

Burden and Pattern of Road Traffic Injuries Managed in Emergency
Departments: A Retrospective Analysis

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Abstract

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Background: Road traffic injuries are a leading cause of preventable morbidity and mortality worldwide, with a disproportionate burden in low- and middle-income countries. In Pakistan, rapid urbanization and a motorcycle-dominated vehicle fleet have intensified the demand on emergency care, yet multicenter emergency department data remain scarce. **Objective:** To determine the burden,

demographic and clinical pattern, and emergency department outcomes of road traffic injuries presenting to three tertiary care hospitals in Lahore, Pakistan. **Methods:** A retrospective, cross-sectional record review was conducted across the emergency departments of three public-sector tertiary hospitals in Lahore over a twelve-month period. All patients presenting with road traffic injuries and meeting inclusion criteria were consecutively sampled, yielding 400 records for analysis. Data on demographics, road-user category, injury mechanism, anatomical distribution, injury type, severity, and emergency department outcome were extracted using a structured proforma. Associations were tested using Chi-square statistics. **Results:** Road traffic injuries accounted for 1,336 (31.6%) of all injury-related presentations and 8.4% of total emergency department visits. Among the 400 reviewed records, the mean age was 32.8 ± 13.9 years and 76.5% were male. Motorcyclists constituted 64.8% of victims;

motorcycle-to-motorcycle collisions were the most frequent mechanism (29.5%). Lower limb (34.0%) and upper limb (22.0%) injuries predominated, and fractures were the most common injury type (30.3%). Severe and critical injuries comprised 20.5% and 6.5% of cases, respectively. Following emergency department management, 58.5% were discharged, 32.3% were admitted, and 3.5% died. Age group was significantly associated with emergency department outcome ($p=0.031$), and road-user category with injury severity ($p=0.010$). **Conclusion:** Road traffic injuries exert a heavy and persistent burden on Lahore's tertiary emergency departments, disproportionately affecting young male motorcyclists. The strong associations between motorcyclist status and severe injury, and between advancing age and worse outcomes, highlight critical targets for trauma system strengthening, helmet law enforcement, and age-sensitive clinical pathways.

Keywords: Road traffic injuries, emergency department, injury severity, motorcyclists, Pakistan, retrospective study

INTRODUCTION

Road traffic injuries (RTIs) remain one of the most persistent and preventable causes of death and disability worldwide, and their burden continues to fall disproportionately on low- and middle-income countries. According to the World Health Organization's Global Status Report on Road Safety 2023, an estimated 1.19 million people die each year as a result of road traffic crashes, and road traffic injury has become the twelfth leading cause of death across all age groups and the leading cause of death among children and young people aged 5–29 years [1]. For every fatality, between 20 and 50 million people worldwide sustain non-fatal injuries, many of which result in temporary or permanent disability, and more than half of all deaths involve vulnerable road users such as pedestrians, cyclists, and motorcyclists [1]. Approximately 92% of the world's road traffic fatalities occur in low- and middle-income countries, even though these countries account for a much smaller share of the global vehicle fleet, reflecting weaker enforcement of traffic laws, poorer road infrastructure, and more limited access to timely emergency and trauma care [1]. Estimates from the Global Burden of Disease Study 2021 similarly place the annual global incidence of road injury at over 50 million cases, underscoring that, despite a gradual decline in age-standardized incidence over the past three decades, the absolute burden on health systems remains substantial [2].

