

# Epidemiologic Characteristics of Injuries among 1–5 Year-Old Children in Hamadan Province: Analysis of 4523 Hospitalized Children over a 6-Year Period

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## Abstract

**Background:** Unintentional injuries are one of the major causes of death in Iranian children. Information on epidemiological pattern of injury among one-to 5-year-old children is limited in Hamadan. The aim of this study was to clarify the person, space and time pattern of injury among 1–5-year-old children in Hamadan Province. **Methods:** All registered incidence cases of injury among 1–5 year-old children in Hamadan Province from March 2009 to March 2015 were included in this cross-sectional study. We analyzed the data on county, gender, age category, type of injury, season and outcome of injury. Temporal trend was explored using time series regression with accounting autocorrelation, seasonality, and short-term variation. **Results:** This study included 4523 injury cases. During the studied period, urban residents and boys had a higher number of injuries. Motor vehicle-related injuries were the most common type of injury. A seasonality pattern was found so that most of the cases were occurred in summer months. The lowest and highest incidence rate ratios (IRRs) were occurred in January 2011 (IRR = 0.61 with 95% confidence interval [CI]: 0.31, 1.18) and May 2014 and August 2013 (IRR = 6.78 with 95% CI: 4.38, 10.51), respectively. **Conclusion:** In Hamadan Province, childhood injury has a variation in person, place, and time pattern, as some groups such as boys and urban residents among 1–5 year-old children are at a higher risk for the incidence of injury. Therefore, it is recommended that health service managers and health policymakers devote more healthcare and resources to the high-risk groups.

**Keywords:** Accidents, children, epidemiology, Hamadan, injury

## INTRODUCTION

Childhood injuries are public health concern. Childhood injuries are as one of the main causes of death among children. Worldwide statistics showed that injury and violence resulted in about 875,000 deaths among children.<sup>[1]</sup> Annually, about 16 million children with injury are admitted to emergency department in the United States, which is resulting in about 30,000 permanent defects.<sup>[2]</sup> According to international documents, more than 95% of all deaths related to injuries in

children occur in less advanced countries.<sup>[3]</sup> Results from two communities in Pakistan revealed that falls, burns, and road traffic injuries (RTIs) were the most common nonfatal injuries.

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Boys had a higher risk of injuries compared to girls, and 61% of the injuries took place inside the home.<sup>[4]</sup> In Mozambique, falls were the most common mechanism of injury, followed by burns and RTIs with more prevalence in boys than in girls.<sup>[5]</sup>

Injury-related death is about 14.6% of all-cause mortality in general population in Iran. The results of the nationwide review of seven million emergency department admissions in Iran from 2009 to 2014 showed that a substantial proportion of injuries occur in children under 5 years of age, especially boys.<sup>[6]</sup> In Iran, roadside was found to be the leading place of injury occurrence, followed by home in children.<sup>[6,7]</sup> In Tuyserkan and Aligudarz, fall was the most frequent injury in children and injuries were more common in boys.<sup>[8]</sup>

Due to the diversity of the cultural and socioeconomic status (SES) and the inequality of health-care facilities, the types of injury in young children are differently distributed across provinces of Iran.<sup>[9]</sup> For example in Kermanshah, the most common cause for injury was falling.<sup>[10]</sup> While in Tehran, RTIs were found to be the most common cause of injury in children.<sup>[11]</sup> Hence, it is necessary that pattern of place, person, and time of injury be studied separately in each province of Iran. Data from person, space, and time analysis can help in developing prevention strategies and health-care allocation for those at higher risk of injury.<sup>[12]</sup>

The absence of reliable estimations regarding pattern of morbidity and mortality of injuries is a major obstacle to effectively adopt preventive policies in less developed countries.<sup>[13]</sup> Although epidemiology of injury in different parts of Iran has been studied,<sup>[11,14-17]</sup> scarce evidence is available regarding childhood injuries in Hamadan Province; also, given that more epidemiological information about the characteristics of childhood accidents can help policymakers to develop better prevention strategies, the present study aimed to assess characteristics of person, place, and time of injuries and accidents in 1–5-year-old children in Hamadan Province, Iran.

## METHODS

### Study setting

Hamadan Province is located in western Iran and consists of 9 counties as follows: (1) Asadabad, (2) Bahar, (3) Hamadan, (4) Famenin, (5) Kabudarahang, (6) Malayer, (7) Nahavand, (8) Tuyserkan, and (9) Razan. According to 2016 National Census, Hamadan measures 19,546 km<sup>2</sup> with a population of 1,738,234. (<http://irandataportal.syr.edu/census/census-2016>).

