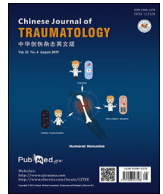




Contents lists available at ScienceDirect

Chinese Journal of Traumatology

journal homepage: <http://www.elsevier.com/locate/CJTEE>

Original Article

Analysis and identification of the hidden relationships between effective factors in the mortality rate caused by road accidents: A case study of Fars Province, Iran

Saeed Lotfi ^a, Ali Reza Honarvar ^{a, *}, Saeid Gholamzadeh ^{a, b}^a Department of Information Technology and Computer Engineering, Safashahr Branch, Islamic Azad University, Safashahr, Iran^b Legal Medicine Research Center, Legal Medicine Organization, Tehran, Iran

ARTICLE INFO

Article history:

Received 2 June 2018

Received in revised form

15 August 2018

Accepted 31 August 2018

Available online 22 May 2019

Keywords:

Road traffic accidents

Mortality

Vehicle

Fars province Iran

ABSTRACT

Purpose: An analysis and identification of the hidden relationships between effective factors in the mortality rate caused by road accidents in Fars Province of Iran to prevent and reduce traffic accidents in the future.

Methods: This cross-sectional study was conducted to integrate all the previous researches performed on mortality rate of road traffic accidents in Fars Province from March 21, 2013 to March 20, 2017. In order to reveal the relationships between the factors affecting mortality rates of road traffic accidents, the data regarding road traffic accidents extracted from resources such as Legal Medicine Organization, Traffic Police, Accident & Emergency Department, as well as Department of Roads and Urban Development of Fars Province, then cleaned and the applicable attributes embedded in the data all aggregated for further analysis. It should be noted that the data not related to Fars Province were deleted, the data analyzed, converted and the aggregation between various attributes identified. The aggregation between these different attributes as well as the FP-growth algorithm and two indexes of support and confidence calculated and interesting and effective rules extracted. In the end, several accident-provoking factors, the degree of consecutive and interdependence of each one in road accidents identified and introduced. The statistical analysis was conducted by using Rapid Miner software.

Results: Of the 6216 people dead due to road traffic accidents, 4865 (79.02%) were male and 1292 (20.98%) were female, 59 of them have no clear gender. The largest portion of people died of road traffic accidents belonged to married and self-employed men who collided with motorcycles in autumn. Moreover, young individuals (aged 19–40 years) with secondary educational level who died of accidents in summer at 12:00 a.m. and then 5:00 p.m. in outer city main roads of Kazerun-Shiraz, then Darab-Shiraz, Fasa-Darab and in within-city main streets had the highest mortality rates. Among women, the middle-aged group (aged 41–65 years) followed by young-aged group (aged 19–40 years) with elementary educational level and then illiterate accounted for the highest mortality rate of road traffic accidents. The automobiles involved in accidents included Pride, Peugeot 405, Peykan pickup, Samand, Peugeot Pars, other vehicles and motorcycles.

Conclusion: The high mortality rate of illiterate and low-literate in various age groups indicates that educational level plays a crucial role as a factor in road accidents, requiring related organizations such as Traffic Police and Ministry of Education to take necessary measures and policies.

© 2019 Chinese Medical Association. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Every year, 1.2 million people in the world died of road traffic accidents and more than 50 million injured. Statistics in Iran reveal

that after cardiovascular diseases, road accidents count the second leading cause of death, and Fars ranks the top of the provinces in Iran.

Fars, a province located in south of Iran, has an area of 122,608 square kilometers, considered as the fourth largest province of the country. On the basis of population evaluation in 2016 by Statistical Center of Iran, Fars is also the fourth populous province of Iran with over 4.85 million people (4,851,274 people). Moreover, according to administrative divisions assessment performed in 2011, Fars has 29 counties, 100 cities, 83 municipalities (an administrative division

* Corresponding author.

E-mail address: alireza_honarvar@yahoo.co.uk (A.R. Honarvar).

Peer review under responsibility of Chinese Medical Association.

below governorate) and 204 villages. The center of the province is Shiraz city, according to the report by Statistical Center of Iran in 2016, with a population of 1.8 million people (1,869,001 overall population) is the most populous city in Fars and the fifth populous city in Iran. Other densely populated cities of Fars province include Marvdasht, Jahrom, Kazerun and Fasa.