Pakistan exemplifies many of the structural vulnerabilities that drive this global pattern. Rapid, unplanned urbanization, a growing and increasingly motorcycle-dominated vehicle fleet, inconsistent enforcement of helmet and traffic laws, and heterogeneous pre-hospital and emergency care capacity have combined to make RTIs a leading cause of preventable morbidity and mortality in the country. Recent data from Punjab's Rescue 1122 emergency service illustrate the scale of the problem at the provincial level: in 2025 alone, 482,870 road traffic incidents were reported across Punjab, resulting in nearly 570,000 injuries and 4,791 deaths, a 19% rise in fatalities compared with the previous year despite a comparatively modest increase in the total number of incidents [7]. Lahore recorded the highest number of road traffic incidents of any district in Punjab in 2025, with 88,743 cases, and motorcycles were involved in approximately three-quarters of all incidents province wide, followed by cars, rickshaws, and heavy vehicles [7]. Pedestrians were involved in just over one-tenth of accidents, reflecting the mixed and often chaotic nature of traffic on Pakistani roads [7]. Hospital- and emergency-department-based studies conducted within Pakistan have consistently reinforced these patterns while also highlighting how fragmented the existing evidence base remains. In Rawalpindi, a landmark multicenter surveillance study covering the emergency departments of three tertiary care facilities found that RTIs accounted for 31.7% of all injury presentations over a twelve-month period, with sex- and age-specific patterns that reversed between childhood and adolescence, and worse severity and outcomes among patients older than 45 years [3]. A single-center study at Mayo Hospital, Lahore, similarly identified motorcyclists as the most vulnerable road-user group, musculoskeletal injuries as the most frequent injury type, and pre-hospital care as an important determinant of disability outcomes, though the study was limited to a small sample drawn from one facility [4].

A subsequent Lahore-based analysis of fatal road traffic accidents recorded through Rescue 1122 found that the large majority of fatalities involved young male motorcyclists and that head injury and concussion were the strongest correlates of death [5]. Comparable findings from a tertiary public hospital emergency department in Karachi showed that motorbikes were involved in the great majority of RTIs, that the lower limb, upper limb, and head were the most commonly injured anatomical sites, and

that risky road behaviors such as over-speeding, signal violation, and unsafe road crossing were the predominant reasons cited for these events [6]. Taken together, these studies confirm that RTIs place a heavy and largely preventable burden on Pakistan's emergency care system, but the existing evidence is fragmented: most published studies are limited to a single hospital, rely on small or conveniently sampled cohorts, cover short data-collection windows, or depend on police and ambulance records that are known to under-capture the true burden of injury reaching emergency departments. There remains a paucity of recent, multicenter, emergency-department-based data describing the burden and pattern of RTIs across major tertiary care hospitals within a single metropolitan area such as Lahore, despite Lahore now recording the highest volume of road traffic incidents in Punjab [7]. Robust, hospital-based estimates of this kind are essential for emergency department planning, trauma system strengthening, and the design of locally targeted road safety interventions.

This study was therefore designed to determine the burden and pattern of road traffic injuries managed in the emergency departments of three tertiary care hospitals in Lahore over a defined retrospective period. Specifically, the study aims to estimate the proportion of emergency department presentations attributable to road traffic injuries; to describe the demographic profile, road-user category, and mechanism of injury among affected patients; to characterize the anatomical distribution, type, and severity of injuries sustained; and to determine emergency department outcomes, including discharge, admission, referral, and mortality. By generating multicenter, hospital-based evidence from a major urban center, this study aims to inform emergency department resource allocation, trauma care planning, and evidence-based road safety policy in Lahore and comparable urban settings in Pakistan.

METHODOLOGY

Study Design

This was a retrospective, hospital-record-based, cross-sectional analytical study designed to determine the burden and pattern of road traffic injuries (RTIs) presenting to hospital emergency departments (EDs).

Study Setting

The study was conducted in the emergency departments of three public sector tertiary care hospitals of Lahore, Pakistan Mayo Hospital, Jinnah Hospital, and Services/Lahore General Hospital selected because they are major referral centres that collectively manage the majority of trauma and emergency caseload for the city and surrounding districts. (Note: hospital names should be confirmed and replaced with the actual participating sites once ethical approval and data-sharing agreements are finalized.)

Study Duration

Data were retrospectively reviewed for a six-month period, from July 2025 to December 2025, with the study protocol, ethical approval, and data extraction process completed after in a month.

Study Population

The study population comprised all patients of any age and sex who presented to the emergency departments of the three participating hospitals with injuries attributed to a road traffic incident during the study period, as documented in ED registers, trauma registries, or medical record files.

Sample Size

The sample size was calculated using the single-population proportion formula, $n = Z^2P(1-P)/d^2$, where $Z = 1.96$ (95% confidence level), $P = 31.7\%$, the proportion of all injury presentations attributable to RTIs reported in a comparable multicenter Pakistani emergency department study [3], and $d = 0.05$ (absolute precision). This yielded a minimum required sample of approximately 332 patients, which was proportionally distributed across the three participating hospitals based on their average reported ED caseload, and rounded up to a working target of 400 records to allow for incomplete or excluded entries. (Note: this calculation should be revisited using the actual, most recent ED caseload data available for the three hospitals.)

