



Original Article

Burden of traffic accidents among pedestrians of Fars province, southern Iran; estimate of years of life lost in a sample of Iranian population from 2009 to 2013

Yaser Sarikhani ^a, Seyed Taghi Heydari ^{b,*}, Saeed Gholamzadeh ^c, Maryam Mazloom ^c, Payam Peymani ^b, Kamran Bagheri Lankarani ^b, Ahmad Kalateh Sadati ^d, Reza Tabrizi ^b, Maryam Akbari ^b

^a Research Center for Social Determinants of Health, Jahrom University of Medical Sciences, Jahrom, Iran

^b Health Policy Research Center, Institute of Health, Shiraz University of Medical Sciences, Shiraz, Iran

^c Legal Medicine Research Center, Legal Medicine Organization, Tehran, Iran

^d Department of Sociology, Yazd University, Yazd, Iran

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ABSTRACT

Purpose: Traffic injuries are among the leading causes of mortality and morbidity worldwide. Pedestrians have been considered as a high-risk group among road users, especially in middle- or low-income communities. This study attempted to determine the burden of pedestrians' fatalities in Fars, the southern province of Iran using years of life lost (YLL) approach.

Methods: The data used in this study were retrieved from Fars Forensic Medicine Organization database on pedestrian traffic accidents. The YLL from 2009 to 2013 was estimated using the method presented by World Health organization. Some epidemiological characteristics of pedestrians' fatalities were analyzed by SPSS.

Results: Although YLL among 1000 male pedestrians decreased from 2.5 in 2009 to 1.5 in 2013, it increased from 0.9 to 2.1 among 1000 females during the same period. Higher proportion of death was found in female, illiterate, and married pedestrians ($p < 0.001$). In addition, mortality was higher in pedestrians living the cities, during daytime, at home, and in hospitals ($p < 0.001$).

Conclusion: Consistent with the global trends, burden of pedestrian accidents in Fars was also exceptionally high. Considering the national and cultural aspects of different countries, improving the safety of pedestrians demands a multi-dimensional approach with interventional factors concerning policies, rules, pedestrians, motor vehicles and environmental conditions taken into consideration.

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Introduction

Except for a few underdeveloped nations, in almost every country worldwide, epidemiological transition changed the profile of diseases.^{1,2} Studies on global burden of diseases observed a shift from infectious diseases to chronic and non-communicable diseases and injuries.^{1–3}

Injuries have proved to account for a remarkable burden of diseases worldwide.⁴ Although the mortality rates of injuries in different states vary,⁵ it is estimated that fatal injuries cause nearly

one in tenth of all deaths around the world.⁶ Traffic injuries, as an important part of all kinds of injuries, are recognized as a serious health hazard in the world.^{7–9}

Traffic injuries as an unexpected event occur on the road and involve at least one moving vehicle.^{10,11} They are one of the leading causes of death and disabilities in many countries, imposing great socioeconomic burden on the communities.^{12,13} Some reports estimated that if no appropriate action is taken, they will result in 67% increase in deaths with more than 1.9 million people involved annually by 2020.^{10,11}

The pattern of traffic accidents (TA) and accordingly traffic injuries vary between developing and developed countries.^{10,11,14} Although with less registered motor vehicles, developing countries boast a higher burden of deaths and disabilities resulting from TA compared with industrial nations.^{9–11}

* Corresponding author.

E-mail address: heydari.st@gmail.com (S.T. Heydari).

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High risk groups in TA include vulnerable road users, unprotected as well as slow moving pedestrians.¹⁵ Motorcycle drivers, bicycle drivers and pedestrians are among the most vulnerable road users especially in developing countries.¹⁶ Studies showed that about 45% of fatal traffic injuries in low- and middle-income communities are related to pedestrians,¹⁷ compared to only 18% of traffic fatalities in developed countries.¹⁵

According to the WHO report in 2009, up to 33% of traffic fatalities in Iran involve pedestrians,⁸ consistent with the results of some local studies which indicate high incidence of fatal accidents among pedestrians.¹⁸ Despite many studies on the high rate of fatal TA among pedestrians in Iran, no study has reported on burden of fatal TA among Iranian pedestrians using YLL approach. As Fars province is one of the places in Iran with the highest rate of traffic accident and the highest incidence of traffic accident mortality,^{19,20} this study is aimed to analyze the burden of pedestrians' fatalities in Fars province as a sample of Iranian population using YLL approach.

