

The relationship between climatic factors of dust than other climatic factors in road accidents

Ali Reza Dehghanpoor¹, Leyla Mirfakharadini² (corresponding author), Morteza Falahpoor³

¹Faculty of Climatology department, Payame Noor University, Mehriz, Yazd, Iran.

²department of Climatology, Payame Noor University, Mehriz, Yazd, Iran.

³Faculty of Climatology department, Payame Noor University, Mehriz, Yazd, Iran.

Abstract: This research is done for investigation about the role of dust on road crash for Yazd province in the year of 2015. This research is quantitative and description which is done as documentary or description-analytic research. Statistical society of this research is total of documents and statistics about road car crashes on different pivots of Yazd province. In this research statistic of road crashes of Yazd province as the result of dust, concern about years of 2010 to 2014 are considered as statistic sample. Needed information are obtained from files and statistics which presented by meteorology organization, Police Department and toll-house bureau of the province. For analyzing data is used from inference statistic indexes like Ki2 test, Fridman statistic, Pierson correlation coefficient and regression. Also results showed that the most car crashes which happened by dust is in spring season and after that is happen in winter. So climate factor of dust has significant role in road car crashes and also it has more effective toward the other factors. This phenomenon is with increasing number of cars in ways of the province and also is with increasing traveling between towns.

[Ali Reza Dehghanpoor, Leyla Mirfakharadini, Morteza Falahpoor. **The relationship between climatic factors of dust than other climatic factors in road accidents.** *Rep Opinion* 2016;8(3):1-8]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). <http://www.sciencepub.net/report>. 1. doi:[10.7537/marsroj08031601](https://doi.org/10.7537/marsroj08031601).

Key words: meteorology organization, dust role, road crashes and Yazd province.

Introduction

Driving accidents especially road car crashes are a global concern and also it is expanding in developing countries. This factor is presented as one of the four most dangerous factors that treat human's life from United Nations organization and World Health Organization (WHO) so these organizations want from countries to attempt immediately about this disaster to reduce damages of it. Based on prediction of WHO ranking of ten causes of dead concluded of disease or damages in world will change meaning that ninth cause of death meaning car crashes will come to the third place (WHO, 2010).

Finding and recognition of climate factors role on road crashes is very important to presenting management solutions. Driving accident management and or management of accident scene is one of the effective solutions. These solutions could decrease next complications including decrement of loses, preventing of new accidents from controlling the climate factors (Saffarzade, 2005). This research is done for purpose of investigation about dust role on road car crashes in cities of Yazd province.

Problem definition

Totally, four important factors have role in outbreak accidents: natural factors or environment factors, human factors, management factors, transporting vehicles (Doagooyan et al, 2013). Plus the accidents that the human has role on it, the natural disasters like flood, earthquake, storm, dust storm and

hurricane have significant role on accidents specially on driving accidents in past decades. Road accidents and loses of it, is one of current challenges in human societies which are caused of heavy costs on economic of the country and also is a big problem for general health (Shariat, 2006). One of the environment factors which have an important role on road car crashes in arid area is dust. Wind with dust is happened in area that has no trees or vegetation. In the other hand dust storm have create many issues that some of these has local and transient effects and rest of it have long-term and universal effects (Wang, 2005).

Because in Yazd province road car crashes concluded of dust storm are not accepted by life and property insurance, most of culprit accident runaway from crime scene and this factor prepare of crime and homicide and also is caused of insecurity in cities of the province. So plus the life and property damages that happened in road crashes in cities of Yazd, will be caused of some cultural issues including disobey from traffic rules, citizenship rights, traffic issues, non-collaboration in crisis management and etc. based on mentioned sentences, the main question or problem in this research is: what is the role of dust climate on road car crashes in cities of Yazd province?

Detailed question are as following:

How much is role of dust toward other factors of climate on road car crashes in cities of Yazd province?

In which season of year dust storm is caused of most car accidents in cities of Yazd province?

What is the procedure and changes of car accidents in cities of Yazd province?

