

An Epidemiologic Study of Deceased Pedestrians in Road Traffic Accidents in Iran during 2012–2013

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Abstract

Background and Objectives: Due to the high rate of pedestrian deaths in traffic accidents and given that describing demographic profiles of pedestrian deaths and features of accident locations is an important factor in the prevention, management, and analysis of road traffic accidents, this study aimed at describing the demographic and personal patterns as well as environmental factors affecting the occurrence of road traffic accidents among pedestrians in Iran. **Materials and Methods:** This cross-sectional study was conducted on all pedestrian deaths caused by traffic accidents referred to the Forensic Medicine Organization in Iran from March 20, 2012, to March 19, 2013. In this study, demographic information as well as the information related to the accidents and other information including trauma location, the final cause of death, date of accident, date of death, time of death, and time of accident were examined. The information received from the Forensic Medicine Organization was first controlled and then analyzed using the Stata 11 software. **Results:** From a total of 4371 pedestrians died in 2012 due to traffic accidents, 3201 cases (73.2%) were males with a mean age of 48.1 ± 0.46 years, and 1170 cases (23.8%) were females with the mean age of 46.1 ± 0.77 years. In terms of age, education, and marital status, the highest frequencies of pedestrian deaths were, respectively, observed in the age group 65 years old and above (33.4%), the illiterate group (44.5%), and married people (67.9%). The highest and the lowest incidence rates of death were seen in Gilan (11 per 1000 people) and South Khorasan Provinces (2.4 per 100,000), respectively. **Conclusions:** Pedestrians as the most vulnerable people in traffic accidents comprise a large proportion of deaths and disabilities caused by road traffic accidents. It seems necessary to take some measures including paying special attention to physiological characteristics of the age group above 65 years old, doing close monitoring by the traffic police in October and the rush hours, and providing facilities for pedestrians to cross in busy locations of suburban areas.

Keywords: Accidents, epidemiology, Iran, pedestrians, traffic

INTRODUCTION

Annually, more than 1.24 million deaths, 10 million disabilities, and 50 million injuries occur due to traffic accidents in the world.^[1,2] The age group 15–44 years old is responsible for 59% of the deaths related to traffic accidents.^[3] According to the World Health Organization, the rate of traffic accidents in Iran is much higher than the rate throughout the world.^[4] Road traffic injuries are the second leading cause of deaths in Iran after cardiovascular diseases, the first cause of wasted life, and one of the most important problems that threaten the Iranians' health.^[5] Deaths from the injuries caused by traffic accidents in Iran are in line with the industrialization process in communities, and various studies

have reported a high incidence of these deaths (29–30 cases per 100,000 persons).^[6]

Pedestrians, motorcyclists, and cyclists suffer the most severe injuries in traffic accidents compared to other road users.^[7] A large proportion of deaths and disabilities caused by traffic accidents is associated with pedestrians as the largest group

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of road users. Pedestrians' collision with motor vehicles is one of the most important public health problems worldwide although death and confinement to bed can be prevented by doing some actions.^[8] More than 270,000 pedestrians lose their lives annually around the world, and it accounts for 22% of all deaths caused by road traffic injuries.^[9] The rates of pedestrian fatalities in road accidents differ in different parts of the world; the highest and the lowest rates of pedestrian deaths have been reported in African (38%) and in South East of Asia (12%), respectively.^[10]

The risk of pedestrian fatalities in road accidents during a journey is several times higher than that of vehicle users. This is particularly a problem in low-income countries where the largest group of road-related deaths is that of pedestrians.^[11] Recent studies have shown that most injuries and deaths from traffic accidents in Asia had occurred to pedestrians and motorcyclists.^[12] In Iran, the deaths caused by traffic accidents are seen among pedestrians (28%), passengers in 4-wheel vehicles (26%), riders of 2-wheel vehicles (23%), drivers of 4-wheel vehicles (22%), and others (1%), respectively.^[5] Results of a study by Moradi and Taleghani showed that 5015 (32.4%) of 15,482 deaths caused by road accidents had happened to pedestrians, and head trauma was the most important cause of death among the pedestrians.^[13] Based on the report by the Legal Medicine Organization in the year 2012, about 23% of all deaths caused by traffic accidents are related to pedestrians.^[14]

Despite the high rate of pedestrian deaths in traffic accidents, information regarding the factors that contribute to the rate is inadequate. Therefore, considering that describing demographic features of pedestrian death cases and accident locations is an important factor in the prevention, management, and analysis of road traffic accidents, the present study aimed to describe the demographic and personal patterns as well as environmental factors affecting the occurrence of road traffic injuries among pedestrians in Iran.

