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Analysis of Particulate matter (PM_{10} and $PM_{2.5}$) concentration in Khorramabad city

Seyed Hamed Mirhosseini, Mehdi Birjandi, Mohammad Reza Zare, Ali Fatehizadeh

Environment Research Center, Isfahan University of Medical Sciences (IUMS), Isfahan, Iran, and Department of Environmental Health Engineering, School of Health, IUMS, Isfahan, Iran

ABSTRACT

Aims: In this study, the concentration of PM10 and PM2.5 in eight station of Khorramabad city was analyzed.

Materials and Methods: For this study, the data were taken from April 2010 to March 2011. The eight sampling point were chosen in account to Khorramabad maps. During this period, 240 daily PM samples including coarse particle (PM_{10}) and fine particle ($PM_{2.5}$) were collected. A two-part sampler was used to collect samples of PM. According to one-way ANOVA, multiple comparisons Scheffe, the obtained data were analyzed and then compared with the Environment protection organization standard rates. Khorramabad

Results: The results revealed that during measuring the maximum concentration of PM_{10} and $PM_{2.5}$ was respectively 120.9 and 101.09 µ/m³ at Shamshirabad station. There was a significant difference between the mean values of PM_{10} concentration (µg/m³) in the seasons of summer. In addition, the mean concentrations of PM_{10} in warmer months exceeded to the maximum permissible concentration.

Conclusions: Year comparison of PM_{10} and $PM_{2.5}$ concentration with standard were revealed particle matter concentration in summer season was higher than standard. Although total mean of particle matter was less than standard concentration.

Key words: Aerosol, air pollution, khorramabad, particulate matters

Address for correspondence:
Eng. Seyed Hamed Mirhosseini,
Isfahan University of Medical Sciences Hezar-Jerib St., Isfahan, Iran.
E-mail: hmirhossaini@gmail.com

INTRODUCTION

Effects of air pollution on human health since the past have been considered by researchers and people. Particulate matter or PM is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. According to report the United Nations environment program (UNEP), the particulate matters are most important pollutants in the world cities.[1] Especially in cities high concentration of airborne particles, are serious problems for air quality.[2] In recent years, numerous epidemiological studies have shown a relationship between the concentration of particle matter in urban air and respiratory diseases, pulmonary damage, and mortality among population.[3-7] Atmospheric particles originate from a variety of sources and possess a range of physical and chemical properties. Collectively, particulate pollution is often referred to as total suspended particulates (TSP). Fine particulates less than 10 and 2.5 microns in size are referred to as PM_{10} and $PM_{2.5}$, respectively. Short-term exposure to PM_{10} can irritate the lungs and perhaps cause

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immune responses; lung constriction, producing shortness of breath and cough may also result. The materials dissolving from the particles can also damage cells. Larger particles deposit in the upper respiratory tract, while smaller inhalable particulates travel deeper into the lungs and are retained for longer periods of time. Long-term, lower level PM_{10} exposure may cause cancer and premature deaths.[8] Exposure to $PM_{2.5}$ is associated with several serious health effects like premature death, respiratory related hospital admissions and emergency room visits and aggravated asthma. $PM_{2.5}$ exposure is also responsible for acute respiratory symptoms, including aggravated coughing and difficult or painful breathing; chronic bronchitis; decreased lung function that can be experienced as shortness of breath; and work and school absences. Adverse health effects have been associated with exposures to PM over both short periods (such as a day) and longer periods (a year or more). Particulate matter of heavy metals, asbestos, aromatic hydrocarbons are carcinogenic.[9] The other hand, aerosols cause reduced visibility, adverse effects on ecosystems and plant growth can be reduced or stopped. World Health Organization study showed that increased by 10 micrograms of aerosols, the mortality rate of 1 to 3 percent increases.[10] PM emissions are a key health concern with estimated economic damage costs much higher than for other pollutants. These pollutants have the highest diversity and complexity and the wide dissemination. Size, concentration and chemical composition of particulate matters is their most important characteristics.[11,12] Thus the need to study the properties of particulate matter and their distribution to determine the origin of these particles in different cities one of the priorities of the program is to control air pollution in cities. Considering the geographical location of Khorramabad the region's topography and urban structure unfit for vehicle traffic, this city has a high potential to increase the concentration of Particulate matter. The purpose of this study was to analysis the average concentration of PM_{10} and $PM_{2.5}$ in different areas and season in the Khorramabad city.

