Short Communication

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Trend in the Deaths of Road Accidents in Iran in Years 2006-2017

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ABSTRACT

BACKGROUND AND OBJECTIVE: Understanding the status and trend of changes in mortality due to road accidents over time is an important step for health policy making in order to reduce mortality. The aim of this study was to investigate the trend of deaths due to road accidents in Iran.

METHODS: In this cross-sectional study, the trend of deaths due to road accidents in Iran between: 2006-2017 were examined including the number of annual deaths by gender and province, population each year, using the sites of the Forensic Medicine Organization and the Statistics Center of Iran. The Bayesian approach connection point regression analysis method was used to analyze the data. Data analysis was performed using R3.5.1 and JAGS 4.3.0 software.

FINDINGS: On average, 27 people per 100,000 people were killed in traffic accidents during 2006-2017. The highest negative growth rates were related to 2007 and 2011 with 15.4% and 10.7%, respectively. The most victims were men and the highest number of casualties were in Semnan and Markazi provinces with 52.6 and 43 people, respectively, and the lowest in Tehran-Alborz and Ardabil provinces with 12.1 and 17.9 people, respectively, per One hundred thousand people during the years 2009-2010.

CONCLUSION: The results of this study showed that the mortality rate due to road accidents during the study period has been decreased.

KEY WORDS: *Trend, Death, Accidents, Iran.*

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Introduction

Road accidents refer to unexpected and unforeseen accidents involving at least one motor vehicle (1). Deaths due to road accidents are those deaths that occur at the time of the accident or 30 days after and due to injuries caused by the accident (1, 2). Mortality and injuries from traffic accidents are one of the major public health concerns (1, 3).According to the World Health Organization, 1.35 million people worldwide are killed each year in road traffic accidents and more than 50 million are injured or disabled, which mortality from road accidents in low-income countries (24.1 per 100,000 population) is 2.6 times higher than in high-income countries (9.2 per 100,000 population) (4-6).

Road injuries are currently the leading cause of death among people aged 5 to 29 and also the eighth leading cause of death for all age groups, most victims of accidents are men(5). About 1 to 3 percent of gross national income in developing countries is allocated to traffic accident injuries (7). If the necessary actions are not taken to reduce accidents, road casualties are predicted to become the fifth leading cause of death by 2030 (8). According to the Global Road Safety Report (2015), the highest death rate due to traffic accidents per 100,000 population in the Eastern Mediterranean region is allocated to Iran (32.1), followed by Saudi Arabia (27.4) and Jordan (26.3) are in the next positions (9).

In Iran, the prevalence of traffic accidents is higher than the global average and this country is ranked as the fifth country in terms of traffic accidents (10). Studies in some countries, including China, Slovakia, and Turkey, have shown a reduction in deaths from traffic accidents in recent years (11-13). Preventing traffic accidents is very important because it helps to avoid incurring costs and other things (14). Understanding the status and trend of changes in fatalities due to traffic accidents over time provides valuable information for policymakers in the health care system to be able to take effective interventions to reduce the casualties caused by these accidents. Therefore, the present study was conducted to investigate the trend of deaths due to road accidents in Iran and also to determine the points of change in the trend during 2006-2017.

Methods

This cross-sectional study was approved by the ethics committee of Shahid Sadoughi University of Medical Sciences in Yazd with the ethics code IR.SSU.SPH.REC.1397.069 to investigate the trend of deaths due to road accidents in Iran and also to determine the points of change in the process over the years 2006-2017. In this study, the number of annual accident deaths by sex and province were collected from the site of the Forensic Medicine Organization and demographic data were collected from the site of the Statistics Center of Iran (although the number of deaths in the first three years was reported in general and regardless of segregation).

To investigate and identify significant changes in the trend, the Bayesian approach connection point regression analysis method was used to model the time trend in mortality or incidence in epidemiological studies. The purpose of the analysis with this model is to identify possible points at which the slope of the linear trend changes significantly. In this model, the significance of the number of change points is based on the significance of estimating the slope of the regression line that beta0 plus betai indicates the slope of the regression line with i change point (15, 16). The model using the Bayesian approach demonstrates information well and accurately describes Annual Percentage Change (APC) in the mortality rate trend. In fact, the APC shows how much the mortality rate has increased or decreased in each year (15).

In this study, a regression model is described by four unknown connection points (change points) to identify the years in which changes occur in the slope of the mortality trend. Significance of estimates (regression line slope and APC values) was based on HPD (Highest probability Density) probability intervals (17-19). In this study, the trend of mortality by gender was also examined and the average annual rate for each province was calculated. Data analysis was performed using R3.5.1 and JAGS 4.3.0 software.

