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A Survey of Cardiovascular and Respiratory Diseases Attributable to PM_{10} pollutant in the western Half of Iran (Ahwaz, Bushehr and Kermanshah Provinces) with Use of AIRQ Model

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ABSTRACT

AirQ software proved to be a valid and reliable tool to estimate the potential short term effects of air pollution. In this study the AirQ2.2.3 model was used to evaluate adverse health effects caused by PM_{10} exposure in Ahwaz, Bushehr and Kermanshah Provinces during 2011. The adverse health effects of PM_{10} in Ahwaz, Bushehr and Kermanshah Provinces at 2011 were calculated by $AirQ_{2.2.3}$ utilizing relative risk and baseline incidence related to health end point defaults. PM_{10} data was taken from Ahvaz Department of Environment (ADoE). These data were in volumetric base. Conversion between volumetric and gravimetric units (correction of temperature and pressure), coding, processing (averaging) and filtering are implemented for solving such problem. Results show that the non hospitalized patients suffer from the cardiovascular and respiratory diseases attributable to Pm_{10}. The patients from Ahwaz allocate the highest rate of hospital admittance to themselves with 19% respiratory and 20% cardiovascular charts those from Bushehr refer to hospitals 14% for respiratory illness and 15% for cardiac disease and the subjects from Kermanshah go to the hospitals 12% for respiratory complications and 14% for cardiac failures. The last group's statistic is the lowest. The highest rate belongs to Ahwaz becames it has greater concentration of dusty air. Therefore, the higher relative risk value can depict mismanagement in urban air quality.

Keywords: Respiratory and Cardiac Diseases, AIRQ Model, Western Half, Iran, Particulate matter

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INTRODUCTION

According to the estimates made by the world health Organization, 800,000 persons suffer from the untimely death due to the effects of cardiovascular and respiratory diseases and lung cancer caused by the air pollution throughout the world annually. Approximately 150000 losses occur in the south of Asia [1], [2]. Results in some studies insist on the point that the long -term contact with particulate matters leads to the decrease of life expectancy. The significant finding refers to the fact that when the air becomes polluted with dust, the rate of cardiac and pulmonary diseases increases 12% and 14% in a row. The models specifying the hygienic effects are mainly statistical and epidemiological. They combine the air quality data with epidemiological parameters such as the relative risk, the basic incidence and its attributable parts in the concentration intervals; as a result, they display the output in the form of death toll. [3]. Bused on the standpoint stated by the public hygiene, the particulate matters are the main air pollutants. The world health Organization has estimated that 500000 individuals experience the untimely death annually owing to their encounter with the air particulate matters existing in the open air. In lieu of increasing every 10microgram of the particulate matters, the rate of mortalities rises from 1 to 3 percent. Furthermore, the organization has appraised that the annual cost spent for the health and hygiene sector was about 30 billion pounds in Austria, France and Switzer land. It is equal to 6% of the whole death toll. It has also been assessed that the united states spend 23 billion pounds in the hygiene sector for the high concentration of the particulate matters annually [4], [5].

In Iran, in a study carried out in zabol, it has been revealed that the cost of the respiratory diseases caused by the dusty air phenomenon has been more than 70 million dollars. Each individual will inhale 6.6240 grams of dust at the time of 10 – hour dusty air on average if they are active for 10 hours and breathe in 17 times per minute and average dust pollution of 0.0368 grams per cubic foot in the breathing air. The particles containing toxic substances can have severe effects on the different cells of the lungs and lead to the cell death. If the dead cells are not replaced by the live and new cells, the amphism disease may be created. The disease leads to depletion or extinction of the walls in bubbles. If the area of the bubbles is reduced, the lung capacity for the exchange of the gases will be weakened.

