International Journal for Traffic and Transport Engineering, 2020, 10(1): 81 - 95
DOI: http://dx.doi.org/10.7708/ijtte.2020.10(1).08 UDC: 656.1.084(55)

USE OF HAZARD INDICES FOR INTER-CITY RECREATIONAL ACCIDENT OCCURRENCE THROUGH IN ORDER TO ANALYZE ROAD SAFETY STATUS

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Received 5 September 2019; accepted 11 October 2019

Abstract: Considering the high number of inter-city recreational travels during Nowruz holidays in Iran and the changes in travel patterns, these holidays are a potential high-risk period. In this research, hazard indices of accident occurrence during these holidays through three consecutive years of 2013, 2014, and 2015 in inter-city roads, for different provinces of the country were analysed and computed. Considering hazardous travels of 20-days of Nowruz holidays, accident analysis in these days and comparing them with other days of the year, in order to identify hazardous provinces (hot spots), can have an important role in executive decision makings in the country. For these objectives, initially, injury rate has been evaluated using injury reduction equation, then hazardous provinces based on different methods were identified, and lastly perceived causes of accidents during these holidays were investigated. The results suggest that traffic exposure, accident risk and total number of traffic injuries have been decreased annually, however, injury rates per accident has been increased possibly due to the worsening of road safety conditions. Furthermore, analysis of hazard indices showed that severity-rate and crash rate methods were consistent and both pointed out Kerman to be the most high-risk province in the country during Nowruz holidays. Moreover, among the perceived causes, front carelessness was the major reason of traffic accidents during Nowruz holidays.

Keywords: accidents, inter-city recreational travels, hazard index, injury, fatal.

1. Introduction

Damage arising from collision of motor vehicle is deemed as one of the major causes of death in the world. Worldwide, approximately 1.2 million people die from traffic accidents and about 50 million experience injuries. According to the prediction of WHO, traffic accidents will be augmented from ninth rank currently to seventh rank up to the year 2030 among leading causes of global death (Peden *et al.,* 2004; WHO, 2015).

Essentially, increase in the amount of vehicles, will result in increase in the traffic accidents accordingly and these accidents will cost about 2% of gross production of a country. In Iran, the rate of increase in the number of vehicles overtook the rate of increase

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in population and according to Figure 1, a surge in motorization rate (the number of passenger cars per 1,000 inhabitants) is expected in the following years. Assessments show that this rate will be twice in the next 10 years. While motorization rate in Iran is growing, recreational travels are decreasing (Poormoalem & Ghorbani, 2015).

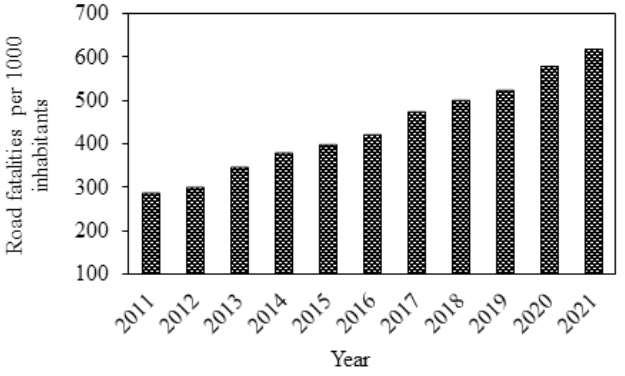

Fig. 1.
Changes of Motorization Rate in Iran
Source: (Poormoalem & Ghorbani, 2015)

Despite the decreasing rate of recreational travels, the number of traffic accidents during these travels is significant. It has been stated that the holidays are the time of risky driving behaviours. There have been many researches that investigated the characteristics of traffic accidents occurring during the holiday periods (Anowar, Yasmin, & Tay, 2013; Bloch, Shin, & Labin, 2004; Farmer & Williams, 2005; French & Gumus, 2015). However, due to the difference between the cultures and socio-economic factors, the behaviour of the drivers may differ and the results of each study change between different countries.

Nowruz is the name of the Iranian New Year, also known as the Persian New Year, which is celebrated worldwide by the Iranians, along with some other ethno-linguistic groups. Iran's Nowruz celebrations last for two weeks and include four official public holidays (usually coincided with March 21 to 24). The first two weeks of the Iranian New Year is a major travel season with the highest number of holidaymakers along with a high number of road accidents.

