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Abstract

Background: There are many debates on socioeconomic indicators influencing trauma outcomes.

Objectives: This study aimed to determine the association between education as a socioeconomic indicator and trauma outcomes.

Methods: This descriptive-analytical study was conducted on 30,448 trauma patients during 2016-2021. The data were based on the minimum dataset of the National Trauma Registry of Iran (NTRI) from six different trauma centers in various cities of the country. The variables used in this study included age, education level, marital status, cause of injury, Glasgow Coma Scale (GCS), intensive care unit (ICU) admission, Injury Severity Score (ISS), and in-hospital mortality. Logistic regression was used to investigate the association between independent variables and trauma outcomes.

Results: The study included 30,448 trauma patients with male predominance (75.8%). The mean age was 36.9 years. The most frequent education level was secondary education, with 14,228 (46.6%). Education levels had significant relationships with ISS, death, and ICU admission ($P < 0.001$). Moreover, after applying the multiple logistic regression, the odds of deaths for trauma patients with no formal, primary, and secondary education levels were 3.36, 5.03, and 3.65 times, respectively, more than the odds of deaths at the higher education level after controlling for other factors (all $P < 0.05$). However, there were no such relationships between education levels and the odds of ICU admission.

Conclusion: Findings of the present study showed a significant association between the education levels and trauma outcomes. Adjusted for other covariates, the chance of death for trauma patients with no formal, primary, or secondary education levels was higher than that at the higher education level.

Keywords: Wounds and injuries, Socio-economic factors, Education status, Fatal outcome, Registries.

Introduction

Trauma is the leading cause of death in people under 35 years of age worldwide.^[1] A total of 5.8 million people get injured by various injury causes annually, and 1.35 million people die from car accidents worldwide, costing 500

billion US dollars.^[2-4] Fatalities are more than conditions such as malaria, tuberculosis, and AIDS, cumulatively.^[5] According to the World Health Organization (WHO), low-income countries contribute to 90% of deaths from road accidents worldwide, becoming a significant health

problem in the upcoming years.^[6] Unfortunately, trauma is perceived to cause most deaths in these countries in the 15-59 age group.^[7,8] In Iran, road traffic injuries (RTI), the most common etiology of trauma, increased from 109.7 to 400.6 per 100 000 population between 1997 and 2016.^[9,10] In 2019, 347,307 people were injured, and 16,946 were killed due to motor vehicle accidents in Iran. These numbers were about 28,942 injuries and 1,412 deaths per month, respectively.^[11]

Studies have shown that people with different socio-economic status have different levels of trauma-related conditions.^[12,13] Moreover, qualitative education is one of the objectives of sustainable development goals related to health, which affects health outcomes.^[14]

Appropriate education is the basis for improving the quality of life and decreasing different types of trauma and injuries. As a result, how each person deals with his health depends partly on their knowledge of injury prevention.^[15]

Before establishing the National Trauma Registry of Iran (NTRI), there was no comprehensive registry of injuries in Iran.^[16-18] The NTRI's main purpose is to provide great information for trauma research and evaluate the services presented to the patients. The NTRI register traumatic patients and records their essential information. The data are collected by dedicated nurses through interviews, medical records, and hospital information systems, then are uploaded to the web portal. In the next step, the trained physicians evaluate the validity and completeness of the data. The data is modified if needed and then stored in the registry database.

Objectives

The current study aimed to determine the association of education as a socio-economic factor with trauma outcomes according to the NTRI data.

Methods

Study design

In this descriptive-analytical study, all patients with one or multiple traumatic intentional or unintentional injuries, such as road traffic crashes (RTCs), falls, blunt force, penetrating injuries, and assaults, admitted to six hospitals affiliated to the NTRI were included from July 24, 2016, to June 23, 2021. These hospitals were major educational trauma centers in six different cities, including Sina Hospital in Tehran, Shahid Beheshti Hospital in Kashan, Shahid Rahnamoun Hospital in Yazd, Imam Khomeini Hospital in Urmia, Taleghani Hospital in Kermanshah, and Imam Hossein Hospital in Shahroud.

