

The Analysis of Deaths Caused by Driving Accidents in Ilam Province, Western Iran and the Related Factors by Using the Method of Time Series

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Received March 04, 2016; Revised July 19, 2016; Accepted September 21, 2016

This paper is available on-line at <http://ijoh.tums.ac.ir>

ABSTRACT

Traffic accident is one of the most important challenges of public hygiene that needs global attention and effort. This research was conducted to determine the crash trend and develop the accident prediction model that leads to death. This descriptive analysis was performed by using the statistical data related to death caused by driving accidents in Ilam, western Iran during 2010 to 2014. In order to determine the related factors to accident death during the years of interest, the time series was used and the ARIMA model was utilized for analyzing the time series. The data was analyzed by STATA 11. During the five years of study, 21.3% of the death people were female while the 78.7% were male from aspect of gender. The results of time series model showed that among all considered variables there was a significant relationship between the type of passageway, situation of deceased person by car accident, accident type, and vehicle type, with fatal accidents ($P < 0.05$). Since the persons died in traffic accidents are mostly men in young ages, so organizing and policy making is considered as a health priority in preventing the accidents and injuries. It is also a key tool for safety improvement in Iran.

KEYWORDS: *Death prediction, Trend of death, Traffic accidents, Time series, Iran*

INTRODUCTION

Nowadays, industrialization, rapid population growth, civilization and motorization are world's biggest problems[1]. The growing rate of car accidents, as reason to increases death and injuries, is one of the basic public health concerns [2-3]. The injuries caused by traffic accidents are the main reason for death, disability, hospitalization and imposing the economic costs throughout the world [4].

Car accidents have special importance due to their special specifications including high abundance, high intensity and direct involvement of all people, that this role in countries with low

and middle income (e.g. Iran) has more effect.

According to WHO report in 2010, more than 1.34 million people have died in car accidents all over the world and millions have hospitalized. Whereas more than 85% of accidents occur in low-income countries meaning where 81% of the world population live and they own 20% of the cars in the world [5-6]. Traffic accidents will be the third reason of death in high-income countries and the second reason in low-income countries till 2020 [7]. According to WHO report, in case of lack of appropriate interventions, the death caused by driving will be increased up to 67% until the end of 2020 from which 83% will be occurred in low-income countries [6]. African

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zone of WHO with 28.3% death per 100000 population, got the highest rate of death, shortly from that, the countries with low and middle income in eastern Mediterranean in where Iran is also located, 26.4 deaths per 100000 population is reported [8].

Our country is counted as one of the high-rate countries in fatal car accidents. Although only 1.1% of the world population belongs to Iran, every 60 dead person by the car accident in the world one of them is from Iran [9]. In Iran, traffic accident is the second cause of death after cardiovascular diseases [10]. In Iran, traffic accidents have resulted in 20068 deaths and 297257 injuries in 2011[10]. According to the report of WHO in 2013, Iran with 73973628 population and with 4520\$ gross national income per capita is classified in-group of middle-income countries. The number of transportation system 20657627 and the number of fatal traffic accident has been reported 23249. Therefore, the scale of death at the result of traffic accident is 31.4 per 100000 inhabitants and it is 11.3 per 10000 registered vehicles [11]. These scales based on 2009 reports have shown 2.5 and 16.3 percent reduction [12]. While based on the report in 2013, Germany with more than 82 million populations, and with more than 50 million transportation systems, just it has reported 3648 dying at the result of traffic accident. Also, in Turkey with the population near the Iran and with more than 15 million transportation system it has had just 4045 dying at the result of traffic accident [12]. While based on the report in 2013, Germany with more than 82 million populations, and with more than 50 million transportation systems, just it has reported 3648 dying at the result of traffic accident. Besides, in Turkey with the population near the Iran and with more than 15 million transportation system it has had just 4045 dying at the result of traffic accident [13].

According to Statistics provided inform official site of Iranian Legal Medicine Organization [14], the amount of death caused by driving in Ilam Province in years of 2012 to 2014 has a negative growth so that it has decreased, but the rate of death caused by driving in Ilam Province in years of 2014 and 2015 was positive, as this amount in year 2014 is 24% growth than the year 2013 whereas 12.9% growth was occurred in year 2015, relative to 2014 which is notable.