MATERIALS AND METHODS

This cross-sectional study was conducted on all pedestrian deaths caused by traffic accidents referred to the Forensics Organization in Iran from March 20, 2012, to March 19, 2013. The data were related to pedestrian traffic accidents throughout Iran. According to Iranian law, all deaths caused by injuries or accidents have to be examined by autopsy to determine the exact cause of death. To extract the required data, some forms provided by the Forensic Medicine Organization were used to collect the information on deaths caused by traffic accidents. The data recorded in the Forensic Medicine Organization included demographic information as well as the information about the accidents. Demographic information included age, gender, education, occupation, marital status, and color of clothing and the information about the accidents included type of the deceased's vehicle, place of death, traffic light, and accident location (urban or suburban). Other information included the trauma location, the final cause of death, date of accident, date of death, time of death, and time of accident.

Since the population in 2012 was not available to calculate the incidence of deaths, results of the census in 2011 published by the Statistical Center of Iran as well as the average annual growth (1.29%) were used to estimate the population in 2012.^[15] To estimate the population assuming a constant population growth, the following formula was used:

$$P_t = P_0 (1 + r)^t$$

Where P_0 was the initial population, and P_t was population t years later.^[16] Furthermore, the standard population by the World Health Organization was used to determine the age-standardized incidence rate.

After obtaining permission, some part of the required information was received from the Iranian Forensic Medicine Organization and other necessary information which was electronically available was extracted from the Statistical Center of Iran and the World Health Organization. The information received from the Forensic Medicine Organization was first controlled and then data were analyzed using descriptive analysis (frequency, percentages, and rates) by the Statistics/Data Analysis (STATA.12 College Station, Texas, USA).

Furthermore, the Poisson regression was used to estimate the incidence rate ratio (IRR).^[17] The IRR is the ratio of two incidence rates. The incidence rate is defined as the number of events divided by the person-time at risk.^[18]

RESULTS

From a total of 4371 pedestrians who died in 2012 due to traffic accidents, 3201 cases (73.2%) were males with the mean age of 48.1 ± 0.46 years and 1170 cases (23.8%) were females with the mean age of 46.1 ± 0.77 years. The crude death rate and the age-standardized incidence rate were, respectively, 5.81 and 6.8 per one hundred thousand people. In terms of age, education, and marital status, the highest frequencies of pedestrian deaths were, respectively, observed in the age group 65 years old and above (33.4%), the illiterate group (44.5%), and the married people (67.9%) [Table 1].

The highest frequency and incidence of mortality were observed in October and after that in November [Table 2]. A statistically significant relationship was seen between the incidence of pedestrian deaths in different months so that the relative risk rates of pedestrian deaths in October and September were, respectively, 16% and 29% higher compared to the base month of June [Table 2].

The frequency of deaths at different times showed that the highest mortality rate had occurred at 7:00 p. m [Figure 1].

The highest and the lowest incidence rates of death were observed in Gilan (11/100 000) and South Khorasan Provinces (2.4/100,000), respectively [Table 3].

Regarding daylight, 61% of the accidents (2617 cases) had happened in the day while 27.5% (1178 cases) and 11.5% (493 cases) had, respectively, occurred at night and at

Table 1: Frequency and rate of pedestrian deaths based on demographic variables of the people under study in 2012 in Iran

Demographic variables	Population	n (%)	Rate (/100,000 people)
Age			
<15	17,664,462	734 (16.8)	4.1
15-24	15,038,077	335 (7.7)	2.2
25-34	15,530,804	394 (9)	2.5
35-64	22,747,313	1446 (33.1)	6.3
>65	4,169,013	1462 (33.4)	33.5
Sex			
Male	37,871,531	3201 (73.2)	8.35
Female	37,278,138	1170 (27.8)	3.1
Education			
Illiterate	11,783,636	1926 (44.5)	19.7
Primary school	16,966,245	1162 (26.7)	7.7
Junior high school	14,400,201	521 (11.8)	4.1
High school and diploma	19,416,461	536 (12.1)	3
High education	12,583,128	226 (4.9)	2
Marital status			
<10 years*	11,691,593	585 (13.6)	4.9
Single	21,844,379	825 (18.5)	3.7
Married	41,613,697	2961 (67.9)	7.1
Occupation			
Student	15,065,549	523 (11)	3.6
Homemaker	21,986,183	885 (20.3)	4.2
Employee	23,665,165	687 (15.2)	2.9
Unemployed	6,567,136	338 (6.3)	7
Other	7,865,636	1938 (47.1)	38.1