Eligible patients were as follows: trauma patients hospitalized ≥ 24 hours or died in the first 24 hours at the mentioned trauma centers and all trauma patients who were referred from the ICU of other centers without considering the time interval of admission.

Data were based on the minimum dataset (MDS), including 109 variables. MDS includes demographics, injury characteristics, pre-hospital and emergency department information, ICD-10 codes, diagnosis, surgical and nonsurgical procedures, outcomes, hospitalization charge, and injury severity. The details of these variables were described before.^[19]

Two dedicated trained nurses in each center performed paper-based data collection and electronic registration by the web-based system. Reviewers were assigned to re-check and control the quality of the submitted data for completeness, accuracy, and consistency.

We used a portion of the data set in this study, including demographics (patients' gender, age, and marital status), education levels, injury characteristics, and outcome. The patients were grouped into no formal education (illiterate), primary education, secondary education, and higher education (university education), considering the education level. Injury causes were road traffic crashes (RTCs), stabbing and/or cutting, blunt force, falls, guns, and others. The trauma severity was measured via the injury severity score (ISS) system. The outcomes were the Glasgow Coma Scale (GCS), ICU length of stay, and death.

Statistical analysis

Baseline characteristics were expressed as mean \pm standard deviation or frequency and percentage. A Chi-square test examined the association between the education level and the cause of injury. ANOVA and Kruskal-Wallis tests were used to compare the mean of ISS and median of GCS between the education levels, respectively. In addition, post-hoc analysis (Bonferroni) was done for a two-way comparison of the mean of ISS. Univariable and multiple logistic regression models estimated crude and adjusted odds ratios (ORs). P-values less than 0.05 were considered statistically significant. Data analyses were performed using Stata 14.0 (StataCorp LLC, College Station, Texas, USA).

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. The Ethics Committee of Sina Hospital, Tehran University of Medical Sciences, approved this study (IR.TUMS.SINAHOSPITAL.REC.1399.090). All participants signed an informed consent form.

Results

Overall, 30,448 patients met the eligibility criteria included in this study. Their ages ranged from 1 to 110 years, with a mean (\pm standard deviation) of 36.9 (\pm 21.8) years. Of these patients, 23083 (75.8%) were males. The most frequent levels of education among males and females were secondary education (N=12,336, 53.4%) and illiteracy (N=3,238, 44%), respectively [Table 1].

There were statistically significant associations between ISS and education levels ($p < 0.001$) [Table 2]. The average ISS in patients with no formal education was more than primary, secondary, and higher education levels ($p < 0.001$). The average ISS in patients with no formal education was 5.5 ± 4.0 , and in those with higher education

levels was 4.3 ± 4.3 ($p \leq 0.001$). The association between education levels and death and education levels and ICU admission were statistically significant ($P < 0.001$).

The crude and adjusted associations of education levels and other independent variables with death are shown in Table 3. According to the crude model, the odds of death for trauma patients with no formal education were 4.66 times higher than the odds of death at higher education levels (4.66, 95% CI: (2.60 to 9.60), $P < 0.001$) [Table 4]. Also, in the multiple logistic regression after controlling the ISS, age, and causes of injuries, the odds of death for trauma patients with no formal education were 3.36 times higher than those in patients with higher education levels (Adjusted OR 3.36, 95% CI: [1.07 to 10.56], $P < 0.05$).

Table 1. Baseline Characteristics

		Male (N=23,082)	Female (N=7,366)	Total (N=30,448)
Age, Mean \pm SD (year)		34.6 \pm 19.7	44.3 \pm 26.1	36.9 \pm 21.8
Education level	No formal education	3,534 (15.3)	3,238 (44.0)	6,772 (22.2)
	Primary education	4,820 (20.9)	1,639 (22.3)	6,459 (21.4)
	Secondary education	12,336 (53.4)	1,892 (25.6)	14,228 (46.6)
	Higher education	2,127 (9.3)	557 (7.6)	2,684 (8.8)
	Missing	265 (1.1)	40 (0.5)	305 (1.0)
Marital status	Married	12,469 (54.0)	4,125 (56.0)	16,594 (54.5)
	Single	9,968 (43.2)	1,971 (26.8)	11,939 (39.2)
	Widowed or divorced	446 (1.9)	1,216 (16.5)	1,662 (5.5)
	Missing	199 (0.9)	54 (0.7)	253 (0.8)

