Resaerch Paper

Identification and Prioritization of Significant Factors in Traffic Casualties of Shiraz-Kazerun Road During the Spring of 2018: An Expert Panel Consensus

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ABSTRACT

Background: Iran has a uniquely catastrophic status for road traffic injury and fatality. Fars province has had the highest number of casualties among the other provinces in recent 5 years. For instance, there are 966 road accident fatalities in 2018. Shiraz-Kazerun road is the deadliest one in Fars province. So, to help the policymakers toward better planning, this study was established to identify and prioritize the significant factors in traffic casualties of the Shiraz-Kazerun road during the spring of 2018 from the experts' point of view.

Materials and Methods: This study was conducted using a three-phase mixed method. The first step was to identify the effective factors in road traffic fatalities using available resources. In the second step, the identified factors were arranged in the form of a checklist and were provided to a team of experts. The important factors were distinguished according to local priorities, availability of data, and the contribution of each factor to the deaths of people. The consensus was considered higher than 75% agreement by experts on each identified factor. In the end, these factors were ranked according to experts' views in the form of a seven-point Likert scale. Data were analyzed using Excel software and mean parameter.

Results: According to panel consensus, 33 out of 41 effective factors were identified in the road traffic accident which were divided into five different categories: driver-pedestrian-passenger, vehicle and equipment, physical environment, non-physical environment, and health services. After analyzing the data, factors of age, seat belts, traffic lanes, police monitoring, and accessibility of the accident scene had the highest values.

Conclusion: This study specifies the need for a systematic and responsive process to evaluate, report, and prioritize the factors affecting road traffic fatalities scientifically. Considering the limitation of resources, policymakers can emphasize more effective factors like fastening seat belts to reduce road traffic accident impacts.

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1. Introduction

Over 3400 people die on the world's roads every day and tens of millions of people are injured or disabled every year [1]. More than 90% of road traffic deaths occur in low- and middle-income countries [2]. Iran, as one of these countries, has a uniquely catastrophic status for road traffic injury and fatality. Global figures show nine deaths per 10000 motor vehicles and Iran's statistics confirmed 37 deaths per 10000 motor vehicles which is more than four times the global average in road traffic injuries and fatalities [3]. According to Legal Medicine Organization's reports, these casualties cover most of the male population and the age group of 18-49 years, which are the working population of the country. Also, Fars province has had the highest number of casualties among the other provinces in recent 5 years. In 2018, 966 out of 1445 people died on the roads [4] and the Shiraz-Kazerun road had the highest number of death [5].

Despite the high mortality rate following traffic accidents, no major steps have been taken. Many studies have mentioned that accidents are predictable and can be largely avoided by safety measures [6]. However, the first step for policymakers to deal with such a risk will be to identify important factors causing them. Factors such as driver, road, vehicle, and environmental conditions have been considered in many epidemic studies [6-16]. However, a few studies have examined factors, such as the level of knowledge and public education [17-19], the effectiveness of traffic laws [20-22], or services in accidents [23-26]. It is necessary to evaluate and monitor all impacts of these factors. Prioritization is deniable by considering the limitation of resources. Nowadays, many techniques are known for developing this process on the type of variables. Therefore, the policymaker can choose the optimal criteria from different ones with multiple quantitative and qualitative nature. The present study was conducted to identify and prioritize the significant factors in traffic casualties of the Shiraz- Kazerun road during the spring of 2018 from the experts' point of view in the context of 16 deaths.

2. Materials and Methods

This study was conducted using a three-phase mixed method. The first step was to identify the effective factors in road traffic fatalities using available resources. In the second step, the identified factors were arranged in the form of a checklist and were provided to a team of 12 experts. In the end, these factors were ranked according to experts' views in the form of a seven-point Likert scale.

Participants

Participants in this study included 12 experts from emergency medical centers (n=4), trauma centers (n=3), police (n=2), forensic medicine (n=1), and road maintenance and transportation organization (n=1). This multidisciplinary panel was invited to regular meetings. Panel members were chosen by related organizations because of their experience and having enough time for attending meetings.

