E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.263

Research Article

Toxicological Profiling Of Road Traffic Accident Victims: A Cross-Sectional Audit of Benzodiazepine and Opiate Influence

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Received: 21.04.2026, Revised: 08.07.2026, Accepted: 14.07.2026

ABSTRACT

Road traffic accidents (RTAs) are a major problem in Pakistan. This study aimed to assess the toxicological profile of RTA victims, specifically highlighting the prevalence and influence of benzodiazepines and opiates. A cross-sectional study was conducted at the Chandka Medical College Hospital Larkana between July 2025 and January 2026. A structured predefined proforma was used to collect comprehensive sociodemographic data for the toxicological audit, urine samples were collected as soon as the patient was stabilized. Data were entered and analyzed using SPSS Version 21. Our study revealed that at least 27 (28.1%) and 20 (20.8%) patients screened positive for benzodiazepines and opiates, respectively. The data demonstrates a clear and statistically significant link between opiate use and worse crash outcomes ($p = 0.015$). While a noticeable clinical trend emerged—with fatal crashes exhibiting the highest proportion of benzodiazepine-positive victims (41.7%) compared to mild crashes (12.5%)—this association did not reach statistical significance ($p = 0.368$). Our analysis revealed an alarming prevalence of central nervous system depressants, with 28.1% (n=27) and 20.8% (n=20) of RTA victims testing positive for benzodiazepines and opiates, respectively. We propose robust public health awareness campaigns and stricter enforcement of safety gear regulations, fines, and suspension of driving licenses to prevent such accidents.

Keywords: Road Traffic Accidents, Benzodiazepines, Opiates, Safety Gear, Substance Abuse, Toxicology.

INTRODUCTION

Road traffic accidents (RTAs) represent a staggering global public health crisis, contributing heavily to worldwide mortality and morbidity. Every year, approximately 1.2 to 1.35 million people lose their lives due to road traffic collisions, with tens of millions more suffering non-fatal injuries that often lead to permanent disabilities. The burden of this crisis disproportionately impacts low- and middle-income countries, including Pakistan, which accounts for a substantial share of global traffic-related casualties. In Pakistan, RTAs are a leading cause of death, often exacerbated by systemic issues such as poorly maintained infrastructure, rapid motorization, and a widespread disregard for traffic safety protocols. The economic toll is equally devastating, continuously straining the healthcare infrastructure and causing immense financial hardship for affected families. Among the most vulnerable demographics are young male drivers and motorcyclists, who frequently engage in high-risk behaviors on the road and represent the largest proportion of accident victims [1-4]. While infrastructural and environmental factors play a definitive role in road safety, human error is widely recognized as the primary catalyst for the vast majority of traffic accidents. Aberrant driving behaviors—such as over speeding, violating traffic signals, and reckless overtaking—are frequently linked to impaired cognitive and psychomotor functions. A critical, yet often underreported, factor contributing to this impairment is driving under the influence of psychoactive substances. Both illicit drugs and prescription medications possess the capacity to severely diminish a driver's reaction time, visual tracking, and decision-making abilities, transforming everyday driving into a lethal hazard [2,5,6]. Among the array of pharmacological agents