It should be noted that the cells of the respiratory system become remedied or replaced more slowly than those of other organs of the body [for instance the coating cells of the digestive system]. The sediment or the deposit of some microbe agents and particles cause the lungs inflame or swell. If the inflammation and swelling occur in the nasal organ or bronchus, they are called rhinitis and bronchitis. If the inflammation pervades the lung parenchyma, it will be known as pneumonia. Ultimately, the chronic inflammation of the lungs could result in fibrosis [6]. Ahwaz, Kermanshah and Bushehr roughly have populations of 969843, 843117 and 181674 individuals in succession. This cites are located in the west and south of Iran. Recently they have been exposed to the inadvertent dust which has made the living difficult and unbearable to the citizens [7].

MATERIALS AND METHODS

In this project, attempts have been made to quantify and compare the hygienic effects of PM_{10} pollutant upon the three cities (Ahwaz, Kermanshah and Bushehr) based on the implementation of AIRQ model. The data available in the environmental protection organization for 2011 have been used to do so. Accordingly, first the raw data necessary for the project were collected from the environment protection organization and the weather forecast institute. Next they were processed based on the software of EXCEL. The processed data were given to AIRQ model which was supposed to be a reliable and valid instrument to estimate the short term effects of the air pollutants. The world Health Organization was responsible for their specification to the research community. Health effects are being related to the mass of pollutants inhaled and this is why the AirQ model was on gravimetric basis. So, there was a conflict between AirQ model and ADoE data. Conversion between volumetric and gravimetric units (correction of temperature and pressure), coding, processing (averaging) and filtering are implemented for solving such problem.

2.2. Characteristics of the Research stings

2.2.1. Research setting of Ahwaz

With an area of 8152 square kilometers, the capital of Khuzestan province extends over between 48 to 49 degrees and 29 minutes of the eastern longitude in the Greenwich meridian and 30 to 32 degrees and 45 minutes of the northern latitude from the equator. The city is 22.5 meters above the sea level. Its climate is not and semi humid. (Bureau of Information and Statistics in Ahwaz 2011).

2.2.2 Research setting of Kermanshah

The city is located in the central part of Kermanshah province with the position of 47 degrees and 4 minutes of the east and 19 degrees and 34 minutes of the north (8). The territory is kind of semiarid and with cooler steppes (moderate and alpine climate). Its physiography pertains to a field and foothill; in addition, its elevation from the sea level is 1200 meters.

2.2.3. Research setting of Bushehr

Bushehr seaport is the capital of Bushehr province. It is situated in the west of the province and extends over an area of 1441 square kilometers. Its geographic limits are specified by 50, $8371^{0}$from the east and 28, 9576 ^{0} from the north. (9).

2.3 The project has been conducted with an adherence to the following steps:

1. Data Collection

The data related to PM_{10} particles of 2011 was obtained from EXCEL file from the organization of environmental protection in Ahwaz, Bushehr and Kermanshah.

2. Production of Input File from Raw Data

To make the file, the following steps were taken in a row:

Temperature and Pressure Correction, Conformity of the unit with the model, primary processing, secondary processing, code writing, Calculating daily mean based on codification, condition modification, primary Filtering and secondary filtering.

Data analysis:
Air Q model is based on statistical equations. Sample community was Ahvaz city which was considered one million persons approximately. Data capture was collected for criteria air pollutants. Attributable proportion was calculated as following formula:

AP= SUM {[RR(c)-1] $\times$p(c)} /SUM [RR(c) $\times$p(c)]

Where: p(c) is population of city
In statistics and mathematical epidemiology, relative risk (RR) is the risk of an event (or of developing a disease) relative to exposure. Relative risk is a ratio of the probability of the event occurring in the exposed group versus a non-exposed group.

$$RR = \frac{\text{Probability of event when exposed}}{\text{probability of event when non - exposed}}$$

Attributable proportion was multiplied at baseline incidence and divided to 10^5. Obtained value should be multiplied at population (10^6). The results will be the excess cases of mortality or morbidity attributed to given pollutant (PM_{10}).

RESULTS

Table 1 shows that the concentration of particulate matter in three city. The average concentration of particulate matter in Ahvaz higher than Bushehr and Kermanshah.

