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Environmental Related Risk Factors to Road Traffic Accidents in Ilam, Iran

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ABSTRACT

Introduction: Road traffic injuries (RTIs) are the most serious health issue in the world and the main cause of death after the first year of birth. Environmental factors are among the most important and effective aspects of RTIs occurrences and their human consequences. **Aim:** This study aimed to identify the environmental factors associated with road traffic accidents (RTAs) in Ilam province. **Methods:** All crash data in Ilam province in 2012 were investigated. RTI's data was collected using COM 114 form which included some human, environmental and vehicle related factors. Through Chi-Square test and logistic regression model, the association between environmental factors and RTIs was examined. For all statistical analyses we used the package Stata 13.1. **Results:** A total of 2314 traffic accidents were investigated. The highest 1659 (72.3%) and lowest 19 (0.83%) frequency of RTAs occurred during day and sunrise respectively. The majority of RTAs took place in July and September. The maximum number of RTAs was when the day was clear (91.7%) 2103 and the minimum when it was cloudy (3.5%) 81. A significant relationship was found between fatal RTAs and factors such as; the sort of the road, the hindered visibility, the location of the accident, the accidents' place, the climate, and lighting of the day ($P<0.05$). The adjusted chance of traffic accidents causing death or injuries in main streets was 9.7 times more than in highways; in sidetracks it was 3.54 times more. And when it was cloudy, the chance was 2.60 times more than when was clear ($P<0.05$). **Conclusion:** Regarding the standards of road construction, development of the roads, and educating drivers how to adjust their driving behavior to the environment and road conditions could have a great role in decreasing RTAs causing death or injury.

Keywords: Traffic Accidents, Environmental Exposure, RTIs, Risk Factors, Injury, Iran.

1. INTRODUCTION

Transportation is the prerequisite and infrastructure for a sustainable development and has an essential role in exploiting facilities and potential talents. This role and importance suggests it as one of the main indexes of growth and development (1). Approximately 1.35 million people die each year as a result of Road Traffic Accidents (RTAs) and 93% of road deaths occur in low and middle-income countries. RTAs are the main leading cause of death for children and young adults aged 5 to 29 years. Also the economic cost of RTAs is estimated to be 1% of gross national product (GNP) in low-income countries, 1.5% in middle-income countries and 2% in high-income countries (2). Iran has one of the highest mortality rates from RTAs among middle-income countries (3-6). RTAs are the first cause of death among under-40-aged people and the second cause of death among all ages in Iran (7). In Iran, more than one-third of the beds in hospitals

are allocated to injured of RTAs (8). Alongside the rapid growth of production, using vehicles, and increase in the number of users of transportation network, the safety level of the roads in Iran is decreasing and accidents' statistics point out an increasing growth. Also the road networks of country have a great role in decreasing RTAs (1, 9). World Health Organization suggest that Iran is one of the countries which has the highest rate of death caused by RTAs (4, 6, 10, 11).

The studies show that RTAs have complicated consequences which are caused by human, vehicle, and environmental factors (12, 13). Based on a study of geographical variations and RTAs which was done in Wales, England, a significant association was found between rainy and foggy days with the number of RTAs (14). Based on Norman et al. study on the effect of roads' slipperiness due to the climate on the increase of accidents in south of Sweden, and presenting the classification scheme of

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roads' slipperiness, they pointed out providing necessary alerts when the climate is not normal (15). On a study of the effect of climates on the occurrence of RTAs in Canada, the effects of rain, the average temperature and snow during the years 1990-1992 were studied. This study suggested that however the effects of these three factors on RTAs were significant, yet snowy weather was more effective (16). According to a study of climate effects on transportation system in highways in USA, these effects have been increased recently; unfavorable climate conditions reduce the traffic pace and increase the frequency of collisions (17). According to the study done by Farajzadeh et al. on analyzing fatal RTAs on New Year holidays, RTAs was increased on some days of holidays. This increase was caused by the unfavorable climate on most of the days, on other days it was because of the increase of travels (15). Therefore, environmental factors have a remarkable importance due to their effects on traffic accidents' severity and their injuries. More importantly, some of these factors are controllable just as engineering and track designing problems.

Regarding the high rate of RTAs in Iran and also in Ilam province, due to the climatic and geographical conditions, RTAs result in a lot of life and financial losses annually and considering there has been no study on the effect of environmental factors on the occurrence of RTAs in Ilam.