Background of the research

Doagooyan and Tavangar (2013) have done research with title of “analysis of roles of dust storm on road car accidents; case study: path of Minab and Jask”. Purpose of this research is examination the effect of dust storm on number of road car crashes in path of Minab and Jask. The results show that the most number of accidents were happened in ways of Minab city in spring season and month of Farvardin which the most dust storms were occurred in the time because of arid climate. With recognition these features and predicting the day before that this disaster occurred, with crisis management and immunization of road and reporting this situation to road help center, emergency, highway police and warning to drivers could decrease the probability damages.

Dehdarzade (2011) in a research about examination the dust storms of Fars province has declared that low-pressure of Persian Gulf and Arabian Desert and followed by air intake to these area, are caused of creation of dust storms.

Sherafati et al, (2013) have done a research to examination the factors that influence on managing the road accidents in Lorestan province. The results show that the factors: learning traffic culture, learning traffic psychology interaction between police and road maintenance, police supervision on technical inspection of vehicle, police supervision on the automakers, interaction between police and emergency, ranking the effective factors of accidents, will impact on road car crashes in Lorestan province.

KheirAndish et al. (2013) have done a research to evaluating the role of elements and phenomena of climates that effect on road crashes. The results show that between whole unfavorable circumstances, cloudy days have the most frequency cases of accident with amount of 409 so this big amount of crashes could be concluded from high humidity weather because this type of weather influence on mental situation of person and finally it is caused of fatigue in drivers. According to the information of Qazvin’s police accidents that are happened by frost in road have a little percent of total meaning 9.09 percent. This little amount of damages is because of on-time acting and operation from road maintenance in the whole roads. The results show that in Qazvin’s roads unfavorable climate circumstances have a significant effect on accidents; but the other factors which impact on car accidents are climate circumstances, human factors, topographic situation and etc. and total of these factors will effect on accidents.

Feng and Indochung (2002) have done a research about relations between road car accidents and climate

phenomenon in occurrence of crashes and they are considered situation of accidents in raining day, misty day and dust storms, they concluded that probability of crash occurrence in days with these phenomenon will be increased. Also they examine the effect of soil on body health and breathing and they showed that there is significant relation between them.

Viphen et al, (2002) in a research with using from fixed multispectral of satellite data have obtained to significant results. Also they considered some strategic policies in transportation field for decrement effects of mist on ground transporting system. But in Iran examination about road securities with considering climate phenomenon are very limit and concerned to recent years.

Arilon and Helidburn (1999) have written in a research named safety road reporting, main purpose of road audit is reducing number of damages through using from prevention methods. Common examinations of accident-prone area is a passive action in regard to security issues and could consider these are as a final result of designer’s weakness and using from security cases in their activities. Safety audit is an effective tool in increasing safety of roads from examination and official recognition of weakness points and problematic of road and environment of it by independent team of experts and experience before happening accidents in roads.

Hypotheses of the research

Main hypothesis

Dust storm has a role on road car accidents in cities of Yazd.

Partial Hypotheses

Dust storm is caused of the most car accidents in first days of spring and autumn in cities of Yazd.

Procedure and changes of road accidents because of dust storm in Yazd are increased.

Research methodology

In this research is used form documentary method for examination the role of dust climate factors on road car crashes in Yazd province, also in this method the source of information is included of documents, evidences and classified statistics (Delavar, 2013). So for gathering data is used from statistics of road car crashes that exists in highway police organization and weather situation in accident days from weather organization of Yazd province, with matching and classification different accidents and human, environment and road factors with each other are compared till specified the role of dust factor toward the other factors.

Totally, the main approach of this research is applicant-developing and also examination method is descriptive-analysis. Statistical society is number of accidents in Yazd province that needed information are gathered from highway police organization and

also from Planning and Management Organization and Yazd province's organization. According to the documents and evidences with using from data and statistics of accidents related to five past years is attempted to evaluating changes of accidents. So for analyzing accidents are used from methods of average of crashes, type of crashes and cause of these crashes, because technique of measurement, analyzing and examination of the past years could have good information about rooting and effective factors in accidents; and also could be used for managing accidents and changes that may happen in the future.