Table 2 shows that the commutative number of cases related to respiratory patients estimating the midpoint of the relative risk (RR=1.008) and the rate of basis emergence 1060 per 10^5 individuals is 2278 subjects. Approximately 50 percent of the cases have occurred in the days when the PM_{10}concentration has not surpassed 300 micrograms per cubic meter.

Table 3 indicates that the cumulative number of the cardiac disease cases is 866 persons in an attempt to appraise the midpoint of the relative risk (RR=1.009) and the rate of the basic emergence 436 per 10^5 individuals.

Table 4 demonstrates that the cumulate number of respiratory disease cases turns out table 1262 persons in estimating the midpoint of the relative risk (rr=1.088) and the rate of the basic emergence 1260 per 10^5 individuals. Approximately, 74 percent of those cases have occurred during the days when PM_{10}concentration has not surpassed 250 micrograms per cubic meter. It has to be observed that 1262 subjects have all been attributable to their contact with PM_{10}. The digits 10634 are better justified for Kermanshah in case the total number of cases relevant to the respiratory disease patients is considered in their references to hospitals**.**

Table 5 shows that the cumulative numbers of cardiac disease cases is 484 subjects to estimate the midpoint of the relative risk (RR=1.009) and the rate of the basic emergence 436 per 105 persons. Nearly 74 percent of these cases have taken place during the days when PM_{10} concentration has not trespassed 250 microgram per cubic meter.

Table 6 indicates that the cumulative number of respiratory disease cases tends to be 310 applicants when the midpoints of the relative risk (RR=1.008) and the basic emergence rate, 1260 per 10^5 individuals are estimated.

Table 7 reveals that the cumulative number of cardiac disease cases is 119 subjects when the midpoint for the relative risk (rr=1.004) and the rate of the basic emergence, 436 per 10^5 persons is calculated. It should be noted that 119 applicants have all been attributable to the contact with PM_{10}.

DISCUSSION

4.1. Quantify PM_{10} effects on respiratory and cardiovascular disease in Ahvaz
Table 2 shows that the approximately 50 percent of the cases have occurred in the days when the PM_{10}concentration has not surpassed 300 micrograms per cubic meter. It should be noted that the whole 2277 individuals are attributable to the contact with PM_{10}. The rate rise has been 726 persons in comparisons to the figure of 2010. The

number of 12222 persons is more justifiable for Ahvaz if the total number of the subjects referring to hospitals for respiratory diseases is taken into consideration. Accordingly, the number of the patients suffering from the respirator diseases attributable to the contact with PM_{10} roughly involves 18.65 percent of the total subjects going to hospital for the same hygienic consequence. The figure represents an increase of 6% in proportionate to the rate of previous year. Table 3 indicates, about 50% of the cases have occurred during the days when PM_{10} concentration has not surpassed 300 micrograms per cubic meter. It ought to be remembered that 866 subjects have all been attributable to the contact with PM_{10}. The rate of 4229 subjects for Ahvaz will be more justifiable provided that the total number of the non hospitalized cases created by the cardiovascular diseased is taken into account. Based on the account put forward, it is deduced that 20.51 percent of the total subjects referring to the hospital can nearly be attributed to the patients suffering from the cardiovascular diseases due to their contact with PM_{10}.

4.2. Quantifying the PM_{10}effects on the cardiac and respiratory diseases Kermanshah

Table 4. It has to be observed that 1262 subjects have all been attributable to their contact with PM_{10}. The digits 10634 are better justified for Kermanshah in case the total number of cases relevant to the respiratory disease patients is considered in their references to hospitals. In this regard, the number of the applicants to hospitals for the respiratory diseases attributed to the contact with PM_{10} is about 11.88 percent of the total subjects. So the cumulative numbers of the hygienic consequence are 795 individuals for the estimation of low relative risk (RR=1.0048) and 1686 persons for the appraisal of high relative risk (RR=1.0112). according Table 5 It should be seem that 484 subjects have all been attributed to the contact with $PM_{10;}$ therefore, the rate of 3674 persons becomes more justified for Kermanshah if the total number of applicants going to hospitals for their cardiovascular diseases is taken into account. In this regard, the number of hospital applicants for their cardiovascular diseases attributable to their contact with PM_{10} is about 13.17 percent of the total subjects suffering from the same illness.

