



## Motor Vehicle-Related Trauma at a Level 1 Trauma Center, in New York

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### Abstract

**Background:** Despite advancements in technology and safety measures, injuries involving motor vehicles remain common. Therefore, our goal is to examine the relationship between various factors (such as age, gender, race, ethnicity, alcohol consumption, mental health, helmet usage, and others) and injuries resulting from motor vehicle collisions (MVCs).

**Methods:** We conducted a retrospective cohort study of patients who sustained injuries in MVCs at a Level 1 Trauma Center from 2016 to 2023, inclusive. All analyses were performed with the help of the inbuilt statistical tools available in SAS.

**Result:** Over 8 years, we identified 536 patients with MVCs-related trauma. The mean age of the cohort was 42.3. Out of the total, 116 (21.6%) individuals were older than 60 years, while 37 (6.9%) were 18 years or younger. The majority (80.4%) involved multi-body region injuries, with 431 occurrences, Single-body region injuries accounted for 19.6% of the cases, totaling 105 occurrences. In most cases, the head had the highest Abbreviated Injury Severity (AIS) score with a mean of 3.7, followed by the thorax with a mean of 2.8. The mean hospital length of stay (LOS) was 12.8 days, whereas ICU LOS was 4.8 days. Out of the entire cohort, 54 (10.1%) had a history of alcoholism, 20 (3.7%) had psychiatric disturbances, and another 20 (3.7%) patients had a history of substance use disorders. The cause of injury involved pedestrians struck by a vehicle (44%), followed by motorcycle crashes (25.2%), bicycle crashes (18.7%), and motor vehicle crashes (9.3%). 99.63 % of patients had blunt trauma, and 0.37% had penetrating trauma. The majority of the injured population were skateboarders, roller skaters, or bladders (44.03%), followed by motorcycle crashes (MCC) (25.19%), bicycles (18.66%), motor vehicle crashes (MVC) (9.33%) and struck by motor vehicle (2.8%). Drivers (48.13%) were highly injured as compared to passengers (8.21%). In the analysis of helmet usage, 30.2% of patients who were required to be equipped with helmets did not use them, while only 11.0% used helmets; in 3.73% of cases, required helmet usage was unknown. 162 riders without helmets had an average Injury Severity Score (ISS) of 20.3, and a high head AIS score of  $\geq 3$ .

**Conclusion:** Based on various age ranges, young adults in their 20s suffered serious MVCs-associated injuries. The majority were pedestrians, skateboarders, roller skaters, or inline skaters, followed by bicyclists, motorcyclists, and car occupants. Many of the injured individuals were not equipped with helmets. Patients suffered more severe injuries as well as longer hospital and ICU stays than those who used helmets. There were significantly more males in the cohort than females. Most cases involved injuries to multiple parts of the body and had blunt-type trauma. The presence of alcohol, psychoactive substances, or other intoxicants in the blood was strongly associated with higher injury severity.

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## Introduction

As of 2022, the number of registered vehicles in the United States totaled just under 283,500,000 [1]. Even in New York City (NYC), with one of the most extensive subway systems in the United States, approximately 38% of commuters use a car to get to work and approximately 13% take the bus [2].

Despite ongoing advancements in vehicle safety and traffic regulations, motor vehicle Collisions (MVCs) remain a leading cause of unintentional deaths in the United States [3]. The U.S. Department of Transportation reports fatalities from MVCs increased from 32,744 in 2014 to 35,484 in 2015 [4]. Behavioral factors such as alcohol consumption and failure to use safety measures like seat belts, and helmets have been consistently linked to increased risk of injury and fatality in MVCs [5]. Additionally, demographic variables such as age, gender, and race have been shown to influence the risk of injuries sustained in MVC [6,7].

The persistently high incidence/prevalence of motor vehicle-related injuries and fatalities underscores the need for continued research into the factors that contribute to the severity of injuries involving motor vehicles. The study aims to explore the connection between demographic and behavioral factors, such as age, gender, race, ethnicity, alcohol consumption, mental health, helmet usage, and the nature and severity of motor vehicle-related injuries.

