

# A nationwide population-based study on incidence and cost of non-fatal injuries in Iran

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## ABSTRACT

**Background:** Elucidating the epidemiological status of injuries is a critical component of preventive strategies in countries with high incidence of injuries, like Iran. Population-based surveys are able to estimate all types of non-fatal injuries.

**Objectives:** This study protocol is the core unit in describing Iran's national cost and epidemiology of non-fatal injuries, and also as a guide for other studies.

**Study design and methods:** In a cross-sectional study, 1525 primary sampling units are randomly selected with probability proportional to size regarding the number of households in each enumeration area based on Iran's 2006 national census. Six of the households are randomly selected. One member of each household is chosen using Kish Grid tables. In all, 9150 subjects are selected. Data on demographics are collected. For each injury during the past three months, activity, place, mechanism, site, type and the place of treatment are coded to match the International Classification of Diseases, 10th revision 2012 (ICD10-2012) classifications. Subjects are contacted via telephone to obtain data on cost of injury. Finally, sampling weights are calculated so that data for each respondent can be inflated to represent other individuals in Iran. Quality control and quality assurance issues are discussed.

**Discussion:** Our objectives will describe the present impact and the future priorities of injury prevention in Iran.

## BACKGROUND

Injury is one of the main causes of morbidity and mortality in developed and developing countries.<sup>1 2</sup> It accounts for around 10% of the total burden of diseases in the world.<sup>3</sup> However, the first national burden of disease study shows that traffic injuries rank first among all causes in Iran. Besides this, falls and burns are also among the top 15 causes of burden of disease.<sup>4</sup> What makes this more important is the fact that many injuries are preventable. Thus, revealing the pattern of injuries is of great importance for public health decision making in every country, from the point of view of the health system and the public sector.<sup>5</sup> Elucidating the epidemiological status of injuries is a critical component for preventive strategies in countries with a high incidence of injuries, like Iran.<sup>6</sup>

Different data sources might be used for studying the epidemiology of injuries. The occurrence of fatal injuries can be estimated by death records, fatal injury reporting systems or hospital-based

databases. Injury surveillance data, hospital-based databases and trauma registries can be used to estimate non-fatal injuries. Less severe injuries which do not require hospitalisation or treatment in a medical facility will not be recorded in any of above-mentioned data sources. Only population-based surveys are able to estimate all types of non-fatal injuries.<sup>7-9</sup> Comparable population-based studies on the prevalence, incidence, severity and cost of injuries can be a useful aid for preventive programmes in developing countries. The outcomes can enlighten research priorities and guide healthcare system planning. Prior studies have suggested that every one out of three people will have an injury each year.<sup>10</sup> The total cost per injury case was estimated to be from US\$2700 to more than US\$3500, with an indirect to total cost per injury ratio of more than 70%.<sup>11 12</sup> Some studies focused on the cost of injury in older and paediatric populations as groups who consume a disproportionate share of resources.<sup>13-15</sup> Others studied injuries caused by specific mechanisms, including motor vehicle accidents, because of their relatively high prevalence.<sup>6 16-18</sup> Trauma is closely bound to the cost of injury.<sup>19</sup> Recent studies have centred on evaluating the cost effectiveness of trauma centres and their readiness.<sup>20-22</sup> Cost-saving approaches have been introduced since these studies.<sup>23-25</sup> Injury and associated costs are under the spotlight around the world,<sup>1 5 10-17 19-27</sup> and to a lesser extent, in the region.<sup>2 4 6-8 18 20</sup>

Before this study, Iran's national health surveys provided limited results on the frequency of injury. Our study protocol acts as a core unit in describing Iran's national cost and epidemiology of non-fatal injuries, and also as a guide for other studies.

## OBJECTIVES

1. Determine the annual incidence of non-fatal injuries in Iran.
2. Describe pictorial details of non-fatal injuries in Iran, from activities leading to injury to treatments resolving the injury.
3. Determine the annual cost of non-fatal injuries in Iran.
4. Describe the pictorial detail of non-fatal injury costs in Iran: who is paying, what amount of money is paid and what is the financial burden on households?
5. Evaluate determinants of non-fatal injuries and their cost in Iran.