4.3. Quantifying PM_{10} effects on the respiratory and cardiac disease in Bushehr

Table 6 indicates that the cumulative number of respiratory disease cases tends to be 310 applicants when the midpoints of the relative risk (RR=1.008) and the basic emergence rate, 1260 per 10^5 individuals are estimated. About 60 percent of these cases have happened during the days when the PM_{10} concentration has not trespassed 300 micrograms per cubic meter. Attention should be paid to the fact that 310 persons have all been attributed to the contact with PM_{10}. So the number, 2293 subjects will be of greater justification for Bushehr when the total number of applicants for their respiratory diseases is taken hospital in to consideration. In this regard, applicant number of the respiratory diseases attributed to the contact with PM_{10} is about 13.6 percent of the total subjects with the same hygienic consequence. Table 3.7 reveals that the cumulative number of cardiac disease cases is 119 subjects when the midpoint for the relative risk (rr=1.004) and the rate of the basic emergence, 436 per 10^5 persons is calculated. It should be noted that 119 applicants have all been attributable to the contact with PM_{10}. The number of 793 persons will be of better justification for Bushehr as soon as the total number of cusses referring to hospitals for their cardiovascular diseases is considered. In this regard, the number of cardiovascular disease applicants attributable to the contact with PM_{10} has been 15 percent of the total applicants with the same hygienic consequences. In 2011, of the three research setting, Ahvaz with its $\mu.g/m^3$ concentration has allocated 323.78 annual mean (the highest) to itself; where as, Bushehr and Kermanshah with $\mu.g/m^3$ concentration have appropriated 234.23 and 174.24 rate of annual concentration (the lowest) for themselves. Studies done in 29 European cities, 20 American cities and some cities of the Asian countries, represent the fact that the hygienic effects related to the short term contact with PM_{10} appear to be identical in the different cities of the developed countries and developing ones, furthermore, in lieu of each 10 $\mu.g/m^3$ increase of daily PM_{10} concentration the rate of death risk rises up to 5 percent. Thus, 150 $\mu.g/m^3$ concentrations are interpreted as 0.5 percent increase of daily death toll (10), (11). The surveys and meta analysis carried out to determine the short term effects on mortalities uncovered that with 10 $\mu.g/m^3$ increase (with certainly intervals of 95 percent), the estimated rate of the effect is given as follows: 1.7 percent in Bankok(1.1-2.3%) (12), Mexico City 1.83 percent (0.9-2.7%) (13) Santiago 1.1% (0.9-1.4 percent) (14), Inchan 0.8% (0.2-1.6 percent) (15), Brisbin Australian 1.6% (0.5-2.6 percent) (16) Sidney 0.95 percent (0.32-1.6 percent) (17). Reports have also been made concerning the estimate of respective mortality with PM_{10} or TSP from Shin Yang of China. Seven cities of South Korean (18) and New Delhi (19). It is discerned that the current investigations have been performed in the cities where the basic situations such as population, climate, the use of smoke, chimneys of houses, occupational encounter socio-economic conditions and PM_{10} concentration have varied greatly and involved an extensive spectrum. As a result, it seems reasonable to generalize the available data into the areas where studies have not curried out. For example, the projects done in Mexico city, Bangkok and Santiago were reported to have the average PM_{10}concentration of 45.65 and 115 $\mu.g/m^3$. The maximum concentration have also been 121.227 and 360 $\mu.g/m^3$. Mean while ,the relation ship of response concentration would probably get out of the linear state. So, to follow the prudence, the range of linear assumption needs to be restricted. These research projects provide the convincing witnesses all in all. Bassed on their implication, PM10plays a significant role in increasing the mortality. Although the relative risk comes down for every individual, a lot of people are exposed to the concentration which means PM_{10}has a crucial effect on the public health. Based on a regression model of examining the air pollution in ten cities of the United States, Schwartz has calculated that the relative risk for the adults older than 65 would be two percent in lieu to each 10µ.g/m^{3}increase of $PM_{10.}$ (20).In 2005, Tominez and colleagues utilized the AIRQ model to assess the PM_{10} hygienic effects on Trusty in Italy. According to the results obtained from the research 1.8 percent of the total cardiovascular mortalities and 2.5 percent of the respiratory mortalities were attributed to the concentrations higher than 20 µ.g/m^3 (21). In 2008, Goudarzi et.al exploited AirQ model to estimate the PM_{10}hygienic effects on Tehran. Based on the results they produced, about 4 percent of the whole cardiovascular and respiratory mortalities is attributed to the concentrations greater than 20 µ.g/m^3 (22). In 2010, Mohammadi and colleagues used the AIRQ to estimate the PM_{10} hygienic effects on Ahvaz. The obtained results of the survey indicated that nearly 13 percent of the total cardiovascular and respiratory mortalities are attributed to the concentrations higher than 180 µ.g/m^3. (23). Owing to the fact that the present has benefited from the AIRQ model, a comparison of the findings made in Tehran, Ahvaz, Bushehr, Kermanshah and Tristy shows the figures as follows: the no hospitalized applicants for respiratory and cardiac diseases attributed to PM_{10} in Ahvaz have allocated 19% of respiratory reference and 20% of cardiac reference (the highest rate), in Bushehr 14% of respiratory reference and 15% of cardiac reference and in Kermanshah 12% respiratory reference and 14% of cardiac reference to hospitals (the lowest rate). The reason Ahvaz has got the highest rate is became of higher concentration and further duration of the dusty air in the city.