In this research, considering the importance of inter-city recreational travels during Nowruz holidays in comparison with regular travels, the fatal accidents caused by these travels were investigated. The data were from the Statistics of Traffic Police which were gathered for three consecutive years from 2013 to 2015. The results were evaluated using hazard indices and the hot spots were determined. Finally, perceived causes of accidents during these holidays were investigated. Furthermore, optimizing roads safety requires performance of integrated and organized activities in different aspects including safety management and arrangements, statistics and information collection required systems.

Among main indices that have been introduced for safety analysis in national level, the index of death per ten thousand vehicles which is the ratio of number of death casualties to the number of vehicles in a country have been used in this study. Rate of changes of this index in Iran from 2011 to 2014 is presented in Figure 2. As can be seen, this index, both with and without accounting motorcycles, was decreasing. Furthermore, Figure 2 shows that this index was much higher when the motorcycles are not accounted (Poormoalem & Ghorbani, 2015).

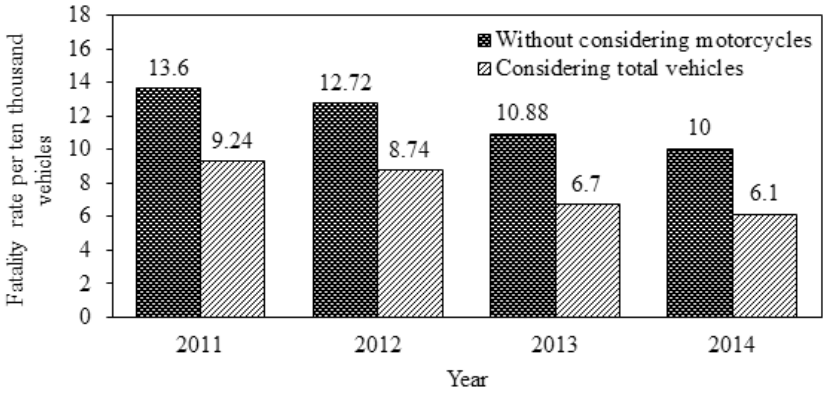

Fig. 2.
Rate of Changes of Index of Dead to Ten Thousand Vehicles

Average amount of index of total death per ten thousand vehicles in countries is 21.93. Iran with 6.7 of total vehicles in 2013, among 175 counties, is in the rank of 110 (Poormoalem & Ghorbani, 2015; WHO, 2009).

Use of hazard index for safety analysis has been vastly performed previously (Ghandour, Hammoud, & Telesca, 2019; Liu & Liao, 2019; Matsuoka & Amai, 2019). In a research conducted in Manizales county of Colombia, hazard index of main factors for traffic accidents including non-motor users were analysed. Also, taking in consideration more accurate considerations, accidents of side walkers and bicycle runners between January 2008 to July 2013 were analysed in respect of descriptive factors by identifying main factors of accidents using hazard index (Valero & Puerta, 2014). In another research, information on traffic events, hazardous points and other factors were analysed using Geographical Information System, and modifications actions have been suggested (De Leon *et al.,* 2013; Raju, 2013).

2. Statistics and Information Extracted from Accidents

Number of driving accidents in Inter-city accidents and injuries arising in the recent years shows that Iran is a high-risk location for drivers. Figures 3 and 4, based on statistics from traffic police, shows that the number of fatal accidents and injuries in inter-city accidents in beginning of the Persian year, i.e. Nowruz holidays from March 25th to April 15th, is increased in comparison to the other days. Therefore, Nowruz holidays can

be considered a potential high-risk period. As can be observed in Figures 3 and 4, fatal and injuring accidents during Nowruz holidays have been decreasing each year.

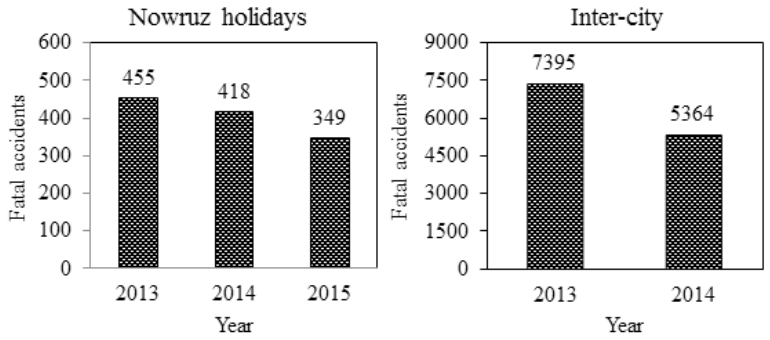

Fig. 3.
Comparison of Fatal Accidents of Inter-City Travels in Total Year and Norowz Holidays