## METHODS

Iran is a large country located in the Middle East. According to Iran's national census of population

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## Study protocol

and housing 2006, Iran has a population of 70 495 782 and a total number of 17 501 771 households.<sup>28</sup>

### Study design and sampling

This study was carried out within the framework of Iran Mental Health Survey (Iran-MHS).<sup>29</sup> Iran-MHS is a cross-sectional household study of Iranians aged 15–64 years. A three-stage sampling scheme was used for this study. Primary sampling units (PSUs) were blocks for municipal areas and villages for non-municipal areas. In the first stage, 1525 PSUs were randomly selected with probability proportional to size regarding the number of households in each enumeration area based on Iran's 2006 national census. At the second stage, the households living in each PSU were enumerated and six were selected by a systematic random sampling method. Finally, one member of each household was chosen using Kish Grid tables.<sup>30</sup> Thus, a total number of 9150 subjects were finally selected (table 1). Standardisation of the survey aspects including definitions, methods and measurements was performed through consultation with injury specialists and epidemiologists.

### Sample size

A total of 6100 simple random samples fit the calculations of Iran-MHS. Considering the design effect of 1.2 for cluster sampling with six households in each cluster, and a response rate of 80% by taking absence of indexes despite multiple visits, 9150 subjects were finally selected. Table 2 demonstrates corresponding precision (d) for injury incidences ranging from 0.1% to 10%<sup>8 10–13 31</sup> for a 95% CI ( $Z_{1-\alpha/2}=1.96$ ).

### Study variables and coding

Data on demographics including age, sex, marital status and residential areas were collected. Further information on years of full-time education, number of children, insurance type (primary vs complementary), employment and job status, and the annual income was also collected.

Subjects were asked to report the occurrence of any kind of injury (or injuries) regardless of its severity in the past 12 months and the past 3 months. For each injury occurring during the past 3 months, activity, place, mechanism, site, type and the place of treatment were described using the Short Form Injury Questionnaire 7 (SFIQ7) and were subsequently coded to match the International Classification of Diseases, 10th revision 2012 (ICD10-2012) classifications. SFIQ7 is a specifically designed questionnaire to be used in the Iran-MHS study and its validation has been described elsewhere.<sup>32</sup> The total cost was ascertained in the categories direct cost, indirect cost, out of pocket payments and catastrophic expenditures.

### Definitions of injury-related variables

1. *Activity*: activity is defined as work related if the case is directly paid (by salary, bonus and other types of income) for a specified activity during injury. In comparison, unpaid work relates to work without direct payment, like caring for children, cleaning, cooking, gardening, learning activities and housework. Sports-related activities are when one's purpose is playing or doing physical exercise with a described functional element. Walking, riding two-wheel vehicles and driving four-wheel vehicles are defined separately. Recreational activities included actions taken for leisure time with an entertainment element and routine personal work like eating, taking a shower and sleeping. Conflicts are a result of human–human fights.