Therefore, efforts towards the travel safety and decreasing the dangers of road accidents through development and applying traffic safety programs are the main duties of

authorities. Identifying the effective factors on accident occurrence and severity is what is considered by the experts [15]. Since most of the traffic accidents are preventable, paying attention to this issue may decrease the car accidents' consequences [2].

Finally, knowing the intervention with higher effect on prevention of car accident death, the authorities may be conveyed to a better planning for preventing the consequences of these kinds of events in the province with less cost and higher efficiency. Therefore, in this research, with determining the most appropriate model of death trend using statistical models of time series, the death rate caused by traffic accidents were predicted and the related factors were analyzed during the period of five years in Ilam Province, Western Iran.

MATERIALS AND METHODS

The present cross-sectional research was a descriptive and analytical study by which the data were collected.

The statistical data related to death caused accidents during the years of 2010 to 2014 registered by the Iranian Legal Medicine Organization in Ilam Province has been used. The accident data was collected through the forms filled by the Iranian Legal Medicine Organization. The extracted data from this form includes the number of accidents based on the age, gender, qualification of the dead person, type of vehicle (both involved in the accident with pedestrian or another vehicle). In addition, the other parameters including the number of dead people in different categories during the accident (driver, pedestrian, or passenger), place of death, the quality of accident occurrence (vehicle to vehicle accident, vehicle to pedestrian crash, overturning the vehicle, falling down the car, colliding the vehicle to the fixed roadside objects, lightning condition, and the crash location in urban or rural areas) were investigated.

For the data analysis, the descriptive and inferential statistics methods have been used. In the present research, the analytical tools including average, standard deviation, amount, charts, and contingency tables were used in order to determine the amount of death based on the related factors. In addition, the Chi-Square test was used to determine the increasing or decreasing trend of death from 2010 to 2014. Moreover, the time series models were utilized in order to identify the related factors to death rate caused by road accidents during the years of 2010 to 2014. Time series are type of data in the form of a particular variable that occur during time. For example, it can be pointed to increasing or decreasing trend of accident due to work or traffic accidents in particular time duration.

Therefore, time series is collection of observations organized based on time (or other quantity). Analysis of time series is related to observation that is not independent and it dependent in Consecutive way [16]. The main use of analysis of time series is prediction. It is obvious if there is a particular dependent between data during the time, it provides good chance to predict future trend of phenomena with the help of observation [17]. The ARIMA model (autoregressive integrated moving average) was also used for analyzing the time series models. These models in time series are used for better understanding or future prediction. These models use when data are non-stationary.

In this study, SPSS-16 (Chicago, IL, USA) and STATA-11 was used for data analysis and the significance level of less than 0.05 was considered.

To calculate the amount of population of province during 2010 to 2014, the population data gathered by the Iran Statistics Center was utilized and the changing trend of death was calculated during the five years.

RESULTS

Totally, 712 death caused by accidents in Ilam Province were reported during the years from 2010 to 2014. Regarding the population of the province in 2010 and the estimation of population from 2010 to 2014 by the Iran Statistics Center, the accident rate per 100000 persons during the years

of interest is shown in Table 1. The rate of death caused by the accident during the 5 yr is estimated 25.53 per 100,000 people.

Table 1. Death caused by accident in Ilam Province from 2010 to 2014

Year	Province population	The Number of Death	Death per 100000 Persons
2010	555201	170	30.61
2011	557599	141	25.28
2012	559996	139	24.82
2013	562404	119	21.15
2013	564822	143	25.31

In terms of gender, 21.3% of dead people during the five years of interest were female and 78.7% were male.

29.1% illiterate, 13.3% primary school, 13.2% secondary school, 28.8% high school and diploma, and 13% university degree

In terms of death persons' condition, totally during the five years of interest, most of the fatality is for the drivers (46.1%), then passengers (37.9%), and the third group is for pedestrians (15.1%).

The comparison of deceased characteristics due to traffic accidents between 2010 and 2014 in Ilam Province is shown in Table 2.