Even though an enormous number of statistical-descriptive studies have been conducted analyzing the data regarding road traffic accidents, but none of them addressed the examination of the relationship between effective factors in mortality caused by road accidents. With the advent of data-mining science and existing algorithms, the present study conducted aiming to examine some of the effective factors leading to mortality in road accidents in Fars province from 2013 to 2017. Using the collected data of death caused by road accidents (including pedestrians, drivers, automobile passengers or motorists) from the resources including the Legal Medicine Organization (accident location, demographic information of victim, color of pedestrians' clothing), Traffic Police (the status of the victim when accidents happening, the precise place of accident, how accident happened, type of the accident vehicle and other involved pedestrian or vehicle), Emergency Department (victim transfer method, date and time of accident, conditions of lighting, the place of death) and Department of Roads and Urban Development of Fars Province (name of the road where accident occurs, the distance from the source place and characteristics of counties) and data-mining algorithms, the study identified effective factors in mortality rates of road accidents. Afterwards, we can figure out the relationships between the variables such as the relationships between marital status and the exact location of the accident, the relationship between the age and the exact location of the accident, the relationship between pedestrian and the dark clothes and etc.

Methods

This cross-sectional study conducted in Fars Province of Iran from March 21, 2013 to March 25, 2017. Fars Province with a total population about 4,850,000, located in south of Iran, with Shiraz as its capital city, is the fourth populous province among all 31 provinces in the country.

The data set at first, and then mechanisms employed to aggregate the necessary data taken into consideration. The data aggregation and correlation adopted to identify the relations, based on the results and with the help of algorithm FP-growth interesting patterns were extracted. Ultimately, the best and the most applicable findings presented.

Data set

The data provided here is a set of collected information belonging to years from 2013 to 2017 including 21 variables (characteristics). They are gender, the status of the dead person while accidents occur, age, habitat, the area where injuries have occurred, date of accident, education, type of the dead vehicle, time of death, the county where the accident occurred, the place of an accident-within-city, the distance from the source place, marital status, time of accident, how the accident take place, the precise place of an accident-outer-city, the name of the road where accident occurs, occupation of deaths, conditions of lighting, pedestrians clothing color, type of the dead's vehicle as well as involved with pedestrian or the vehicle.

Data refinement

Moreover, since unavailable values, noises, and incompatibilities create errors in the data and also given the outdated nature of some

of the information registration forms, data, human errors, some multi-nominal characteristics and data defects, in the phase of cleaning, the noisy or incompatible data identified and excluded using deviation recognition methods like Covariance Matrix. For example, the data regarding Fars province citizens, whose accident location was in other provinces, or data belonging to people with no identity all excluded from the study.

Data integration

As it can decrease incompatibility in dataset, data integration regarded as one of the most significant stage of data pre-processing integration. Accordingly, the data gathered from and belonging to the Legal Medicine centers (all the Fars province counties), Traffic Police Centers (outer- and within-city traffic centers), Emergency Department and Department of Roads and Urban Development of Fars Province, refined, cleaned, integrated, aggregated in a data warehouse, re-cleaned and prepared to be analyzed by a software.

Data conversion

All the in-put data were numeric, because they need to be in nominal format for initial statistics, identification by employed operators, alleviation of data ambiguity for the reader and useable in algorithms, all the numeric characteristics changed into nominal ones (e.g. gender stored in the data warehouse in the form of two numbers: 1 for male, 2 for female, so did the other attributes). Moreover, as a transactional database required for using FP-growth algorithm, all the existing characteristics and their sub-sets all turned, from nominal, into binary characteristics and stored in the data warehouse, prepared to be entered into the software for FP-growth algorithm. In certain phases of the study, some of the characteristics described (types of vehicles, bus, pickup, truck, and trailer) and then used in a general fashion. (e.g. pickup included four subsets of Nissan, Peykan, and other unknown pickups.)

Results

This section of the study addresses the evaluation of datasets regarding the people died of road accidents in Fars Province during 2013–2017 included an overall number of 6216 individuals. After the necessary analyses conducted, each one of the variables examined in particular and separately as the ultimate goal of this study has been to reveal the hidden relationship between these variables. At the outset, the general statistics belonging to all 21 mentioned attributes, discussed for reader familiarity to value them. In the end, the results obtained from FP-Algorithm and other cases all presented. Of 6216 dead people, 95% were Iranians and the remaining 5% were from other countries.

Among the dead people, 79% of them were men and the rest were women (rate 4:1). Moreover, the highest mortality rate belonged to the young group (aged 19–40 years) accounting for 50% and the least were infants (less than one year). With regard to marital status, nearly 62% of dead people were married and the remaining 38% were single individuals. With respect to urban and rural populations, 61% and 38% of those people died of road accidents belonged to urban and rural areas, respectively. Furthermore, illiterate group are the highest amount of mortality rate (almost 22%), suggesting that the higher the educational level, the less the likelihood of death from road accidents. The university students, people with associate degree, B.A., M.A. and higher education degree, accounted for an overall 12% of the entire mortality rate.