Results

According to the results of connection point regression analysis with Bayesian approach, the existence of a change point in the trend in approximately 2010 due to the significance of estimating the slope of the regression line with a change point (HPD Intrerval= -0.03, -0.44 and 1beta= -0.23) was accepted. Figure 1 shows the mortality trend of road accidents. The red line represents the mortality trend with the linear regression model (no change point in the trend) and the lines perpendicular to the time axis of the year represent the estimation of change points in the trend. According to

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this chart, the mortality rate has decreased significantly from 2006 to 2007 and then has a relatively stable trend until 2010. Then the trend changed and until 2016 it had a decreasing trend but in 2017 it increased slightly. Mortality rate in the first year had a significant decrease of 15.4%, which continued until 2010, which was not significant from 2007 to 2009 due to the probability intervals (Table 1). Mortality rate has decreased from 2010 to 2016, which was a significant decrease in all years and in 2011 with 10.7% had the highest negative growth rate. Then in 2017, there was an increase of 0.13% which was not significant due to the probability interval of HPD (1.25, -1.11). Estimation of mortality rate in general from 2006 to 2017 has decreased from approximately 27287 to 16169, which in 2016 with 15921 deaths had the lowest mortality rate (Figure 1) and during this 12-year period no significant increase occurs. Estimation of mortality rate in men has decreased from 18442 in 2009 to 12924 in 2017 and in women from 4849 in 2009 to 3492 in 2017 (Figure 2). The difference in mortality rates between men and women shows that men were the most victims of road accidents. According to the chart, the mortality rate for men from 2009 to 2014 has been declining sharply but has fluctuated in the last 4 years. But in women, the mortality rate decreased with a milder slope from 2009 to 2012 and has been fluctuating with slight changes since then. The incidence of deaths due to accidents has decreased from 39.1 per hundred thousand people in 2006 to 20 per hundred thousand people in 2017. On average, between 2006 and 2017, 27 people per 100,000 populations were killed in road accidents. During 2009-2010, the Semnan (52.6 people per hundred thousand people), Markazi (43 people per hundred thousand people) and Kerman (34.9 people per hundred thousand people) were the most and the Tehran and Alborz (12.1 per 100,000 people), Ardabil (17.9 per 100,000 people) and West Azerbaijan (19.9 per 100,000 people) have the lowest road accident mortality (Table 2).

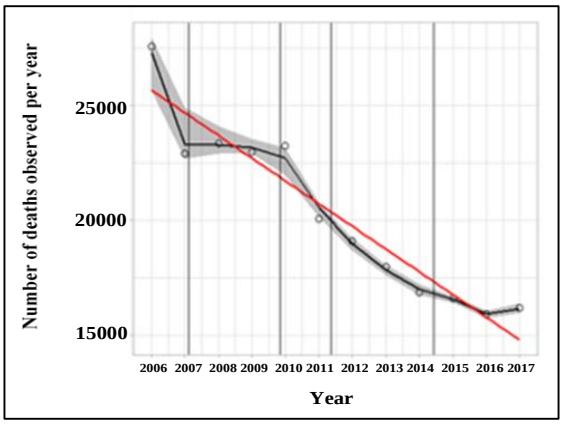


Figure 1. The trend of road accident mortality in Iran over the years 2006-2017

Table 1. Summary of the results of Bayesian connection point regression analysis for road accident mortality in Iran during 2006-2017

	Mean±SD	Lower 95	Median	Upper 95
APC_1	-15.41±5.1	-19.5	-17.61	-4.6
APC_2	-1.47±1.62	-4.84	-0.77	0.18
APC_3	-1.66±1.68	-5.19	-1.04	0.11
APC_4	-3.23±1.28	-5.83	-2.78	-1.72
APC_5	-10.7±1.65	-12.84	-11.15	-8.31
APC_6	-8.6±0.93	-10.18	-8.49	-6.84
APC_7	-7.27±0.74	-8.46	-7.41	-5.7
APC_8	-5.82±0.98	-7.77	-5.53	-4.44
APC_9	-3.67±0.42	-4.42	-3.69	-2.88
APC_{10}	-5.27±0.55	-6.17	-5.34	-4.13
APC_{11}	0.13±0.58	-1.11	0.16	1.25

Reported probability intervals are HPD probability intervals.