2. AIM

This study aimed to identifying the environmental factors affecting RTAs causing injuries in Ilam, Iran.

3. METHODS

This was a retrospective cross sectional study. The database of all traffic crashes registered through the "COM114" police forms from 2012 to 2013 in Ilam province was investigated. In Iran, data on traffic crashes are collected and recorded by the police. The system for collecting data on road traffic accidents based on the needs of traffic-related organizations is based on the use of a tool called "COM114" that based on expert opinions and the use of similar systems in the countries of the region, collects information from the main dimensions of a traffic crash, including the person, vehicle and environmental conditions. One of the most important goals of this system is to analyze the situation of traffic accidents in the country, and to find out the factors influencing the crashes and severity of the consequences of it and to use the results obtained in decision making, policy making and design of proper interventions. The data of COM114 form are collected in two sections of the general and specific information. In the general section, the time, location, road status, weather conditions, lighting conditions, vehicle characteristics, characteristics of the road user (driver, passenger, and pedestrian) and the causes of the RTAs. In the specific section the data of the crash scene and expert opinion are gather and import to the traffic accident database. Tool questions are designed to be open and closed. The data has been logged by the police in different parts of the country, and it is possible to

process and report it to users at provincial and national levels (18). In this study, the collected data was about the environmental conditions of crashes, human factors, and vehicle characteristics as well as the consequences of traffic accidents. Traffic accidents data in the police database is maintained in four separate sections and stored in the Microsoft Excel® environment. The data of each section were reviewed separately and controlled and modified in terms of human errors (redundancies, typographical errors, etc.) as necessary. The method of controlling missing data was to add them to the categories that had the most frequency. Duplicates were removed in terms of three components of series of code names, serial number and date of accident. Frequency and frequency percent was used for descriptive analysis of qualitative variables. Also to define the connection between variables classified qualitatively and discussed consequences (fatal and injurious accidents), Chi-square test was done, and to diminish the effect of different variables on the occurrence of discussed consequences, logistic regression model was used. All statistical analysis performed using STATA 13.1.

4. RESULTS

Totally, 2314 RTAs were recorded by traffic police in 2012 in Ilam. Although more than 72% of the whole traffic accidents had occurred during the day, the maximum proportion of accidents causing injury and death according to the collected data was (74%) and during the evening. The highest and lowest numbers of RTAs had happened during Tuesdays (15.3%) 361 and Friday (12.6%) 298 in order. The highest frequency of traffic accidents was in June and September (10.6%) 397, and the lowest frequency was in November (7.0%) 264.

Variable	Accidents causing Injury or death	No injuries	Total (%)	P
Light condition				
Day	970 (58.4)	689 (41.5)	1659 (100)	
Night	350 (65.3)	186 (34.7)	536 (100)	0.003
Sunrise	11 (57.8)	8 (42.1)	19 (100)	
Sunset	59 (73.7)	21 (26.2)	80 (100)	
Total	1390 (60.5)	904 (39.4)	12294 (100)	
Driver's visual condition				
Visual obstruction (yes)	22 (40.7)	32 (59.2)	54 (100)	
Visual obstruction (No)	1260 (59.0)	873 (40.9)	2133 (100)	0.007
Total	1282 (58.6)	905 (41.3)	2187 (100)	
Accident's location				
Road	1050 (59.5)	712 (40.4)	1762 (100)	
Verge	59 (48.3)	63 (51.6)	122 (100)	<0.05
Edge of the road	170 (57.2)	127 (42.7)	297 (100)	
Total	1279 (58.6)	902 (41.3)	2181 (100)	
Sort of the track				
Highway	3 (21.4)	11 (78.6)	14 (100)	
Avenue	688 (73.2)	251 (26.8)	939 (100)	
Main road	471 (50.5)	462 (49.5)	933 (100)	0.001
Sidetrack	333 (54.5)	194 (45.5)	427 (100)	
total	1395 (60.3)	918 (39.7)	2313 (100)	

Table 1. Frequency distribution of traffic accidents based on the environmental related risk factors