Regarding seasons from the highest to the lowest mortality rate in traffic accident are summer (28%), spring (27%), autumn (25%) and winter (21%).

According to the results of the study, the highest mortality rate caused by road traffic accidents happened at 6:00 p.m., while the lowest mortality rate was at 3:00 a.m. It should be noted that the highest road traffic accident-prone counties in Fars province counties were Shiraz (1510 cases, 24.56%), Kazerun (520 cases, 8.46%), Marvdasht (435 cases, 7.12%), and Darab (334 cases, 5.43%). Also, the findings revealed that the highest number of road traffic accidents occurred during the day and then at night, the lowest rate belonging to sunrise and sunset. With regard to within-city locations, main streets accounted for 64% of road accidents, boulevards account for nearly 12%, and secondary streets take 7% of all the road accidents. Moreover, regarding outer-city locations, main roads, highways, and rural roads accounted for 65%, 9% and 8.5% of all the road accidents, respectively. The results and analyses also indicated that Kazerun-Bushehr, Kazerun-Shiraz, and Isfahan-Abadeh were the highest accident-prone routes, accounting for about 1.36%, 1.12% and 0.84% of all fatal road traffic accidents.

With regard to the attribute of the damaged area, head and face with 3340 cases (52.26%) takes the highest proportion of body parts injury, after that head, face, neck, chest and abdomen together were 798 cases (13%). It should be noted that most of the people died at the accident site (54%). Additionally, according to statistics, people died in hospital, the way transferring to hospital, and at home take 37%, 7%, and 2% of all the road traffic victims, respectively. This is an issue require extra attention. Among the people dead in road traffic accident, 2675 people are drivers (43.84%), 2116 people are vehicle or motorcycle passengers (34.68), and 1270 people are pedestrians (20.81%) Forty-three percent of pedestrians were in light color clothes when accidents happened, while the 38% of them in dark the rest (19%) are unknown. The findings also indicated that the highest occurrence rate belonged to vehicle-to-vehicle collisions (50%), followed by vehicle-overturning (25%), vehicle-passenger collisions (21%) and other cases (4%).

At first, motorcycles involved in most of the accidents, which takes 25% of all the accidents, followed by pedestrians involved accidents (20%). With regard to the type of vehicle, Pride accounted for 14%, Peugeot 405 accounted for 11% of all road accidents. According to the findings, almost 26% of accidents were of the type, in which vehicles not involved with other vehicles or pedestrians, suggesting that driving culture should be modified and vehicles need to be standardized. It should be borne in mind that Pride and Peugeot 405 accounted for the highest proportion of such accidents with values 11% and 9%, respectively. Also, based on results of the study, the greatest number of road traffic accidents happened in the groups of self-employed (34%) and housekeepers (14%) and the lowest number was the group of military workers (0.68%).

After obtaining the initial statistics and determining the correlation between the variables, consecutive patterns and hidden relations between some of the variables also extracted from the analyzed data. As an example, explanations provided in Table 1 depict that most of the people killed at the time of accidents were self-employed driver men and after that most of the married and self-employed casualties were males.

As it shows that most of the dead people were male, women's group separated from men and the relevant data analyzed with the label "females". Afterwards, using data-mining algorithms, the consecutive patterns and rules discovery (the hidden relations between the variables) calculated and related results obtained.

As illustrated by Table 2, most women who are married, housekeeper and vehicle's passengers dead in traffic accidents.

In another section of the study, the aggregation operator used to analyze. It selects a certain characteristic and evaluates it in terms of its relation to other variables, revealing the hidden associations among different characteristics.

By selecting educational level variable, giving it a label and examining the relationship this variable has with other variables, the results of this analysis provided as follows (Table 3).

Illiterate

There are 1362 people in this group. Most of the people in this group were male, married, aged more than 66 years, mostly residents of cities, who underwent accidents during the day, summer season at 6:00 p.m. It is worth to note that most of them were housekeepers. Likewise, most of the people died due to accidents in this group were passengers with light color clothes in Darab-Fasa main roads.

Elementary

There are 1308 people in this group. Most of the people in this group were married men, aged 41–65 years, mostly living in cities, who experienced accidents during the day, spring season at 07:00 p.m. It should be noted that most of them were self-employed people. Likewise, most of the people died due to traffic accidents in this group were drivers collided with motorists. Their clothes color were light and suffered accidents in Kazerun-Bushehr main roads.