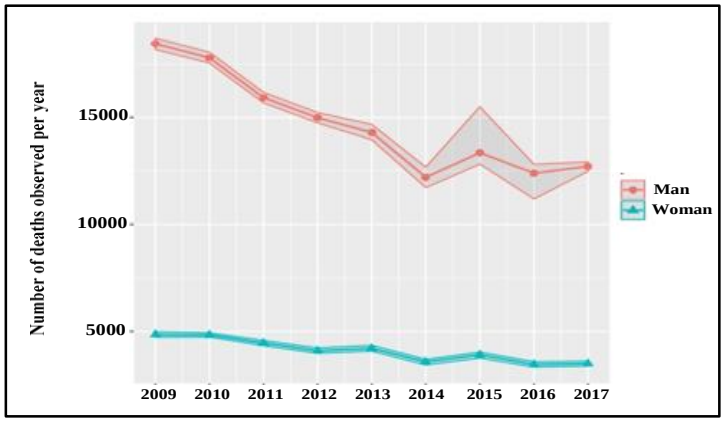


Figure 2. Trend of road accidents in Iran by gender during 2009-2017

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Table 2. Amount of deaths due to road accidents by province by population* (per hundred thousand people)

Province	Year												Average annual rate
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Semnan				69.9	72.5	61.6	51.4	50.5	41.6	44.3	37.2	44.3	52.6
Markazi				50.7	58.9	44.1	47.6	44.6	34.8	34.7	35.9	35.7	43.0
Kerman				42.9	43.5	35.9	36.9	29.9	29.8	32.4	29.1	34.2	34.9
North Khorasan				48.6	42.2	32.5	38.1	30.8	29.8	29.7	26.7	34.2	34.7
Fars				40.5	41.0	35.3	31.7	32.8	30.7	28.6	30.1	29.4	33.3
Sistan and baluchestan				35.8	38.5	36.7	35.7	31.8	32.5	28.0	27.5	29.2	32.9
Qazvin				45.7	40.1	36.1	34.5	27.1	29.0	29.2	27.9	24.1	32.6
Hamedan				41.3	39.4	35.5	32.1	26.7	28.7	27.0	25.5	25.5	31.3
South Khorasan				35.4	37.2	25.5	28.3	37.5	31.6	27.9	26.0	31.3	31.2
Bushehr				36.1	37.0	36.2	32.7	28.0	28.0	28.8	28.8	24.3	31.1
Zanjan				42.3	40.1	34.5	29.9	30.7	28.5	25.6	23.8	20.4	30.7
Lorestan				34.4	39.4	34.7	31.5	28.4	26.4	24.4	26.4	24.9	30.1
Gilan				32.9	35.7	32.0	31.6	26.1	25.0	25.8	24.8	26.0	29.6
Yazd				40.9	40.3	36.7	30.5	25.0	24.4	21.9	18.7	21.8	28.9
Qom				38.6	41.0	29.9	29.1	28.9	24.4	22.0	23.8	18.5	28.5
Ilam				39.4	31.7	27.2	24.7	22.1	27.1	30.4	21.7	26.1	27.8
Kurestan				37.9	37.4	29.9	23.2	25.0	23.2	26.5	23.3	23.9	27.8
Hormozgan				37.5	37.7	26.6	25.8	28.4	24.9	24.0	21.4	20.0	27.3
Mazandaran				34.8	34.9	29.3	27.6	27.5	22.9	23.0	19.9	18.7	26.5
Kermanshah				33.0	31.9	27.7	25.6	27.3	23.7	21.8	22.1	24.1	26.4
Chaharmahal and Bakhtiyari				28.1	27.1	25.7	30.7	26.1	24.6	22.4	23.5	23.4	25.7
Golestan				32.5	35.6	29.4	27.8	22.4	19.8	19.7	17.2	20.6	25.0
Kohgiloye and Boyerahmad				24.0	28.1	24.1	22.6	22.5	26.6	23.9	23.6	25.3	24.5
Isfahan				30.7	30.8	25.6	24.1	22.4	22.4	21.8	19.9	19.1	24.1
Razavi Khorasan				31.2	31.3	26.7	21.9	22.3	19.7	20.4	17.6	17.2	23.1
Khuzestan				28.0	27.8	25.3	22.3	19.7	19.1	17.6	19.2	17.0	21.8
East Azerbayjan				25.5	26.1	24.6	21.9	21.1	18.3	19.7	17.0	17.1	21.2
West Azerbayjan				23.6	25.3	19.8	22.4	20.1	17.7	16.5	17.1	17.0	19.9
Ardabil				23.6	22.1	19.6	18.5	16.9	17.1	15.7	15.4	12.2	17.9
Tehran and Alborz				17.1	15.8	13.3	13.0	11.9	10.4	9.5	9.0	9.0	12.1
Total	39.1	32.1	32.3	31.3	31.3	26.7	25.1	23.4	21.6	21.0	19.9	20.0	27.0

