ORIGINAL ARTICLE

High-risk Driving and Its Associated Observable Driving Behaviors, Police Records, and Car Condition: A Case-control Study

Masumeh Daliri[1], MSc;
Hesamuddin Taheri[2], PhD;
Mohammad Fararouei[3], PhD

Abstract

Background: The incidence of traffic accidents in Iran is significantly higher than the global average (more than 17000 deaths a year, mostly young adults). The aim of this study was to determine the risk factors of high-risk drivers based on their observable driving behaviors, police records, and car condition in Fars province (Iran).

Methods: In this case-control study, an interviewer interviewed a random sample (about 1 in 5 of the drivers) of all drivers who were referred to Shiraz traffic accident court from March 21, 2021, to June 21, 2021, due to being involved in a traffic accident. Based on the police report, we interviewed at-fault drivers who caused injurious or fatal traffic accidents as the case group (200 at-fault drivers) and those not-at-fault drivers as the control group (200 not-at-fault drivers). No matching was done. Data were collected using a researcher-made questionnaire filled out through face-to-face interviews with the drivers. Using univariate and multivariate logistic regression, the statistical analyses were conducted in R 4.0.2 software.

Results: In this study, a total of 400 drivers were interviewed, of whom 367 (91.8%) were male. The mean ages of the case and control groups were 32.35 years (SD=9.84) and 31.75 (SD=10.33) years, respectively (P>0.05). In addition, 102 (51.0%) and 95 (47.5%) drivers were married in the case and control groups, respectively. Based on the results of a multiple logistic regression model, statistically significant associations were observed between the risk of being the at-fault driver in an injurious or fatal traffic accident and receiving a traffic ticket due to speeding-overtaking ($OR_{speeding\text{-}overtaking/no\ ticket}$=3.38, 95%CI: 1.75, 6.49, P<0.001), self-reported high-speed driving ($OR_{yes/no}$=2.41, 95%CI: 1.25, 4.63, P=0.008), and having a history of car accident within the recent two years ($OR_{yes/no}$=1.87, 95%CI: 1.11, 3.14, P=0.017).

Conclusion: Our study suggested that among several potential factors, recently receiving traffic tickets due to speeding or overtaking, self-reported speed driving, and recent car accidents may effectively be used to screen out high-risk drivers who will probably cause injurious or fatal car accidents in the future. Intervention measures for the defined high-risk drivers including closer supervision and training programs may reduce the risk of fatal accidents in Iran.

Please cite this article as: Daliri M, Taheri H, Fararouei M. High-risk Driving and Its Associated Observable Driving Behaviors, Police Records, and Car Condition: A Case-control Study. J Health Sci Surveillance Sys. 2024;12(1):66-74.

Keywords: Accident, Traffic, Case-control studies, Distracted driving

[1]Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Department of Social Sciences, Faculty of Literature and Humanities, Islamic Azad University, Jahrom Branch, Shiraz, Iran
[3]Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran

Correspondence:
Mohammad Fararouei, PhD;
Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
Tel: +98 9173107059
Email: fararooei@gmail.com
Received: 22 October 2023
Revised: 26 November 2023
Accepted: 07 December 2023

Introduction

Road traffic accidents (RTAs) are recognized as the most common types of fatal/injurious accidents and considered as major challenges for public health and social development.[1, 2] According to the World Health Organization (WHO), traffic accident is currently the eighth leading cause of death in the world, 73% of which occur among young men under 25 years of age.[3] If no effective interventions are made to reduce the above figures, by 2030, road traffic accident will have been the fifth leading cause of death in the world.[4]

Studies show that human factors account for 70-90% of traffic accidents.[5, 6] However, safe driving is not enough in preventing road traffic accidents as car accidents are also caused by several multidimensional mechanisms including the vehicle condition, infrastructure of the road, and law enforcement.[7, 8] Studies have reported several factors such as gender, employment, and age of the driver, fatigue, driving with no valid license, vehicle safety, visibility, and time of the day that seem to alter the risk of accident and its severity.[9-11]

Although the above factors are undoubtedly important in traffic accidents, they are not globally and practically usable in effectively recognizing high-risk drivers in different communities. For example, researchers from different countries diversely suggest that accidents leading to serious injuries are affected by the driver's age.[10, 12]

In terms of traffic accidents, Iran is ranked fifth in the world, with more than 17000 deaths due to traffic accidents nationally. In Iran, Fars is a large province where the number of traffic accidents is so high that, according to the statistics from the Iranian Forensic Medicine Organization, this province ranks first regarding the number of deaths due to traffic accidents.[13, 14] Despite the importance of injurious and fatal traffic accidents, our knowledge about the contributors of such accidents is sparse as no study was found to investigate this issue in Iran. Therefore, it is important to identify the factors affecting the occurrence of traffic accidents, especially those resulting in injury or death in Iran. In this regard, several studies have been conducted to define high-risk driving behaviors that are involved in injurious traffic accidents. By focusing on the factors detectable by traffic surveillance systems, the aim of this study was to identify the human and observable car factors which contribute to serious (fatal or injurious) traffic accidents. We aimed to investigate if the contributing factors introduced by studies from other countries are also important in Iran and identify Iranian high-risk drivers based on a few remotely measurable/observable behaviors using police records and traffic cameras. By being detected and screened out, high-risk drivers can undergo necessary preventive interventions to reduce the risk they cause and prevent life and economic losses due to these types of accidents.

