Original Article

Bull Emerg Trauma 2024;12(2):67-72.

Bulletin of Emergency And Trauma

Economic Burden of Trauma-Related Injuries in Iran in 2019

***Pirhossein Kolivand*[1], *Peyman Saberian*[2], *Peyman Namdar*[3], *Fereshte Karimi*[4], *Soheila Rajaie*[4], *Mehdi Raadabadi*[5*], *Samad Azari*[4,6]**

[1]*Department of Health Economics, Faculty of Medicine, Shahed University, Tehran, Iran*
[2]*Department of Anesthesiology, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran*
[3]*Department of Emergency Medicine, Metabolic Disease Research Center, Qazvin University of Medical Sciences, Qazvin, Iran*
[4]*Research Center for Emergency and Disaster Resilience, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran*
[5]*Health Policy and Management Research Center, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*
[6]*Hospital Management Research Center, Health Management Research Institute, Iran University of Medical Sciences, Tehran, Iran*

***Corresponding author:** *Mehdi Raadabadi*
Address: Department of Health Management and Economics, School of Public Health, Yazd University of Medical Sciences, Yazd, Iran
e-mail: Mehdiraadabadi@gmail.com

Received: February 7, 2024
Revised: March 8, 2024
Accepted: March 18, 2024

ABSTRACT

Objective: Trauma-related injuries are the leading cause of death and disability in the active population, with devastating economic, health, and social consequences for nations. TThis study aimed to assess the economic burden of injuries in Iran.
Methods: In this study, the economic impact of trauma in Iran in 2019 was estimated using a prevalence-based approach. The prevalence was estimated based on available statistics in Iran and the GBD website. Direct medical expenditures were calculated using a top-down approach. The cost of lost production due to injuries and premature death was also estimated using the DALY value. Microsoft Excel 2019 and Stata software version 13.0 were used for the analysis.
Results: In Iran, approximately 16,500,000 individuals were estimated to have sustained injuries in a single year. The average direct medical expenses for each trauma patient were around $226. Fractures contributed to 39% of the financial impact of trauma. The overall economic burden of trauma in Iran was calculated to be $10,214,403,423. Approximately 66% of this economic burden was attributed to lost productivity and premature death resulting from trauma, while direct medical costs made up 34%.
Conclusion: The economic burden of trauma in Iran is expected to significantly rise in the future. It may be necessary to enhance awareness of injury-related mortality and disability, improve therapies, and expand evidence-based interventions to reduce the economic impact of injuries.

Keywords: Economic burden of disease, Injuries, Hospital costs, Iran.

Please cite this paper as:
Kolivand P, Saberian P, Namdar P, Karimi F, Rajaie S, Raadabadi M, Azari S. Economic Burden of Trauma-Related Injuries in Iran in 2019. *Bull Emerg Trauma*. 2024;12(2):67-72. doi: 10.30476/beat.2024.102266.1507.

Introduction

Almost everyone worldwide has been impacted by traumatic events. These events can manifest in various ways, such as natural disasters, warfare, violence, road accidents, falls, workplace injuries, or other traumas [1]. Injuries have emerged as a global public health concern, contributing significantly to mortality and complications. The World Health Organization (WHO) reports that injuries are responsible for approximately 10% of global deaths and 16% of disabilities [2].

Injury not only escalates the likelihood of adverse health consequences but also imposes a substantial economic strain on patients' families and communities [3, 4]. Data regarding the economic impact of occupational injuries and illnesses is crucial for policymakers aiming to distribute scarce resources to key areas of occupational health and safety policy [5].

In recent years, trauma-related deaths have emerged as a major public health issue in Iran. According to recent studies, road traffic crashes were the leading cause of injury in Iran, followed by falls and blows [6, 7]. Iran, with a population of more than 80 million people, reported 15,932 fatalities from road traffic crashes in 2017 [8].