Variable ()	OR adjusted	P	CI %95
Light condition (day)	-	-	-
Night	1.35	0.005	1.1–1.7
Sunrise	1.05	0.922	0.4–2.9
Sunset	2.31	0.002	1.4–3.9
Weather condition (clear)	-	-	-
Rainy	0.76	0.212	0.5–1.2
Cloudy	2.60	0.001	1.5–4.6
Road (highway)	-	-	-
Avenue	9.74	0.001	3.0–35.5
Main road	2.84	0.120	0.8–10.6
Sidetrack	3.45	0.068	0.9–13.6
Accident's location (road)	-	-	-
Verge	0.90	0.635	0.6–1.4
Road's edge	1.35	0.033	1.1–1.8
Area (flat)	-	-	-
Mountainous	1.14	0.294	0.9–1.5
Visual obstruction (no)	-	-	-
Yes	0.39	0.002	0.2–0.7
Accident's place (inside the city)	-	-	-
Suburb	0.95	0.786	0.6–1.3
Total	998	908	90

Table 2. Estimation of the effect of environmental factors on the occurrence of RTAs leading to death or injury

The highest frequency of RTAs was for clear weather (91.7%) 2013 and the lowest was for cloudy weather (3.5%) 81. There was also a significant relationship between climate and RTAs causing injury or death ($P < 0.05$).

The highest and lowest frequency of RTAs considering their location were 1762 (80.7%) and 122 (5.5%) in order. The highest frequency of road injury or death was 1050 (59.55). Moreover a significant correlation was found between the location of accidents and fatal or injurious traffic accidents ($P < 0.05$). Based on visual obstruction data, the highest frequency of accidents was for situations in which there was no a visual obstruction 2133 (97.5%), and a significant statistic correlation was found between the existence of visual obstruction and injurious or fatal traffic accidents ($P < 0.05$) (Table 1). Analysis of RTAs inside and outside of cities shows that the highest frequency of accidents was for outside the city 1256 (53.3%) and the highest frequency of injury or death caused by traffic accidents was for inside the city 749 (68.7%). A significant correlation was found between the location of accidents and injurious or fatal traffic accidents ($P < 0.001$). Considering the sort of roads, the highest frequency was for avenues (40.65) and lowest for highways (0.315) 14, moreover, the highest frequency of injury or death was for avenues 688 (73.2%). Also a significant connection was observed between the sort of roads and traffic accidents causing injury or death ($P < 0.001$) (Table 1). Considering the location of accidents, the highest frequency of crashes was 1806 (78.1%) and the highest frequency of injury or death caused by RTAs was 1109 (61.45) in flat areas. Also a significant statistic correlation was found between the location of crash and traffic accidents causing injury or death ($P < 0.05$). To evaluate the effect of environmental factors on the consequences of injurious

or fatal traffic accidents Logistic Regression model were used. The adjusted chance of injurious or fatal RTAs in avenues was 9.74 and in sidetracks was 3.54 times more than in highways and also the adjusted chance of injurious or fatal traffic accidents occurred in the evening was 2.31 times more than in daytime, and in a cloudy day 2.60 times more than in a clear day (Table 2).

5. DISCUSSION

The highest frequency of RTAs had occurred in a clear weather and in daylight, and the maximum rate of injury or death had occurred during the night. Also, In Lankarani et al., study, the results showed that the RTAs were most prevalent on clear weather conditions and proportion of RTAs led to injury and death in sunrise and sunset was significantly higher than the daytime hours (19). The highest frequency of RTAs in clear weather could be the result of the weather in Iran, because the weather is often clear and sunny in most days. The highest rates of RTAs that leading to injury or death at night could be due to poor visibility because of insufficient light at night and sleepiness of drivers. The highest number of traffic crashes referred to June and September. Most of the traffic accidents had occurred on Tuesdays and least of them on Fridays. The highest frequency of accidents and also injury or death was in avenues and the most traffic accidents had happened in flat areas and suburbs.