Study population

The study population was the victims of the Shiraz-Kazerun road accidents in the spring of 2018. They included 23 people whose data were collected by the research team based on factors identified in the checklist. If the data for a particular case did not exist completely, that case was excluded. As a result, 16 dead people entered the research.

Procedure

The first step of the research was a literature review which resulted in identifying 38 effective factors in traffic and road casualties. These factors were divided into five different categories: driver-pedestrian-passenger, vehicle and equipment, physical environment, non-physical environment, and health services.

In the second step, the identified factors were set in the form of a checklist. Then, it was provided to a team of experts from emergency medical centers, trauma centers, police, forensic medicine, and road maintenance and transportation organization in two stages. A total of 12 and 10 experts participated in the first and second stages respectively. Each of the factors and their categories was examined in terms of relevance, transparency, necessity, specification, and classification. At last, this checklist was reviewed by taking a 3-person pilot from the Shiraz-Kazerun road.

In the third step, the final checklist was given to a team of 5 experts during the meetings. Then, all the collected data about each case was provided to the experts based on the factors and specific codes of victims. After that, experts were asked to assign the appropriate weight to the victim by examining the dimensions of the accident and the cause of death without knowing other opinions. These weights were in the form of a 7-point Likert scale (low=1, high=7), which were assigned based on the importance and necessity of each factor in the death.

Statistical analysis

According to previous studies, an agreement above 75% is considered the consensus of experts on factors. The collected data were entered into the Excel table to determine the priority of each factor and the mean was calculated. Then, each of the factors was reported according to the importance and priority in the death of individuals based on categories.

3. Results

Based on the consensus of experts, the final checklist consisted of five different categories: driver/pedestrian/passenger (n=8 factors), vehicles and equipment (n=7 factors), physical environment (n=9 factors), non-physical environment (n=2 factors) and health service (n=7 factors). These factors and their categories are reported in Table 1. As can be seen, five factors in 1 and 4 categories have been removed due to lack of data and the consensus was reached 100% in the second round for all factors. Only factors such as the effectiveness of traffic laws, traffic safety awareness, cultural agents, and insurance in the non-physical environment category reached less agreement in the first round.

Driver/Pedestrian/Passenger

Table 2 presents the means of weights assigned by the panel. According to the experts' view, the lowest and highest mean scores were related to physical disability and age respectively. Gender, behavioral issues, and job

Table 1. Factors, their categories, and expert's consensus

Category	Factors	Definition	Round 1	Round 2
			No.(%)	
			Agreement	
1. Driver / pedestrian / passenger	Age		12(100)	10(100)
	Gender		12(100)	10(100)
	Driving record	Driving license - records of fines and violations (deleted due to lack of data)	12(100)	10(100)
	Behavioral issues	Under the influence of drugs/alcohol - mental illness - asleep- mental state (acceleration, recklessness, carelessness, etc.) - distraction (mobile - children – other passengers- environment - eating and drinking)	12(100)	10(100)
	Physical disability	Specific disease - handicap	12(100)	10(100)
	Degree of education		12(100)	10(100)
	Income	(Deleted due to lack of data)	12(100)	10(100)
	Job		12(100)	10(100)
	Marital status		12(100)	10(100)
	Familiarity with The road	Native - non-native	12(100)	10(100)
2. Vehicles and equipment	Car type & model		12(100)	10(100)
	Automotive defect	Automotive Defect sheet - defect in the car	12(100)	10(100)
	Number of passengers		12(100)	10(100)
	Speed	Depending on the type of road and driving rules	12(100)	10(100)
	Seat belt / helmet		12(100)	10(100)
	Car safety equipment	Airbag - anti-lock braking system (ABS) - automatic emergency brake - blind spot monitoring system - adaptive HID lighting system - tire Pressure surveillance system (TPMS) - night vision imaging system (NVIS) - lane departure warning system (LDW)	12(100)	10(100)
	Gas burning car		12(100)	10(100)