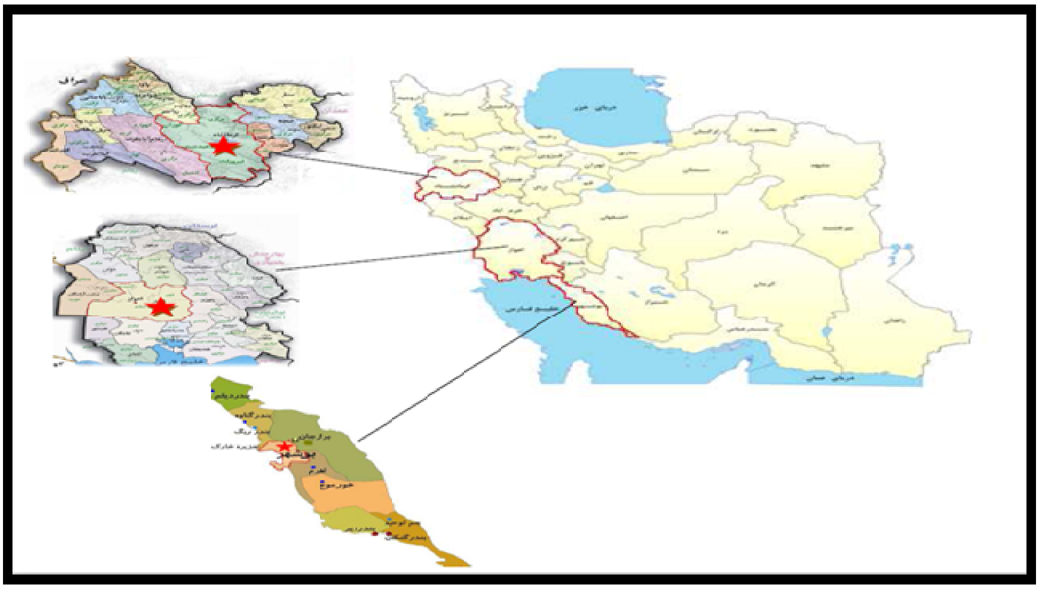

Figure 1- Map of Research Settings (Ahwaz, Bushehr and Kermanshah)