2. *Place of injury*: home covers residential houses and their surrounding area, excluding abandoned or derelict houses. Streets and highways include freeways, motorways, pavements and the sidewalks. Industrial and construction areas also include factories, workshops, under construction buildings or tunnels, dockyards, industrial yards, mines, oil rigs, offshore installations, pits, power stations and shipyards. Trade and service areas are chosen as commercial areas and transportation-related places, including airports, banks, cafés, gas stations, hotels, markets, office buildings, petrol stations, radio or television stations, restaurants, service stations, shops and warehouse. Sports and athletic areas include fields, courts, sports grounds, stadiums and gyms. Farm and natural environments include forests, beaches, campsites, deserts, harbours, hills, lakes, marshes, mountains, rivers and seas. Public administrative areas include buildings (and adjacent grounds) used by the general public or by a particular group, like public schools, colleges, galleries, assembly halls, churches, mosques, cinemas, court houses, hospitals, libraries, museums, post offices, theatres and universities.
3. *Mechanism of injury*: categorised using ICD10 blocks, under the menu of external causes of morbidity and mortality, including accidents (V01–X59) and intentional self-harm (X60–X84). Major indices are exposure to inanimate mechanical forces (ICD10: W20; W49), falls (ICD10: W00; W19), exposure to animate mechanical forces (ICD10: W50; W64), contact with heat and hot substances (ICD10: X10; X19), occupant of four-wheeled motor vehicle injured in transport accident (ICD10: V40; V79), motorcycle rider or pedal cyclist injured in transport accident (ICD10: V20; V29), pedestrians injured in transport accident (ICD10: V01; V09), exposure to electric current, radiation and extreme ambient air temperature and pressure (ICD10: W85; W99), intentional self-harm (ICD10: X60; X84), and two codes which further help us in categorising mechanisms: non-medicinal toxic effects of substances (ICD10: T51; T65) and effects of heat and light (ICD10: T67).
4. *Site of injury*: categorised using ICD10 S00–S99 codes under the menu of injury, poisoning and certain other consequences of external causes. Our major groups are head (ICD10: S00; S09), thorax (ICD10: S20; S29), abdomen, lower back, lumbar spine and pelvis (ICD10: S30; S39), shoulder and upper arm (ICD10: S40; S49), elbow and forearm (ICD10: S50; S59), wrist and hand (ICD10: S60; S69), hip and thigh (ICD10: S70; S79), knee and lower leg (ICD10: S80; S89), ankle and foot (ICD10: S90; S99). Moreover, we used three other blocks involving T00–T65 codes for further clarification of the following conditions: injuries involving multiple body regions (ICD10: T00; T07), foreign body entering through natural orifice (ICD10: T15; T19), toxic effects of substances chiefly non-medicinal (ICD10: T51; T65).
5. *Type of injury*: using ICD10 descriptions of S00–S99 codes with modifications, types of injuries are categorised as follows: superficial injury (differentiating cuts and others), laceration, puncture by external objects, sprain and strain, tendon rupture, dislocation, fracture, traumatic amputation, burn and corrosion, toxicity (allergic, respiratory, gastrointestinal) and bite (animals and insects).
6. *Place where treatment was obtained*: considering possibilities and further help by the pilot study, the following categories are defined. We consider the highest level of health

**Table 1** Population and household description based on 2006 national consensus, along with the visited households from each province

Province	Total population	15–64-year-old population (eligible)	Total households	Residing households (eligible)	Visited households
Overall	70 495 782	49 157 562 (100%)	17 501 771	17 331 365 (100%)	9150 (100%)
1. Markazi	1 351 257	945 368 (1.92%)	364 564	359 756 (2.08%)	174 (1.90%)
2. Gilan	2 404 861	1 718 228 (3.50%)	669 695	666 021 (3.84%)	312 (3.41%)
3. Mazandaran	2 922 432	2 124 616 (4.32%)	783 737	775 695 (4.48%)	378 (4.13%)
4. East Azarbaijan	3 603 456	2 544 059 (5.18%)	911 930	905 992 (5.23%)	462 (5.05%)
5. West Azarbaijan	2 873 459	1 937 562 (3.94%)	655 961	652 108 (3.76%)	366 (4.00%)
6. Kermanshah	1 879 385	1 320 805 (2.69%)	445 863	442 830 (2.56%)	246 (2.69%)
7. Khuzestan	4 274 979	2 891 965 (5.88%)	866 914	857 624 (4.95%)	552 (6.03%)
8. Fars	4 336 878	3 075 626 (6.26%)	1 022 746	1 005 032 (5.80%)	558 (6.10%)
9. Kerman	2 652 413	1 776 341 (3.61%)	615 936	606 348 (3.50%)	336 (3.67%)
10. Khorasan razavi	5 593 079	3 784 510 (7.70%)	1 427 516	1 419 222 (8.19%)	726 (7.93%)
11. Isfahan	4 559 256	3 288 512 (6.69%)	1 224 763	1 216 105 (7.02%)	594 (6.49%)
12. Systan and Baluchestan	2 405 742	1 400 207 (2.85%)	470 064	465 995 (2.69%)	324 (3.54%)
13. Kurdistan	1 440 156	985 847 (2.01%)	337 688	335 346 (1.93%)	186 (2.03%)
14. Hamedan	1 703 267	1 185 419 (2.41%)	428 289	425 346 (2.45%)	216 (2.36%)
15. Char-mahal Bakhtiari	857 910	581 389 (1.18%)	194 594	193 396 (1.12%)	114 (1.25%)
16. Lorestan	1 716 527	1 178 488 (2.40%)	384 099	380 876 (2.20%)	228 (2.49%)
17. Ilam	545 787	382 593 (0.78%)	111 560	109 864 (0.63%)	66 (0.72%)
18. Kuhgiluyeh-Buyrahmad	634 299	423 580 (0.86%)	126 514	124 228 (0.72%)	84 (0.92%)
19. Bushehr	886 267	622 576 (1.27%)	190 150	183 526 (1.06%)	120 (1.31%)
20. Zanjan	964 601	663 339 (1.35%)	236 117	233 888 (1.35%)	126 (1.38%)
21. Semnan	589 742	420 663 (0.86%)	160 062	156 402 (0.90%)	78 (0.85%)
22. Yazd	990 818	692 119 (1.41%)	259 095	254 487 (1.47%)	132 (1.44%)
23. Hormozgan	1 403 674	912 403 (1.86%)	304 513	297 202 (1.71%)	186 (2.03%)
24. Tehran	13 422 366	9 882 447 (20.10%)	3 730 396	3 697 818 (21.34%)	1746 (19.08%)
25. Ardabil	1 228 155	837 539 (1.70%)	281 901	279 511 (1.61%)	162 (1.77%)
26. Ghom	1 046 737	723 133 (1.47%)	262 477	261 582 (1.51%)	138 (1.51%)
27. Ghazvin	1 143 200	806 997 (1.64%)	294 539	292 252 (1.69%)	150 (1.64%)
28. Golestan	1 617 087	1 108 179 (2.25%)	380 244	377 910 (2.18%)	210 (2.30%)
29. North Khorasan	811 572	533 257 (1.08%)	199 850	197 446 (1.14%)	102 (1.11%)
30. South Khorasan	636 420	409 795 (0.83%)	159 994	157 557 (0.91%)	78 (0.85%)