Category	Factors	Definition	Round 1	Round 2
			No.(%)	
			Agreement	
3. Physical environment	Roadway characteristics	Straight and level/straight at hillcrest/straight in sag – curve and level/curve at hillcrest/curve in sag -straight and grade - curve and grade	12(100)	10(100)
	Traffic lanes	One lane- multi-lane	12(100)	10(100)
	Road defect	Road repair, potholes, surface deterioration, edge failure, cracking, rutting, and subsidence.	12(100)	10(100)
	Road safety	Signboard - road shoulder - speed camera - traffic lines	12(100)	10(100)
	Sight level	Lighting conditions, weather conditions, pedestrian clothing color	12(100)	10(100)
	Weather Conditions	Clear or partly cloudy - cloudy - severe crosswind - sleet or hail or freezing rain - snowing/raining - fog or smog or smoke/blowing sand or dirt	12(100)	10(100)
	Month	The months when exposure increases (March - April - July - August – September)	12(100)	10(100)
	Day of week	The days when exposure increases (Saturday-weekend (from 17:00 Thursday to 23:59 Friday) - official holiday)	12(100)	10(100)
	Time of day	The time when exposure increases	12(100)	10(100)
4. Non-physical environment	Effectiveness of traffic laws	(Deleted due to lack of data)	12(100)	10(100)
	Traffic safety awareness	(Deleted due to lack of data)	12(100)	10(100)
	Cultural agents	(Deleted due to lack of data)	12(100)	10(100)
	Car insurance	Bodily injury liability – collision and comprehensive.	12(100)	10(100)
	Police supervision		12(100)	10(100)
5. Health service	Access to the scene	Insecure environment – locked doors – car falling off – opened the way for relief	12(100)	10(100)
	Scene security	Police presence - controlling the scene	12(100)	10(100)
	Transfer time	Arrival – delivery of the patient (depending on distance)	12(100)	10(100)
	Relief equipment	Equipment of ambulance – firefighting - Red Crescent and road organization	12(100)	10(100)
	Therapeutic measures		12(100)	10(100)
	Safe transfer	EMS - personal - Red Crescent vehicles	12(100)	10(100)
	Hospital care	Waiting time - doctors - equipment - mistakes or hospital infections - hospital type	12(100)	10(100)

Table 2. Means of assigned weights in the driver /passenger /pedestrian category

Case	Driver/pedestrian/Passenger							
	Age	Gender	Behavioral Issues	Physical Disability	Degree of Education	Job	Marital Status	Familiarity With the Road
1	5.3	3.8	2.0	1.3	1.3	4.0	2.3	2.5
2	2.5	2.8	6.0	1.0	1.3	2.5	2.0	4.5
3	2.0	2.8	1.8	1.0	3.5	3.0	1.8	1.8
4	4.5	3.3	2.5	1.0	2.0	2.5	2.5	1.8
5	2.0	2.0	1.0	1.0	3.3	3.5	3.0	1.3
6	4.8	2.5	1.8	1.0	1.8	2.8	2.0	1.3
7	2.5	2.3	1.3	1.3	3.8	3.5	2.0	4.5
8	2.8	3.0	1.0	1.0	3.3	3.3	2.0	2.0
9	3.8	3.3	1.0	1.0	4.8	2.3	1.8	1.5
10	2.8	2.3	1.0	1.0	3.5	2.8	1.8	1.5
11	2.5	2.5	6.5	1.0	2.5	2.5	2.3	1.5
12	2.0	2.3	6.5	1.0	2.0	2.3	2.3	1.0
13	3.0	3.0	6.8	1.0	1.8	2.3	1.8	2.8
14	2.8	2.8	1.0	1.0	1.8	2.3	1.8	1.3
15	5.8	3.0	1.5	2.0	2.8	2.3	1.8	1.0
16	3.8	2.5	1.0	1.8	2.0	1.8	1.8	1.0
sum	52.5	43.8	42.5	18.3	41.0	43.3	32.5	31.0
%	4.18	3.48	3.38	1.45	3.26	3.44	2.58	2.46

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were also influential factors with little difference in their sum of means.

