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Research Article

Analysis of the Patterns of Mortality Causes in Traffic Accident Injuries Using Logistic Regression Model in Northeastern Iran

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ABSTRACT

Background and objective: Traffic accidents in Iran are considered a major health issue and one of the leading causes of mortality. This study analyzes the mortality rate of traffic accidents in Iran in 2023.

Materials and methods: This cross-sectional study examined all traffic accident-related deaths in hospitals affiliated with Mashhad University of Medical Sciences in 2023. In addition to mapping the pattern of traffic accident mortality during this year, the association of certain variables with hospital deaths was analyzed using logistic regression.

Findings: Regarding total traffic accident injuries, 25.2% were women and 74.8% were men. Logistic regression results indicated that men had a 38% higher chance of death compared to women. The average age of the injuries was 30.07 ± 16.93 years. The highest percentage of injuries was related to motorcycle-vehicle collisions, while the highest number of fatalities was related to pedestrian-vehicle collisions. Injuries with higher consciousness levels had a 2.1 times higher chance of death compared to others. The highest number of injuries was observed in the summer, and the lowest in the winter. The variable of time to reach the casualty and the outcome (death or survival in the hospital) was statistically significant (p-value < 0.05).

Conclusion: Since the majority of traffic accident fatalities were young men, policy-making and organizing efforts in the prevention of accidents and injuries are essential as a health priority and a key tool in enhancing safety in the country.

Keywords: Epidemiology, Mortality, Traffic Accidents, Trauma.

1. Introduction

Accidents have been one of the main causes of mortality in recent years, posing significant social, cultural, and economic threats to human societies. Accidents increase direct costs such as medical and care costs for the disabled and indirect costs such as psychological problems and depression in family members, and the loss of active labor force either permanently or temporarily. Iran is one of the countries with the highest cases of injuries and fatalities resulting from traffic accidents. Traffic injuries are the third leading cause of death worldwide, but in Iran, this problem is much more severe, ranking second only to cardiovascular diseases[1]. In managing traumatic patients and traffic accident

injuries, time is of utmost importance; most deaths occur before the arrival of the ambulance or within the initial hours of injury. Therefore, time plays a crucial role in reducing injuries and determining the outcome for traumatic patients. Implementing preventive policies requires a comprehensive study to evaluate trends and assess the mortality status of accidents and the role of organizations in the occurrence and severity of these incidents, providing valuable information for policymakers to take preventive actions and reduce injuries. This study will analyze the factors related to the mortality of accident injuries[2].

Traffic accidents are a major challenge for health systems today. According to the World Health Organization, 1.35 million people worldwide die annually from road traffic injuries, and between 20 to 50 million people are injured and disabled, with the majority of injuries being men[3]. The mortality rate due to traffic accidents in low-income and high-income countries is reported to be 27.5 and 8.3 per 100,000 people, respectively[4]. Nearly 3,700 people are killed on the world's roads every day, having both direct and indirect adverse effects on the national economy and health outcomes[5]. In 24 Asian countries, which account for 56% of the world's population, 750,000 people die annually due to road accidents. International studies have shown that countries lose the most active economic years through road traffic accident injuries, with individuals aged 15-44 constituting more than half of road traffic deaths[6].

Studies conducted in developing countries have shown that 80% of deaths and 90% of disabilities are related to road accidents[7]. In Iran, the incidence of traffic accidents is about twenty times higher than the global average. In recent years, the rate of disabilities resulting from traffic accidents has doubled compared to European countries[8]. According to the Global Status Report on Road Safety (2015), the mortality rate from traffic accidents in Iran is reported to be 32.1 per 100,000 people[9].

The study by Moradi et al. (2014) shows that although the mortality rate has been decreasing since 2007, the mortality rate from traffic accidents is still higher than in many countries in the region and the world[10]. Today, traffic accident fatalities in Iran are in a critical state. According to Iran's traffic police, a road accident occurs every three minutes, and one person is killed every 19 minutes in these accidents[11]. Therefore, traffic accident-related mortality and injuries should be a specific concern in Iran and prioritized by the government and health care system[12].

