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Effective Factors prioritizing the Decreasing Rate of Accidents in Iran Freeways

Madji Jinlou
Department of Transportation Engineering
K. N. Toosi University of Technology of Tehran
Iran

ABSTRACT

Traffic accidents is one of the causes for death, serious financial and bodily harms and its significant social, economic and cultural consequences threatens the societies seriously. Iran's ground transportation system is one of the most eventful transportation systems in the world and mortality rate and financial harms cost too much for the country in national aspect. Therefore, we have presented a data collection by referring to recorded statistics of the accidents occurred in freeways from 2013 to 2015. These statistics are recorded in different related data bases, generally police and road transportation system. The data is separated and arranged in tables and after preparing, processing and prioritizing the factors, the achieved collection is presented to the departments, managers and researchers to help them suggest practical solutions.

Keywords: Death, Drowsiness, Freeways Accidents, Humane Causes, Tiredness

Introduction

Road accidents demand an international responsibility; this matter is most noticeable in poor or developing countries which allocate 90% of road accident deaths to them. Road accidents caused 1.4 million deaths in 2013, which are more than 1.1 million deaths in 1990. About 68,000 of these occurred among children less than 5 years (GBD). According to the World Health Organization statistics, about 685,611 accidents cause injury and 22918 cause death. The average rate of injury and death in the world is 3 people per 10,000 vehicles, while this rate in Iran is the 33 persons in 10,000 (Nikzad MF. 2006). The reasons for this may include the young population of Iran, lack of common culture of personal automobiles, and popular approach to the use of public transport, non-standard design of roads, freeways, and vehicles(Bhalla K, Naghavi M, Shahraz S. 2009). In fact, road accidents are considered third reason of death in Iran.

On the other hand, analyzing the number of road accidents during a specified period of time is among the most common methods to determine the factors to be considered in the likelihood of accidents. Therefore, this study is conducted with the goal to collect a vast amount of data related to factors in accidents taken place in a freeway and to categorize and analyze them in order to obtain key results to promote freeways and

public road managers and planners' knowledge. Data collected includes statistics of freeway accidents in years 91 to 93 which are among the most serious record statistics. Data are collected from different databases and related services, mainly belonging to the police and road transport organization. The special feature of this research is that for the first time in Iran all the factors in the freeway accidents for three consecutive years and has been piecing together in the latest statistics so not only to make a powerful tool for traffic control facility managers and planners but also can make a complete reference for researchers in the field.

Accident Investigation Models at a Specified Time

Models used to analyze vehicle crashes within a specified period, include a wide range of data which in short include: Poisson model(Jovanis P, Chang H. 1989),negative binomial models, Poisson log-normal model, Poisson models Conway- Maxwell, Gamma models, model of overall formula, (2009, Mahlawat), Extensions of the cumulative model(Li X, Lord D, Zhang Y. 2011 & Mohammadi F 2012), a random effects model , positive multiple models , random parameter model counters , models compositing and Makov switching.

Speed

Speeding has been a problem for traffic engineers for a long time, serial overtaking is of acceleration, brake and steer the car measures when the driver is forced to viewing, analysis and making decisions before or simultaneously to adopt appropriate response in various situations (HCM, 2009). Of the research conducted in this regard include models in terms of the distance vision, lateral displacement during overtaking(Charlton SG. 2007), the speed of both cars in the act of overtaking and also observation of the distance(Polus A, Livneh M, Frischer B. 2005). Such a study will show that younger drivers tend to understand the differences between the intelligible speeds, while they may be due to inexperience and recklessness reaction with less impact to show(Bar-Gera H, Shinar D, 2005). Other notable results achieved in previous studies modeling based on statistical inference has been written.

A thoughtful look at the study in this regard shows that young drivers' behavior during overtaking and speeding has not yet been systematically discussed. Tendency to such study will show that younger drivers tend to understand the intelligible speeds differently; meanwhile they may project reactions with less impact due to inexperience and recklessness(Bar-Gera H, Shinar D, 2005). Of other notable results achieved in previous studies, modeling has been created based on statistical inference.

