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The Relationship between Air Quality and Cases of Myocardial Infarction in Yazd in 2016

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ABSTRACT

Introduction: Air pollution is now one of the greatest environmental hazards to human health in the world. The aim of this study was to investigate the relationship between air quality and cases of myocardial infarction in Yazd.

Methods: This Ecological study was performed in Yazd, Iran. In this study, all the cases with myocardial infarction in Yazd who referred to emergency rooms from March 20, 2016 to March 20, 2017 entered the study. Information on the daily concentration of air pollutants included five pollutants SO_2, CO, O_3, NO_2 and PM_{10} and was validated according to the World Health Criteria. In the next step the raw data from air pollutants related to each station using equation and table standard was converted to separate AQI values for each pollutant and the pollutant having the highest index was introduced as the pollutant responsible for the day. Excel 2007 and R (3.4.3) software were used to analyze the data. The significant level was considered to be less than 0.05.

Results: According to measurements of air pollutants, out of 349 days, the air quality index (AQI <100) was standard in 245 days and in 104 days of the year was above the standard (AQI> 100).PM10 and CO emissions were for air pollutants in 86 days out of 104 days.

Conclusion: Given that in 104 days of the year, air quality has exceeded the standard, the children and elderly people should take caution in those days.

Keywords: Air Pollutants, Myocardial Infarction**,** Air Quality Index (AQI), Yazd

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Introduction

Air pollution is now one of the greatest environmental hazards to human health in the world [(1)]. According to the definitions, air pollution includes an increase in the heterogeneous mixture of gases, liquids and particulate matter, which include carbon monoxide, nitrogen oxides, sulfur dioxide, ozone, suspended particles with a diameter of less than 10 µg / m3 (PM_{10}) and very small particles with a diameter of less than 2.5 µg / m3 ($PM_{2.5}$) [(2)].

High concentrations of air pollutants are associated with hospitalization due to the progression and exacerbation of cardiovascular disease [(3)]. According to the World Health Organization (WHO), in 2012, 3.7 million deaths were attributed to air pollution[(4)].

Environmental pollution is one of the dangers that is due to urbanization, rapid population growth, industrial development in an unstructured way, lack of precise control over pollutants and increasing fossil fuels which results in ecosystem changes, environmental degradation, economic losses, climate fluctuations and air pollution, in which air pollution is more and more overlooked [(5)]. Although environmental pollutants are the most commonly used in these studies, Gaseous pollutants such as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3) and carbon monoxide (CO) have also a direct impact on the increase in mortality rates. Hence, the effects of this pollutant are discussed extensively [(6)].

Nowadays, many important cities of Iran have the problem of poor air quality status and dusty phenomena. Statistics show that in many metropolitan areas air quality exceeded the limit set by the World Health Organization [(7)]. One of the most important and effective measures to control air quality is determining the actual amount of pollutants and describing the air quality compared to standard conditions which can be used as indicators of air quality [(8)].

The results of Kermani et al. study showed that in the cities of Tehran, Tabriz, Mashhad, Urmia, Ahvaz and Arak, the air quality index has been the standard Environmental Protection Agency of Iran's in 341, 139, 347, 28, 162 and 81 days of the year respectively. All of the cities have been responsible for the particle of the major pollutant [(9)]. Mokhtari et al. in assessing the air quality index and health risks associated with PM_{10}, $PM_{2.5,}$ and SO_2 in the air of Yazd concluded that unhealthy quality of air in Yazd in some days of the year could result from fuel combustion, wind, dust and air dry [(10)]. The main purpose of this research determied the air quality of Yazd using the air quality index and its relation with cases of myocardial infarction in Yazd in one year from March 20, 2016 to March 20, 2017 using a negative binomial regression model.

Methods

This Ecological study was performed in Yazd, Iran. In this study, all the cases with myocardial infarction who referred to emergency rooms of Shahid Sadoughi hospitals, Rahnemoun, Martyrs of Mehrab and Afshar in one year from March 20, 2016 march 20 to March 20, 2017 March 20 entered the study.. A total of 970 myocardial infarction occurred with an average of 2.78 and a standard deviation of 2.57. Information was on the daily concentration of air pollutants, including five pollutants SO_2, CO, O_3, $NO_{2,}$ and PM_{10}. This information was received by referring to Yazd Environmental Protection Agency in one year from March 20, 2016 to March 20, 2017. Since the online station in Yazd just a sampling of the air pollution index in Student Boulevard was active in this study required data has been received from an air monitoring station. At the next step raw data of air pollution in each station converted to AQI index for each pollutant by using equation 1[(11)].

Equation 1:

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{HI} - BP_{Lo}}(C_p - BP_{Lo}) + I_{Lo}.$$

Where I_p = the index for pollution p C_p = the truncated concentration of pollutant p

BP_{HI} = the concentration breakpoint that is greater than or equal to C_p

BP_{L0} = the concentration breakpoint that is less than or equal to C_p

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I_{Hi} = the AQI value corresponding to BP_{Hi},

I_{L0} = the AQI value corresponding to BP_{L0}

The Air Quality Index was coded into six categories according to the table. Code 1: Good air quality level, Code 2: Moderate Code 3: Unhealthy for Sensitive Groups, Code 4: unhealthy, Code 5: Very unhealthy and code 6 is a hazardous level of air quality. Statistically, the frequency of myocardial infarction in one day is a discrete variable [11].