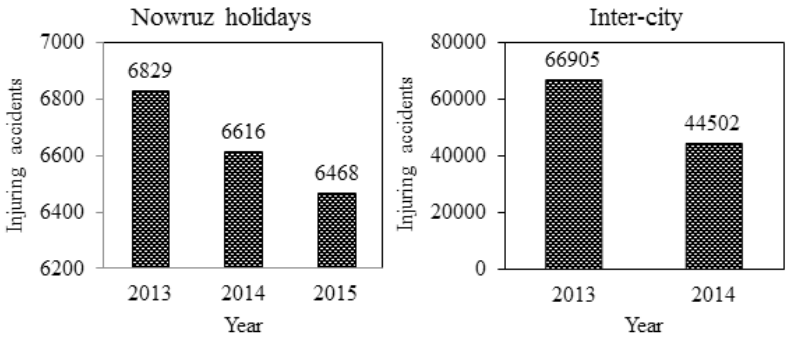

Fig. 4.
Comparison of Injuring Accidents of Inter-City Travels in Total Year and Norowz Holidays

Recreational travels in Nowruz holidays in respect to their special specifications are critical because of number of travels, heavy traffic, driving behaviours. Critical conditions are deemed as intensifier factors and leads to increase in Inter-city accidents. During recreational travels of Nowruz holidays, Traffic Police may also make special policies and regulations for improving safety, still, the number of accidents in these days are higher compared to other days throughout the year.

3. Statistical Analysis

3.1. Analysis of Rate of Injuries

Number of traffic injuries, I, can be expressed as a function of traffic exposure E, accident occurrence for each emergence of accident (or accident hazard) (A/E), and rate of injury for each accident (or injury rate) (I/A) are considered. The relation between this factors is defined in Equation (1) (Gunnarson, 1996).

$$I = E \times \frac{A}{E} \times \frac{I}{A} \quad (1)$$

In which A is equal to all accidents leading to fatality, injury and property damage, E based on each 100 million passing vehicle and also rate of injury, I, based on EPDO (Equivalent property damage only index). Considering the increase of vehicles during recreational Nowruz holidays in comparison with other days and considering accident casualties, in 31 provinces of Iran during recreational Nowruz travels in three consecutive years, the results are presented in Table 1. Then one can determine other parameters like total accidents, rate of injuries, accident occurrence per vehicle and rate of damage for each accident. These values are presented in Table 2 for three consecutive years.

Table 1

Statistics of Analysis of Rate of Injuries in Recreational Nowruz Holidays Travels in Three Years

Year	**2013**	**2014**	**2015**
Total fatal (31 provinces)	455	418	349
Total injury (31 provinces)	6829	6616	6468
Total property damage (31 provinces)	8965	8789	7286
E	3.01	2.92	2.91

Table 2

Number of Parameters for Analysis of Rate of Injuries in Recreational Nowruz Holidays Travels in Three Years

Year	2013	2014	2015
A	16249	15823	14103
I	37189	35916	33239
A/E	5392.68	5413.93	4845.42
I/A	2.290	2.270	2.360

Considering Equation (1) and the parameters in three years in Table 2, to analyse the rate injuries of travels, the related diagrams are drawn in Figure 5, for the consecutive years of 2013, 2014, and 2015.

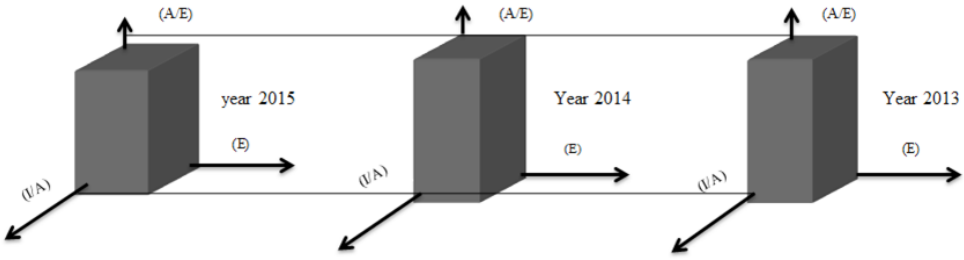

Fig. 5.

Diagrams of Rate of Injuries for Three Consecutive Years in Nowruz Holidays

Analysing diagrams of 2013, 2014 in comparison with 2015, it can be deduced that reduction in *I*, and reduction in *A*, results in increased *I/A* index. On the other hand by increasing the rate of motorization, we experienced reduction in *E*, but *A/E* was also decreased, indicating that reduction in *A* is reduced more than the reduction of *E*. Therefore, it can be concluded that reduction in *I* in consecutive years, were just for reduction of accidents and minor reduction in E, while severity of accidents was not decreased significantly, therefore *I/A* in 2015, in comparison with other previous 2 years, not only decreased, but also increased. In other words, injuries reduction rate is less than accidents reduction rate. Thus, it is necessary to find out affecting factors in each province and determining hazardous provinces. Determination of influencing factors of injuries reduction let us act in optimizing the whole the country.

