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ORIGINAL ARTICLE

Effective factors in the occurrence of road accidents in west Azerbaijan, Iran (2010-2016)

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Abstract

Introduction: Car accidents are the most common accidents and one of the major health problems endangering the health of society. In fact, they are predictable and preventable events that can cost lives and money. The identification of the factors that influence these events can help control and reduce them. The present study aimed to identify the effective factors in the occurrence of road accidents in West Azerbaijan, Iran, during 2010-2016.

Methods: All the traffic accident data recorded by the traffic police of West Azerbaijan during 2010-2016 were used in this cross-sectional study. The data were analyzed descriptively by the Chi-square test and analytically using SPSS software (version 16) and time series using Minitab (version 17).

Results: The data of 79,296 registered accidents were included in the study. Most accidents were reported among males (93.9%) and high school education holders (56%), during 12-18 p.m. (39%) and the day (62%), by light vehicle (65%), disregarding longitudinal and transverse distance (63%), and resulting in damage (53%).

Conclusions: There was a higher frequency of traffic accidents among male drivers holding a diploma. Further investigations are required to determine the contribution of each of the risk factors and plan for the prevention of accidents.

Key words: Accidents, Risk Factor, Trauma

Introduction

According to the reports of the World Health Organization (WHO) released in 2013, 1.24 million (18% of the total) people lose their lives in road accidents, and more than 50 million individuals are injured or disabled. Accordingly, if no effective measure is taken, this number will reach 1.9 million by 2020 (1). According to other reports of the WHO, 400.000 mortalities and more than 4,000,000 injuries occur in Asia, and more than 90% of these mortalities occur in low and middle-income countries, including Africa and the eastern part of the Middle East (2-4).

In the United Arab Emirates, the rate of mortalities resulted from motor vehicle accidents

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is higher, compared to that reported for industrialized countries. In Saudi Arabia, an individual dies each hour due to traffic accidents, and four people are injured (5, 6). In Kuwait, traffic accidents are among the top three causes of mortality (7). Traffic accidents leading to death in Iran are 34.1%, exceeding the global average (18%). Traffic accidents are the second cause of mortality and most common cause of injury (8, 9).

Worldwide accidents are the cause of 12% of disease burden and highest mortality rate, compared to those reported for unintentional accidents (10). In Iran, 29% of disease burden and injury was estimated to be due to intentional and unintentional accidents. The traffic accidents in Iran are responsible for over 1,000,000 and 200,000 years of life loss each year due to disability-adjusted life years (11).

Accident-related mortality in developed countries ranks thirdly after cardiovascular disease and will be the second leading cause of mortality in developing countries by 2020 (12, 13). Traffic-related mortalities will increase by 80% in developing countries and decrease by 30% in developed countries by 2020 (14). More than one-third of hospital beds in countries are devoted to individuals in traffic accidents (15). However, on average, accidents are the ninth leading cause of mortality in the world. In developed countries, including the United States, trauma-related injuries, especially motor vehicle accidents, are the seventh leading cause of mortality (16, 17).

According to the literature, it was shown that 29% of all mortalities in the country are due to traffic accidents (18). The results of a study carried out by Montazeri et al. on the mortalities resulting from traffic accidents in Iran revealed that 79% of the victims were male, and most of them were pedestrians or car travelers aged 40 years or younger. The most common cause of mortality resulting from the accidents was the hit on the head (19).

New technologies are increasing the safety of the roads every day and their impact on human behavior. In addition, the way modern technologies reduce the risk of accidents should be investigated. The identification of human causes and their impact on accident reduction are among the important topics. Based on the evidence, three factors, including driving (i.e., human factors), vehicle, and environmental factors, are involved in the occurrence of accidents (20). A study conducted in the United States in 1997 identified the role of the human factor equal to 57% and role of environmental and road factors equal to 34%, out of which 30% were shared between the environment and humans, and 4% were solely dependent on environmental conditions (11).

Based on the results of studies examining human- and vehicle-related factors, human factors were reported as drowsiness while driving (21), gender (22), age (23), and smoking (24). In addition, vehicle factors include not wearing a seat belt (22), high speed in driving, and level of vehicle safety. Finally, environmental factors, such as the time of the accident in the 24 hours, road design, and traffic laws, are the main causes of accidents (25-27).

In a study conducted by Khodadadizadeh et al., the results showed that most of the accidents occurred between the two vehicles at night (28). In a study conducted by Rostami (29) in Ardebil, Iran, the males within the age range of 21-30 years, low education level, summer, and vehicle were the effective factors in the rate of mortality due to road accidents, and the main cause of mortality was multiple injuries and brain injuries. In a study carried out by Tavakoli et al. (23) in Kerman, Iran, it was observed that being male and young were among the contributing factors in road accidents.