## Methods

### Study design and setting

This is a retrospective cohort study conducted at a level 1 trauma center verified by the American College of Surgeons in Queens, New York City. The study population consisted of patients who experienced injuries in motor vehicle collisions (MVCs) between January 1, 2016, and December 31, 2023. Patients who did not sustain injuries in MVCs were excluded. Patients were selected from the National Trauma Registry of the American College of Surgeons (NTRACS) Database based on the injury mechanism and the Abbreviated Injury Severity (AIS) score body region classifications. The AIS score ranges from 1 to 6 per body region.

### Data collection

The data collected includes a range of variables such as demographic information (age, gender, race, and ethnicity), injury characteristics AIS score by body region, Injury Severity Score [ISS], and type of trauma), and hospital Length of stay (LOS) information for both the total hospital LOS and the LOS in the intensive care unit (ICU). We also collected data on behavioral factors, such as blood alcohol content

(BAC), use of psychoactive substances (benzodiazepines, opiates, cocaine, and marijuana), previous psychiatric history (including alcoholism, substance abuse, and psychiatric disturbances), and helmet usage. It was also determined whether the type of vehicle being driven required helmet usage, according to New York State's "universal motorcycle helmet law." The data was gathered and organized in a data collection sheet. All patient identifying information was taken out, and each patient was given a unique ID number. We focused on the severity of injuries, measured by the AIS and ISS, as well as the LOS at the hospital and in the ICU.

### Statistical analysis

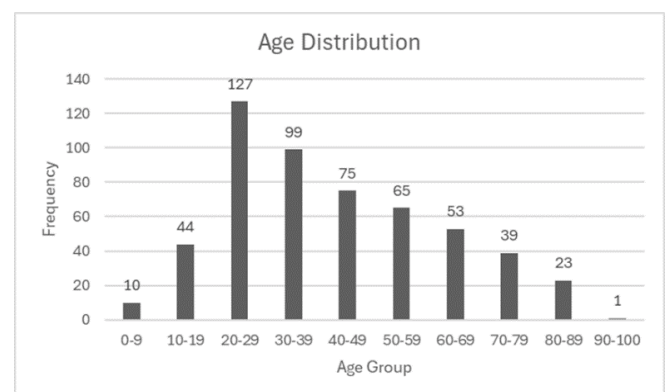
Analysis was conducted using SAS Viya 2023.09. Initially, descriptive statistics were calculated for the entire dataset. Mean and standard deviation (SD) were used to summarize continuous variables, while frequency and percentage were used to summarize categorical variables. Independent t-tests were used for continuous data, and groups were compared using logistic regression. A p-value of less than 0.05 was considered significant. All analyses were performed with the help of the built-in statistical tools available in SAS.

## Results

### Demographic Characteristics

Over the 8-year study period, 536 patients who encountered traumatic injuries from MVC were identified. The majority of patients were male (75%), with females making up the remaining 25%. The mean age of the cohort was 42.3 years (SEM). The most represented age group was 20-29 years, making up 23.69% of the total sample, followed by 30-39 years at 18.47%. The least represented age groups were 0-9 years (1.87%) and 90-100 years (0.19%). The representation of various age groups is illustrated in figure 1.

The racial distribution of the patients was as follows: 61.38% were classified as "Other," 15.3% as White, 12.31% as Asian, 4.29% as Black, 6.16% as "Unknown," and 0.56% as Native Hawaiian or Other Pacific Islander. Non-Hispanic



**Figure 1:** Patients' age range/group and frequency associated with motor vehicle collisions.

**Table 1:** It shows the demographics of patients who have experienced traumatic injuries from motor vehicle collisions (MVC).

Demographic Information	Number (%) of patients* n=536
<b>Sex</b>	
Female	134 (25.0)
Male	402 (75.0)
<b>Race</b>	
Asian	66 (12.31)
Black	23 (4.29)
Native Hawaiian or Other Pacific Islander	3 (0.56)
Other	329 (61.38)
Unknown	33 (6.16)
White	82 (15.3)
<b>Ethnicity</b>	
Hispanic Origin	230 (42.91)
Non-Hispanic Origin	252 (47.01)
Unknown	54 (10.07)
<b>Age (years)</b>	
0-9	10 (1.87)
10-19	44 (8.21)
20-29	127 (23.69)
30-39	99 (18.47)
40-49	75 (13.99)
50-59	65 (12.13)
60-69	53 (9.89)
70-79	39 (7.28)
80-89	23 (4.29)
90-100	1 (0.19)

individuals accounted for 47.01% of the injuries, while Hispanic individuals accounted for 42.91%. The complete demographic breakdown can be found in table 1.