Table 2. The comparison of deceased characteristics due to traffic accidents between 2010 and 2014 in Ilam Province

Variable		Accident year				
		2010	2011	2012	2013	2014
Gender	Male	137	110	104	97	112
	Female	33	31	35	22	31
	Illiterate	55	46	31	38	37
Education	Primary	20	15	27	15	18
	Secondary	24	18	15	10	27
	High school and diploma	52	38	45	30	40
	University degree	14	21	16	22	19
Deceased status	Unknown	5	2	5	4	2
	Driver	77	68	63	56	59
	Passenger	33	23	14	18	18
	Pedestrian	54	45	58	44	65
	Unknown	6	5	4	1	1
Age category	≤10	19	15	11	9	17
	11-20	19	18	19	16	11
	21-30	44	39	34	27	33
	31-40	27	19	15	16	20
	41-50	26	17	25	12	30
Accident season	≥51	35	33	34	39	31
	Spring	44	34	33	27	27
	Summer	39	46	46	51	35
	Fall	52	34	38	26	48
	Winter	35	27	21	15	32

According to Table 3, the results of time series model showed that among the variables of interest, the death person's condition is of

meaningful relationship with the fatal accidents from aspect of statistics.

The Chi-Square analysis showed that only the quality of accident occurrence (as overturning

the vehicle) and the vehicle's ignition have had a decreasing trend during the five years from 2010 to 2014 ($P < 0.05$), while the other cases are of fixed trend ($P > 0.05$). Without considering to decreasing or increasing trend of the quality of accident, vehicles' collisions have occurred meaningful more than other crashes.

Furthermore, during 2010 to 2014, the percent of fatality caused by the vehicles' collision is 51.8%, vehicles' turnover 24.7%, vehicle's collision to pedestrian 15.4 %, vehicle's object to fixed objects 4.5 %, and falling down the vehicle 2.2%.

In terms of accident time, the most of accidents occurred between 13:00 to -18:00 (9.75

per 100000 people), then between 5:00 to -12:00 (9.03 per 100000 people), and the minimum occurred between 1:00 to -4:00 (0.6 per 100000 people).

From aspect of season, most of accidents have occurred in summer (30.56%) during 2010 to 2014 and less accident occurred in winter (18.3%) in Ilam Province.

Fatal accidents are of minimum and maximum during the period of time (Fig. 1). Based on the results mentioned in Fig. 2, most of the fatal accidents have occurred between 13:00 to -18:00 (38.3%).

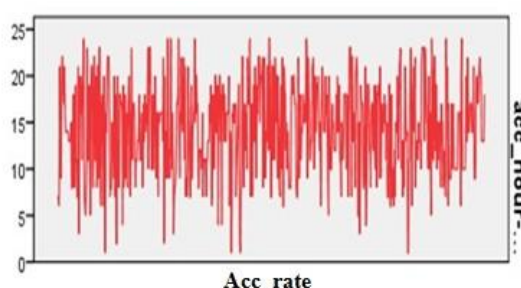


Fig.1. The time process of deaths cause by accidents divided into hours

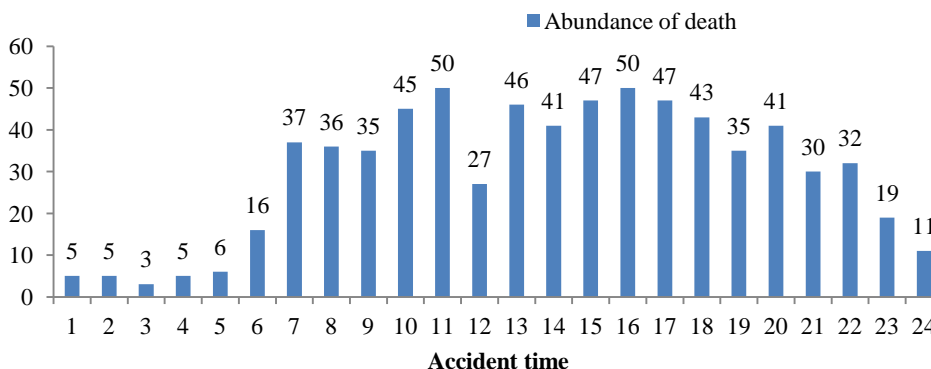


Fig.2. Abundance of death caused by road accidents in Ilam Province from 2010 to 2014

In addition, the analysis of time series has indicated that variable of season has a significant influence on fatal accident's trend ($P < 0.001$), therefore, the most of fatal road accidents have occurred in summer. However, there is no specific

time pattern for fatal accident occurrence from aspect of month variable. In other words, occurring these kinds of accidents in different month of the year is no special statistical trend and is not meaningful.