### Data source

In this cross-sectional study, all registered incidence data on accidents among 1–5 year-old children that occurred between March 2009 and March 2015 were obtained from Hamadan Health Center. The pattern of accidents was studied according to counties, gender, location (urban/rural), type of accidents (electrocuted, scorpion and snake, animal attack,

burn, drowning, fall, strike, motorcycle accidents, pedestrian accidents, poisoning, suicide, violence, car accidents, etc.), time of accidents (season), and outcome of the accidents.

The patient registration process was as follows: when injured patients were admitted to hospital, his/her information was registered on the medical records by the medical staff and at the end of stay in the emergency department, data were added into the related electronic offline software. Quality control was performed by injury prevention experts from universities. Although university hospitals should register all admitted injured patients and registry for injured patients was obligatory, we could not ignore possibility of underreporting in some cases.

This information was fulfilled by hospital staffs and at each 3 months (end of each season) through health centers of the counties. This information was gathered from all hospitals in the county and transported to the deputy of health. In Hamadan province, this information was obtained from 26 hospitals of 9 covered counties. Data were collected using the census method, and 4523 cases were entered in to the study.

### Statistical methods

The number (%) of accidents among 1–5 year-old children was illustrated by the studied variables. Statistically significant of accidents during the studied period was determined by *P* value for the trend. Here, the question to be addressed was “Is there a systematic pattern in month-to-month variation over time in the number of accidents among 1–5 year-old children?” In other words, accidents data close in time likely to be more similar than those distant in time. Thus, it is necessary to control these sources of variation in the time series regressions for estimating unbiased effect measures.<sup>[18]</sup> In other words, overlooking this autocorrelation in the regression model (e.g., Poisson model) can lead to over dispersion of the model so that the variance of the outcome counts is higher than predicted under the regression model.<sup>[18]</sup> We used the time series regression model with defining some function of time as explanatory variable and count of accidents as dependent variable (the time stratified model). This model is the easiest method for modeling sources of variation in the outcome. Data over the study period split into time intervals, and effect measures were estimated for each interval compared with baseline time interval.<sup>[18]</sup>

Our dataset consisted of the number of accidents for every month from March 2009 to March 2015. The time period of the study split into 72 months. The incidence rate ratios (IRRs) were estimated by dividing the number of accidents in each month compared with that in baseline. The number of accidents in March 2009 was regarded as the baseline category. Statistical analyses were conducted using Stata 12 (StataCorp, College Station, TX, USA). Statistical significance was set at  $P \leq 0.05$ .

### Ethics

The ethical review board of Hamadan University of Medical Sciences approved this study (Ethics code: IR.UMSHA.REC.1398.414).

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RESULTS

Background characteristics

In this study, in total, 4523 accident cases were registered in the province of Hamadan from 2009 to 2015. Table 1 presents the descriptive statistics of the accident cases from March 2009 to March 2015. The number of cases has increased over time so that the minimum and maximum numbers of cases were in 2009–2010 ( $n = 389$ ) and 2014–2015 ( $n = 1143$ ), respectively. The variation of accidents over time across

county, gender, location, and accident type was statistically significant ( $P < 0.05$ ). Most of the injures in children had occurred among urban residents and boys. The most common type of the traffic accidents occurred as a result of strike. Less than 2% of the accidents resulted in death during each year of the study period.

Temporal analysis

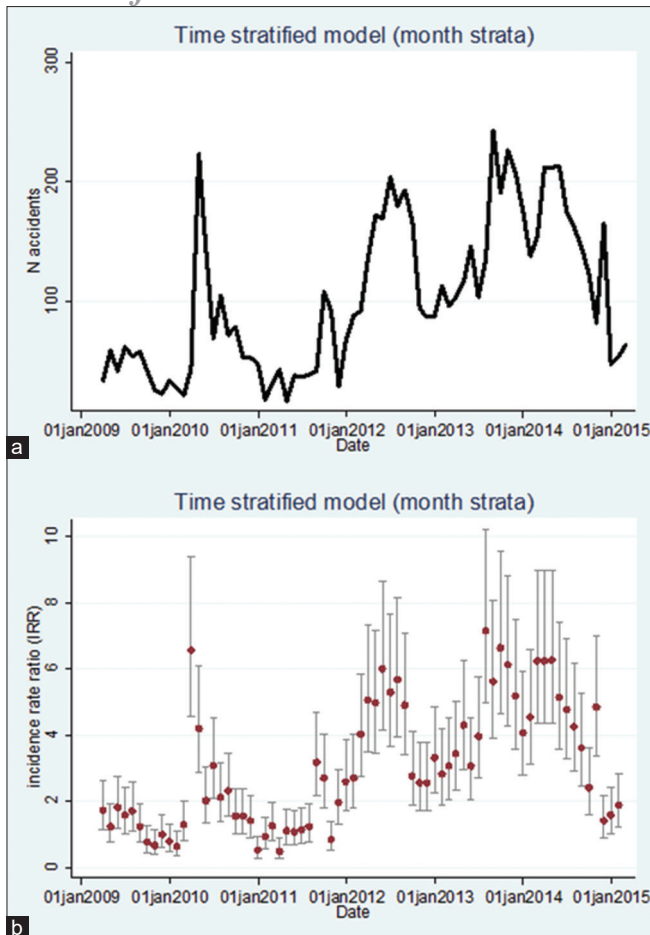
Figure 1a illustrates the numbers of accidents from March 2014 to March 2015 and Figure 1b demonstrated the IRR during the