Injuries have a negative impact on the health and well-being of individuals, leading to premature death, disability, medical expenses, and lost productivity. It is essential to accurately assess this impact to understand the relative burden of injuries compared to other preventable health issues within a population and to determine the necessary investment in injury prevention strategies. Quantifying the economic cost of injuries is a vital initial measure in comprehending the societal impact of injuries and in comparing these costs between different countries [9, 10].

Considering the high economic burden of injuries in countries, the fair allocation of medical resources and the proper implementation of preventive policies can help to mitigate the increase in health expenses [11]. Therefore, measuring the economic burden of injuries is of great importance. The present study was conducted to estimate the economic burden of trauma and identify the factors affecting the cost of trauma patients so that the findings can be used to determine the educational and promotional priorities at the community level to reduce trauma incidents.

Materials and Methods

In this study, the prevalence-based approach was used to determine the economic burden of trauma in Iran in 2019. The Global Burden of Disease (GBD) study (https://vizhub.healthdata.org/gbd-results/) provided statistics on the prevalence of trauma in Iran. The economic burden of trauma in Iran was calculated by estimating direct and indirect expenditures (cost of lost production).

To determine the overall direct medical costs in Iran, data from the Hospital Information System (HIS) was used. For this study, data on 10,954 individuals admitted to trauma centers in Iran's five regions (North, South, East, West, and Central) was collected. Subsequently, the average hospital expenses for trauma patients were computed based on seven main injury categories. The study did not examine direct non-medical costs.

Indirect costs include the cost of lost productivity due to trauma as well as premature death due to trauma. In this study, we employed the human capital approach to calculate indirect costs. In this approach, it was assumed that the value of lost production of each person was equal to that person's income or wages.

Estimation of the morbidity cost: Trauma patients need to pause their work or daily activities for a few days to undergo medical treatment. Moreover, individuals experiencing severe trauma often end up disabled for life, rendering them unable to work. Consequently, both work absences and disability resulting from trauma lead to an economic burden for both the affected individuals and society. The YLD (Years of healthy life lost due to disability) index by sex, based on GBD data, was used to estimate the cost of lost productivity due to trauma. Based on the wages established by the Ministry of Labor and Social Affairs for different occupational groups [12], the average annual income of a working person in Iran, in 2019, was estimated to be $2662.

Estimation of the mortality cost: Trauma causes some people to die prematurely, that is, die at an age lower than society's life expectancy. In this situation, due to the early death of the traumatized person, several years of potential life are lost, and if the deceased person is employed, the production that could be created by this person is also lost. Therefore, when a traumatized person dies prematurely, economic loss is caused to the sick person's family and society. To estimate the cost of lost production due to deaths caused by trauma in Iran, the YLL (Years of life lost from mortality) index and GDB data by gender were used. In the next step, the potential years lost were multiplied by the average annual income to determine the value of productivity lost due to premature death.

The economic burden of Trauma was estimated by adding direct and indirect medical costs. Microsoft Office Excel (2019) and Stata software (version 13, Stata Corp, College Station, Texas) were used to analyze the data. Then, all costs were converted to US dollars, using the average exchange rate in 2019 (USD=450,869 IR Rials) [13].

Results

Table 1 shows the one-year prevalence of trauma in Iran categorized by gender and type of trauma. The total number of individuals affected by one-year trauma in Iran was approximately 16,500,000. Amputations and fractures were the most common types of trauma reported, while spinal trauma had the lowest occurrence percentage.

Table 1. One-year incidence of trauma in Iran by gender and type of trauma

Types of Trauma	Gender			Total percentage (%)
	Male	Female	Both	
Amputations	4,654,411	2,154,282	6,808,693	40.98
Burns	1,628,845	1,331,629	2,960,474	17.82
Fractures	2,591,459	1,466,864	4,058,322	24.43
Head Injuries	319,841	159,087	478,928	2.88
Spinal Injuries	117,419	74,973	192,392	1.16
Minor Injuries	937,676	508,176	1,445,852	8.70
Other Injuries	417,651	251,156	668,808	4.03
Total	10,667,302	5,946,167	16,613,469	100