affecting driver competency, benzodiazepines require distinct scrutiny. Commonly prescribed globally as anxiolytics and sedatives, benzodiazepines carry well-documented side effects that impair central nervous system functions, including delayed reflexes and reduced alertness. Epidemiological studies have demonstrated that the consumption of both long-acting and short-acting benzodiazepines significantly increases the risk of road traffic accidents. Despite these inherent risks, individuals frequently operate vehicles under the influence of these medications without fully understanding or acknowledging the extent to which their psychomotor performance is compromised [7,8]. Similarly, the influence of opiates on road safety remains a pressing concern that requires targeted investigation. Opiates are frequently administered for intensive pain management, particularly following traumatic events or surgical procedures, but their prolonged or inappropriate use can lead to dangerous levels of sedation and cognitive impairment. The risk of developing dependency and subsequently operating a vehicle under the influence of these drugs highlights a critical intersection between clinical pain management and broader public safety. Furthermore, the concurrent use of multiple psychotropic substances, or mixing them with alcohol, compounds these negative effects and drastically elevates the likelihood of a fatal collision [2, 8]. Despite the severe implications of driving under the influence, toxicological profiling of RTA victims is not routinely integrated into post-crash clinical or medico-legal assessments in Pakistan, largely due to resource constraints and enforcement gaps. The existing literature primarily focuses on physical injury patterns, geographic hotspots, or socio-demographic factors, leaving a critical knowledge deficit regarding the specific biochemical influencers of traffic accidents [3,6,9]. Recognizing this gap, it is imperative to quantify the exact burden of prescription and illicit drug influence on local road networks. Therefore, the primary objective of this study is to conduct a cross-sectional toxicological audit of road traffic accident victims, specifically profiling the prevalence and influence of benzodiazepines and opiates. By establishing this foundational data, the study aims to highlight the true scope of substance-impaired driving, providing actionable insights to inform stricter regulatory frameworks, targeted law enforcement strategies, and comprehensive public health awareness campaigns.

METHODS AND MATERIALS

This research was conducted as a cross-sectional study to assess the toxicological profile of road traffic accident (RTA) victims. The study was carried out at the emergency and trauma departments of Chandka Medical College Hospital Larkana, serving as a primary tertiary care facility for the region. The data collection and patient screening spanned a timeframe of exactly seven months, operating from July 2025 to January 2026. A non-probability convenience sampling technique was used to recruit patients to ensure that data could be gathered efficiently from incoming RTA victims arriving at the emergency department, provided they met the inclusion criteria. Patients of either gender aged over 10 years were included in the study. Patients who were not stabilized or expired before reaching the hospital were not included. Informed consent was obtained from the patients or their legal guardians/attendants. The required sample size for this cross-sectional audit was calculated using the standard proportion formula: $n = Z^2 P(1-P) / d^2$. To establish a contextually relevant baseline, an estimated road traffic accident prevalence (P) of 56% was extracted from recent local literature mapping road traffic injuries in Pakistan [5]. The standard normal deviate (Z) was set at 1.96 to achieve a 95% confidence interval. Given the exploratory nature of this single-center toxicological audit and the resource constraints of an active emergency department, the margin of error (d) was set at 10% (0.10). Using these parameters we determined a sample size of 95 RTA victims. A structured predefined proforma was used to collect comprehensive sociodemographic data including age, gender, and occupation, characteristics of the crash (type of vehicle, time of accident, role in the accident), and clinical presentations of the patients. Furthermore, to account for regional occupational hazards and confounding behavioral factors, the data collection tool was adapted to capture the continuous hours driven prior to the crash (to quantify fatigue/sleep deprivation) and the concurrent use of local smokeless stimulants (such as 'Naswar'), which are frequently utilized by heavy vehicle operators in this demographic to sustain prolonged shifts. For the toxicological audit, urine samples were collected as soon as the patient was stabilized. The screening was

conducted using commercially available, multi-panel Immunochromatographic (ICT) rapid diagnostic test cassettes. This method provided a qualitative assessment (positive/negative) for the presence of benzodiazepines and opiates in the patients' systems. Due to resource constraints typical of the local tertiary care setting, quantitative serum analysis and compound-specific confirmatory testing were not performed; therefore, results reflect recent exposure or use of these substances rather than exact intoxication levels at the precise moment of the crash. Data were entered and analyzed using SPSS Version 21. Statistics, including frequencies and percentages, were utilized to summarize categorical variables (e.g., gender, positive/negative toxicological outcomes). To evaluate the relationships between substance influence (benzodiazepines/opiates) and categorical crash variables (e.g., injury severity, accident type), associations were tested using the Chi-square test. A p-value of less than 0.05 was considered statistically significant for all associative analyses.