Worldwide investigations show that men have higher traffic accidents than that reported for women. The results of a study in the United States on the young people within the age range of 16-19 years while driving confirm this finding caused by high speed, crossing unauthorized areas, as well as risky driving for recreation and leisure. Furthermore, the results of a study conducted in the country revealed that the cause of most fatal accidents is related to human risk factors, and the prevalence of fatal traffic accidents is higher in inexperienced people (30, 31). According to the findings of a study conducted by Abdollahzadeh et al. in West Azerbaijan, Iran, the role of human factors, including neurobiological factors and factors beyond the control and management of the driver, were involved in the occurrence of road traffic accidents (32).

One of the strengths of this study was the absence of such a study at the provincial level as multiyear and multivariable, with the type of accident, and total annual information of the province whether urban or suburban. The results of studies showed that the seriousness of accidents and their casualties in Iran are recognized among the health problems that directly and indirectly affect the health system. On the other hand, controlling these accidents in some countries indicates the potential for effective interventions to reduce the occurrence of traffic accidents. There are numerous factors affecting driving accidents, and West Azerbaijan is one of the most disaster-

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prone provinces in Iran with widespread casualties, financial loss, and lack of such studies at the provincial level. The present study aimed to identify the effective factors in the occurrence of road traffic accidents in West Azerbaijan during 2010-2016.

Methods

The required data of this cross-sectional descriptive study were obtained from West Azerbaijan police sources. The data of provincial and suburban accidents were obtained from traffic police sources, along with their causes in the three categories resulting in injuries and mortalities. In other words, in the traffic police system, accidents are divided into three categories, including casualty accidents, which is only the vehicle accident, surgical accidents, which cause personal injury, and fatal accidents, which leads to people's death. (33). Datasheets in road police (COM 114) contain many cases; with the guidance of the then provincial police chief, responsible for the office of the applied research of police and on the recommendation of road police statistics experts, the data registered for 2010-2016, according to the driver gender, education, vehicle, type of accident, cause of accident, and accident time were used for the analysis.

The inclusion criteria were the accident location in West Azerbaijan and registry in the traffic police system, and the exclusion criteria were incomplete and unregistered cases in the traffic police system. The data were analyzed descriptively in terms of absolute and relative frequencies and analytically using the Chi-square test, binomial test, and linear regression analysis in SPSS software (version 16) at a significant level of 0.05. The thesis was also approved under the ethics code of IR.UMSU.REC.1396.373 in Urmia University of Medical Sciences in Urmia, Iran.

Results

During 2010-2016, traffic accidents were 76,596 in West Azerbaijan with significantly the highest incidence in 2012 (15.7%), 2011 (15.2%), and 2013 (15.1%), respectively (Table 1; P=0.001). Table 2 tabulates the incidence of accidents reported according to the type of accident. The highest (53%) and lowest (1%) incidence of the accidents led to damage and mortality, respectively (P=0.001). In addition, there was a nondifference between the type of accidents in different years (P=0.001).

In the present study population, the males were more abundant than the females (Table 3; P=0.001). Furthermore, there was a nonsignificant difference between gender proportion in different years (P=0.001) and different types of accidents (P=0.001).

In the present study population, the people with a high school diploma were more likely than others to have accidents. The frequencies of the accidents were reported as 43,646 with a high school diploma, 12,777 with elementary-junior high school, 3,958 with above diploma degrees, 3,134 with illiteracy, and 166 with the ability of reading and writing. Most (56%) accidents led to damage, and only 1% of the accidents resulted in mortality (P=0.001). There was a nonsignificant difference between the type of accidents in different years (P=0.001). Moreover, the results of the present study showed that people with a high school diploma were more likely to involve in an accident than others (Table 3; P≤0/001), and there was a

Table 1: Traffic accidents in West Azerbaijan, Iran, in different years

Year	Total (%)	P-value
2010	11,263 (14.7)	
2011	11,627 (15.2)	
2012	11,997 (15.7)	
2013	11,562 (15.1)	0.001
2014	10,214 (13.3)	
2015	9,728 (12.7)	
2016	10,205 (13.3)	
Total (%)	76,596 (100)	

Table 2: Type of accident distribution in West Azarbaijan, Iran, during 2010-2016