Fatigue Factor

The rapid progress of motorization in recent years has caused severe losses due to accidents and traffic jams. That proves driver fatigue has now become a major cause of accidents and deaths. Approximately, 32% of drivers in America are driving while tired at least once a month. In addition, 16.5% of accidents related to fatigue driving result in

death and 12.5% result in injury. In addition, 20% of all accidents worldwide, are related to driver sleepiness factor(Fernandes R, Hatfield J, Job RFS 2004 & Xie Y, Zhang Y. 2008). Drivers in developing countries are more likely to drive while tired and sleepy, that this is due to their economic and financial reasons(Smith S, Carrington M, Trinder J. 2005). However, the potential dangers of driving fatigue have not been fully investigated. Some researches in America, Australia, and Norway found that many people are still driving while tired and are unaware of its consequences, however, people may take measures such as opening windows, listen to music to stop your tiredness while driving, but few of these methods are effective. So driving fatigue is called "silent killer".

Many studies that have been done on the impact of driving fatigue by individual factors such as gender or age of the driver(Hatfield J, Murphy S, Kasparian N, Job R 2005),found that 50% of drivers in southwestern England who are driving while tired are men and less than 30 years. Risk Management Research Center of South Wales found that 50% of young drivers, who are fatigued drivers, insist on driving despite tiredness(NHTSA, 1998). High-risk driving groups in America, including male drivers between the ages of 16 to 29 years, drivers who work irregular shifts, are drivers who suffer from sleep deprivation(Toscano G, Windau J 1994). Also about 25% of fatal accidents in The US and more than 20% of accidents in Denmark, Finland, and Norway are linked to these conditions(Zucconi M. 2001).

Of the other studies conducted, the study of Marco Zucconi(Milia LD, Smolensky MH, Costa G, Howarth HD, Ohayon MM, Philip P. 2011),can be mentioned which examines the random distribution within 24 hours, selective study of this research was conducted over a period of four years and the results of this study indicates that the peak accident hours are approximately 23:00, 1: 00, which may be related to factor of drowsiness. In(Soleimani M. 2009),reviewed the literature on the relationship between demographic variables (eg, age, gender, race, and socio-economic Statement) with the fatigue factor. This study also examines the potential impact of their interaction with some work shifts, commuting time, and professional features of the people, and ultimately barriers of communication including lack of a common definition in the framework of this communication, the Duma, although fatigue factor with the use of various schemes were discussed.

Other Studies on Road Accidents

Developed countries with the pace of industrial growth and excellence of science are facing trouble in crisis and accidents resulting from increased production volumes and the entry of cars in the domestic market. Therefore governors of these countries have taken action in order to reduce accidents and fatalities, and by investigating how traffic accidents occurred, they have tried to adopt a scientific approach, such as the use of intelligent transportation systems, optimize and secure vehicles, equipment, general education, development and implementation of strict regulations for certification stop and enforcement of severe traffic violators and norm-breakers the governors have taken a major step in the management of accidents, especially road accidents, which has the

major share. Also with importation of the automobile, automobile production in developing countries and especially the third world countries have caused enormous costs and have a high mortality rate in accidents due to lack of proper facilities, road improvements and vehicle standards and cultural isolation, lack of strict rules and training incorrectly(Nikzad MF. 2006).

In(Mohammadi F. 2012),examined the factors affecting road accidents and how to reduce its solutions, which aims to review and identify effective factors in accidents; human factors have the most significant role with 54 percent. Among the indicators of human factors, fast speed, rushing off in pursuit of purpose, non-compliance with traffic rules and sleepy drivers have a greater role than other indicators. Natural and management factors are respectively 34 and 12 percent of other factors in causing accidents. In(Farzipour H. 2007),has conducted a study entitled Economic Factors Influencing on road accidents in Iran (1972-2010) at the University of Bu Ali Hamadan that identified some economic factors affecting road accidents in the form of EKC. Based on this hypothesis we conclude that the road deaths increase at the early stages of economic growth and eventually due to technical advances, increasing investment in relevant sectors and improved medical care, the rate at a later stage of economic growth is reduced. Therefore this study analyzes the relationship between the two methods and panel data econometrics OLS, respectively, for periods of time (2002-2010) and (2010-1972).