Table 2. Comparison of ISS, Death, and ICU Admission among Different Education Levels

	No formal education (N=6,772)	Primary education (N=6,459)	Secondary education (N=14,228)	higher education (N=2,684)	P value	Pairwise comparison ^a
ISS, Mean (SD)	5.5 (4.0)	4.5 (3.3)	4.4 (4.2)	4.3 (4.3)	<0.001	N>P, N>S N>H, P=S P=H, S=H
Death, N (%)	93 (1.4)	62 (1.0)	68 (0.5)	8 (0.3)	<0.001	N>P, N>H P>H, S>H P=S, N>S
ICU admission, N (%)	769 (11.4)	500 (7.7)	1,084 (7.4)	175 (6.5)	<0.001	N>P, N>S N>H, P>H P=S, S=H

a: Bonferroni method, N= No formal education, P= Primary education, S= Secondary education, H= Higher education

The crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for associations of education levels and other independent variables with ICU admission were reported in Table 4. According to the crude model, the odds of ICU admission for trauma patients with no formal education were 1.84 times higher than the odds of death at a higher education level (1.84, 95% CI: (1.55 to 2.18), $P < 0.001$) [Table 4].

Moreover, according to the multiple logistic regression analysis, there was no statistically significant association between ICU admission and the education level. After controlling ISS, age, and causes of injury, the odds of ICU admission for trauma patients with no formal education were 1.11 times higher than the odds of ICU admission for patients with higher education levels (Adjusted OR 1.11, 95% CI: [0.90 to 1.36], $p = 0.26$).

Table 3. Univariable and Multiple Logistic Regression Models of Death, OR (95% CI for OR)

		Crude OR (95%CI)	Adjusted OR (95%CI)
Education level	Higher education	Ref	Ref
	Secondary	1.27 (0.77 to 3.34)	3.65 (1.19 to 11.23) ^a
	Primary	3.24 (1.55 to 6.78)	5.03 (1.61 to 15.71)
	No formal education	4.66 (2.60 to 9.60)	3.36 (1.07 to 10.56)
ISS		1.12 (1.10 to 1.15)	1.11 (1.09 to 1.13)
Age (years)		1.04 (1.03 to 1.05)	1.04 (1.03 to 1.05)
Causes of injury	Road traffic crashes	Ref	Ref
	Blunt trauma	0.39 (0.20 to 0.75)	0.74 (0.34 to 1.62)
	Fall	1.34 (1.05 to 1.71)	0.85 (0.60 to 1.22)
	Cut/stab	0.16 (0.07 to 0.35)	0.14 (0.03 to 0.59)
	Others	2.16 (1.42 to 3.29)	1.77 (0.96 to 3.27)

^a Bold indicates p<0.05**Table 4.** Univariable and Multiple Logistic Regression Models of ICU Admission

		Crude OR (95%CI)	Adjusted OR (95%CI)
Education level	Higher education	Ref	Ref
	Secondary	1.14 (0.97 to 1.34)	1.14 (0.91 to 1.42)
	Primary	1.20 (1.01 to 1.44) ^a	1.10 (0.88 to 1.37)
	No formal education	1.84 (1.55 to 2.18)	1.11 (0.90 to 1.36)
ISS		1.26 (1.25 to 1.28)	1.18 (1.16 to 1.19)
Age (years)		1.02 (1.01 to 1.03)	1.02 (1.01 to 1.04)
Gender	Male	Ref	-
	Female	1.22 (1.12 to 1.34)	-
Causes of injury	Road traffic crashes	Ref	Ref
	Blunt trauma	0.22 (0.17 to 0.28)	0.34 (0.25 to 0.46)
	Fall	0.89 (0.82 to 0.97)	0.73 (0.65 to 0.83)
	Cut/stab	0.24 (0.19 to 0.28)	0.52 (0.41 to 0.65)
	Others	0.68 (0.55 to 0.84)	0.42 (0.30 to 0.57)
GCS		0.56 (0.54 to 0.58)	0.57 (0.55 to 0.60)