Research sample and sampling method

Group of members and things and phenomena belong to special group, when will be considered as a real sample for a society that it has the main features of society based on variables of the research (Delavar, 2013). Aim of every sampling in scientific researches is preparation specific and meaningful predicates about one group based on subset study of that group (Human, 2007).

In current research, statistic of road accidents in cities of Yazd province in five past years is as sample of research.

Analyzing method

For analyzing concluded data of this research are used from descriptive statistic indexes and inferential

statistics. Also in necessary cases is used from SPSS 20 software.

Descriptive statistic indexes: are used from frequency indexes, Frequency percent and etc. for describing data (and also are used for classification of data and drawing diagram and tables.).

Inferential statistics indexes: for testing the hypotheses of this research is used from Non-parametric chi-square test (significant test) with using from SPSS 20 software.

Descriptive findings

In this section is attempted to presenting raw data of research in form of tables and diagrams. Purpose of presenting the descriptive findings, is showing dust phenomenon situation in under study area and also accident statistic.

Frequency number of storms in Yazd province

For showing amount of storm occurrence in Yazd province are used from statistic of Synoptic stations between years of 2010 to 2013. Results of occurrence of this phenomenon are shown in table 1. As it is shown in the tables, most frequency of storms is in statistic period of 2013 with 47 times occurrence. Also frequency based on month, the Ordibehest month with 53 times of occurrence has most frequency between the other months. Storm occurrence based on season has most frequency in spring season with 113 times happening.

Table 1: number of stormy days in Yazd province between statistic periods based on month and year

sum	Esfand	Bahman	Dey	Azar	Aban	Mehr	Shahrivar	Mordad	Tir	Khordad	Ordibehest	Farvardin	
26	1	2	0	3	1	0	0	0	0	0	10	9	2009
34	5	2	1	0	0	1	0	0	2	5	9	9	2010
21	2	0	0	2	1	1	0	0	0	0	7	8	2011
45	5	5	1	0	1	0	2	1	0	5	10	15	2012
47	8	2	1	0	0	0	0	0	0	0	17	9	2013
173	21	11	3	5	3	2	2	1	2	10	53	50	sum

Source: Meteorological Organization in Yazd, 2014

Table 2: number of stormy days in Yazd province between statistic periods based on seasons

Winter	Autumn	Summer	Spring	
3	4	0	19	2009
8	1	2	23	2010
2	4	0	15	2011
11	1	3	30	2012
11	0	0	26	2013
35	10	5	113	sum

Source: Meteorological Organization in Yazd, 2014

Number of dusty days

Results show that there are 326 dusty days in the under study period meaning years between 2010 and 2014. Also most frequency of dust are happened in 2013 with amount of 100 days and in regards to month it happened in Ordibehesht with frequency of 58 days also spring season has the most frequency of dust occurrence.

Table 3: dusty days in Yazd province based on year and month

sum	Esfand	Bahman	Dey	Azar	Aban	Mehr	Shahrivar	Mordad	Tir	Khordad	Ordibehest	Farvardin	
41	3	5	3	1	1	1	1	5	6	0	10	5	2009
35	8	2	1	1	1	2	0	0	2	5	7	6	2010
68	12	8	0	0	1	3	6	5	10	5	11	7	2011
100	16	13	3	1	0	1	5	11	9	16	12	13	2012
82	7	8	2	1	1	2	1	1	8	19	18	14	2013
326	46	36	9	4	4	9	13	22	35	45	58	45	sum

Source: Meteorological Organization in Yazd, 2014

Table 4: dusty days in Yazd province based on season

Winter	Autumn	Summer	Spring	
11	3	12	15	2009
11	4	2	18	2010
20	4	21	23	2011
32	2	25	41	2012
17	4	10	51	2013
91	17	70	148	sum

Source: Meteorological Organization in Yazd, 2014

Number of days with visibility less than 2 km

Results show that the under study area in year of 2013 has the most frequency of visibility reduction. Also this reduction in visibility has most frequency in Azar toward the rest of the months and in winter season this area has most visibility reduction since most

frequency of dust storms happened in spring season. So may conclude that occurrence of visibility reduction in the under study are affected by another climate factors like raining and fog and dust phenomenon is placed in the third rank of factors of visibility reduction.