Inon the status of traffic safety in the country refers to these cases. Since the human factor is the most common one in road accidents, the role of culture in reducing traffic accidents is very high, introduced a program to promote a culture of citizen's traffic causes achievement of long and short term goals in this area. In the present era, most countries in the world, especially developed countries, focus on culture in traffic area has been put on agenda and all believe that people awareness leads to more regulation.

Research Methodology

This study includes a total of freeway accidents in Iran in years 2013 to 2015, which is among the latest registered statistics. Data is collected from different databases and related services, mainly belonging to the police and Road Transport Organization and are collected with the goal to collect data related to factors in the range of continuous-time accidents on freeways in Iran and to categorize and analyze them to achieve key results in order to promote managers' knowledge and has been carried out to hire freelance freeway programmers. Then this information from the data is classified and identified in separate packages to determine the direction of the freeway in traffic safety research to relevant researchers.

Evaluation of the Recorded Data

According to statistics, the total length of Rural Roads built in Iran by the end of the year 2015 is 41775 km that of those ordained 2401 kilometers of motorway is equivalent to 74.5 (source: Department of Transportation toll road). Given the extent of

Iran (1648000 sq km) per square meters land area, 1.46 km highway is available. Generally, in the year 2013, number of 116403 accidents with 11811 deaths, and in year 2014, number of 112114 accidents with 11568 deaths, and 2015 years with 102275 accidents with 10951 deaths include statistics of Rural Roads. Among the factors that affect the rate of accidents are divided in several major categories include: lighting, climate, geographical location, structure and superstructure design, vehicle defects, and human factors causes before the accident.

Factors Affecting the Drivers' Vision

Of the factors influencing road accidents are brightness, weather, and physical barrier factors that can delay drivers. The factors details are provided in Tables 1 to 3.

Table 1: Brightness effect on car crashes

Sl. No.	Title	Year 2013	Year 2014	Year 2015
1	Day	8267	7683	8002
2	Night	3847	3367	3652
3	Sunrise	300	212	242
4	Sunset	290	265	285
5	Unknown	1021	377	168

According to Table 1 factor of brightness can be divided into 4 categories of Day, night, sunrise, and sunset. This information indicate that most accidents on the road happened considering road brightness factor in day and then at night. On the other hand, the rate of accidents assigned the lowest to themselves in year 2014, and most of it has been in the year 2013.

Other factors are weather conditions governing the freeway that increases the rate of road accidents. In the meantime, despite the public perception that the bad weather conditions is the first factor in accidents, but these figures show is that most accidents happened in clear weather. This accident rate of 11350 in the year 2013 reaches to 10213 and eventually in Year 2014 and eventually reaches 10917 in year 2015. And another issue that is worth focusing on is that the percentage of this factor in the incidence of accident in years 2013, 2014 and 2015 has increased to the point that 88.5% of accidents in year 2015 occurred in clear weather.

Table 2: Impact of weather in accidents

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013 By%	Year2014 By %	Year 2015 By %
1	cloudy	403	221	217	2.94	1.86	1.76
2	rainy	800	524	812	5.84	4.4	6.58
3	Snowy	57	510	134	0.42	4.28	1.09
4	Clear	11350	10213	10917	82.9	85.8	88.5
5	Stormy	5	10	9	0.04	0.08	0.07
6	Dusty	13	3	5	0.09	0.03	0.04
7	Foggy	49	41	80	0.36	0.34	0.65
8	Unknown	1048	382	175	7.65	3.21	1.42

Among the most important are physical barriers on freeways that lead to accidents include: Trees and bushes, dip in the road, smoke, moving objects, stopped objects and so on. That among these trees and bushes on the edge of road is the most important factors in accidents due to obstacles vision in the years 2013 to 2015. That during these three years this factor is imperceptibly less effective in accidents. Moving objects, buildings and kiosks along the road and signs, include a series of reasons that accidents have had a negative growth during the years 2013 to 2015, which for example, in the case of roadside kiosks this amount of has reached from 9 accidents in the year 2013 to 19 accidents in the year 2015.