***The population statistics of the country are based on the announcement of the Statistics Center of Iran and the estimates made by that center for different years. Mortality rates by province were not reported in 2006-2008.**

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Discussion

The results of the study showed that the rate of deaths due to road accidents in Iran has decreased during these years, so that this rate from 39.1 per hundred thousand people in 2006 to 20 per hundred thousand people per year 2017 has decreased. Part of these changes and slowing down the process can be due to the four executive activities of the country's traffic police since 2005, which include laws on mandatory use of seat belts, laws on mandatory use of helmets, implementation and enforcement of special traffic laws and educational program production and broadcasting them in media. Also, the revision of traffic laws after about 40 years from its initial formulation and implementation of these laws since 2011 can be one of the effective reasons for the continuous reduction of road casualties in recent years. The first phase of this law, which was the calculation of negative points for offending drivers, began in May 2011 and the next phase, which was related to increasing the rate of fines, began in January 2011.

In the study of Shahbazi et al., the death rate due to road traffic in Iran has decreased from 41.5 per 100,000 people in 2006 to 20.4 per 100,000 people in 2016, which is in accordance with the results of the present study, and minor differences in mortality rates may be due to the round of data from demographic estimates (20). In many other studies, including the study of Bahadorimonfared et al. (1), Ghadirzadeh et al. (21) and Moradi et al. (22), the mortality rate due to road accidents has been decreasing since 2006. Also, according to the findings, there was a trend change point in 2010 that since no similar work has been done so far to determine the change points in the trend of deaths due to accidents, the discussion in this case is limited to the results of this study.

In this study, the death rate due to accidents during the years 2006 to 2017, 27 people per one hundred thousand population was obtained, which in the study of Ghadirzadeh et al. in the 80's this rate was 34.6 (21). Also, in the World Road Safety Report, in 2016, the death rate due to traffic accidents per 20,000 population in Iran was reported to be 20.5 (5), which shows the death rate over the years has declined dramatically. Despite the decreasing trend in road accident mortality, evidence shows that Iran is one of the countries with the highest prevalence of road accidents. According to the World Road Safety Report, road casualties in Iran are reported at 16,426 people, which is more than 4 times the number reported from France, 5 times more than Germany and about 1.5 times more than Turkey (5). The results of the present study show that the rate of mortality due to road accidents in men and women has decreased during 2009-2017 and this incidence has been higher in men than women due to less driving by women than men. In Iran, this result was not far from expected. This difference may be due to job differences between men and women and greater use of vehicles by men compared to women. It could also be because women are more likely to follow traffic rules and drive less dangerously than men. According to the World Health Organization, 80% of road accident victims in Iran were men (5). Similar studies in Iran, USA, India, France, Sweden, Spain, the Netherlands, Thailand, Turkey, Brazil, China and many other countries agreed with the results of the present study (11, 21, 29-23).

According to the findings of the study, during 2009-2017, Semnan, Kerman and Markazi provinces had the most casualties due to traffic accidents. The high traffic of transportation axes in these provinces as well as the large area and desert of Semnan and Kerman provinces. Which makes drivers drowsy can be one of the main causes of accidents in these provinces. Also, the lower number of casualties in Tehran and Alborz provinces could be due to the existence of highways on the main roads, the installation of radar cameras to record speeding violations, the scope of the traffic plan and the increase of police control.

Similarly, in the study of Ghadirzadeh et al., the highest mortality rate due to traffic accidents during the 80s belonged to Semnan, Qazvin and Kerman, provinces and the lowest to Tehran and Alborz, Ardabil and West Azerbaijan provinces which is consistent with the results of the present study (21). But in the 35-month study of Azami-Aghdash et al., which was performed by analyzing the data of the Red Crescent Rescue Organization of Iran, the highest rate of traffic accidents occurred in Isfahan and Mazandaran provinces and the highest mortality rate in Kerman and Sistan and Baluchestan provinces. The difference in data collection sources and study period could be one of the reasons for the discrepancy between the results of this study and the results of the present study (30).

In this study, the trend of road accident mortality in Iran over a period of time was examined and the years of trend change during the study period were identified as being of great importance and can be helpful for the country's health policy makers in reducing casualties due to accidents. Also, the findings of this study are very reliable due to the use of accurate statistical analysis, which is one of the strengths of this study. Lack of

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studies to determine the points of change in the process of road accident mortality to compare with the results of this study is one of the limitations of the present study. The results of the study showed that the number of deaths due to road accidents during the study period has decreased, but compared to other countries, it is still not in a favorable condition. Therefore, health care managers and policy makers are advised to pay more attention to prevent injuries caused by car accidents, especially in men, who are the most victims of these accidents.

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