Type of accident Year	Damage (n)	Injury (n)	Death (n)	P-value
2010	7,647	3,557	293	
2011	6,185	5,817	513	
2012	5,729	6,558	492	
2013	4,781	6,355	469	0.001
2014	5,152	4,862	314	
2015	5,251	4,317	285	
2016	5,751	4,742	226	
Total 79,296 (100%)	40,496 (53%)	36,208 (42%)	2,592 (1%)	

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Table 4: Distribution of traffic accidents according to education in West Azerbaijan, Iran, during 2010-2016

Year	Academic degree (n)	Diploma (n)	Primary school/Junior high school (n)	Reading and writing (n)	Illiterate (n)	Undetermined (n)	P-value
2010	517	5,768	2,003	33	457	2,552	
2011	457	6,902	1,891	44	426	2,283	
2012	447	6,850	1,908	43	471	2,339	
2013	459	7,531	1,908	43	394	1,490	0.001
2014	536	6,294	1,683	8	438	1,206	
2015	779	5,110	1,850	16	519	1,408	
2016	763	5,191	2,007	7	429	1,795	
Type of accident							
Damage	2,705	2,1695	7,637	102	1,626	5,602	
Injury	1,191	2,0533	5,137	61	1,427	6,809	0.001
Death	62	1,418	326	3	81	662	
Total 77,077 (100%)	3,958 (5%)	43,646 (56%)	13,100 (17%)	166 (1%)	3,134 (4%)	13,073 (17%)	

Table 5: Distribution of accidents according to time during 2010-2016

Year		Unknown (n)	Day (n)	Night (n)	Sunrise/Sunset (n)	P-value
	2010	541	8,332	2,194	378	
	2011	2,322	7,715	2,186	294	
	2012	3,304	7,744	2,000	294	
	2013	2,756	6,720	2,063	249	0.001
	2014	1,261	7,001	1,835	239	
	2015	2,434	5,840	1,371	208	
	2016	2,665	6,707	1,131	216	
Type of accident						
	Damage	4,761	28,357	6,278	966	0.001
	Injury	9,748	19,818	5,970	822	
	Death	774	774	534	90	
Total 78,892 (100%)		15,283 (19/5%)	48,949 (62%)	12,782 (16/5%)	1,878 (2%)	

nonsignificant difference between education proportion in different years (P=0.001) and different types of accidents (Table 4; P=0.001).

The accidents more frequently (49,359) occurred during the day, and 15,283 accidents were reported as unknown in terms of the time. In addition, the incidence of 12,782 and 1,878 accidents were reported at night and sunrise/sunset, respectively. The highest number of crashes per year was 8,332 during the day in 2010, and 3,308 accidents were reported as unknown in terms of the time in 2012. In addition, 2,186 and 378 accidents were reported at night in 2011 and 2010, respectively.

Most (62%) accidents led to damage, and only 2% of the accidents resulted in mortality (P=0.001). There was a nonsignificant difference between the type of accident in different years (P=0.001). In addition, the results of the present study revealed that people were more frequently at risk of crashing during the day than other times (Table 3; P≤0.001). There was a nonsignificant difference between time proportion in different years (P=0.001) and different types of accidents (P=0.001; Table 5).

The most common causes of the crash were failure to observe the longitudinal and transverse distance in 47,004 cases, failure to control the speed of the car and overturning in 16,376 cases, change of the line to the opposite direction in 6,650 cases, as well as forbidden turn and other causes of damage in 4,202 cases, respectively. Most (63%) accidents led to damage, and only 6% of them resulted in mortality (P=0.001). There was also a nonsignificant difference between the type of accident in different years (P=0.001). The results of the present study showed that failure to observe longitudinal and transverse distance and lack of driving skills were the most important causes of accidents (Table 3; P≤0.001). There was a nonsignificant difference between time proportion in different years (P=0.001) and different types of accidents (Table 6; P=0.001).

The most common causes of accidents were light vehicles (64,179 cases), semi-heavy vehicles (17,317 cases), heavy vehicles (8,621 cases), and

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Table 6: Distribution of traffic accidents during 2010-2016 according to cause of accident

Year	Failure to observe longitudinal and transverse distance (n)	Violation of speed, lack of car control, and overturning (n)	Change of line in opposite direction (n)	Forbidden turn and other causes of loss (n)	P-value
2010	5,637	2,857	1,582	842	
2011	6,846	2,517	1,202	655	
2012	7,210	2,388	1,170	776	
2013	7,013	2,351	1,118	739	0.001
2014	6,113	2,567	897	433	
2015	6,795	2,029	395	293	
2016	7,390	1,738	286	464	
Type of accident					
Damage	24,177	7,038	4,836	2,397	
Injury	21,781	8,247	1,733	1,664	0.001
Death	1,046	1,162	81	121	
Total 78,892 (100%)	47,004 (63%)	16,447 (22%)	6,650 (9%)	4,182 (6%)	