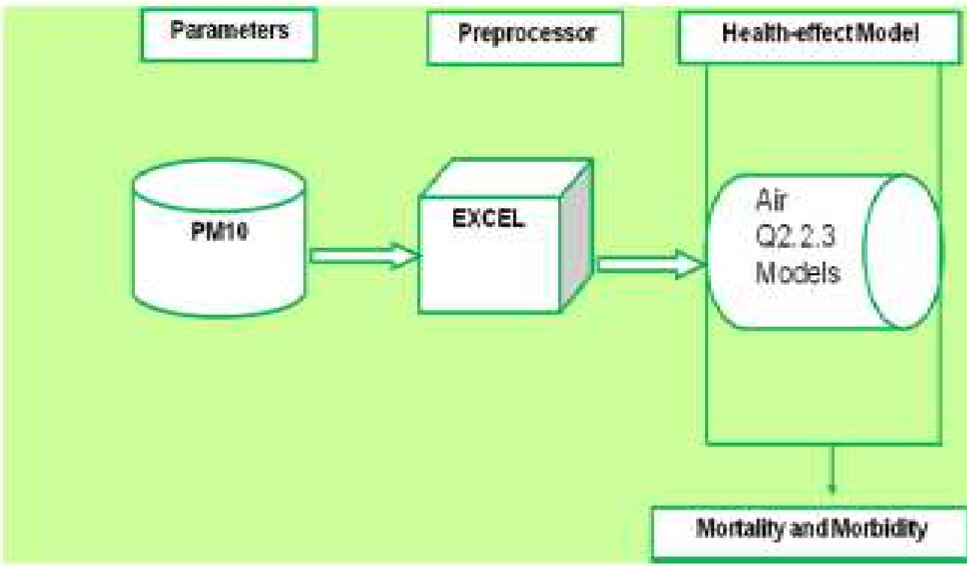

Figure 2: Research Profile

Table 1. PM_{10} Concentration in terms of microgram per Cubic Meter to be used in the model (Ahwaz, Bushehr and Kermanshah 2011)

(PM_{10}) Parameter	Bushehr	Kermanshah	Ahwaz
Annual Average	234.23	174.26	323.78
Summer Average	241.15	214.81	361.18
Winter Average	227.09	132.12	283.89

Table 2. Index Estimation of Relative Risk, Part and Cases Attributable to $PM_{10}$for Respiratory Patients Referring to Hospitals (BI=1260) (Ahwaz 2011)

Estimation	Relative Risk(High)	Part Attributable	Cumulative Number of Caser
Low	1.0048	12.0968	1476.9
Mid-Point	1.008	18.6568	2277.9
High	1.013	27.1513	1147.1

Table 3.Estimation of the indexes for the Relative Risk. Part and Cases Attributable to $PM_{10}$for Cardiac Patients Referring to Hospitals (BI=436) (Ahwaz 2011)

Estimation	Relative Risk(High)	Part Attributable	Cumulative Numberof Caser
Low	1.006	14.6772	620.1
Mid-Point	1.009	20.5106	866.5
High	1.013	27.1513	1147.1

Table 4.Estimation of the indexes for the Relative Risk, Part and Cases Attributable to PM_{10} for Cardiac Patients Referring to Hospitals (BI=1260) (Kermanshah 2011)

Estimation	Relative Risk(High)	Part Attributable	Cumulative Numberof Caser
Low	1.0048	7.4842	795.0
Mid-Point	1.008	11.8809	1262.0
High	1.0112	15.8786	1686.6

Table 5.Estimation of the indexes for the Relative Risk, Part and Cases Attributable to $PM_{10}$for Cardiac Patients Referring to Hospitals (BI=436) (Kermanshah 2011)

Estimation	Relative Risk(High)	Part Attributable	Cumulative Numberof Caser(Individual)
Low	1.006	9.1834	337.5
Mid-Point	1.009	13.1704	484.1
High	1.013	17.9719	660.6