RESULTS

The study analyzed a total sample of 96 road traffic accident victims. The mean age of the participants was 36.18 years (SD = ± 13.64), with the cohort encompassing a wide demographic range spanning from 14 to 65 years of age (Table 1).To assess the potential confounding role of fatigue and physical exhaustion, the continuous duration of driving prior to the accident was evaluated. On average, victims had been driving for 3.57 hours (SD = ± 5.27) before the crash occurred. However, this variable exhibited significant dispersion, ranging from 0 hours (representing pedestrians, passengers, or newly initiated journeys) to an extreme maximum of 18 continuous hours. This high maximum value highlights a critical sub-group within the sample—likely commercial or heavy vehicle operators—who were experiencing severe sleep deprivation and physical exhaustion at the time of the collision. The occupational distribution of the victims revealed significant diversity, reflecting the broad demographic exposed to road traffic risks. Students formed the largest single group (13.5%, n=13), closely followed by heavy vehicle operators, specifically truck drivers, who accounted for 10.4% (n=10) of the casualties. Other highly represented groups included housewives, manual laborers, and shopkeepers (each comprising 8.3% of the sample), highlighting the vulnerability of daily commuters, commercial drivers, and pedestrians alike (Table 2).

Table 1: Descriptive Statistics for Continuous Variables (N = 96)

Variable	Minimum	Maximum	Mean	SD
Age (Years)	14.0	65.0	36.18	± 13.64
Hours Driving Before Crash	0.0	18.0	3.57	± 5.27

Table 2: Occupational Distribution of RTA Victims (N = 96)

Occupation	Frequency (n)	Percentage (%)
Student	13	13.5%
Truck Driver	10	10.4%
Housewife	8	8.3%
Laborer	8	8.3%
Shopkeeper	8	8.3%
Farmer	7	7.3%
Unemployed	7	7.3%
Delivery Boy	5	5.2%
Teacher	5	5.2%
Bus Driver	3	3.1%
Businessman	3	3.1%
Govt Employee	3	3.1%
Mechanic	3	3.1%
Nurse	3	3.1%
Office Worker	3	3.1%
Guard	2	2.1%
Retired	2	2.1%
Taxi Driver	2	2.1%

Plumber	1	1.0%
Total	96	100.0%

The gender distribution of the study cohort showed a strong male predominance. Of the 96 RTA victims evaluated, 80.2% (n=77) were male, while females accounted for 19.8% (n=19) (Table 3).

Table 3: Gender Distribution of RTA Victims (N = 96)

Gender	Frequency (n)	Percentage (%)
Male	77	80.2%
Female	19	19.8%
Total	96	100.0%

An analysis of the victims' roles during the accidents indicated that the overwhelming majority were actively operating a vehicle. Drivers constituted 72.9% (n=70) of the casualties, followed by passengers at 15.6% (n=15), and pedestrians at 11.5% (n=11) (Table 4).

Table 4: Role of Victims in Road Traffic Accidents (N = 96)

Role in Accident	Frequency (n)	Percentage (%)
Driver	70	72.9%
Passenger	15	15.6%
Pedestrian	11	11.5%
Total	96	100.0%

An assessment of vehicular involvement demonstrated that motorcycles (bikes) were the most frequently involved vehicle type, accounting for 44.8% (n=43) of the accidents. This was followed by cars at 27.1% (n=26) and heavy vehicles (such as trucks and buses) at 16.7% (n=16). Additionally, 11.5% (n=11) of the victims were pedestrians (classified as "None").

Table 5: Types of Vehicles Involved in the Accidents (N = 96)

Vehicle Type	Frequency (n)	Percentage (%)
Motorcycle (Bike)	43	44.8%
Car	26	27.1%
Heavy Vehicle	16	16.7%
None (Pedestrian)	11	11.5%
Total	96	100.0%

The largest proportion of patients presented with severe injuries (40.6%, n=39), followed by moderate injuries requiring admission (30.2%, n=29). Mild, treat-and-discharge injuries accounted for 16.7% (n=16) of the cases. Alarmingly, 12.5% (n=12) of the recorded accidents resulted in fatal outcomes (Table 6).