Also, the important point is that, if motorization rate in 2014 was increased based on annual development rate, its impacts on A/E and I/A should be evaluated. Therefore, for the purpose of analysing the rate of accidents in 2015, it can be said that if the year 2013 is considered as base year, in a comparison based on Figure 1, prediction of *E* in 2013 is for 350000000 vehicle, while by comparing 2013, *E* value had *n%* development, for which, real values of *I/A* and *A/E* in injuries rate diagram in 2013 for ideal conditions based on *n%* rate of development is drawn in Figure 6, and if in the same manner injuries rate diagram is set for 2015, then we can compare those of 2013 and 2015, then we see it changed from vertical to horizontal state, in which by increasing motorization rate, *A/E* and *I/A* indices will decrease significantly. Ideal value is 1.707 but real value is 2.360, which shows critical conditions in lack of reducing process in rate of injuries and accidents reduction, for which we shall identify hazardous locations in the country.

Therefore, by considering Equation (1) and E based on motorization rate in 2013 and 2015, the following equations will be obtained (2 and 3):

(Increasing *n%* in motorization rate in 2013):

$$E_2=350000000,\ A_2=11752.5,\ I_2=23082.64,\ A_2/E_2=3357.857,\ I_2/A_2=1.96 \quad (2)$$

(Increasing *n%* in motorization rate in 2015):

$$E_3=400000000,\ A_3=10219.57,\ I_3=17453.78,\ A_3/E_3=2554.892,\ I_3/A_3=1.707 \quad (3)$$

Considering comparison of damage rate diagram in Figure 6 from 2013 to 2015 it can be concluded that by increasing *n%* in motorization rate, we will see *n%* reduction in injuries indices and accident occurrence.

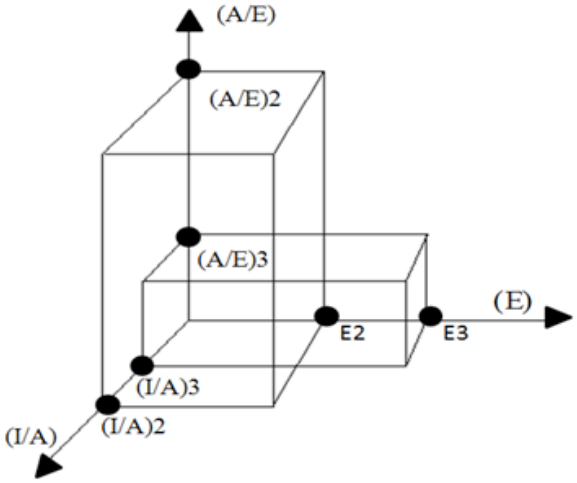

Fig. 6.
Comparison of Rate of Injuries in Years 2013 and 2015

By analysing injuries statistics during Nowruz holidays, the areas in which the damage index has been reduced and the reasons for this can be evaluated. Therefore, we shall consider influencing factors in rate of injuries reduction in different provinces, by considering hazardous provinces, their portion in rate of injuries reduction will be determined, then suitable solutions in priority of locational and geographical conditions shall be offered.

3.2. Analysis of Hazardous Locations Based on Rate of Damages, Rate of Accident and Severity

The process based on index of damage is equal to EPDO: This method dedicates a weights ratio which is given to each accident and is a function of the worst accident injuries. This method focus more on accidents, therefore, for an accident in which people are dead and injured, different weight coefficients are offered (Poormoalem & Ghorbani, 2015). In this section, the following coefficients were considered:

- Coefficient equal to 1 in damaging accidents PDO;
- Coefficient equal to 3.5 of injuring accidents;
- Coefficient equal to 9.5 in fatal accidents.

Calculation of EPDO index and average of EPDO is done by Equations (4) and (5).

$$EPDO_j = \sum W_j \times f_{ij} \quad (4)$$

In which,
$EPDO_j$: Index of EPDO in j district;
W_j: Weight coefficient of accident j;
f_{ij}= frequency of accident in districts j and i;

$$\overline{EPDO_j} = \frac{EPDO_j}{f_i} \quad (5)$$

In which,
f_i= total frequency of accident in district i;
Also, to measure EPDO average in reference population, Equation (6) is used.

$$\overline{EPDO_{rp}} = \frac{\sum\sum W_j \times f_{ij}}{\sum f_i} \quad (6)$$

Finally, districts which EPDO average is more than twice of that of reference population, ($I_t = 2\times EPDO_{rp}$), are introduced as a hazardous location. (Amount of allowed limit may be change at expert's idea.)

