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Study of Particulates Air Pollution in Gachsaran and the Need to Protect the Environment

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ABSTRACT

Introduction: Increasing consumption of fossil fuels has caused many urban environmental problems. Air pollution is one of the most important of these problems, PM10 (Particulate Matters with a diameter less than 10 micrometer) is also one of the pollutants in air, and an increase of 10 µgr/m3 in concentration may cause an increase of 1-2 percent in the mortality rate. The aim of this study was to determine air pollution in the city of Gachsaran.

Materials & Methods: This is an analytic-longitudinal study. 6936 air samples were collected during 334 days from April 2005 to March 2006 using a SM200 dust monitor sampler machine. The data were analyzed conducting oneway ANOVA, Tukey and t-student tests and then compared with the WHO standard rates.

Results: The results revealed a direct linear correlation between air temperature and concentration of PM10. There was a significant difference between the mean value of PM10 concentration (µgr/m3) in the seasons of summer (226.3), spring (167.8), autumn (111.6), and winter (85.7). In addition, the mean concentrations of PM10 in warmer months exceeded to the maximum permissible concentration.

Conclusion: It can be concluded that some important variables such as high temperature, air dryness, low rate of humidity and rainfall, along with the huge local oil industries are the potential factors of air pollution in Gachsaran.

Keywords: Air Pollution, fossil fuels, Particulate Matters, Temperature

Introduction

Increasing consumption of fossil fuels has caused many urban environmental problems. Air pollution is one of the most important of these problems, and constitutes a serious threat to the environment and the health of societies. Air pollution means the presence of one or more pollutants in the air that, depending on their concentrations, durations of remaining in the air, and characteristics, are harmful for man, animals, plants, and objects and property (1).

Effects of air pollution on human health have been of interest of late, and in most developed countries programs of controlling air pollutants have been developed for protecting people's health and for preventing environmental degradation, but air pollution has continuously deteriorated in developing countries (2).

Based on the environmental report published by the United Nations, particulates are the most important air pollutant in large cities of the world (2). The dust lifted from the surface of the earth and emitted into the air by wind, together with dust resulting from forest fires and volcanoes, viruses, bacteria, and pollens, are among the natural sources of particulates. Unnatural sources of particulates include fuel combustion, various processes in industry, pulverization (or abrasion) of materials, and motor vehicle traffic. Research has revealed particulates with diameters of less than 10 microns are harmful for the health of living organisms (3). Contrary to other gas pollutants such as nitrogen oxides in the air, particulates in the form of combinations of organic and mineral matter with different characteristics and different shapes are emitted and distributed in the air (4). According to studies conducted by the World Health Organization, for every 10 microgram of particulates added to the air, mortality rate increases by 1-3 percent (5). Therefore, one of the basic priorities in programs of controlling urban air pollution is to study the characteristics of particulates and the way they are emitted, and to determine their sources.

Gachsaran, with a population of 70422 in 1995, an altitude of 720 meters, and an area of more than 18 square

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kilometers, is located in southwest of Iran (6). It has warm and dry weather and its temperature rises up to 50 degrees centigrade in warm seasons of the year. The annual rainfall was 39.8 millimeters in 2003. One of the most important characteristics of the oil-rich city of Gachsaran is the expansion of huge petroleum and gas industry installations in it (6).

Therefore, the presence of factors causing air pollution has turned the issue of dealing with air pollution into one of the top health and environmental priorities of the city. These factors include low rainfall and dry air, warm air and a long warm season, a relatively high population density together with urban traffic, insufficient green spaces in the city and its outskirts, and the presence of massive oil and gas installations. Available data show that so far no study has been carried out about air pollution in Gachsaran. That is why we conducted this research to determine the concentrations of particulates in Gachsaran.

Materials and Methods

This was a survey research in which air samples were taken to determine concentrations of particulates throughout the year 2009. We took, collected, and analyzed samples all day long seven days a week. Due to some technical problems, it was not possible to take any samples during the second month of winter, and the concentrations for the eleven months of the year were reported. In all, 6936 air samples (one per hour) were taken and analyzed in 334 days.

A dust- monitoring instrument manufactured by the Environmental Technology Services Company in England (2) that automatically analyzes and records particulates in air samples was used for determining concentrations of particulates. Air intake was set at 2.3 cubic meters per hour and filter paper with the diameter of 47-50 millimeters was used in the instrument that was set up in the area around the Environmental Office of Gachsaran (where they measure other air pollutants too). Temperature and relative humidity were also measured and recorded when samples were taken.

Collected data was examined to check for normality and homogeneity of variances in the groups and was then analyzed using SPSS (3) and the t-student, Pearson's coefficient of correlation, ANOVA, and Tukey follow-up statistical tests (4).