Materials and methods

In this analytical study we used data on deaths from TA among pedestrians of Fars province of Iran. The data were retrieved from database of Fars Forensic Medicine Organization, an official registration center of data on road traffic injuries at the provincial level. Fars is the second-largest province of Iran located in the south of the country with around 5.9% of Iran's population (ranking third in the country in terms of population). Given its availability of data and high rate of TA mortality, we selected Fars province to study.²¹ Also it should be noted that the higher risk of TA among pedestrians in Fars province can be attributed to the fact that it is located in the north-south and east-west transit corridors where many main and minor roads pass through the residential areas.

In this study we analyzed burden of traffic injuries among pedestrians of Fars province in Iran using YLL analysis. Five-year trend of YLL from accidents for pedestrians of different gender groups was estimated using YLL formula adopted by WHO in study on global burden of disease,²² as described in the following formula:

$$YLL = NC^{(ra)} / (\beta + r)^2 \left[e^{-(\beta+r)(L+a)} [- (\beta + r)(L + a) - 1] - e^{-(\beta+r)a} [- (\beta + r)a - 1] \right]$$

Table 1

Years of life lost (YLL) due to traffic accident fatalities among pedestrians in Fars province of Iran from 2009 to 2013.

Year	Male					Female				
	Total population	Total deaths	Deaths per 1000	Total YLL	YLL per 1000	Total population	Total deaths	Deaths per 1000	Total YLL	YLL per 1000
2009	2,203,220	295	0.13	5610	2.5	2,182,378	101	0.04	2066	0.9
2010	2,229,003	227	0.10	4155	1.9	2,207,920	113	0.05	2320	1.1
2011	2,249,105	201	0.09	3859	1.7	2,234,009	94	0.04	1805	0.8
2012	2,278,571	213	0.09	3969	1.7	2,260,153	211	0.09	4181	1.8
2013	2,305,237	243	0.11	4481	1.9	2,286,604	243	0.10	4731	2.1

Table 2

Years of life lost (YLL) due to traffic accidents fatalities among pedestrians in Fars province of Iran from 2009 to 2013 in terms of age and gender groups.

Year	Male							Female						
	0–4	4–14	15–29	30–44	45–59	60–69	70+	0–4	4–14	15–29	30–44	45–59	60–69	70+
2009	451	676	1558	817	983	419	706	212	567	248	150	460	168	260
2010	361	617	875	500	865	313	624	273	448	361	273	453	264	237
2011	572	620	629	733	553	256	496	121	298	224	147	544	218	253
2012	361	323	1060	606	899	237	483	364	326	1078	625	959	267	561
2013	331	734	711	709	1035	360	603	334	741	723	730	1101	402	700

where N refers to the number of decedents in a given age and gender, L the standard life expectancy of mentioned group, A the age at death, C the constant value (0.1658), R the discount rate (0.03), β a parameter of age-weighting function (0.04), and e the Napier's constant.

The Standard Expected Years of Life Lost method was used to calculate the YLL from premature death. The standard life expectancy of different age and gender groups was calculated based on global burden of disease 2010 study standard life table.²³ The total number of inhabitants of Fars province and population of both genders in each year were retrieved from the database of Statistics Center of Iran, an official bureau of population census in Iran.

The epidemiological characteristics of pedestrians' deaths were also investigated when the burden of TA fatalities was estimated. The pedestrians' death was analyzed in terms of year, gender, age, time of accidents (day, night, and sunset/sunrise), marital status (married, single, and others), educational level (illiterate, basic education including primary and secondary school, and collage education), location of accident (inside city, inside village, and outside city/village roads), and the location of death (accident scene, during transfer to hospital, in hospital, and at home).

YLL of different groups was calculated using the formula in Microsoft Office Excel 2003. Also the data were analyzed by statistical software for windows SPSS 16 using Chi-Square and t -test.

This study was approved by the ethics committee of Shiraz University of Medical Sciences.

Results

A total of 8689 traffic accident-related deaths including 1651 pedestrians were registered in the Fars Forensic Medicine Organization database between 2009 and 2013. This study revealed that the YLL resulting from pedestrians' TA fatalities among 1000 males decreased from 2.5 in 2009 to 1.7 in 2012; while it demonstrated an increasing trend from 0.9 in 2009 to 2.1 in 2013 (Table 1) among the same number of females.