**Table 1: background characteristics of accidents in one to 5 year old children in Hamadan province, 2009-2014**

| Characteristics      | 1388 HS*<br>2009-2010<br>n (389) | 1389 HS*<br>2010-2011<br>n (570) | 1390 HS*<br>2011-2012<br>n (400) | 1391 HS*<br>2012-2013<br>n (704) | 1392 HS*<br>2013-2014<br>n (1317) | 1393 HS*<br>2014-2015<br>n (1143) | Total        | P-trend |
|----------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|--------------|---------|
| County               |                                  |                                  |                                  |                                  |                                   |                                   |              |         |
| Asadabad             | 36 (9.25)                        | 1 (0.18)                         | 13 (3.25)                        | 78 (11.08)                       | 58 (4.40)                         | 10 (0.87)                         | 196 (4.33)   | <0.001  |
| Bahar                | 35 (9)                           | 35 (6.14)                        | 16 (4)                           | 41 (5.82)                        | 50 (3.80)                         | 57 (4.99)                         | 234 (5.17)   |         |
| Hamadan              | 33 (8.48)                        | 216 (37.89)                      | 25 (6.25)                        | 61 (8.66)                        | 720 (54.67)                       | 577 (50.48)                       | 1632 (36.08) |         |
| Kabudarahang         | 7 (1.80)                         | 2 (0.35)                         | 6 (1.50)                         | 12 (1.70)                        | 15 (1.14)                         | 8 (0.70)                          | 50 (1.1)     |         |
| Malayer              | 84 (21.59)                       | 95 (16.67)                       | 59 (14.75)                       | 155 (22.02)                      | 145 (11.01)                       | 160 (14)                          | 698 (15.43)  |         |
| Nahavand             | 111 (28.53)                      | 124 (21.75)                      | 157 (39.25)                      | 194 (27.56)                      | 183 (13.90)                       | 193 (16.89)                       | 962 (21.27)  |         |
| Razan                | 57 (14.65)                       | 53 (9.300)                       | 27 (6.75)                        | 34 (4.83)                        | 38 (2.89)                         | 67 (5.86)                         | 276 (6.1)    |         |
| Famenin              | 0                                | 18 (3.16)                        | 72 (18)                          | 93 (13.21)                       | 66 (5.01)                         | 41 (3.59)                         | 290 (6.4)    |         |
| Tuyserkan            | 26 (6.68)                        | 26 (4.56)                        | 25 (6.25)                        | 34 (4.83)                        | 35 (2.66)                         | 28 (2.45)                         | 174 (3.84)   |         |
| Out of province      | 0                                | 0                                | 0                                | 2 (0.28)                         | 7 (0.53)                          | 2 (0.17)                          | 11 (0.24)    |         |
| Gender               |                                  |                                  |                                  |                                  |                                   |                                   |              |         |
| Male                 | 249 (64.01)                      | 359 (62.98)                      | 262 (65.50)                      | 633 (89.91)                      | 819 (62.19)                       | 698 (61.07)                       | 3020 (66.77) | 0.03    |
| Female               | 140 (35.99)                      | 211 (37.02)                      | 138 (34.50)                      | 71 (10.09)                       | 498 (37.81)                       | 445 (38.93)                       | 1503 (33.23) |         |
| Location             |                                  |                                  |                                  |                                  |                                   |                                   |              |         |
| Urban                | 206 (52.96)                      | 332 (58.25)                      | 221 (55.25)                      | 418 (59.38)                      | 864 (65.60)                       | 845 (73.93)                       | 2886 (63.8)  | <0.001  |
| Rural                | 134 (34.45)                      | 196 (34.39)                      | 153 (38.25)                      | 241 (34.23)                      | 313 (23.77)                       | 210 (18.37)                       | 1247 (27.58) |         |
| Unspecified          | 49 (12.60)                       | 42 (7.37)                        | 26 (6.50)                        | 45 (6.39)                        | 140 (10.63)                       | 88 (7.70)                         | 390 (8.6)    |         |
| Accident type        |                                  |                                  |                                  |                                  |                                   |                                   |              |         |
| Electrocuted         | 0                                | 0                                | 1 (0.25)                         | 2 (0.28)                         | 4 (0.30)                          | 2 (0.17)                          | 9 (0.2)      | 0.004   |