### Behavioral Factors

A significant percentage of patients had tested positive for alcohol or illicit substances before the accident. Specifically, 97 (18.1%) were positive for alcohol, 13 (2.4%) for illicit substances, and 8 (1.5%) for both upon arrival at the Emergency Department. Out of the entire group, 54 individuals (10.1%) had a history of alcoholism, 20 (3.7%) had a history of substance abuse, and another 20 (3.7%) had psychiatric disturbances. Our analysis showed no strong correlation between a positive blood alcohol concentration (BAC) and the severity of injury. In many cases, severely injured patients had a negative BAC

In terms of helmet usage, although 30.2% of patients required helmets, only 11.0% were equipped with helmets at the time of the accident. Out of a total of 225 patients, 163 (72%) were not equipped with helmets, and they had

an average ISS of 20.3. Among these patients, the average hospital stay was 8.9 days, and the average ICU stay was 3.8 days. The average ISS for helmeted riders was 22.6, and their mean LOS in the hospital was 8.4 days, with an average ICU LOS of 3.2 days. The mortality rate for helmeted riders

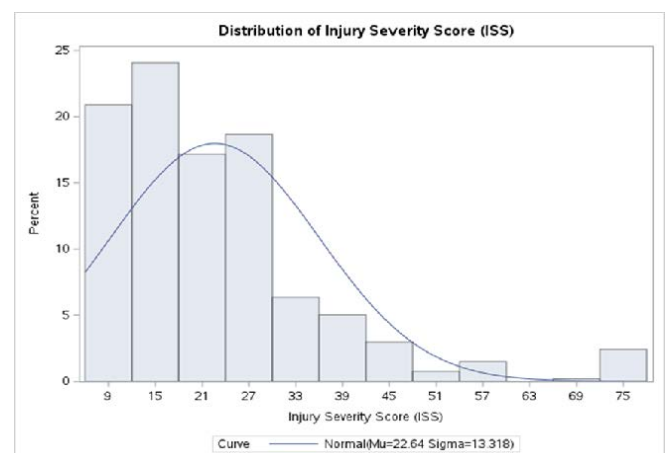
**Table 2:** Behavioral factors in patients who encountered traumatic injuries from MVC

Behavioral	Number (%) of patients n=536
Alcoholism	54 (10.1)
Psychiatric illness	20 (3.7)
Previous substance abuse	20 (3.7)
Alcohol use	97 (18.1)
Illicit Drugs	13 (2.43)
Alcohol and illicit drugs	8 (1.49)
No drugs or alcohol	242 (45.15)
Helmet used	59 (11.01)
Helmet required but not used	162 (30.22)

was 4.4%, while the mortality rate for unhelmeted riders was twice as high at 8.9%. More detailed information on behavioral factors is available in table 2.

### Injury characteristics and hospital stay

The study found that injuries involving multiple body regions were significantly more common than those involving a single body region, accounting for 80.4% (431 occurrences) and 19.6% (105 occurrences) of the cases, respectively. Nearly all patients (99.63%) sustained blunt trauma, with only 0.37% experiencing penetrating trauma. The most severely affected region was the head, with a mean AIS score of 3.7, followed



**Figure 2:** Distribution of injury severity score (ISS) by frequency percentage in patients who encountered traumatic injuries from MVC

by the thorax with a mean AIS score of 2.8. The mean ISS was 22.6. The distribution of ISS scores is illustrated in figure 2. The median length of hospital LOS was 5.0 days, with a median length of ICU stay of 1.5 days.

The majority of the injured population consisted of pedestrians, including skateboarders, roller skaters, or bladders (44.03%), followed by motorcycle crashes (25.19%), bicycles (18.66%), motor vehicle crashes (9.33%), and being struck by a motor vehicle (2.8%). In MVC crashes, 48.13%