Table 6: Injury Severity of RTA Victims (N = 96)

Injury Severity	Frequency (n)	Percentage (%)
Severe	39	40.6%
Moderate	29	30.2%
Mild	16	16.7%
Fatal	12	12.5%
Total	96	100.0%

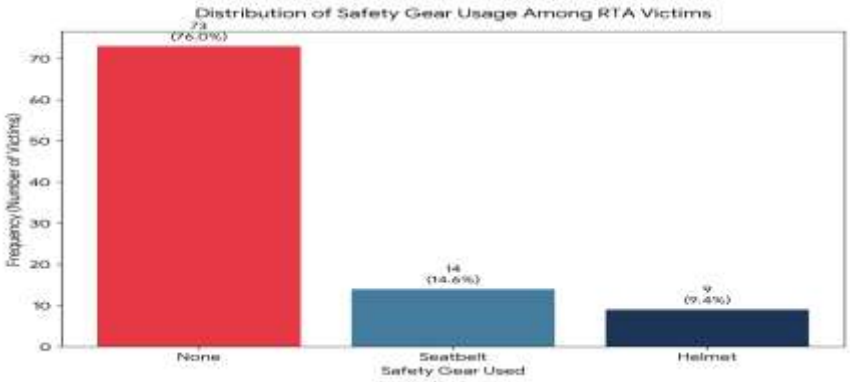

Figure 1: Safety Gear Utilization among RTA Victims (N = 96)

A staggering 76.0% (n=73) of the victims were not using any form of protective equipment (neither helmet nor seatbelt) when the collision occurred. Among those who did utilize safety measures, seatbelt compliance accounted for only 14.6% (n=14), while helmet usage among motorcyclists was alarmingly low, Representing just 9.4% (n=9) of the total sample (Figure 1).

Our study revealed that over one-third of the accident victims (35.4%, n=34) were suspected to be experiencing fatigue or sleep deprivation at the time of the crash (Table 7).

Table 7: Suspected Fatigue among RTA Victims (N = 96)

Suspected Fatigue	Frequency (n)	Percentage (%)
No	56	58.3%
Yes	34	35.4%
Unknown	6	6.3%
Total	96	100.0%

Results indicated that 28.1% (n=27) of the victims had recently used naswar prior to the accident (Table 8).

Table 8: Naswar and Stimulant Use among RTA Victims (N = 96)

Naswar / Stimulant Use	Frequency (n)	Percentage (%)
No	67	69.8%
Yes	27	28.1%
Unknown	2	2.1%
Total	96	100.0%

An assessment of the victims' pre-existing medical histories revealed that nearly one-third of the cohort (30.2%, n=29) suffered from a known chronic illness at the time of the accident. The most frequently reported conditions were hypertension (5.2%), followed by chronic pain conditions including back pain, sciatica, and arthritis.

Table 9: Prevalence of Known Chronic Illnesses among RTA Victims (N = 96)

Known Chronic Illness	Frequency (n)	Percentage (%)
No Chronic Illness	67	69.8%
Any Chronic Illness (Sub-categorized below)	29	30.2%
Hypertension	5	5.2%
Back Pain (including Chronic Back Pain)*	4	4.2%
Diabetes	4	4.2%
Sciatica	4	4.2%
Arthritis	3	3.1%
Insomnia	3	3.1%
Vision issues	3	3.1%
Anxiety	1	1.0%

Asthma	1	1.0%
Cardiac	1	1.0%
Total	96	100.0%

An analysis of the environmental conditions at the time of the accidents revealed that while the highest proportion of crashes occurred under clear visibility (46.9%, n=45), a cumulative majority of the accidents (53.1%) took place under impaired environmental conditions.

Table 10: Weather and Visibility Conditions at the Time of Accident (N = 96)

Weather / Visibility	Frequency (n)	Percentage (%)
Clear	45	46.9%
Dark	29	30.2%
Fog	13	13.5%
Rain	9	9.4%
Total	96	100.0%

The toxicological audit yielded highly significant findings regarding the prevalence of central nervous system depressants and analgesics among the trauma cohort. Rapid urine screening revealed that 28.1% (n=27) of the victims tested positive for benzodiazepines, while 20.8% (n=20) tested positive for opiates at the time of their emergency presentation.