Secondary School

There are 1304 people in this group. Most of the people in this group were married men, aged 19–40 years, mostly living in cities, who experienced accidents during the day, spring season at 08:00 p.m. It is noteworthy that most of them were self-employed men. It should be borne in mind; most of the people died due to accidents in this group were drivers collided with motorists. Their clothes color were dark and suffered accidents in Shiraz-Fasa main roads.

High School

There are 427 people in this group. Most of the people in this group were single men, aged 19–40 years, mostly residents of cities, who experienced accidents during the day, summer season at 08:00 p.m. It should be said that most of them were self-employed male drivers who experienced accidents with motorists, also it should mention that they were in light color clothes and experienced accidents in Kazerun-Bushehr main roads.

Diploma

There are 914 people in this group. Most of the people in this group were married men, aged 19–40 years, mostly living in cities, who underwent road accidents during the day, spring season at 06:00 p.m. It should be noted that most of them were self-employed male drivers who collided with motorcycles. The pedestrians' clothes color were light and experienced accidents in Kazerun-Bushehr main roads.

University students

There are 158 people in this group. Most of the people in this group were single men, aged 19–40 years, mostly residents of cities, who experienced accidents during the day, spring season at midnight (00:00 a.m.). One should bear in mind that most of them were drivers who experienced accidents with Pride vehicle. It should be noted that the color of pedestrians' clothes were dark and experienced accidents in old Darab-Shiraz road.

Table 1
Consecutive patterns (all attributes).

Rule (consecutive patterns)		Confidence (%)
Diver – self-employed	Men	99.20
Married – self-employed	Men	98.30
Vehicle-vehicle collisions – driver	Men	98.10
Self-employed	Men	97.60
Head and face – driver	Men	97.20
Driver	Men	97.00
Vehicle-vehicle collisions – motorcycle	Men	96.70
Young	Men	86.80
head and face – vehicle-vehicle collisions	Men	84.50
Vehicle-vehicle collisions	Men	83.40
Single (bachelor)	Men	83.20
Night	Men	82.90
Residents of rural (habitat)	Men	81.20
Season of death-autumn	Men	79.50
Married	Men	76.40
Young	Single (Bachelor)	71.60
Driver	Vehicle-vehicle collisions	62.50
Night	Residents of cities (Habitat)	61.40
Single	Residents of cities (Habitat)	60.20
Vehicle or motorcycle passengers	Men	60.00

Table 2
Consecutive patterns (women).

Rule (consecutive patterns)		Confidence (%)
Women- housekeepers- outer city (main road)	Married	91.80
Women- vehicle-vehicle collisions	Vehicle or motorcycle passengers	91.70
Housekeepers- head and face	Women - married	91.00
Housekeepers- day	Women - married	89.70
Women- no vehicle-collision involved	vehicle overturning	86.30
Women- married - outer city (main road)	Housekeepers	85.20
Women- married – outer city (main road)	Vehicle or motorcycle passengers	83.80
Married - outer city (main road)	Women- vehicle or motorcycle passengers	83.80
Women - outer city (main road)	Vehicle or motorcycle passengers	82.70

Associate degree

There are 142 people in this group. Most of the people in this group were married men, aged 19–40 years, mostly residents of cities, who experienced accidents during the day, summer season at 06:00 p.m. It should be noted that most of them were self-employed drivers who underwent road accidents with Pride vehicle. It is noteworthy that the color of pedestrians' clothes were light and experienced accidents in Kazerun-Shiraz main roads.

Bachelor of arts

There are 282 people in this group. Most of the people in this group were married men, aged 19–40 years, mostly residents of cities, who experienced accidents during the day, summer season at 01:00 a.m. It is worth to note that most of them were employees who experienced accidents with Pride vehicle as the driver. It should also be noted that the color of pedestrians' clothes were light and experienced accidents in Neiriz-Qatrouyeh main roads.

Table 3
Correlation (Education and other Attributes).

