffic volumes [29]. Intracranial hemorrhage (ICH) was the leading cause of death, accounting for 46.34% of the cases. This finding is consistent with the high incidence of head injuries observed, further emphasizing the critical role of helmet use in preventing fatalities [30]. Internal organ injuries (34.15%) and fractures (16.26%) were also significant contributors to mortality, highlighting the need for rapid and effective emergency medical response in cases of severe trauma. The relatively lower percentage of crush injuries (3.25%) may reflect the specific dynamics of two-wheeler accidents, where blunt force trauma is more common. As regards the cause of death, Singh PK *et al*. has reported that shock and hemorrhage were the cause in 36.64% of cases, whereas injury to the brain was seen in 30.73% of cases. Intracranial hemorrhage was the cause of death in 18.54% of cases [31].

Limitations of the study: It is impossible to predict the incidence of accidents in the local area as the traffic accident cases brought to the casualty can be from nearby regions or referred from other places. Amongst the cases of road traffic accidents, a few cases may be taken to different hospitals. More data regarding issues like wearing helmets are unavailable and may be looked into in further studies.

Conclusion and Recommendations

The study concludes that two-wheeler accidents in Bangladesh predominantly affect males aged 30-39, with a significant number of fatalities resulting from collisions with four-wheelers. Drivers are at the highest risk (39.02%), and most fatal injuries involve multiple regions, particularly the head (16.47%). Intracranial hemorrhage is the leading cause of death (46.34%), underscoring the importance of helmet use. The majority of accidents occur during late-night and early-morning hours. These findings highlight the need for targeted interventions, such as stricter enforcement of traffic laws, improved road safety measures, and enhanced public awareness to reduce two-wheeler accident fatalities.

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