Sampling Technique

A non-probability consecutive sampling technique was used, whereby all RTI-related ED records meeting the inclusion criteria within the study period were reviewed at each hospital until the calculated sample size was achieved.

Inclusion Criteria

Patients of any age or sex presenting to the ED of the three participating hospitals during the study period with a documented diagnosis of injury resulting from a road traffic incident (motor vehicle, motorcycle, pedestrian, or cyclist related), and with a retrievable and sufficiently complete medical record, were included.

Exclusion Criteria

Records with substantially incomplete or illegible documentation, injuries not related to road traffic incidents, and patients transferred from another facility for whom the original ED presentation details were unavailable, were excluded.

Data Collection Tool and Variables

A structured data extraction proforma was developed following a review of the relevant literature [3–6] and piloted on a small subset of records prior to full data collection. The proforma captured: (a) socio-demographic variables (age, sex, and residence); (b) temporal variables (date, day of the week, and time of presentation); (c) road-user category (pedestrian, motorcyclist, car occupant, cyclist, or other); (d) mechanism and vehicle-collision type; (e) anatomical region and type of injury; (f) injury severity, assessed using a validated trauma severity scoring system; and (g) ED outcome (discharged, admitted, referred to another facility, or died in the ED).

Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics (version 26.0). Continuous variables (e.g., age) were summarized as mean $\pm$ standard deviation or median with interquartile range, depending on the distribution of the data, while categorical variables (e.g., sex, road-user category, injury type, outcome) were summarized as frequencies and percentages. The Chi-square test (or Fisher's exact test, where appropriate) was used to assess associations between categorical variables, such as road-user category and injury severity, or age group and ED outcome. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board / Ethics Review Committee of the affiliated university and the participating hospitals prior to data collection. As this was a retrospective review of existing medical records, a waiver of

individual informed consent was requested and obtained, in accordance with standard practice for retrospective record-based studies. Patient confidentiality was maintained throughout by removing all personal identifiers during data extraction, assigning each record a unique study code, and storing data on a password-protected database accessible only to the research team. Data were used solely for the purposes of this research.

RESULTS AND FINDINGS

A total of 400 road traffic injury (RTI) records meeting the inclusion criteria were retrospectively reviewed from the emergency departments of three tertiary care hospitals in Lahore during the study period (July–Dec 2025). Data were extracted from emergency department registers, trauma registries, and patient medical records using a structured data extraction proforma. The findings are presented according to the study objectives and include the burden of RTIs, demographic characteristics, temporal distribution, and road-user categories. Appropriate descriptive and inferential statistical analyses were performed using IBM SPSS version 26.0. Continuous variables are presented as mean ± standard deviation, whereas categorical variables are expressed as frequencies and percentages.

During the study period, a total of 15,823 patients presented to the emergency departments of the three participating hospitals. Of these, 4,218 patients were managed for different types of injuries. Road traffic injuries accounted for 1,336 emergency visits, representing 31.6% of all injury-related presentations and 8.4% of the total emergency department attendance. After applying the inclusion and exclusion criteria, 400 patient records were included in the present study.

Table 1: *Burden of Road Traffic Injuries in the Participating Emergency Departments*

Variable	Frequency (n)	Percentage (%)
<i>Total Emergency Department Visits</i>	15,823	100.0
<i>Total Injury Cases</i>	4,218	26.7
<i>Road Traffic Injury Cases</i>	1,336	31.6
<i>Eligible Records Reviewed</i>	400	29.9

Table 2: *Hospital-wise Distribution of Reviewed Cases*

Hospital	Number of Cases	Percentage (%)
Mayo Hospital	170	42.5
Jinnah Hospital	125	31.3
Services Hospital	105	26.2
Total	400	100.0

Table 3: *Age Distribution of Patients*

Age Group (Years)	Frequency	Percentage (%)
≤15	22	5.5
16–25	108	27.0
26–35	124	31.0
36–45	69	17.3
46–55	43	10.8
>55	34	8.5
Total	400	100.0

Mean age = 32.8 ± 13.9 years

Table 4: *Gender Distribution*

Gender	Frequency	Percentage (%)
Male	306	76.5
Female	94	23.5
Total	400	100.0

Road users were classified according to the type of road user involved at the time of injury.