Findings

Obtained results showed that in the warm months and seasons of the year (spring and summer), the 24-hour average particulate concentration was higher than those of the cold months and seasons (fall and winter). The maximum concentration of particulates was recorded in the second month of summer with an average of 249.1 micrograms per cubic meter, and the minimum that of the first month of winter with an average of 48.3 micrograms per cubic meter. The maximum average concentration of particulates during summer was 226.3 micrograms per cubic meter, and the maximum range of changes and of standard deviation belonged to summer too (Table 1).

Figure 1 shows 24-hour concentrations of particulates in the various Seasons together with the average temperature of each Season. The ANOVA was used to compare the degrees of air pollution in the various seasons and months of the year and, following that, Tukey's HSD test detected where the differences occurred. It must be added that the t-test was used for winter months because we did not have the information for the second month of winter. Based on this, the degree of pollution in spring was higher in the second month compared to the first, while in summer it was higher in the first and second months compared to the first ($p < 0.05$). In the fall, the degree of pollution was higher in the first month compared to the second and higher in the second compared to the third, while in winter it was higher in the last month compared to the first ($p< 0.001$). In all, concentrations of particulates were lower in winter compared to the other seasons. Moreover, there was a direct significant linear correlation between air temperatures and particulate concentrations ($p<0.001$, $r =0.833$).

Table 1: Mean concentration of suspended particles in air pollution according seasons. Gachsaran city, 2006.

Season	Mean, SD	Range	Compare seasons, Sig.
S1=Spring	167.8, 117.7	49.5 – 730.1	S1> S3, S4 (P<0.05)
S2=Summer	226.3 , 159.4	78.4- 994.8	S3> S1, S2, S3 (P<0.05)
S3=Autumn	111.6, 41.7	27.6- 246.8	S3> S4 (P<0.05)
S4=Winter	85.7, 50.7	8.8 – 239.3	S4< S1, S2, S3 (P<0.05)

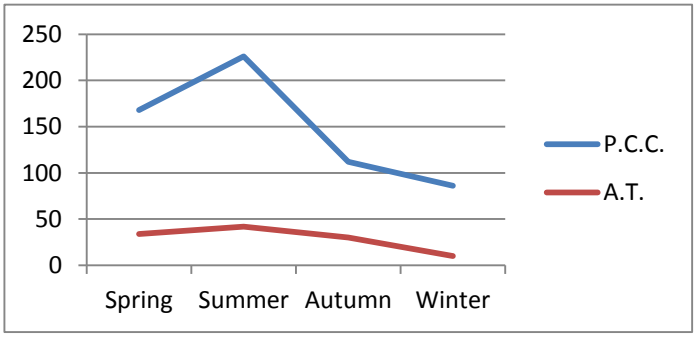

Figure 1: Particulate pollutant concentrations (P.C.C.) and the average of temperature (A.T.). Gachsaran city, 2006.

Conclusions and Discussion

The standards set by the World Health Organization and the Environment Protection Agency for clean air are the maximum 24-hour concentration of 260 micrograms per cubic meter, that should not happen more than once per year, and the average annual concentration of 75 micrograms per cubic meter. Comparison of 24-hour averages of particulate concentrations we found for the various months of the year with these standards shows that the average annual concentration of particulates in Gachsaran exceeds the permissible limit. The average 24-hour concentration of particulates (at least during the second month of spring and during the first two months of summer) was higher than the permissible limit. Since there was a direct linear correlation between rises in the concentration of this pollutant and the mortality rate (5), the air in Gachsaran during summer may be considered more unsafe compared to other seasons; and, for this reason, recommendations may be made to vulnerable people on reducing their comings and goings, especially during the warm hours of the day.

Of the total 334 days that concentrations of particulates in the air in Gachsaran were measured, in 29 days they exceeded the permissible level (260 micrograms per cubic meter): three days in the second month of spring, two in the third month of spring, 18 in the first month of summer, and six in the second month of summer.

Results of a similar study Malekootian et al. (1996) conducted in Kerman suggested that the air was polluted by particulates, though they did not study the correlation between air pollution and air temperature (8). It seems climatic similarities between the two cities including dry air (which itself causes substantial scattering of dust particles), together with similar industrial situations, are among the main reasons for the high concentrations of particulates in Gachsaran and Kerman. In another study Ahrampoosh et al. carried out on air pollution in Yazd, it was found that high concentrations of particulates were related to low rainfall and to very low humidity (9).

Moreover, Quinn and Oduyemi (2002) in another similar study in Dundee in England reported that activities related to soils and building operations, together with industries related to petroleum products, were the main sources of emission of particulates (10).

Given the ecological conditions in Gachsaran, strategies that can be considered for the general controlling of pollutants with the purpose of improving air quality can be listed as below:

- Controlling pollution resulting from the man industries, especially the oil and gas industries, that pollute the air, at the sources of pollution
- Optimization of city transportation through implementing traffic control and applying technical and city planning rules to have fluid traffic flow
- Expansion of urban green spaces and district parks, public education, and attracting cooperation and participation of managers and industrialists, to control air pollution

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