| Scorpion and snake   | 2 (0.51)                         | 0                                | 2 (0.50)                         | 1 (0.14)                         | 1 (0.08)                          | 2 (0.17)                          | 8 (0.18)     |         |
| Animal attack        | 16 (4.11)                        | 13 (2.28)                        | 14 (3.50)                        | 13 (1.85)                        | 1 (0.08)                          | 1 (1.09)                          | 58 (1.28)    |         |
| Burn                 | 6 (1.54)                         | 16 (2.81)                        | 8 (2)                            | 10 (1.42)                        | 42 (3.19)                         | 24 (2.10)                         | 106 (2.34)   |         |
| Drowning             | 1 (0.26)                         | 1 (0.18)                         | 2 (0.50)                         | 3 (0.43)                         | 0                                 | 1 (0.09)                          | 8 (0.18)     |         |
| Fall                 | 71 (18.25)                       | 147 (25.79)                      | 48 (12)                          | 83 (11.79)                       | 351 (26.65)                       | 278 (24.32)                       | 978 (21.62)  |         |
| Strike               | 96 (24.68)                       | 153 (26.84)                      | 132 (33)                         | 215 (30.54)                      | 330 (25.06)                       | 362 (31.67)                       | 1288 (28.48) |         |
| Motorcycle accidents | 8 (2.06)                         | 12 (2.11)                        | 7 (1.75)                         | 13 (1.85)                        | 37 (2.81)                         | 25 (2.19)                         | 102 (2.26)   |         |
| Pedestrian accidents | 44 (11.31)                       | 82 (14.39)                       | 32 (8)                           | 49 (6.96)                        | 121 (9.19)                        | 136 (11.90)                       | 464 (10.26)  |         |
| Poisoning            | 51 (13.11)                       | 30 (5.26)                        | 86 (21.50)                       | 125 (17.76)                      | 115 (8.37)                        | 53 (4.64)                         | 460 (10.17)  |         |
| Violence             | 7 (1.80)                         | 19 (3.33)                        | 16 (4)                           | 41 (5.82)                        | 39 (2.96)                         | 15 (1.31)                         | 137 (3.03)   |         |
| Car accidents        | 59 (15.17)                       | 53 (9.30)                        | 32 (8)                           | 73 (10.37)                       | 161 (12.22)                       | 141 (12.34)                       | 519 (11.47)  |         |
| Error code           | 9 (2.31)                         | 13 (2.28)                        | 12 (3)                           | 51 (7.24)                        | 24 (1.82)                         | 24 (2.10)                         | 133 (2.94)   |         |
| Other**              | 19 (4.88)                        | 31 (5.44)                        | 8 (2)                            | 25 (3.55)                        | 91 (6.91)                         | 79 (6.91)                         | 253 (5.59)   |         |
| Season               |                                  |                                  |                                  |                                  |                                   |                                   |              |         |
| Spring               | 106 (27.25)                      | 174 (30.53)                      | 74 (18.50)                       | 168 (23.86)                      | 281 (21.34)                       | 393 (34.38)                       | 1196 (26.44) | 0.16    |
| Summer               | 139 (35.73)                      | 194 (34.04)                      | 106 (26.50)                      | 267 (37.93)                      | 348 (26.42)                       | 390 (34.12)                       | 1444 (31.93) |         |
| Autumn               | 71 (18.25)                       | 134 (23.51)                      | 114 (28.50)                      | 158 (22.44)                      | 388 (29.46)                       | 224 (19.60)                       | 1089 (24.08) |         |
| Winter               | 73 (18.77)                       | 68 (11.93)                       | 106 (26.50)                      | 111 (15.77)                      | 300 (22.78)                       | 136 (11.90)                       | 794 (17.55)  |         |
| Outcome of accident  |                                  |                                  |                                  |                                  |                                   |                                   |              |         |
| Lived                | 384 (98.71)                      | 566 (99.30)                      | 397 (99.25)                      | 696 (98.86)                      | 1308 (99.32)                      | 1136 (99.39)                      | 4487 (99.2)  | 0.29    |
| Died                 | 5 (1.29)                         | 4 (0.70)                         | 3 (0.75)                         | 8 (1.14)                         | 9 (0.68)                          | 7 (0.61)                          | 36 (0.8)     |         |