Methods

Setting

This study was conducted in the capital of Fars province (Shiraz city) with a population of about 1,869,000 individuals. Fars province is in the southern part of Iran with a population of 4851274 individuals with a road coverage of 7367 km. Also, in Iran all car crashes are registered by traffic police and those with serious consequences (injurious or fatal car accidents) are investigated in a court specialized in traffic accidents. All drivers who were selected in the current study had finished the judicial investigation procedures and were about to receive the final court verdict. In this case-control study, the study population consisted of car drivers who were involved in a traffic accident.

Selection of Case and Control Participants

Drivers who were at-fault in an injurious or fatal traffic accident and whose case was being investigated by the court from March 21, 2021 to June 21, 2021 were selected as the case group.

Not-at-fault drivers who were involved in an accident and whose case was being investigated by the court during the above period were selected as the control group. All accidents were recorded and investigated by traffic police officers.

Inclusion Criteria

All drivers were involved in a traffic accident that was being investigated by the traffic accidents court during the study period. Drivers were healthy enough to be interviewed. Vehicle occupants and bicycle and motorcycle riders were not included. Before the interview, a trained interviewer provided the necessary explanations to the selected drivers, and verbal consent was obtained from the participants as a significant number of the drivers were illiterate. The study protocol was reviewed and approved by the research and ethics committee of Shiraz University of Medical Sciences (ethical approval no: IR.SUMS.REC.1400.787).

Sampling and Sample Size Calculation

The participants were selected randomly (about 1 in 5 of the drivers) from drivers who had just finished the judicial investigation procedures and were about to receive the final court verdict. As to the objectives of the research, the drivers answered the questions if they expressed their oral consent (a significant number of the participants were illiterate). The required sample size of the current study was estimated to be 400

for detecting any type of association between being involved in a fatal/injurious car accident as an at-fault driver and recent history of a car accident (n=200 as cases and n=200 as controls).

Data Collection

Data were collected using a researcher-designed questionnaire through a face-to-face interview. The content validity of the questionnaire was approved by a group of experts (two traffic police officers, one epidemiologist, and one health nurse); the reliability of the questionnaire was evaluated using the test-retest approach with a two-week interval (Cronbach's alpha=0.89). Before the interview, a trained interviewer provided the selected drivers with necessary explanations regarding the objectives of the research. The drivers answered the questions if they expressed their oral consent (a significant number of the participants were illiterate). The questionnaire consisted of 4 sections namely demographic status, behavioral factors, driving history, condition of the vehicle, and environmental factors at the time of the accident.

The studied variables included three categories: 1) demographic variables: age (years), gender, marital status (married, other); job (employed/student, self-employed, driver), education (<diploma, diploma, >diploma), perceived income (low, moderate good), and score (a score that drivers gave themselves from zero to ten in terms of compliance with driving rules).

2) driving behaviors: over-speeding (never, sometimes, always), using a mobile phone while driving (never, occasionally, always/ringing), having spiral movement (never, sometimes, always), parking parallelly (never, Sometimes/Always), using the turn signals, contravening red traffic light, contravening zebra crosswalk, wearing a seat belt while driving, cleaning the car (often dirty, often clean, always clean), and replacing defective headlights (replacement period of defective car headlights). All information was self-reported.

3) driving history: driving experience (year), hours of daily driving, date of issuing driving license (<5 years, >=5 years), history of collisions that required refinement, 0-1, >=2), the part of your car that was damaged (front, back, right and left), fines issued since 3 years ago (1-3, >=3), the reason for the last fine issued (no fine, speeding, overtaking, contravening red traffic lights, unauthorized stops, lack of wearing a seat belt, smoked glass, mobile phone use, not having a driving license or insurance, and alcohol consumption), time since the last accident (no accident; <2 years ago; 2-5 years ago; >5 years), and cause of the last accident.

Statistical Analysis

The statistical analyses were carried out using R 4.0.2 software. For descriptive analysis of the quantitative variables, median and interquartile ranges were calculated and for categorical variables, absolute and relative frequencies were used. We used univariate logistic regression to determine the unadjusted associations between the study variables and the odds of being the at-fault drivers in injurious or fatal car accidents. Finally, multivariate logistic regression with a stepwise variable selection strategy was used to measure the adjusted relationships of the study variables with the outcome. The significance level was set at P<0.05.