Main Attribute	Age	Habitat	CL ^a	Job	SoA ^b	Gender	Status ^c	PCC ^d	WATP ^e	TDV ^f	NRWA ^g	DSP ^h	TPoV ⁱ	MS ^j	ToA ^k
Illiterate	≥ 66 years	City	Day	Housekeeper	Summer	Men	Pedestrian	Bright	VCP ^l	Pedestrian	Darab-Fasa	11to60 ^m	NVC ⁿ	Married	6:00p.m.
Elementary	41–65 years	City	Day	Self-Employed	Spring	Men	Driver	Bright	WC ^o	Motorcycle	Kazerun- Bushehr	11to60	NVC	Married	7:00p.m.
Secondary (Middle) School	19–40 years	City	Day	Self-Employed	Spring	Men	Driver	Dark	WC	Motorcycle	Shiraz-Fasa	11to60	NVC	Married	8:00p.m.
High School	19–40 years	City	Day	Self-Employed	Summer	Men	Driver	Bright	WC	Motorcycle	Kazerun- Bushehr	11to60	NVC	Single	8:00p.m.
Diploma	19–40 years	City	Day	Self-Employed	Spring	Men	Driver	Bright	WC	Motorcycle	Kazerun- Bushehr	11to60	NVC	Married	6:00p.m.
University Students	19–40 years	City	Day	University Students	Spring	Men	Driver	Dark	WC	Pride	Darab-Shiraz (Old road)	11to60	NVC	Single	0:00p.m.
Associate Degree subjects	19–40 years	City	Day	Self-Employed	Summer	Men	Driver	Bright	WC	Pride	Kazerun-Shiraz	11to60	NVC	Married	6:00p.m.
Bachelor of Arts	19–40 years	City	Day	Employee	Summer	Men	Driver	Bright	WC	Pride	Neiriz-Qatrouyeh	11to60	NVC	Married	1:00a.m.
Master of Arts and higher	19–40 years	City	Day	Employee	Winter	Men	Driver	Unknown	WC	Pedestrian	Jam-Firuzabad	11to60	NVC	Married	2:00p.m.
Unknown	19–40 years	City	Day	Worker	Summer	Men	Passenger ^p	Bright	WC	Pedestrian	Isfahan-Abadeh	11to60	NVC	Married	8:00a.m.

^a Conditions of lighting, ^b Season of accident, ^c The status of the dead person while accidents occur, ^d Pedestrians clothing color, ^e The way an accident takes place, ^f Type of the dead vehicle, ^g Name of the road where accident occurs, ^h The distance from the source place, ⁱ Type of the dead's vehicle as well as involved with pedestrian or the vehicle, ^j Marital status, ^k Time of accident, ^l Vehicle collision with pedestrians, ^m From 11 to 60 km, ⁿ No vehicle-collision involved, ^o Vehicle-vehicle collisions, ^p vehicle or motorcycle passengers.

Master of arts and higher

There are 63 people in this group. Most of the people in this group were married men, and aged 19 to 40 years, mostly residents of cities, who experienced accidents during the day, summer season at 02:00 p.m. It is safe to say that most of them were employees who experienced accidents the vehicle drivers. It should also be noted that the color of pedestrians' clothes were light and experienced accidents in Jam-Firuzabad main roads.

Results obtained from correlation between the marital status and the precise place of accident (within-city) showed that both groups, married and single, accounted for the highest degree of accident-caused deaths in main streets of counties of Shiraz, Kazerun and Marvdasht, respectively, with married group having greater accidents-caused mortality cases. Moreover, both married and single people accounted for the largest percentage of accident-caused mortality in Boulevards in cities like Shiraz, Kazerun and Marvdasht in the main roads in which married people were the highest cases. The results also revealed that married people had the highest degrees of accident-caused mortalities in beltway of Darab while the single people experienced such accidents in secondary roads of Fasa.

The findings gained from the correlation between age and precise place of accidents (within-city), as illustrated in Table 4, revealed that Shiraz accounts for the highest number of accident-caused deaths in various age groups, except for the fetal group. Marvdasht county had the highest number of accident-caused deaths in fetal group. Other counties presented in Table 4 such as Kazerun, Marvdasht, Fasa and Darab had different statistical population comprised of distinct age groups. It should be noted that counties Abadeh and Jahrom in two age groups fetal and the elderly had a significant average.

The findings gained from the correlation between pedestrians and dark clothes color reveal most of the people who underwent the highest degrees of accidents were middle-aged married men (41–65), followed by married men higher than 66 years. With regard to the place of accidents, it should be noted that they occurred mostly in Firuzabad-Kavar, Qaemiyeh-Bushehr and then Darab-Fasa, Qaemiyeh-Shiraz, Kazerun-Bushehr.

The findings showed that in the winter, the occurrence of such accidents reached its peak, followed by autumn. The time range of accident occurrence was, according to the statistics, 11:00 a.m., the

highest accident-prone time, followed by 06:00 and 09:00 p.m. Illiterate and elementary educated people, who are respectively housekeepers, self-employed, retired and workers, are the most casualties in traffic accidents. These individuals underwent accidents as a result of collisions with vehicles such as Pride, Peugeot 405 and Nissan pickup.