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out in the Khorramabad city. Khorramabad city with a population over 540 000 people is the most important cities in western Iran. This city in 48° 21′E longitude and 30° 43′ N latitude is located. For this study data from April 2010 to March 2011 were taken. To determine the sampling points; after studying maps Khorramabad, metropolitan area was divided into four zones. And each of these areas is considered as a class then within each of these areas was randomly sampled in two locations. A total of eight sites were determined as measuring stations [Figure 1]. During the sampling period, 240 daily PM samples including PM_{10} and $PM_{2.5}$ were collected. A two-part sampler was used to collect samples of PM (Anderson sampler for collection of PM_{10} and $PM_{2.5}$). The sampler has an inlet with PM_{10} cut-off, which collects particles smaller than 10 μm. The particles are collected on Teflon membrane filters with a diameter of 37 μm and 2 μm pore size. Sampling with a low -volume flow rate of 2.4 was operated. Similarly, $PM_{2.5}$ was performed according to standard of United State Environmental Protection Agency.[13] The membrane filters were placed into the desiccators at room temperature for at least 24 hours to achieve stable humidity before Sampling. Initial and final weightings filters were performed in the laboratory at a temperature and humidity controlled room (T = 25 ± 1°C, RH = 50 ± 2%). For each sample, measurements were repeated three times and average weights are reported.

RESULTS

In Table 1 is showed the average 24-hour particulate matter concentration during the entire period of the study. Results showed that the maximum 24 h of particulate matter concentration during measurement period is related to S_5 station. In this station, PM_{10} and $PM_{2.5}$ concentrations were found 120.9 ± 28.6 and 101.9 ± 51 μg/m³, respectively.

During this time, in S_1 Station was obtained minimum average concentration of particulate matter with PM_{10} and $PM_{2.5}$ concentrations 63.37 ± 35 and 52 ± 20.2 μg/m³, respectively.

Figure 2 is showed daily PM_{10} concentration at stations in different season and Figure 3 is showed $PM_{2.5}$ concentration at stations in different season. The daily average concentration of particulate matter in the months and warm seasons (spring and summer) were higher than average concentration in cold seasons (autumn and winter). The comparison of PM_{10} and $PM_{2.5}$ concentrations at different season is showed that the mean particle concentration in different seasons, there are significant differences (P value < 0.001). Scheffe paired comparison between the average PM_{10} and $PM_{2.5}$ particles in autumn and winter revealed there is no significant difference and the other seasons are significant differences [Table 2].

DISCUSSION

In recent decades, Asian countries have significant growth and urban development and energy use. Thus, air pollution is considered as a serious threat to the environment,

Table 1: Average 24-hour particulate matter concentration during the entire period

Sampling Station	PM_{10} (μg/m³)	$PM_{2.5}$ (μg/m³)
S_1	88 ± 43.4	77.5 ± 34.2
S_2	63.37 ± 35	52 ± 20.2
S_3	95.55 ± 30.3	78.5 ± 25.3
S_4	115.27 ± 39.4	105.3 ± 54.6
S_5	120.9 ± 28.6	101.09 ± 51
S_6	104.9 ± 36.27	89.7 ± 39.5
S_7	95.55 ± 30.3	78.5 ± 25.3
S_8	94.46 ± 60.5	83.01 ± 38.7