Table 2. Direct medical costs by type of trauma

Types of Trauma	Average Cost ($)	Prevalence rate	Total Cost ($)
Amputations	121.4	6,808,693	826,348,711.5
Burns	253.3	2,960,474	749,990,031.9
Fractures	324.9	4,058,322	1,318,444,350.0
Head Injuries	230.3	478,928	110,290,514.8
Spinal Injuries	203.6	192,392	39,166,627.8
Minor Injuries	158.6	1,445,852	229,362,607.5
Other Injuries	290.2	668,808	194,111,850.0
Total		16,613,469	3,467,714,693.7

Table 3. The number of working years lost due to disability caused by trauma and the cost of lost production due to trauma in Iran

Types of Trauma	YLDs (Years Lived with Disability)				Cost of lost production ($)
	Male	Female	Total	Total percentages (%)	
Amputations	45,259	23,065	68,325	12.10	181,848,830
Burns	36,995	29,044	66,039	11.69	175,764,579
Fractures	144,233	82,624	226,857	40.17	603,786,022
Head Injuries	47,190	23,002	70,192	12.43	186,817,901
Spinal Injuries	36,468	22,457	58,925	10.43	156,830,476
Minor Injuries	8,037	4,275	12,312	2.18	32,768,720
Other Injuries	38,871	23,246	62,117	11.00	165,326,070
Total	357,053	207,713	564,767	100.00	1,503,142,598

Table 4. Number of working years lost due to death caused by trauma and cost of lost production

Types of Trauma	YLLs (Years of Life Lost)			Cost of lost production ($)
	Male	Female	Total	
Amputations	191584	50935	242519	645,470,857
Burns	156602	64139	220741	587,508,123
Fractures	610548	182461	793009	2,110,614,835
Head Injuries	199758	50796	250554	666,856,227
Spinal Injuries	154371	49592	203963	542,853,024
Minor Injuries	34021	9441	43462	115,675,285
Other Injuries	164544	51335	215879	574,567,779
Total	1,511,429	458,699	1,970,128	5,243,546,130

To calculate hospitalization costs, the information of 10,954 patients hospitalized in trauma hospitals across the country in 2019 was reviewed using the trauma patients' information registration system. The average direct medical cost of each trauma patient was about $226. To determine the total direct medical expenses, the total patient count was multiplied by the average cost associated with each specific type of injury. Based on the results, the direct cost of trauma medicine in Iran was estimated at $3,467,714,693.7 per year (Table 2).

Table 3 displays the working years lost due to disability and the trauma costs in Iran. The total of work years lost due to trauma was 564,767 per year. Men represented approximately 63% of all lost working years. The total cost of production loss due to trauma in Iran was estimated at $1,503,142,598.

Table 4 shows the number of deaths as well as the cost of lost production due to premature death caused by trauma in Iran. The rate of premature death due

Table 5. Economic burden by the type of trauma in Iran

Cost	Amputation	Burns	Fractures	Head Injuries	Spinal Injuries	Minor Injuries	Other Injuries
Medical direct	826,348,712	749,990,032	1,318,444,350	110,290,515	39,166,628	229,362,608	194,111,850
Lost production due to disability	181,848,830	175,764,579	603,786,022	186,817,901	156,830,476	32,768,720	165,326,070
Production lost due to premature death	645,470,857	587,508,123	2,110,614,835	666,856,227	542,853,024	115,675,285	574,567,779
Total	1,653,668,399	1,513,262,734	4,032,845,207	963,964,643	738,850,128	377,806,613	934,005,699
Percentage (%)	16.19	14.81	39.48	9.44	7.23	3.70	9.14

Table 6. Economic burden of trauma and injuries by the type of cost in Iran

Cost	Amount	Total percentages (%)
Medical direct	3,467,714,695	33.95
Lost production due to disability	1,503,142,598	14.72
Production lost due to premature death	5,243,546,130	51.33
Total	10,214,403,423	100.00

to trauma in one year was 1,970,128. The cost of lost production towing to premature death from trauma was also estimated at $5,243,546,130.