Given the multifaceted nature of this public health crisis, there is a pressing need for comprehensive data to inform policy-making and preventive measures. This study aims to provide an in-depth analysis of the epidemiological aspects of fatal traffic accidents in Khorasan Razavi province, focusing on the year 2023. By identifying patterns in traffic accident fatalities, including demographic factors, types of accidents, and emergency response times, this research seeks to contribute valuable insights to aid in the development of targeted interventions and evidence-based policies to reduce road traffic mortality in Iran.

2. Materials and Methods

This research is a descriptive-analytical study with cross-sectional data collection. The target population includes all traffic accident injuries at Mashhad University of Medical Sciences in the year 2023-2024.

Data analysis will be performed using R statistical software and the Chi-square test, Student's t-test, and logistic regression. To collect data according to the study objectives, a checklist including demographic variables, consciousness level, blood pressure, time to reach the casualty, place of death, type of accident, etc., recorded by pre-hospital emergency technicians, was used. No specific inclusion or exclusion criteria were considered, and all traffic accident-related deaths within the university were examined.

Considering the cross-sectional nature of the study, frequency, mean, and standard deviation were initially used to describe the variables. Then, to examine the relationship between variables such as age, gender, place of death, etc., with hospital deaths, the Chi-square test, independent t-test, and logistic regression were used. The method of entering variables into the logistic regression was Enter. The significance level in the tests was set at 0.05. Logistic regression is a statistical method used to analyze the relationship between a dependent variable and one or more independent variables. In the context of accident analysis, logistic regression can be used to analyze the factors that influence the likelihood of a death outcome.

In logistic regression, the dependent variable is binary (i.e., it has two possible outcomes) such as whether death occurred. Independent variables can be continuous or categorical, such as age or gender. The logistic regression model estimates the probability that the dependent variable has a specific value based on the values of the independent variables.

The logistic regression model is a mathematical equation that predicts a binary outcome, meaning a dependent variable that can only take two possible values, such as yes or no, success or failure, etc[13].

3. Results

In the year 2023-2024, the total number of traffic accident injuries at Mashhad University of Medical Sciences was 47,947 individuals. Among these figures, 12,096 (25.2%) were women and 35,851 (74.8%) were men. The logistic regression results showed that the likelihood of death for female injuries in accidents was 1.46 times that of males, meaning that the chance of death due to accidents was 46% higher for men than for women.

The mean age and standard deviation of the injuries were 30.07 ± 16.93 years, with the oldest casualty being 98 years old and the youngest one year old. Logistic regression analysis indicated that the younger the casualty, the higher the chance of death. The odds ratio is 0.941, indicating a 5.9% decrease in odds per unit increase in age. Additionally, using the Chi-square test, it was found that there was an inverse correlation between age and accident outcome (death or survival) (p-value < 0.05).

The logistic regression results showed that the likelihood of death for injuries with higher levels of consciousness was 2.14 times higher than for other injuries. It means that for every one-point increase in GCS, the odds more than double. The mean level of consciousness for injuries was 14.89 ± 0.82.

The mean and standard deviation of the blood pressure of the injuries were 117.16 ± 9.81 mmHg. According to logistic regression, a small positive effect is observed with an odds ratio of 1.013, indicating a 1.3% increase in odds per unit increase in BPM **(Table 1)**.

Table 1: Logistic regression analysis results.

Variable	B	OR	P value
Sex	0.381	1.46	0.044
Age	-0.061	0.941	<0.001
GCS	0.762	2.14	<0.001
BPM	0.012	1.01	0.001

(Table 2) provides details about the number of injuries by type of accident. The highest percentage of injuries (35.2%) was related to motorcycle-vehicle collisions. The highest number of fatalities (36.8%) was related to pedestrian-vehicle collisions. Additionally, of the total number of traffic accident injuries, 8,032 (16.8%) were related to road accidents, and 39,915 (83.2%) were related to urban accidents.