**Table 3:** Injury description, severity, and outcomes in patients who encountered traumatic injuries from MVC

Injury/Outcome	Mean ± SD*
<b>AIS</b>	
Head	3.71 ± 0.82
Face	1.50 ± 0.58
Neck	2.11 ± 0.93
Thorax	2.89 ± 1.03
Abdomen	2.43 ± 1.27
Upper extremity	1.71 ± 0.63
Lower extremity	2.07 ± 0.89
<b>ISS</b>	22.64 ± 13.31
<b>Length of Stay (LOS), Median (Range)</b>	
Hospital	5.0 (0-375)
ICU	1.48 (0-66)
<b>Mortality, No. (%)</b>	
Died after withdrawal of care	13 (2.43)
Died as full code	74 (13.83)
Died with care not begun (DNR/DNI)	5 (0.93)
Met brain death criteria	14 (2.62)
Died unknown	1 (0.19)
Total	107 (19.96)

\*Except where otherwise noted.

of the injured population were drivers and 8.21% were passengers. The overall mortality rate was 19.96%, with 50 (9.33%) patients passing away in the ED or within 15 minutes of arrival. We have summarized the overall clinical outcomes in table 3.

## Discussion

Our research reveals several important factors linked to the severity of injuries sustained in motor vehicle crashes. Young adults, especially those in their 20s (23.69%), were the most likely to be injured in such crashes, followed by individuals in their 30s (18.47%) and 40s (13.99%). This is similar to prior data which showed that injury rates were highest amongst the 16-20 and 21-25 age groups with a rate of 1,283 and 1,284 per 100,000, respectively, followed by a rate of 1,020 per 100,000 in the 25-34 age group [7]. This

study also found that males were more likely to be involved in MVCs than females with a ratio of 3:1, which is consistent with other studies [7,13].

Racial disparities were evident, with a higher proportion of injuries among individuals classified as "Other" (61.38%), followed by White (15.3%) and Asian (12.31%) populations. By comparison, the population by race in Queens County, New York in 2020 was 31.8% Other/Two or More races, 28.7% White, and 30.6% Asian [8]. Similarly, while non-Hispanic individuals were slightly more likely to sustain injuries compared to their Hispanic counterparts (47.01% vs 42.91%, respectively), Hispanic individuals only make up 27.8% of the population of Queens County [8]. Though some of these differences can likely be attributed to differences in self-reporting, the large disparity between the studied trauma patient racial and ethnic demographics and overall population demographics suggests that certain races and ethnicities are at an increased risk of injury in MVCs.

Pedestrians, skateboarders, roller skaters, and inline skaters were the most commonly injured groups at 44%, followed by cyclists, motorcyclists, and car occupants. In New York City less than 40% of commuters use a car [2] compared to the entire United States where 80-90% of commuters drive or carpool [12]. Even those whose main mode of transportation is public transit still often walk, sometimes multiple blocks, to reach their final destination. This presents unique challenges to decreasing the number of pedestrian MVC injuries, with limited use of safety precautions for car occupants (such as seat belts and airbags).

Helmet usage was notably low among those who were required to wear one. While ISS, hospital LOS, and ICU LOS were relatively similar between helmeted vs un-helmeted riders (22.6 vs 20.3, 8.4 vs 8.9, and 3.2 vs 3.8, respectively), the mortality rate for un-helmeted riders of 8.9% was double that of helmeted riders. This shows that helmet usage can reduce mortality, likely related to injuries sustained to the head. Interestingly, in a study comparing urban vs rural off-road vehicle crash injury patterns, Butts et al. [9] found that urban riders were less likely to wear a helmet and had higher AIS scale head scores. This suggests that there are factors specifically related to an urban environment that are influencing helmet usage. Further study is needed to determine what these factors are to create and promote programs and/or regulations to reduce the number of un-helmeted injuries.

Compared to other studies, this study found considerably less substance usage among patients who sustained injuries in MVCs. In total, only 22% of the cohort tested positive for alcohol and/or an illicit substance, compared to 65.7% [10] and 59.3% [11] in other studies. Of the patients who tested positive for alcohol and/or illicit substances, 54.3% were drivers, 34.8% were pedestrians, 7.1% were passengers, and 3.8% were unspecified occupants/passengers (n=184). This

is not similar to prior literature, which found higher rates of alcohol in injured pedestrians compared to other MVC patients [10]. Additionally, passengers and unspecified occupants of a vehicle suffered slightly higher severity injury with a mean ISS of 24.6, followed by pedestrians with 23.6, and drivers with 21.3.