Table 3. Influence of variables on death caused by road accidents

P-value	T	Variables
0.589	0.542	Gender
0.701	-0.385	Age
0.574	-0.564	Light
0.034	2.151	Passageway
0	3.643	Condition of person involved in accident
0.004	-2.977	The quality of accident
0.435	-0.784	Type of vehicle
0.042	2.068	The type of vehicle involved
0.977	0.028	Qualification
0.476	0.717	Occupation

The results of time series model showed that among the effective factors, road type, death person's condition, quality of accident, and the type of vehicle involved in the accident, is of meaningful relationship with the fatal accidents ($P < 0.05$).

According to time series results, the relationship between the type of vehicle involved in the accident with the fatal road accidents is meaningful ($P < 0.05$) and regarding Fig. 3, the passenger car is the reason of most of death during the accident occurrence while the agricultural vehicles are in the second rank.

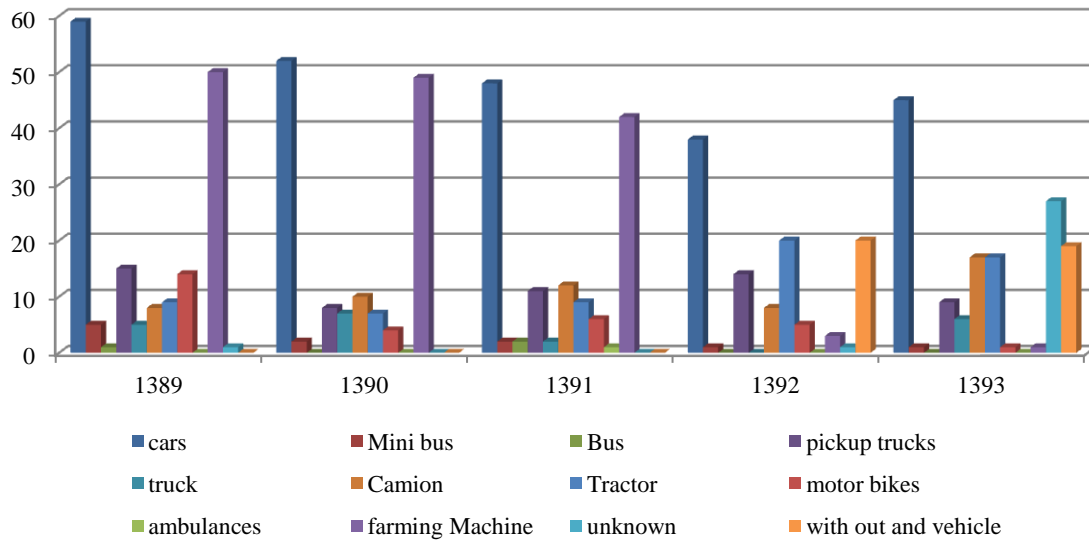


Fig. 3. Abundance of the vehicles involved in fatal accidents during the years from 2010 to 2014 in Ilam Province

In this research, from aspect of quality of road accident, the most percent is related to vehicles collision, (51.8%), then turnover the

vehicle, and thirdly, vehicle collision to pedestrian (Fig. 4)