The results obtained from the correlation between female and vehicle Pride indicated that such accidents occur among young women aged 19 to 40 who are mostly vehicle or motorcycle passengers. Main roads of Kazerun-Shiraz and Kazerun-Bushehr, respectively, account for the largest degrees of accidents occurred by members of this group. The highest number of accidents took place in spring at time ranges of 03:00, 04:00 and 06:00 p.m. In terms of educational status, these women were mostly illiterates and then elementary educated, working as housekeepers and subsequently students.

The results obtained from the correlation between children and vehicle collision with pedestrians indicated that male children were more likely to sustain traffic accidents compared to female children. Such accidents took place mostly in summer and then spring at time periods of 05:00 p.m., then 11:00 a.m. and finally soaring up at 06:00 p.m. Main streets and outer-city routes of Shiraz-Isfahan and Qaemiyeh-Bushehr located in main roads account for the largest degrees of accidents occurred to students, who were died of collision mostly with vehicles such as Pride, Nissan pickup and Peugeot 405.

Discussion

The present study carried out aiming to explore the hidden mortality patterns caused by road traffic accidents and their related factors in Fars Province.

It should be noted that results obtained in this study are in line with those of other studies performed in various parts of the world. In most of the cases, the results proved the mortality rate caused by road accidents in different areas of the world such as 22 November 2009 to 21 November 2010, whereby a total of 3642 accident-caused death cases reported, out of which 78.3% were males and the proportion of females to males was 3:6. It should be noted that time had a large effect on road traffic accidents.¹

Young and middle-aged people predominantly involved in injuries and road traffic accidents. Two-wheeler users sustained maximum road traffic accidents. Human factor was a significant determinant in road traffic accidents (RTAs) and injuries. A majority of victims admitted that human factors were the predominant cause of road accidents; and opined that the events were preventable.²

The number of the car accidents in India is so high that every week about 2650 Indians die in the car accidents and the 30–59 years age group is the most vulnerable. These accidents also take the lives of more males than females.³

Among the number of 1668 people died in road accidents in Fars province during March 21, 2011 to March 19, 2012, 1291 (77.4%) were male and 337 (22.6%) were female, aged 21–30 years old. It also concluded that the highest rate of mortality belonged to illiterate people. Also, large degrees of mortality rate belonged to cyclists, particularly motorists who did not use helmets and in case of vehicle drivers, accidents-caused deaths were due to not fastening their seatbelts.⁴ Additionally, in other studies conducted on the mortality rate caused by road accidents from March 2009 to June 2010 in Fars province, it reported that 2345 cases led to deaths, comprised of 542 (23%) cases of motor vehicles with the age range of 15–35 and the male to female ratio was 28. In this group of victims, damage to head (due to not using helmet) was the commonest causes of mortality, because of the victims' low social,

Table 4
Age group and accident location.

Age group (years)	Location
Fetal (during being in womb)	The counties where death cases took place respectively, Marvdasht, Shiraz, Abadeh and Kazerun
Infants (<1)	The counties where death cases took place respectively, Shiraz, Abadeh, Fasa and Marvdasht.
Child (1–10)	The counties where death cases took place respectively, Shiraz, Marvdasht, Kazerun, and Darab.
Teenager (11–18)	The counties where death cases took place respectively, Shiraz, Kazerun, Marvdasht and Fasa.
Young (19–40)	The counties where death cases took place respectively, Shiraz, Kazerun, Marvdasht and Darab.
Middle-aged (41–65)	The counties where death cases took place respectively, Shiraz, Kazerun, Marvdasht and Darab.
Elderly (≥ 66)	The counties where death cases took place respectively, Shiraz, Marvdasht, Kazerun and Jahrom.

economic and educational levels as well as lack of monitoring and obeying traffic regulations.⁵ On the other hand, 56.1% of lethal accidents took place inside the city whereas 33.1% occurred out of the cities.⁶ Also, given the frequency of age group, namely, 20–30 years old, in road accidents and lower educational levels, 79% of victims were among the people with lower-diploma. Moreover, frequency of 79% of motorists suggests that speed of vehicles should be controlled and necessary changes should be made to the design of motorcycles, plus using safety clothes.⁷ In a study conducted by Kristensen et al.⁸ on the Norway people born in 1967–1976, it indicated that parents' educational levels related with the number of accidents, suggesting that the lower the education, the higher the accident occurrence will be. In addition, another study carried out by Bachani et al.⁹ revealed that the highest degrees of road accidents took place among pedestrians with mean age of 35 years old as reported in years from 2004 to 2009 in Kenya.