Table 2 shows the YLL from pedestrians' TA in different age and genders from 2009 to 2013. In addition, the results of t -test (Table 3) indicated a significantly higher mean age of TA decedents among pedestrians than among non-pedestrians in different years ($p < 0.000$).

Table 3
Evaluation of traffic accident mortality with respect to mean age and year.

Year	Pedestrians		Non-Pedestrians		p value
	Number	Mean (SD)	Number	Mean (SD)	
2009	396	46.47 (25.95)	1426	33.62 (16.48)	0.000
2010	340	47.94 (26.61)	1518	34.94 (17.67)	0.000
2011	295	47.45 (26.97)	1407	35.23 (18.51)	0.000
2012	293	48.41 (25.44)	1260	35.35 (18.48)	0.000
2013	323	49.74 (25.59)	1357	35.11 (17.54)	0.000

Table 4
Evaluation of traffic accident mortality with respect to sociodemographic and accident-related data.

Parameter	Pedestrians (n, %)	Non-pedestrians (n, %)	p value
Gender			0.000
Male	1179, 17.2	5677, 82.8	
Female	472, 25.8	1359, 74.2	
Education			0.000
Illiterate	737, 36.2	1301, 63.8	
Basic education	791, 13.9	4909, 86.1	
Collage education	90, 12.4	633, 87.6	
Marital status			0.000
Single	430, 15.2	2393, 84.8	
Married	936, 21.0	3511, 79.0	
Divorced/widow	14, 17.5	66, 82.5	
Accident location			0.000
Inside cities	963, 39.2	1496, 60.8	
Roads	514, 9.7	4805, 90.3	
Inside villages	139, 18.8	602, 81.2	
Place of death			0.000
Accident scene	623, 13.3	4073, 86.7	
Ambulance	123, 19.2	518, 80.8	
Hospital	837, 26.5	2320, 73.5	
Home	60, 43.8	77, 56.2	
Accident time			0.000
Day	834, 19.4	3460, 80.6	
Night	329, 15.7	1766, 84.3	
Sunset/sunrise	197, 22.4	681, 77.6	

Table 4 presents the sociodemographic and traffic-related parameters of TA decedents. The results of Chi-Square test showed TA mortality among female pedestrians (25.8%) was significantly higher than males (17.2%). Pedestrians with lower educational level had higher rate of TA mortality ($p < 0.001$). Furthermore, the rate of traffic accident-related death was significantly higher among married pedestrians (21.0%) than among other groups.

As shown in Table 4, the proportion of pedestrians' mortality inside cities was 39.2% compared to 18.8% inside villages and 9.7% outside city/village roads. Besides, the proportion of pedestrians' death in sunrise/sunset times (22.4%) was significantly higher than that in daytime (19.4%) and night-time (15.7%). Finally the statistical analysis indicated that more pedestrians' deaths occur at home (43.8%) than in other places such as accident scene (13.3%) and hospital (26.5%).

Discussion

According to previous studies, Iran among other countries witnessed the highest mortality rate of TA in 2006.^{20,24,25} The mortalities and disabilities caused by TA imposed great burden on Iran's economy.^{20,24,25} Recent studies in Iran revealed that from 2006 to 2012, the pattern of fatal and non-fatal injuries resulting from TA experienced a change in which a significant decrease was observed in the number of deaths and injuries.^{20,24,25}

Similar to the above mentioned pattern, our study in Fars province indicated that the YLL due to TA showed a significant

decreasing trend from 2009 to 2012 among both pedestrian and non-pedestrian groups. These findings imply that pedestrian protection was improved by reinforcing the programs of reducing TA in Fars. Meanwhile, strengthened emergency medical services oriented at timely and effective cares for injured pedestrians also contributed to the reduced YLL.^{26,27} However, it should not be neglected that growing age directly relates to YLL so that population aging could increase the average age of the victims despite the concomitant decrease in YLL.

Although the YLL from TA among pedestrians decreased during the aforementioned years, there was a difference between male and female population. YLL decreased from 2.5 in 2009 to 1.9 in 2013 per 1000 male population while increased from 0.9 to 2.1 per 1000 females during the same period. According to our results, YLL increased in all female age groups and they should thus be considered as a high risk population when preventive programs and policies are being arranged. The increasing trend among females can partially be attributed to their increasing exposure to traffic brought about by their more socially active lifestyle.