^a Bold indicates p<0.05

Discussion

We conducted a large-scale study containing 30,448 patients from six trauma centers nationwide to determine the association of the education level as a socio-economic factor with trauma outcomes. According to the present study results, the most frequent levels of education were secondary education in men and no formal education (illiteracy) in women.

In this study, most trauma patients were men and young. Compared with other studies, the current study population was younger due to different trauma etiologies.^[20,21] It was similar to Potenza et al.'s findings and WHO report on the European region.^[22,23] That meant that most trauma victims were youths who lived in their active life periods. It is important because many trauma survivors have functional disabilities and

psychological problems years after injury. Some of them need prolonged rehabilitation to achieve a stable condition necessary for returning to their daily activities.^[24]

Regarding the educational status, most of the patients (50.7%) in the present study were below the high school level, similar to Moddagheh et al.'s study.^[25] Although most of our patients did not need ICU admission, a positive relationship was shown between ISS and ICU admission. In Tamim et al.'s report, ISS was a good predictor of ICU admission.^[26] In Sharif-alhosseini et al.'s paper, the education level could have been more meaningful in ICU admission.^[19] However, our results did not show such an association.

There was a significant association between ISS and the levels of education (p<0.001), as Kalahroudi et al., showed

in their study.^[27] ISS had a negative relationship with the levels of education; that is, as patients were higher educated, the severity of trauma was lower. Sharif-alhosseini reported a strong relationship between traumatic event-related mortality and ISS.^[19] Based on our study results, ISS was statistically higher in people with no formal education, confirming Brattstrom's study. These findings emphasize that scoring systems should be taught to medical care providers to triage injured people by severity and provide instant medical facilities to people with high scores with a higher mortality risk.^[19] Abedzadeh stated that lower education is associated with occupations requiring physical strength. This factor urges these people to return to work sooner than those with higher educational and socio-economic status after traumatic events. Therefore, outcomes worsen for people with lower education levels.^[6]

The correlation of socio-economic status with each patient's education level is a critical issue that avoids broad conclusions regarding health conditions' outcomes.^[28,29] Higher education levels may lead to higher socio-economic status and better outcomes following trauma. Also, socio-economic status affects accessibility to higher and better education. It can be concluded that health outcomes are multifactorial variables, and disparities research has to consider various aspects.^[12,30,31,32]

In Iran, gender, socio-economic status, and education level have more prominent roles than racial categories in causing inequalities. Due to the recent lack of a registry system, these studies were limited to local states and needed more data. The National Trauma Registry of Iran aimed to overcome these limitations and visualize precise and comprehensive results, helping policymakers reveal integrated results.^[19] Overall, the current study results indicated that educating the general population may decrease the overall mortality and morbidity associated with traumatic events.

The present study had some limitations. This research was a hospital-based study, and population-based investigations are required to more precisely evaluate the education level's impact on the different aspects of traumatic injuries.

Conclusions

Considering our large sample research from the NTRI, there were relationships between trauma outcomes and the levels of education in trauma patients. In this study, there was an association between education levels and ICU admission. No formal, primary, or secondary education levels were associated with higher in-hospital

mortality following trauma compared with the higher education level. Further population-based research is suggested.

Acknowledgment

None.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

National Trauma Registry of Iran: NTRI;
Glasgow Coma Scale: GCS;
Intensive care unit: ICU;
Injury Severity Score: ISS;
World Health Organization: WHO;
Road traffic injuries: RTI;
Minimum dataset: MDS.

Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The Ethics Committee of Sina Hospital, Tehran University of Medical Sciences, approved this study (IR.TUMS.SINAHOSPITAL.REC.1399.090). All participants signed an informed consent form.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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