Table 7: Distribution of driving accidents according to vehicle type during 2010-2016

Year	Unknown (n)	Light (n)	Semi-heavy (n)	Heavy (n)	P-value
2010	670	9,611	2,761	1,059	
2011	1,538	9,883	2,807	1,217	
2012	1,383	10,068	2,685	1,285	
2013	204	9,980	2,475	1,260	0.001
2014	322	8,778	2,417	1,293	
2015	580	8,127	2,104	1,303	
2016	1,863	7,732	2,068	1,204	
Type of accident					
Damage	1,929	32,524	9,116	5,277	
Injury	4,366	29,479	2,819	7,394	0.001
Death	265	2,176	807	525	
Total 96,677 (100%)	6,560 (8%)	64,179 (65%)	12,742 (13%)	13,196 (14%)	

unspecified cases (6,560), respectively. Most (65%) accidents led to damage, and only 8% of them resulted in mortality (P=0.001). In addition, there was a nonsignificant difference between the types of accidents in different years (P=0.001). The results of the study showed that light vehicle was the most important cause of accidents (Table 3; P≤0.001), and there was a nonsignificant difference between time proportion in different years (P=0.001) and different types of accidents (Table 7; P=0.001).

Most accidents were in the hours of 12-18 (30,983 cases), 18-24 (26,233 subjects), 6-12 (18,552 individuals), and 0-6 (4,196 people). In the whole study period, the most common cases were (4,881 cases) at 12-18 in 2011, (4,174 subjects) at 14-18 in 2012, (2,756 individuals) at 6-12 in 2015, and (764 people) at 0-6 in 2011. The highest (39%) and lowest (6%) incidence of accidents led to damage and mortality, respectively (P=0.001). Furthermore, there was a nonsignificant difference between the types of accidents in different years (P=0.001). The results of the present study revealed that the interval of 12-18 was the most important period for occurring accidents (Table 3; P≤0.001). Moreover, there was a nonsignificant difference between time proportion in different years (P=0.001) and different types of accidents (Table 8; P=0.001).

Most traffic accidents leading to damages, injuries, and mortalities occurred among the male subjects. Most traffic accidents leading to damages, injuries, and mortalities happened at the diploma level. The difference observed in both cases was statistically significant. The obtained results showed that summer traffic accidents were more frequent, compared to the accidents in other seasons. Despite the large fluctuations in the rate of traffic accidents occurring during the study period, they were decreasing (Diagram 1).

Discussion

According to the obtained results of the present study, 93.9% of the subjects experiencing traffic accidents were male. It was probably due to the higher frequency of male drivers than female drivers, their higher access to vehicles, greater risk-taking, and female driving restrictions on the

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Table 8: Distribution of driving accident according to accident hour during 2010-2016

Year	6-0	12-6	18-12	24-18	P-value
2010	490	2,726	4,556	3,716	
2011	764	2,760	4,881	4,165	
2012	706	2,912	4,949	4,174	
2013	623	2,609	4,638	3,968	0.001
2014	494	2,411	3,969	3,474	
2015	475	2,756	3,896	3,214	
2016	644	2,378	4,094	3,522	
Type of accident					
Damage	1,528	10,155	16,608	12,233	
Injury	2,431	7,870	13,487	13,062	0.001
Death	237	527	888	938	
Total 79,964 (100%)	4,196 (6%)	18,552 (23%)	30,983 (39%)	26,233 (32%)	