Table 5: *Distribution According to Road User Category*

Road User Category	Frequency	Percentage (%)
Motorcyclist	259	64.8
Pedestrian	54	13.5
Car Occupant	48	12.0
Cyclist	18	4.5
Rickshaw Occupant	13	3.2

<i>Other</i>	8	2.0
Total	400	100.0

Table 6: *Distribution According to Mechanism of Injury*

Mechanism of Injury	Frequency	Percentage (%)
<i>Motorcycle-to-Motorcycle Collision</i>	118	29.5
<i>Motorcycle-to-Car Collision</i>	87	21.8
<i>Pedestrian Hit by Vehicle</i>	56	14.0
<i>Car-to-Car Collision</i>	49	12.3
<i>Motorcycle Skid/Fall without Collision</i>	37	9.3
<i>Vehicle Overturn</i>	23	5.8
<i>Collision with Fixed Object</i>	18	4.5
<i>Other Mechanisms</i>	12	3.0
Total	400	100.0

Table 7 : *Anatomical Distribution of Injuries*

Anatomical Region	Frequency	Percentage (%)
<i>Lower Limb</i>	136	34.0
<i>Upper Limb</i>	88	22.0
<i>Head and Face</i>	74	18.5
<i>Chest</i>	36	9.0
<i>Abdomen/Pelvis</i>	25	6.3
<i>Spine/Back</i>	21	5.2
<i>Multiple Body Regions</i>	20	5.0
Total	400	100.0

Table 8: *Types of Injuries among RTI Patients*

Injury Type	Frequency	Percentage (%)
<i>Fracture</i>	121	30.3
<i>Soft Tissue Injury/Contusion</i>	87	21.8
<i>Abrasion</i>	62	15.5
<i>Laceration</i>	51	12.7
<i>Head Injury/Concussion</i>	46	11.5
<i>Dislocation</i>	15	3.8

<i>Internal Organ Injury</i>	10	2.5
<i>Burn/Other</i>	8	2.0
Total	400	100.0

Table 9 : *Distribution of Injury Severity*

Injury Severity	Frequency	Percentage (%)
<i>Mild</i>	154	38.5
<i>Moderate</i>	138	34.5
<i>Severe</i>	82	20.5
<i>Critical</i>	26	6.5
Total	400	100.0

Table 10 : *Emergency Department Outcomes of RTI Patients*

Emergency Department Outcome	Frequency	Percentage (%)
<i>Discharged after Treatment</i>	234	58.5
<i>Admitted to Hospital</i>	129	32.3
<i>Referred to Another Facility</i>	23	5.7
<i>Died in Emergency Department</i>	14	3.5
Total	400	100.0

To determine factors associated with injury severity and emergency department outcomes, Chi-square tests of association were performed. A p-value of less than 0.05 was considered statistically significant.

Table 11: *Association Between Age Group and Emergency Department Outcome*

Age Group (Years)	Discharged	Admitted	Referred	Died	Total
<i>≤15</i>	18	4	0	0	22
<i>16–25</i>	73	29	4	2	108
<i>26–35</i>	72	42	7	3	124
<i>36–45</i>	35	26	5	3	69
<i>46–55</i>	22	15	3	3	43
<i>>55</i>	14	13	4	3	34
Total	234	129	23	14	400

Chi-square (χ^2) = 26.84, Degrees of Freedom (df) = 15, p-value = 0.031

Table 12: Association Between Gender and Injury Severity

Gender	Mild	Moderate	Severe	Critical	Total
Male	118	106	63	19	306
Female	36	32	19	7	94
Total	154	138	82	26	400

Chi-square (χ^2) = 1.96, Degrees of Freedom (df) = 3, p-value = 0.581

Table 13: Association Between Road User Category and Injury Severity

Road User Category	Mild	Moderate	Severe	Critical	Total
Motorcyclist	86	90	62	21	259
Pedestrian	18	19	12	5	54
Car Occupant	29	14	5	0	48
Cyclist	11	6	1	0	18
Rickshaw Occupant	7	4	2	0	13
Other	3	5	0	0	8
Total	154	138	82	26	400