Table 5: Number of days with visibility less than 2 km in Yazd province based on year and month

sum	Esfand	Bahman	Dey	Azar	Aban	Mehr	Shahrivar	Mordad	Tir	Khordad	Ordibehest	Farvardin	
21	0	1	5	14	0	0	0	0	0	0	1	0	2009
8	1	4	0	2	0	0	0	0	0	1	0	0	2010
21	5	2	1	3	0	1	2	2	3	0	1	1	2011
22	2	2	4	6	0	0	0	0	2	2	1	2	2012
9	3	0	0	0	0	0	0	1	0	2	2	1	2013
81	11	9	10	25	1	1	2	3	5	5	5	4	sum

Source: Meteorological Organization in Yazd, 2014

Table 6: Number of days with visibility less than 2 km in Yazd province based on season

Winter	Autumn	Summer	Spring	
6	14	0	1	2009
5	2	1	1	2010
8	4	5	2	2011
8	7	4	5	2012
3	0	3	5	2013
30	27	13	14	sum

Source: Meteorological Organization in Yazd, 2014

Number of total accidents in the under study period

Results show that in the under study period, year of 2013 has most accidents between rest of years. Number of registered accidents in this year is 1602 times. Also most frequency of accidents based on month and season are related to Farvardin and spring

season, respectively. Given that frequency of dust storms in year of 2013 is more than the other years and also this phenomenon is happened in spring season more than other seasons, so could conclude dust storms have an effective role on accident occurrence in Yazd province.

Table 7: Number of registered accidents in Yazd province based on year and month

sum	Esfand	Bahman	Dey	Azar	Aban	Mehr	Shahrivar	Mordad	Tir	Khordad	Ordibehst	Farvardin	
1432	159	134	78	60	66	78	174	93	108	143	163	176	2009
1356	139	121	91	72	73	89	154	95	99	129	141	153	2010
1483	148	132	106	77	84	97	161	101	111	140	157	169	2011
1661	172	154	102	87	98	101	182	113	123	165	173	191	2012
1542	143	132	95	91	78	99	181	107	113	152	165	186	2013
	761	673	472	387	399	464	852	509	554	729	799	875	sum

Source: Meteorological Organization in Yazd, 2014

Table 8: Number of registered accidents in Yazd province based on season

Winter	Autumn	Summer	Spring	
371	204	375	482	2009
351	234	348	423	2010
386	258	373	466	2011
428	286	418	529	2012
370	268	401	503	2013
1906	1250	1915	2403	sum

Source: Meteorological Organization in Yazd, 2014

Number of accidents based on roads of Yazd province

For showing happened accidents in roads of Yazd province, six main roads were chosen. Results of number of occurred accidents in these roads that were caused of dust storm are shown in table no. 9 separately. As it is shown in the table, if amount of road accidents were caused of dust storm considered

based on distance/length, the Meybod- Ardakan road has most road accidents. Also in table no. 10 frequency of accidents occurrence in regards to distance from Yazd are shown. As it is shown in the table, if amount of road accidents were caused of dust storm considered based on distance/length, the Yazd- Ardakan road has most road accidents.