According to the research by Yotsutsuji et al.¹⁰ who studied the traffic accidents on the Japanese highways based on the driving speed, drivers' awareness, and the direct relationship between the driving speed and the accidents, the wrong driving speed selected by the drivers on the highways with more curvatures and twists was higher than the straight highways.

Aidoo et al.¹¹ carried out a study in Ghana to identify the effects of the road features on the occurrence of the accidents involving the pedestrians using the actual data. The results from the estimated model indicate that fatal accidents, unclear weather, nighttime conditions, and straight and flat road sections without medians and junctions significantly increase the likelihood that the vehicle driver leave the scene after hitting a pedestrian. These researchers concluded that the use of the speed humps in the design and construction of the roads and the installation of traffic lights along the roads were among the factors preventing the accidents.

Kar et al.¹² used the data collected from Bhubaneswar (India) in 2012 to conclude that most accidents occur between 12:00 p.m. and 9:00 a.m. and 84% of the accidents occur in the urban areas and on the highways (47%). Motorcycles had the largest share of these accidents, which involved victims in the 18–24 years age group and 68% of the victims were male.

In addition, from 2007 to 2009 on the Thailand highways, Vatanavongs and Sonnarong¹³ analyzed that, there were a total of 2194 accidents recorded in 3 categories including 1455 property damage-only accidents (66.32%), 700 injury accidents (31.90%), and 39 fatal accidents (1.78%). The recorded average speed was approximately 70 km/h and the accidents occurred mainly during the day ($n = 1106$). However, of the 39 fatal accidents, 25 accidents happened at the night time in clear weather conditions (2013). These researchers introduced the driving speed as the main cause of the accidents and suggested that speed control was an important factor in reducing the accidents. They also requested the more careful and precise imposition of the speed limits on different highway parts based on the road geometries to reduce the accidents.

Furthermore, Dapilah et al.¹⁴ studied the traits of the bike riders in the north of Ghana and reported the following results that age, occupation and ownership of motorcycle significantly associated with wearing-helmet. Again, age and alcohol use found to have a significant relationship.

Goel and Sachdeva¹⁵ conducted a study to identify the causes and nature of the accidents, the accident time, and the vehicle type and reported the following findings: head on/rear end collisions, caused mainly due to over speeding/driver's fault account for 46% of the accidents. It seen that trucks/canter/buses found involved in maximum number of accidents (42%). The daytime accidents found to be more than nighttime accidents.

Bardal and Jorgensen¹⁶ conducted investigations in Norway with the following two objectives. They first intended to study the risks and intensity of the accidents on the rural roads in the cold and snowy winter weather (632 km of the Nordland highway in Norway). Afterwards, they assessed the results obtained during winter and summer using the data on the private motor vehicles and heavy vehicles to study and calculate the delay costs, which covered the victims of the traffic accidents and the road closures. They concluded that the heavy vehicles involved in more accidents during winter.¹⁶ Sweden also considered one of the safest traffic zones of the world, but its people suffered 8389 car accidents in 2013. The results also showed that 91% of the seriously injured were transported by car, bike or by foot.¹⁷ The number of the car accidents in Russia is 5–10 times the European countries such as Britain, Netherlands, and Sweden.¹⁸ Given that the road accidents affect the victims and their families (i.e. the job and financial problems), the consequences of the accidents must also be studied along with the causes of these accidents.¹⁹

However, in the present study, the results presented in a more precise fashion, indicating that most of the people who underwent road accidents were self-employed and low educated moreover, with respect to women, they were married housekeepers who lacked normal educational levels. In this study, the consecutive patterns present in the road accidents data identified. It also identified the precise accident locations in accordance with variables such as age, gender, time of accident (season and exact daily time) and type of vehicle so as to provide more precise assistance to the officials and those in charge of taking measures to prevent road accidents. It also recommended that considering the obvious communities, location and time of accidents, using modern and up-to-date technologies as well as special trainings and instructions plus multimedia, consecutive of such accidents controlled and decreased.

Funding

Nil.

Acknowledgements

The authors would like to thank the Dr. Arqavan Dehqani and Dr. Mohammad Zarenezhad for help and consultation.

Ethical statement

This study was approved by Fars legal medicine ethical committee.

Conflicts of interest

This study supported by the Islamic Azad University Safashahr Branch.