Table 2: The frequency of traffic accidents injuries by vehicle.

Accident type	Frequency
Vehicle pedestrian accident	12074(25.2%)
Two-car accident	15642(32.6%)
Motorcycle accident with Vehicles	16887(35.2%)
Other	3344(7%)
Sum	47947

According to **(Figure 1)**, the highest number of injuries was observed in the summer and the month of July (5,225 individuals), while the lowest number was observed in the winter and the month of February (2,513 individuals).

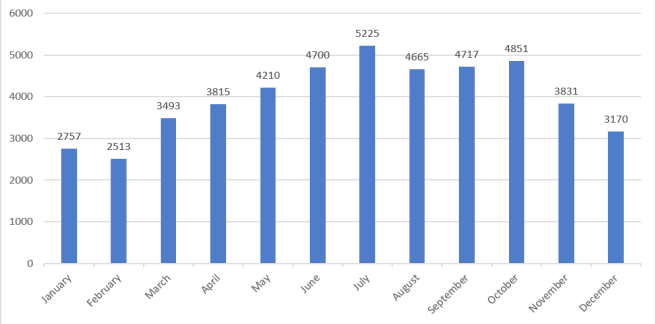

Figure 1: The number of traffic accident injuries by month.

Among traffic accidents, the highest number of injuries for men was related to motorcycle-vehicle collisions, while for women it was car-to-car collisions. The variable of the time taken to reach the casualty and the outcome (death or survival) in the hospital was statistically significant (p-value < 0.001). The mean time to reach the casualty for deceased individuals was 15.46 ± 13.06 minutes, and for survivors, it was 12.67 ± 9.02 minutes.

4. Discussion

This study aimed to analyze the patterns of mortality caused by traffic accident injuries in Northeastern Iran. Similar to the study by Saki, et al[14], our results showed that men constitute the majority of traffic accident injuries. This outcome could be due to the higher number of male drivers compared to female drivers. Moreover, men are more at risk of death from traffic accidents than women. These findings are consistent with other studies, including those by Kenarangi, et al[2] and Erfanpour, et al[15], which also indicate that men are more likely than women to die in road accidents. Given the cultural conditions and legal restrictions in the country, the use of bicycles and motorcycles is not common among women, so, naturally, the number of female fatalities is lower than that of men[15].

Demographic factors such as age also play an important role in mortality. The average age of the injuries was 30.07 years, and this study showed that young people and children are more likely to die from accidents compared to older individuals. This finding is consistent with the study by Mikak, et al[16], which indicates that young people are more at risk due to lack of experience and less caution. Additionally, the study by Zhang, et al[17], in Canada showed that high-risk behaviors are more prevalent among young drivers, and the higher risk in this group is due to inexperience and negligence.

The type of accident also impacts the likelihood of death. Specifically, pedestrian-vehicle collisions accounted for the highest number of fatalities, highlighting the importance of safety measures for pedestrians. This result is in line with the study by Holman, et al[18], showed that motorcycle collisions with other vehicles constitute a significant percentage of injuries and fatalities, which aligns with the findings of the present study. This underscores the need for special attention to motorcycle safety. Statistical details showed that motorcycle-vehicle collisions accounted for 35.2% of all accidents, while pedestrian-vehicle collisions constituted 25.2% of all traffic accidents.

Additionally, this study showed that the time taken for emergency services to arrive at the accident scene significantly impacts the mortality rate. The mean arrival time for emergency services was considerably higher for deceased individuals compared to survivors. This finding indicates that improving the response time of emergency technicians and responders can have a significant effect on reducing mortality. On average, the arrival time for emergency services for deceased individuals was approximately 3 minutes longer than for survivors.