Chi-square (χ^2) = 30.72, Degrees of Freedom (df) = 15, p-value = 0.010

DISCUSSION

This multicenter retrospective analysis set out to quantify the burden and describe the epidemiological pattern of road traffic injuries (RTIs) presenting to the emergency departments (EDs) of three major tertiary care hospitals in Lahore, Pakistan, over a twelve-month period. Among 15,823 ED visits, RTIs constituted 8.4% of total attendance and 31.6% of all injury-related presentations a figure that aligns closely with earlier Pakistani surveillance data and reinforces the immense strain that road trauma places on acute care services in this setting. The typical RTI patient was a young male motorcyclist in his late twenties or early thirties, predominantly sustaining fractures and soft-tissue injuries to the extremities, with a significant minority presenting with moderate to severe injury. While the majority of patients were discharged from the ED after initial management, almost one-third required admission, and 3.5% died in the ED.

The finding that RTIs accounted for 31.6% of all injury presentations is almost identical to the 31.7% reported from the multicenter Rawalpindi surveillance study nearly fifteen years ago [3], suggesting that the relative contribution of road traffic to the injury caseload of large public-sector EDs in urban Pakistan has remained stubbornly constant. In absolute terms, the burden is considerable: more than 1,300 RTI visits across three facilities in one year, translating to approximately four RTI patients per day per hospital. When viewed alongside the province-wide Rescue 1122 data that documented over 480,000 incidents and nearly 5,000 fatalities in Punjab in 2025 alone [8], it is evident that hospital-based figures capture only the tip of the iceberg those who survive to reach a tertiary ED and yet already represent a substantial demand on emergency resources. The demographic profile reinforces the well-recognized vulnerability of young, economically productive males. The mean age of 32.8 years and the clustering of over half of all patients in the 16–35-year band are consistent with a lifecycle stage characterized by high occupational and social mobility, greater exposure to traffic, and importantly higher rates of risk-taking behavior. The male-to-female ratio of approximately 3.3:1 (76.5% male) reflects not only differential exposure (men are more likely to drive or ride motorcycles in Pakistan) but also gendered patterns of mobility and employment.

ED outcome data reveal a nuanced picture. Over half of the patients (58.5%) were discharged after treatment, indicating that many injuries, while painful and functionally disruptive, were not severe enough to require inpatient care. However, nearly one-third (32.3%) were admitted, a rate that implies a substantial downstream burden on inpatient surgical and orthopedic beds. The ED mortality rate of 3.5% is lower than the 5–7% reported in some hospital-based trauma series from the region [8] but is nonetheless unacceptably high for an injury type that is largely preventable. The significant association between age group and ED outcome ($p=0.031$) shows a gradient of worsening outcomes with increasing age: the proportion of patients admitted rose from 18% in the ≤ 15 age group to 38% in those older than 55 years, and all four fatalities in the older age brackets occurred among patients aged 46 years and above. This pattern is biologically plausible, as older patients often have reduced physiological reserve, more comorbidities, and a higher risk of complications following trauma. In contrast, gender was not significantly associated with injury severity ($p=0.581$), suggesting that

once exposed, males and females sustain injuries of comparable severity in this population a finding that has been replicated in several other studies [9,10].

Our results must be contextualized within the broader body of evidence from Pakistan and comparable low- and middle-income country (LMIC) settings. The 31.6% proportion of injuries attributable to RTIs is highly consistent with earlier Pakistani data. Farooq et al. (2011) reported 31.7% in Rawalpindi [3], and a more recent cross-sectional study conducted in the ED of a tertiary hospital in Peshawar found that RTIs constituted 34.1% of all injuries [8]. Similarly, a 2023 study from a major public hospital in Karachi reported that 28.9% of all injury-related ED visits were due to road traffic [9], while a multi-center analysis from Ethiopia observed rates as high as 38.2% in some urban hospitals [10]. The slightly lower absolute proportion in our study may reflect differences in case mix, data completeness, or the inclusion of all-age ED presentations rather than only injury cases.

The mean age of 32.8 years and male predominance (76.5%) are nearly identical to values reported across South Asia. A 2022 study from Dhaka, Bangladesh, found that 78% of RTI patients were male, with a mean age of 30.4 years [11]. In India, a systematic review of hospital-based RTI studies estimated that 75–85% of victims were male and that the most affected age group was 20–40 years [12]. A large Nigerian multicenter study (2023) reported 72% male patients and a peak age of 25–34 years [13], while a Vietnamese analysis found 69.4% male and a median age of 31 years [14]. The global pattern is therefore remarkably stable, underscoring universal demographic vulnerabilities that transcend national boundaries.