The adjusted chance of injurious or fatal RTAs on avenue was 9.74 times and on main road was 2.84 times more than on highway. It seems that developing the road as the vehicle and considering accident-prone areas might have been influential in decreasing the number of traffic accidents. In a study done by Sherafati et al., identical results were obtained and also training the driver how to adjust their driving behavior with factors related to the environment and the road might have a great effect on reducing the incidents (1, 20, 21). Despite the higher frequency of accidents during the day, the adjusted chance of traffic accidents causing injury or death during the night was more (2.31). It seems that training the diver to consider resting hours while driving during the day, might have a great effect on decreasing traffic accidents. On a study Bakhtiary et al., the results were consistent with the present study (22). Also on the reports of a study Hatam Abadi et al., most of the RTAs had occurred during 9 am and 9 pm (23). And according to the study done by Afshari Azad et al., most of the highest frequency of the hour of accidents in 10 years was during the hours 2 pm – 6 pm, and according to the discussed study, the highest frequency of traffic accidents was during the hours 6 pm – 8 pm (24). Considering the weather condition, the highest frequency of accidents had occurred in clear days which might have caused by not driving with caution. There were the same results in the study Moradi et al. (25). The results of the study by Christopher et al., showed that inclement weather conditions reduced the traffic speed and increased the frequency of collisions that did not coincide with the present study (26). Also a significant statistical correlation was found between the injurious or fatal traffic accidents and the place of accidents inside

or outside of the city which might be because of some human factors, and violation of driving rules. Identical results were obtained in a study done by Bakhtiari et al. (27). These results are consistent with the present study.

Also, according to the national data on RTAs in Iran, 69% of deaths due to traffic crashes occur outside of cities or in the rural roads. Non-standard transition of rural roads to other routes, inappropriate use of motorcycles in rural areas, the low presence of emergency medical services and police in these areas, inappropriate use of tractors and other agricultural vehicles, are among the factors contributing to severe accidents in the regions that leads to high mortality (28). Considering the place of traffic accidents, the highest frequency of traffic accidents was in flat areas and considering the position of accidents, the highest frequency was in roads which seems that paying attention to the roads' safety condition and of course training drivers to recognize the condition of the roads and tracks might have an influential effect on reducing the traffic accidents.

6. CONCLUSION

Environmental related risk factors are one of the most affecting factors of road traffic accidents. It seems that developing roads and paying attention to road construction standards and training drivers to coordinate their driving behavior with road conditions can have a significant role in reducing death and injury from RTAs.

Also, it is recommended to introduce changes to the road-associated environmental factors to reducing RTAs related injuries and deaths.

- **Author's contribution:** MMJ, HS, AK gave a substantial contribution to the conception and design of the study. JB, MSK, and LM gave a substantial contribution of data. MMJ, HS, JB, and AK gave a substantial contribution to the acquisition, analysis, or interpretation of data for the work. MMJ, HS, MSK, LM, and AK had a part in article preparing for drafting or revising it critically for important intellectual content. All authors gave final approval of the version to be published..
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REFERENCES