Also, we used the receiver performance characteristic curve (ROC) and area under the curve (AUC) to measure the ability of the final model (in terms of sensitivity and specificity) in detecting drivers who were prone to cause fatal accidents.[15] AUC <0.5 was considered as no discrimination, 0.7 to 0.8 as acceptable, 0.8 to 0.9 as excellent, and more than 0.9 as prominent.[16]

Results

In this study, a total of 400 drivers were interviewed (200 drivers in each of the case and control groups), of whom 367 (91.8%) were male. The mean ages of the case and control groups were 32.35 years (SD=9.84) and 31.75 (SD=10.33) years, respectively. In addition, 102 (51.0%) and 95 (47.5%) drivers were married in the case and control groups, respectively. Most of the drivers in the case (43.5%) and control groups (46.0%) had finished their mandatory education (diploma) and more than half of the drivers in both groups were self-employed. The perceived income level of about half of the drivers in the two groups was moderate. Also, 25% of people in the case group and 13% in the control group reported a history of alcohol consumption while driving (Table 1).

Table 1 also shows significant unadjusted associations regarding the history of alcohol use (P=0.003), always high-speed driving (P<0.001), always spiral movement (P=0.003), and sometimes/always parallel parking (P=0.015). No statistically significant association was observed regarding the other study variables (Table 1) (P>0.05 for all).

Table 2 shows the results of univariate logistic regression measuring the associations between the driving history of the drivers and vehicle and environmental status at the time of the accident with being the at-fault driver. Statistically significant associationswere observed between car collision location (front, $OR_{yes/no}$=2.03, 95%CI: 1.36, 3.02 P<0.001), (left, $OR_{yes/no}$=1.64, 95%CI: 1.08, 2.50 P=0.020) and (right, $OR_{yes/no}$=1.52, 95%CI: 1.01, 2.28 P=0.041), no of tickets issued since 3 years ago ($OR_{3</no\ ticket}$=2.83, 95%CI: 1.55, 5.16), the reason for tickets issued ($OR_{driving\ fault/no\ ticket}$=3.60, 95%CI: 1.97, 6.60, P<0.001), no traffic accidents within

Table 1: Univariate analysis of the demographic and behavioral characteristics of the participants

Variable	Characteristics	At-fault-drivers N (%)	Not-at-fault drivers N (%)	OR	95% CI	P value
Age	Median (Q1,Q3)	32 (25,37)	30 (25,36)	1.05	0.98-1.02	0.555
Score	Median (Q1,Q3)	7 (6,8)	8 (7,9)	0.85	0.75-0.95	0.007
Gender	Male	183 (91.5%)	184 (92.0%)	1	0.46-1.90	0.856
	Female	17 (8.5%)	16 (7.0%)	0.93		
Job	Employed/student Unemployed	41 (20.5%)	48 (24.0%)	1		
	Self-employed	120 (60.0%)	128 (64.0%)	1.09	0.67-1.78	0.707
	Driver	39 (19.5%)	24 (12.0%)	1.90	0.98-1.67	0.055
Marital status	Married	102 (51.0%)	95 (47.5%)	1	0.58-1.28	0.484
	Single/divorced	98 (49.0%)	105 (52.5%)	0.86		
Education	Diploma<	64 (32.0%)	60 (30.0%)	1		
	Diploma	87 (43.5%)	92 (46.0%)	0.95	0.56-1.62	0.871
	<Diploma	49 (24.5%)	48 (24.0%)	0.60	0.56-1.40	0.887
Perceived income	Good	33 (16.5%)	25 (12.5%)	1		
	Moderate	94 (47.0%)	105 (52.5%)	0.45	0.42-1.46	0.790
	Low	73 (36.5%)	70 (35.0%)	0.19	0.37-1.22	0.678
Alcohol use	No	150 (75.0%)	174 (87.0%)	1	1.32-3.75	0.003
	Yes	50 (25.0%)	26 (13.0%)	2.23		
Keeping distance from the front vehicle	Important	159 (79.5%)	171 (85.5%)	1	0.90-2.56	0.116
	Not important	41 (20.5%)	29 (14.5%)	1.52		
Over speed	Never	37 (18.5%)	57 (28.5%)	1		
	Sometimes	104 (52.0%)	115 (57.5%)	1.39	0.85-2.27	0.186
	Always	59 (29.5%)	28 (14.0%)	3.24	1.76-5.98	<0.001
Mobile use	Never	78 (39.0%)	77 (38.5%)	1		
	Occasionally	55 (27.5%)	69 (34.5%)	1.22	0.49-1.26	0.322
	Always/ringing	67 (33.5%)	54 (27.0%)	1.01	0.76-1.97	0.405
Spiral movement	Never	140 (70.0%)	159 (79.5)	1		
	Sometimes	38 (19.0%)	35 (17.5%)	1.23	0.73-2.05	0.423
	Always	22 (11.0%)	6 (3.0%)	4.16	1.64-10.56	0.003
Parallel parking	Never	73 (36.5%)	97 (48.5%)	1	1.09-2.44	0.015
	Sometimes/Always	127 (63.5%)	103 (51.5%)	1.63		
Using turn signal	Never/Sometimes	41 (20.5%)	37 (18.5%)	1	0.53-1.44	0.614
	Always	159 (79.5%)	163 (81.5%)	0.88		
Contravening red traffic light	Never	157 (78.5%)	160 (80.0%)	1	0.82-1.94	0.276
	Sometimes/always	43 (21.5%)	40 (20.0%)	1.26		
Wearing seat belt	Never	55 (27.5%)	53 (26.5%)	1		
	Sometimes	53 (26.5%)	63 (31.5%)	0.81	0.47-1.37	0.433
	Always	92 (46.0%)	84 (42.0%)	1.05	0.65-1.70	0.825
Contravening zebra crosswalk	Never/ Sometimes	135 (67.5%)	145 (72.5%)	1	0.82-1.94	0.276
	Always	65 (32.5%)	55 (27.5%)	1.26		