This study showed that the mean age of pedestrian deaths from TA in Fars province increased significantly from 46.47 (SD = 25.95) to 49.74 (SD = 25.59). With consistent result, many studies revealed that adult and elderly pedestrians had a higher rate of traffic fatalities compared with other pedestrian age groups.^{28,29} Besides, some studies indicated that the risk of death from TA rises with age.³⁰ As for the reasons, it is proposed that further outdoor activities could lead to higher risk of traffic deaths among younger adult pedestrians while age-related functional abilities may help explain the vulnerability of older adults.³¹

Our study showed that although the total number of fatalities among male pedestrians was higher than females, there was a significant difference in mortality rate of TA between female (25.8%) and male (17.2%) pedestrians. This finding clearly reveals that female pedestrians as a group are associated with higher risk of fatal TA than male pedestrians. Though conflicting with some researches,²⁹ our findings were in agreement with other studies.^{32,33} Different modes of exposure to transportation could help interpret the gender difference in pedestrians' fatality. However, such disparity between the results of studies can be reduced to the under-studied behavior of female pedestrians, calling for further investigation.^{34,35}

The mortality rates of pedestrians due to TA in Fars province correlates to the educational level. The study showed that 36.2% of TA deaths were among illiterates, 13.9% among people with elementary and high school education and 12.4% among people with college education. Similarly, many studies have verified a strong relation between increased education level and reduced risk of fatal TA among pedestrians.^{29,36} Pedestrians with higher education level have better knowledge, attitude, and behavior when facing risky traffic behaviors.³⁷ And their further training in safety and protection could also add up to the above-mentioned result.³⁴ Furthermore, socio-economic status is usually associated with car ownership; therefore those with higher education level are more likely to own a car which decreases their high-risk exposure to traffic as pedestrians.

This present study also observed higher proportion of TA fatalities in married people (20%) among different groups of pedestrians. Younger adults in Fars province were at higher risk of TA and the majority of victims were at marriageable age, which accounted for the increasing proportion of deaths in married pedestrians.

We found that a high percent of TA mortalities in Fars province was related to the road accidents (62.43%). However, as expected, the proportion of pedestrians death was significantly higher inside cities (39.2%) compared to that inside villages (18.8%). These findings indicated that pedestrians in the cities of Fars should be

considered as a leading high-risk group when preventive measures are implemented. Consistent with other studies, the result of our study is reinforced by other reports worldwide which regarded pedestrians as the most at-risk road users, especially in low- and middle-income communities.³⁸

Our findings showed that the largest number of pedestrians died in hospital ($n = 837$) or at the accident scene ($n = 623$). However, the highest proportion of pedestrians' deaths occurred at home (43.8%) compared to the hospitals (26.5%). Moreover, the mortality rate of TA among pedestrians depends on several variables such as vehicle conditions, pedestrians-related factors, and emergency medicine services.³⁴ The efficiency of emergency medicine services teams, especially the timely, precise, and effective essential cares has great impact on the outcome of pedestrians accidents.²⁶

The highest rate of TA fatalities in our study was found to occur in daytime (59.08%), when people have more outdoor activities. Nevertheless, the highest proportion of pedestrians' deaths was related to the sunrise/sunset times (22.4%). The reduced power of decision making by drivers and pedestrian induced by the reduced visibility at sunrise and sunset could explain, among other factors, such high mortality rates.^{18,19,28,34}

The main limitations of the study were missing data of the database and diminished validity of some subsidiary (non-core) data due to using a third person information in order to complete victims' data profiles.

In conclusion, pedestrians have been considered as an extremely vulnerable group to road TA. Vulnerable road users account for about 46% of TA fatalities worldwide, and the rate is even higher in many low- and middle-income communities. Considerably high mortality rate of pedestrians in Iran should be addressed by a multi-dimensional approach suitable to the specific national conditions.

Based on the factors contributing to the pedestrians' fatal accidents in Iran, a comprehensive national approach should entail clear legislation and law enforcement,²⁸ various educational programs to raise awareness of pedestrian safety among the public,³⁹ and finally vehicles and environmental reengineering aimed at protecting pedestrians.^{40–43}

Conflict of interest

All authors dismissed any financial or personal relationships with other people or any organization that could inappropriately influence this work.

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