Regions Topography

As Table 4 shows, the amount of accidents on flat, mountain, and foothill roads have respectively allocated the most accident rates to themselves. In a way that 99.24 percent of the accidents occurred on flat roads in year 2015, while this rate is respectively about 96.38 and 97.73 percent in the years2013 and 2014.

Road Design Principles

In suburban roads high driving speed and unfamiliarity with the environment has a crucial role in reducing accidents, also according to research conducted, the drivers' reaction time in rural roads have increased by about 2 to 3 seconds, comparing to urban streets that the appropriate and standard suburban road design play a significant role in reducing accidents.

Table 3: Barriers to see on the road

Sl. No.	Title	Year 2013	Year 201 4	Year 2015	Year 2013 by %	Year 2014 by %	Year 2015 by %
1	Signs	0	0	1	0	0	0.01
2	Sand dunes and similar items	6	2	1	0.04	0.02	0.01
3	Tree/ Bushes	200	197	194	1.46	1.65	1.57
4	Buildins / Kiosks	9	13	19	0.07	0.11	0.15
5	Steep	20	2	5	0.15	0.02	0.04
6	Sand dust	4	3	2	0.03	0.03	0.02
7	Vertical arc	8	4	7	0.06	0.03	0.06
8	Blizzard	4	6	2	0.03	0.05	0.02
9	Fog / Smoke	18	12	5	0.13	0.1	0.04
10	Unknown	1747	609	237	12.73	5.12	1.92
11	Nothing	11679	11034	11843	85.09	92.7	95.9
12	Opposite car light	5	1		0.04	0.01	0
13	Sunlight	1			0.01	0	0
14	Moving Object	15	15	30	0.11	0.13	0.24
15	Stopped Object	9	6	3	0.07	0.05	0.02

Table 4: Random distribution density in different areas

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013 by %	Year 2014 by %	Year 2015 by%
1	Dunes	61	64	19	0.44	0.54	0.15
2	Mountainous	206	162	71	1.5	1.36	0.57
3	Unknown	230	44	4	1.68	0.37	0.03
4	Flat	13228	11634	12255	96.38	97.73	99.24

Table 5: Geometric road design condition

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013 by %	Year2014by %	Year2015by %
1	uphill downhill turn	248	116	136	1.81	0.97	1.1
2	turn, flat	330	131	110	2.4	1.1	0.89
3	Straight, steep / down the steep	437	350	294	3.18	2.94	2.38
4	Straight, flat	10964	10699	11582	79.88	89.88	93.79
5	Unknown	1746	608	227	12.72	5.11	1.84

Table 6: Terms of surface pavement

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013 by %	Year 2014 by %	Year 2015 by %
1	Wet	786	689	969	5.73	5.79	7.85
2	Dry	10991	10108	11020	80.08	84.12	89.24
3	Oily and dirty	0	5	6	0	0.04	0.05
4	Gravel and dirt	5	0	4	0.04	0	0.03
5	Muddy	0	2	3	0	0.02	0.02
6	Unknown	1747	607	229	12.74	5.1	1.86
7	Snow and Ice	196	492	118	1.43	4.1	0.96

Table 7: Deficiencies in road accidents

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013by %	Year 2014 by %	Year 2015 by %
1	Pavement and shoulder not level	4	6	7	0.03	0.05	0.06
2	Non-standard transverse and longitudinal tilt	8	6	5	0.06	0.05	0.04
3	Non-standard guard rails	2	3	2	0.01	0.03	0.02
4	Lack of side guard rails	16	14	10	0.12	0.12	0.08
5	Lack of shoulders and parking	9	8	5	0.07	0.07	0.04
6	Bend at sharp angles	16	11	9	0.12	0.09	0.07
7	Narrow passageway	72	27	28	0.52	0.23	0.23
8	Slippery road surface	36	75	13	0.26	0.63	0.11
9	Unknown	1111	396	172	8.09	3.33	1.39
10	Nothing	11528	10369	11233	83.99	87.11	90.96
11	Road Damages	6	3	3	0.04	0.03	0.02
12	Defective marking passages	17	8	15	0.12	0.07	0.12
13	Lighting defected passage	285	363	232	2.08	3.05	1.88
14	Failure of asphalt pavement	52	12	5	0.38	0.1	0.04
15	Perfect horizontal signs	25	19	23	0.18	0.16	0.19
16	Perfect vertical signs	218	207	207	1.59	1.74	1.68
17	There barrier bump	3	1		0.02	0.01	0
18	Not reported	317	376	380	2.31	3.16	3.08