3 years ($OR_{2=</no\ accidents}$=2.47, 95%CI: 1.49, 4.11 P<0.001), time since the last accident ($OR_{<2\ years\ ago/no\ accidents}$=2.51, 95%CI: 1.55, 4.08, P<0.001), cause of the last accident ($OR_{driving\ fault/no\ accidents}$=2.06, 95%CI: 1.36, 3.12, P=0.001), and cause of the current accident ($OR_{driving\ fault/other\ fault}$=0.45, 95%CI: 0.23, 0.88, P=0.020). However, no statistically significant association was observed in terms of vehicle refinement frequency, vehicle cleanliness, and replacing defective headlights with being an at-fault driver (P>0.05 for all).

Table 3 shows the results of multiple logistic regression. Based on the results, driving wth highspeed ($OR_{yes/no}$=2.41, 95%CI: 1.25, 4.63, P=0.008), having a history of accident within the recent two years ($OR_{yes/no}$=1.87, 95%CI: 1.11, 3.14, P=0.017), and receiving traffic ticket (due to speed, overtaking) (OR=3.38, 95%CI: 1.75, 6.49, P<0.001) were significantly associated with the risk of being an at-fault driver in a fatal/injurious car accident.

Figure 1 shows the ROC curve in the model prediction. The area under the curve (AUC) value, sensitivity, and specificity of the model were 0.716 (95% CI: 0.666-0.765), 0.82, and 0.51, respectively. The AUC value indicates that the regression model has an acceptable prediction value.

Discussion

Previous studies conducted on driving behaviors affecting traffic accidents have stated that gender influences high-risk driving, as male drivers are more prone to be engaged in high-risk driving behaviors than female drivers.[17, 18] Age is another important factor that can affect high-risk driving behaviors.[17]

Table 2: Univariate analysis of the characteristics of the participants and driving history

Variable	Characteristics	Case-driver N (%)	Control-drive N (%)	OR	95% CI	P value
Driving history(years)	Median (Q1,Q3)	10 (6,16)	10 (6,15)	1.00	0.98-1.02	0.866
Daily driving (hrs/day)	Median (Q1,Q3)	3 (2,5)	2 (1,5)	1.02	0.96-1.08	0.423
Driving license issued	<5 years	59 (29.5%)	56 (28.0%)	1		0.740
	>=5 years	141 (70.5%)	144 (72.0%)	0.92	0.60-1.43	
No of collisions	0-1	139 (69.5%)	155(77.5%)	1		0.071
	>=2	61 (30.5%)	45 (22.5%)	1.51	0.96-2.36	
Front collisions	No	84 (42.0%)	119 (59.5%)	1		<0.001
	Yes	116 (58.0%)	81 (40.5%)	2.03	1.36-3.02	
Back collision	No	162 (81.0%)	164 (82.0%)	1		0.797
	Yes	36 (18.0%)	38 (19.0%)	1.06	0.64-1.77	
Right collision	No	112 (56.0%)	132 (66.0%)	1		0.041
	Yes	88 (44.0%)	68 (34.0%)	1.52	1.01-2.28	
Left collision	No	122 (61.0%)	144 (72.0%)	1		0.020
	Yes	78 (39.0%)	56 (28.0%)	1.64	1.08-2.50	
No of tickets issued in the last 3 years	No ticket	40 (20.0%)	74 (37.0%)	1		
	1-3	114 (57.0%)	96 (38.0%)	2.19	1.37-3.51	0.001
	>3	46 (23.0%)	30 (15.0%)	2.83	1.55-5.16	0.001
Why tickets issued	No ticket	18 (9.0%)	45 (22.5%)	1		
	Driving fault	140 (70.0%)	97 (48.5)	3.60	1.97-6.60	<0.001
	Other faults	42 (21.0%)	58 (29.0%)	1.81	0.92-3.55	0.085
No of traffic accidents within 3 years	0	84 (42.0%)	122 (61.0%)	1		
	1	58 (29.0%)	44 (22.0%)	1.91	1.18-3.09	0.008
	>=2	58 (29.0%)	34 (17.0%)	2.47	1.49-4.11	<0.001
Time since the last accident	No accident	63 (31.5%)	96 (48.0%)	1		
	<2 years	76 (38.0%)	46 (23.0%)	2.51	1.55-4.08	<0.001
	2-5 years	48 (24.0%)	40 (20.0%)	1.82	1.08-3.09	0.025
	>5 years	13 (6.5%)	18 (9.0%)	1.10	0.50-2.40	0.810
Cause of the last accident	No accident	63 (31.5%)	96 (48.0%)	1		
	Driving fault	126 (63.0%)	93 (46.5%)	2.06	1.36-3.12	0.001
	Other causes	11 (5.5%)	11 (5.5%)	1.52	0.62-3.72	0.356
Replacing defective headlights	Immediately	164 (82.0%)	164 (82.0%)	1		
	In free time	36 (18.0%)	36 (18.0%)	1.00	0.60-1.66	0.999
Car cleanliness	Dirty	30 (15.0%)	23 (11.5%)	1		
	Often clean	146 (73.0%)	163 (81.5%)	1.57	0.38-1.23	0.210
	Always clean	24 (12.0%)	14 (7.0%)	0.39	0.55-3.08	0.531
Collision with	Car/bus	98 (49.0%)	91 (45.5%)	1		
	Motorcycle	59 (29.5%)	84 (42.0%)	0.65	0.42-1.01	0.056
	Pedestrian	43 (21.5%)	25 (12.5%)	1.59	0.90-2.82	0.107