The method based on rate of accident: Based on its definitions, rate of accident is measured in comparison with the QTY of existing vehicles, and its unit is in accident on million vehicle-km, in roads, the traffic volume is equal to total passing vehicles in both directions for days subjected to analysis (Poormoalem & Ghorbani, 2015). Therefore, for calculations of accident rate of each districts, the Equation (7) is used.

$$R_i = \frac{N_{accident} \times 10^6}{ADT \times N_d} \quad (7)$$

In which,
R_i= Accident rate in million vehicles;
$N_{accident}$= QTY of accidents in point *i;*
ADT= average daily traffic;
N_d= number of days of period or analysis;

Finally, districts whose accident rate is more than 1.5 times of average accident rate in reference population, i.e. allowed limit. ($I_t = 1.5\times \overline{R_i}$) are introduced as a hazardous location district. (Allowed limits may be changed at expert's idea.)

The method based on rate of severity: It is just like accident rate, with a bit difference that, instead of number of accidents, the EPDO index is used to calculate severity rate of each districts (Poormoalem & Ghorbani, 2015). Equation (8) shows the calculation of severity rate.

$$R_s = \frac{EPDO_j \times 10^6}{ADT \times N_d} \quad (8)$$

Finally, points whose severity rate is more than 1.5 rate of average accident rate in reference population ($I_t = 1.5\times \overline{R_s}$) are introduced as a hazardous location. (Rate of allowed limit is subject to idea of expert).

Considering statistics and information of fatal, injuring, and damaging accidents and traffic load of passing vehicles in recreational travels of Nowruz holidays in 31 provinces of Iran in three consecutive years and implementation of Equations of methods of identifying hazardous location by statistical analysis software, one can identify hazardous provinces whose data are demonstrated in Tables 3, 4 and 5.

Table 3

Identification of Hazardous Location in the Year 2013

Province	Fatality	Injury	Property damage	QTY of accidents	EPDO	ADT	R_i	R_s
East Azerbaijan	25	391	330	746	1936	11,456,640	3.25575387	8.449248645
West Azerbaijan	16	201	160	377	1015.5	6,758,400	2.78912169	7.512872869
Ardabil	5	53	46	104	279	5,402,880	0.96244966	2.58195629
Isfahan	44	615	1171	1830	3741.5	15,459,840	5.91856061	12.10070738
Alborz	6	90	324	420	696	35,020,800	0.59964364	0.993695175
Tehran	17	590	1699	2306	3925.5	26,322,720	4.38024642	7.45648626
Ilam	7	61	46	114	326	1,172,160	4.86281736	13.90595141
Bushehr	12	89	54	155	479.5	6,690,240	1.15840388	3.583578467
Chaharmahal and Bakhtiari	6	64	59	129	340	4,374,720	1.47438007	3.885962987
Razavi Khorasan	28	623	191	842	2637.5	11,888,640	3.54119563	11.09252194
South Khorasan	9	95	19	123	437	2,770,560	2.21976784	7.886492261
North Khorasan	4	155	71	230	651.5	4,546,560	2.52938485	7.164757531
Khuzestan	21	282	345	648	1531.5	4,638,720	6.98468543	16.50778663
Zanjan	3	115	117	235	548	5,976,000	1.96619813	4.585006693
Sistan and Baluchestan	17	145	34	196	703	1,824,000	5.37280702	19.27083333
Semnan	18	188	244	450	1073	6,364,800	3.53506787	8.429172951
Fars	56	638	776	1470	3541	24,583,680	2.98978835	7.201932339
Qazvin	16	113	126	255	673.5	11,027,520	1.15619831	3.053723775
Qom	4	149	130	283	689.5	14,572,800	0.97098704	2.365708718
Kerman	15	214	423	652	1314.5	4,602,720	7.08276845	14.27959989
Kurdistan	13	94	87	194	539.5	3,532,800	2.74569746	7.635586504
Kohgiluyeh and Boyer-Ahmad	4	30	73	107	216	1,503,360	3.55869519	7.183908046
Kermanshah	10	109	132	251	608.5	6,005,760	2.08966059	5.065970002
Golestan	10	335	79	424	1346.5	5,980,800	3.5446763	11.25685527
Gilan	10	420	258	688	1823	15,681,600	2.19365371	5.812544638
Lorestan	7	163	189	359	826	4,835,520	3.71211369	8.540963536
Mazandaran	22	169	606	797	1406.5	28,425,600	1.40190532	2.474002308
Markazi	20	146	935	1101	1636	8,992,320	6.12189068	9.096651365
Hamadan	12	122	66	200	607	8,180,640	1.22239825	3.709978681
Hormozgan	13	140	127	280	740.5	5,718,720	2.44810027	6.474350904
Yazd	5	230	48	283	900.5	7,004,160	2.02022798	6.428322597
Total	455	6829	8965	16249	37189	301,315,680	94.8092456	235.9871294
					$\overline{EPDO}$= 1199.64516		$\overline{R_i}$ = 3.05836276	$\overline{R_s}$ = 7.612488045
I_t					2399.29032		4.58754414	11.41873207