According to the classification conducted in the matter of road geometry design given in Table 5 which includes steep and flat curves and straight steep and flat roads, it can be concluded that a flat and straight road have the highest road accidents in this sector, and the amount in the year 2015 with 93.79% of the accidents, is accounted for the greatest amount. This is contrary to popular belief about mountain roads that only have allocated 1.1 percent of car accidents this year. Road pavement is another effective issue in accidents, but statistics represent important and influential factor in comparison with that, because the highest percentage of accidents occurred on dry roads are at a rate of 80.08, 84.12 and 89.24 with a rising trend in years 2013, 2014 and 2015, respectively (Table 6).

Table 7 shows that fixing lighting, vertical signs, lack of street width, asphalt pavement, horizontal signs, pavement markings, and lack Guard rail deficiencies are among the most important measures that can be done to reduce accidents, therefore the vertical marks on the road is the most important accident factor. Also taking a glance at the table reveals that the policies applied in almost all cases in the year 2014 have had better performance compared with the year 2013 years, although this study witnessed a slightly negative rate of these factors in the year 2015.

Table 8: Vehicles deficiency in accidents

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013 by %	Year 2014 by %	Year 2015 by %
1	Smooth tires	36	24	29	0.26	0.2	0.23
2	Wiper failure	4	5	5	0.03	0.04	0.04
3	The absence of chains	9	70	1	0.07	0.59	0.01
4	Unknown	1161	381	167	8.46	3.2	1.35
5	Nothing	12241	11117	11925	89.19	93.39	96.57
6	Suspension Defects	1	2	3	0.01	0.02	0.02
7	Brake system malfunction	27	19	11	0.2	0.16	0.09
8	Perfect lighting system	221	241	195	1.61	2.02	1.58
9	Steering system defects	10	10	9	0.07	0.08	0.07
10	Not reported	15	35	4	0.11	0.29	0.03

Defective Vehicles in a Crash

According to the table below, car defects that lead to road accidents are in the order of priority as follows

- **Lighting System Deficiency**

Standard lighting system in the event of the night, storms, dust, snow, and rain, are of essential car equipment so that driving conditions without standard sound and lighting system, in the mentioned conditions will be very dangerous. So, more than 221 of the total accidents of 2013 occurred, due to defective lighting system. This factor has increased to 241 cases in the year 2014 but is at its lowest level in the 3 years of the study in the year 2015 years which is 195 cases.

- **Smooth Tires**

When driving with worn-out and non-standard tires, risk of bursting tires and driving accident and overturn occurrence exists at any time. This factor allocates the numbers of 36, 24, and 29 accidents respectively in the years 2013, 2014, and 2015.

- **Brake and Steering System Failure**

The vehicle's braking and steering system are two main factors of driver control on the car that without accurate performance of the two, driving accident, including collision, overturning, fall and ... are definite and unavoidable. In fact, lacking the standard braking system is embracing risk of exposure to traffic accidents, given that it is the most expected of the existing risks. These factors lead to 37 cases of road accidents in the year 2013, which fortunately this has been a growing trend in years 2014 and 2015, which in the year 2015 has reduced to 20.

Effective Human Factors in Accidents

According to Table 9, the highest percentage on the impact of human factors on the accidents and severity of road accidents, relate to the unnecessary hurry and haste of drivers (41.99% in year 2013, 42.64 cases in the year 2014, and37.97 cases in the year 2015) and then the fatigue and drowsiness of drivers (18.46% in the year 2013 and 18.24% in the year2014, and 20.42% in the year 2015) and neglecting the regulations that have had a growing process to the point that of 7.88% in the year 2013 reaches to 2.9% of the accident factors in the year 2015. On the other hand drug use only has allocated 0.02 percent of human factors in accidents on average[35,36].