Table 3: Multivariate analysis of the association of the study variables with being an at-fault driver in a fatal/injurious car accident

Characteristics	OR	95%CI	P value
Why tickets issued			
No ticket	1		
Speeding-overtake	3.38	1.75, 6.49	<0.001
Other reasons	1.82	0.88, 3.75	0.103
Time since the last accident			
No accident	1		
<2 years	1.87	1.11, 3.14	0.017
2-5 years	1.50	0.86, 2.61	0.148
>5 years	1.07	0.47, 2.44	0.863
Speeding			
Never	1		
Sometimes	1.01	0.59,1.71	0.964
Always	2.41	1.25, 4.63	0.008

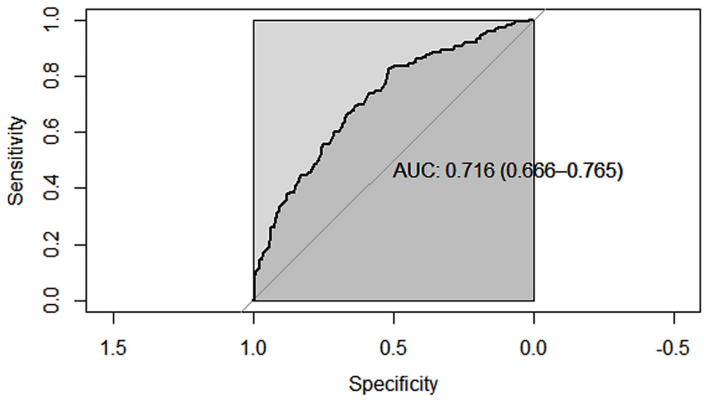

Figure 1: Receiver-operating characteristic curve (ROC curve).

Studies have suggested that younger age and less driving experience are two important driver's related risk factors for severe accidents.[19-21] In addition to gender and age, factors such as alcohol or drug use,[22, 23] education,[21] and salary[24] are also mentioned as contributing factors in severe accidents. The current case-control study was conducted to investigate and identify various factors affecting the incidence of injurious and fatal traffic accidents among Iranians (drivers in Shiraz, the capital of Fars province). For this purpose, we interviewed 400 drivers (200 as the at-fault drivers and 200 as the not-at-fault drivers). The unadjusted results suggested that drivers with a history of parallel parking and spiraling, those with a history of refinement of the front, left, and right of their car, as well as drivers with more than one accident or ticket in the last three years, had a higher risk for being an at-fault driver in an injurious/fatal car accident. According to the results controlled for other variables, driving at high speed, history of traffic tickets due to driving faults (high speed and overtaking), and history of car crashes within the past two years can significantly predict the risk of fatal and injurious traffic accidents caused by a driver.

The results of our study showed that driving at high speeds increased the risk of being an at-fault driver in the fatal and injuries accidents. Our result was consistent with that of another study conducted by Al-Thaifani and Bakhtiyari, suggesting high speed as the most important cause of severe and fatal accidents.[25, 26] Also, studies in China reported that human error could account for 92 percent of all road deaths in the country and speeding was one of the most common contributing factors for fatal traffic accidents.[27, 28] This is because increasing the speed of the vehicle, whether due to ignorance or overconfidence, can make the car difficult to be controlled by the drivers in due time.[29] As a result, braking in emergencies cannot prevent an accident.