Furthermore, the results showed that blood pressure did not have a significant impact on the likelihood of death or survival of the casualties. However, the level of consciousness significantly affected the chances of death. This study revealed that casualties with higher levels of consciousness had a higher likelihood of death compared to others. This result may be due to human error in data recording or the initial condition of the casualty upon hospital arrival with a high level of consciousness, which may have led to incomplete care for the casualty.

Finally, the analyses showed that the number of casualties and fatalities varies across different seasons of the year. The highest number of casualties, similar to the study by Torkali and Khanjani[19], occurred in the summer and the month of August, which could be due to the increase in travel and outdoor activities during this season.

Based on this, the following actions are recommended to reduce traffic accident fatalities:

- **Promote safety measures for pedestrians:** Improve urban infrastructure for pedestrians and increase public education on road safety.
- **Enhance emergency medical services:** Reduce response time to accidents and decrease the time to get patients to medical centers.
- **Upgrade services:** Strengthen and update the ambulance fleet and emergency medical bases.
- **Education and cultural awareness:** Provide more training for young and novice drivers on safe driving practices and necessary precautions.

- **Policy making based on data:** Use collected data to develop comprehensive and effective policies to reduce traffic accidents.
- **Special attention to motorcyclists:** Increase safety measures and deterrent laws for motorcyclists and create specific educational programs for this group.
- **Improve data recording systems:** Establish more accurate and systematic systems for recording casualty and accident data to improve analysis and decision-making.
- **Implement smart emergency systems:** Utilize smart technology to enhance the quality of pre-hospital emergency services.
- **Improve the quality of domestic vehicles:** Car manufacturers should produce safe, high-quality vehicles that meet global standards.
- **Enhance road quality:** Relevant authorities should take steps to standardize road markings, warning signs, highway lighting, and more.

5. Conclusion

This study examined the patterns of mortality causes among traffic accident victims in Northeastern Iran and found that men are more at risk of dying from traffic accidents than women. Demographic factors such as age significantly impact mortality, with younger individuals and children being more likely to die from accidents. The type of accident also affects the likelihood of death, with pedestrian-vehicle collisions accounting for the highest number of fatalities.

The time taken for emergency services to reach the accident scene was another important factor impacting the mortality rate. Reducing the response time of emergency responders can significantly reduce fatalities. The results also showed that blood pressure did not significantly impact the likelihood of death or survival, but the level of consciousness significantly affected the chances of death.

Overall, this study's results emphasize the importance of developing and implementing comprehensive and effective policies to reduce traffic accident fatalities. Recommendations for improving road safety include promoting safety measures for pedestrians, reducing emergency response times, providing education and cultural awareness on safe driving, and developing policies based on accurate data.

6. Limitations

This study has several limitations that should be considered:

- **Limited to a specific region:** This study only addresses traffic accidents in Northeastern Iran, and the results may not be generalizable to other regions of the country. Regional differences in factors influencing accidents may affect the results.
- **Time constraints:** The data pertains to a specific year (2023-2024), and the findings may not adequately reflect temporal changes and long-term trends.
- **Incomplete data access:** Due to limitations in the existing data recording systems, some data may be incomplete or inaccurate, which can impact the results and analyses.
- **Uncontrolled variables:** Certain variables such as environmental conditions or driver behavior, which can influence the results, were not controlled in this study. This may lead to misinterpretation of the findings.
- **Statistical limitations:** The use of logistic regression as the sole statistical method may limit the analysis and interpretation of the results. Utilizing different statistical methods could enhance the accuracy of the findings.
- **Impact of human errors:** The presence of human errors in data recording and collection can affect the accuracy of the results. This is particularly relevant for variables such as consciousness level and emergency response time.

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8. Conflict of Interest

The authors of the article declare that there are no conflicts of interest in the present research.

9. Authors' Contributions

All authors contributed to the conceptualization and implementation of the project, as well as the initial drafting or revising of the article. All authors have approved the final version of this article and accept responsibility for the accuracy and integrity of the content contained herein.

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