Vehicles and Equipment

Table 3 also shows the means of weights related to the vehicle and equipment categories, separately. Also, this table shows the important role of wearing a seat belt in the death of 16 cases. The lowest score was assigned to gas-burning cars and then automotive defects.

Physical environment

In Table 4, the four factors of traffic lanes, time of day, roadway characteristics, and road safety have had the greatest effect on the death of cases, respectively. The lowest scores were related to weather conditions and road defects.

Non-physical environment and health service

In this Table, two categories of non-physical environment and health services are reported together. Police supervision had the highest effect on the deaths of 16 people examined in the non-physical environment. Access to the scene had also been the most important factor in the health service. As seen, the safe transfer was the second affected factor from the experts' point of view.

4. Discussion

This study through the agreement of experts has evaluated the effective factors in 16 deaths caused by acci-

Table 3. Means of Assigned Weights in the vehicle and equipment category

Case	Vehicles and Equipment						
	Car Type & Model	Automotive Defect	Number of Passengers	Speed	Seat Belt / Helmet	Car Safety Equipment	Gas Burning Car
1	2.8	1.5	1.8	5.0	6.3	3.0	3.3
2	5.8	1.5	2.3	6.0	5.5	6.3	1.0
3	6.0	1.8	2.5	3.0	6.3	6.3	1.5
4	3.3	1.0	2.3	2.3	6.3	3.3	1.5
5	6.3	1.0	1.0	6.5	5.5	4.5	1.3
6	4.0	1.3	1.8	5.8	5.5	4.5	2.5
7	5.8	1.3	2.0	4.5	5.5	5.8	2.0
8	4.5	1.8	1.3	3.3	6.0	4.5	1.0
9	4.8	5.8	1.0	5.5	6.8	5.3	1.0
10	3.0	1.5	1.0	2.3	6.0	1.8	1.5
11	5.5	1.5	1.8	5.5	6.5	5.8	1.0
12	5.5	1.5	1.8	5.5	6.5	5.8	1.0
13	5.5	2.0	1.5	4.5	6.5	5.8	1.3
14	2.5	1.0	1.8	5.3	6.5	1.5	1.0
15	2.8	1.0	2.0	5.8	6.5	2.3	1.0
16	2.8	1.0	2.0	5.8	6.5	2.3	1.0
sum	70.5	26.3	27.5	76.3	98.5	68.3	22.8
%	5.61	2.09	2.18	6.07	7.84	5.43	1.81

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dents in the Shiraz-Kazeron road during the spring of 2018. The Shiraz-Kazeron road is one of the deadliest one in Fars Province. On the other hand, Fars Province has the first rank of deaths caused by traffic and road accidents among other provinces of the country. Therefore, the present study includes two key findings for the officials: Effective factors on deaths caused by traffic and road accidents based on local data, and prioritization of these factors based on one of the high-casualty road of this province. In a study conducted by Hassan et al. in the United Arab Emirates, 12 effective factors were evaluated and analyzed [6]. In another study conducted by Zhang et al, 23 factors were investigated in the form of 4 categories including human, road, vehicle, and environment [10]. In many studies, the effective factors in traffic and road accidents are examined separately or in the form of classifications [6-26]. However, such an approach is not used in any of these studies. Therefore, this study by discussing and exchanging experts' ideas on 16 deceased, despite the restrictions, was able to analyze and review 33 factors affecting traffic accidents. In the first round of meetings to identify the effective factors, all experts agreed with each category and its factors, and only four factors from the non-physical category did not achieve a complete agreement. In the second round, these factors also received a 100 % agreement. Also, some factors were merged. For example, the Car type & model factor, which separated before, was merged based on experts' opinions.