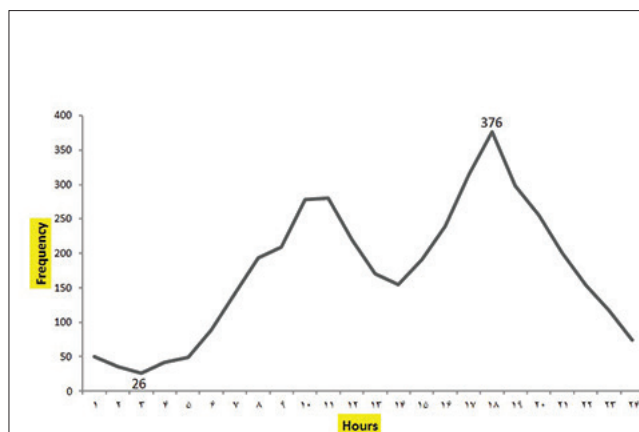
*Age <10 years considered outside of age at marriage

Table 2: The incidence rate of pedestrian deaths in different months of the year (2012) and statistical relationship between pedestrian deaths and different months in Iran among the studied sample

Month	n (%)	Rate (/100,000 people)	IRR	P	95% CI
April	364 (8.3)	0.484	1.03	0.65	0.89-1.2
May	385 (8.8)	0.512	1.09	0.22	0.94-1.26
June**	352 (8.1)	0.468	Reference	-	-
July	366 (8.4)	0.487	1.04	0.6	0.9-1.2
August	359 (8.2)	0.478	1.02	0.79	0.88-1.18
September	410 (9.4)	0.545	1.16	0.036	1.01-1.34
October	455 (10.4)	0.605	1.29	<0.001	1.12-1.48
November	365 (8.3)	0.485	1.04	0.62	0.89-1.2
December	363 (8.3)	0.483	1.03	0.68	0.89-1.19
January	303 (6.9)	0.403	0.86	0.056	0.74-1.003
February	312 (7.1)	0.415	0.88	0.121	0.76-1.03
March	337 (7.7)	0.448	0.95	0.57	0.82-1.11
Total	4371 (100)	5.81	1.03	0.65	0.89-1.2

**Reference group. CI: Confidence interval, IRR: Incidence rate ratio

sunrise or sunset. Colors of the clothing were light in almost 50% of the cases (1665) and dark in the other 50% (1666 cases). In terms of location, 58.9% of the accidents (2555 cases) had

**Figure 1: Frequency of deaths in terms of hour among the study sample in 2012 in Iran**

occurred in urban roads, 33.7% (1463 cases) in suburban roads, and 7.4% (320 cases) in rural roads and dirt tracks. In 74.5% of the cases (3104 cases), the vehicles involved in the accidents were sedans and pickup trucks, 16.2% (676 cases) were heavy vehicles, and 9.3% (388 cases) were motorcycles. Furthermore, 82.4% of the cases (3466) were transferred by ambulance while 1.3% (54 cases) and 16.3% (684 cases) were transferred by police cars and the other vehicles, respectively. Injuries to the head were the most common injury so that the trauma had affected their heads (87.5%), chests and abdomens (38.7%), legs (28.8%), hands and arms (23.4%), and necks (15.6%). The major final causes of death were, respectively, head trauma (61.6%), multiple fractures (21.6%), and bleeding (11.4%).