provision obtained as the index for our variables: hospital, emergency department, general day clinic, private clinic, primary care provider, traditional healer and drugstore.

7. *Type of treatment obtained*: the highest treatment obtained is taken into account. Again, using outputs from the pilot study, treatments are categorised as follows: surgical operation, minor outpatient surgery, cast/splint/physiotherapy, suturing, dressing, injectable medication, non-injectable medication.
8. *Direct costs*: actual cash paid either for medical or non-medical issues to assess the care for injury using details of the exact care or service and the exact amount. The questionnaire has three parts including pre-hospital (or the place medical care was obtained), hospital and post-hospital

periods. The participants are asked about money paid directly for visits, ambulatory services, drugs, dressings, casts and splintings, imaging modalities, laboratory exams, nursing, rehabilitation, travelling and trafficking, hotels and any other direct payments.

9. *Indirect costs*: calculated by taking income (converted to daily income) of individual multiplied by work days missed due to the reported injury. The same question is asked to cover anyone accompanying the patient who may have missed some days at work.
10. *Out-of-pocket costs*: the amount paid by insurance and the type of insurance.
11. *Financial load of the costs (imposed on the family)*: assessed on a 0–100 scale: 100 refers to losing all of the family's savings (loans, selling properties); 75 means spending all of the family's savings; 50 refers to using all the monthly income of the family; 25 means more than half of the monthly income of the family is consumed; 0 means there was no charge. We define a score of 75 and higher as 'catastrophic payment'. To reveal the actual costs, the care taker of the family is asked to answer the questions.

**Table 2** Injury incidences and their corresponding precision at an error level of 5%

Injury incidence (p)	Precision (d)
0.1	$7.53 \times 10^{-3}$
0.05	$5.47 \times 10^{-3}$
0.01	$2.50 \times 10^{-3}$
0.005	$1.77 \times 10^{-3}$
0.001	$0.79 \times 10^{-3}$

### First part of survey: interviews about the incidence of injury

Interviewers were selected from provincial health centres in each region. They participated in a 1-week training course to learn the sampling procedures, data collection tools and

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reporting forms. In each province there were two field managers responsible for monitoring the field procedures, reviewing the questionnaires and submitting the data to the national coordinating centre. There was also a national supervisor for each province who was responsible for auditing the field procedures and reviewing the submitted questionnaires and reports. Each interviewer team included one male and one female interviewer. At each given block, the interviewer team enumerated the number of residential houses and selected six houses based on a systematic random sampling method. They approached each household on at least three separate dates, with at least one of them being at the weekend. If a selected house was non-residential then the next nearest house would be selected, in a clockwise manner. When the interview team contacted a person in the selected house for the first time they introduced themselves using an identification card and briefly described the project while delivering an introductory pamphlet. Next, they assessed the eligibility criteria of the household members. Then, they used previously specified Kish grid tables for each household to randomly select a member for interview.<sup>30</sup> They set an appointment time for the interview with the selected member. The non-contact or non-respondent households or subjects were not replaced in the sampling procedure since these cases were already considered in sample size calculation. The demographics and all the injury-related data except for costs were obtained during the in-person interview. The questionnaires and reports were sent to the national coordinating centre and the data entry procedures were carried out at the national level.