Table 4

Identification of Hazardous Location in the Year 2014

Province	Fatality	Injury	Property damage	QTY of accidents	EPDO	ADT	R_i	R_s
East Azerbaijan	17	456	370	843	2127.5	12,055,680	3.496277273	8.823641636
West Azerbaijan	14	216	191	421	1080	5,554,560	3.78967911	9.721742136
Ardabil	4	58	64	126	305	4,334,400	1.453488372	3.51836471
Isfahan	39	596	992	1627	3448.5	14,446,080	5.631285442	11.93576389
Alborz	6	106	295	407	723	25,132,800	0.80969888	1.438359435
Tehran	18	551	1635	2204	3734.5	33,935,520	3.247334946	5.502346804
Ilam	2	75	38	115	319.5	1,425,600	4.03338945	11.20580808
Bushehr	15	127	47	189	634	6,072,000	1.556324111	5.220685112
Chaharmahal and Bakhtiari	7	44	40	91	260.5	4,515,840	1.007564484	2.884291738
Razavi Khorasan	26	500	215	741	2212	10,691,520	3.465363204	10.34464697
South Khorasan	11	150	13	174	642.5	3,095,040	2.810949132	10.37951044
North Khorasan	8	128	83	219	607	3,947,520	2.773893482	7.688371433
Khuzestan	28	350	392	770	1883	4,915,200	7.832845052	19.15486654
Zanjan	9	123	103	235	619	5,328,000	2.20533033	5.808933934
Sistan and Baluchestan	14	166	23	203	737	2,016,000	5.034722222	18.27876984
Semnan	12	211	258	481	1110.5	7,964,160	3.019778608	6.971858928
Fars	38	554	588	1180	2888	15,840,000	3.724747475	9.116161616
Qazvin	5	131	139	275	645	14,837,760	0.926689743	2.17350867
Qom	7	144	131	282	701.5	16,125,120	0.874412097	2.175177611
Kerman	19	210	437	666	1352.5	4,809,120	6.924343747	14.0618242
Kurdistan	8	116	79	203	561	3,340,800	3.038194444	8.396192529
Kohgiluyeh and Boyer-Ahmad	4	22	40	66	155	1,399,680	2.357681756	5.536979881
Kermanshah	12	110	81	203	580	6,491,520	1.56357833	4.467366657
Golestan	13	241	102	356	1069	5,644,800	3.153344671	9.468891723
Gilan	5	363	300	668	1618	17,470,080	1.911840129	4.630774444
Lorestan	13	156	145	314	814.5	5,387,520	2.914142314	7.559136671
Mazandaran	20	131	586	737	1234.5	25,200,000	1.462301587	2.449404762
Markazi	17	160	1203	1380	1924.5	10,104,960	6.82832985	9.522551302
Hamadan	13	121	53	187	600	8,426,880	1.109544695	3.560036455
Hormozgan	9	116	102	227	593.5	6,226,560	1.822836366	4.765873934
Yazd	5	184	44	233	735.5	5,529,600	2.106843171	6.65057147
Total	418	6616	8789	15823	35916	292,264,320	92.88675447	233.4124136
					$\overline{EPDO}$= 1158.58065		$\overline{R_i}$ = 2.996346919	$\overline{R_s}$ = 7.529432695
I_t					2317.16129		4.494520378	11.29414904