According to experts, the age of the driver/passenger/pedestrian category was assigned the highest

Table 4. Means of assigned weights in the physical environment category

Case	Physical Environment								
	Roadway Characteristics	Traffic Lanes	Road Defect	Road Safety	Sight Level	Weather Conditions	Month	Day of Week	Time of Day
1	1.8	2.8	1.0	1.8	1.3	1.0	3.8	2.5	2.5
2	1.8	3.8	1.3	2.0	1.3	1.5	3.8	2.0	4.3
3	2.3	2.0	1.0	2.8	1.0	1.5	4.0	3.5	2.0
4	1.8	2.3	1.3	2.0	5.5	1.5	4.0	4.0	6.0
5	1.5	4.3	1.5	2.8	2.5	1.8	2.5	3.8	4.0
6	3.5	4.3	3.0	4.0	4.8	1.8	2.3	3.5	4.0
7	3.5	4.3	1.3	2.0	1.5	1.5	1.8	2.0	2.5
8	4.0	3.5	1.5	4.3	2.3	1.5	1.3	3.3	2.0
9	4.5	3.3	2.0	4.0	5.5	1.3	1.3	2.8	5.0
10	3.5	3.8	1.5	3.0	1.3	1.3	1.3	1.3	2.0
11	4.0	4.0	1.3	3.3	2.0	1.5	3.8	3.8	2.5
12	4.0	4.0	1.3	3.3	2.0	1.5	3.8	3.8	2.5
13	5.0	4.3	1.5	1.8	1.8	1.3	3.5	4.0	2.8
14	2.5	2.5	1.0	3.0	1.3	1.3	1.5	1.5	2.8
15	2.5	4.0	1.3	3.8	1.5	1.3	1.5	1.5	2.0
16	2.5	4.0	1.3	3.8	1.5	1.3	1.5	1.5	2.0
sum	48.5	56.8	22.8	47.3	36.8	22.5	41.3	44.5	48.8
%	3.86	4.51	1.81	3.76	2.92	1.79	3.28	3.54	3.88

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score. The age range of the deceased people was between 19 and 77 years. Four of them were between 19 and 30 years old, 6 people were between 30 and 40 years old, and the rest were over 40 years old. Also, 3 deceased people were women and the rest were men. In this study, gender was the second most influential factor in the driver/passenger/pedestrian factor. According to previous studies [27-31], the male gender has contributed more to the casualties caused by traffic accidents. Although carelessness and distraction were mentioned only for 3 cases in the behavioral issue, the score of these factors according to experts were the highest (6 and 7 from Likert scale) and it is considered the fourth effective factor. The educational qualification of all the deceased was a diploma or sub-diploma. For this reason, this factor had the fifth rank in terms of influence on the driver/pedestrian/passenger category. Since all the deceased did not have any special physical problems, the lowest score was assigned to the physical disability factor in this category.

In the vehicle and equipment factor, the safety belt was assigned the highest score. Despite the existence of traffic laws requiring the wearing of seat belts, most deceased did not wear seat belts. Also, the car type of 6 deceased was a Pride and 2 of them were motorcycle drivers. According to forensic reports, the Pride car is the record holder of vehicles in deaths caused by traffic and road accidents in Iran [32]. Also, studies showed a significant number of male deaths

Table 5. Means of assigned weights in the non-physical environment and health service category