Table 5 displays the total economic burden in Iran categorized by the type of trauma and associated costs. The data presented in this table reveals that fractures were the type of trauma responsible for the highest economic burden, representing approximately 39% of the total. Conversely, minor injuries like sprains accounted for the smallest percentage of the economic burden. The total economic burden of trauma in Iran was calculated to be $10,214,403,423. Lost productivity and premature death due to trauma contributed to about 66% of the total economic burden, while direct medical costs made up the remaining 34% (Table 6).

Discussion

Most countries have a dedicated fund for covering trauma treatment costs, financed through car insurance, public insurance, or government funds [14, 15]. It is essential to ensure that traffic accident victims and trauma patients receive necessary services promptly, regardless of their financial circumstances. Therefore, evaluating the hospital expenses of trauma patients, which are covered by public funds, is crucial to understand the economic impact and effectively allocate resources. Detailed data on the economic consequences of trauma can assist policymakers and healthcare professionals in identifying areas that require further advancements in trauma prevention and treatment. Calculating the overall costs associated with various types of trauma, such as traffic accidents, domestic injuries, workplace incidents, and intentional harm, provides valuable insights and may shed light on other health issues that are not receiving adequate policy attention. Once high-cost harms have been identified, specific preventive interventions can be developed, which should be evaluated for cost-effectiveness prior to implementation.

The average direct medical cost of each trauma patient was about $226. There are two approaches for estimating direct medical unit costs: the top-down and the bottom-up approaches. These two approaches use different methods to calculate the total costs. In the current study, the bottom-up approach was utilized. This amount was less than the figures documented in high-income nations [16, 17], possibly due to the more affordable public services and lower service charges in Iran. The overall healthcare expenditures related to injuries highlighted the significance of injuries in the healthcare sector and could help persuade policymakers, researchers, and other stakeholders of their importance.

The total economic burden of trauma in Iran was estimated at 10,214,403,423. About 66% of the total economic burden of trauma was related to lost productivity and premature death, due to trauma, with direct medical costs accounting for 34%. Polinder *et al*. conducted a study on the economic burden of trauma in the Netherlands and found that the total cost of injuries was €3.5 billion annually. Healthcare expenses accounted for €2 billion, while indirect costs amounted to €1.5 billion [18]. Corso et al. also published a study on the direct and indirect costs of injuries in the United States [19]. They stated that the indirect costs were five times higher than the direct costs. However, in the current study, the indirect costs were twice as much as the direct costs, and this ratio in Polinder's study favored direct costs over indirect costs. In the research conducted by Lim et al., [2011], the prevalence rate of treated injury in the Korean population in 2006 was 26.5 per 100 individuals, leading to an annual economic burden of $39-37 million ($4,703 million direct and $35-134 million indirect costs). The expenses for medical treatment associated with injuries represented 9.5% of the total health expenditure in Korea. The cost of premature death had the largest share in the total injuries and damages caused by cars, accounting for 30.3% of the total costs [20].

Previous research on injury costs has indicated that the expenses related to decreased productivity outweigh the direct costs of healthcare. Productivity losses were found to be 1.1 times higher than direct healthcare costs in Canada [21], 2.2 times higher in Australia [22], and 2.4 to 4.0 times higher in the United States [19]. Premature death was identified as the primary contributor to the overall cost of injuries. International comparisons revealed that premature death accounted for the largest proportion of total costs in most countries (20.6 to 31.3%) [21]. Discrepancies in findings may be attributed to variations in the calculation of indirect costs.

The majority of the trauma occurred among men, and the cost incurred for men was 1.5 times that of women. These findings were consistent with other previous studies [23-25]. Men are more prone to experiencing trauma than women as they spend more time outside the home and use heavy equipment more often. In terms of the injury type, the majority of injuries were to the head, commonly referred to as head injuries. These findings were consistent with previous studies conducted in Iran [26] and other countries [27, 28]. Regarding the explanation of these findings, studies indicated that utilizing safety equipment decreased the risk of fatality by 70% and severe injuries by 40%, despite the fact that the utilization rate of safety equipment was very low [29].