1. Hekmatnia H AZ, Givehch S. Optimization of Urban Transportation and Study on Causes of Accidents, Yazd City, Iran (in Persian). *Human Geography Research Quarterly*. 2014; 46(88): 293-310.
2. World Health Organization. Global status report on road safety 2018. 2018.
3. Khorasani-Zavareh D, Mohammadi R, Khankeh HR, Laflamme L, Bikmoradi A, Haglund BJ. The requirements and challenges in preventing of road traffic injury in Iran. A qualitative study. *BMC public health*. 2009; 9: 486.
4. Zavareh DK, Bohm K, Khankeh H, Talebian MT, Mohammadi R, Bigdeli M, et al. Why should being visible on the road? A challenge to prevent road traffic injuries among pedestrians in Iran. *Journal of injury and violence research*. 2015; 7(2): 93-94.
5. Heidari M, Aryankhesal A, Khorasani-Zavareh D. Laypeople roles at road traffic crash scenes: a systematic review. *International journal of injury control and safety promotion*. 2018: 1-10.
6. Saadat S, Soori H. Epidemiology of traffic injuries and motor vehicles utilization in the Capital of Iran: A population based study. *BMC public health*. 2011; 11(1): 488.
7. Khireandish M AA, Zajkaniha F. The role of atmospheric phenomena on road accidents(Full Text in Persian). *Journal of rahvar*. 2013; 10(21): 53-71.
8. GhorbaniBirgani A HA, Zare K. Epidemiologic Study of Fatal Traffic Accidents in Khuzestan Province in 2010 (in Persian). *Scientific Journal of Rescue & Relief*. 2012; 4(2): 28-35.
9. Almaci A HA. Road traffic situation in Kermanshah (in Persian) *Journal of Science reserch*. 2002; 6(1): 47-54.
10. Fallah Karkan M BH, Taeefe N, Soltani Moghaddam R, Khoshbakht Pishkhani M. Visual Disorders in Drivers Causing Accidents (in Persian). *Journal of Guilan University Medical Sciences*. 2013; 22(85): 48-53.
11. Seyyedmehdi SM DF, Salari S , Hedayati Mashkale M , Attarchi M. Assessment of frequency of accidents and related factors in professional drivers of heavy vehicles (in Persian). *Forensic Medicine*. 2010; 16(3): 187-194.
12. Khosravi Shadmani FSH, Zayeri F, Eini E , Mehmandar M. Effect of Some Person and Vehicle Related Factors on Offenses Status of Road Traffic Injuries in Iran (in Persian). *Journal of Transportation Engineering*. 2011; 3(2): 117-124.
13. Bahadorimonfared A, Soori H, Mehrabi Y, Delpisheh A, Esmaili A, Salehi M, et al. Trends of Fatal Road Traffic Injuries in Iran (2004–2011). *PLOS ONE*. 2013; 8(5): e65198.
14. Jones AP, Haynes R, Kennedy V, Harvey I, Jewell T, Lea D. Geographical variations in mortality and morbidity from road traffic accidents in England and Wales. *Health & place*. 2008; 14(3): 519-535.
15. Farajzadeh Asl M BA. Analysis of Deathly Road Accidents in Novrooz Holidays of Year 2007 with Climatic Approach (in Persian). *Geography and Development Iranian Journal*. 2012; 10(26): 73-85.
16. Papa M. Comorbidities and Crash Involvement among Younger and Older Drivers. *PLOS ON*. 2014; 9(4): 1-6.
17. Strong CK, Ye Z, Shi X. Safety effects of winter weather: the state of knowledge and remaining challenges. *Transport reviews*. 2010; 30(6): 677-699.
18. Khorshidi A, Ainy E, Sabagh M, Soori H. Traffic injury data collection in Iran, challenges and solutions. *Safety promotion and injury prevention (Tehran)*. 2015; 3(1): 35-42.
19. Lankarani KB, Heydari ST, Aghabeigi MR, Moafian G, Hoseinzadeh A, Vossoughi M. The impact of environmental factors on traffic accidents in Iran. *Journal of injury & violence research*. 2014; 6(2): 64-71.
20. Shrafati A KS, Mahmandar M. Factors affecting the management of road traffic accidents in the province (in Persian). *Journal of Extension*. 2013; 10(22): 51-72.
21. Kazemi I TM, Moamenian S , Hagh Shenan H. Factors Determining the Number of Accidents According to Severity Using Bayesian Multivariate Log-Normal Poisson Regression (in Persian). *Journal of Health System Research*. 2012; 8(4): 627-680.
22. Bakhtiari M SH, Ainy E, Salehi M, Mehmandar M. The Survey of the Role of Humans' Risk Factors in the Severity of Road Traffic Injuries on Urban and Rural Roads (in Persian). *Journal of Safety promotion and injury Prevention*. 2014; 2(1): 1-8.
23. Hatamabadi HVR, Haddadi M, Akbarpour S, Soori H. Road traffic injuries and deaths: comparing reports by different sources (in Persian). *Payesh*. 2014; 13 (2): 189-196.
24. Afshariadzad M, Poraki H. Environmental and Geomorphological Hazards Assessment and their Role on Road Transport (Case Study: Col Almass). *Journal of Geography and Planning*. 2013; 16(42): 23-44.
25. Moradi A RK. Trend of Traffic Accidents and Fatalities in Iran over 20 Years (1993-2013)(in Persian). *Journal Mazandaran University Medical Science*. 2014; 24(118): 223-234.
26. Christopherk KSY, Xianiming SHI. Safety Effects of Winter Weather: The State of Knowledge and Remaining Challenges. *Transport Reviews*. 2010; 30(6): 677-699.
27. Bakhtiari MSH. Epidemiology of traffic crashes outcomes and related factors (in Persian). *safty promotion and injury prevention*. 2013; 1(3): 50-159.
28. Lankarani KB, Sarikhani Y, Heydari ST, et al. Traffic accidents in Iran, a decade of progress but still challenges ahead. *Medical journal of the Islamic Republic of Iran*. 2014; 28: 96..