Table 5

Identification of Hazardous Location in the Year 2015

Province	Fatality	Injury	Property damage	QTY of accidents	EPDO	ADT	R_i	R_s
East Azerbaijan	13	455	330	798	2046	12,168,000	3.279092702	8.4072978
West Azerbaijan	9	233	182	424	1083	5,343,360	3.967541023	10.134073
Ardabil	4	52	65	121	285	4,273,920	1.415562294	3.3341757
Isfahan	38	506	896	1440	3028	16,346,880	4.404510218	9.2617062
Alborz	6	111	392	509	837.5	30,278,400	0.840533185	1.3829991
Tehran	14	478	1731	2223	3537	29,133,600	3.81518247	6.0703106
Ilam	4	99	22	125	406.5	1,510,080	4.138853571	13.459552
Bushehr	10	127	68	205	607.5	6,756,480	1.517062139	4.4956841
Chaharmahal and Bakhtiari	2	49	30	81	220.5	4,072,320	0.994519095	2.707302
Razavi Khorasan	18	494	272	784	2172	11,475,840	3.415871954	9.4633595
South Khorasan	8	173	20	201	701.5	2,471,040	4.067113442	14.194428
North Khorasan	9	176	50	235	751.5	4,270,080	2.751704886	8.7996009
Khuzestan	26	339	266	631	1699.5	5,898,240	5.349053277	14.40684
Zanjan	7	116	123	246	595.5	6,432,000	1.912313433	4.6291978
Sistan and Baluchestan	18	110	27	155	583	3,600,000	2.152777778	8.0972222
Semnan	12	205	220	437	1051.5	6,185,280	3.532580578	8.5000194
Fars	32	538	487	1057	2674	14,256,000	3.707210999	9.3785073
Qazvin	11	120	99	230	623.5	13,487,040	0.852670415	2.3114783
Qom	9	139	125	273	697	17,043,840	0.800875859	2.044727
Kerman	13	171	674	858	1396	4,582,080	9.362560235	15.233257
Kurdistan	6	84	88	178	439	3,148,800	2.826473577	6.9709096
Kohgiluyeh and Boyer-Ahmad	4	31	69	104	215.5	1,658,880	3.134645062	6.4953463
Kermanshah	6	102	131	239	545	7,440,960	1.605975573	3.6621619
Golestan	7	224	45	276	895.5	5,779,200	2.387873754	7.7476121
Gilan	7	345	186	538	1460	17,184,960	1.565322235	4.2479005
Lorestan	14	164	162	340	869	5,078,400	3.347511027	8.5558444
Mazandaran	12	130	68	210	637	25,670,400	0.409031414	1.2407286
Markazi	11	175	297	483	1014	8,372,160	2.884560257	6.0557849
Hamadan	8	140	27	175	593	6,539,040	1.33811691	4.5343047
Hormozgan	10	188	70	268	823	5,409,600	2.477077788	7.6068471
Yazd	1	194	64	259	752.5	5,191,680	2.494375616	7.2471724
Total	349	6468	7286	14103	33239.5	291,058,560	86.74855277	220.67635
					$\overline{EPDO}$= 1072.242		$\overline{R_i}$ = 2.798340412	$\overline{R_s}$ = 7.1185919
I_t					2144.484		4.197510618	10.677888

By considering three identification methods, the said provinces were identified by means of EPDO index method. The provinces were as in the order of Isfahan, Tehran, Khorasan Razavi, and Fars considering high traffic load and higher number of accidents for three consecutive years are among hazardous provinces and in 2014, Isfahan Province removed from the list which shows great potential of this province in reducing number of accidents.

By considering and identification of methods of accident rate and severity rate, we observed an optimization in country provinces in the years 2013 to 2015 and as you observed in Tables 3, 4 and 5, in the year 2013, five provinces as in the order of Isfahan, Ilam, Khouzestan, Sistan and Balouchestan, and Kerman were identified as most hazardous provinces whose status was optimized during 2014 to 2015, and just Kerman province is located in critical status, while some provinces with more traffic load and great tourism attractions are not among these hazardous location.

Totally, taking into consideration definition of main factors on accidents, these factors are co-related in a chain mode in a way that compliance with these rules in the level of hazardous provinces in respect of accident rate and severity rate, we observed removal of 4 hazardous provinces.

Kerman province, due to special climate conditions, desert status, far distance of Inter-city and smoothness of asphalt of Inter-city roads due to high temperature, is remained among one of the most hazardous provinces. From offered solutions for reducing accident rate and severity rate in this province we can name speed control of vehicle, hidden control, supplying sufficient lighting in roads, creating welfare and rest facilities between road in far distances, vehicles safety, installation of dividers in roads in two line basis (NEWJERSI) in Inter-city roads.

Other influencing factors on accidents decrease and increase in recreational Inter-city travels in Norowz holidays is the speed of vehicle. As you see in Table 6, portion of speed violation-based accidents in 2015, in comparison with that of the years 2013 and 2014 shows negative value.