Table 6. Estimation of the indexes for the Relative Risk, Part and Cases Attributable to $PM_{10}$for Cardiac Patients Referring to Hospitals (BI=1260) (Bushehr 2011)

Estimation	Relative Risk(High)	Part Attributable	Cumulative Numberof Caser(Individual)
Low	1.0048	8.6309	169.8
Mid-Point	1.008	13.6021	310.2
High	1.0112	18.0603	411.9

Table 7. Estimation of the indexes for the Relative Risk, Part and Cases Attributable to $PM_{10}$for Cardiac Patients Referring to Hospitals (BI=436) (Bushehr 2011)

estimation	Relative risk (high)	Part attribute able	Communicative number of cuses (individual)
Low	1.006	10.5607	83.3
Mid-point	1.009	15.0465	118.3
High	1.013	20.3716	160.8

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REFERENCES

[1] Bateson TF, Schwartz J, *Epidemiology*, **2004**, **15**(2): 131-132
[2] WHO .AQG Air Quality Guidelines for Europe, Second edition. Copenhagen, WHO Regional Office for Europe, *WHO Regional Publications, European Series*, (**2000**). No.91
[3] Krzyzanowski M, Cohen A, Anderson R and the WHO Working Group .Quantification of health effects of exposure to air pollution. Occup *Environ Med*. (**2010**), 59:791-793
[4] Curtis A J, Rea W, Smith-Willis, P, Fenyves E, Pan Y, et al. *Environment International Review*. **2006**, **32**(**6**): 815- 830.
[5] Pelliccioni A, Tirabassi T. *Environmental Modelling& Software* .**2006**, **21**: 539-546.

[6] Collis j , Air Pollution, 2nd edition. Spon Press, London and New York .**2006**, 12-40, 103-140.
[7] Zolfaghari H, Abedzadeh A. *Geography and Development Iranian Journal*, **2006**, **3 (6)** :173-8.
[8] Bureau of Information and statistics of Kermanshah Governor's Office-2011.
[9] Planning Deputy's Office of Bushehr Province **2008**.
[10] Katsou Yanni K, et al. *Epidemiology*, **2001**, **12**: 521 – 231.
[11] CohenA, et al, Mortality impacts of urban air Pollution. In: Ezzati M., et al., eds. *World Health Organization*. **2004**: 1353-1434.
[12] Ostro B, et al. *Journal of the Air and Waste Management Association*, **1999**, **49**: 100-107.
[13] Castillejos, M., et al,. *Inhalation Toxicology*, **2000**, 12: 67-72.
[14] Ostro B, et al, *Journal of Exposure Analysis and Environmental Epidemiology*. **1996**, **6**: 67-114.
[15] Hong VC, et al., *Environmental Health perspectives*, **1999**, **107**: 873-878.
[16] Simpson RW, et al., *Archives of Environmental Health*, **1997**, 52 (6): 442-454.
[17] Morgan G, et al., *American Journal of Public Health*, **1998**, **88**: 759-764.
[18] Lee JT, et al., *Environmental Research*, **2000**, **84**: 247-254.
[19] Cropper ML, et al., *American Journal of Agricultural Economics*, **1997**, **79**: 1625 – 1629.
[20] Schwartz J, *Epidemiology*, **2000**, **11**: 320-326.
[21] Tominz R, Mazzoleni B, Daris F, *Epidemiologia e Prevenzione*. **2005**, **29**(3).
[22] Goudarzi Gh, Nadafi K, Mesdaghiniya A. Quantification of health effects of air pollution in Tehran and determining the impact of a comprehensive program to reduce air pollution in Tehran on the third axis, Ph.D. thesis, Tehran University of Medical Sciences **2010**.
[23] Mohammadi M, Goudarzi Gh, Naisi A Survey health Effects of Air Pollution Ahwaz with Uses of AIR Q Model, Master's thesis, Ahvaz Jundishapur University of Medical Sciences **2010**