It is better to model numerical data and use distributions for discrete variables such as Poisson distribution or negative binomials [12]. In the Poisson regression, due to the excessive skewness of the numerical data, there is no equality of mean and variance condition [13]. It causes overdispersion in the model. To solve the problem of the over-dispersion of data, alternatives such as negative binomial regression are presented [14]. Excel 2007 and R (3.4.3) software were used to analyze the data. The significant level was considered to be less than 0.05.

Table 1. Breakpoints for the AQI(11)

and this category	**equal this AQI**	**These Breakpoints...**						
	AQI	NO2 (ppb) 1-hour	SO2 (ppb) 1-hour	CO (ppm) 8-hour	PM10 (µg/m3) 24-hour	PM2.5 (µg/m3) 24-hour	O3 (ppm) 1-hour[1]	O3 (ppm) 8-hour
Good	0 - 50	0 – 0.053	0 – 0.034	0.0 - 4.4	0 - 54	0.0 – 12.0	-	0.000 - 0.054
Moderate	51 - 100	0.054 – 0.1	0.035 – 0.144	4.5 - 9.4	55 - 154	12.1 – 35.4		0.055 - 0.070
Unhealthy for Sensitive Groups	101 - 150	0.101 – 0.36	0.145 – 0.224	9.5 - 12.4	155 - 254	35.5 – 55.4	0.125 - 0.164	0.071 - 0.085
Unhealthy	151 - 200	0.361 – 0.64	0.225 – 0.304	12.5 - 15.4	255 - 354	55.5 - 150.4	0.165 - 0.204	0.086 - 0.105
Very unhealthy	201 - 300	0.65 – 1.24	0.305 – 0.604	15.5 - 30.4	355 - 424	150.5 - 250.4	0.205 - 0.404	0.106 - 0.200
Hazardous	301 - 400	1.25 – 1.64	0.605 – 0.804	30.5 - 40.4	425 - 504	250.5 - 350.4	0.405 - 0.504	(2)
Hazardous	401 - 500	1.65 – 2.04	0.805 – 1.004	40.5 - 50.4	505 - 604	350.5 - 500.4	0.505 - 0.604	(2)

[1] Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a few numbers of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone value may be calculated, and the maximum of the two values should be reported.

[Two] 8-hour O3 values do not define higher AQI values (≥ 301). AQI values of 301 or higher are calculated with 1-hour O3 concentrations.

Results

In this study, a total of 970 myocardial infarction occurred with an average of 2.78 and a standard deviation of 2.57. Table 2 and Figure 1 show the air quality of Yazd for the whole year and four seasons of the year according to the air quality index in each of the classes regarding percentage and day. According to measurements of air pollutants in 349 days, air quality was observed standard(AQI<100)in 245 days and i it was above the standard in 104 days.

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Table 2. Health Quality of air in Yazd using air quality index considering year and season

AQI	Status	Spring(%)	Summer(%)	Fall(%)	Winter(%)	Total(%)
0 - 50	Good	12 (13.3%)	0	0	5 (6.9%)	17 (4.8%)
51 - 100	Moderate	64 (71.1%)	71 (82.5%)	32 (36.8%)	61 (70.9%)	228 (65.3%)
101 - 150	Unhealthy for Sensitive Groups	12 (13.3%)	8 (9.3%)	50 (57.4%)	12 (13.9%)	82 (23.5%)
151 - 200	Unhealthy	0	4 (4.6%)	4 (4.6%)	8 (9.3%)	16 (4.6%)
201 - 300	Very unhealthy	1 (1.1%)	3 (3.6%)	1 (1.2%)	0	5 (1.4%)
301 - 400	Hazardous	1 (1.1%)	0	0	0	1 (0.4%)
Number of days since the valid data was available		90	86	87	86	349
The number of days that the AQI was higher than thestandard in Iran (100)		14	15	55	20	104

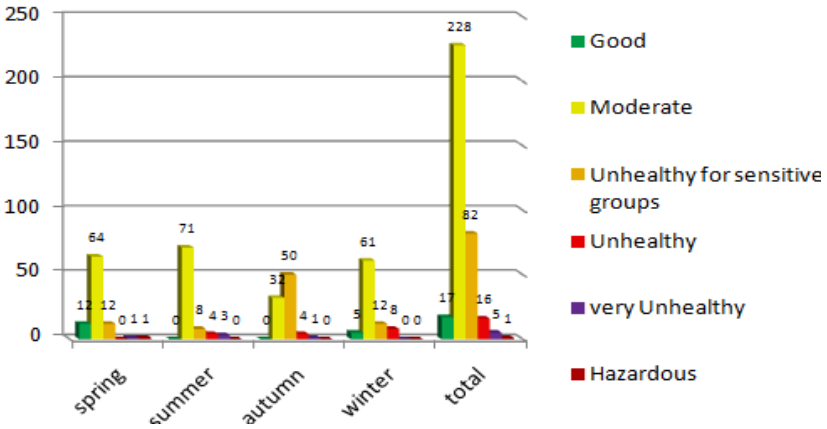

Figure 1. General condition of air quality in Yazd using air quality index considering year and season