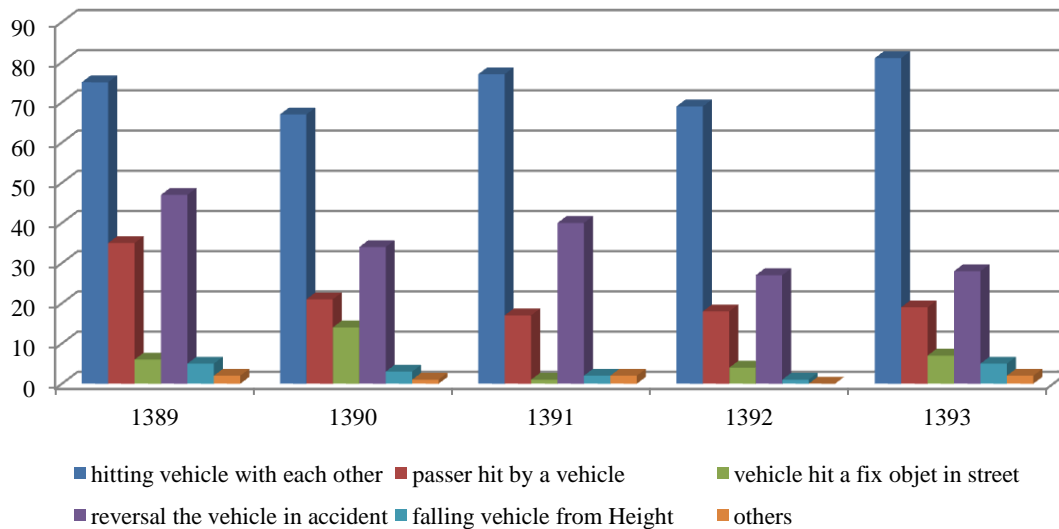


Fig.4. Abundance of type of vehicle involved in fatal accidents from 2010 to 2014 in Ilam Province

In relation to road type, the results of research showed that 81.88% of fatal accidents occurred on rural roads, 12.92% on urban roads, and 5.19% in local roads.

DISCUSSION

According to the obtained results in Ilam Province, the amount of fatality in 2010 was 30.61 persons in 100000, and this amount has been decreased gradually to 6% from 2010 to 2013 so

that this decreasing trend was meaningful. In 2013, this amount reached to 21.15 persons per 100000. This increasing from 21.15 in 2013 to 25.31 in 2014 is meaningful.

In terms of gender, the death rate of male to female is 3.69 to 1 in average. While this proportion in our country is variable from 3.3 to 5 [18]. Besides, this rate is from 1.6 to 3.6 in developing countries, which agrees with recent research [19]. Based on the findings in this research, among all death people by road accidents from 2010 to 2014, 78.7% were male and 21.3% were female which agrees with previous researches in Sanandaj [20]. In a study in Iran, 79% of the death persons were male [21] and in another research study, the gender rate (male to female) was 4.1 to 1 [22]. In addition, in another research performed in Singapore, 82.8% of the total death persons were male [10]. Studies in other countries such as the USA in the context of dangerous behavior performed among the young people while driving showed that males' dangerous behaviors are more than the females. Also, in other researches were conducted in Kermanshah [22] and Khuzestan Provinces [23] the proportion of dead males to females was reported 4 to 1. Therefore, gender distribution of the death people in the province, as well as the country for males, is higher than females, which are probably due to the male's occupation type and their exposure to accident. However, other factors such as females' more conservatory behavior can be considered and investigated in this regard. This finding corresponded to other researches [24-25].

In this study, although the minimum percent of death belongs to educated persons (13%) but the amount of fatality in these educated groups was not considerably different with other groups. The death rate in illiterate people with the average of 5 yr old was more than other educational levels and then the high school students stand in the following. The minimum percent of death caused by road accidents were related to academic persons [26] corresponded with results of this study and other researches [27-29]. In various researches conducted in Iran such as studies in Shahrood and Ardebil, the drivers with lower level of education involved in more accidents than well-educated people [29-30].

Undoubtedly, having higher level of education is of important role in increasing the public awareness and improving the attitude and performance of people in different subjects including traffic safety. A Higher level of education, with increasing the level of awareness, is of important role in increasing the drivers' efficiency that consequently leads to decreasing the accident injuries. In another research regarding the awareness, attitude and the drivers' performance,

and their effect on traffic accidents in both cities of Tehran and Zahedan, having higher awareness and safer attitude is in relation with decreasing the road accidents [31].