Although the present study investigated the economic burden of trauma in Iran, some of the costs were not estimated due to a lack of reliable data, such as direct nonmedical costs (the costs of traveling and accommodation in other cities for receiving treatment; the costs of information cares and treatments); intangible costs (decreased quality of life); and hidden cost such as informal payment.

Trauma is a costly injury that places a significant economic burden on society. The primary portion of the economic burden of trauma in Iran stems from lost production costs. With the rising incidence and prevalence of trauma in Iran, it is anticipated that the economic burden of trauma will increase substantially in the future.

Trauma prevention has the potential to significantly decrease the economic burden of injuries. Enhanced awareness of injury-related mortality and disability, the advancement of more efficient treatments, and the expansion of evidence-based interventions may be necessary to reduce the economic burden of injuries.

Declaration

Ethical approval and consent to participate: This study was approved by the Research Ethics Committees of Education, Research and Technology Division of the Iranian Red Crescent Society (ID: IR.RCS.REC.1401.027). Due to the retrospective nature of the study, no study-specific consent form was used. However, patients admitted to our hospital were asked to sign a general consent upon admission, which covers the collection of patient data and publication of these results. The data used in the study were anonymized. The ethics committee approved this procedure with the above ethical code. The present study was conducted in terms of the principles of the revised Declaration of Helsinki.

Consent for publication: Not applicable.

Conflict of Interest: All authors declared that they had no competing interest regarding this study.

Funding: This study was part of a research project by the Iranian Red Crescent Society.

Authors' Contribution: MR and PK designed the study and supervised the thesis. SA and FK collected the data and analyzed it. They also prepared the first draft of the manuscript. SR, PS, and PN edited and finalized the manuscript. All authors read and approved the final manuscript.

Acknowledgment: The authors would like to thank the Iranian Red Crescent Society for partially funding the study.

References

1. Fodor KE, Unterhitzenberger J, Chou CY, Kartal D, Leistner S, Milosavljevic M, et al. Is traumatic stress research global? A bibliometric analysis. *Eur J Psychotraumatol*. 2014;**5**.
2. Fomete B, Adebayo ET, Agbara R, Osunde DO, Abah ER. Pattern of Ocular Involvement in Midface Injuries Seen at a Tertiary Care Hospital in Northern Nigeria. *Niger J Surg*. 2021;**27**(1):33-7.
3. Leng Y, Byers AL, Barnes DE, Peltz CB, Li Y, Yaffe K. Traumatic Brain Injury and Incidence Risk of Sleep Disorders in Nearly 200,000 US Veterans. *Neurology*. 2021;**96**(13):e1792-e9.
4. Brier ZMF, Connor J, Legrand AC, Price M. Different trajectories of PTSD symptoms during the acute post-trauma period. *J Psychiatr Res*. 2020;**131**:127-31.
5. Tompa E, Mofidi A, van den Heuvel S, van Bree T, Michaelsen F, Jung Y, et al. Economic burden of work injuries and diseases: a framework and application in five European Union countries. *BMC Public Health*. 2021;**21**(1):49.
6. Haji Aghajani M, Haddadi M, Saadat S. Epidemiological Pattern of Injuries in Iran; a Nationwide Review of Seven Million Emergency Department Admissions. *Emerg (Tehran)*. 2017;**5**(1):e10.
7. Azami AS, Abolghasem GH, Sadeghi BH, Shabaninejad H. Epidemiology of Road Traffic Injuries in Iran: Based on the Data from Disaster Management Information System (DMIS) Of the Iranian Red Crescent. 2017.
8. Organization WH. Global status report on road safety 2018: World Health Organization; 2019.
9. Corso P, Finkelstein E, Miller T, Fiebelkorn I, Zaloshnja E. Incidence and lifetime costs of injuries in the