Table 6

Comparison of Speed Limit Violation Accidents in Traffic of Inter-City Recreational Travels of Norowz Holidays in Three Consecutive Years

Year 2013	Year 2014	Year 2015
14	9	9
Change of speed of 2015 compared to mean of 2013 and 2014	mean 2013 and 2014	Change the speed of 2015 compared to 2014
-3	12	0

It shall be mentioned that accidents reduction is due to reduction of average speed of vehicles and on the other hand, statistics of average speed in Inter-city recreational travels in Norowz holidays in Table 7 approved this matter, but on the other hand, based on Table 8, the second factors of accidents in Inter-city recreational travels in Norowz holidays is violating the safe speed.

Table 7

Comparison of Average Speed of Vehicles in Inter-City Recreational Travels in Norowz Holidays in Three Consecutive Years

Year 2013	Year 2014	Year 2015
84	81	83
Change of average speed of 2015 compared to mean of 2013 and 2014	mean 2013 and 2014	Change the average speed of 2015 compared to 2014
1	82	2

Table 8

Absolute Reasons of Accidents in Inter-City Recreational Travels in Norowz Holidays in Three Consecutive Years

Reasons	Norowz holidays 2013 (Percent)	Norowz holidays 2014 (Percent)	Norowz holidays 2015 (Percent)
Carelessness of front	30.4	29.5	31.9
Violating safe speed	20	23.9	23
Left deviation	18.1	17.1	18
Violating priority	14.1	13.8	12.6
Fatigue and sleepiness	7	6.5	5.7
Inability to control the vehicle	1.3	2.2	2.3
Change direction suddenly	3.2	2.5	2.2
Tailgating	1.7	1.4	1.6
Move in the opposite direction	0.9	1	0.8
Technical problem	0.4	0.9	0.8
Illegally crossing pedestrian	0.1	0.3	0.3
Crossing the prohibited area	0.8	0.5	0.3
Other	1.9	0.6	0.3
Total	100	100	100

Absolute reason of accidents in Inter-city recreational travels in Norowz holidays is one of the most important issues. Based on reports prepared by experts, the most important reason of accidents in Inter-city recreational travels in Norowz holidays is due to carelessness of front, violating safe speed, left deviation, violating priority, and fatigue and sleepiness. Based on these statistics, human factor has a large portion in accidents.

4. Conclusion

1. Taking into consideration that in 20 days of Norowz holidays each year as critical days of traveling QTY, we observe the most statistics of passing traffic on country roads, therefore, analysis of number of accidents in these days and its comparison with other days of year to identify hazardous provinces which are in identification priority can have an important role in decision making of executive managers in the country and balance of accident reduction can be determined by rate of damage.

2. While having high number of recreational travels in Norowz holidays in comparison with total annual traffic, further to considering hazardous provinces, it is concluded that tourism attraction is not the only reason, and accident severity

and number of accidents is a function of geographical climate of southern and central districts, and therefore, desert conditions and lack of controlling speed limit in these areas can be defined as hazard potential, in line of which, Kerman Province is introduced as one hazardous province of the country.

3. By analyzing the Equation of injury in different provinces in three consecutive years, it was clear that, for traffic related to Norowz holidays, while having accidents reduced, but due to minor rate of injuries, we observed increase in I/A index, which made is necessary for analysis which by considering 3D models, it was determined that in ideal conditions, by increasing rate of motorization in proportionate to annual development, by remaining cube as fixed in different years, further to increase E traffic, we shall see significant decrease in other indexes, in which in three-year analysis while having E traffic reduced, it was due to governmental economic policies and existence of high costs of travels and also rate of inflation. We shall have more reduction in values of A/E and I/A indexes, in which due to lack of balance in injuries reduction, it can be concluded that not only roads safety in respect of accidents reduction was not acceptable, but also, rate of injuries are so less and even lower than that.

4. Therefore, necessity of reduction of accidents cannot be the only reason of influencing factors in presenting safety statistics and information and its relation with rate of inflicted injuries in proportionate to balance amount of reduction, taking into account increase of vehicles in traffic shall be deemed as influencing factor of accidents performance analysis in line of which after identifying province with high accident rate we shall take action for accidents rate and severity and accordingly, it will cause reduction of total injuries indexes of accidents up to limit of lower than the average amount.

5. Analysis of hazardous provinces showed that the provinces with higher recreational travels traffic attractions are not necessarily deemed as accident-province and existence of different geographical factors like desert status and lack of speed limit control and also fatigue and sleepiness shall be as higher potential of injuries hazards in this district.

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