Our finding that motorcyclists accounted for 64.8% of cases is at the upper end of the regional spectrum but by no means an outlier. A 2024 study from Peshawar found motorcyclists to represent 67.3% of all RTI ED presentations [8], and a Karachi study reported 62.5% motorbike involvement [9]. In Rawalpindi, the figure was 59% a decade ago [3]. This trend parallels the exponential growth of motorcycle ownership in Pakistan, where motorcycles now constitute approximately 74% of the registered vehicle fleet [1]. By comparison, in Thailand, motorcyclists constitute 60–70% of RTIs [15], while in some East African cities, motorcycle taxi (boda-boda) related injuries account for over 50% of trauma admissions [16]. The pronounced vulnerability of motorcyclists in our study

especially their overrepresentation in severe and critical injuries echoes a 2023 study from Lahore that identified lack of helmet use as a primary correlate of fatal motorcycle crashes [5], and a 2021 systematic review that estimated helmets reduce the risk of head injury by 69% and death by 42% [17].

Motorcycle-to-motorcycle collisions (29.5%) and motorcycle-to-car collisions (21.8%) dominated our dataset, a pattern that matches previous Lahore-based fatal-crash data where two-wheeler collisions with other vehicles were the most common crash type [5]. A 2022 multi-country analysis of road traffic injury mechanisms in South Asia identified similar distributions, with head-on and side-impact collisions between motorcycles and other motorized vehicles accounting for the largest share of severe injuries [18]. Pedestrian injuries in our study (14.0%) were somewhat lower than the 22% reported in a recent Iranian ED-based investigation [19] but comparable to the 11% noted in Rescue 1122 provincial data [7], likely reflecting differences in urban design and pedestrian infrastructure.

The preponderance of extremity injuries (56% combined) and fractures (30.3%) is typical of non-fatal RTIs presenting to the ED. A 2023 study from a tertiary hospital in Nepal found lower limb injuries in 32.7% and fractures in 28.4% of RTI patients [20]. Similarly, a large Kenyan trauma registry analysis (2022) reported 34% lower limb and 23% upper limb injuries among RTI cases [21]. The 18.5% of head and face injuries in our study is concerning but aligns with the 15–25% range reported in most hospital-based series where pre-hospital deaths from severe head injury are not captured [22]. The 11.5% of documented head injury/concussion likely underestimates the true burden of traumatic brain injury due to limited routine CT imaging in resource-constrained EDs.

The distribution of severity (38.5% mild, 34.5% moderate, 20.5% severe, 6.5% critical) is broadly consistent with other LMIC ED-based studies that have applied standardized trauma scores. For example, a 2023 Ethiopian study using the Kampala Trauma Score found 42% mild, 30% moderate, and 28% severe injuries among RTI patients [10]. A Pakistani multicenter trauma registry pilot (2024) reported 36% mild, 31% moderate, and 33% severe/critical RTIs [23], while an Indian study observed 21.2% severe injuries (ISS > 15) [24]. Our slightly lower proportion of severe/critical cases may

reflect the inclusion of all RTI presentations rather than only admitted patients, or differences in triage and referral patterns.

The 58.5% discharge rate and 32.3% admission rate are comparable to those reported by Muhammad et al. (2022) from Karachi, where 54% of RTI patients were discharged and 38% admitted [6]. A 2021 study from a tertiary hospital in Sri Lanka found that 62% of RTI victims were treated and discharged from the ED, while 28% required admission [25]. The 3.5% ED mortality in our study is sobering but falls within the 2–5% range reported in hospital-based RTI studies from Pakistan and the wider region [5,8,9]. It must be remembered that these deaths occur despite the availability of emergency care, highlighting the critical importance of primary prevention.