Table 11: Toxicological Profiling of RTA Victims (N = 96)

Substance Screen	Frequency (n)	Percentage (%)
Benzodiazepines		
Positive	27	28.1%
Negative	69	71.9%
Opiates		
Positive	20	20.8%
Negative	76	79.2%

We examined the relationship between positive benzodiazepine screening and the severity of road traffic injuries. While a noticeable clinical trend emerged—with fatal crashes exhibiting the highest proportion of benzodiazepine-positive victims (41.7%) compared to mild crashes (12.5%)—this association did not reach statistical significance (p = 0.368).

Injury Severity	Benzodiazepines: Negative	Benzodiazepines: Positive	Total
Fatal	7 (58.3%)	5 (41.7%)	12
Severe	27 (69.2%)	12 (30.8%)	39
Moderate	21 (72.4%)	8 (27.6%)	29
Mild	14 (87.5%)	2 (12.5%)	16
Total	69 (71.9%)	27 (28.1%)	96

Chi square (3) = 3.160, p = 0.368.

The data demonstrates a clear and statistically significant link between opiate use and worse crash outcomes (p = 0.015). Strikingly, not a single patient who tested positive for opiates escaped with only "mild" injuries (0%). Instead, opiate impairment heavily shifted the outcomes toward moderate (34.5%) and severe (20.5%) physical trauma.

Injury Severity	Opiates: Negative	Opiates: Positive	Total
Fatal	10 (83.3%)	2 (16.7%)	12
Severe	31 (79.5%)	8 (20.5%)	39
Moderate	19 (65.5%)	10 (34.5%)	29
Mild	16 (100.0%)	0 (0.0%)	16
Total	76 (79.2%)	20 (20.8%)	96

Pearson chi^2 (3) = 7.615, p = 0.055; Likelihood Ratio = 10.498, p = 0.015.

DISCUSSION

The present study aimed to assess the toxicological profile of patients who present to the department after being in a road traffic accident, specifically to study the history of benzodiazepine and opiate intake prior to the accident. We aimed to highlight the impact of substance-impaired driving, offering actionable insights and initiating a comprehensive public health awareness campaign. Our study revealed that at least 27 (28.1%) and 20 (20.8%) patients screened positive for benzodiazepines and opiates, respectively. The data demonstrates a clear and statistically significant link between opiate use and worse crash outcomes ($p = 0.015$). While a noticeable clinical trend emerged—with fatal crashes exhibiting the highest proportion of benzodiazepine-positive victims (41.7%) compared to mild crashes (12.5%)—this association did not reach statistical significance ($p = 0.368$). Our analysis revealed an alarming prevalence of central nervous system depressants, with 28.1% (n=27) and 20.8% (n=20) of RTA victims testing positive for benzodiazepines and opiates, respectively. Crucially, the data demonstrated a statistically significant association between opiate use and severe crash outcomes ($p = 0.015$). Furthermore, while a concerning clinical trend emerged—wherein fatal crashes exhibited the highest proportion of benzodiazepine-positive victims (41.7%) compared to mild collisions (12.5%)—this specific association did not reach statistical significance ($p = 0.368$). Beyond toxicological impairment, the study identified critical compounding risk factors: over one-third of victims (35.4%, n=34) were experiencing suspected fatigue or sleep deprivation, and a majority of the collisions (53.1%) occurred under impaired environmental visibility, highlighting a dangerous interplay of chemical, physical, and environmental hazards. The prevalence of benzodiazepines (28.1%) within our trauma cohort is alarmingly high and represents a significant public health challenge. Psychoactive drugs like benzodiazepines (BZDs) inherently alter mental functioning by delaying reaction times, reducing perceptual-motor coordination, and impairing overall attention [10]. These side effects of sedation and drowsiness significantly impair driving performance, leading to high-risk behaviors such as lane-weaving and delayed braking [10, 11]. Crucially, research has shown that driving ability is dangerously compromised even when BZDs are taken at standard therapeutic doses, with a majority of impaired drivers showing drug concentrations strictly within normal therapeutic ranges [12].Furthermore, our finding that 20.8% of the cohort tested positive for opiates is equally concerning, especially given that none of the opiate-positive patients escaped with merely "mild" injuries. The concurrent use of multiple central nervous system (CNS) depressants frequently compounds crash risks. Studies on older populations have similarly highlighted the dangers of polypharmacy, demonstrating that hypnotic users frequently co-administer antidepressants and opioids [13]. Recent high-throughput pharmacoepidemiologic data confirm that drug interaction triads involving BZDs exponentially amplify the inherent risk of traumatic injuries [14]. The high rate of chemical impairment in this study must be contextualized within local occupational realities. We observed a large proportion of professional and heavy vehicle drivers who frequently endure prolonged shifts. Occupational demands have been shown to influence RTA rates; for instance, a study among public transportation drivers found a 17% accident prevalence tied directly to employee conditions and income stressors [15]. To manage the grueling hours, drivers often engage in a volatile "upper/downer" dynamic. The widespread use of local smokeless stimulants like Naswar to artificially stave off fatigue (noted alongside a 35.4% suspected fatigue rate in our cohort) is frequently counterbalanced by the overuse of unprescribed BZDs or opiates off-shift to manage pain and force sleep. This is particularly dangerous, as the prolonged, uninterrupted use of BZDs, as well as the immediate period following treatment discontinuation, have been strongly linked to increased risks of occupational and workplace accidents [16]. Chemical and physical impairment becomes particularly lethal when compounded by adverse environmental conditions. In our study, 53.1% of the crashes occurred in sub-optimal visibility (darkness, fog, or rain). This aligns with broader epidemiological data indicating that adverse weather significantly increases accident lethality; for example, cloudy or hindered visibility conditions have been shown to increase the adjusted chance of RTA-related death or injury by 2.6 times compared to clear days [17]. A driver impaired by BZDs simply cannot muster the rapid reflex adjustments