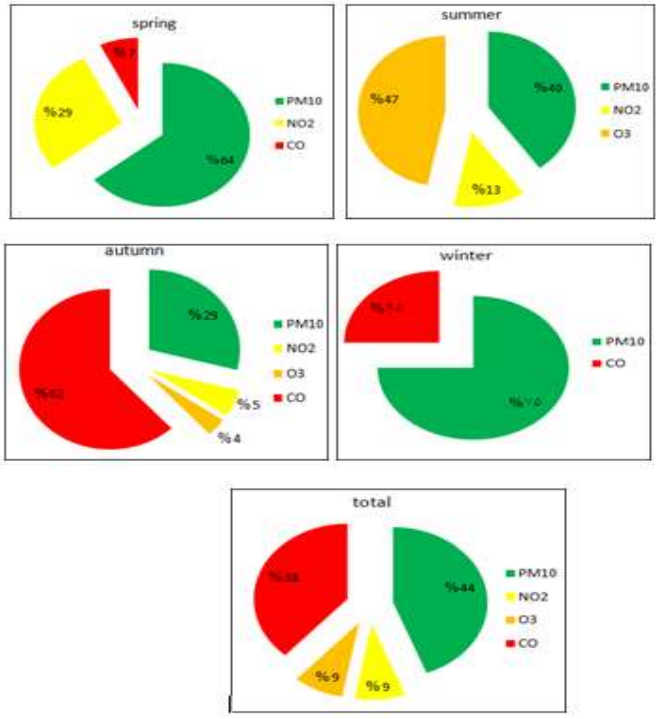

Figure 2. Contribution of contaminants responsible for pollution in Yazd (in cases where the air quality index exceeds the standard of Iran) considering year and season

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Figure 2 shows the contribution of each pollutant and seasons when the air quality index was above the standard level, based on percentage points. In 86 days, 104 days of PM_{10} and CO contaminants were introduced as responsible contaminants.The maximum and minimum number of days the air quality index exceeded the standard level was 55 days in Autumn and 14 days in the Spring.

Table 3. Fit the findings of the negative binomial regression model

	IRR	CI 95% IRR	p-value
Good	1.76	1.12 2.72	0.01
Moderate	1.29	0.82 2.06	0.27
Unhealthy for Sensitive Groups	2.1	1.31 3.4	0.002
Unhealthy	3.36	1.92 5.96	<0.001
Very unhealthy	2.07	0.98 4.44	0.056
Hazardous	1.83	0.66 13.71	0.16

Table 3 shows the relationship between air quality index and cases of myocardial infarction. There is a significant relationship between " Unhealthy for Sensitive Groups " and "Unhealthy" relative to air quality.

Discussion

According to the findings of this study, the air quality index in Yazd is standard in the 70% of the days in a year, and exceeds the standard by 30% of the days in a year. The results showed that in most days of the year, contaminants CO and PM10 are responsible for pollutants. Moreover, 442 cases (45/5%) of myocardial infarction have occurred in the days that the air quality has exceeded the standard. This study also examined the relationship between air quality and myocardial infarction cases in the days that the air was unhealthy for sensitive and unhealthy groups. ASignificant relationship was observed between the days that the air quality was good. In this study, the relationship between air quality index and myocardial infarction rates was studied, which was not investigated in other studies. Considering the findings of the study and standards on air quality announced by the US Environmental Protection Agency, the air quality can only exceed the standard in just one day of the year, and more than a day is beyond the standard limits [11].

In a study by Mokhtari et al. in Yazd, the risk attributed with PM10 in early death and cardiovascular disease was 460 cases [10].

In a study by Cheraghi et al., in the air quality of Tehran,CO was identified as a responsible contaminant [15].

In the study by Arfaeinia et al. which compared the quality of metropolitan areas of Tehran, Isfahan and Shiraz, air quality exceeded the standard for 341, 322 and 85 days respectively. PM_{10} was responsible for the pollutantin those days [16] . The limitations of the study was ecological nature of the study that prevents the examination of individual characteristics and inaccessibility of PM2.5 and PM1 pollutant data due to the lack of a measuring device for these pollutants

Conclusion

Theair quality of Yazd is beyond the standard in 104 days. It is recommended that people with heart and respiratory disease, and the children reduce long and heavy out-of-home activities. Considering that there is an air pollution monitoring station in Yazd, it is suggested to have a more accurate assessment of the air quality according to existing standards and to increase the number of air pollutant measurement stations.

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Conflict of Interest

There are no conflicts of interest to declare.

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