Table 9: Frequency of road accidents toward lengths of Yazd province's roads

Ratio (frequency to distance)	Distance (Km)	Frequency of accidents	Roads
51.90	22	1142	Yazd- Ashkezar
28.77	44	1266	Yazd- Mehriz
41.06	23	1314	Ashkezar- Meybod
6.45	181	1168	Ashkezar- Robat
110.66	6	664	Meybod- Ardakan
6.16	160	987	Robat- Tabas
-	-	1683	Other

Table 10: Frequency of road accidents toward lengths of roads between Yazd and cities

Ratio (frequency to distance)	Distance (Km)	Frequency of accidents	Roads
28.16	60	1690	Yazd- Ardekan
23.25	54	1256	Yazd- Meybod
22.18	22	642	Yazd- Ashkezar
5.46	203	1110	Yazd- Robat
5.22	363	1897	Yazd- Tabas
19.97	44	879	Yazd- Mehriz

Source: findings of research, 2014

Accidents resulting from climate factors

Table no. 11 is showing impact of each climate factors on amount of accidents in Yazd province. The results of this table show that in total statistic time of under study period dust storm phenomenon is caused of

car crashes and accidents more than the other factors. In this statistic period, dust phenomenon is caused of 1948 times accidents and storms phenomenon are caused of 913 times accidents.

Table 11: number of happened accidents based on different climate factors

Snow and	rain	dust	storm	
409	541	1948	913	Happened accidents

Source: Yazd Police Department, 2014.

Inferential findings

For inferential analysis of data are used from Chi-square test, Fridman statistic, Pierson correlation coefficient and regression. Results of tests are in following.

Seasonal relation of dust and accidents in Yazd province

To assess the fact that in what season accidents and dust phenomenon happened more than the other seasons and also for evaluating agreement or non-

agreement between dust phenomenon occurrence and accidents are used from Chi-square and Fridman test. As it is shown in table 18 amount of Chi-square is equal with 1137.492 and significance level of it is less than 0.05. Based on obtained results, there is a significance difference between amounts of occurred accidents due to dust phenomenon in different seasons of year. So most accidents that happen because of dust, were occurred in spring season and after that were happened in winter season.

Table 12: results of Chi-square test for comparing dust role in different seasons

Significance level	Degrees of freedom	Chi-square statistic	Seasons of year				Number of accidents
			winter	autumn	summer	spring	
0.004	3	1137.492**	1906	1250	1915	2403	

** . Significance level of 99 percent (0.01)

Also results of Fridman test in significance level of 95 percent show that most frequency of dust phenomenon is happened in spring season. Fridman statistic for dust phenomenon in spring season is equal with 3.67; in summer season is equal with 2.33; in autumn season is equal with 1.17 and in winter season is equal with 2.83. Also results of this test for accidents

in significance level of 95 percent show that most accidents were happened in spring season. Amount of Fridman statistic for accidents in spring season is equal with 3.33; in summer is 3; in autumn is 1 and in winter in 2.67. Also results of this test show that most frequency of accidents and dust were happened in spring season.

Table 12: specifications of Fridman statistic test for variables of dust and accidents

Accidents	Dust	
3	3	number
5.8	6.103	Ki-square statistic
3	3	Degrees of freedom
0.022	0.007	Significance level

Table 13: Independent and dependent variable of Fridman statistic separately by seasons

Fridman statistic of accidents	Fridman statistic of dust	
3.33	3.67	spring
3	2.33	Summer
1	1.17	Autumn
2.67	2.83	Winter

source: findings of research, 2014.

Procedure of road accidents in under study period

For showing procedure of accidents that happened because of dust in Yazd province are used from Chi-square test and Fridman test. As it is shown in table 21 amount of Chi-square is equal with 124.627 and significance level of it is less than 0.05. So could conclude that there is significance difference between amount of accidents that happened by dust in different

years. Based on obtained information, it is specified that procedure of road accidents happened by dust storm has increasing procedure from 2010 to 2014, so that in year of 2010 number of accidents happened by dust were equal with 1432 and in 2013 this amount became 1542. Also amount of accidents depend on dust phenomenon meaning if frequency of dust be increased then accidents became more.