United States. *Injury prevention*. 2015;**21**(6):434-40.
10. Peterson C, Xu L, Florence C. Average medical cost of fatal and non-fatal injuries by type in the USA. *Injury prevention*. 2021;**27**(1):1-10.
11. Lim S-J, Chung W-J, Cho W-H. Economic burden of injuries in South Korea. *Injury prevention*. 2011;**17**(5):291-6.
12. Ministry of Labour and Social Affair. https://bimeh.mcls.gov.ir/. Accessed 22 March 2022.
13. World Development Indicators database, World Bank. https://data.worldbank.org/indicator/PA.NUS.PPP?locations=IR. Accessed 11 Feb 2023.
14. Arin D, Hongoro C. Scaling up national health insurance in Nigeria: learning from case studies of India, Colombia, and Thailand. *Washington, DC: Futures Group Health Policy Project*. 2013.
15. Yongchaitrakul T, Juntakarn C, Prasartritha T. Socioeconomic inequality and road traffic accidents in Thailand: comparing cases treated in government hospitals inside and outside of Bangkok. *Southeast Asian J Trop Med Public Health*. 2012;**43**(3):785-94.
16. Gardner R, Smith GA, Chany AM, Fernandez SA, McKenzie LB. Factors associated with hospital length of stay and hospital charges of motor vehicle crash related hospitalizations among children in the United States. *Arch Pediatr Adolesc Med*. 2007;**161**(9):889-95.
17. Odero W, Khayesi M, Heda PM. Road traffic injuries in Kenya: magnitude, causes and status of intervention. *Inj Control Saf Promot*. 2003;**10**(1-2):53-61.
18. Polinder S, Haagsma J, Panneman M, Scholten A, Brugmans M, Van Beeck E. The economic burden of injury: Health care and productivity costs of injuries in the Netherlands. *Accid Anal Prev*. 2016;**93**:92-100.
19. Corso P, Finkelstein E, Miller T, Fiebelkorn I, Zaloshnja E. Incidence and lifetime costs of injuries in the United States. *Inj Prev*. 2006;**12**(4):212-8.
20. Lim SJ, Chung WJ, Cho WH. Economic burden of injuries in South Korea. *Inj Prev*. 2011;**17**(5):291-6.
21. Angus D, Cloutier E, Albert T, Chenard D, Shariatmadar A, Pickett W, et al. The economic burden of unintentional injury in Canada. *Toronto: Smartrisk*. 1998.
22. Watson WL, Ozanne-Smith J. The cost of injury to Victoria: Monash University Accident Research Centre Melbourne; 1997.
23. Singh A, Bhardwaj A, Pathak R, Ahluwalia S. An epidemiological study of road traffic accident cases at a tertiary care hospital in rural Haryana. *Indian Journal of Community Health*. 2011;**23**(2):53-5.
24. Hsiao M, Malhotra A, Thakur JS, Sheth JK, Nathens AB, Dhingra N, et al. Road traffic injury mortality and its mechanisms in India: nationally representative mortality survey of 1.1 million homes. *BMJ Open*. 2013;**3**(8):e002621.
25. Shavaleh R, Motevalian SA, Mahdavi N, Haddadi M, Mohaghegh MR, Hamedi Z. Epidemiological study of hospitalized road traffic injuries in Iran 2011. *Med J Islam Repub Iran*. 2018;**32**:50.
26. Weijermars W, Bos N, Stipdonk HL. Serious road injuries in The Netherlands dissected. *Traffic Inj Prev*. 2016;**17**(1):73-9.
27. Getachew S, Ali E, Tayler-Smith K, Hedt-Gauthier B, Silkondez W, Abebe D, et al. The burden of road traffic injuries in an emergency department in Addis Ababa, Ethiopia. *Public Health Action*. 2016;**6**(2):66-71.
28. Pathak SM, Jindal AK, Verma AK, Mahen A. An epidemiological study of road traffic accident cases admitted in a tertiary care hospital. *Med J Armed Forces India*. 2014;**70**(1):32-5.
29. Organization WH. Global status report on road safety 2015: World Health Organization; 2015.