Case	Non-physical Environment	Health Service							
	Car Insurance	Police Supervision	Access to the Scene	Scene Security	Transfer Time	Relief Equipment	Therapeutic Measures	Safe Transfer	Hospital Care
1	1.0	2.0	1.3	1.5	1.0	1.0	1.0	1.0	1.0
2	1.0	1.8	3.0	1.5	1.3	1.0	1.0	1.0	1.0
3	1.0	2.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0
4	1.0	2.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5	2.5	1.8	2.5	1.0	1.0	1.0	1.0	1.0	1.0
6	1.8	2.3	1.8	1.5	1.0	1.0	1.0	1.0	1.0
7	1.0	1.5	1.3	1.0	1.0	1.0	1.0	1.0	1.0
8	1.0	2.3	1.8	1.0	1.5	1.0	1.0	1.0	1.0
9	1.3	1.8	1.5	1.0	1.0	1.0	1.0	1.0	1.0
10	1.0	2.0	1.8	1.3	1.3	1.3	1.3	1.3	1.3
11	1.0	2.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0
12	1.0	2.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0
13	1.0	2.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0
14	1.0	1.5	1.5	1.0	2.5	1.5	1.5	1.3	1.0
15	1.0	2.0	4.8	1.8	2.8	1.5	1.5	1.5	1.0
16	1.0	2.0	4.8	1.8	2.8	1.5	1.5	1.5	1.0
sum	18.5	31.0	32.0	19.3	22.0	17.8	17.8	17.5	16.3
%	1.47	2.46	2.54	1.53	1.75	1.41	1.41	1.39	1.29

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used motorcycles [30, 31]. Out of the 14 cars, only 4 cars were dual-fuel cars, and no fire was reported at the scene of the accident. Therefore, the subcategory of the dual-fuel car had the least impact in the death of people according to experts. Since few studies have been conducted in the field of evaluating the special conditions of dual-fuel vehicles and their impact on the death of people in traffic and road accidents, it can be considered as a suggestion for future research. Also, the technical defect was the other factor in vehicle and equipment category with low impact. According to the experts' opinions, the presence of a technical examination sheet stating vehicle health monitoring and analysis had greatly reduced this impact.

Traffic lanes were the most effective factor in the physical environment category. It should be mentioned that the Shiraz-Kazeron road has one-lane lines with two round-trip routes in some places. Twelve deaths had accidents in places where the lanes have one. Also, the weather had been mostly clear to partly cloudy in this period. Therefore, this factor had the least impact to the death of people according to experts. As it was reported in the findings, police sur-

veillance in the non-physical environment category was assigned the highest score, and this surveillance was mostly through vehicles. Three factors included Effectiveness of traffic laws, Traffic safety awareness, and Cultural agents despite their impacts [15-17] were removed due to a lack of data. In a study conducted by Madani and Jenahi, only half of the drivers understood the warning signs correctly [17]. Therefore, evaluating the impact of these factors on deaths caused by traffic and road accidents can be an interesting topic for researchers. The last effective category in the death caused by traffic accidents was Health service. This category, with 7 factors, did not have a significant score in the death of 16 examined cases because 15 person died at the scene of the accident. Only the factor of Access to the scene had a higher score among others. Therefore, in this study, it was not possible to make a correct judgment about the score of the health service.

5. Conclusion

Based on the ranking, the highest score was assigned to six factors including seat belt, speed, car type and model, car safety equipment, traffic lanes, and finally age. This study scientifically specified the necessity of creating a systematic and responsive process to evaluate, report and prioritize the effective factors in casualties caused by traffic and road accidents. The agreed factors identified in this study indicate the joint goals of the organizations to provide advance and comprehensive services in Fars Province and help to implement high-level programs to reduce deaths caused by traffic and road accidents in a local area. To prevent or reduce the impacts of factors identified in such deaths, these factors can be divided into two categories, individual and organizational level. Factors, such as wearing a seat belt, speed, mood, job, etc. relate on the individual level, and education and culture will be the main key to reducing or eliminating their negative impacts. Also, most of the factors of the Health service, physical and non-physical environment will include the category of organization level, which requires the unity of the relevant organizations and the improvement of infrastructure and coordination despite the measures taken.

Limitations

The main limitations of this study is the lack of complete and accurate data on the deaths, which was tried to be controlled by limiting the sample size and using experts' opinions. Of course, the use of expert opinion has limitations, including human error. In addition, the lack of financial and professional resources is another limitation.

Ethical Considerations

Compliance with ethical guidelines

The authors declare that they have no known competing financial interests or personal relationships which could have influenced the work reported in this paper.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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