DISCUSSION

This study aimed at investigating the epidemiology of pedestrian deaths in traffic accidents in Iran in 2012. Overall, 4371 pedestrians died in 2012 in Iran due to traffic accidents. The results of this study showed that 73% of all deaths occurred to male pedestrians. The rate of death in men was higher than in women. These results were consistent with the findings of the previous studies.^[19-21] Findings of the study conducted by Beck *et al.* with the aim of investigating the deaths of pedestrians in traffic accidents in the United States of America indicated that 75% of all deaths caused by road traffic injuries occurred to male people.^[19] According to the World Health Organization, more than two-thirds (77%) of all deaths from traffic accidents in 2015 had occurred to males.^[20] A study carried out by Zegeer and Bushell in 2012 about the procedure of pedestrian accidents and potential countermeasures throughout the world showed that the incidence rate of death was higher in men than in women.^[21]

The higher incidence of deaths in men compared to women could be partly due to their higher exposure to risks because of their jobs and social roles. Compared to men, women were less engaged with the outside of their homes. When calculating the actual incidence rate, we had to consider the people at

Table 3: The incidence rate and frequency of pedestrian deaths in provinces of Iran in 2013

Province	Urban roads		Suburban roads		Total	
	<i>n</i> (%)	Rate (/100,000 people)	<i>n</i> (%)	Rate (/100,000 people)	<i>n</i> (%)	Rate (/100,000 people)
Gilan	81 (3.2)	3.2	194 (10.9)	7.8	275 (6.3)	11
Mazandaran	95 (3.7)	3.1	174 (9.8)	5.6	269 (6.2)	8.7
Kermanshah	93 (3.6)	4.7	49 (2.8)	2.5	142 (3.2)	7.3
Qazvin	34 (1.3)	2.8	52 (2.9)	4.3	86 (2)	7.1
Markazi	53 (2.1)	2	45 (2.5)	1.7	98 (2.3)	6.9
Qom	57 (2.2)	4.8	23 (1.3)	1.9	80 (1.8)	6.8
Golestan	38 (1.5)	2.1	80 (4.5)	4.4	118 (2.7)	6.5
West Azerbaijan	125 (4.9)	4	79 (4.4)	2.5	204 (4.7)	6.5
Lorestan	45 (1.8)	2.5	68 (3.8)	3.9	113 (2.6)	6.4
Chaharmahal and Bakhtiari	25 (1)	2.8	31 (1.7)	3.4	56 (1.3)	6.2
Fars	165 (6.5)	3.5	111 (6.2)	2.4	276 (6.4)	5.9
Tehran	624 (24.4)	5	103 (5.8)	0.8	727 (16.7)	5.9
Alborz	79 (3.1)	3.2	64 (3.6)	2.6	143 (3.3)	5.8
Kohgiluyeh and Boyer-Ahmad	14 (0.6)	2.1	23 (1.3)	3.5	37 (0.9)	5.5
Hamedan	52 (2)	2.9	46 (2.6)	2.6	98 (2.2)	5.5
Yazd	44 (1.7)	4	11 (0.6)	1	55 (1.3)	5.4
Kerman	92 (3.6)	3.1	70 (3.9)	2.3	162 (3.7)	5.4
Khorasan Razavi	229 (10)	3.8	93 (5.2)	1.5	322 (7.4)	5.3
Semnan	15 (0.6)	2.3	18 (1)	2.8	33 (0.7)	5.1
North Khorasan	22 (0.9)	2.5	22 (1.2)	2.5	44 (1)	5
Khuzestan	141 (5.5)	3.1	74 (4.2)	1.6	215 (5)	4.7
East Azerbaijan	90 (3.5)	2.4	85 (4.8)	2.3	175 (4)	4.7
Isfahan	166 (6.5)	3.3	59 (3.3)	1.2	225 (5.2)	4.6
Zanjan	18 (0.7)	1.7	29 (1.6)	2.8	47 (1.1)	4.6
Bushehr	22 (0.9)	2.1	22 (1.2)	2.1	44 (1)	4.2
Sistan and Baluchestan	39 (1.5)	1.5	62 (3.5)	2.4	101 (2.3)	3.9
Kurdistan	34 (1.3)	2.1	25 (1.4)	1.7	59 (1.3)	3.9
Ardabil	29 (1.1)	2.3	19 (1.1)	1.5	48 (1.1)	3.8
Hormozgan	18 (0.7)	1.1	36 (2)	2.2	54 (1.2)	3.3
Ilam	9 (0.4)	1.6	7 (0.4)	1.2	16 (0.4)	2.8
South Khorasan	9 (0.4)	1.3	9 (0.5)	1.3	18 (0.4)	2.4

the risk of accidents, i.e., the people who left home during the day. Since in the calculation of the incidence rate, the denominator included all women, the incidence rate of deaths in women was estimated less than the actual rate. Another reason for this difference might be the risky behaviors of men when crossing streets and their less attention to traffic signs compared to women.