This study highlights the complex interplay of demographic, behavioral, and environmental factors in the severity of injuries resulting from MVC. The unique transportation landscape of NYC, where pedestrian and cyclist injuries are prevalent, presents specific challenges in reducing MVC injuries, especially given the low rates of helmet usage. These findings underscore the need for targeted public health interventions that address these risk factors, such as promoting helmet use and education around alcohol consumption as well as substance use, to effectively reduce the occurrence of MVC-related injuries.

### Limitations

Data was collected from the NTRACS Trauma Registry, which may not always provide complete or detailed information. For example, the classification of race as "Other" lacks specificity, potentially obscuring important demographic nuances. Additionally, not all patients were tested for alcohol or substance use, especially those who died early in their hospital course, which may have led to an underestimation of the role that intoxication plays in the severity of injuries. Additionally, this study did not include fatalities that occurred at the scene of the accident, which could result in a bias toward less severe injuries among those who survived long enough to reach the hospital. Finally, the study's findings are drawn from data collected at a single level 1 trauma center in NYC, limiting the generalizability of the results. Given the variability in driving behaviors, traffic patterns, and population demographics across different boroughs, the data may not accurately represent the entirety of NYC. These limitations suggest that further research, incorporating more comprehensive and geographically diverse data, is necessary to fully understand the epidemiology of motor vehicle accident-related injuries in urban settings.

### Conclusion

This study provides valuable insights into the demographic and behavioral factors that contribute to the severity of injuries sustained in motor vehicle collisions within an urban context. The findings underscore the importance of targeted interventions, such as promoting helmet usage, and education around alcohol consumption as well as substance use, to reduce the occurrence of motor vehicle-related trauma. The unique transportation patterns of NYC, with a high prevalence of pedestrian and cyclist injuries, further underscore the need for tailored public health interventions. Future research should focus on identifying additional risk factors and evaluating the effectiveness of preventive measures in reducing the

incidence and severity of injuries in MVCs.

### Author contributions

Conceptualization- BS; writing—original draft preparation- BS and SK; writing—review and editing- BS, AA, KT, NDB, GA, JD, JM, ZS, and JW; figures and table, BS and AA; supervision- BS; project administration- BS

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### Institutional Review Board (IRB) Statement

This retrospective study has IRB approval

### Conflicts of interest

The authors have no competing interests to declare.

### References

1. Bureau of Transportation Statistics, U.S. Department of Transportation. Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances (2024).
2. NYC Department of City Planning, Transportation Division. Peripheral Travel Study (2010).
3. Centers for Disease Control and Prevention. Injuries and violence are the leading causes of death (2022).
4. National Highway Traffic Safety Administration, U.S. Department of Transportation. Fatality Analysis Reporting System Data Tables (2024).
5. National Center for Statistics and Analysis, National Highway Traffic Safety Administration. Traffic Safety Facts 2022 Data [DOT HS 813 592]. Passenger Vehicles (2022).
6. National Center for Statistics and Analysis, National Highway Traffic Safety Administration. Traffic Safety Facts: 2021 Data [DOT HS 813 572] Race and Ethnicity (2024).
7. National Center for Statistics and Analysis, National Highway Traffic Safety Administration. Traffic Safety Facts 2020: A Compilation of Motor Vehicle Crash Data [DOT HS 813 375].
8. United States Census Bureau, Queen County, New York. Decennial Census (2020).
9. Butts CA, Gonzalez R, Nguyen L, et al. Twelve-Year Review of Urban versus Rural off-Road Vehicle Injuries at a Level 1 Trauma Center. *Journal of Surgical Research* 233 (2019): 331-334.

10. Walsh JM, Flegel R, Atkins R, et al. Drug and Alcohol Use among Drivers Admitted to a Level-1 Trauma Center. *Accident Analysis & Prevention* 37 (2005): 894-901.
11. Walsh JM, Flegel R, Canigianelli LA, et al. Epidemiology of Alcohol and Other Drug Use among Motor Vehicle Crash Victims Admitted to a Trauma Center. *Traffic Injury Prevention* 5 (2004): 254-260.
12. Bureau of Transportation Statistics, U.S. Department of Transportation. *State Transportation Statistics: Commute Mode* (2022).
13. Kashkooe A, Yadollahi M, Pazhuheian F. What factors affect length of hospital stay among trauma patients? A Single-Center Study, Southwestern Iran. *Chinese Journal of Traumatology* 23 (2020): 176-180.