According to the results of this study, drivers with a history of traffic tickets due to driving errors such as speeding and overtaking have a higher risk of being an at-fault driver in injurious accidents. Our result is consistent with those of Jørgenrud's study, suggesting that people with a history of high-speed tickets were more likely to be involved in traffic accidents.[20] Also, a study showed that those who had previous driving offenses were at greater risk for future offenses, and having a serious offense during one year of driving almost doubled the likelihood of commencing further serious offenses in the subsequent year.[30] Other studies also stated that increasing the number of driving offenses per year or receiving a driving ticket during the previous 12 months increased the probability of being involved in a fatal or severe accident.[31, 32] Our finding is, however, inconsistent with the reports suggesting that speed ticket policy is associated with a reduction in being involved in severe and fatal accidents.[33, 34] This discrepancy is possibly due to the fact that law enforcement and fining policy in Iran is not adequately preventive of driving offenses.[32]

Based on the results of our study, having a history of an accident less than two years before the current accident increases the risk of being involved in a serious car accident as the at-fault driver. This result is consistent with those of other studies that reported an increased risky driving behavior in relation to having a history of accidents in the past year.[24, 30, 35, 36] For example, drivers with a history of car accidents are more likely to take the risk of dangerous driving or other high-risk behaviors such as speeding offenses.[37, 38] The result is, however, inconsistent with what was reported by Ngueutsa and Kouabenan in Cameroon and Weinstein who noted that being involved in a road accident reduces the possibility of subsequent risky driving, and drivers who had been involved in accidents tended to fear traffic risks more than did those who had not.[39, 40] The result of ROC analysis suggested that the final model can detect high-risk drivers with acceptable accuracy.

Strength and Limitation

Strong points: The strength of this study was the inclusion of all the factors related to traffic accidents, including environmental, human, and vehicle factors with an emphasis on human behavior and a person's driving history, by asking the driver.

Limitation: In our study, the data were collected by interviewing the drivers involved in fatal or injurious traffic accidents. Due to the anonymity of the participants, we had no access to the official data of the drivers, and it was not possible to link the driver's responses to the legal file data to confirm the self-reported data.

Conclusion

The results of our study show that a combination of a few risk factors including driving at high speed, a history of receiving traffic tickets due to speeding and overtaking, and a history of accidents within the last two years can be used to screen-out Iranian high-risk drivers who will probably be involved in serious car accidents. It seems that certain driving behaviors are the major causes of serious traffic accidents in Iran. Therefore, intervention measures such as identifying high-risk drivers (detectable with few observable driving behaviors and police data) and providing them with training programs are possible effective actions to reduce the fatality of car accidents in Iran.

Acknowledgment

Many thanks to Non-Communicable Diseases Research Center, Shiraz University of Medical Sciences, Mr. Abbasi, Head of Fars Province Traffic Department, Mr. Mohammadi, Shiraz Traffic Department Traffic Expert, Dr. Ashrafi, Deputy Chief of Human Resources of Fars Province, Mr. Rahbar, Deputy Chief Justice of Shiraz Public and Revolutionary Courts, Mr. Bustan, the head of the Shiraz Accidents Court, Mr. Ferdowsi, the respected traffic expert of the Shiraz Accidents Court, and all the respected experts of the Shiraz Accidents Court, who cooperated with to finish this study.

Authors Contribution

Conceptualization: Masumeh Daliri, Mohammad Fararouei, Methodology: Masumeh Daliri, Mohammad Fararouei.; Software: Masumeh Daliri, Mohammad Fararouei.; Validation: Masumeh Daliri, Hesamuddin Taheri, Mohammad Fararouei.; Formal analysis: Masumeh Daliri, Mohammad Fararouei.; Investigation Masumeh Daliri, Hesamuddin Taheri, Mohammad Fararouei.; Resources: Masumeh Daliri, Hesamuddin Taheri, Mohammad Fararouei.; Data Curation: Masumeh Daliri, Mohammad Fararouei.; Writing (original draft): Masumeh Daliri, Hesamuddin Taheri, Mohammad Fararouei.; Writing (review & editing): Masumeh Daliri, Hesamuddin Taheri, Mohammad Fararouei.; Visualization Masumeh Daliri, Mohammad Fararouei.; Supervision, Mohammad Fararouei

Funding

Research funded by Shiraz University of Medical Sciences, Grant number: 1400.7883.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by Ethics Committee of Shiraz University of Medical Science. (Protocol code IR.SUMS.REC.1400.787, date of approval: 2022-01-19).

Conflict of Interest: None declared.

References

1 Abegaz T, Gebremedhin S. Magnitude of road traffic accident related injuries and fatalities in Ethiopia. PloS one. 2019;14(1). doi: 10.1371/journal.pone.0202240. PMID: 30695028. PMCID: PMC6350968.

2 Akter T, Pervaz S, editors. Assessing motorcycle accident and injury characteristics in Dhaka Metropolitan City. First International Conference on Urban and Regional Planning (ICURP) Dhaka, Bangladesh. 2019.