required to navigate a sudden patch of fog. Additionally, the severity of outcomes in our cohort was massively exacerbated by a severe lack of safety gear, with 76% of victims using neither helmets nor seatbelts. The failure to use a helmet has been proven to increase the risk of severe injury by 3.44 times [18]. This widespread non-compliance is particularly devastating given that head and facial trauma, alongside severe hemorrhage, remain the leading causes of fatality in road traffic accidents [19].When compared to the broader literature, the toxicological burden in our study is exceptionally high. For context, large-scale European analyses have found BZDs in just 5% of drivers involved in RTAs [12], while Canadian data indicate an 11.8% prevalence among older drivers [12]. Our 28.1% prevalence points to a localized epidemic of non-judicious sedative use. Demographically, our cohort aligns well with standard RTA profiles; our 80.2% male majority mirrors findings by Jalili et al., who reported a 75% male predominance with fatalities heavily concentrated in the active 15–44 age group [19].The primary strength of this study is the use of objective, rapid urine screening in the emergency setting, bypassing the unreliability of self-reported drug use. However, a limitation inherent to this methodology is that rapid screening detects the presence of metabolites but cannot quantify the exact active blood concentration at the time of the crash. Nonetheless, as previously noted, even low therapeutic levels of BZDs are known to induce sufficient cognitive impairment to cause an accident [12], validating the clinical relevance of our positive screens. Road traffic injuries are projected by the World Health Organization to become the fifth leading cause of mortality globally by 2030, imposing a massive socioeconomic burden [10]. Mitigating this requires urgent systemic interventions. Health professionals must practice judicious prescribing of CNS depressants and explicitly warn patients about the driving risks induced by BZDs, particularly during prolonged use [13, 16]. Furthermore, policymakers must prioritize comprehensive public awareness campaigns targeting the dangers of driving under the influence of prescription medications [11], alongside strict enforcement of safety gear regulations to stem the tide of preventable trauma on the roads.

CONCLUSION

Our study offers valuable insights into the toxicological profiling of RTA victims. Out of the total participants, 28.1% screened positive for benzodiazepines, 20.8% screened positive for opiates, respectively. There was a clear link between opiate use and worse crash outcomes. Furthermore, we also revealed fatigue or sleep deprivation and environmental visibility as additional crucial factors, emphasizing the need to further explore the contributing factors to a high rate of RTA among this demographic. We propose robust public health awareness campaigns and stricter enforcement of safety gear regulations, fines, and suspension of driving licenses to prevent such accidents.

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