Table 9: Effective human factors in accidents (police and Road Transport Authority)

Sl. No.	Title	Year 2013	Year 2014	Year 2015	Year 2013 by %	Year 2014 by %	Year 2015 by %
1	Drug used	3	1	4	0.02	0.01	0.03
2	Disregarding the rules	1082	926	358	7.88	7.78	2.9
3	Intentional Abuse	4	2	3	0.03	0.02	0.02
4	Fatigue and drowsiness of the driver	2533	2171	2522	18.46	18.24	20.42
5	Weakness due to high age	7	4	8	0.05	0.03	0.06
6	Undue hurry	5763	5076	4689	41.99	42.64	37.97
7	Lack of familiarity with the road	39	66	80	0.28	0.55	0.65
8	Lack of understanding of the right to rest	161	161	89	1.17	1.35	0.72
9	Alcohol consumption	7	9	15	0.05	0.08	0.12
10	Failure to properly restrain times	16	29	33	0.12	0.24	0.27
11	The human factor (Unknown)	461	125	65	3.36	1.05	0.53
12	Nothing	3439	3146	4275	25.06	26.43	34.62
13	Effective birth defects	9	9	7	0.07	0.08	0.06
14	Not reported	201	719	201	1.46	6.04	1.63

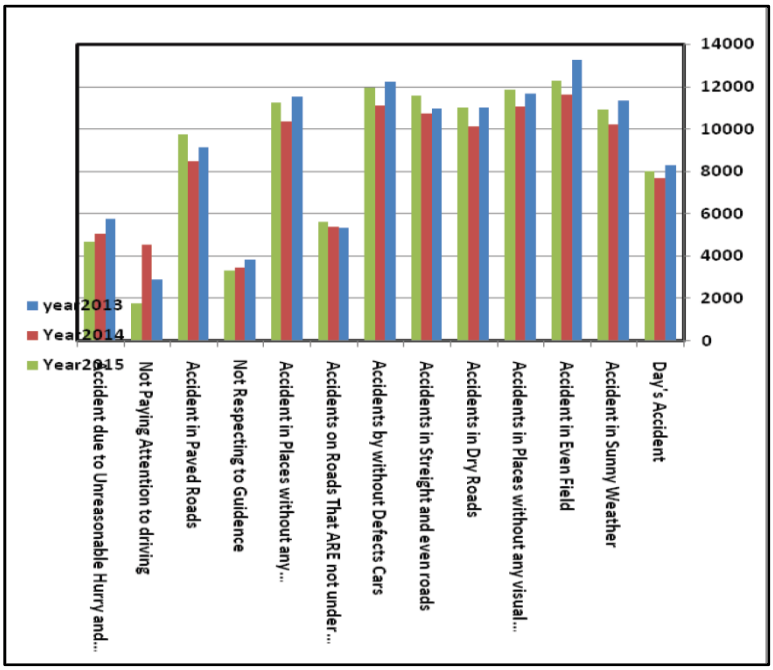

Figure 1: The most effective factor on accidents from 2013-15.

Conclusion

Figure 1 covers the factors which are the most important reasons of accidents and provides the preliminaries for deducing so as to present the most efficient technical, cultural and educational solutions. According to the following table, most of the situations in which the accidents occur are not generally considered as dangerous factors. For example, driving in sunny days, in dry, asphalt, straight and smooth roads needless to better technical design and the loss of crested, the rate of accidents in 2014 in the same situation is less than this rate in 2013, but this process is not continual and these cases increase in 2015. Ignoring the traffic signs and disobeying the rules are the two factors which cause the least rate of accidents and are considered as the cofactor. The only factors, which are fixed, and have positive movement, showing precise plan in this aspect are obeying the rules and driver's precipitation.

On the other hand, the humane factors related to accidents have had a positive movement and the accidents have decreased. Among the factors most effective on the rate of accidents because of rush and unreasonable precipitation are disobeying the rules and ignoring the driving precipitation, according to the gathered data. Based on this information, we should deduce these causes so as to decrease the rate of accidents more and faster by proper planning and managing the transportation process.

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