### Second part of the survey: phone calls on cost of injuries

After finalising the first part of the survey, subjects who reported having an injury which made them seek medical care from a healthcare provider were extracted from the database. These cases were contacted by telephone to obtain data on injury costs. All telephone calls were made at the national coordinating centre by trained interviewers. Non-contact was defined as when the telephone was not answered on three separate attempts on different days.

### Quality control, quality assurance

For the purpose of quality control, all gathered data were checked twice by the provincial manager and the national supervisor. During the first part of the survey, 5% of the questionnaires were randomly selected by the national coordinating centre to check the obtained responses, including demographics and injury data. When data editing was necessary, all interviewers, field managers and national supervisors were asked to cross out and highlight the changes while avoiding overwriting the original data. Changes were recorded according to the time and the editor's name. In the second part of the survey, all subjects with an injury which made them seek medical care were called. Details on the injury data were again checked for all cases before obtaining cost data.

### Data entry and data cleaning

Data were entered using SPSS software (V.16; Chicago, Illinois, USA). Ten percent of the data were double entered to calculate the error rate. Data cleaning was performed by the national supervisors. Missing and erroneous data were reclassified.

### Sampling weights and statistical analysis

Sampling weights were calculated so that data for each respondent could be inflated to represent other individuals in Iran. These sampling weights were produced in three steps. First,

sampling weights were obtained which were inverse probabilities of unit selection of the sample. Second, the weight for adjustment of non-response was calculated. Third, post-stratification weights for adjustment of age, gender, and urban/rural status for each individual were produced by comparing the sample with the National Census 2006.

Descriptive and frequency analyses of the study variables were performed. The annual incidence of all types of injury and the type of care obtained were derived. Nationwide costs of injuries were determined in total and according to different types of injuries and different types of insurance. Further, regression analysis revealed the association between age, gender and demographic variables with the incidence and costs of injuries, all differentiated by the category of the injury.

### Ethical issues

This study was approved by the ethical committee of Tehran University of Medical Sciences and the Iran's National Institute of Health Research. The participants were completely informed about the study in their native language. They were free not to participate in the study if they so wished. The confidentiality of all participants' information was maintained through our epidemiological approach.

### DISCUSSION

Iran's national injury survey is a cross-sectional population-based study, which has almost the same methodology as part of the multi-domain study of Iran-MHS.<sup>29</sup> This study protocol describes the design, sampling and classification of the epidemiology and costs of injuries. Our forthcoming objectives are the present impact of injury and the future priorities of injury preventive programmes in Iran.

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**Contributors** NH-N: participated in research design, analysis of data, interpretation and preparation of final report. AR-M, AM, MA-E, VS, AH, RR and MH: had a major role in data gathering, trained research assistants, study design and final approval of the manuscript; proofread the data from all provinces and approved the completed data to be gathered in the central data bank; reviewed the analysis. VE: contributed to finalising and editing the data, preparing the report, interpreting the results and final approval of the manuscript. SS: along with Abbas Motevalian, was epidemiologist and biostatistician; made major contribution to study design, weighting the population to represent Iranian general population; audited the process, final analysis and statistical derivation of the manuscript, and final approval of the text. VR-M: chief director of the study; participated in handling the data from all provinces of Iran along with AR-M; contributed primary idea and design of the study and questionnaires, approved the analysis, aided in writing the manuscript, edited and made final approval of text.

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**Competing interests** None.

**Ethics approval** The Ethical Board of the Tehran University of Medical Sciences (TUMS).

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**Data sharing statement** The raw data and the primary analyses of the results are available on SPSS files (also in English). Any proposals for cooperation and mutual studies are welcomed.

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Updated information and services can be found at:  
<http://injuryprevention.bmj.com/content/early/2014/02/20/injuryprev-2013-041127.full.html>

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