3 WHO. Road traffic injuries. 2021.

4 González MPS, Sotos FE, Ponce ÁT. Impact of provincial characteristics on the number of traffic accident victims on interurban roads in Spain. Accident Analysis & Prevention. Accid Anal Prev. 2018;118:178-189. doi: 10.1016/j.aap.2018.02.015. PMID: 29477460.

5 Petridou E, Moustaki M. Human factors in the causation of road traffic crashes. European journal of epidemiology. Eur J Epidemiol. 2000;16(9):819-26. doi: 10.1023/a:1007649804201. PMID: 11297224.

6 Authority CA. Global Fatal Accident Review 1980-96. Civil Aviation Authority London; 1998.

7 de Winter JC, Dodou D. The Driver Behaviour Questionnaire as a predictor of accidents: A meta-analysis. Journal of safety research. J Safety Res. 2010;41(6):463-70. doi: 10.1016/j.jsr.2010.10.007. PMID: 21134510.

8 Bucsuházy K, Matuchová E, Zůvala R, Moravcová P, Kostíková M, Mikulec R. Human factors contributing to the road traffic accident occurrence. Transportation research procedia. 2020;45:555-61. doi: 10.1016/j.trpro.2020.03.057.

9 Zhang G, Yau KK, Chen G. Risk factors associated with traffic violations and accident severity in China. Accident Analysis & Prevention. Accid Anal Prev. 2013;59:18-25. doi: 10.1016/j.aap.2013.05.004. PMID: 23743298.

10 Adanu EK, Jones S. Effects of human-centered factors on crash injury severities. Journal of advanced transportation. 2017;2017.

11 Plankermann K. Human factors as causes for road traffic accidents in the Sultanate of Oman under consideration of road construction designs 2014.

12 Koppel S, Bohensky M, Langford J, Taranto D. Older drivers, crashes and injuries. Traffic injury prevention. Traffic Inj Prev. 2011;12(5):459-67. doi: 10.1080/15389588.2011.580802. PMID: 21972856.

13 LMO ILMO. accidents. 2021.

14 Yadollahi M, Gholamzadeh S. Five-year forecasting deaths caused by traffic accidents in Fars province of Iran. Bulletin of Emergency & Trauma. Bull Emerg Trauma. 2019;7(4):373-380. doi: 10.29252/beat-070406. PMID: 31858000; PMCID: PMC6911725.

15 Das S, Sun X, Wang F, Leboeuf C. Estimating likelihood of future crashes for crash-prone drivers. Journalof traffic and transportation engineering (English edition). 2015;2(3):145-57. doi: 10.1016/j.jtte.2015.03.003.

16 Mandrekar JN. Receiver Operating Characteristic Curve in Diagnostic Test Assessment. Journal of Thoracic Oncology. J Thorac Oncol. 2010;5(9):1315-6. doi: 10.1097/JTO.0b013e3181ec173d. PMID: 20736804.

17 Rhodes N, Pivik K. Age and gender differences in risky driving: The roles of positive affect and risk perception. Accident Analysis & Prevention. Accid Anal Prev. 2011;43(3):923-31. doi: 10.1016/j.aap.2010.11.015. PMID: 21376884.

18 Oviedo-Trespalacios O, Scott-Parker B. The sex disparity in risky driving: A survey of Colombian young drivers. Traffic injury prevention. Traffic Inj Prev. 2018;19(1):9-17. doi: 10.1080/15389588.2017.1333606. PMID: 28548584.

19 Hanrahan RB, Layde PM, Zhu S, Guse CE, Hargarten SW. The association of driver age with traffic injury severity in Wisconsin. Traffic injury prevention. Traffic Inj Prev. 2009;10(4):361-7. doi: 10.1080/15389580902973635. PMID: 19593714. PMCID: PMC4890477.

20 Mullin B, Jackson R, Langley J, Norton R. Increasing age and experience: are both protective against motorcycle injury? A case-control study. Injury Prevention. Inj Prev. 2000;6(1):32-5. doi: 10.1136/ip.6.1.32. PMID: 10728539. PMCID: PMC1730576.

21 Issa Y. Effect of driver's personal characteristics on traffic accidents in Tabuk city in Saudi Arabia. Journal of transport literature. 2016;10:25-9. doi: 10.1590/2238-1031.jtl.v10n3a5.

22 Jørgenrud B, Bogstrand ST, Furuhaugen H, Jamt RE, Vindenes V, Gjerde H. Association between speeding and use of alcohol and medicinal and illegal drugs and involvement in road traffic crashes among motor vehicle drivers. Traffic injury prevention. Traffic Inj Prev. 2018;19(8):779-785. doi: 10.1080/15389588.2018.1518577. PMID: 30681887.

23 Sornpaisarn B, Sornpaisarn S, Shield KD, Rehm J. Alcohol use and injury risk in Thailand: A case-crossover emergency department study. Drug and alcohol review. Drug Alcohol Rev. 2020 Jul;39(5):539-545. doi: 10.1111/dar.13094. PMID: 32515099.