References

- Heydari ST, Hoseinzadeh A, Sarikhani Y, et al. Time analysis of fatal traffic accidents in Fars Province. *Chin J Traumatol*. 2013;16:84–88.
- Neelakantan A, Kotwal BA, Ilankumaran M. Determinants of injuries and Road Traffic Accidents amongst service personnel in a large Defence station. *Med J Armed Forces India*. 2017;73:216–221. <https://doi.org/10.1016/j.mjafi.2016.08.002>.
- Singh SK. Road traffic accidents in India: issues and challenges. *Transport Res Procedia*. 2017;25:4708–4719.
- Rakhshani T, Rakhshani F, Asadi ZS, et al. Study of the pattern of mortality caused by traffic accidents (TAs) in the south of Iran. *J Pak Med Assoc*. 2016;66:644–649.
- Heydari ST, Maharlouei N, Foroutan A, et al. Fatal motorcycle accidents in Fars Province, Iran: a community-based survey. *Chin J Traumatol*. 2012;15:222–227.

6. Peymani P, Heydari ST, Hoseinzadeh A, et al. Epidemiological characteristics of fatal pedestrian accidents in Fars Province of Iran: a community-based. *Chin J Traumatol*. 2012;15:279–283.
7. Ghadipasha M, Salari A, Zarenezhad M, et al. One year study of the member of the lower extremities due to injury of traffic accidents referred to the kerman legal medicine center. *Forensic Med Sci J*. 2013;19:215–220.
8. Kristensen P, Kristiansen T, Rehn M, et al. Social inequalities in road traffic deaths at age 16–20 years among all 611 654 Norwegians born between 1967 and 1976: a multilevel analysis. *Inj Prev*. 2012;18:3–9. <https://doi.org/10.1136/ip.2011.031682>.
9. Bachani AM, Koradia P, Herbert HK, et al. Road traffic injuries in Kenya: the health burden and risk factors in two districts. *Traffic Inj Prev*. 2012;13(Suppl. 1):24–30. <https://doi.org/10.1080/15389588.2011.633136>.
10. Yotsutsuji H, Kita H, Xing J, et al. A car-accident rate index for curved roads: a speed choice-based approach. *Transport Res Procedia*. 2017;25:2108–2118. <https://doi.org/10.1016/j.trpro.2017.05.404>.
11. Aidoo EN, Amoh-Gyimah R, Ackaah W. The effect of road and environmental characteristics on pedestrian hit-and-run accidents in Ghana. *Accid Anal Prev*. 2013;53:23–27. <https://doi.org/10.1016/j.aap.2012.12.021>. 2013.
12. Kar S, Das SC, Tiwari A, et al. Pattern of road traffic accidents in Bhubaneswar, Odisha. *Clin Epidemiol Global Health*. 2016;4:115–119.
13. Ratanavaraha V, Suangka S. Impacts of accident severity factors and loss values of crashes on expressways in Thailand. *IATSS Res*. 2014;37:130–136. <https://doi.org/10.1016/j.cegh.2015.07.003>.
14. Dapilah F, Guba BY, Owusu-Sekyere E. Motorcyclist characteristics and traffic behaviour in urban Northern Ghana: implications for road traffic accidents. *J Transport Health*. 2017;4:237–245. <https://doi.org/10.1016/j.jth.2016.03.001>.
15. Goel G, Sachdeva NS. Analysis of road accidents on NH-1 between RD 98 km to 148 km. *Perspect Sci*. 2016;8:392–394. <https://doi.org/10.1016/j.pisc.2016.04.086>.
16. Bardal K, Jørgensen F. Valuing the risk and social costs of road traffic accidents – seasonal variation and the significance of delay costs. *Transport Pol*. 2017;57:10–19. <https://doi.org/10.1016/j.tranpol.2017.03.015>.
17. Berg HY, Ifver J, Hasselberg M. Public health consequences of road traffic injuries – estimation of seriously injured persons based on risk for permanent medical impairment. *Transport Res F Traffic Psychol Behav*. 2016;38:1–6. <https://doi.org/10.1016/j.trf.2015.12.007>.
18. Petrov A. Model of calculation and subsequent assessment of the economic losses of the Ural Federal district subjects in case of death and injury in road traffic accidents. *Transport Res Procedia*. 2017;20:493–498. <https://doi.org/10.1016/j.trpro.2017.01.080>.
19. Másilková M. Health and social consequences of road traffic accidents. *Kontakt*. 2017;19:e43–e47. <https://doi.org/10.1016/j.kontakt.2017.01.007>.