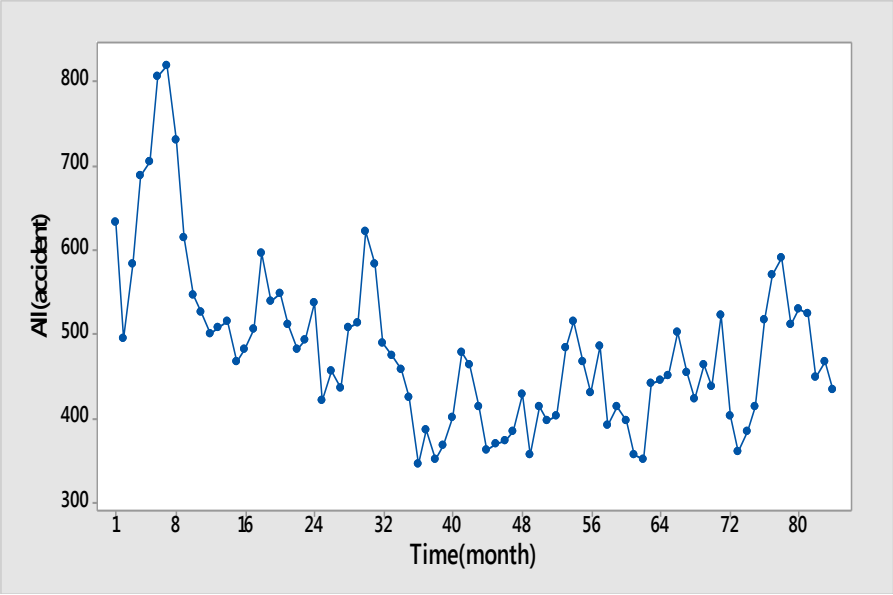

Diagram 1: Traffic accidents trend curve in West Azerbaijan, Iran, during 2010-2016

road. In studies carried out by Akbari et al. and Garkaz et al., the male to female ratio was 4:1, which is consistent with the results of this study (34, 35). In the study conducted by Murlidhar et al. (2004) in India, 84% of the injured subjects were male (36). In Israel, Prato et al. demonstrated that gender is an influential factor in the development of high-risk driving behaviors in young people (37). It was also observed that the incidence of accidents in summer is higher, compared to those in other seasons, which is in line with the findings of other studies (38, 39). This is probably due to the high volume of road traffic at this time of year resulting from the increased number of journeys.

In the present study, the highest frequency of education was at the diploma level, which may be due to the higher number of drivers with a diploma. In a study carried out in Qazvin, Iran, Ahadi and Fahmandi Moghaddam showed that drivers with a PhD had the highest frequency of registered accidents, compared to others. However, in total, the number of diploma drivers was the most frequent regardless of their share of the total population (40). In contrast, Sami et al. in China indicated that the level of education was not related to accidents (41).

In the present study, disregarding longitudinal and transverse distance, not driving the right way, paying no attention to the front, and lacking driving skills were the most common causes of crashes. The conclusion is consistent with the results obtained from studies conducted by Zangabadi et al. (42), Khanjani et al. (43), Khorshidi et al. (44), and Bakhtiari et al. (45). Moreover, 39% of the accidents occurred at the period of 12-18. This finding is not consistent with the results of a study by Masoumi et al. conducted in Ahwaz, Iran, indicating that most accidents

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occurred during 8 p.m. to 2 a.m. (46) and a study by Rezazadeh performed in Khuzestan, Iran, where the most frequent occurrence of traffic accidents was during 6 to 9 a.m. (47). The high frequency of accidents during the day is probably related to the high volume of traffic.

In this study, 62% of the accidents occurred during the day; however, in a study carried out by Vorko-Jović a et al. in Croatia, most accidents occurred at night (23). In a study conducted by Konstantopoulos in England, driving at night was considered dangerous attributed to a decrease in visual acuity and adaptation that can be improved by increasing the driver experience. This risk is higher in older people due to age and vision impairment, compared to that in younger drivers (48). In addition, air lighting directly and indirectly, signs and lights directly, as well as appropriate lighting to observe these signs, condition of the road, and circumstances are indirectly involved in the accidents (49). In this study, the highest frequency of traffic accidents was related to light vehicles. It is consistent with the results of studies by Khanjani et al. in Kerman, Iran, (43) and Adl et al. in Tehran, Iran (50).

As the results show, the frequency of traffic accidents in West Azerbaijan was declining, and the reduction of traffic accidents at the end of each year was due to a sharp increase in the enforcement of traffic laws. The increase in the frequency of traffic accidents at the end of the summer is due to the increased volume of travel. The limitations of this study were the lack of proper collaboration between the traffic departments and access to more details of the traffic accidents, including the information on the number of registered traffic accidents. Moreover, another limitation was the inconsistency of the total number of registered variables for each of them (due to no registration of some variables, their insignificance, and different individuals who recorded the information).

One of the strengths of this study was the inclusion of a large amount of data over a period of several years throughout West Azerbaijan and several multiple variables per year. It is recommended to carry out similar studies in other provinces periodically and for a longer period with a higher number of variables for the identification of the effective factors in the events.

Conclusions

Most of the accidents occurred in this study among the male individuals, subjects with a high school diploma, at the period of 12-18, during the day, by domestic vehicles, and with the lack of longitudinal and transverse distance are the most important variables affecting accident distribution. Considering these factors, as well as designing and implementing effective intervention programs, will have important roles in the reduction of accidents.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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