In the present study, the mean ages of men and women were reported 48.1 ± 0.46 and 46.1 ± 0.77 , respectively. The results of Peymani *et al.*'s study showed that the average age of the deceased pedestrians was 47.2 ± 26.2 years, and it was 33 ± 21 years in the study conducted by Roudsari *et al.* in Tehran.^[22,23]

The results of the present study showed that the highest incidence of death occurred in the age group ≥ 65 . This is consistent with the findings of Harruff *et al.* study who found the highest incidence of death in the oldest age group.^[24] The incidence of death in the age group ≥ 65 was higher perhaps because they were more vulnerable, spent more time to cross the street, and showed slower reactions to danger.

In terms of education, the highest frequency of pedestrian deaths was observed among illiterate people (44.5%). In a study conducted by Peymani *et al.* on epidemiological characteristics of fatal pedestrian accidents in Fars Province, 45% of the victims were illiterate.^[22] Furthermore, the results of a study by Zadvalikhajeh and Zadvali titled as "the effective factors in pedestrian accidents in the city of Orumiyeh" showed that low-literacy people were more prone to accidents.^[25]

The highest frequency and incidence of mortality were observed in October. Results of the study by Peymani *et al.* also showed that the highest mortality rate occurred in September.^[22] The increased mortality rate in October might be caused by the opening of schools and educational institutions and in general the increased exposure of the pedestrians to risks.

Our results are in consistent with the results of the studies conducted by Ghafari Fam *et al.*, Lankarani *et al.*, Zegeer and Bushell, and Peymani *et al.* showed that the most pedestrian deaths happened during the day so that they were about twice as much as the deaths occurred at night, sunrise, and sunset.^[21,22,26-28] It seems that the highest rate of pedestrian

deaths occurred during rush hours. The increased number of vehicles and pedestrians in the day would increase the exposure and therefore the risk of collisions and pedestrian deaths. On the other hand, 33% of all deaths occurred as a result of low traffic volume and pedestrians at night, sunrise, and sunset.

Moreover, 58.9% of the accidents had occurred on urban roads. The results of a study carried out by Paulozzi with the aim of investigating pedestrian fatality rates by different types of vehicles indicated that the risk of pedestrian deaths by a variety of vehicles on urban roads was higher than that on suburban roads and rural routes.^[29] In Peymani *et al.*'s study, 56% of the deaths occurred on urban roads.^[22] The higher rate of mortality on urban roads could be due to the larger number of vehicles and pedestrians per square kilometer of urban areas. The existence of schools and buses inside the city and the prohibition of pedestrian crossing in some suburban areas could justify the higher proportion of deaths on urban roads. In 74.5% of the cases, the vehicles colliding with the pedestrians were sedans and pickup trucks, and this was consistent with the findings of the Paulozzi's study in 2005.^[29]

The most common location of trauma accidents was the head. In a study by Atkins *et al.*, head trauma was reported to be the most common.^[30] Moradi and Taleghani suggested that head trauma was the most important cause of death among pedestrians.^[13] In a study by Ghafari Fam *et al.* conducted in 2014, trauma to the lower limbs and legs was reported as the most common one. It seems that the reason for this difference is that in Ghafari Fam's study, only the age groups 18–65 years old were included, but in our study and the ones in which head trauma was the most common trauma, children and low-age groups were also participated and they were more susceptible to head injuries due to their anatomical characteristics.

CONCLUSIONS

Every year, traffic accidents endanger the lives of many people in the world. As the most vulnerable people in traffic accidents, pedestrians are involved in a large proportion of deaths and disabilities caused by road traffic injuries. The study found that the highest incidence of mortality was observed in the age group ≥ 65 . Therefore, it is necessary to pay special attention to physiological characteristics of this age group. Furthermore, prediction of safety plans should be proportionate to the needs of this age group and provide safer conditions for crossing the roads.

The most frequent and the highest incidence of pedestrian deaths occurred in October. Hence, it is suggested to do closer monitoring in this month by the traffic police. Since 33.7% of the pedestrian deaths occurred on suburban roads while pedestrian traffic on those roads was much less than urban roads, it is necessary to identify suburban areas where pedestrian traffic is heavy and provides some facilities for pedestrian crossing.

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Conflicts of interest

There are no conflicts of interest.

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