Table 14: results of Chi-square test of accidents' procedure in Yazd

Significance level	Degrees of freedom	Chi-square statistic	Period of under study time					
			2014	2013	2012	2011	2010	
0.003	4	124.657**	1542	1661	1483	1356	1432	Number of accidents

** . Significance level of 99 percent (0.05)

Also results of Fridman test in significance level of 99 percent show that most frequency of accident occurrence has been happened in 2013 year. Fridman statistic for other years have been shown in the

following; for 2010 is equal with 2.25, for 2011 is 1.42, for 2012 is 2.88, for 2013 is 4.83 and for 2014 is equal with 3.63.

Table 22: specification of statistic Fridman test for procedure of accidents

Fridman statistic	Year	Statistic specification	
2.25	2010	12	Number
1.42	2011	32.954	Ki-square statistic
2.88	2012	4	Degrees of freedom
4.83	2013	0.000	Significance level
3.63	2014		

source: findings of research, 2014.

Conclusion

According to the climate and topographic situation that those are warm and dry in Yazd province, crowded roads of the province are under the influence dust so climate factor of dust has more effective role on road car accidents and after evaluating data it is specified that these accidents happened in spring and winter seasons more than the other seasons, respectively. Accident occurrence has an increasing procedure with increasing in the years of under study period. In the other hand yearly increment of cars and increment of between cities traveling are the other factors which could confront results of the research with challenging.

Suggestions

1. Presenting solutions to people that prevent road car accidents due to dust. Meaning that present information and statics about dust occurrence categorized by days, months, places and roads based on the experience of previous years.

2. Highways police department after notification about dust occurrence must deployed the policemen in the crowded roads immediately, and support all roads and also warn to drivers that road are not safe because of bad climate situation. In emergency cases they must prevent from driving and stop cars.

3. With forecasting weather by meteorologists could predict dust phenomenon one day before it

happens and after sure about occurrence of this all police officers be ready and stand by in all roads.

4. After occurrence the dust storm, there is probability of reduction in visibility for automobiles and motorcycles so after this phenomenon the information about it must be noticed for all peoples from general media.

Reference

1. Doaguyan, Davood., Behrozi, Mahmoud, and Tavangar, M. (2014). "Analysis of dust storms in the incidence of road accidents (Case Study of Minab – Jask)". *Traffic Management Studies / Issue 31 - Winter*. 57-72.
2. Dhdarzadeh, M. (2011)." Synoptic analysis and dust storms in the province". Master Thesis, University of Ardabil researcher.
3. Haddon Jr W. (1973). The changing approach to the epi-demiology. prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively based. *American Journal of Public Health*, 1438–58:1431.
4. Feng Q, Endo Cheng K.N. (2002). Dust storm in China:A case study of dust storm Variation and dust characteristics, *Bull Eng Geol Env* 61.
5. Moore, R. Cooper, L. (1972). Fog and road Traffic. *Transport and road research laboratory Report 446*. Ssp.
6. Lonero L and et al.(2002). Road safety as a social construct. Ottawa, Northport Associates, (Transport Canada Report No. 1112-00-8080).
7. Kheir Andish, Muhammad. Asgari, Ahmad and Zajkaniha, F. (2013). The elements and atmospheric phenomena governing road accidents. *Journal promote*. 21. Number of Dhmspring.
8. Saffarzadeh, Mahmoud. (2003). "Role in the advancement of transportation safety and management of road traffic". Police University.
9. Shariat, A. (2006). "The feasibility of using crisis management in the Ministry of Transportation's road transport network".
10. Sherafati, A, Kashfi, Said, Mehmandost, M. (2013). "Factors affecting the management of road accidents in the province". *Journal-promotional traffic*. Tenth year. Number 22, Summer.
11. Squires, V. R. (2002)."Dust and storm: An early warning of impending disaster. *Journal of Arid Environments*, Vol.34.
12. Wang, w. (2005). A synoptic model on East Asian dust emission and transport, *Atmospheric science and air quality conferences*. Beijing, China.
13. Whiffen, Bruce; Delanoy, Paul; Siok, Stanislas. (2002). Fog: Impact on road Transportation and Mitigation option. Presented at 10th World congress and Exhibition on Intelligent Transportation Systems and Services, 16-20 November, Madrid, spin.

2/21/2016