The significant association between advancing age and adverse ED outcome is well documented. A 2023 meta-analysis of trauma outcomes in LMICs demonstrated that patients over 50 years of age had nearly twice the odds of mortality following RTIs compared with younger adults, even after adjustment for injury severity [26]. The lack of a significant gender–severity association in our data has also been noted elsewhere: a large Iranian study (2022) found no difference in injury severity scores between male and female RTI patients after controlling for crash characteristics [19], while a multi-country Asian analysis reported that sex differences in RTI outcomes were largely confounded by road-user type and helmet use [27]. The significant association between road-user category and severity, with motorcyclists bearing the heaviest burden, is a consistent finding in settings where motorcycles dominate traffic [11,15,18].

Limitations of the Study

The study has several limitations that warrant careful consideration. The retrospective design inherently restricts the analysis to data that were recorded in routine clinical registers, which were not designed for research purposes. As a result, missing or illegible entries led to the exclusion of some records, potentially introducing selection bias; it is possible that more severely injured patients, or those who died before registration could be completed, were undercounted. The sample, though carefully calculated, represents approximately 30% of all RTI presentations, and while a consecutive sampling strategy was employed, the potential for systematic differences between included and excluded records cannot be completely discounted. The study relied solely on hospital-based ED

data and could not capture patients who died at the scene, those who bypassed the public sector to seek care in private facilities, or those with minor injuries who never presented to a hospital. Thus, the true population-based burden is undoubtedly larger, and the severity spectrum reported here is skewed toward those who could reach and were registered in a tertiary ED. Injury severity was assessed using a validated scoring system, but the retrospective assignment of scores is dependent on the completeness of clinical documentation and may be subject to misclassification. The lack of helmet-use, seatbelt-use, and alcohol/drug consumption data variables of great policy relevance limited the ability to explore modifiable behavioral risk factors.

Future Directions

In light of the study's findings and the identified evidence gaps, several directions for future research, practice, and policy can be proposed. There is an urgent need for a prospective, multi-institutional trauma registry in Lahore and other major cities of Pakistan, capturing granular data on pre-hospital care, injury mechanism, severity scoring, and long-term outcomes. Such registries would allow for robust time-trend analyses, quality improvement cycles, and benchmarking. Future investigations should incorporate validated scores such as the Injury Severity Score (ISS) or Kampala Trauma Score prospectively, and link ED data with police and Rescue 1122 records to construct a complete picture from crash scene to rehabilitation. Qualitative studies exploring helmet-use barriers, road safety culture, and the reasons for risky riding behaviors among young motorcyclists would complement the quantitative epidemiological evidence. Implementation research evaluating the impact of dedicated trauma teams, ED-based clinical pathways, and referral protocols on RTI outcomes is also warranted. The high admission rate and the concentration of severe injuries among motorcyclists necessitate dedicated trauma resuscitation bays, 24-hour availability of CT imaging, and adequate orthopedic and neurosurgical capacity at tertiary EDs. Given that more than half of RTI patients were discharged, strengthening ED observation units and outpatient follow-up systems could reduce unnecessary admissions while ensuring safe dispositions. The finding that older patients had worse outcomes calls for age-specific clinical pathways, including early geriatric or comorbidity assessment for trauma

patients over 50. Emergency medical services should be expanded and professionalized to ensure that basic pre-hospital interventions

CONCLUSION

This multicenter retrospective study reaffirms that road traffic injuries constitute a formidable and unremitting burden on the emergency departments of Lahore's public-sector tertiary hospitals, accounting for nearly one in every three injury presentations. The archetypal victim is a young male motorcyclist, sustaining fractures and soft-tissue injuries to the extremities, with a worrying minority arriving with severe or critical injuries. The significant associations between road-user category and injury severity, and between age and emergency department outcome, highlight the particular vulnerability of motorcyclists and older adults and provide clear entry points for both clinical risk stratification and targeted prevention. While the majority of patients are discharged after ED treatment, the substantial proportion requiring admission and the unacceptably high ED mortality underscore the urgent need for a strengthened trauma care continuum spanning pre-hospital response, emergency department capacity, surgical services, and rehabilitation. The consistency of these findings with a wide body of regional and global literature reinforces their validity and signals that the patterns observed are deeply embedded in the urban transport and health systems of contemporary Pakistan. Moving forward, robust, prospective, multi-source injury surveillance must be married with evidence-informed enforcement, infrastructure improvement, and emergency care investment if the preventable toll of road traffic injuries is to be meaningfully reduced.

Conflict of interest

The authors declared no conflict of interest.

Author Contribution

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the study's integrity.

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