\*HS: Hijri Solar, \*\*Miss codes or unknown

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**Figure 1:** The long-term patterns of accident in under-5 children using by (a) time stratified model, (b) incidence rate ratio with 95% confidence interval of accident during March 2009–March 2015

study period. There were substantial month fluctuations in the number of IRRs of the accidents over the study period as the highest and lowest cases of the accidents occurred in summer and winter months, respectively. The lowest IRR was observed in January 2011 (IRR = 0.61; 95% confidence interval [CI]: 0.31, 1.18) and the highest IRR was observed in May 2014 and August 2013 (IRR = 6.78; 95% CI: 4.38, 10.51).

## DISCUSSION

In this study, the results showed that there was a periodic pattern in the number of injuries during the study period. Additionally, the highest IRRs were found for summer months. Differences were observed with respect to Hamadan counties, age group, gender, types of injuries, as well as outcome of injury. The largest number of injuries in 1–5 year-old children was found in Hamadan county, in urban residents, and among males.

Injuries and accidents in 1–5 year-old children mostly occurred during summer months that it is in line with the results of studies conducted in other countries.<sup>[19,20]</sup> The results of one of these studies showed that most severe pediatric injuries

occurred in both spring and summer and in boys is higher than girls.<sup>[21]</sup> In summer months, greater exposure to risk factors of injuries may be occurred and certain injuries may be more common than others. The highest IRR (7.14) was found for July 2013; it means that the rate of injury was more than 6 times higher compared with that of the baseline month (March 2009). The lowest IRR (0.50) was reported for March 2011, so that the rate of injury declined by 0.50% in comparison with that in baseline month. Our results showed that a large number of cases was seen in children from urban areas; however, some findings from developed countries have demonstrated that most of the injuries in children occurred in rural areas.<sup>[19,22]</sup>

As expected in our study, most of the injuries happened because of motor vehicle accidents. It should be noted that in developing countries road traffic accidents have not been regarded as a health priority.<sup>[23]</sup> In these countries, most injuries occurred among children in the age range of 0–4 and 5–14 years. Hence, the teenagers and young adults are the most vulnerable groups.<sup>[24]</sup> From total 66 death registered cases in Hamadan Province, most of the deaths (54%) were related to road traffic accidents, which this result is in accordance with the results of studies conducted in Sierra Leone,<sup>[25]</sup> Ghana<sup>[26]</sup> Pakistan,<sup>[3]</sup> as well as another study in Iran.<sup>[27]</sup> According to the findings of the narrative review conducted on RTIs in Iran, negligence and improper use of seatbelt and helmets are the main reasons for the high fatality of traffic accidents.<sup>[9]</sup>

In the present study, similar to the results of the previously published studies,<sup>[16,28]</sup> falls were one of the most important types of injuries in young children. In rural areas, falls are found as one of the main reasons for injuries.<sup>[25]</sup> Our results showed that among injuries registered for rural areas, 20% of the cases were as results of falls. This type of injuries in the young children has different etiologies including hazardous environments, low attention by caregiver, etc.<sup>[29]</sup> The results showed that other important type of injuries among young children in Hamadan Province was poisoning. Some studies showed that child home environment and parenting characteristics are two important risk factors for poisoning in children.<sup>[17]</sup> Fardazar *et al.* showed that protection motivation theory should be applied to design educational programs to enhance the prevention behaviors of home injuries in mothers who have children aged <5 years.<sup>[30]</sup>

The present study has some limitations that should be considered. One of these limitations is related to missing data and error codes including misclassification, so that surveillance data were collected in an inactive way and it was influenced by many factors such as gender, age, SES and etc., Other limitation was nonavailability of important explanatory variables such as data on external causes of injury, International Classification of Disease codes, causes of death, injury severity scores, and vital signs and location; the findings of the studies have demonstrated that most of the injuries in children have been occurred inside home.<sup>[31,32]</sup> Finally, underestimation of the reported accidents and selection bias due to referring

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more severe injuries to hospital can affect generalizability of findings.

### CONCLUSION

In Hamadan Province, childhood injury has a variation in person, space and time pattern. Some groups such as boys and urban residents are at higher risk of injury. Our results can be taken into account in health resource allocation and health policy making in Hamadan Province.

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### Conflicts of interest

There are no conflicts of interest.

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