24 Mekonnen TH, Tesfaye YA, Moges HG, Gebremedin RB. Factors associated with risky driving behaviors for road traffic crashes among professional car drivers in Bahirdar city, northwest Ethiopia, 2016: a cross-sectional study. Environmental health and preventive medicine. Environ Health Prev Med. 2019;24(1):17. doi: 10.1186/s12199-019-0772-1. PMID: 30851730. PMCID: PMC6408773.

25 Al-Thaifani AA, Al-Rabeei NA, Dallak AM. Study of the injured persons and the injury pattern in road traffic accident in Sana'a city, Yemen. Advances in Public Health. Article ID 4138163. doi: 10.1155/2016/4138163.

26 Bakhtiyari M, Mehmandar MR, Khezeli M, Latifi A, Jouybari TA, Mansournia MA. Estimating the avoidable burden and population attributable fraction of human risk factors of road traffic injuries in iran: application of penalization, bias reduction and sparse data analysis. International journal of injury control and safety promotion. Int J Inj Contr Saf Promot. 2019;26(4):405-11. doi: 10.1080/17457300.2019.1660374. PMID: 31514568.

27 Zhang X, Hongyan Y, Guoqing H, Mengjing C, Yue G, Xiang H. Basic characteristics of road traffic deaths in China. Iranian journal of public health. Iran J Public Health. 2013;42(1):7-15. PMID: 23515114; PMCID: PMC3595633.

28 Zhang G, Yau KKW, Gong X. Traffic violations in Guangdong Province of China: Speeding and drunk driving. Accident Analysis & Prevention. Accid Anal Prev. 2014;64:30-40. doi: 10.1016/j.aap.2013.11.002. PMID: 24316505.

29 Hadaye RS, Rathod S, Shastri S. A cross-sectional study of epidemiological factors related to road traffic accidents in a metropolitan city. Journal of family medicine and primary care. J Family Med Prim Care. 2020;9(1):168-72. doi: 10.4103/jfmpc.jfmpc_904_19. PMID: 32110585. PMCID: PMC7014833.

30 Elliott MR, Waller PF, Raghunathan TE, Shope JT, Little RJ. Persistence of violation and crash behavior over time. Journal of Safety Research. 2000;31(4):229-42. doi: 10.1016/S0022-4375(00)00042-6.

31 Blows S, Ameratunga S, Ivers RQ, Lo SK, Norton R. Risky driving habits and motor vehicle driver injury. Accident Analysis & Prevention. Accid Anal Prev. 2005;37(4):619-24. doi: 10.1016/j.aap.2005.03.003. PMID: 15949452.

32 Factor R. The effect of traffic tickets on road traffic crashes. Accident Analysis & Prevention. Accid Anal Prev. 2014;64:86-91. doi: 10.1016/j.aap.2013.11.010. PMID: 24342150.

33 Luca DL. Do traffic tickets reduce motor vehicle accidents? Evidence from a natural experiment. Journal of Policy Analysis and Management. 2015;34(1):85-106. doi: 10.2139/ssrn.1939586.

34 Mercan MA. The Relationship between Crash Severity and Speeding Tickets: Lessons from a Nation-wide Survey. Journal of Finance and Economics. 2021;9(3):147-51. doi:10.12691/jfe-9-3-5.

35 Perneger T, Smith GS. The driver's role in fatal two-car crashes: a paired "case-control" study. American journal of epidemiology. Am J Epidemiol. 1991;134(10):1138-45. doi: 10.1093/oxfordjournals.aje.a116017. PMID: 1746524.

36 Fararouei M, Sedaghat Z, Sadat SJ, Shahraki G. Risk factors for being the at-fault driver: A case–control study. Traffic injury prevention. Traffic Inj Prev. 2017;18(3):262-6. doi: 10.1080/15389588.2016.1244604. PMID: 27715286.

37 Chumpawadee U, Homchampa P, Thongkrajai P, Suwanimitr A, Chadbunchachai W. Factors related to motorcycle accident risk behavior among university students in northeastern Thailand. Southeast Asian J Trop Med Public Health. Southeast Asian J Trop Med Public Health. 2015;46(4):805-21. PMID: 26867401.

38 Iversen H, Rundmo T. Personality, risky driving and accident involvement among Norwegian drivers. Personality and Individual Differences. 2002;33(8):1251-63. doi: 10.1016/S0191-8869(02)00010-7.

39 Ngueutsa R, Kouabenan DR. Accident history, risk perception and traffic safe behaviour. Ergonomics. Ergonomics. 2017;60(9):1273-82. doi: 10.1080/00140139.2016.1259508. PMID: 27827567.

40 Weinstein ND. Effects of personal experience on self-protective behavior. Psychological bulletin. Psychol Bull. 1989;105(1):31-50. doi: 10.1037/0033-2909.105.1.31. PMID: 2648439.