The most of fatality in this study was related to vehicles' drivers, then passengers, and finally pedestrians. In the research, 42% of fatality was assigned to pedestrians [32]. In addition, drivers were involved in 44.66% of fatality in Northern provinces, then pedestrians and passengers were in the following [33].

The passengers and drivers are the most victims of the road accidents happened due to the misuse of seat belt and weak attention to traffic rules by the drivers. All of these actions may be owing to the existing weaknesses in monitoring of the police in enforcing the drivers to respect the rules [34]. Drivers' injuries were happened because of misusing the seat belt [35].

In terms of Lightning (Brightening) condition, 67% of accidents happen in daytime and 24.8% in nighttime. The accident probability in daytime was more than the nighttime, which corresponds with the results of this study [36]. From aspect of lightening, the fatality rate caused by accidents is 56.11% at daytime, 32.31% at night, and 9.93% at sunrise and sunset time, respectively, which corresponds to the current study [37].

The results of this research shows that the season in which the most accidents happens in Ilam during 2010 to 2014 is summer (30.56%), that agrees with results of other studies in Golestan and Isfahan [38-39] In these two provinces of Golestan and Isfahan, 38% and 33% of accidents happened in summer, respectively. The most of accidents happened in summer [40]. In Sistan & Baluchestan Province, the most of accidents were reported in fall and spring seasons that it does not agree with this research [37]. In Northern provinces, according to time pattern, the most abundance is related to summer, and the least abundance is related to winter [33]. In a research in Kermanshah, it was found that 34.8% of death was occurred in summer [22].

In this research, the passenger cars (Fig. 3) were the maximum reason of accident and death which agrees with the other study [33, 35]. However, this issue may be because of a high number of passenger cars comparing to another type of vehicles, lack of being standard of passenger cars, having higher speed and non-suitable road design. After the passenger cars, the farming trucks are of high rate of death caused by accidents. According to Fig. 3, the rate of death has a decreasing trend from 2010 to 2014 that shows the countermeasures being effective.

In this research, from aspect of quality of accidents, the most percent of vehicle to vehicle collision is 51.8% that corresponds to study in

Khuzestan Province [23]. This issue can show increasing the average of drivers' speed on roads so that vehicles' overturning and consequently the rate of death are increased.

The results of research showed that 81.88% of the fatal accidents in rural roads, 12.92% on urban roads, and 5.19% in local roads. The results of the current research agreed with the results of study in Sanandaj [40] and in Ardabil [41]. The reason of this difference can be due to not respecting to the speed limit on rural roads in Iran that may lead to dangerous situation.

Probably the high number of death in rural roads is correlated with numerous reasons such as severity of accidents, problems, and deficiencies related to emergency actions, services and first aid medical care, and transport to health centers. Francesca has conducted a research in order to determine the important factors related to fatal accidents and serious injuries with using the 10320 information in one of provinces in Italy. Regarding this research, the death exposure of drivers was more on rural roads.

CONCLUSION

The rate of occurring traffic accident lead to death in suburban roads in Ilam is high, that can be due disobedience of speed limit in suburban roads that at result accident occur with more deterioration. Drivers and passengers are the most victims in driving accidents. Moreover, passenger cars are the main reason of passenger's death. Of course, this is maybe the number of this vehicle in comparison with another transportation system, lack of standard passenger vehicles, their high speed and failure to properly roads design. Most deceased of traffic accidents are men. According to this issue attention to more training by media, school and educational places to young and teenagers in obey the traffic regulations, enhancing the level of public culture society in the direction of decreasing necessary damages are required. In this regard, it should not neglect the role of public education, periodic evaluation executive programs, enhancing roads quality and cars. In order to strengthening of the general guidelines for decreasing and controlling traffic accidents, more study should be done in effective factors and the share of each of them in the incidence of these events.

ACKNOWLEDGMENTS

Hamadan University of Medical Sciences financially supported this study. The authors are so grateful to all employees of Ilam legal Medical organization for their help in providing the necessary requirements for accomplishment and data gathering in this research study. The authors declare that there is no conflict of interest.

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