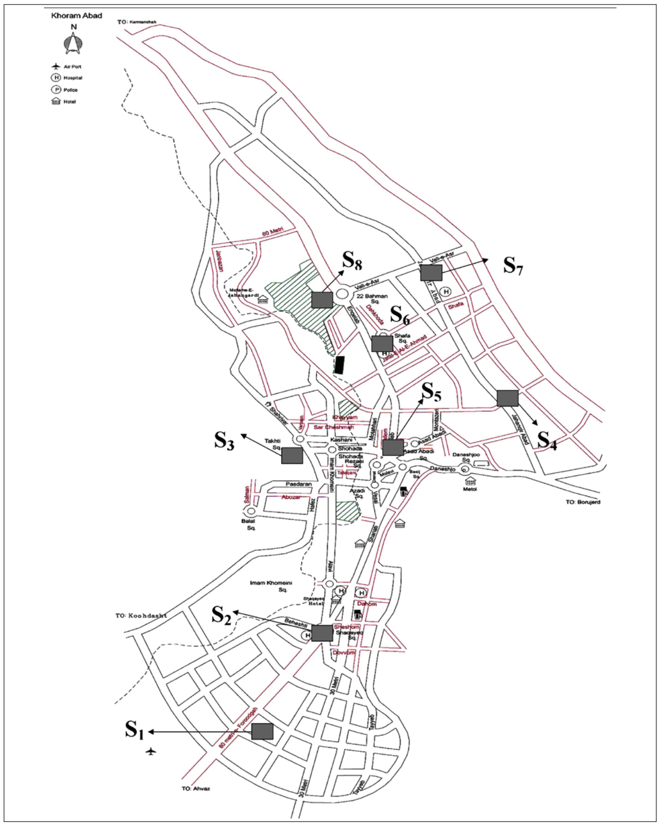

Figure 1: Location of the monitors in the city of Khoramabad

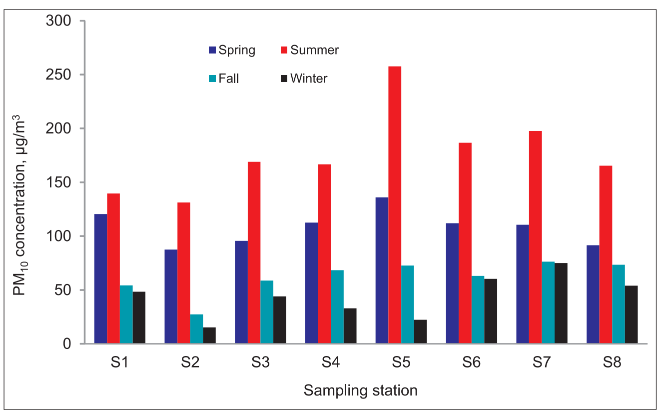

Figure 2: Daily PM_{10} concentration at stations in different season

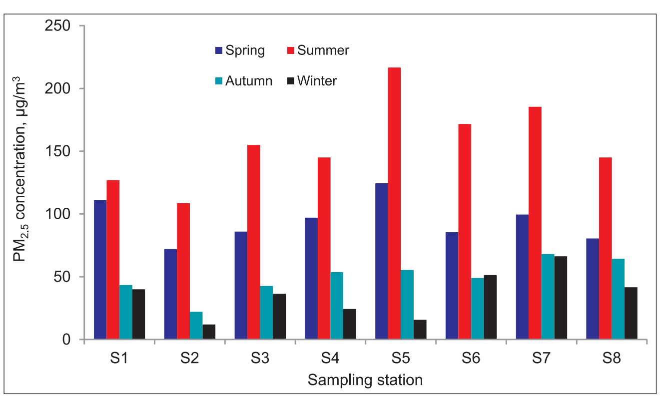

Figure 3: Daily $PM_{2.5}$ concentration at stations in different season

Table 2: The comparison of PM_{10} and $PM_{2.5}$ concentrations at different season

	Season	Arithmetic mean ± standard deviation	P
PM_{10}(µg/m^3)	Spring	108.25 ± 18.92	< 0.001
	Summer	176.75 ± 74.74	
	Autumn	61.75 ± 23.94	
	Winter	44.04 ± 22.2	
	Total	96.74 ± 71.36	
$PM_{2.5}$(µg/m^3)	Spring	94.5 ± 19.16	< 0.001
	Summer	156.79 ± 76.46	
	Autumn	49.8 ± 22.7	
	Winter	36 ± 20.5	
	Total	83.3 ± 65.6	

quality of life and health of people in these countries. In developing countries to identify emission sources, effects and pattern transfer is difficult because the data are scarce, high emissions and health effects are severe. Increased concentrations of PM (PM_{10} and $PM_{2.5}$) have been reported in six Asian countries (Bandung, Bangkok, Beijing, Chennai, Manila, and Hanoi).The average concentrations of $PM_{2.5}$ and PM_{10} were in the range 44 – 168 and 54 – 262 µg/m^3 in the dry season and 18 – 104 and 33 – 180 µg/m^3 in the wet season, respectively.[14] Study conducted by the Gujar, *et al.* (2008) showed that Karachi ranks as the most polluted megacity with an PM annual average concentration of 668 µg/m^3.[15] Studies conducted by the Clean Air Initiative (CAI 2006) for the twenty megacities showed the average concentration of TSP and PM_{10} has decreased from 1993 to 2004, but ambient levels remain above the World Health Organization (WHO) guidelines.[16] The results obtained in this research showed that the annual values of the PM_{10}, $PM_{2.5}$ concentrations in Khorramabad are lower than the maximum values of standards of national submissions. However, the average concentration of particulate matter in summer was higher than national standard. The main reason for the higher concentration of particulate matter in the summer was the occurrence of very strong dust entered from Iraq that it has significant impact on the air quality of Khorramabad and even in the days to thirteen times the standard limit is reached. The efforts must be performed in this field, given that the relationship between mortality and increasing the concentration of particulate matter. According to the results of the study during and after storms in Taiwan, spatial patterns of PM_{10} and $PM_{2.5}$ concentrations show seasonal variation that has occurred due to storms and meteorological conditions and the difference of the mixture distribution of high and low particulate matter concentrations during the dust storm is significant.[17] In research conducted by Celis and, *et al.* (2004) in the sixth points in the city of Chile showed that in the downtown area the concentration of particulate matter PM_{10} were higher than from other area.[18] According to research conducted in USA (2005), particulate matter measurement results showed that highway and marginal urban areas by improving traffic bottleneck, the amount of particulate matter is reduced to 41 percent.[19] The studies of on the mass $PM_{2.5}$ and PM_1 effects in Helsinki urban air pollution (2004) showed that $PM_{2.5}$ is the most effective PM index for air pollution which is most significantly associated with respiratory and Cardiovascular disease.[20] Measurements of PM_{10} and $PM_{2.5}$ in urban area of Nanjing, China showed that more than 70% of total suspended particles are of a size that they are deposited in the respiratory tract below trachea, whereas about 22% of the mass is respirable and will reach the alveoli.[21]

CONCLUSION

Overall, based on the results obtained in this study PM_{10} and $PM_{2.5}$ Concentrations at warm month in year were higher than the WHO and EPA standard and in high-traffic areas and crowded of city, the concentration of particles is higher than other areas. Specific topographic conditions in this region and also sometimes by farmers burning of farms around the city in order to eliminate weeds is an important role in increasing the density of particulate matter in this city. Finally, the survey results show that implementation of basic actions to the control dust entering to the country by spreading mulch and development of green space is essential. Also traffic control and optimization of urban traffic, public education and application of technical regulations and urban development will have an important role in controlling air pollutants including particulate matter.

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